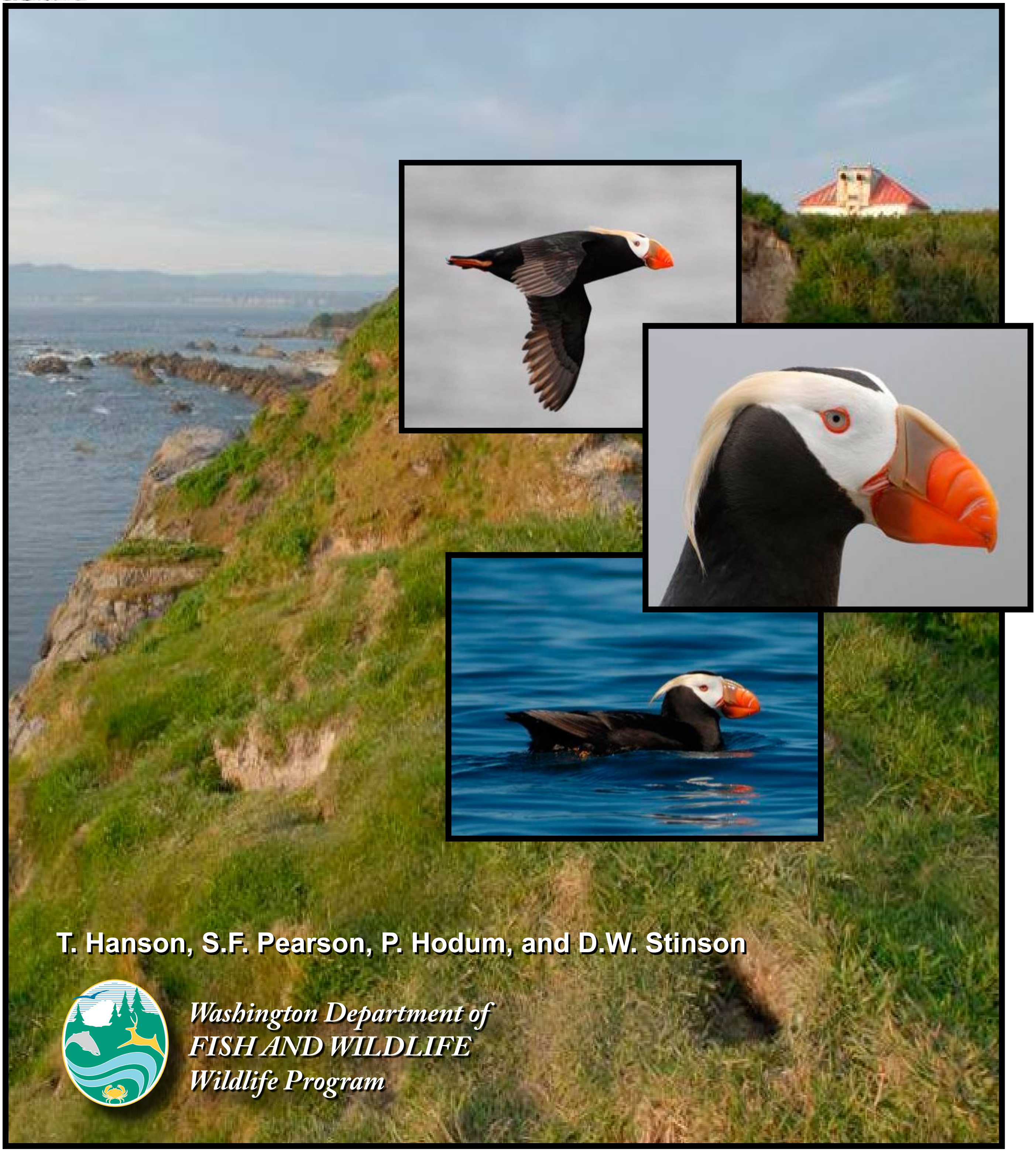
STATE OF WASHINGTON September 2019

Tufted Puffin Recovery Plan
and Periodic Status Review



T. Hanson, S.F. Pearson, P. Hodum, and D.W. Stinson

Washington Department of
FISH AND WILDLIFE
Wildlife Program

In 1990, the Washington Wildlife Commission adopted procedures for listing and de-listing species as endangered, threatened, or sensitive and for writing recovery and management plans for listed species (WAC 220-610-110; Appendix A). The procedures, developed by a group of citizens, interest groups, and state and federal agencies, require preparation of recovery plans for species listed as threatened or endangered, and periodic review of listed species at least every five years.

Recovery, as defined by the U.S. Fish and Wildlife Service, is the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured.

This document is the final Washington State Recovery Plan and Periodic Status Review for the Tufted Puffin. It provides an update to the status of Tufted Puffins in Washington, and prescribes strategies to recover the species, such as protecting populations and existing habitat, evaluating and restoring habitat, and initiating research and cooperative programs. Target population objectives and other criteria for down-listing to state Threatened and Sensitive status are also identified.

As part of the State's listing and recovery procedures, the draft recovery plan and status review was reviewed by researchers and technical staff from state, and federal agencies an dregional experts. This was followed by a 90-day public comment period. Responses to the public comments are included in Appendix B; comments received were considered in the preparation of the final document. The Department presented a summary of the recovery plan and periodic status review to the Fish and Wildlife Commission at the June 14-15, 2019 meeting in Port Angeles.

For additonal information about Tufted Puffins or other state-listed species, check our website, or contact us by at wildthing@dfw.wa.gov, or by mail to:

Recovery Section Manager, Wildlife Program
Washington Department of Fish and Wildlife
P. O. Box 43141
Olympia, WA 98504-3200

This report should be cited as:

Hanson, T., S. F. Pearson, P. Hodum, and D. W. Stinson. 2019. Washington State Recovery Plan and Periodic Status Review for the Tufted Puffin. Washington Department of Fish and Wildlife, Olympia. 53+vi pp.

Cover photos by Peter Hodum; Tufted Puffin illustrations on cover and title page by Darrell Pruett.

This work was supported in part by personalized and endangered species license plates

Washington State Recovery Plan and Periodic Status Review for the Tufted Puffin

Thor Hanson
The SeaDoc Society, 942 Deer Harbor Road, Eastsound, WA 98245

Scott F. Pearson
Washington Department of Fish and Wildlife

Peter Hodum
Biology Department, University of Puget Sound, 1500 N. Warner St., Tacoma, WA 98416
and
Oikonos Ecosystem Knowledge, Tacoma, WA 98407

Derek W. Stinson
Washington Department of Fish and Wildlife

Washington Department of Fish and Wildlife
Wildlife Program
P.O. Box 43141
Olympia, WA 98504-3200

September 2019

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

ACKNOWLEDGEMENTS

This project was supported by the SeaDoc Society, a program of the Karen C. Drayer Wildlife Health Center, School of Veterinary Medicine, University of California, Davis, thanks to a generous donation from Kathleen Dickenson. The draft was improved by comments by Heather Renner, Mark Hipfner, Sue Thomas, Gary Wiles, Michelle Culver, Dayv Lowry, and Lorna Wargo. The authors also thank Hannah Anderson, Joe Gaydos, Sue Thomas, Russell Bradley, Shawn Stephensen, Peter Arcese, and Jeffrey Williams for their contributions.

EXECUTIVE SUMMARY

The Tufted Puffin (*Fratercula cirrhata*) is an iconic seabird found throughout the upper latitudes of the North Pacific Ocean. It spends the winter at sea, and nests during spring and summer in coastal colonies from California north to Alaska, and from Siberia south to Japan. Steep population declines throughout the southern part of its range suggest that the species may be undergoing a significant range contraction. Formerly common in Washington along the outer coast and in the Strait of Juan de Fuca and San Juan Islands, puffins have suffered the reduction and disappearance of many breeding colonies in the state, accompanied by a dramatic population decline. Reasons for the decline are uncertain, but may include reduced prey availability, predation at nesting colonies, human disturbance (mainly historical), or factors related to climate change. A comprehensive examination of puffin natural history, population trends, and habitat status, as well as threats to their continued existence, can be found in the Washington State Status Report for the Tufted Puffin (Hanson and Wiles 2015). Based on the findings and recommendation of the status report, the Tufted Puffin was listed as endangered by the Washington Fish and Wildlife Commission in April 2015.

This document is the state recovery plan and first periodic status review for the Tufted Puffin; it is intended to guide conservation and recovery efforts, and also provide a status update. It identifies a recovery goal, specifies population targets for reclassification, and outlines recovery strategies and tasks. It also provides a brief update to the status information in the 2015 status report, and new research and monitoring information relevant to Tufted Puffins in Washington.

Monitoring data since publication of the status report in 2015 indicate populations remain well below thresholds recommended for long-term viability, justifying classification of the species as endangered. The recovery goal for Tufted Puffins in Washington, as defined in this plan, is to rebuild and maintain a viable population across a substantial portion of the species' historical range in the state. Objectives for reaching that goal, with criteria for accompanying reclassifications, are based on the same measurement tools used to establish population trends for the status report: boat-based surveys, breeding colony occupancy records, and breeding colony attendance counts. The Tufted Puffin will be considered for down-listing to threatened when the following conditions are achieved:

1. Monitoring data from breeding colony attendance surveys indicate a minimum of 8 occupied colonies distributed along at least 100 km of the coast between Point Grenville and Cape Flattery.

2. In at least three of the five years prior to the down-listing decision, data from boat-based monitoring indicate a mean on-the-water population of at least 4,500 individuals,
   OR
   breeding colony attendance counts indicate a mean breeding population of at least 6,500 individuals;

3. Spring/summer boat-based monitoring data show a positive trend in on-the-water density for the ten-year period prior to the down-listing decision.

Objectives for down-listing to sensitive and de-listing are included in the recovery section of the document.

Specific strategies and tasks are described in the Recovery section to help guide recovery efforts in Washington, including priorities for research, monitoring, invasive species management, habitat conservation, and public outreach and education. Among these, the continuation of boat-based surveys for population monitoring stands out as a high priority for tracking the status of the population, and the removal of rabbits from Destruction Island offers an immediate, tangible opportunity for improving nesting habitat. High priority research areas include gaining a better understanding of puffin diet and foraging areas in Washington, and how those needs might influence the management of forage fish stocks. Other strategies and tasks are ranked in an implementation plan that highlights numerous opportunities for partnering with tribes, government agencies, and other stakeholders invested in Tufted Puffin recovery efforts.

INTRODUCTION

The Tufted Puffin (*Fratercula cirrhata*) is an iconic seabird found throughout the upper latitudes of the North Pacific Ocean, wintering at sea and nesting in spring and summer on coastlines and offshore islands from Japan north to Siberia, and from northern Alaska south to California. Though still abundant in the Gulf of Alaska and Aleutian Islands, the species has declined drastically throughout the southern parts of its range, including Washington, Oregon, California, and Japan (Osa and Watanuki 2002, Pearson et al. 2018). Formerly common along the outer coast and in the Strait of Juan de Fuca and San Juan Islands, puffins have suffered widespread breeding colony decline and disappearance and a ~90% population decline in Washington in recent decades (Hanson and Wiles 2015). Designated as a candidate for state listing in October 1998, the Tufted Puffin was state-listed as endangered in April 2015.

Recovery plans set specific recovery goals and objectives, and establish an implementation plan to reach them. Criteria for reclassification are delineated, as are priorities for research, education, restoration, and other relevant topics. This document is the recovery plan and also a periodic status review for the Tufted Puffins in Washington. It addresses progress toward recovery and also updates status information and briefly summarizes new puffin research and data since the publication of the 2015 status report (Hanson and Wiles 2015). Readers interested in a thorough review of population trends and habitat status for Tufted Puffins in Washington, as well as a summary of their taxonomy and natural history, are referred to the status report. It can be downloaded from the Washington Department of Fish and Wildlife (WDFW) website: https://wdfw.wa.gov/publications/01642/.

DISTRIBUTION

Tufted Puffins range throughout the temperate and sub-arctic North Pacific and are generally restricted to the cool waters above 30–34°N latitude (Gould and Piatt 1993, Piatt and Kitaysky 2002). Relatively little is known about Tufted Puffins during winter on the open seas, but individuals and small groups have been sighted on surveys throughout the central North Pacific (Gould and Piatt 1993). Sub-adults may remain at sea year-round, but breeding birds congregate on rocky coastal islands from as early as March through September. Breeding concentrations are highest around the Bering Sea, Aleutian Islands, and Gulf of Alaska (Figure 1), but colonies occur as far south as the Channel Islands in California (McChesney et al.

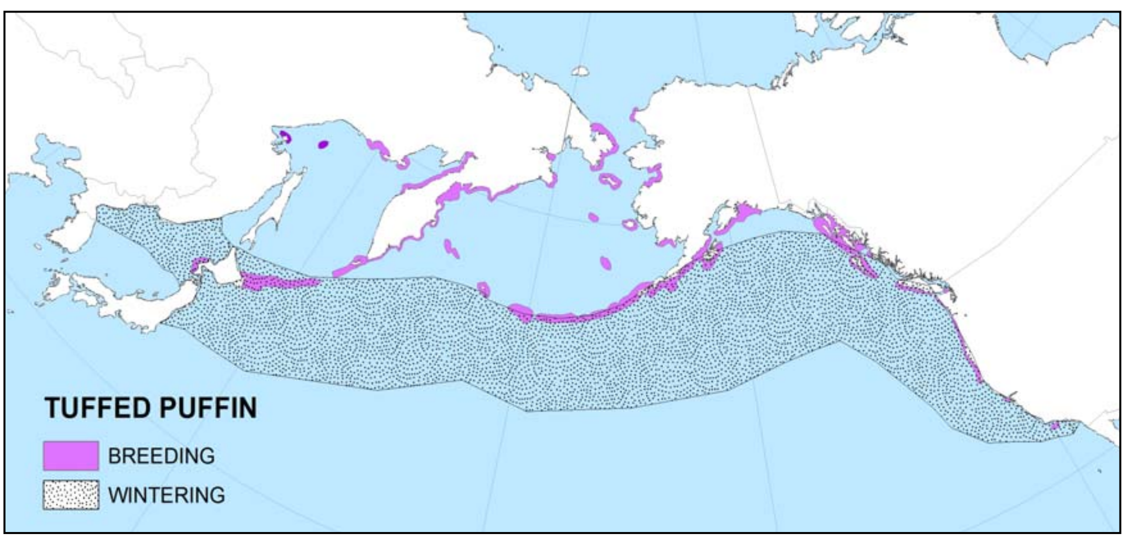


Figure 1. Range of the Tufted Puffin.

1995), and along the Asian coast as far south as Hokkaido, Japan (Brazil 1991, Osa and Watanuki 2002). Of the 1,031 nesting colonies known worldwide, 802 (78%) occur in North America (Piatt and Kitaysky 2002), with most in the Aleutian Islands and along the Alaskan Peninsula, where some colonies host more than 100,000 birds. Tufted Puffins also breed in significant numbers (i.e., tens of thousands) in Southeast Alaska and British Columbia, and are less numerous in Washington, Oregon, and California.

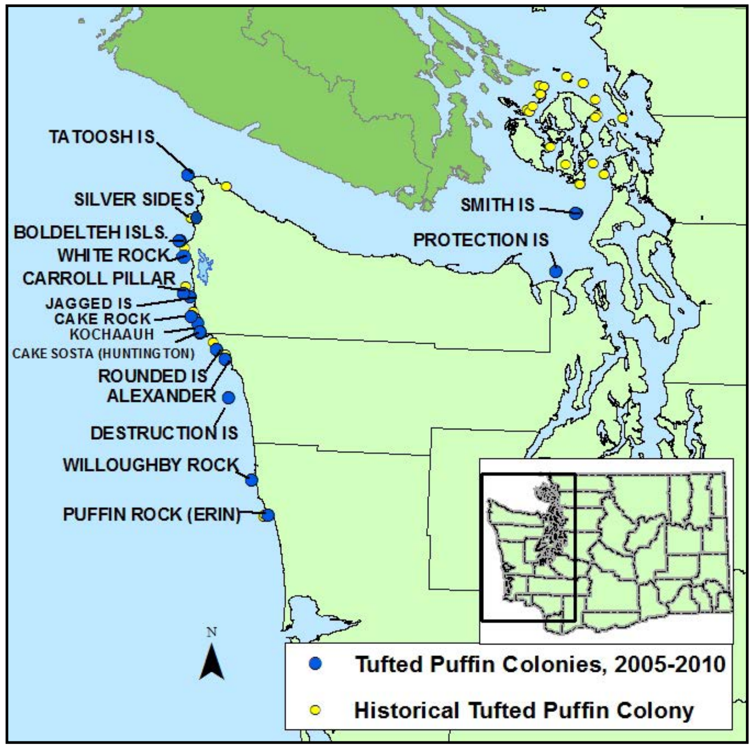


Figure 2. Recent and historical Tufted Puffin colony locations in Washington.

Washington. Tufted Puffin breeding colonies lie mainly along the outer coast from Point Grenville north to Cape Flattery (Hanson and Wiles 2015). The species formerly bred in small numbers at sites throughout the San Juan Islands, but colonies on inland marine waters are now restricted to Protection and Smith islands in the eastern Strait of Juan de Fuca (Figure 2). During the winter months, Tufted Puffins migrate far offshore, but a few occur in Washington waters over the continental shelf as late as October (Wahl 1975). During a January 1977 survey, 21 puffins were observed 60–155 km offshore (Wahl 2005). The species occasionally wanders south from the Strait of Juan de Fuca into northern Puget Sound (e.g., Wahl 2005, Hunn 2012).

POPULATION AND HABITAT STATUS

A decline in Washington's Tufted Puffin population observed in recent decades corresponds with a broader pattern of declines, range contraction, and breeding colony disappearance noted throughout the southern portion of the species' range, including California, Oregon, and Japan (Piatt and Kitaysky 2002, Ono 2012, Warzybok et al. 2012, Suryan et al. 2012). A recent meta-analysis of Tufted Puffin populations trends indicated continued widespread declines in recent years in both the California Current and Gulf of Alaska Large Marine ecosystems, and declines since 2000 are greater than those of the past (Goyert et al. 2017, Pearson et al. 2018). At the same time, Tufted Puffins in the Aleutian Islands have been increasing (Pearson et al. 2018). In addition, research evaluating the effects of global warming on occupied puffin breeding colonies suggests that the persistence of the remaining California Current colonies is in question under different climate scenarios (Hart et al. 2018). Causes for the decline are unknown, but potentially include historical and recent factors such as reduced prey availability, changing oceanic and climatic conditions, entrapment in fishing nets, mortality from oil spills and chemical contaminants, human disturbance of breeding colonies, impacts from introduced species, and increased Bald Eagle predation and/or disturbance.

Washington population. Recent colony counts found birds nesting at 19 sites in 2007–2010 (Hanson and Wiles 2015). Of the 19 occupied sites surveyed, only three (Cakesota, Erin's Bride, and Rounded islands) continued to support populations similar in size to those reported in 1978–1982 by Speich and Wahl (1989) (Table 1). There were 43 active colonies in Washington in the early 1900s; this declined to 35 between 1978 and 1984. Prior to 1978, there were nine colonies in Washington with at least 1,000 birds (Pearson and Hodum 2018a, Hanson and Wiles 2015). By 2007–2014, the state had no colonies of that size remaining.

Table 1. High counts of Tufted Puffins in most recent year of boat-based surveys since 2000 at breeding sites and other locations in Washington (WDFW[1]).

Colony Name	Catalog Number[1]	County	Year	High count	Other recent counts[2]
Bodelteh Island	155058, 9	Clallam	2010	63	2017: 11
Cake Rock	174002	Clallam	2014	97	2015: 1; 2017:86
Paahwoke-it (Carroll Pillar)	155010	Clallam	2014	291	2015: 136; 2017:63
Jagged Island (Wishalooth)	174027	Clallam	2016	136	2015: 5 2017: 2
Quillayute Needles Group[3]	174043	Claalam	2015	173	2014: 90
Cakesosta	174050	Clallam	2014	23[2]	2017: 18; 2008: 82; 2009: 2
Dhuoyautzachtahl (Huntington, Petrel Rock)	174049	Clallam	2014	13	2015: 2
Table Rock	174051	Clallam	2011	6	
Kochaauh	174041	Clallam	2014	15	2015: 2
Silver Sides	155039	Clallam	2016	86	
Tatoosh Island	155001	Clallam	2010	36	
White Rock	155008	Clallam	2015	28	2009: 1; 2014: 14
Puffin Rock (Erin)	174101	Grays Harbor	2010	25	2007: 32; 2011: 2; 2017: 0
Willoughby Rock	174017	Grays Harbor	2010	7	2017:0
Smith Island	156034	Island	2016	28	
Alexander Island	174010	Jefferson	2017	189	2015: 18, 2011: 2
Destruction Island	174016	Jefferson	2010	30	
Protection Island	156035	Jefferson	2013	22	
Rounded Island	174007	Jefferson	2016	102	2017:57
Half Round Rock	174082	Jefferson	2012	1	

[1] Catalog of Washington Seabird Colonies, 2019 (data from WDFW, Washington Marine National Wildlife Refuge Complex, and P. Hodum); does not include colonies with no non-zero records since 2000; for a more complete list, see Hanson and Wiles (2015).
[2]Other recent counts; extraordinary low counts in 2015 and other counts that differed substantially are reported here; 2015 was a year of extraordinary ocean temperatures (the warm 'Blob'), and many colonies had little nesting activity.
[3] The Quillayute Needles Group is comprised of various rocks and small islands, including Quillayute Needle, Cakesosta, Dhuoyautzachtahl, and Table Rock (Speich and Wahl 1989).

