STATE OF WASHINGTON June 2018

Periodic Status Review for the Sea Otter

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Washington Department of
FISH AND WILDLIFE
Wildlife Program

The Washington Department of Fish and Wildlife maintains a list of endangered, threatened, and sensitive species (Washington Administrative Codes 220-610-010 and 220-200-100). In 1990, the Washington Wildlife Commission adopted listing procedures developed by a group of citizens, interest groups, and state and federal agencies (Washington Administrative Code 220-610-110). These procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

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

This periodic status review for the Sea Otter was reviewed by species experts and was available for a 90-day public comment period from February 6, to May 9, 2018. All comments received were considered during the preparation of this the final periodic status review. The Department intends to present the results of this periodic status review to the Fish and Wildlife Commission for action at the June 2018 meeting.

This report should be cited as

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On the cover: *photo of Otter with sea urchins by Neil Fisher, otter group by Roy Toft; background by Joe Rocchio.*

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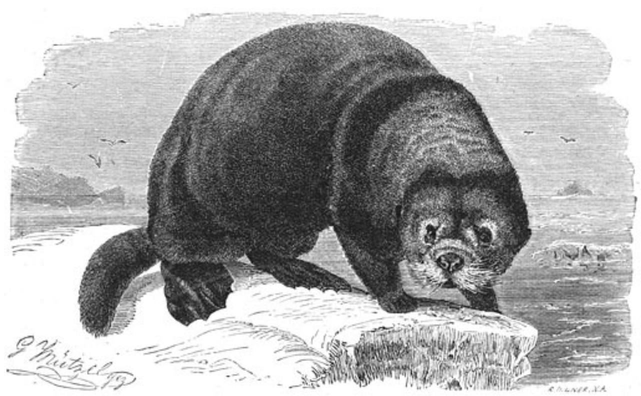
Washington State Periodic Status Review for the Sea Otter



From A.E. Brehm 1899

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

Sea otters originally ranged along the Pacific coast from northern Hokkaido, Japan, through eastern Russia to the Aleutian and Pribilof Islands, and along the coast of mainland Alaska south to British Columbia, Washington and California. Sea otters in Washington historically ranged from the Columbia River to near Port Angeles. The species was exploited during the heyday of the fur trade beginning in 1792, and was extirpated in the state by 1910. The sea otter has been classified as a state endangered species in Washington since 1981.

Sea otters were reintroduced to Washington in 1969 and 1970, when 59 animals were translocated to sites at Point Grenville and La Push from Amchitka Island, Alaska. The current Washington population is descended from between 10 to 43 individuals that survived these introductions. The population numbered 208 animals when combined aerial and ground surveys were first conducted in 1989, and has steadily grown since then. The sea otter population's current range in Washington encompasses the outer coast from Point Grenville in the south to Pillar Point on the Strait of Juan de Fuca. Distribution patterns have changed as the population has grown.

Washington's sea otter population is restricted to a roughly 130-kilometer stretch of outer coast along the Olympic Peninsula. The population has shown strong growth, averaging 9.5 percent per year since 1989 and has increased to a 3-year running average of 1,753 individuals from 2015 through 2017. This exceeds the downlisting objective in the 2004 Recovery Plan of 1,640 sea otters over a 3-year period.

Range expansion is another objective of the 2004 Recovery Plan. Suitable habitat for expansion is available along the Strait of Juan de Fuca and north to Vancouver Island. There is also potential for range expansion south into unoccupied habitat such as Grays Harbor and Willapa Bay, although anthropogenic habitat alteration in those areas may curtail movement. Currently there is no consensus on why sea otters are not clearly expanding into available habitat.

Despite a steady increase in numbers and density, the Washington sea otter population is at risk of losing significant numbers should a catastrophic event such as a large oil spill occur off Washington's coast. Sea otters also remain at risk from disease, toxins, and effects of climate change. Studies have found that genetic exchange between the British Columbia and Washington sea otter populations is occurring, but to an unknown degree. Interbreeding between the Washington and British Columbia populations may lessen the impact of a catastrophic event by contributing to repopulation and through an increase in overall genetic fitness of the remaining Washington population.