Additional Washington data from 2001 through 2017 are available from boat-based surveys along the outer coast conducted for Marbled Murrelets (*Brachyramphus marmoratus*) and other seabirds from Cape Flattery south to Point Grenville (Fig. 3; see Raphael et al. 2007 and Falxa et al. 2011 for methods). Using encounter rates, the overall trend is a 4% linear decline per year (95% CI = -0.36 – -7.61; P =0.03).

Nesting habitat status. Tufted Puffins nest in earthen burrows and rocky crevices, on isolated offshore islands and inaccessible headlands (Piatt and Kitaysky 2002). Burrows are occasionally in dense shrubbery, but typical habitat includes grassy slopes, bluffs, and plateaus with soil deep enough for burrowing in areas that are free of mammalian predators (e.g., foxes, rats) and human disturbance. Nesting Tufted Puffins are sensitive to disturbance, generally avoiding inhabited areas and have abandoned nests accessed for scientific observation (Pierce and Simons 1986).

Nearly all documented former and current breeding locations for Tufted Puffins in Washington are now included in the Washington Maritime National Wildlife Refuge Complex and all but four of the current colonies are in the Washington Islands Wilderness Area. The refuge complex includes six distinct management units: the San Juan Islands, Protection Island, Dungeness, Flattery Rocks, Quillayute Needles, and Copalis national wildlife refuges. Additionally, many sites in the San Juan Islands are included in the San Juan Islands Wilderness. Destruction Island is owned by U.S. Geological Survey (USGS), and the Natioanl Park Service has some management authority. Caretakers reside on Protection Island, and other islands receive periodic visitation from researchers and refuge managers, but the amount of human disturbance at current Washington breeding colonies is probably low and likely to remain so. In most instances, light stations have been automated or decommissioned and other human activities are greatly reduced at these sites. Some of the rocks and islands formerly occupied by puffins in the San Juan Islands are not regularly patrolled, however, so may be subject to occasional human disturbance. Known invasive species at nesting sites include European Rabbits (*Oryctolagus cuniculus*) on Destruction Island, where control measures have been proposed (USFWS 2007, 2010).

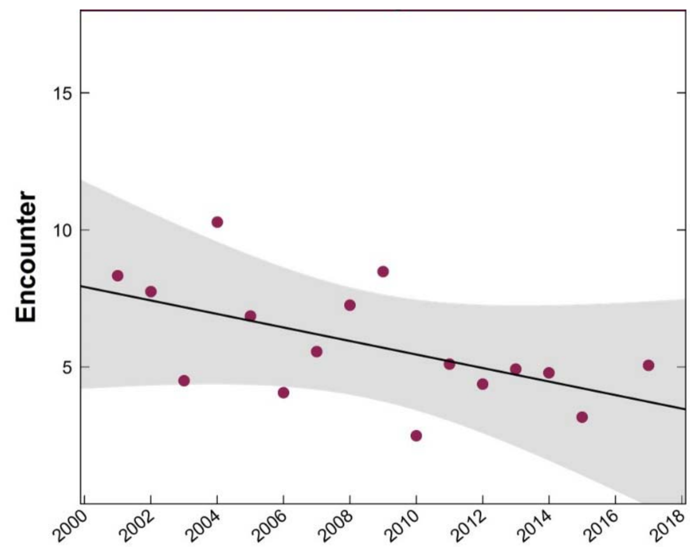


Figure 3. Tufted Puffin trends (birds encountered/km) during boat-based surveys (15 May- 31 July) along the outer Washington coast between Cape Flattery and Point Grenville, 2001–2018. Black line is the linear trend and the gray band is the 95% confidence interval of the trend (WDFW data).

With the shipping and recreational vessel traffic that occurs in Washington's waters, oil spills remain a threat to both nearshore and foraging habitat. Derelict fishing gear poses a chronic threat of entanglement, but has been the subject of recent cooperative clean-up efforts by the Northwest Straits Foundation and multiple partner organizations, that have removed >6,000 nets (Good et al. 2010, WDFW data).

CONSERVATION STATUS

In the U.S., Tufted Puffins are protected from direct take under the Migratory Bird Treaty Act. The U.S. Fish and Wildlife Service (USFWS) is currently considering the Tufted Puffin for listing under the federal Endangered Species Act (Sewell 2014, USFWS 2015). In Washington, puffins were listed as a state endangered species by the Fish and Wildlife Commission in 2015, and are protected from killing and malicious harassment.

Concern for the future of Tufted Puffins is not limited to Washington, as they have been listed as an endangered species in Japan since 1993 (Osa and Watanuki 2002). Environment Canada included puffins as a Priority Species in its North Pacific Rainforest Bird Conservation Strategy in 2013 (Environment Canada 2013), and the government of British Columbia increased the conservation status of breeding populations from Vulnerable (S3B) to Imperiled/Vulnerable (S2S3B) in 2015 (B.C. Conservation Data Center 2018). Breeding populations in Oregon are considered Critically Imperiled (S1B) (Oregon

Biodiversity Information Center 2016), and the California Department of Fish and Wildlife lists puffins as a Bird Species of Special Concern, Priority 1 (S2; McChesney and Carter 2008).

FACTORS AFFECTING TUFTED PUFFIN POPULATIONS

Climate change may be largely responsible for recent puffin declines (Hart et al. 2018), but it is not clear what other conditions may be contributing factors in Washington (Hanson and Wiles 2015). Tufted Puffins are the most pelagic members of the auk family, spending much of the fall and winter far out at sea. Even when breeding on nearshore rocks and islands, puffins retain their pelagic behavior by foraging in part along the shelf-break, a 50 km one-way flight from the coastal colonies (Menza et al. 2015). Key habitat considerations during this period include prey availability, the condition of breeding sites, and potential exposure to a range of threats including predation, contaminants, coastal erosion, nonnative species, human disturbance, and more. Reduced prey availability is a topic of active research in Washington, and several recent studies are mentioned below.

Forage fish abundance. Several studies have linked Tufted Puffin breeding success with the availability of forage fish in nearby waters (Vermeer et al. 1979, Baird 1990, Golubova 2002, Gjerdrum et al. 2003). But populations of forage fish and zooplankton can vary dramatically and cycle in response to large-scale changes in oceanic conditions (e.g., El Niño, La Niña, decadal oscillations) (Chavez et al. 2003, Brodeur et al. 2005, Mackas et al. 2007, Lindegren and Checkley 2013), as well as fishing or other human pressures (Ainley and Lewis 1974, Essington et al. 2015). Some forage fish stocks in Washington are greatly diminished from early 20th century levels, including Cherry Point Pacific Herring (*Clupea pallasii*), Eulachon (*Thaleichthys pacificus*), Pacific Sardines (*Sardinops sagax*), and some Puget Sound rockfish (Gustafson et al. 2016; Stick et al. 2014; WDFW 2011, WDFW unpublished data, Hill et al. 2018), and models suggest that seabirds dependent upon forage fish, particularly alcids and grebes, are at increased risk of local population declines (Vilchis et al. 2015).

A recent archaeological analysis of fish bones from Native American sites found that Pacific Herring were once the most common fish taken from coastal Washington north to Alaska, with consistently abundant stocks over a 2,000-year period before the advent of commercial harvest (McKechnie et al. 2014). The authors suggested that mid-20th century data often used as a baseline for herring distribution and abundance may dramatically underestimate historical population levels (McKechnie et al. 2014). Stable isotope analysis of feathers from Marbled Murrelet and Glaucous-winged Gull (*Larus glaucescens*) specimens collected in Washington and British Columbia also indicated a greater proportion of fish in the diet and suggests higher forage fish populations in the past (Norris et al. 2007, Blight et al. 2015). For murrelets, populations in the Salish Sea prior to the 1950s were apparently capable of growth and less limited by diet quality (Norris et al. 2007).

A recent forage fish study in Puget Sound, though largely outside waters frequented by Tufted Puffins (Greene et al. 2015), found widespread change in forage fish communities from 1970 through 2010; this included local decreases in populations of the once-dominant Pacific Herring (e.g. Cherry Point) and Surf Smelt (*Hypomesus pretiosus*), and widespread increases in Pacific Sand Lance (*Ammodytes hexapterus*) and Three-spine Stickleback (*Gasterosteus aculeatus*) (Greene et al. 2015). While some methodological discrepancies among datasets reported in this study (e.g., sampling at night in the 70s and 80s but during the day from 2003 forward) weaken quantitative comparisons, the broad conclusions are supported by other qualitative indices.

A model-based analysis of catch reports and trawl survey data indicated -3.9% per annum declines of rockfish between 1977 and 2014 in Washington's inner waters (including puffin habitat in the Strait of Juan de Fuca and San Juan Islands; Tolimieri et al. 2017). The same study, however, found that rockfish in the shallow-water reef assemblages sampled by citizen scientists using scuba gear had increased by 4.1% per annum between 1998 and 2014. Contrary to this, however, a systematic scuba-based assessment of marine fish abundance from 1995-2010 at six index sites in Puget Sound found dramatic declines for several rockfish species, despite clear recruitment pulses (LeClair et al. 2018). While trawling and scuba diving sample different rockfish species assemblages and life history stages, together these findings demonstrate how marked spatial heterogeneity and localized declines in rockfish abundance can impact prey availability to Tufted Puffins and other piscivores,

Springer and van Vliet (2014) reported that competition with Pink Salmon for limited prey affected nesting phenology and productivity of Tufted Puffins, and several other seabird species in the Aleutians and Bering Sea; nesting was later and less productive in odd years when Pink Salmon were abundant. The numerical abundance and biomass of combined natural-origin and hatchery Pink, Chum, and Sockeye salmon (*Oncorhynchus gorbuscha,O. keta, O. nerka*) in the North Pacific are the highest since collection of comprehensive data began in 1925 (Ruggerone and Irvine 2018). It is unknown if Pink Salmon are negatively affecting prey availability for Tufted Puffins in Washington, or in what ways that could vary temporally or geographically, from inner waters to the coastal nearshore to the continental shelf break. Tufted Puffins have a relatively broad diet and the effects of competition can be complex and hard to predict. The broad diet of puffins was evident in two recent studies from Alaska, where puffins fed over 75 different species to their chicks and maintained similar provisioning rates and breeding success across a wide range of conditions from the Alaskan Peninsula to the Western Aleutian Islands (Piatt et al. 2018, Schoen et al. 2018). Williams et al. (2008) reported analyses of stable isotope and fatty acid from puffins captured near Kodiak Island, Alaska, indicated a change in foraging niche of adults over the course of the breeding season; they suggested this was likely due to the shift away from winter feeding areas and constraints imposed by reproductive stages.

Koehn et al. (2017) used a food web model to examine the economic trade-offs of commercial forage fish harvest and predators in the California Current. Their model suggested that commercial harvest of Pacific Sardine, Northern Anchovy (*Engraulis mordax*), and Pacific Herring relate to decreases in biomass of most seabird and marine mammal species based on an assumed linear relationship between forage fish availability and predator feeding response, which they acknowledged may be appropriate for fish, but less so for seabirds. Nonetheless, their model suggested a slight increase in the biomass of Tufted Puffins. This result was presumably due to the puffins' ability to prey switch in order to exploit more abundant prey, and an overall reduction in competition produced by negative consequences for their more specialized competitors (Koehn et al. 2017, though see Hilborn et al. 2017).

Squid and zooplankton. The availability of marine invertebrates is probably closely linked to the trends in climate and ocean temperatures discussed below. Squid and large zooplankton likely make up part of the Tufted Puffin diet in Washington, and are also thought to be a critical winter at-sea food source (Davies et al. 2009, Piatt and Kitaysky 2002). Zooplankton blooms in the Northeastern Pacific respond directly to ocean surface temperatures and other climatic trends, and, in turn, are a primary factor controlling fluctuations in forage fish numbers (Mackas et al. 2007). In general, increases in ocean temperature results in declining zooplankton biomass and changes in community composition of zooplankton (King et al. 2011).

Climate change effects. The increased level of greenhouse gases in the atmosphere from human activities, particularly the burning of fossil fuels, is changing the climate (USGCRP 2017), and the interplay between changing climate, ocean conditions, plankton blooms, and forage fish creates a dynamic environment with significant implications for Tufted Puffins. Seabird reproductive success can be dramatically affected by prey availability near breeding sites (Cury et al. 2011), and forage fish populations respond to changes in sea surface temperature (SST) and other climate-related effects (Lyndegren and Checkley 2013, Parker-Stetter et al. 2016, Sydeman et al. 2017). For Tufted Puffins, high SST anomalies have been associated with low reproductive performance due to prey scarcity, a potential driver of their widespread declines (Gjerdrum et al. 2003). However, Borstad et al. (2011) reported that breeding success of Rhinoceros Auklets (*Cerorhinca monocerata*; a species of puffin) on Triangle Island was tied to the timing of seasonal winds, water movements, phytoplankton blooms, and the availability of juvenile sandlance, which were more important than absolute SST. Recent species distribution models predict that rising SST and other factors under two likely climate change scenarios will contribute to the loss of more than 92% of suitable Tufted Puffin breeding habitat throughout the California Current, a part of the North Pacific Gyre that passes south along all of coastal Washington (Hart et al. 2018). These and earlier climate-related predictions (reviewed in Sydeman et al. 2012) are important reminders that future conditions are expected to be more challenging for puffins in Washington, and that global processes may play a strong role in local and regional population trends.

In addition, recent mass mortality events suggest that puffins and other members of the alcid family, including murres, auklets, and murrelets, are at higher risk of warm-water induced mortality than other marine bird families (e.g., larids, procellariids; Parrish et al. 2017). Parrish et al. (2017) documented five such events between 2013 and 2017 that totaled more than 15,000 carcasses, mostly alcids, found on beaches from northern California to Alaska. Models of total deposition, and/or total mortality, suggest that these events involved over one million birds (Parrish et al. 2017, Jones et al. 2018). Parrish et al. (2017) and Jones et al. (2018) suggest that alcids may be altering their distribution towards nearshore environments in response to ocean warming and "bottom-up" shifts in the marine food web, such that the chances of carcasses beaching is greatly increased (Jones et al. 2018). In October and November 2016, over 200 Tufted Puffin carcasses were counted along the beaches of St. Paul Island in the Pribilofs, located in the Bering Sea. This number of dead puffins is worrisome because in 10 years of standard beach surveys on the island, volunteers have encountered, at most, three Tufted Puffins (J. Parrish unpublished). Model results suggested that 6,850–16,400 Tufted Puffins died in this event (Jones et al. 2018). Given that roughly 6,000 puffins breed in the Pribilofs, if these birds were from the local area, a majority of the local breeding population may have been lost. Carcasses were emaciated, suggesting the kind of severe prey shortage often associated with high SST anomalies (Pearson et al. 2018).

Sea level rise caused by climate change may negatively affect the abundance of some forage fish species by altering the intertidal and subtidal habitat conditions (e.g., water depths) preferred for egg deposition and refuge (Penttila 2007, Krueger et al. 2010). This problem may be especially acute where shoreline armoring has reduced or eliminated the ability of the beach face to erode landward, the so-called 'coastal squeeze' (Glick et al. 2007, Krueger et al. 2010). Climate change is also predicted to increase the frequency of high intensity storms (IPCC 2013), which can negatively impact Tufted Puffins during the breeding season, when fledglings have been known to die by the thousands from severe weather and wave action (Reagan 1910). The predicted sea level rise of ~1–3 ft by 2100 may be mitigated by ongoing uplift of Washington's outer coast shorelands (Miller et al. 2018). The increasing severity of storms, however, has the potential to damage or destroy some Tufted Puffin colonies through increased erosion of unconsolidated bluffs used as nesting areas (Miller et al. 2013), including those on Protection, Smith, and Destruction islands. Jewett et al. (1953) previously described the loss of occupied nesting burrows on Smith Island caused by wave erosion.

The absorption of increased levels of atmospheric carbon dioxide (CO_2) by the oceans, is altering the acidity of seawater (Jewett and Romanou 2017), particularly at higher latitudes where Tufted Puffins reside. The increased acidity (lowered pH) impairs the ability of marine organisms to form calcareous shells and skeletal structures (Fabry et al. 2008). This change could shift planktonic and benthic communities away from calcium-dependent species, with unpredictable but potentially profound implications for marine food webs (Fabry et al. 2008, Branch et al. 2013). Rising ocean surface temperatures and increased acidity are expected to change the abundance and composition of zooplankton communities and the forage fish that consume them (Roemmich and McGowan 1995), with unknown consequences for Tufted Puffins.

Harmful algal blooms, or "red tides," have been increasing globally in recent decades and some laboratory experiments predict increased occurrence with climate change (Peperzak 2003, Glibert et al. 2005, Lewitus et al. 2012). The effects of harmful algae on Tufted Puffins have not been studied directly, but harmful algal blooms may be an important and underreported cause of seabird mortality (Shumway et al. 2003). Negative impacts on seabirds include mortality from the ingestion of algae-produced toxins, and the fouling of feathers by proteinaceous foam produced by the dinoflagellate *Akashiwo sanguinea* (Jessup et al. 2009). Seabirds are also known to alter their movements and foraging behavior during blooms resulting in additional energy expenditure (Shumway et al. 2003), a particular concern during sensitive breeding periods. Jessup et al. (2009) hypothesized that the negative effects from these events could become more common in the future. If this occurs and the blooms overlap with critical breeding and fledging periods, their effect on puffin populations could be severe.

Miscellaneous factors. Hanson and Wiles (2015) discussed several other issues having or potentially having important negative impacts on the Tufted Puffin population in Washington. These factors include Bald Eagle predation and activity, human disturbance at nesting colonies, plastic and chemical pollution, and oil spills. The U.S. Navy's Quinault Training Area and Offshore Area W-237 appear to overlap with the area of concentrated presence of Tufted Puffins mapped by Menza et al. (2016; Fig. 5); current and proposed training activity such as those that involve underwater explosions (U.S. Navy 2019), may affect foraging puffins.

Persistent organic pollutants (POPs; e.g. PCBs, PBDEs, HCB) have been detected in puffin prey species off the coast and in the Salish Sea, and one recovered puffin carcass from Puget Sound exhibited POP concentrations ten times higher than sympatric Rhinoceros Auklets (Good et al. 2014). In addition, introduced species, particularly European Rabbits, Cheatgrass (*Bromus tectorum*), and Scotch Broom (*Cytisus scoparius*), may negatively impact puffins indirectly or affect the suitability of nesting habitat. European Rabbits persist on Destruction Island where they likely compete with puffins for burrow sites, attract more eagles to the island, and degrade habitat (Fig. 4).

Figure 4. Comparison of rabbit free (left) and rabbit occupied (right) habitat on Destruction Island in 2011. Note the heavily grazed grasses, considerable slope slipping, and loss of soil needed for burrowing by seabirds in the right photograph (*photos by P. Hodum*)

MANAGEMENT ACTIVITIES

Surveys and monitoring. Regular surveys or monitoring programs designed specifically for Tufted Puffins have not been conducted in Washington. Estimating puffin colonies is difficult due to their burrow nesting habit, and colony estimates are often made from sample plots, and involve some disturbance. The 2007–2010 surveys led by Hodum were the first statewide attempt to estimate the numbers of puffin at breeding colonies in 25 years. Tufted Puffins are counted on the water during semi-annual boat-based surveys focused on Marbled Murrelets (surveys were done annually from 2001–2015), and during the Westport Seabirds trips traveling west out of Westport, Washington, since 1972. The species is also recorded during annual boat-based surveys in the San Juan Islands National Wildlife Refuge. Tufted Puffins are currently included in long-term monitoring of eight select seabird colonies in Alaska (Goyert et al. 2017), and at Triangle Island, British Columbia (M. Hipfner, pers. comm.). Pearson and Hodum (2018b) recently proposed a draft range-wide monitoring scheme, but it is uncertain if funding will be available to implement it.

Interagency/partner coordination. The Tufted Puffin Technical Committee was formed in 2017 among members of the Pacific Seabird Group. The group provides a forum for identifying range-wide Tufted Puffin conservation and research needs, and developing standardized monitoring methods.

Restoration of puffins and habitat at colonies. No attempts have been made to re-establish puffins at former colony sites in Washington. Conditions around some former nesting sites in Washington may be opportune, however, for either natural re-occupation or reintroduction of puffins. Site selection would require careful analysis to avoid encouraging puffins to reoccupy poorly suited sites.

Eradication of European Rabbits on Destruction Island is under consideration and management experiments for the control of non-native plants at Protection Island has been proposed (USFWS 2010). If puffins are nesting in sub-optimal conditions due to competition from rabbits for deep soil sites, erosion or predation related to rabbit presence, this may affect their productivity. Croll et al. (2016) noted that six pairs of nesting puffins were found at a presumed abandoned site at Hawadax Island, Alaska, five years after successful rat eradication, suggested that Tufted Puffins can re-colonize suitable breeding habitat following long-term abandonment. Nest predation by non-native Norway Rats (*Rattus norvegicus*) introduced to the island in the 18th century is believed to have caused the extirpation of puffins. The colonizing birds are thought to have emigrated from a source population on an isolated rocky islet 2.4 km southwest of the island, or possibly from more distant neighboring islands (J. C. Williams, pers. comm.).

New Marine National Wildlife Area. The Ministries of Fisheries and Oceans, Canada, announced the creation of the Scott Islands Marine National Wildlife Area in June 2018 under the Canada Wildlife Act. The 11,546 km^2 area is located off the northwestern tip of Vancouver Island. It includes nesting habitat for 90% of the Tufted Puffins that breed in British Columbia, including Triangle Island. An advisory committee is being organized to develop a management plan. (https://www.canada.ca/en/environment-climate-change/services/national-wildlife-areas/locations/scott-islands-marine.html)

Recent research. Recent studies have added important baseline information to our knowledge of Tufted Puffin populations, biology, and natural history. Menza et al. (2015, 2016) developed a predictive map of April-October puffin distributions in Washington that identified the importance of offshore foraging areas at the continental shelf break, over 50 km from the coast (Figure 5). This discovery adds an important habitat element to puffin conservation considerations, with implications for diet, competition, by-catch threat, and the distance traveled to provision chicks.