Given the steady and substantial increase in numbers and evidence of genetic exchange with the British Columbia sea otter population, the sea otter is no longer "*seriously threatened with extinction throughout all or a significant portion of its range within the state,*" which is the definition of an endangered species. It is recommended that the sea otter be reclassified to state threatened in Washington.

INTRODUCTION

Sea otters are a textbook example of a keystone species and have a considerable impact on the structure and complexity of their nearshore ecological community. Sea otters increase biodiversity and primary productivity of the nearshore environment by controlling populations of sea urchins and other grazers that feed on kelp. They are a sensitive indicator for the health of the nearshore marine ecosystem throughout their range (Estes and Duggins 1995, Kvitek et al. 1998, Watson 2000).

This periodic status review summarizes the biology, population status, threats, and recent management activities for sea otters in Washington and assesses whether the species should retain its current endangered status or whether it deserves reclassification under state law. A more detailed review of the species' biology, past status, population stressors in the state, and required recovery actions appears in the state recovery plan (Lance et al. 2004).

Figure 1. Sea otter (photo by Mike Baird).

SPECIES BACKGROUND

Description. The sea otter (*Enhydra lutris*) is the smallest of the marine mammals, and differs from most in that its primary form of insulation is an extremely thick coat of fur, the densest of any animal at approximately 100,000 hairs per square centimeter (Kenyon 1969). Male sea otters may reach 45 kg and a total length of 148 cm. Females may reach 36 kg and 140 cm (Kenyon 1969). The largest individuals are found in Washington; one captured male weighed in at 50.5 kg (Laidre and Jameson 2006, Brancato 2009). The sea otter's skull is massive, with powerful jaws well adapted to crushing hard-shelled prey. Adults are generally dark brown, with the head, neck and shoulders lighter colored and somewhat grizzled in some individuals. Molting takes place gradually throughout the year and frequent grooming is essential to maintain the fur's

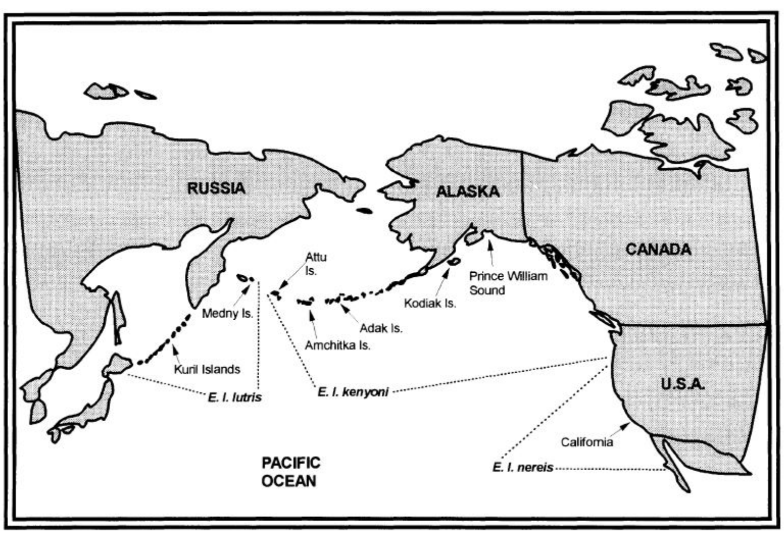

Figure 2. Geographic distribution of locations and ranges of sea otter subspecies (Cronin et al. 1996).

insulating properties. At birth, pups are about 0.6 m long and weigh 1.4 to 2.3 kg (Kenyon 1969). They have a thick coat of long black or brown fur.