Hart et al. (2018) used species distribution models to analyze the implications of two climate change scenarios for Tufted Puffin distribution; models suggested that ~92% of currently suitable puffin nesting areas in the California Current Ecosystem would become unoccupied by 2050.

Pearson and Hodum (2018b) contrasted the population trend (since 2005) of two burrow-nesting puffin species, Tufted Puffins with Rhinoceros Auklets, and examined potential reasons why puffins have been declining, while auklets have remained stable. They suggested that, based on limited data, the puffin's diet breadth may be more limited, but this would seem to contradict work in Alaska (Sydemen et al. 2017); puffin foraging trips also seem to be more energetically costly. Alternatively, the auklet's nocturnal habits may reduce the frequency of interactions with diurnal predators (Bald Eagles and Peregrine Falcons), and kleptoparasitic gulls (*Larus* spp.) (Pearson and Hodum 2018b).

Hipfner and Burg (M. Hipfner, pers. comm.) have initiated collecting samples for genetic analyses of Tufted Puffins across their range in North America. No subspecies of Tufted Puffins are recognized, but if genetically different and isolated populations exist, this will have implications for management and potential listing under the federal Endangered Species Act.

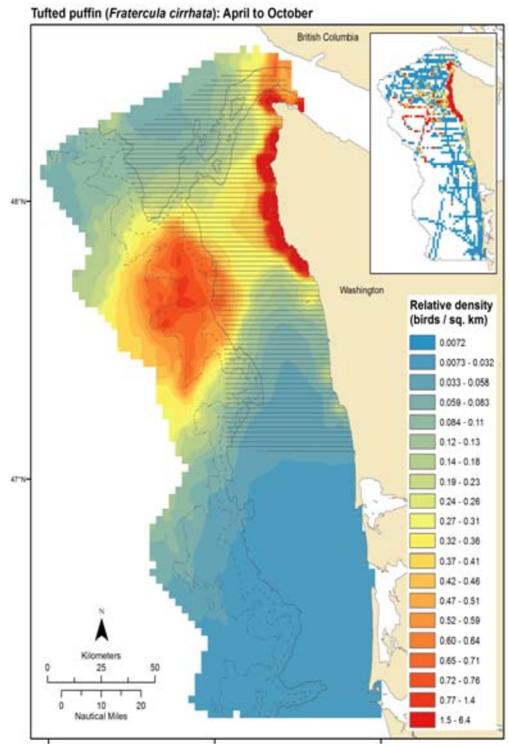


Figure 5. Predicted relative density of Washington's Tufted Puffins during April-October (Menza et al. 2015).

RECOMMENDATION

The Tufted Puffin was added to the state endangered list in 2015; their status is not known to have improved significantly since then. We recommend that the species remain classified as endangered until such time as the objectives for down-listing outlined in the following section are met.

RECOVERY

RECOVERY GOAL

The goal of this recovery plan is to rebuild and maintain a viable breeding population of Tufted Puffins within a substantial portion of the species' historical range in Washington.

RECOVERY OBJECTIVES

The Tufted Puffin will be considered for down-listing to threatened when the following conditions are achieved for the Washington breeding population:

1. **Monitoring data from breeding colony attendance surveys indicate a minimum of 8 occupied colonies distributed along at least 100 km of the coast between Point Grenville and Cape Flattery.**

2. **In at least three of the five years prior to the down-listing decision, data from boat-based monitoring indicate a mean population estimate of at least 4,500 individuals in Washington's waters,**
   OR
   breeding colony attendance counts indicate a mean breeding population of at least 6,500 individuals.

3. **Spring/summer boat-based monitoring data show a positive trend in on-the-water density for the ten-year period prior to the down-listing decision.**

The Tufted Puffin will be considered for down-listing to sensitive when the following conditions are achieved:

1. **Monitoring data from breeding colony attendance surveys indicate a minimum of 10 occupied colonies distributed along at least 100 km of the coast between Point Grenville and Cape Flattery, and ideally with two or more active colonies within the Salish Sea.**

2. **In at least three of the five years prior to the down-listing decision:**
   data from boat-based monitoring indicate a mean population estimate of at least 7,500 individuals,
   OR
   breeding colony attendance counts indicate a mean breeding population of at least 10,000 individuals.

3. **Spring/summer boat-based monitoring data show a positive trend in on-the-water density for the fifteen-year period prior to the down-listing decision.**

The Tufted Puffin will be considered for de-listing when the following condition is achieved:

1. **Spring/summer boat-based monitoring data show a stable or positive trend in on-the-water density for the twenty-year period prior to the down-listing decision.**

2. **Objectives 1 and 2 for down-listing to sensitive (above) have been met.**

Definitions

Occupancy: at least one bird observed entering or exiting a burrow on a given rock, island, or coastal bluff site during the nesting season.

Colony: a rock/island or section of coastline with at least one occupied burrow.

Boat-based monitoring: line transect or distance based surveys conducted along the outer coast and inland marine waters as part of the Northwest Effectiveness Monitoring Program. These surveys encompass the waters surrounding all of Washington's occupied colonies and are conducted between 15 May and 31 July.

Rationale

The conditions for down-listing and de-listing outlined in these objectives rely on the same metrics used to determine Tufted Puffin population trends in the status report: boat-based surveys, breeding colony attendance counts, and breeding colony occupancy records. This strategy allows comparison to previous data and encourages the continuation of monitoring activities that will inform puffin recovery efforts. The objectives emphasize positive growth trends toward the restoration of a substantial proportion of the historical puffin population in Washington. Colony occupancy targets focus on geographic distribution to maintain puffins across much of their historical range and to help protect against catastrophic events. Increasing the total number of nesting sites is not emphasized, however, acknowledging that most abandoned colonies contained few (< 100) birds, and that the recovery goal may well be achievable through the growth of existing colonies. Similarly, the small size of current and historical colonies in the Salish Sea limits their potential contribution to population targets. Barring identification of unique genetic or ecological factors (*see* Research Task 6.10 below), Salish Sea colonies are valued here primarily for their role in maintaining geographic diversity if the distribution of occupied colonies diminishes along the outer coast.

Recovery objectives for depleted populations often hinge on estimating a minimum viable population size (MVP), operationally defined as the smallest number of individuals required for a species to have a ≥95-99% probability of survival in its natural environment for 50–100 years or 40 generations. Reviews of estimates of MVP based on demographic factors and for maintaining genetic diversity and evolutionary potential suggest that generally populations of at least several thousand individuals should be maintained (Reed et al. 2003, Traill et al. 2007, Palstra and Ruzzante 2008, Frankham et al. 2014, 2017). Reed et al. (2003) used population viability analysis to estimate MVP for 102 vertebrates, including 28 bird species, and concluded that conservation programs should plan on maintaining populations of ~7,000 adults. Traill et al. (2007) conducted a meta-analysis of studies of 212 species that yielded a median MVP of 4,169. Both papers defined viability as 99% likelihood of persistence for 40 generations (Reed et al. 2003, Traill et al. 2007). However, estimates of MVP vary among and even within taxa under different conditions and life histories. As Flather et al. (2011) cautioned, there are no 'magic numbers'.

Recent guidelines for maintaining perpetual genetic fitness and evolutionary potential are broadly similar to guidelines based on viability modeling, and suggest maintaining an 'effective population size' (N_e) of 1,000 individuals (Frankham et al. 2014). N_e is an idealized population where every individual makes an equal genetic contribution to the next generation. Given the variability in demographics, sex ratios, and breeding habits found in natural populations, the estimated ratio of N_e/N generally ranges from 0.1–0.2 (Palstra and Ruzzante 2008, Frankham et al. 2014). Maintaining an N_e of 1,000 would typically require a census population (N) of 5,000–10,000 for most species.

The only detailed MVP analyses available for an alcid were conducted on a presumed metapopulation of Marbled Murrelets in British Columbia. In one model, viability for single populations was achieved at 6,000 individuals (Steventon et al. 2003), while a second model recommended the much higher number of 15,000 (Steventon et al. 2006). With no specific MVP estimates available for Tufted Puffins in Washington, and considering the inherent variability among models and taxa, population targets in this plan were adopted to meet or exceed general viability guidelines.

Recent population estimates for Tufted Puffins in Washington have been derived from boat-based surveys (Table 1) and put the minimum on-the-water population for the outer coast at 1,278 individuals in 2017 (S. F. Pearson, unpubl. data). This figure did not account for individuals provisioning chicks, individuals farther offshore, or the two small colonies located in the Strait of Juan de Fuca, so the total population was somewhat higher. Even taking that into account, this estimate falls well below general MVP recommendations, further confirming the status of Tufted Puffins as endangered in Washington. The population target of 4,500 individuals set for down-listing puffins to threatened would more than triple the 2017 on-the-water estimate, and the 7,500 target for down-listing to sensitive would put them well within the range of MVP recommendations (especially when considering that not all birds are detected in these surveys). At that level, the puffin population would be theoretically sustainable and eligible for de-listing, but still at a threshold where persistent declines would return their status to threatened or endangered. In both down-listing scenarios, sustained population growth and stable, well-distributed colony occupancy are also required. The objective for de-listing puffins requires the maintenance of population thresholds set for down-listing to sensitive for a period of 20 years, long enough to confirm viability through a range of long-term oceanographic conditions, such as El Niño cycles and the Pacific Decadal Oscillation.

For the purposes of this recovery plan, it is important to acknowledge that factors outside of Washington may exert a strong influence on local Tufted Puffin population trends. Puffins primarily reside in the state only during their nesting season, and it is well known that carry-over effects from wintering grounds can impact birds at other times of year (Norris 2005). Reproductive output and/or survival has been linked to prey quality, availability, or other conditions prior to the breeding period in many other seabird species (Kouwenberg et al. 2013, Szostek and Becker 2015, Hinke et al. 2007, Sorensen et al. 2009). It is not known where Washington's Tufted Puffins spend the winter, what affects them there, or how environmental conditions in these locations may have changed or will change in the future. In addition, regional and global climate factors are beyond state or regional control. Although, short-term (~1–2 year) extreme climate events did not seem to affect adult survival of Tufted Puffins or Rhinoceros Auklets on Triangle Island, BC (Morrison et al. 2011), climate factors have been shown to impact breeding success, adult survival, and other demographic parameters for members of the auk family, including Dovekies (*Alle alle*; Moe et al. 2009), Least Auklets (*Aethia pusilla*; Jones et al. 2002), Razorbills (*Alca torda*; Sandvik et al. 2005), and Atlantic Puffins (Durant et al. 2003, Sandvik et al. 2005), as well as many other seabirds (Ramos et al. 2002, Cubaynes et al. 2011, Thompson and Ollason 2001).

The link between climate-driven sea surface temperature and prey availability has been suggested as a leading cause of Tufted Puffin declines (Gjerdrum et al. 2003), and a predictor for the continued loss of suitable breeding-season foraging habitat throughout the California Current (Hart et al. 2018). Reaching the population targets set forth in this plan will involve the maintenance and improvement of local conditions for Tufted Puffins in Washington, but wider trends will also certainly affect the recovery process.

In spite of global and regional influences, evidence suggests that particular conditions around breeding colonies often play a decisive role in the reproductive success of seabirds, and presumably, long-term persistence of colonies. Examples include the importance of local vs. regional prey populations (Durant et al. 2010, Frederiksen et al. 2005), and how the proximity of multiple, high quality foraging areas can help individual breeding colonies withstand downturns in prey availability (Paredes et al. 2012). For Tufted Puffins, Hipfner et al. (2007) reported that subcolonies exhibited differences in breeding success apparently as a result of differences in foraging locations. Data from the Farallon Islands in California suggest that individual colonies still have the potential to grow in the face of broader range contraction. While other populations in the California Current have declined precipitously in recent decades, puffins in the Farallons increased by a mean annual rate of 4.3% between 1972 and 2016 (R. Bradley, unpubl. data). Potential explanations for this anomaly are all local: proximity to good foraging at the continental shelf break, relatively consistent local availability of prey, and lack of predation and disturbance from Bald Eagles (*Haliaeetus leucocephalus*) (R. Bradley, pers. comm.). The puffins may also be experiencing long-term benefits/predation release from the removal of non-native Domestic Cats (*Felis catus*) and European Rabbits in the 1970s (R. Bradley, pers. comm.).

These examples confirm the potential importance of local recovery efforts in the face of regional trends. Tufted Puffin populations in Washington have declined dramatically, remain very low, and are below levels considered sustainable. Reaching the objectives outlined in this recovery plan will return the status of Tufted Puffins in Washington to one of long-term viability. Among the strategies and tasks outlined below, the order does not reflect priority; research needs are listed under strategy 6 but a strong research component is needed to better understand the causes of the dramatic decline in the population. Research that identifies how best to improve Tufted Puffin food and habitat resources in Washington is important, both to foster local breeding success and to make local conditions responsive to any improvement in regional population trends. Population monitoring, restoration of habitat on breeding islands and prey resources, reducing disturbance and other threats, working with other stakeholders, and increased outreach to the public are other important strategies for advancing these goals.

RECOVERY STRATEGIES AND TASKS

1. Monitor Tufted Puffin populations in Washington.

1.1 Continue boat-based surveys for on-the-water Tufted Puffin population estimates.

Data on Tufted Puffins have been collected as part of boat-based surveys for Marbled Murrelets along Washington’s outer coast since 2001. Surveys are done in zone 1 (Puget Sound, San Juans, and Strait of Juan de Fuca), and zone 2 (Washington coast) in alternate years. The Marbled Murrelet surveys follow established transects that pass all of Washington’s outer coast colonies and through some waters where puffins commonly forage. This provides one of the best ongoing datasets for Tufted Puffins in Washington and will be an important measure for determining future population estimates and, in particular, growth trends. Westport Seabird surveys have been conducted annually since 1972 (although puffins are rarely detected in these surveys due to geographic location), and annual surveys are also done in the San Juan Islands and Protection Island national wildlife refuges.

1.1.1 Coordinate with USFWS and other stakeholders for continuing surveys.

With Tufted Puffins now state listed as endangered in Washington (and under consideration for federal listing), and Marbled Murrelets listed at both state and federal levels, these surveys offer a cost effective way to obtain data on both species. Agency funding levels and priorities fluctuate over time, however, so it will be important to coordinate with USFWS, and other relevant parties to ensure that surveys continue uninterrupted.

1.1.2 Consider expansion of surveys to include the shelf break or other potentially relevant areas.

Because ongoing boat-based surveys were designed with Marbled Murrelets as the primary focus, some areas relevant to Tufted Puffins have not been included. Consideration should be given to additional or expanded surveys that would capture foraging activities at the shelf break or other potentially important puffin areas.

1.1.3 Analyze survey data to monitor puffin abundance and population trends.

1.2 Conduct and/or coordinate Tufted Puffin colony attendance counts and colony occupancy surveys.

Comprehensive efforts to estimate attendance at all current and historical Tufted Puffin colonies in Washington have occurred in the past, most recently from 2007 to 2010 (Catalogue of Washington Seabird Colonies). Additional individual colony attendance counts have taken place as part of other puffin or general seabird projects, and were compiled in the status report (Hanson and Wiles 2015). These data, particularly the comprehensive surveys, offer another important method for generating state-wide population estimates, and also provide information on trends in colony occupancy.

1.2.1 Conduct and/or coordinate periodic comprehensive attendance counts of current Tufted Puffin breeding colonies and survey historical colony sites in Washington.

Regular attendance counts are needed to inform key down-listing decisions outlined in the recovery plan objectives, but may also occur opportunistically to coincide with other research projects. Puffins can also quickly re-colonize former nesting colonies when conditions are favorable (Croll et al. 2016), so vacant colony sites and other suitable locations should be surveyed periodically for signs of re-colonization. Coordination among agencies, researchers, and other relevant parties will help ensure that data from all such efforts in Washington are shared and compatible.

1.2.2 Compile attendance and occupancy data from all surveys and relevant research projects.

Colony counts and survey data should continue to be regularly compiled into a central database that WDFW, USFWS, university researchers, etc. contribute to, which is then available to all researchers and managers to use (Catalog of Washington Seabird Colonies). Research projects focused on the biology and natural history of puffins or sympatric species may also include observations relevant to colony attendance and occupancy, and are an additional source of information relevant to overall progress toward recovery objectives. The Cornell Laboratory of Ornithology's eBird platform has made the observations of birdwatchers and other citizen-scientists increasingly useful, and may, in the future, contain the early signs of colony re-occupancy and therefore should be checked periodically for observations during the nesting season.

2. Maintain and enhance habitat at nesting colonies for Tufted Puffins in Washington.

2.1 Ensure that current protected status for nesting colonies is maintained or enhanced.

At present, nearly all known current and historic Tufted Puffin nesting sites occur within the Washington Maritime National Wildlife Refuge Complex and overlapping wilderness areas. National wildlife refuges are administered by the USFWS and island nesting sites within them enjoy some legal protections, including restrictions on public access, including mandatory buffer zones of 183 meters in surrounding waters for Protection Island and Dungeness NWRs However, the buffer zone is voluntary on San Juan Islands, Flattery Rocks, Quillayute Needles & Copalis NWRs, and Outreach/Education/Enforcement is very limited and trespass into buffer zones likely regularly occur. Tatoosh Island is part of the Makah Reservation, and access is by permit only. Enforcement of access restrictions is important for Tufted Puffins, a species known to neglect eggs or even abandon burrows entirely when disturbed (Pierce and Simons 1986, Hatch et al. 2000).

2.1.1 <u>Advise relevant agencies and stakeholders about sensitivity of Tufted Puffin colonies during regulatory revisions and protected area designations</u>.

When management guidelines or the designation status for lands containing puffin colonies are up for review, it will be important to advise agencies and other stakeholders about puffin sensitivities to disturbance. Current protections (i.e. access and use restrictions) should be maintained or expanded, as needed, based on best available science at the time. Additionally, new threats such as recreational or commercial drone technology may emerge that require adjustments of existing regulations to ensure appropriate buffers and precautions.

2.1.2 <u>Ensure protection of any Tufted Puffin nesting colonies outside of current protected areas</u>.

Given the ability of puffins to quickly colonize suitable habitat (Croll et al. 2016), headlands or other currently unregulated areas may become occupied in the future. The cliffs at Point Grenville, for example, a site with recreational access overseen by the Quinault Indian Nation, held breeding puffins as recently as 1980 (Hanson and Wiles 2015). If such colonies materialize, landowners should be contacted to explore means for enacting access restrictions, buffer zones, or other protections.

2.2 Assess and manage invasive, non-native species at Tufted Puffin nesting colonies.

The presence of nonnative species, particularly mammals, can negatively impact the breeding success of seabirds (Croxall et al. 2012). Population declines or extirpations of Tufted Puffins have followed introductions of Arctic Foxes (*Alopex lagopus*; Bailey 1976), Norway Rats (Croll et al. 2016), and European Rabbits (Ainley and Lewis 1974). Nonnative plants have also been implicated in the degradation of nesting habitat and subsequent seabird declines, including for Atlantic Puffins (van der Wal et al. 2008). Techniques for removing nonnative species from island habitats are now well-established (Veitch and Clout 2002), and have been shown to have a positive impact on a wide range of seabirds (Jones et al. 2016), including Tufted Puffins (Croll et al. 2016).

2.2.1 Assess the impacts of non-native species on Tufted Puffins at nesting colonies in Washington.

Non-native species are currently known from two of Washington's Tufted Puffin colonies: European Rabbits and various plants on Destruction Island (Aubry and West 1984), and various plants (e.g., Cheatgrass, Orchard Grass) at Protection Island (USFWS 2010). It is unknown whether non-native species have played a role in recent population declines, though competition for burrows is suspected at Destruction Island (Hanson and Wiles 2015). A comprehensive assessment of non-native species at nesting colonies would better inform management and control decisions, but require substantial effort, and may be impractical at some inaccessible islands and in surface-nesting seabird colonies. Such information could come from a systematic survey, or on an ad hoc basis as current and former colony sites are accessed for other purposes. This activity will require close coordination and collaboration with relevant agencies and researchers.

2.2.2 Remove non-native European Rabbits from Destruction Island.

The presence of rabbits on Destruction Island is thought to have contributed to the decline of Tufted Puffins from several hundred birds in the 1970s to only approximately 40 individuals today (P. Hodum, unpubl. data), and rabbit eradication has long been discussed. Removing non-native rabbits from islands can benefit nesting seabirds (e.g., Hodum 2007, Brodier et al. 2011), improve habitat, reduce disturbance, and – for burrow-nesting species like puffins – eliminate competition for nest sites. Negative effects of removal are possible, however, including the transfer of predation pressure from rabbits to birds (Lees and Bell 2008), and the release of invasive plants held in check by rabbit browsing (van der Wal et al. 2008). If preliminary investigations find that negative effects are unlikely, the coordination of rabbit removal should be pursued as a high priority. Among several options, depopulation and exclusion by fencing could be quickly achieved on the narrow finger of land containing the bulk of the island's puffin nests. Removal of rabbits from the island represents one of the most tangible measures immediately available to improve Tufted Puffin nesting habitat in Washington.

2.2.3 Pursue opportunities to remove invasive species and restore native communities at other nesting colonies.

Based on existing knowledge or the results of assessments outlined in 2.2.1 above, pursue opportunities to remove invasive species and restore habitat at other nesting colonies as needed. At Protection Island, for example, ongoing management experiments to replace invasive grasses and shrubs with native plant communities include work in 8 ha of sandy bluff habitat used by nesting puffins (USFWS 2010).

2.3 Explore other habitat restoration opportunities at current and former Tufted Puffin nesting colonies.

Historical colony sites with a history of human use and disturbance should be evaluated for the need for habitat restoration. One example of this work is the proposed removal of the caretaker's cabin, a private home, and associated structures from 2.5 ha of sandy bluffs on Protection Island to expand nesting habitat for Rhinoceros Auklets (USFWS 2010), which may benefit the island's puffins by reducing human disturbance.

3. Reestablish colonies with reintroductions if feasible.

If research indicates active reintroduction is feasible and is likely to be successful, conduct reintroduction(s) using social attraction, translocation, and other active strategies to re-establish historic colonies. Passive colonization of suitable habitat by Tufted Puffins from neighboring colonies has been documented at distances ≥ 2.4 km (J. C. Williams, pers. comm.). Many former nesting sites in Washington are near active sites, well within range of passive re-colonization. Active reintroduction, on the other hand, has never been attempted with Tufted Puffins, but was used in part to re-establish Atlantic Puffins on Eastern Egg Rock in the Gulf of Maine (Kress and Jackson 2015). In that example, chicks were translocated to the colony for nine years before a breeding population was reestablished (Kress and Jackson 2015). Less intrusive "social attraction" methods were also employed, including the establishment of artificial burrows and the placement of puffin decoys. It is unknown how Tufted Puffins would respond to such strategies, and a reliable, multi-year source of chicks would be needed for any translocation. Though commonly kept and displayed in captivity, Tufted Puffins have proven sensitive to disturbance and handling by researchers in the wild (Pierce and Simons 1986, Hatch et al. 2000). Gaining a better understanding of active restoration potential may become increasingly important if Tufted Puffins continue to decline in Washington, or if the population becomes concentrated in only a few active sites vulnerable to stochastic events (e.g. storms, erosion, contamination). However, it is important to not attract puffins to sites that could potentially act as population sinks (see discussion under Task 6.7 below).

4. Ensure adequate prey availability for Tufted Puffins in Washington.

4.1 Prioritize maintenance of the prey base for Tufted Puffins in Washington

The importance of small fish species in the puffin diet makes forage fish conservation measures a clear priority in Washington, but policies could be better informed by more local knowledge, such as the importance of juvenile rockfish or invertebrates in puffin diets, and potential differences among diets along the coast, at the shelf break, and in the Strait of Juan de Fuca.

4.1.1 <u>Incorporate Tufted Puffin prey requirements into management of forage fish stocks in Washington</u>.

As a regulatory agency and member of the Pacific (PFMC), and North Pacific (NPFMC) fishery management councils, WDFW plays an important role in setting policy for the commercial and recreational harvest of forage fish. Overharvest of forage fish is known to be detrimental to piscivorous seabirds (Essington et al. 2015), whereas lower harvest levels are predicted to have positive or mixed effects on various seabird species, and their specific prey and foraging habits (Koehn et al. 2017). Both fishery management councils currently advocate an ecosystem services approach to forage fish harvest, emphasizing forage fish importance to seabirds and other predators, and PFMC takes a precautionary approach in setting annual forage fish catch limits. The West Coast Pacific sardine fishery has been closed since 2014 and Northern

Anchovy harvest in Washington occurs primarily in Grays Harbor and Willapa Bay at relatively low levels. Current levels of forage fish harvest in Washington are not thought to have a significant impact on Tufted Puffins (Hanson and Wiles 2015), but maintaining an ample prey base should be a priority in all future harvest and management decisions.

4.1.2 Incorporate Tufted Puffin prey requirements into the management of rockfish stocks in Washington.

Juvenile rockfish are a major component of the Tufted Puffin diet at Triangle Island, B.C. (Vermeer 1979), and are common in the diet of co-occurring Rhinoceros Auklets in coastal Washington (Wilson and Manual 1986, Good et al. 2014). Most coastal rockfish populations are healthy in Washington with the exception of Yelloweye Rockfish, which are still managed under a rebuilding plan, but are recovering faster than anticipated. Two Puget Sound/Salish Sea rockfish populations are listed as threatened or endangered under the Federal ESA—Yelloweye Rockfish and Bocaccio Rockfish. It is likely that Tufted Puffins in Washington consume juvenile rockfish, at least along the outer coast where co-occurring Rhinoceros Auklets regularly bring rockfish back to their chicks, a possibility that may be confirmed by future research (see task 6.2.1). Although juvenile rockfish abundance does not track well with rockfish stock status because of high mortality rates at early life stages, maintaining rockfish stocks as integral parts of the ecosystem, including as forage for seabirds and other species, is part of the PFMC Fishery Ecosystem Plan and Groundfish Fishery Management Plan on the coast, and the Puget Sound Groundfish Management Plan (Bargmann 1998) and the federal recovery plan for Bocaccio and Yelloweye Rockfish (NMFS 2017).

4.1.3 Include Tufted Puffin prey requirements in priorities used for setting policies and making decisions regarding forage fish habitat protection.

Efforts to protect forage fish habitat and enhance abundance will improve Tufted Puffins resilience in the face of climate change. Important spawning and rearing habitats for forage fish in Washington include eelgrass beds, estuaries, and various sand and gravel beaches, as well as freshwater rivers and streams. Many of these habitats are under pressure from urban and suburban development, industrial development, and the impacts of commercial forestry and agriculture. Policy and permitting actions that impact these areas often include review by local, state, and/or federal regulators who must balance broad environmental and human concerns in their decision-making. Tufted Puffin prey considerations should now be factored into those processes, particularly for species identified as major components of puffin diet in Washington (tasks under 6.2).

4.2 Encourage urgent measures to reduce human-generated greenhouse gases and mitigate climate change that threatens marine ecosystems.

Human-caused climate change is is expected to make conditions increasingly challenging for the Tufted Puffin population in Washington, impacting puffin prey and the entire marine ecosystem. All other recovery measures may fail if this issue is not addressed very soon.

5. Reduce threats of disturbance, mortality, and contamination to Tufted Puffins at nesting colonies and on the water in Washington.

5.1 Reduce threats of disturbance and mortality by predators and other species affecting Tufted Puffins at nesting colonies in Washington, if necessary.

Tufted Puffin nesting colonies in Washington occur primarily within national wildlife refuges and enjoy reduced risk from human disturbance, as described in Strategy 2 above. Natural sources of disturbance and mortality remain, however, and management action may be appropriate when reproductive success and colony persistence are threatened.

5.1.1 If research demonstrates that Bald Eagle predation is having a significant impact on puffins, explore options for reducing disturbance and mortality from Bald Eagles at nesting colonies.

Bald Eagle predation has been suggested as a factor in puffin declines in Washington and has probably increased in recent decades as eagles have recovered (Hanson and Wiles 2015). Options for management are limited, though an intriguing study found reduced eagle predation and increased reproductive output for Common Murres (*Uria aalge*) at Triangle Island, B.C. in years when Peregrine Falcons (*Falco peregrinus*) nested nearby (Hipfner et al. 2011). Aggressive territorial defense by the falcons apparently kept eagles at bay, providing benefits that far outweighed the cost of occasional falcon predation. If additional research demonstrates that eagle predation is having a significant impact on puffins (see Paragraph 6.8.1), options for reducing threats from eagles should be explored.

5.1.2 Manage other species at nesting colonies as needed.

If research indicates that predation, kleptoparasitism, or disturbance by other species is having a significant negative impact on struggling colonies, implement management actions that have been identified and recommended by research. Land management for endangered species sometimes involves decisions that favor target species over other residents of the same habitat. Re-establishing Atlantic Puffins on Egg Island, Maine, for example involved the elimination of Herring Gulls (*Larus argentatus*) and Great Black-backed Gulls (*Larus marinus*) nesting on the island (Kress and Jackson 2015). It is currently unknown whether disturbance from or competition with co-occurring species at nesting colonies is significantly affecting Tufted Puffins at Washington colonies, or whether any management actions may be required. Harassment of puffins by Glaucous-winged Gulls and Glaucous-winged X Western Gull hybrids has been observed, however, including chasing behavior and blocking puffins from their burrows (P. Hodum, pers. obs.). Managers at Seabird Rocks, B. C., suspect that seabird predation was carried out by one resident otter family and recommended their removal, or the erection of protective structures around nesting habitat until bird populations recover (Carter et al. 2012). With puffin populations at historic lows in Washington, predation effects are a concern and such measures would merit consideration where small numbers of predators threaten entire colonies. Another potential disturbance has been observed at Protection Island, where Black-tailed Deer (*Odocoileus hemionus columbianus*) are known to incidentally startle Rhinoceros Auklets or collapse their burrows when traversing or bedding down in colonies, and managers have proposed removing them from the island (USFWS 2010).

5.2 Identify and reduce threats of human-related disturbance, mortality, and contamination affecting Tufted Puffins on the water in Washington.

Outside of the small protective buffer zones around nesting colonies, puffins on the water are exposed to a wide range of threats. Little is known about how these concerns have impacted puffins in Washington, whether they have played a significant role in puffin declines, or if ocean changes related to climate are the predominant factor. A better understanding of these issues, as well as identification of critical foraging habitats will be useful in reducing threats through policy input, education and outreach, or other potential management activities.

5.2.1 Identify and reduce sources of human disturbance affecting Tufted Puffins on the water in Washington.

Seabirds are considered at risk from a variety of human disturbances while on the water and in transit to and from foraging areas (McGowan et al. 2013). Tufted Puffin habitat in Washington overlaps with shipping lanes accessing major ports at Seattle, Tacoma, and Vancouver, B.C., as well as major oil refineries and the third largest naval base in the U.S. (Hanson and Wiles 2015). Recreational boaters also traverse puffin habitat, and puffins are known to flush from staging areas on the water near colonies when approached closely by commercial ecotourism vessels (S. F. Pearson, pers. obs.). Effects of these activities are unknown, but could potentially be reduced by changes in vessel routing, expanded buffers around nesting colonies, the creation of marine protected areas in some locations, and increased education and outreach. Outreach, education, and enforcement on the refuges will need dedicated funding.

Offshore energy development, including wind farms, tidal energy, and the proposed re-opening of Washington's coast to offshore oil drilling leases all have the potential to impact Tufted Puffins. Puffin considerations should be included in policy decisions and environmental impact reviews for such activities. The development of a puffin-focused brief or fact sheet to inform policymakers would be beneficial.

5.2.2 Reduce the threat of oil spills to Tufted Puffins on the water in Washington.

An estimated 9% of Washington's Tufted Puffin population was killed by the 1991 Tenyo Maru oil spill (Tenyo Maru Trustees 2000), and contamination from vessel spills or potential future offshore drilling remains a major concern. The stationing of a rescue tugboat at Neah Bay to aid disabled vessels and thereby prevent oil spills should be maintained. In addition to the rescue tug program, contingency plan improvements, readiness drills, training, new equipment, enforcement and voluntary compliance programs have reduced the potential for spills and improved capabilities of response. Furthermore, an "*Area to be Avoided*" routes oil tankers and large freighters offshore of refuge islands. This addresses the risk near the mouth of the Strait, however, tanker traffic in the Strait of Juan de Fuca is expected to increase dramatically with the planned expansion of the Trans Mountain petroleum pipeline to Burnaby, British Columbia. In 2019, the Washington legislature passed additional restrictions and requirements for tanker traffic to improve safety to reduce threats to southern resident killer whales (ESHB 1578). Seabird conservation should be included in decisions about offshore drilling permits, spill response planning, and vessel safety.

5.2.3 Reduce threats of contamination and mortality affecting Tufted Puffins on the water in Washington.

Puffins should be considered in efforts to clean up known sources of persistent organic pollutants (POPs), identified through research (Task 6.6).

5.2.4 Rescue and rehabilitate Tufted Puffins when they are affected by oil spills or harmful algae blooms in Washington.

When an oil spill occurs, Washington state agencies follow the federal model of emergency response, known as the Incident Command System. The WDFW Oil Spill Team leads the wildlife branch focused on deploying resources to rehabilitate oiled wildlife, and would manage the capture and rehabilitation of any oiled puffins.

5.2.5 Identify and reduce potential threats of fishing gear entanglement if it is affecting Tufted Puffins in Washington waters.

Direct mortality to puffins may be a threat from entanglement in gillnets in Puget Sound. A study of Rhinoceros Auklets caught in salmon gillnets in Puget Sound, for example, suggested that mortality can be reduced by 70–75% through a combination of gear modifications and timing restrictions, without a concomitant reduction in fishing efficiency (Melvin et al. 1999). However, on-the-water observations in other net fisheries off Washington (e.g., purse seine, lampara, trawl) have not recorded any interactions with Tufted Puffins. There is a system for derelict gear removal in the Salish Sea that began in 2002 and has been evolving and expanding since. Commercial fishers are required by law to report lost fishing gear within 24 hours and a rapid-response team is on standby to remove reported gear as soon as practicable. Over 6,000 ghost nets have been removed as part of this program over the last 17 years.

5.2.6 Encourage alternative energy projects while considering potential impacts of coastal wind or tidal energy capture on puffins.

Alternative energy can help reduce the effects of climate change, but the potential impacts of coastal projects on Tufted Puffins should be considered. The report by Menza et al (2016) was a collaborative effort to develop predicted density surfaces for birds and mammals on the Washington Coast, including the Tufted Puffin. This work is a critical first step in compiling information that will help reduce the potential conflicts between coastal wind, tidal, and wave energy development while minimized potential impacts to puffins.

5.2.7 Evaluate, review and comment on U.S. Navy training activities that may affect Tufted Puffins.

The Quinault Training Area overlaps with the high puffin density area mapped by Menza et al. (2016), indicating that foraging puffins could be affected by training activity, particularly if there is any use of underwater explosives (U.S. Navy 2019).

6. Conduct research necessary to conserve and recover Tufted Puffin populations in Washington.

Tufted Puffin declines are a major concern among seabird biologists who work in the North Pacific Ocean. The following projects have all been identified as action items by the Pacific Seabird Group (PSG) Tufted Puffin Technical Committee and/or in the status report. A Washington Tufted Puffin working group should be convened (Task 7.1) to identify and prioritize resaerch actions specific to Washington that might escape attention of a range-wide group so that management can be trailored to support puffin recovery in Washington.

6.1 Coordinate research activities with the Pacific Seabird Group (PSG) Tufted Puffin Technical Committee and other interested researchers.

The Pacific Seabird Group (PSG) Tufted Puffin Technical Committee met for the first time in February 2017 and includes seabird researchers from agencies and universities studying the species across its range. The committee will play a valuable role in coordination, setting priorities, avoiding duplication, sharing results, and refining research questions that address the significant needs for widespread recovery of Tufted Puffins. Additional puffin research will likely take place in other contexts as well.

6.2 Investigate the diet, foraging areas, and the effects of prey availability on productivity of Tufted Puffins in Washington.

The following work will require working on colonies, potentially capturing birds on the water to attach devices for tracking movement and dive patterns, and observing birds from boats adjacent to colonies. This work will likely entail working on index sites such as Destruction, Protection, and Smith islands as well as observations of, or brief visits to, other colonies as well. All work will be initiated and coordinated with the appropriate land managing agency. Work on tribal lands requires approval by the governing tribal council.

6.2.1 <u>Investigate the diet of Tufted Puffins in Washington and how the prey base differs temporally and among colonies, and develop an understanding of the prey base needs for colony growth</u>.

A better understanding of diet quality, quantity and composition can provide important insights into population limiting factors. Both diet composition and quality (e.g., calories) vary over time and space and have significant impacts on seabird survival and reproduction. For example, poor growth conditions for puffin chicks on Triangle Island, B.C., have been associated with warm sea surface temperatures, which are related to poor recruitment of sand lance (Hedd et al. 2006) and minimal representation of sand lance in nestling diets (Gaston 2009).

6.2.2 <u>Compare trends in prey availability to Tufted Puffin breeding success in Washington and assess whether reproductive output and population trends of puffins are driven by "bottom up" or other factors</u>.

Dietary parameters, including prey availability, may impact seabird reproductive success. Bottom-up control has been documented as a factor regulating seabird populations (Parrish and Zador 2003), although given the extremely limited information available about diet composition of Tufted Puffins in Washington, the degree to which prey availability may constrain reproductive productivity is unknown at present.

6.2.3 <u>Assess the effects of climate change on diet, prey availability, and puffin productivity.</u>

Climate change is likely to affect forage fishes in multiple, and unknown ways. Schoen et al. (2018) found that Tufted Puffins in Alaska were able to adjust their foraging behavior to maintain comparable breeding success across a wide range of environmental conditions. A similar assessment of trends in dominant prey species and environmental variables in the California Current System would be an important complement to the necessary studies of diet quality and composition in the region. At the same time, especially warm sea surface temperatures corresponded with drastically decreased chick growth rates and fledging success (Gjerdrum et al. 2003). In general, poor chick growth conditions are associated with warm sea surface temperatures, which results in poor recruitment of Pacific Sand Lance (*Ammodytes* spp.) (Hedd et al. 2006) and minimal representation of sand lance in nestling diets (Gaston et al. 2009).

6.2.4 Identify important Tufted Puffin foraging areas and key foraging habitats near colonies and at the shelf break

Tufted Puffins in Washington travel an average of 4.67 km from nesting colonies to forage, but will range as far as 100 km to find suitable prey (Cody 1973). In Washington, foraging areas occur in the vicinity of colonies along the outer coast and in the Strait of Juan de Fuca, and also at the shelf break approximately 50 km offshore (Menza et al. 2015). It is currently unknown whether there are critical, heavily-used places within these zones, and whether or not puffin foraging habitat requires additional protection. Identification of such areas, and study of puffin behavior within them, would better inform management and help set policy for shipping routes, wind farms, and other marine activities potentially impactful to puffin foraging.

6.2.5 Determine how Tufted Puffin diets and breeding success in Washington are affected by foraging locations and habits.

Breeding seabirds are central place foragers, meaning that they have to commute between nesting colonies and foraging areas. As such, they are restricted to a maximum foraging radius around their breeding colony and are predicted to minimize transit time to improve foraging efficiency (Ydenberg et al. 1994). Tufted Puffins forage within 100 km of colonies (Cody 1973, Piatt and Kitaysky 2002). Within the California Current, Tufted Puffins are known to forage offshore in continental shelf and slope waters (summarized in Piatt and Kitaysky 2002). In Washington, Menza et al. (2016) have modeled predicted distributions and densities of Tufted Puffins during the breeding season for the outer coast, but those spatial data have not been linked to diet or breeding success.

6.2.6 Determine Tufted Puffin diving depths in various foraging conditions.

Information on foraging depths has important implications for assessing the energetic costs of foraging, as well as understanding the vulnerability of puffins to various forms of offshore energy development.

6.3 Investigate the winter movements and ecology of Washington's Tufted Puffins.

6.3.1 Determine Tufted Puffin distribution, habitat use, diet, migratory routes, and other life history traits during their winters at sea.

Puffin distribution during the winter months is basically unknown. A pilot study is proposed and initially funded to place solar satellite tags on approximately 7 puffins on the Washington coast during the summer of 2019 to provide information on late breeding season foraging patterns and early winter movement patterns. This information will provide novel insights into how at-sea variables such as changing oceanic and climatic conditions, changes in prey availability, and overlap with fisheries and shipping routes may interact with wintering puffin populations. It will also inform the need for additional study.

6.3.2 Assess Tufted Puffin seasonal survival rates and effects of winter on body condition and subsequent reproduction, and evaluate how winter conditions are affecting population trends in Washington.

Information on survival and fecundity by life stage is critical to understanding how both vital rates (fecundity and/or survival) and season (breeding vs. non-breeding) are affecting Tufted Puffin populations. Determining which factors limit puffin populations will help set conservation priorities.

6.4. Investigate the biology, distribution, and habits of sub-adult Tufted Puffins, and determine age at first breeding.

Factors affecting survival of sub-adults are fundamentally important since the rate at which they recruit into the breeding population affects demographic trends. Age at first breeding is an important demographic parameter that influences generation time and, ultimately, maximum growth rates of populations. Given that sub-adult birds are not spatially constrained to the same degree that breeding adults are, the pressures affecting them may differ. Early nutrition may be very important for recruitment; Morrison et al. (2009) reported that wing length and mass of juveniles at fledging predicts survival and age at first return to the colony. Longer wings likely aid foraging efficiency and the greater mass help them through the early period of independence.

6.5 Investigate other aspects of the natural history of Tufted Puffins.

While research focused on recovery goals is a high priority, knowledge gaps also exist about the basic biology of Tufted Puffins, including physiology, life history, and ecological interactions. These questions also merit attention, and often produce unexpected insights with direct bearing on conservation activities.

6.5.1 Determine the origin and longevity of Tufted Puffin pair bonds, and the fidelity of pairs to particular burrows.

In burrow-nesting seabirds, pair-bonds are often associated with location and condition of individual burrows (Bried and Jouventin 2002). Birds returning to breeding colonies locate their mate at the burrow used in the previous year. If this is true for puffins, then it has important implications for burrow loss and the importance of maintaining burrows, even in the non-nesting season.

6.5.2 Assess Tufted Puffin fidelity to natal colonies, and determine if and how birds move among colonies, and how new breeding sites are established.

Natal colony philopatry can have important consequences for the degree to which breeding colonies are isolated. Spatially discrete populations are at a greater risk of disappearing as isolation increases. If Tufted Puffins exhibit high fidelity to natal colonies, movement among colonies will be low and isolation of those colonies high.

As such, understanding the rate at which puffins disperse among colonies will inform an assessment of the likelihood of long-term persistence of breeding colonies.

6.5.3 Investigate other aspects of Tufted Puffin biology, including physiology, life history, and ecological interactions.

6.6 Identify and evaluate potential threats of contaminants for Tufted Puffins in Washington.

Persistent organic pollutants (POPs; e.g., PCBs, PBDEs, HCB) have been detected in puffin prey species off the coast and in the Salish Sea, and one recovered puffin carcass from Puget Sound exhibited POP concentrations 10 times higher than sympatric Rhinoceros Auklets (Good et al. 2014). Additional sources of contamination include ingested plastics, a growing global issue for seabirds (Cole et al. 2011).

6.7 Investigate the feasibility and techniques of restoring Tufted Puffin colonies in Washington.

6.7.1 Assess feasibility of social attraction (i.e. using puffin models and call recordings), artificial nest boxes, translocation, and other means for spurring re-colonization of abandoned Tufted Puffin breeding colonies where adequate prey resources are within foraging range.

Active and passive approaches for establishing new colonies have been used for a variety of land and seabird species. Literature review should be pursued to establish which approaches may be successful with Tufted Puffins and field trials should be pursued if warranted. It is important to view these activities with an understanding that Tufted Puffins appear to be more sensitive to disturbance and colony abandonment than Atlantic Puffins. In addition, it is critical to gain a better understanding of what factors make a site more likely to be a source vs. a sink habitat to avoid attempting to establish new colonies on sites that are likely to become population sinks or where reproduction and survival is poor. Studies of re-colonization potential should address cost-effectiveness, and whether or not restored sites are likely to become self-sustaining. For example, a colony of Atlantic Puffins and other seabirds re-established on East Egg Rock in Maine still requires active, on-site management to control invasive weeds and protect the birds against gull predation (Kress and Jackson 2015).

6.7.2 Assess viability of habitat enhancement, artificial nest boxes and burrows, social attraction, and other means for spurring growth of existing Tufted Puffin breeding colonies.

A variety of methods have been used to expand nesting areas and increase nesting populations at active seabird colonies, including vegetation management, social attraction, artificial burrows, and nest boxes (Jones et al. 2011). Conduct a literature review and, if warranted, field trials should be pursued to evaluate the potential of these activities for Tufted Puffins at existing sites in Washington. Cost effectiveness and puffin sensitivity should be considered, and guidelines should be to avoid creating unsustainable nesting areas.

6.8 Investigate ecological relationships of Tufted Puffins that affect survival and recruitment in Washington.

6.8.1 Study impact of Bald Eagles and other predators on Tufted Puffins in Washington to determine the importance of "top down" factors on reproductive success, population trends, and site use/activity.

Bald Eagle predation at coastal seabird nesting colonies has increased in recent decades, with substantial effects on surface-nesting species like Common Murres (Schrimpf et al. 2012). Eagles may kill seabirds directly (Vermeer et al. 1976, Hipfner et al. 2012), or create disturbances that expose eggs and nestlings to other predators such as Glaucous-winged Gulls and crows (*Corvus* spp). Puffins may minimize activity levels, and when approaching colonies modify their fly-by behavior or avoid landing on the colony, to minimize the risk posed by eagles (Hipfner et al. 2012). These types of behavioral changes have impacted breeding success in other seabirds (Parrish et al. 2001). Eagle predation has been suggested as a factor in puffin declines in Washington (Hanson and Wiles 2015), but the effect on puffin populations has not been studied.

6.8.2 Assess threats to Tufted Puffins from other predators at nesting colonies, and explore options for management.

In addition to eagles, other native predators may pose a risk to nesting puffins in Washington, including American Mink (*Neovison vison*), Raccoons (*Procyon lotor*) and River Otters (*Lontra canadensis*). Mink and Raccoons are known predators of burrow-nesting seabirds, though they have not been specifically observed attacking puffins (Hanson and Wiles 2015). River Otters, on the other hand, killed the last nesting pair of puffins on Mandarte Island, B.C. (P. Arcese, pers. comm.), and were implicated in the extirpation of Cassin's Auklets and Rhinoceros Auklets from Seabird Rocks, B.C. (Carter et al. 2012), a colony from which puffins also disappeared.

6.8.3 Monitor potential effects of kleptoparasitism and harassment by gulls or other species on Tufted Puffin breeding success in Washington.

Glaucous-winged and Western (*Larus occidentalis*) gulls are the most common kleptoparasites at puffin colonies in Washington (Cody 1973, Frazer 1975), and kleptoparasitism occurs at Triangle Island, BC (Blackburn et al. 2009). Though occasional harassment of puffins by gulls has been observed at Tatoosh and Destruction islands, researchers do not currently consider kleptoparasitism a significant issue for puffins at either site (S. Pearson and P. Hodum, pers. obs.). Levels of kleptoparasitism can vary widely among seasons, however, and may limit chick provisioning when food resources are scarce (Piatt and Kitaysky 2002).

6.9. Refine monitoring protocols for Tufted Puffin surveys in Washington and develop methods for maintaining and improving state-wide population estimates and trend estimates.

Boat-based surveys are used to produce data on Tufted Puffin population trends and were used to determine site occupancy of historical breeding locations from 2007–2010. A standardized protocol is needed for colony attendance counts to facilitate comparisons across breeding colonies and seasons and strengthen trend analyses. Pearson and Hodum (2018b) provided a proposed monitoring strategy. Data generated by the Westport Seabirds birding trips might benefit from a more rigorous survey protocol.

6.10 Analyze range-wide genetic structure for Tufted Puffins to determine whether there are distinct subpopulations and how much gene flow exists among them.

Genetic analysis will play an important role in determining whether puffins in the California Current, including those in Washington, form a distinct population segment that should be considered for listing under the federal Endangered Species Act. Ongoing research led by Dr. Theresa Burg at the University of Lethbridge (Alberta) is using a microsatellite approach to examine Tufted Puffin genetic differentiation across the northern Pacific. WDFW is collaborating on this project by providing samples from Washington colonies. Genetic data will also be useful for other management and restoration activities, such as potential translocations of chicks, which should be sourced from appropriate, closely-related populations.

7. Develop partnerships with tribes, agencies, conservation groups, and other stakeholders to help advance Tufted Puffin recovery strategies and conservation goals in Washington.

Look for synergies and partner organizations for addressing common threats to multiple species, such as contaminants, climate change, forage fish abundance, etc.

7.1 Convene a Washington Tufted Puffin working group to develop a recovery action outline or plan that identifies and prioritizes research and management needs, that is periodically updated.

Action documents that prioritize recovery tasks needed in the near term (1-3 years), and are regularly revised have proven to be helpful in directing funds and in maintaining momentum for recovery of other listed species. A working group of scientists, agency, and conservation organization representatives involved in puffin work in Washington would be valuable.

7.2 Coordinate with tribal governments for research and management activities, and in the gathering and dissemination of information on Tufted Puffin status and recovery.

Partnerships with tribal governments will play an important role in puffin recovery efforts in Washington. The nesting colony on Tatoosh Island, for example, has been a significant research site and is administered and managed by the Makah Tribal Council. Similarly, the Quinault Indian Nation owns and oversees the cliffs at Point Grenville, where puffins nested until at least 1980. Historically, Native Americans along the outer coast and in the Salish Sea hunted puffins for meat, gathered their eggs, and used their bills and plumes to decorate ceremonial objects (Piatt and Kitaysky 2002). These cultural ties give tribes a particular interest in puffin recovery and also have the potential to inform puffin research efforts. Archaeological evidence from Native American sites has already helped clarify the historical distribution of puffins in Washington (Bovy 2007), as well as the distribution of the forage fish they prey upon (McKechnie et al. 2014). Contemporary observations are also highly relevant, as many tribal fishers are active in waters frequented by foraging puffins. There is widespread evidence that local ecological knowledge can be an important resource for scientists and managers (e.g. Gilchrist et al. 2005).

7.3 Coordinate Tufted Puffin recovery activities with relevant federal, state, and local government agencies).

Tufted Puffin recovery in Washington will require close coordination with the Washington Maritime National Wildlife Refuge Complex and other divisions of USFWS, including the Migratory Bird Program and potentially, pending outcome of their listing decision, the Endangered Species Program (Ecological Services). Because nearly all nesting colonies occur within the refuge complex, cooperation on research and management decisions is critical. The USFWS and NOAA may also be important partners in securing funding for recovery activities. Partnerships and information sharing with local and state government agencies will also be important during the recovery process, ensuring that puffin concerns are a priority in a range of local and regional policy decisions, including coastal development and oil spill preparedness.

7.4 Inform and coordinate with Canadian officials regarding Tufted Puffin recovery efforts and explore opportunities for international cooperation.

Tufted Puffins nesting in Washington travel and forage to some extent in British Columbia waters (Figure 5). It is not known how much time the birds spend in Canadian waters, but the proximity of several former nesting sites there (e.g., Mandarte Island, Seabird Rocks) suggests there was once a larger trans-boundary population. Current nesting colonies in British Columbia lie 400 km to the north at the tip of Vancouver Island and further north in Haida Gwaii. The relationship of those birds to Washington's population is unknown, but interaction on wintering grounds and some level of gene flow are suspected. Informing and coordinating with Environment and Climate Change Canada and provincial authorities strengthens opportunities for international cooperation, with the goal of regional consistency in research, management, and recovery efforts.

7.5 Pursue collaborations with non-governmental organizations to advance Tufted Puffin conservation.

Broad opportunities exist for collaboration on Tufted Puffin research and conservation activities. Puffins are charismatic, and have the potential to attract significant funding and attention from private sources and from the scientific and conservation communities. The preparation of the status report and this recovery plan, for example, were both achieved through a public-private partnership between WDFW and the SeaDoc Society, a nongovernmental university-based organization (Hanson et al. 2016). Similar opportunities should be pursued whenever possible to help accomplish recovery tasks in an efficient and cost-effective manner.

7.6 Collaborate with fisheries agencies, management council, and commercial fishers regarding management of forage fish stocks.

WDFW is a member of the Pacific Fishery Management Council (PFMC) and the North Pacific Fishery Management Council (NPFMC). These regional fishery management councils set the policy and manage fisheries in federal Pacific Ocean waters off the West Coast and Alaska, respectively. The Councils' policies currently prioritize forage fish as a food source for seabirds, marine mammals, salmon, and other marine predators (NMFS 2004, PFMC 2011; NFPMC 2013). Continued support for this position will help emphasize the importance of a healthy prey base for rebuilding diminished populations of Tufted Puffins in Washington, and throughout the range of puffins. Coordination through the PFMC and NPFMC processes will also be important for continued monitoring of Tufted Puffin interactions in various fisheries as ocean conditions, management strategies, and techniques change over time.

8. Develop and implement public outreach and education programs to advance Tufted Puffin conservation and recovery in Washington.

Tufted Puffins are a charismatic species often sought by birdwatchers and others interested in wildlife viewing. Tourism and other organized visits to waters where puffins occur can be effective educational opportunities, helping transfer knowledge and generate enthusiasm for Tufted Puffin recovery efforts. Such groups would also benefit from prepared educational materials, including protocols for how to minimize disturbance to puffins while observing them in the wild.

8.1 Develop informative educational materials to communicate Tufted Puffin recovery efforts and needs to policymakers, educational organizations, and the public.

8.1.1 <u>Develop fact sheets and concise briefs to inform local and state policymakers about Tufted Puffin status and recovery efforts in Washington.</u>

The need to efficiently communicate Tufted Puffin recovery priorities to policymakers would be aided by concise briefs or fact sheets targeting specific issues, such as fishing, tourism, and offshore energy development. Such information could be shared in coordination with other listed species (e.g., Marbled Murrelets), and made readily available through the WDFW website (see Task 8.1.3).

8.1.2 <u>Develop education materials for safe observation of puffins in the wild, and distribute to ecotourism operators, birdwatching organizations, whale-watch naturalists, outdoor educators, boaters, fishers, and others.</u>

Protocols for eco-tour operators, boaters, and others likely to encounter puffins in the wild would be helpful for reducing disturbance on the water and around nesting sites. Similar efforts have long been used to reduce stress from vessels on Killer Whales (*Orcinus orca*) and other marine mammals in Washington (Giles and Koski 2012). Voluntary guidelines developed in coordination with user groups provide a potentially effective alternative to regulation (e.g. Parsons and Woods-Ballard 2003).

8.1.3 <u>Develop Tufted Puffin exhibits, videos, sign boards, and other materials for use at local museums, parks, and viewing points</u>.

8.1.4 <u>Include Tufted Puffin materials and recovery information on the WDFW website</u>.

Develop and maintain a WDFW webpage with information about Tufted Puffin recovery efforts in Washington. This would also include information on natural history and research, briefs for policy makers, status reviews, and updates to regulatory documents. Consider partnerships to establish and maintain a puffin web camera to engage the public in the lives of Tufted Puffins.

8.2 Partner with educators and other organizations to communicate information about Tufted Puffin recovery efforts in Washington.

The popularity of Tufted Puffins makes them well-suited for public outreach and education. Partnering with educators at all levels offers the opportunity to communicate to a wide audience about the natural history, cultural history, and recovery of the species in Washington.

8.3 Develop a network of trained volunteers capable of contributing to Tufted Puffin fieldwork, research, outreach, and recovery efforts.

Trained volunteers can be a substantial resource to research and recovery efforts for endangered species. Ongoing monitoring of the Tufted Puffin colony at Haystack Rock, Oregon, for example, currently relies on collaboration between Oregon Coast National Wildlife Refuge Complex (USFWS) staff and one dedicated and highly experienced local volunteer (Stephensen 2018; S. Stephensen, pers. comm.). Similar opportunities may exist in Washington if volunteers can be recruited and trained, either directly or through educational partnerships. This would require close coordination with the refuge or agency with management jurisdiction.

9. Periodically review and revise conservation planning documents and legal classifications for Tufted Puffins in Washington.

9.1. Prepare periodic status reviews for Tufted Puffins in Washington, as needed, and provide recommendations for revising legal classification.

Recommendations are made to the Washington State Fish and Wildlife Commission, based on information compiled during periodic status reviews or through other processes.

9.2 Update the WDFW recovery plan for Tufted Puffins in Washington, as needed.

Revise the recovery plan as needed when changes in management and recovery objectives are needed.

IMPLEMENTATION PLAN

Table 2 details the implementation plan for Tufted Puffins in Washington, listing and prioritizing all recovery tasks, and identifying potential partners to help achieve them. The listing of a potential partner does not require them to implement the action(s) or to secure funding for implementing the action(s), but they are possible collaborators to accomplish the action(s). Potential WDFW resources affected by each task are also identified, and each task is ranked by a priority system based on its potential contribution to the overall recovery effort (described below). **Implementation of this recovery plan is contingent upon current and future funding levels and staff capacity of WDFW and its partners**.

The following conventions are used for priority rankings:

Priority 1: Actions essential for advancing the recovery process, and/or with potential to provide rapid and significant benefit to Tufted Puffins in Washington.

Priority 2: Actions with high potential for informing and advancing the recovery process, and/or with potential to provide long-term benefit to Tufted Puffins in Washington.

Priority 3: All other actions desirable for advancing the recovery of Tufted Puffins in Washington.

The following acronyms are used for potential partners:

EDU – Educators (e.g. local schools, universities)
IG – Interest groups (e.g. commercial fishers, recreational boaters, eco-tour operators)
NGO – Non-governmental organizations (e.g. the SeaDoc Society, Audubon chapters)
OGA – Other government agencies (e.g. other state agencies, federal agencies, counties, municipalities, Canadian agencies)
PL – Private landowners
SCI – Scientific community (e.g. Pacific Seabird Group Tufted Puffin Technical Committee)
TG – Tribal governments (e.g. Makah Tribal Council, Quinault Indian Nation)
USFWS – United States Fish and Wildlife Service
VO – Volunteers

Table 2. Implementation plan for the recovery of Tufted Puffins in Washington.

Recovery Task	Priority	Timing	Potential Partners	Potential WDFW Resources[a,b] Staff	Funding	Facilities	Web Support
1.1 Continue boat-based surveys for on-the-water population estimates.	**1**	ongoing	USFWS, SCI, EDU, VO, NGO	✓	✓	✓	✓
1.2 Conduct and/or coordinate colony attendance counts and colony occupancy surveys.	**1**	ongoing/ periodic	USFWS, TG, SCI, VO, NGO, EDU	✓	✓	✓	
2.1 Ensure that current protected status for nesting colonies is maintained or enhanced.	**1**	ongoing/ proposed	USFWS, TG, OGA, PL	✓			
2.2 Assess and manage invasive, nonnative species at Tufted Puffin nesting colonies.	**1**	ongoing/ proposed	USFWS, SCI, NGO, VO, EDU	✓	✓	✓	
2.3 Explore other habitat restoration opportunities at current	**3**	proposed	USFWS, TG, SCI, NGO	✓	✓	✓	

Recovery Task	Priority	Timing	Potential Partners	Potential WDFW Resources[a,b]			
				Staff	Funding	Facilities	Web Support
and former Tufted Puffin nesting colonies.							
3.1 Reestablish nesting colonies through reintroductions if feasible.	**2**	proposed	USFWS, TG, SCI, NGO	✓	✓	✓	
4.1 Prioritize the maintenance of the prey base for Tufted Puffin in Washington.	**1**	proposed	SCI, NGO, OGA, EDU	✓	✓	✓	
4.2 Encourage urgent measures to reduce human generated greenhouse gases and mitigate climate change.	1		All				
5.1 Reduce threats of disturbance and mortality by predators and other species affecting Tufted Puffins at nesting colonies in Washington, if necessary.	**1**	ongoing/ proposed	USFWS, SCI, TG, NGO, EDU	✓	✓	✓	
5.2 Identify and reduce threats of human-related disturbance, contamination, and mortality affecting Tufted Puffins on the water in Washington.	**2**	ongoing/ proposed	SCI, NGO, USFWS, OGA, EDU	✓	✓	✓	✓
6.1 Coordinate research activities with the Pacific Seabird Group Tufted Puffin Technical Committee and other interested researchers.	**1**	ongoing	SCI	✓			
6.2 Investigate the diet, foraging areas, and the effects of prey availability on productivity of Tufted Puffins in Washington.	**1**	proposed	USFWS, SCI, TG, NGO	✓	✓	✓	
6.3 Investigate the winter movements and ecology of Washington's Tufted Puffins.	**1**	proposed	SCI, USFWS, NGO	✓	✓	✓	
6.4 Investigate the biology, distribution, and habits of sub-adult Tufted Puffins, and determine age at first breeding.	**2**	proposed	SCI, USFWS, NGO	✓	✓	✓	
6.5 Investigate aspects of the natural history of Tufted Puffins.	**2**	proposed	SCI, USFWS, TG, NGO	✓	✓	✓	
6.6 Identify and evaluate potential contaminant threats for puffins in Washington waters							
6.7 Investigate the feasibility and techniques of restoring colonies.	**2**	proposed	SCI, USFWS, TG, NGO	✓	✓	✓	
6.8 Investigate ecological relationships of Tufted Puffin that affect survival and recruitment in Washington.	**2**	ongoing/ proposed	SCI, USFWS, TG, NGO	✓	✓	✓	
6.9 Refine monitoring protocols for surveys in Washington and develop methods for maintaining and improving state-wide population estimates and trend estimates.	**2**	ongoing/ proposed	USFWS, SCI	✓	✓		
6.10 Analyze range-wide genetic structure for Tufted Puffins to determine whether there are distinct subpopulations.	**1**	ongoing/ proposed	SCI, USFWS, NGO	✓	✓		
7.1 Convene a Washington Tufted Puffin working group	**1**	proposed	SCI, USFWS, TG, NGO,	✓			✓
7.2 Coordinate with tribal governments for research and management activities, and in the gathering and dissemination of Tufted Puffin information.	**1**	ongoing/ proposed	TG	✓			
7.3 Coordinate Tufted Puffin recovery activities with relevant government agencies, including the Washington Maritime National Wildlife Refuge Complex and other divisions of USFWS.	**1**	ongoing	USFWS, TG, OGA	✓			
7.4 Inform and coordinate with Canadian officials regarding puffin recovery efforts and explore opportunities for cooperation.	**2**	ongoing	OGA	✓			
7.5 Pursue collaborations with non-governmental	**2**	ongoing	NGO	✓			

Recovery Task	Priority	Timing	Potential Partners	Potential WDFW Resources[a,b] Staff	Funding	Facilities	Web Support
organizations to advance Tufted Puffin conservation.							
7.6 Collaborate with agencies, fisheries biologists, and commercial fishers regarding management of forage fish stocks.	**2,3**	proposed	IG, TG, NGO, EDU	✓			
8.1 Develop informative educational materials to communicate Tufted Puffin recovery efforts and needs to relevant policymakers and organizations.	**2**	proposed	EDU, SCI, OGA, TG, IG, NGO	✓			✓
8.2 Partner with educators and other organizations to communicate information about puffin recovery efforts in Washington.	**3**	proposed	EDU, NGO	✓			✓
8.3 Develop network of trained volunteers capable of contributing to Tufted Puffin fieldwork, research, outreach, and other recovery efforts.	**3**	proposed	EDU, NGO, SCI, VO	✓			
9.1 Prepare periodic status reviews for Tufted Puffins in Washington, as needed, but at least every five years, and provide recommendation for update of legal classification.	**3**	periodic		✓			✓
9.2 Update the WDFW recovery plan for Tufted Puffins in Washington, as needed.	**3**	periodic	SCI	✓			✓

[a] Only potential demands on WDFW resources are noted. Precise commitments by WDFW to any particular recovery task will depend on future budgetary capacity and the contributions made by various partner agencies, governments, and organizations.
[b] Staff = WDFW staff time; Funding = direct WDFW funding to support field activities, research, etc.; Facilities = use of WDFW facilities, boats, and other equipment; Web support = use and maintenance of WDFW website.

Immediate High Priority Actions. Among more than 50 strategies and tasks described in this recovery plan and ranked in the implementation table, three items stand out as immediate high priorities for advancing Tufted Puffin recovery efforts in Washington. They include one monitoring task, one research need, and one restoration task. They are fully described in the Strategies and Tasks section, but repeated here for emphasis should the need arise to direct limited funding and staff time toward particular activities in the short term.

1.1 Continue boat-based surveys for on-the-water Tufted Puffin population estimates.

2.2.2 Remove non-native European Rabbits from Destruction Island.

Removal of rabbits from Destruction Island offers the most tangible and immediate opportunity for improving Tufted Puffin breeding habitat in Washington.

4.2 Encourage urgent measures to reduce human generated greenhouse gases and mitigate climate change that threatens marine ecosystems.

6.2 Investigate the diet, foraging areas, and the effects of prey availability on productivity of Tufted Puffins in Washington, and set conservation priorities.

LITERATURE CITED

The references cited in the *Tufted Puffin Recovery Plan and Periodic Status Review* are categorized for their level of peer review pursuant to section 34.05.271 RCW, which is the codification of Substitute House Bill 2661 that passed the Washington Legislature in 2014. A key to the review categories under section 34.05.271 RCW is provided in Table A. References were categorized by the author in October 2015.

Individual papers cited cover a number of topics discussed in the report, including information on: 1) the species' description, taxonomy, distribution, and biology; 2) habitat requirements; 3) population status and trends; 4) conservation status and protections; 5) research, monitoring, and restoration activities; and 6) factors affecting the continued existence of the species.

Table A. Key to 34.05.271 RCW Categories:

34.05.271(1)(c) RCW	Category Code
(i) Independent peer review: review is overseen by an independent third party.	i
(ii) Internal peer review: review by staff internal to the department of fish and wildlife.	ii
(iii) External peer review: review by persons that are external to and selected by the department of fish and wildlife.	iii
(iv) Open review: documented open public review process that is not limited to invited organizations or individuals.	iv
(v) Legal and policy document: documents related to the legal framework for the significant agency action 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.	v
(vi) Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under the processes described in (c)(i), (ii), (iii), and (iv) of this subsection.	vi
(vii) Records of the best professional judgment of department of fish and wildlife employees or other individuals.	vii
(viii) Other: Sources of information that do not fit into one of the categories identified in this subsection (1)(c).	viii

Reference	Category Code
Ainley, D. G., and T. J. Lewis. 1974. The history of Farallon Island marine bird populations, 1854-1972. Condor 76:432-446.	i
Anderson, C. R., S. K. Moore, M. C. Tomlinson, J. Silke, and C. K. Cusack. 2015. Living with harmful algal blooms in a changing world: strategies for modeling and mitigating their effects in coastal marine ecosystems. Pages 495-561 in J. T. Ellis, D. J. Sherman, and J. F. Shroder Jr., editors. Coastal and Marine Hazards, Risks, and Disasters. Elsevier, Amsterdam.	i
Aubry, K. B., and S. D. West. 1984. The status of native and introduced mammals on Destruction Island, Washington. Murrelet 65:80-83.	i
Bargmann, G. 1998. Forage fish management plan. Washington Department of Fish and Wildlife, Olympia, Washington. 77 pp.	ii
Bailey, E. P. 1976. Breeding bird distribution and abundance in the Barren Islands, Alaska. Murrelet 57:2-12.	i

Reference	Category Code
Baird, P. H. 1990. Influence of abiotic factors and prey distribution on diet and reproductive success of three seabird species in Alaska. Ornis Scandinavica 21:224-235.	i
B.C. Conservation Data Centre. 2018. BC Species and Ecosystems Explorer. B.C. Ministry of the Environment, Victoria, B.C. http://a100.gov.bc.ca/pub/eswp/ [accessed January 24, 2018].	viii
Blackburn, G. S., J. M. Hipfner, and R. C. Ydenburg. 2009. Evidence that Tufted Puffins *Fratercula cirrhata* use colony overflights to reduce kleptoparasitism risk. Journal of Avian Biology 40: 412-418.	i
Blight, L. K., K. A. Hobson, T. K. Kyser, and P. Arcese. 2015. Changing gull diet in a changing world: A 150-year stable isotope (δ13C, δ15N) record from feathers collected in the Pacific Northwest of North America. Global Change Biology 21:1497-1507.	i
Bovy, K. 2007. Prehistoric human impacts on waterbirds at Watmough Bay, Washington, USA. Journal of Island and Coastal Archaeology 2:210-230.	i
Branch, T. A., B. M. DeJoseph, L. J. Ray, and C. A. Wagner. 2013. Impacts of ocean acidification on marine seafood. Trends in Ecology & Evolution 28:178-186.	i
Brazil, M. 1991. Birds of Japan. Smithsonian Institution Press, Washington, D.C.	viii
Bried, J. and P. Jouventin, 2002. Site and mate choice in seabirds: an evolutionary approach. Pages 263-305 in E. A. Schreiber and J. Burger (eds.), Biology of Marine Birds. Boca Raton, FL: CRC Press.	i
Borstad, G., W. Crawford, J. M. Hipfner, R. Thomson, and K. Hyatt. 2011. Environmental control of the breeding success of rhinoceros auklets at Triangle Island, British Columbia. Marine Ecology Progress Series 424:285-302.	i
Brodeur, R. D., J. P. Fisher, R. L. Emmett, C. A. Morgan, and E. Casillas. 2005. Species composition and community structure of pelagic nekton off Oregon and Washington under variable oceanographic conditions. Marine Ecology Progress Series 298:41–57.	i
Brodier, S., B. Pisanu, A. Villers, E. Pettex, M. Lioret, J. L. Chapuis, and V. Bretagnolle. 2011. Responses of seabirds to the rabbit eradication on Ile Verte, sub-Antarctic Kerguelen Archipelago. Animal Conservation 14:459-465.	i
Carter, H. R., A. E. Burger, P. V. Clarkson, Y. Zharikov, M. S. Rodway, S. G. Sealy, R. W. Campbell, and D. F. Hatler. 2012. Historical colony status and recent extirpations of burrow-nesting seabirds at Seabird Rocks, British Columbia. Wildlife Afield 9:13-48.	i
Catalog of Washington Seabird Colonies. 2019. Washington Department of Fish and Wildlife geodatabase. (Accessed: 2 January 2019).	vi
Chavez, F. P., J. Ryan, S. E. Lluch-Cota, M. Niquen. 2003. From anchovies to sardines and back: multidecadal change in the Pacific Ocean. Science 299 (10 January):217-221.	i
Cody, M. L. 1973. Coexistence, coevolution and convergent evolution in seabird communities. Ecology 54:31-44.	i
Cole, M., P. Lindeque, C. Halsband, and T. S. Galloway. 2011. Microplastics as contaminants in the marine environment: a review. Marine Pollution Bulletin 62:2588-2597.	i
Croll, D. A., K. M. Newton, M. McKown, N. Holmes, J. C. Williams, H. S. Young, S. Buckelew, C. A. Wolf, G. Howald, M. F. Bock, and J. A. Curl. 2016. Passive recovery of an island bird community after rodent eradication. Biological Invasions 18: 703-715.	i
Croxall, J. P., S. H. Butchart, B. Lascelles, A. J. Stattersfield, B. Sullivan, A. Symes, and P. Taylor. 2012. Seabird conservation status, threats and priority actions: a global assessment. Bird Conservation International 22:1-34.	i
Cubaynes, S., P. F. Doherty, E. A. Schreiber, and O. Gimenez. 2011. To breed or not to breed: a seabird's response to extreme climatic events. Biology Letters 7:303-306.	i
Cury, P. M., I. L. Boyd, S. Bonhommeau, T. Anker-Nilssen, R. J. M. Crawford, et al. 2011. Global seabird response to forage fish depletion – one-third for the birds. Science 334:1703-1706.	i
Davies, W. E., J. M. Hipfner, K. A. Hobson, and R. C. Ydenberg. 2009. Seabird seasonal trophodynamics: isotopic patterns in a community of Pacific alcids. Marine Ecology Progress Series 382:211-219.	i

Reference	Category Code
Dragoo, D. E., H. M. Renner, and R. S. A. Kaler. 2018. Breeding status and population trends of seabirds in Alaska, 2017. U.S. Fish and Wildlife Service Report AMNWR 2018/02. Homer, Alaska.	viii
Durant, J. M., T. Anker-Nilssen, and N. C. Stenseth. 2003. Trophic interactions under climate fluctuations: the Atlantic puffin as an example. Proceedings of the Royal Society of London B: Biological Sciences 270:1461-1466.	i
Durant, J. M., R. J. Crawford, A. C. Wolfaardt, K. Agenbag, J. Visagie, L. Upfold, and N. C. Stenseth. 2010. Influence of feeding conditions on breeding of African penguins—importance of adequate local food supplies. Marine Ecology Progress Series 420:263-271.	i
Environment Canada. 2013. Bird Conservation Strategy for Bird Conservation Region 5: Northern Pacific Rainforest. Canadian Wildlife Service, Environment Canada. Delta, British Columbia. 128 pp. + appendices.	viii
Essington, T. E., P. E. Moriarty, H. E. Froehlicha, E. E. Hodgsona, L. E. Koehna, K. L. Okenb, M. C. Siplea, and C. C. Stawitzb. 2015. Fishing amplifies forage fish population collapses. Proceedings of the National Academy of Sciences 112:6648–6652.	i
Fabry, V. J., B. A. Seibel, R. A. Feely, and J. C. Orr. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. ICES Journal of Marine Science 65:414–432.	vii
Falxa, G., J. Baldwin, D. Lynch, S. L. Miller, S. K. Nelson, S. F. Pearson, M. G. Raphael, C. Strong, T. Bloxton, B. Galleher, B. Hogoboom, M. Lance, and R. Young. 2011. Marbled Murrelet effectiveness monitoring, Northwest Forest Plan: 2009 and 2010 summary report. 26 pp.	v
Flather, C. H., G. D. Hayward, S. R. Beissinger, and P. A. Stephens. 2011. Minimum viable populations: is there a 'magic number'for conservation practitioners? Trends in Ecology & Evolution, 26:307-316.	i
Frankham, R., C. J. Bradshaw, and B. W. Brook. 2014. Genetics in conservation management: revised recommendations for the 50/500 rules, Red List criteria and population viability analyses. Biological Conservation 170:56-63.	i
Frankham, R., Ballou, J.D., Ralls, K., et al. 2017. Genetic management of fragmented animal and plant populations. Oxford University Press, Oxford, U.K.	i
Franklin, I. R. 1980. Evolutionary change in small populations. Pages 135-150 *in* M. E. Soule´ and B. A. Wilcox, editors, Conservation Biology: an Evolutionary–Ecological Perspective, Sinauer Associates, Sunderland, MA.	i
Frazer, D. A. 1975. Breeding biology of the Tufted Puffin (*Lunda cirrhata*): a review. M.S. thesis, University of Washington, Seattle, Washington.	viii
Frederiksen, M., P. J. Wright, M. P. Harris, R. A. Mavor, M. Heubeck, and S. Wanless. 2005. Regional patterns of kittiwake *Rissa tridactyla* breeding success are related to variability in sandeel recruitment. Marine Ecology Progress Series 300:201-211.	i
Gaston, A.J., Bertram, D.F., Boyne, A.W., Chardine, J.W., Davoren, G., Diamond, A.W., Hedd, A., Montevecchi, W.A., Hipfner, J.M., Lemon, M.J.F., Mallory, M.L., Rail, J.-F., and G.J. Robertson. 2009. Changes in Canadian seabird populations and ecology since 1970 in relation to changes in oceanography and food webs. Environmental Reviews 17: 267-286.	i
Gilchrist, G., M. Mallory and F. Merkel. 2005. Can local ecological knowledge contribute to wildlife management? Case studies of migratory birds. Ecology and Society 10:20. [online] URL:http://www.ecologyandsociety.org/vol10/iss1/art20/.	i
Giles, D. A. and K. L. Koski. 2012. Managing vessel-based killer whale watching: a critical assessment of the evolution from voluntary guidelines to regulations in the Salish Sea. Journal of International Wildlife Law & Policy 15:125-151.	i
Gjerdrum, C., A. M. J. Vallée, C. C. St. Clair, D. F. Bertram, J. L. Ryder, and G. S. Blackburn. 2003. Tufted Puffin reproduction reveals ocean climate variability. Proceedings of the National Academy of Sciences 100:9377-9382.	i
Glibert, P. M., D. M. Anderson, P. Gentien, E. Graneli, and K. G. Sellner. 2005. The global, complex phenomena of harmful algal blooms. Oceanography 18:135-147.	i
Glick, P., J. Clough, and B. Nunley. 2007. Sea-level rise and coastal habitats in the Pacific Northwest: an analysis for Puget Sound, southwestern Washington, and northwestern Oregon.	viii

Reference	Category Code
Seattle, WA: National Wildlife Federation. 106 pp.	
Golubova, E. Y. 2002. The state of food resources and reproductive success of Tufted and Horned Puffins in the northern Sea of Okhotsk. Ekologiya 5:378-387.	i
Good, T. P., J. A. June, M. A. Etnier, and G. Broadhurst. 2010. Derelict fishing nets in Puget Sound and the Northwest Straits: patterns and threats to marine fauna. Marine Pollution Bulletin 60:39–50.	i
Good, T. P., S. F. Pearson, P. Hodum, D. Boyd, B. F. Anulacion, and G. M. Ylitalo. 2014. Persistent organic pollutants in forage fish prey of rhinoceros auklets breeding in Puget Sound and the northern California Current. Marine Pollution Bulletin 86:367-378.	i
Gould, P. J., and J. F. Piatt. 1993. Seabirds of the central North Pacific. Pages 27-38 in K. Vermeer, K. T. Briggs, K. H. Morgan, and D. Siegel-Causey, editors. The status, ecology, and conservation of marine birds of the North Pacific. Canadian Wildlife Service Special Publication, Ottawa, Ontario.	viii
Goyert, H.F., E.O. Garton, B.A. Drummond, and H.M. Renner. 2017. Density dependence and changes in the carrying capacity of Alaskan seabird populations. Biological Conservation 209:178–187.	i
Greene, C., L. Kuehne, C. Rice, K. Fresh, D. Penttile. 2015. Forty years of change in forage fish and jellyfish abundance across greater Puget Sound, Washington (USA): anthropogenic and climate associations. Marine Ecology progress Series 525:153-170.	i
Gustafson, R. G.,L. Weitkamp, Y.W. Lee, E. Ward, K. Somers, V. Tuttle, and J. Jannot. 2016. Status review update of Eulachon (*Thaleichthys pacificus*) listed iunder the Enadangeed Species Act: Southern Distinct Population Segment. Northwest Fisheries Science Center, National Marine Fisheries Service, Seattle, Washington.	v
Hanson, T. and G. J. Wiles. 2015. Washington state status report for the Tufted Puffin. Washington Department of Fish and Wildlife, Olympia, Washington. 66 pp.	iii
Hanson, T., G. J. Wiles, and J. K. Gaydos. 2016. A novel public–private partnership model for improving the listing of endangered species. Biodiversity and Conservation 25:193-198.	i
Hart, C. J., R. P. Kelly, and S. F. Pearson. 2018. Will the California Current lose its nesting Tufted Puffins? PeerJ 6:e4519; DOI 10.7717/peerj.4519	i
Hatch, S. A., P. M. Meyers, D. M. Mulcahy, and D. C. Douglas. 2000. Seasonal movements and pelagic habitat use of murres and puffins determined by satellite telemetry. Condor 102:145-154.	i
Hedd, A., D. F. Bertram, J. L. Ryder, and I. J. Jones. 2006. Effects of interdecadal climate variability on marine trophic interactions: Rhinoceros Auklets and their fish prey. Marine Ecology Progress Series 309:263-278.	i
Hill, K.T., P.R. Crone and J.P. Zwolinski. 2018. Assessment of the Pacific Sardine Resource in 2018 for U.S. Management in 2018-19. US Department of Commerce. NOAA Technical Memorandum NMFS-SWFSC-600. https:// doi.org/10.7289/V5/TM-SWFSC-600	v
Hilborn, R., R. O. Amoroso, E. Bogazzi, O. P. Jensen, A. M. Parma, C. Szuwalski, and C. J. Walters. 2017. When does fishing forage species affect their predators? Fisheries Research 191:211-221.	i
Hinke, J. T., K. Salwicka, S. G. Trivelpiece, G. M. Watters, and W. Z. Trivelpiece. 2007. Divergent responses of *Pygoscelis* penguins reveal a common environmental driver. Oecologia 153:845-855.	i
Hipfner, J. M., M. R. Charette, and G. S. Blackburn. 2007. Subcolony variation in breeding success in the Tufted Puffin (*Fratercula cirrhata*): association with foraging ecology and implications. Auk 124(4): 1149-1157.	i
Hipfner, J. M., K. W. Morrison, and R. Darvill. 2011. Peregrine Falcons enable two species of colonial seabirds to breed successfully by excluding other aerial predators. Waterbirds 34:82-88.	i
Hodum, P. J. 2007. Respuesta de la fardela blanca (*Puffinus creatopus*) a la erradicación de conejos en Isla Santa Clara. CONAF Technical Report.	viii

Reference	**Category Code**
Hunn, E. S. 2012. Birding in Seattle and King County: site guide and annotated list. Seattle Audubon Society, Seattle, Washington.	viii
IPCC (Intergovernmental Panel on Climate Change). 2013. Summary for policymakers. in T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley, editors. Climate change 2013: the physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom.	i
Jessup, D. A, M. A. Miller, J. P. Ryan, H. M. Nevins, H. A. Kerkering, et al. 2009. Mass stranding of marine birds caused by a surfactant-producing red tide. PLoS ONE 4:e4550.	i
Jewett, L. and A. Romanou, 2017: Ocean acidification and other ocean changes. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 364-392, doi: 10.7930/J0QV3JQB	i
Jewett, S. G., W. P. Taylor, W. T. Shaw, and J. W. Aldrich. 1953. Birds of Washington state. University of Washington Press, Seattle, Washington.	viii
Jones, H. P., N. D. Holmes, S. H. Butchart, B. R. Tershy, P. J. Kappes, I. Corkery, A. Aguirre-Muñoz, D. P. Armstrong, et al. 2016. Invasive mammal eradication on islands results in substantial conservation gains. Proceedings of the National Academy of Sciences, 113:4033-4038.	i
Jones, H. P., D. R Towns, T. Bodey, C. M. Miskelly, J. C. Ellis, M. J. Rauzon, S.W. Kress, and M. McKown. 2011. Recovery and restoration on seabird islands. pp, 317-353 *in* C. P. H. Mulder, W. B. Anderson, D. R. Towns, and P. J. Bellingham, eds. Seabird Islands: Ecology, Invasion, and Restoration. Oxford: Oxford University Press.	viii
Jones, I. L., F. M. Hunter, and G. J. Robertson. 2002. Annual adult survival of Least Auklets (Aves, Alcidae) varies with large-scale climatic conditions of the North Pacific Ocean. Oecologia 133:38-44.	i
Jones, T., J. K. Parrish, W. T. Peterson, E. P. Bjorkstedt, N. A. Bond, L. T. Ballance, V. Bowes, M. J. Hipfner, H. K. Burgess, J. E. Dolliver, K. Lindquist, et al. 2018. Massive mortality of a planktivorous seabird in response to a marine heatwave. Geophysical Research Letters 45:3193-3202.	i
King, J. R., V. N. Agostini, C. J. Harvey, G. A. McFarlane, M. G. G. Foreman, J. E. Overland, E. Di Lorenzo, N. A. Bond, and K. Y. Aydin. 2011. Climate forcing and the California Current ecosystem. ICES Journal of Marine Science 68:1199-1216.	i
Koehn, L. E., T. E. Essington, K. N. Marshall, W. J. Sydeman, A. I. Szoboszlai, and J. A. Thayer. 2017. Trade-offs between forage fish fisheries and their predators in the California Current. ICES Journal of Marine Science 74:2448–2458.	i
Kouwenberg, A. L., J. M. Hipfner, D. W. McKay, and A. E. Story. 2013. Corticosterone and stable isotopes in feathers predict egg size in Atlantic Puffins *Fratercula arctica*. Ibis 155(2):413-418.	i
Kress, S. W. and D. Z. Jackson. 2015. Project Puffin: The Improbable Quest to Bring a Beloved Seabird Back to Egg Rock, Yale University Press, New Haven, CT.	viii
Krueger, K. L., K. B. Pierce, Jr., T. Quinn, and D. E. Penttila. 2010. Anticipated effects of sea level rise in Puget Sound on two beach-spawning fishes. Pages 171-178 in H. Shipman, M. N. Dethier, G. Gelfenbaum, K. L. Fresh, and R. S. Dinicola, editors. Puget Sound shorelines and the impacts of armoring—proceedings of a state of the science workshop. U.S. Geological Survey Scientific Investigations Report 2010–5254. 262 pp.	viii
LeClair, L, R. Pacunski, L. Hillier, J, Blaine, and D. Lowry. 2018. Summary of findings from periodic scuba surveys of bottomfish conducted over a sixteen-year period at six nearshore sites in central Puget Sound. Washington Department of Fish and Wildlife Technical Report. Olympia, WA. FPT18-04. 174 pp.	ii
Lees, A. C. and D. J. Bell. 2008. A conservation paradox for the 21st century: the European wild rabbit *Oryctolagus cuniculus*, an invasive alien and an endangered native species. Mammal Review 38:304-320.	i

Reference	Category Code
Lewitus, A. J., R. A. Horner, D. A. Caron, E. Garcia-Mendoza, B. M. Hickey, M. Hunter, D. D. Huppert, R. M. Kudela, G. W. Langlois, J. L. Largier, E. J. Lessard, R. RaLonde, J. E. J. Rensel, P. G. Strutton, V. L. Trainer, and J. F. Tweddle. 2012. Harmful algal blooms along the North American west coast region: history, trends, causes, and impacts. Harmful Algae 19:133-159.	i
Lindegren, M., and D. M. Checkley, Jr. 2013. Temperature dependence of Pacific sardine (*Sardinops sagax*) recruitment in the California Current Ecosystem revisited and revised. Canadian Journal of Fisheries and Aquatic Sciences 70:245–252.	i
Mackas D. L., S. Batten, and M. Trudel. 2007. Effects on zooplankton of a warmer ocean: recent evidence from the Northeast Pacific. Progress in Oceanography 75:223-252.	i
McChesney, G. J., and H. R. Carter. 2008. Tufted Puffin (*Fratercula cirrhata*). Pages 213-217 *in* W. D. Shuford and T. Gardali, editors. California bird species of special concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1, Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento, California.	viii
McChesney, G. J., H. R. Carter, and D. L. Whitworth. 1995. Reoccupation and extension of southern breeding limits of Tufted Puffins and Rhinoceros Auklets in California. Waterbirds 18:79-90.	i
McGowan, J., E. Hines, M. Elliott, J. Howar, A. Dransfield, N Nur, and J. Jahncke. 2013. Using Seabird Habitat Modeling to Inform Marine Spatial Planning in Central California's National Marine Sanctuaries. PLoS ONE 8:e71406. doi:10.1371/journal.pone.0071406.	i
McKechnie, I., D. Lepofsky, M. L. Moss, V. L. Butler, T. J. Orchard, G. Coupland, F. Foster, M. Caldwell, and K. Lertzman. 2014. Archaeological data provide alternative hypotheses on Pacific herring (*Clupea pallasii*) distribution, abundance, and variability. Proceedings of the National Academy of Sciences 111:E807-E816.	i
Melvin, E. F., J. K. Parrish, and L. L. Conquest. 1999. Novel tools to reduce seabird by-catch in coastal gillnet fisheries. Conservation Biology 13:1386-1397.	i
Menza, C. J., T. Leirness, A. White, B. Kinlan, J. E. Zamon, L. Balance, E. Becker, K. Forney, J. Adams, D. Pereksta, S. Pearson, J. Pierce, L. Antrim, N. Wright, and E. Bowlby. 2015. Modeling seabird distributions off the Pacific Coast of Washington. Final report to Washingtont State Department of Natural Resources. 63 pp.	vi
Menza, C. J., T. Leirness, A. White, B. Kinlan, L. Kracker, J. E. Zamon, L. Ballance, E. Becker, K. Forney, J. Barlow, J. Adams, D. Pereksta, S. Pearson, J. Pierce, S. Jeffries, J. Calambokidis, A. Douglas, B. Hanson, S. Benson, and L. Antrim. 2016. Predictive mapping of seabirds, pinnipeds and cetaceans off the Pacific Coast of Washington. NOAA Technical Memorandum NOS NCCOS 210. Silver Springs, MD. 96 pp. doi:10.7289/V5NV9G7Z.	vi
Miller, I.M., H. Morgan, G. Mauger, T. Newton, R. Weldon, D. Schmidt, M.Welch, and E. Grossman 2018. Projected Sea Level Rise for Washington State – A 2018 Assessment. A collaboration of Washington Sea Grant, University of Washington Climate Impacts Group, Oregon State University, University of Washington, and US Geological Survey. Prepared for the Washington Coastal Resilience Project.	viii
Miller, I. M., C. Shishido, L. Antrim, and C. E. Bowlby. 2013. Climate change and the Olympic Coast National Marine Sanctuary: interpreting potential futures. Marine Sanctuaries Conservation Series ONMS-13-01, Office of National Marine Sanctuaries, National Oceanic and Atmospheric Administration, Silver Spring, Maryland.	viii
Moe, B., L. Stempniewicz, D. Jakubas, F. Angelier, O. Chastel, F. Dinessen, G. W. Gabrielsen, F. Hanssen, et al. 2009. Climate change and phenological responses of two seabird species breeding in the high-Arctic. Marine Ecology Progress Series 393:235-246.	i
Morrison, K. W., J. M. Hipfner, C. Gjerdrum, and D. J. Green. 2009. Wing length and mass at feldging predict local juvenile survival and age at first return in Tufted Puffins. Condor 111(3): 433-441.	i
Morrison, K. W., J. M. Hipfner, G. S. Blackburn, and D. J. Green. 2011. Effects of extreme climate events on adult survival of three Pacific auks. Auk 128(4): 707-715.	i

Reference	Category Code
NMFS (National Marine Fisheries Service). 2004. Alaska groundfish fisheries: final programmatic supplemental environmental impact statement. National Marine Fisheries Service, Alaska Region. National Oceanic and Atmospheric Administration, U.S. Department of Commerce.	v
NMFS (National Marine Fisheries Service). 2016. 5-Year Review: Summary and Evaluation. Yelloweye rockfish (*Sebastes ruberrimus*), canary rockfish (*Sebastes pinniger*), and bocaccio (*Sebastes paucispinis*) of the Puget Sound/Georgia Basin. Office of Protected Resources, Seattle, Washington. 131 pp.	v
NMFS (National Marine Fisheries Service). 2017. Removal of the Puget Sound/Georgia Basin distinct population segment of Canary Rockfish from the federal list of threatened and endangered species and removal of designated critical habitat, and update and amendment to the listing descriptions for the Yelloweye Rockfish DPS and Bocaccio DPS. Federal Register 82(13):7711-7726.	v
NOAA (National Oceanic and Atmospheric Administration). 2017. Rebuilding success continues for west coast groundfish. NOAA Fisheries, West Coast Region. http://www.westcoast.fisheries.noaa.gov/stories/2017/19_06192017_.html [Accessed February 4, 2018].	viii
Norris, D. R. 2005. Carry-over effects and habitat quality in migratory populations. Oikos 109:178-186.	i
Norris, D. R., P. Arcese, D. Preikshot, D. F. Bertram, and T. K. Kyser. 2007. Diet reconstruction and historic population dynamics in a threatened seabird. Journal of Applied Ecology 44: 875–884.	i
NPFMC (North Pacific Fisheries Management Council). 2013. Pacific Coast Fishery Ecosystem Plan for the U. S. Portion of the California Current Large Marine Ecosystem. Pacific Fishery Management Council, Portland, Oregon. 190 pp.	v
Oregon Biodiversity Information Center. 2016. Rare, Threatened and Endangered Species of Oregon. Institute for Natural Resources, Portland State University, Portland, Oregon. 130 pp.	viii
Osa, Y., and Y. Watanuki. 2002. Status of seabirds breeding in Hokkaido. Journal of the Yamashina Institute for Ornithology 33:107-141.	i
Palstra, F. P. and D. E. Ruzzante, D.E. 2008. Genetic estimates of contemporary effective population size: what can they tell us about the importance of genetic stochasticity for wild population persistence? Molecular Ecology 17:3428-3447.	i
Paredes, R., A. M. Harding, D. B. Irons, D. D. Roby, R. M. Suryan, R. A. Orben, et al. 2012. Proximity to multiple foraging habitats enhances seabirds’ resilience to local food shortages. Marine Ecology Progress Series 471:253-269.	i
Parker-Stetter, S., S. Urmy, J. Horne, L. Eisner, and E. Farley. 2016. Factors affecting summer distributions of Bering Sea forage fish species: assessing competing hypotheses. Deep Sea Research Part II: Topical Studies in Oceanography 134:255-269.	i
Parrish, J. K., K. Litle, J. Dolliver, T. Hass, H. K. Burgess, E. Frost, C. W. Wright, and T. Jones. 2017. Defining the baseline and tracking change in seabird populations: The Coastal Observation and Seabird Survey Team (COASST). Pages 37-56 in J. A. Cigliano and H. L. Ballard (eds.), Citizen Science for Coastal and Marine Conservation, New York: Routledge.	iii
Parrish J. K., M. Marvier, and R. T. Paine. 2001. Direct and indirect effects: interactions between Bald Eagles and Common Murres. Ecological Applications 11:1858-1869.	i
Parrish, J. K., and S. G. Zador. 2003. Seabirds as indicators: An exploratory analysis of physical forcing in the Pacific Northwest coastal environment. Estuaries 26:1044-1057.	i
Parsons, E. C. M. and A. Woods-Ballard. 2003. Acceptance of voluntary whalewatching codes of conduct in West Scotland: the effectiveness of governmental versus industry-led guidelines. Current Issues in Tourism 6:172-182.	i
Pearson, S.F., and P.J. Hodum. 2018a. A Tale of Two Puffins: Insights into Tufted Puffin Declines. Washington Department of Fish and Wildlife, Wildlife Science, Olympia, Washington, USA.	iii
Pearson, S.F. and P.J. Hodum. 2018b. A Proposed North American Monitoring Strategy for the Tufted Puffin (Draft).Washington Department of Fish and Wildlife Science Division,	iii

Reference	Category Code
Olympia, Washington USA, and University of Puget Sound, Tacoma, Washington USA.	
Pearson, S.F., I. Keren, and P.J. Hodum. 2018. Ecosystem-level changes in the North American Tufted Puffin breeding population. Washington Department of Fish and Wildlife, Wildlife Science, Olympia, Washington, USA.	iii
Penttila, D. 2007. Marine forage fishes in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-03, U.S. Army Corps of Engineers, Seattle, Washington.	viii
Peperzak, L. 2003. Climate change and harmful algal blooms in the North Sea. Acta Oecologica 24:S139-S144.	i
PFMC (Pacific Fishery Management Council). 2011. Status of the Pacific coast coastal pelagic species fishery and recommended acceptable biological catches: stock assessment and fishery evaluation, 2011. Pacific Fishery Management Council, Portland, Oregon. 85 pp.	v
Piatt, J. F., M. L. Arimitsu, W. J. Sydeman, S. A. Thompson, H. Renner, S. Zador, D. Douglas, S. Hatch, A. Kettle, and J. Williams. 2018. Biogeography of pelagic food webs in the North Pacific. Fisheries Oceanography, DOI: 10.1111/fog.12258, pp. 1-15.	i
Piatt, J. F., and A. S. Kitaysky. 2002. Tufted Puffin *Fratercula cirrhata*. Birds of North America 708:1-31.	i
Pierce, D. J., and T. R. Simons. 1986. The influence of human disturbance on Tufted Puffin breeding success. Auk 103:214-216.	i
Ramos, J. A., A. M. Maul, V. Ayrton, I. Bullock, J. Hunter, J. Bowler, et al. 2002. Influence of local and large-scale weather events and timing of breeding on tropical roseate tern reproductive parameters. Marine Ecology Progress Series 243:271-279.	i
Raphael, M. G., J. Baldwin, G. A. Falxa, M. H. Huff, M. Lance, S. L. Miller, et al. 2007. Regional population monitoring of the Marbled Murrelet: field and analytical methods. General Technical Report PNW-GTR-716, Pacific Northwest Research Station, USDA Forest Service, Portland, Oregon. 70 pp.	iii
Reagan, A. B. 1910. Destruction of young water birds by a storm. Auk 27:92.	i
Reed, D. H., J. J. O'Grady, B. W. Brook, J. D. Ballou, and R. Frankham. 2003. Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates. Biological Conservation 113:23–34.	i
Roemmich, D., and J. McGowan. 1995. Climatic warming and the decline of zooplankton in the California Current. Science 267:1324-1326.	i
Ruggerone, G.T., and J. R. Irvine. 2018. Numbers and Biomass of Natural- and Hatchery-Origin Pink Salmon, Chum Salmon, and Sockeye Salmon in the North Pacific Ocean, 1925–2015. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 10: 152-168	i
Sandvik, H., K. E. Erikstad, R. T. Barrett, and N. G. Yoccoz. 2005. The effect of climate on adult survival in five species of North Atlantic seabirds. Journal of Animal Ecology 74:817-831.	
Schoen, S. K., J. F. Piatt, M. L. Arimitsu, B. M. Heflin, E. N. Madison, G. S. Drew, M. Renner, N. A. Rojek, D. C. Douglas, and A. R. DeGange. 2018. Avian predator buffers against variability in marine habitats with flexible foraging behavior. Marine Biology 165:47-60.	i
Schrimpf, M. B., J. K. Parrish, and S. F. Pearson 2012. Trade-offs in prey quality and quantity revealed through the behavioral compensation of breeding seabirds. Marine Ecology Progress Series 460:247–259.	i
Sewell, B. 2014. Petition to list the contiguous U.S. distinct population segment of Tufted Puffin (*Fratercula cirrhata*) under the Endangered Species Act. Natural Resources Defence Council, New York, New York. 51 pp.	viii
Shumway, S. E., S. M. Allen, and P. D. Boersma. 2003. Marine birds and harmful algal blooms: sporadic victims or under-reported events? Harmful Algae 2:1-17.	i
Sorensen, M. C., J. M. Hipfner, T. K. Kyser, and D. R. Norris. 2009. Carry-over effects in a Pacific seabird: stable isotope evidence that pre-breeding diet quality influences reproductive success. Journal of Animal Ecology 78:460-467.	i
Springer, A. M. and G. B. van Vliet. 2014. Climate change, pink salmon, and the nexus between	i

Reference	Category Code
bottom-up and top-down forcing in the subarctic Pacific Ocean and Bering Sea. Proceedings of the National Academy of Sciences 111:E1880-E1888.	
Stephensen, S. W. 2018. Tufted Puffin monitoring study at Haystack Rock, Cannon Beach, Oregon 2010-2018. U.S. Fish and Wildlife Service Unpublished Report, Oregon Coast National Wildlife Refuge Complex, Newport, Oregon 97365. 20 pp.	vi
Steventon, J. D., G. D. Sutherland, and P. Arcese. 2003. Long-term risks to Marbled Murrelet (*Brachyramphus marmoratus*) populations: assessing alternative forest management policies in coastal British Columbia. Tech. Report 12, Research Branch, British Columbia Ministry of Forests and Range, Victoria, B.C. 51pp.	viii
Steventon, J.D., G. D. Sutherland, and P. Arcese, P., 2006. A population-viability-based risk assessment of Marbled Murrelet nesting habitat policy in British Columbia. Canadian Journal of Forest Research 36:3075-3086.	i
Stick, K., A. Lindquist, and D. Lowry. 2014. 2012 Washington State herring stock status report. Washington Department of Fish and Wildlife Technical Reports. Report Number FPA 14-09. July 2014. 100 pp.	ii
Sydeman, W. J., J. F. Piatt, S. A. Thompson, M. García-Reyes, S. A. Hatch, M. L. Arimitsu, et al. 2017. Puffins reveal contrasting relationships between forage fish and ocean climate in the North Pacific. Fisheries Oceanography 26:379-395.	i
Sydeman, W. J., S. A. Thompson, and A. Kitaysky. 2012. Seabirds and climate change: roadmap for the future. Marine Ecology Progress Series 454:107-117.	i
Szostek, K. L., and P. H. Becker. 2015. Survival and local recruitment are driven by environmental carry-over effects from the wintering area in a migratory seabird. Oecologia 178:643-657.	i
Tenyo Maru Trustees. 2000. Final restoration plan and environmental assessment for the *Tenyo Maru* oil spill. U.S. Fish and Wildlife Service, Lacey, Washington. 70 pp. https://www.cerc.usgs.gov/orda_docs/DocHandler.ashx?task=get&ID=551 [accessed February 5, 2018].	v
Thompson, P. M. and J. C. Ollason. 2001. Lagged effects of ocean climate change on fulmar population dynamics. Nature 413:417-420.	i
Tolimieri, N., E. E. Holmes, G. D. Williams, R. Pacunski, and D. Lowry. 2017. Population assessment using multivariate time-series analysis: a case study of rockfishes in Puget Sound. Ecology and Evolution 7:2846-2860.	i
Traill, L. W., C. J. Bradshaw, and B. W. Brook. 2007. Minimum viable population size: a meta-analysis of 30 years of published estimates. Biological Conservation 139:159-166.	i
Traill, L.W., B. W. Brook, R. R. Frankham, and C. J. Bradshaw. 2010. Pragmatic population viability targets in a rapidly changing world. Biological Conservation 143:28-34.	i
USGCRP (U.S. Global Change Research Group). 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 470 pp.	i
USFWS (U.S. Fish and Wildlife Service). 2007. Washington Islands National Wildlife Refuges, Flattery Rocks, Quillayute Needles, and Copalis National Wildlife Refuges: comprehensive conservation plan and environmental assessment. U.S. Fish and Wildlife Service, Port Angeles, Washington.	v
USFWS (U.S. Fish and Wildlife Service). 2010. Protection Island and San Juan Islands National Wildlife Refuges comprehensive conservation plan and San Juan Islands Wilderness stewardship plan. U.S. Fish and Wildlife Service, Seattle, Washington. 557 pp.	v
USFWS (U.S. Fish and Wildlife Service). 2015. Endangered and Threatened Wildlife and Plants: 90-day Findings on 25 petitions. Federal Register Vol. 80, No 181/Friday, September 18, 2015/Proposed rules: 56423-56432.	v
van der Wal, R., A. Truscott, I. S. Pearce, L. Cole, M. P. Harris, and S. Wanless. 2008. Multiple anthropogenic changes cause biodiversity loss through plant invasion. Global Change Biology 14:1428-1436.	i
U. S. Navy. 2019. Appendix A. Northwest Training and Testing, Draft Supplemental	v

Reference	Category Code
Enviroanmental Impact Statement/OEIS. 100 pp.	
Veitch, C. R. and M. N. Clout, eds. 2002. Turning the tide: The eradication of invasive species: Proceedings of the International Conference on Eradication of Island Invasives. IUCN Species Survival Commission (Occasional Paper No. 27), IUCN, Gland, Switzerland. 414 pp.	i
Vermeer, K. 1979. Nesting requirements, food and breeding distribution of Rhinoceros Auklets, *Cerorhinca monocerata*, and Tufted Puffins *Lunda cirrhata*. Ardea 67:101-110.	i
Vermeer, K., K. R. Summers, and D. S. Bingham. 1976. Birds observed at Triangle Island, British Columbia, 1974 and 1975. Murrelet 57:35-42.	i
Vilchis, L. I., C. K. Johnson, J. R. Evenson, S. F. Pearson, K. L. Barry, P. Davidson, M. G. Raphael, and J. K. Gaydos. 2015. Assessing ecological correlates of marine bird declines to inform marine conservation. Conservation Biology 29:154-163.	i
Wahl, T. R. 1975. Seabirds in Washington's off-shore zone. Western Birds 6:117-134.	i
Wahl, T. R. 2005. Tufted Puffin. Pages 205-206 in T. R. Wahl, B. Tweit, and S. G. Mlodinow, editors. Birds of Washington: status and distribution. Oregon State University Press, Corvallis, Oregon.	i
WDFW (Washington Dept. of Fish and Wildlife). 2011. Puget Sound Rockfish Conservation Plan. Washington Dept. of Fish and Wildlife, Olympia. 28 pp.	iii
WDOE (Washington State Department of Ecology). 2007. Spill Scene Spill Prevention, Preparedness, and Response Program 2006 Annual Report Program. Volume 10, Number 1. February 2007. WDOE Publication:07-08-002.	ii
Williams, C. T., S. J. Iverson, and C. L. Buck. 2008. Stable isotope and fatty acid signatures reveal age- and stage-dependent foragin niches in tufted puffins. Marine Ecology Progress Series 363: 287-298.	i
Wilson, U. W. and D. A. Manuwal. 1986. Breeding biology of the Rhinoceros Auklet in Washington. Condor 88:143-155.	i
Ydenberg, R. C., C. V. J. Welham, R. Schmid-Hempel, P. Schmid-Hempel, and G. Beauchamp. 1994. Time and energy constraints and the relationships between currencies in foraging theory. Behavioral Ecology 5:28-34.	i

PERSONAL COMMUNICATIONS

Peter Arcese
University of British Columbia
Vancouver, British Columbia

Russell Bradley
Point Blue Conservation Science
Petaluma, California

Mark Hipfner, Wildlife Research Division,
Environment and Climate Change Canada,
Delta, British Columbia, Canada

Shawn W. Stephensen, U. S Fish and Wildlife Service
Oregon Coast National Wildlife Refuge Complex
Newport, Oregon

Sue Thomas, U. S Fish and Wildlife Service
Washington Maritime National Wildlife Refuge Complex
Sequim, Washington

Jeffrey C. Williams, U. S Fish and Wildlife Service
Alaska Maritime National Wildlife Refuge
Homer, Alaska

APPENDIX A. Washington Administrative Code 220-610-110. Endangered, threatened, and sensitive wildlife species classification.

PURPOSE

1.1 The purpose of this rule is to identify and classify native wildlife species that have need of protection and/or management to ensure their survival as free-ranging populations in Washington and to define the process by which listing, management, recovery, and delisting of a species can be achieved. These rules are established to ensure that consistent procedures and criteria are followed when classifying wildlife as endangered, or the protected wildlife subcategories threatened or sensitive.

DEFINITIONS

For purposes of this rule, the following definitions apply:

2.1 "Classify" and all derivatives means to list or delist wildlife species to or from endangered, or to or from the protected wildlife subcategories threatened or sensitive.

2.2 "List" and all derivatives means to change the classification status of a wildlife species to endangered, threatened, or sensitive.

2.3 "Delist" and its derivatives means to change the classification of endangered, threatened, or sensitive species to a classification other than endangered, threatened, or sensitive.

2.4 "Endangered" means any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state.

2.5 "Threatened" means any wildlife species native to the state of Washington that is likely to become an endangered species within the forseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.

2.6 "Sensitive" means any wildlife species native to the state of Washington that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats.

2.7 "Species" means any group of animals classified as a species or subspecies as commonly accepted by the scientific community.

2.8 "Native" means any wildlife species naturally occurring in Washington for purposes of breeding, resting, or foraging, excluding introduced species not found historically in this state.

2.9 "Significant portion of its range" means that portion of a species' range likely to be essential to the long term survival of the population in Washington.

LISTING CRITERIA

3.1 The commission shall list a wildlife species as endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available, except as noted in section 3.4.

3.2 If a species is listed as endangered or threatened under the federal Endangered Species Act, the agency will recommend to the commission that it be listed as endangered or threatened as specified in section 9.1. If listed, the agency will proceed with development of a recovery plan pursuant to section 11.1.

3.3 Species may be listed as endangered, threatened, or sensitive only when populations are in danger of failing, declining, or are vulnerable, due to factors including but not restricted to limited numbers, disease, predation, exploitation, or habitat loss or change, pursuant to section 7.1.

3.4 Where a species of the class Insecta, based on substantial evidence, is determined to present an unreasonable risk to public health, the commission may make the determination that the species need not be listed as endangered, threatened, or sensitive.

DELISTING CRITERIA

4.1 The commission shall delist a wildlife species from endangered, threatened, or sensitive solely on the basis of the biological status of the species being considered, based on the preponderance of scientific data available.

4.2 A species may be delisted from endangered, threatened, or sensitive only when populations are no longer in danger of failing, declining, are no longer vulnerable, pursuant to section 3.3, or meet recovery plan goals, and when it no longer meets the definitions in sections 2.4, 2.5, or 2.6.

INITIATION OF LISTING PROCESS

5.1 Any one of the following events may initiate the listing process.

5.1.1 The agency determines that a species population may be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

5.1.2 A petition is received at the agency from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the classification process.

5.1.3 An emergency, as defined by the Administrative Procedure Act, chapter 34.05 RCW. The listing of any species previously classified under emergency rule shall be governed by the provisions of this section.

5.1.4 The commission requests the agency review a species of concern.

5.2 Upon initiation of the listing process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the classification process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

INITIATION OF DELISTING PROCESS

6.1 Any one of the following events may initiate the delisting process:

6.1.1 The agency determines that a species population may no longer be in danger of failing, declining, or vulnerable, pursuant to section 3.3.

6.1.2 The agency receives a petition from an interested person. The petition should be addressed to the director. It should set forth specific evidence and scientific data which shows that the species may no longer be failing, declining, or vulnerable, pursuant to section 3.3. Within 60 days, the agency shall either deny the petition, stating the reasons, or initiate the delisting process.

6.1.3 The commission requests the agency review a species of concern.

6.2 Upon initiation of the delisting process the agency shall publish a public notice in the Washington Register, and notify those parties who have expressed their interest to the department, announcing the initiation of the delisting process and calling for scientific information relevant to the species status report under consideration pursuant to section 7.1.

SPECIES STATUS REVIEW AND AGENCY RECOMMENDATIONS

7.1 Except in an emergency under 5.1.3 above, prior to making a classification recommendation to the commission, the agency shall prepare a preliminary species status report. The report will include a review of information relevant to the species' status in Washington and address factors affecting its status, including those given under section 3.3. The status report shall be reviewed by the public and scientific community. The status report will include, but not be limited to an analysis of:

7.1.1 Historic, current, and future species population trends.

7.1.2 Natural history, including ecological relationships (e.g., food habits, home range, habitat selection patterns).

7.1.3 Historic and current habitat trends.

7.1.4 Population demographics (e.g., survival and mortality rates, reproductive success) and their relationship to long term sustainability.

7.1.5 Historic and current species management activities.

7.2 Except in an emergency under 5.1.3 above, the agency shall prepare recommendations for species classification, based upon scientific data contained in the status report. Documents shall be prepared to determine the environmental consequences of adopting the recommendations pursuant to requirements of the State Environmental Policy Act (SEPA).

7.3 For the purpose of delisting, the status report will include a review of recovery plan goals.

PUBLIC REVIEW

8.1 Except in an emergency under 5.1.3 above, prior to making a recommendation to the commission, the agency shall provide an opportunity for interested parties to submit new scientific data relevant to the status report, classification recommendation, and any SEPA findings.

8.1.1 The agency shall allow at least 90 days for public comment.

8.1.2 The agency will hold at least one public meeting in each of its administrative regions during the public review period.

FINAL RECOMMENDATIONS AND COMMISSION ACTION

9.1 After the close of the public comment period, the agency shall complete a final status report and classification recommendation. SEPA documents will be prepared, as necessary, for the final agency recommendation for classification. The classification recommendation will be presented to the commission for action. The final species status report, agency classification recommendation, and SEPA documents will be made available to the public at least 30 days prior to the commission meeting.

9.2 Notice of the proposed commission action will be published at least 30 days prior to the commission meeting.

PERIODIC SPECIES STATUS REVIEW

10.1 The agency shall conduct a review of each endangered, threatened, or sensitive wildlife species at least every five years after the date of its listing. This review shall include an update of the species status report to determine whether the status of the species warrants its current listing status or deserves reclassification.

10.1.1 The agency shall notify any parties who have expressed their interest to the department of the periodic status review. This notice shall occur at least one year prior to end of the five year period required by section 10.1.

10.2 The status of all delisted species shall be reviewed at least once, five years following the date of delisting.

10.3 The department shall evaluate the necessity of changing the classification of the species being reviewed. The agency shall report its findings to the commission at a commission meeting. The agency shall notify the public of its findings at least 30 days prior to presenting the findings to the commission.

10.3.1 If the agency determines that new information suggests that classification of a species should be changed from its present state, the agency shall initiate classification procedures provided for in these rules starting with section 5.1.

10.3.2 If the agency determines that conditions have not changed significantly and that the classification of the species should remain unchanged, the agency shall recommend to the commission that the species being reviewed shall retain its present classification status.

10.4 Nothing in these rules shall be construed to automatically delist a species without formal commission action.

RECOVERY AND MANAGEMENT OF LISTED SPECIES

11.1 The agency shall write a recovery plan for species listed as endangered or threatened. The agency will write a management plan for species listed as sensitive. Recovery and management plans shall address the listing criteria described in sections 3.1 and 3.3, and shall include, but are not limited to:

11.1.1 Target population objectives.

11.1.2 Criteria for reclassification.

11.1.3 An implementation plan for reaching population objectives which will promote cooperative management and be sensitive to landowner needs and property rights. The plan will specify resources needed from and impacts to the department, other agencies (including federal, state, and local), tribes, landowners, and other interest groups. The plan shall consider various approaches to meeting recovery objectives including, but not limited to regulation, mitigation, acquisition, incentive, and compensation mechanisms.

11.1.4 Public education needs.

11.1.5 A species monitoring plan, which requires periodic review to allow the incorporation of new information into the status report.

11.2 Preparation of recovery and management plans will be initiated by the agency within one year after the date of listing.

11.2.1 Recovery and management plans for species listed prior to 1990 or during the five years following the adoption of these rules shall be completed within five years after the date of listing or adoption of these rules, whichever comes later. Development of recovery plans for endangered species will receive higher priority than threatened or sensitive species.

11.2.2 Recovery and management plans for species listed after five years following the adoption of these rules shall be completed within three years after the date of listing.

11.2.3 The agency will publish a notice in the Washington Register and notify any parties who have expressed interest to the department interested parties of the initiation of recovery plan development.

11.2.4 If the deadlines defined in sections 11.2.1 and 11.2.2 are not met the department shall notify the public and report the reasons for missing the deadline and the strategy for completing the plan at a commission meeting. The intent of this section is to recognize current department personnel resources are limiting and that development of recovery plans for some of the species may require significant involvement by interests outside of the department, and therefore take longer to complete.

11.3 The agency shall provide an opportunity for interested public to comment on the recovery plan and any SEPA documents.

CLASSIFICATION PROCEDURES REVIEW

12.1 The agency and an ad hoc public group with members representing a broad spectrum of interests, shall meet as needed to accomplish the following:

12.1.1 Monitor the progress of the development of recovery and management plans and status reviews, highlight problems, and make recommendations to the department and other interested parties to improve the effectiveness of these processes.

12.1.2 Review these classification procedures six years after the adoption of these rules and report its findings to the commission.

AUTHORITY

13.1 The commission has the authority to classify wildlife as endangered under RCW 77.12.020. Species classified as endangered are listed under WAC 220-610-010, as amended.

13.2 Threatened and sensitive species shall be classified as subcategories of protected wildlife. The commission has the authority to classify wildlife as protected under RCW 77.12.020. Species classified as protected are listed under WAC 220-200-100, as amended.

[Statutory Authority: RCW 77.12.047, 77.12.655, 77.12.020. 02-02-062 (Order 01-283), § 232-12-297, filed 12/28/01, effective 1/28/02. Statutory Authority: RCW 77.12.040. 98-05-041 (Order 98-17), § 232-12-297, filed 2/11/98, effective 3/14/98. Statutory Authority: RCW 77.12.020. 90-11-066 (Order 442), § 232-12-297, filed 5/15/90, effective 6/15/90.]

APPENDIX B. RESPONSES TO WRITTEN PUBLIC COMMENTS RECEIVED ON THE DRAFT RECOVERY PLAN

Note: Many comments have been abbreviated and combined with similar comments.

Section	Comment and response
General comments	I fully support any and all measures to fully recover the Tufted Puffin in Washington State.
	Thank you, we appreciate the support.
	Things change! Populations move! As long as we are not intentionally harming them, let it be. Through NATURAL evolution, more species have died off than are alive.
	We do not think that Tufted Puffin declines are the result of natural evolution, but are likely a consequence of human-caused changes in the marine ecosystem, whether due to human-caused climate change, contaminants, or a combination of factors. WDFW is dedicated to preserving, protecting, and perpetuating the state's fish, wildlife, and ecosystems while providing sustainable fish and wildlife recreational and commercial opportunities. Working to understand and address puffin declines, if possible, is part of that mission.
Recommendation	I strongly support the recommendation to keep the tufted puffin on the state's endangered species list.
	Thanks, just makes sense.
Recovery	I strongly urge WDFW and the state of Washington to invest in the financial and personnel resources necessary to take all needed puffin recovery actions listed in the implementation plan.
	We would like to be able to do that.
	Surveys, investigations, analysis, outreach, and communications are critical for improving our understanding and ultimately taking productive steps towards recovery; they don't however, do much to reduce threats or increase puffin survival or productivity. I encourage WDFW to fully and immediately fund the following recovery tasks: 2.1 Ensure that current protected status for nesting colonies … 2.2 Assess and manage invasive, nonnative species …nesting colonies, (specifically remove rabbits from Destruction Island, 2.2.2); 3.1 Reestablish nesting colonies through reintroductions, if feasible 5.1 Reduce threats of disturbance and mortality by predators, other species … 5.2 Identify and reduce threats of human-related disturbance, contamination, and mortality …
	We agree these are important actions. The current colonies are generally protected in wildlife refuges, national parks, and/or wilderness status; reintroductions would have to be approached carefully, determining the likelihood of success, and to avoid impacting existing colonies; contaminants do indeed need additional investigation as an aggravating factor in declines.
	Changing ocean conditions associated with climate change are likely impacting puffin prey availability, it is indeed curious that similar declines are not occurring in Rhinoceros Auklets. Pursuing a research and monitoring agenda that provides greater certainty about the particular factors influencing puffin breeding success is therefore a critical need. Similarly, the winter range of the species points to the equally critical task

	of collaborating with partners across the southern range to understand and address limiting factors in their wintering grounds.
	We agree on the need for more research. The Tufted Puffin Technical Committee of the Pacific Seabird Group has begun assessing and prioritizing range-wide research needs.
	The needs for successful recovery are considerable, and will necessitate a rapid mobilization of staff and partner resources, a highly targeted research and monitoring agenda, strong external partnerships, and substantially greater department support than has been outlaid to date. We are concerned that WDFW and relevant partners' limited resources and capacity to fulfill these tasks will result in the ultimate extirpation of the species in our state and region.
	We agree that an aggressive, fully funded recovery effort would take much more funding than WDFW is currently able to devote to it.
	We recommend that WDFW develop a more refined roadmap for recovery that prioritizes actions that: 1) immediately address known threats in our region; 2) test hypotheses related to bolstering reproductive success; and 3) that are designed with specific management or policy decision points in mind. We offer the following recommendations: 1. Use an experimental design approach at scale. • Review monitoring and research tasks in the Plan to ensure that they are designed to distinguish between contributing factors. • Reframe research questions as hypotheses. • Evaluate the suitability of out-of-state locations and partners for inclusion in experimental design. 2. Strengthen links between tasks and expected outcomes. Recommendations: • Reframe or elaborate on the specific hypotheses that need to be tested for research-related tasks. • Be specific about policy needs - what are the relevant policies that govern puffin prey and habitat management that could be leveraged to support their recovery? • Identify management actions or policy modifications that can be pursued with existing knowledge. • Describe objectives for policy and public outreach tasks. 3. Leverage External and Internal Assets. In addition to collaboration with external partners, leverage the data, skills and expertise across various WDFW program divisions • Consider using puffin recovery as an opportunity to develop an internal (and external) conservation and policy strategy for marine ecosystem health.
	Some very good suggestions. We did take the unusual step in this plan of identifying immediate high priority tasks. Recovery plans in general provide the broad strategies, while leaving specialists and researchers to develop specific hypotheses, and identify specific priorities, which often need regular updates and revision. We have engaged with partners to develop and regularly update 'action plans' for several listed species that identify and prioritize actions needed in the short-term (~1-3 years); the Pacific Seabird Group's puffin technical committee will play this role at the range-wide scale, but we added a task to convene a Washington working group (7.1) to develop and regularly revise such a document.
	The Tufted Puffin has the potential to serve as an iconic species for our state that helps galvanize conservation efforts that benefit ocean health and address climate change mitigation.
	Good idea. The attention, funding, and action recently focused on Orcas is needed for this species, too. It could be combined with salmon and Orcas in such a campaign; the long-term cost of climate change, marine pollution, etc. for species needs to be made

	more clear to the public.
	We would like to see a prioritized list of research and recovery actions that have measurements for progress or completion.
	As mentioned above, we have helped create such lists for species with partner researchers and organizations; however, these documents need to be updated frequently (i.e. 1-3 year interval), as work is completed, research reveals additional questions/needs, and priorities change. Recovery plans are not updated frequently, so are kept somewhat general for this reason. The Pacific Seabird Group's puffin technical committee has begun working on identifying range-wide priorities, and we added a task (7.1.) to convene a Washington Tufted Puffin working group for this purpose.
	Be specific about policy needs that require Fish and Wildlife Commission action.
	There are no specific policy needs apparent at this point that require Commission action.
	I am in favor of removing rabbits from Destruction Island and reducing invasive plants on Protection Island.
	Agreed, these actions appear to be a good start.
	Perhaps removal of structures from Protection Island to reduce human disturbance and open more nesting habitat for both puffins and Rhinoceros Auklets (task 2.3) could be accomplished in the short term.
	Habitat does not appear to be limiting on Protection Island; there would probably be no immediate benefit for puffins, so this is not a short-term priority.
	I've noticed that boats get close to puffins at Protection and Tatoosh Islands; perhaps there should be a required viewing distance from boats.
	The issue should be looked into if it continues to appear to be an issue; it would likely require action by federal and tribal agencies due to the islands' status as national wildlife refuge and tribal lands.
	I look forward to puffin observations on pelagic trips …this year was by far the worst experience searching for puffins near Protection Island; other observers also noted this, suggesting a sharply fallen population. … good numbers off Cape Flattery but encourage the Department to take whatever steps they can to help the population in the strait.
	Identifying the actions needed through research are among many of the first steps.
	We advocate for the use of community science to support additional data collection. Western Washington offers a large number of highly skilled birders who routinely lend their time and talent to help collect, document and analyze field data in support of conservation efforts. Many of these volunteers are highly skilled and certified across a variety of monitoring protocols. Use of these volunteers and recognition of their skills would help relieve some of the ongoing strains on budget and staff at WDFW and associated partners on this effort.
	We are using data generated by the Christmas Bird Count, Pacific Seabird Survey, and Coastal Observation and Seabird Survey Team (COASST), and observations posted on eBird. Given that Tufted Puffins are highly pelagic, and winter far offshore, opportunities for citizen science engagement are more limited than for many other species. Volunteer use also can require considerable staff time to coordinate and supervise.
	Shame on us as a people if, in our lifetimes, these delightful birds become extirpated in our state. Yet, if the current rate of decline continues, that is exactly what will happen. Our highest priority is to find out exactly why these birds are declining. How else will

	we know best how to help them? Thus, I hope you devote more resources to investigation than your plan currently calls for.
	The plan identifies and emphasizes the many research needs; it makes no attempt to estimate or commit the funding required.
	We should enhance their prey fish in every possible way. We should also do more to protect not only their current nesting sites, but historical ones too. We should make a massive effort to educate the public so any steps we take that might impact human activities are understood and accepted.
	Addressing climate change is likely the most important task; prey fish abundance should be addressed through the ecosystem approach now used by the fishery management councils. There is a need to develop and implement information and education tools and programs.
	We should set higher levels of what we consider to be a healthy population; I believe your goal is too small.
	The recovery objective (i.e. colony counts indicate mean of $\geq$ 10,000) is a level at which they would likely persist, and would not require state listing; they would still be 'protected wildlife' and conservation actions would continue.
	We agree that climate change may be the most significant cause for the drop in puffin numbers due to temperature and current/drift changes in the Pacific. Although climate change may be the source of puffin decline it is by far the toughest factor to correct and will take a national and world commitment and of course time to resolve.
	Agreed. Though WDFW's ability to affect this issue is limited, we took the unusual step of including urging national action in the recovery tasks (4.2).
	We recommend immediate actions that could help reverse puffin decline, including: • Removal of the rabbits from Destruction Island. • Appropriate actions to protect and monitor current nesting sites. • Determine and protect, through regulations, foraging areas. • Start reintroduction actions immediately to determine early, if reintroductions are a feasible alternative.
	We agree with the intent of these, however, protection of offshore foraging areas would involve national, or likely international, agreement, and would be a long term endeavor. Reinroductions are not always the best approach; enhancing productivity of extant populations so that natural recolonization can occur is often more effective and cost efficient. Also, reintroductions involve disturbance, capture and handling of puffins would, of necessity, have some effect on existing colonies and, can result in mortalities due to stress. Assessment of prey availability, and other conditions at reintroduction locations would be needed first, and then passive attraction may be the next step. Tufted Puffins currently in captivity may not be genetically appropriate for introduction to the Washington population.
	We support the idea of active reintroduction. While we understand there is no information regarding the reintroduction of Tufted Puffin, the very successful work conducted at Eastern Egg Rock with Atlantic Puffins provides an excellent model for how reintroduction using social attraction, translocation and other active strategies could be effective for re-establishing historic colonies.
	The Atlantic Puffin reintroduction on Eastern Egg Rock took 8 years before the first chicks returned as adults, and it involved moving 954 chicks from New Foundland. That project still involves managing gulls and other predators. Such a project might be successful with Tufted Puffins depending on the reasons for extirpation, but involves a great deal of time, funding, and commitment.

	Additional threats to Tufted Puffins not evaluated in the draft PSR/Recovery Plan are the Navy's proposed increase in military exercises under its Northwest Training and Testing program. At Naval Air Station Whidbey Island, the Navy is proposing adding 35-36 Growler aircraft to its current fleet of 118 Growlers. This represents a 47% increase in flights to 130,000 per year, including 79,000 Growler flights that will train over and around the Pacific Coast "Offshore Area" and "Inland Waters Areas".
	We are not overly concerned about the added Growler aircraft and flights, for which the Record of Decision has already been published; we are, however, concerned about potentail impacts of training involving in water explosions(U. S. Navy 2019) in an area that overlaps with the puffin foraging areas. We added a task to review and comment on potential impacts on puffins from in water/underwater explosions (task 5.2.7).

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

Periodic Status Reviews

2018 Sea Otter
2018 Pygmy Rabbit
2017 Sharp-tailed Grouse
2017 Fisher
2017 Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017 Woodland Caribou
2017 Sandhill Crane
2017 Western Pond Turtle
2017 Green and Loggerhead Sea Turtles
2017 Leatherback Sea Turtle
2016 American White Pelican
2016 Canada Lynx
2016 Marbled Murrelet
2016 Peregrine Falcon
2016 Bald Eagle
2016 Taylor's Checkerspot
2016 Columbian White-tailed Deer
2016 Streaked Horned Lark
2016 Killer Whale
2016 Western Gray Squirrel
2016 Northern Spotted Owl
2016 Greater Sage-grouse
2016 Snowy Plover
2015 Steller Sea Lion
2015 Brown Pelican

Conservation Plans

2013 Bats

Recent Status Reports

2017 Yellow-billed Cuckoo
2015 Tufted Puffin
2007 Bald Eagle
2005 Mazama Pocket Gopher, Streaked Horned Lark, and Taylor's Checkerspot
2005 Aleutian Canada Goose
1999 Northern Leopard Frog
1999 Mardon Skipper
1999 Olympic Mudminnow
1998 Margined Sculpin
1998 Pygmy Whitefish

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 Upland Sandpiper

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