Taxonomy and distribution. Sea otters are the only species in the genus *Enhydra* and belong to the order Carnivora, suborder Caniformia and family Mustelidae (ITIS 2017). Three subspecies are recognized, based primarily on skull and dental characteristics: *E. l. kenyoni* from the Aleutian Islands to Prince William Sound, Alaska, and the coasts of British Columbia, Washington, and Oregon; *E. l. lutris* from the Asian range of the Kuril Islands northeast to the Kamchatka Peninsula and the Commander Islands; and *E. l. nereis* from California and Mexico (Figure 2, Doroff and Burdin 2015).

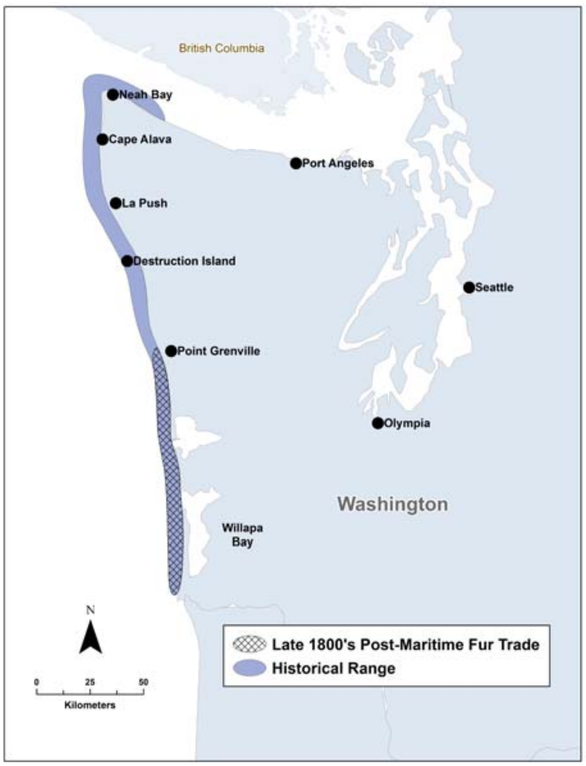

Figure 3a. Approximate historical distribution of the sea otter in Washington (adapted from Scheffer 1940, Lance et al. 2004).

Figure 3b. Approximate current distribution of the sea otter in Washington, 1969 to 1970 release sites and isolated sightings in Washington (adapted from Lance et al. 2004).

Historically, Washington sea otters were distributed in estuarine and sandy habitats from the mouth of the Columbia River to Point Grenville, along the rocky outer Olympic Peninsula coast, and into the Strait of Juan de Fuca (Figure 3a, R. Lyman, pers. comm. *in* Lance et al. 2004). Few animals reached the San Juan Islands and Discovery Bay, and none were present in Puget Sound (Scheffer 1940, Kenyon 1969). Currently, during the summer, they are found primarily from Point Grenville on the outer northwest coast to Tatoosh Island, with a handful of otters reported in the Straits of Juan de Fuca and south Puget Sound (Figure 3b). Most of the current sea otter range is within the Olympic Coast National Marine Sanctuary (OCNMS). In recent years, an increasingly large proportion of the population has occurred between La Push and Point Grenville (Jeffries et al.

2017). In 2017, one sea otter was sighted two miles south of the South Jetty of Grays Harbor (Jeffries et al. 2017). Large groups of sea otters, called rafts, have not been reported in the Strait of Juan de Fuca east of Cape Flattery since 2000, although suitable habitat exists in areas along the northern coast (Lance et al. 2004, Laidre et al. 2009, Jeffries et al. 2016a). Rare sightings of individuals or pairs have occurred in the Washington portion of the Salish Sea east of Pillar Point since the 1970s. Scattered individuals and small rafts east of Cape Flattery occur near Neah Bay and as far east as Chito Beach (S. Jeffries, pers. comm. 2017). A few sea otters have been reported in south Puget Sound for several years (Jeffries et al. 2017).

NATURAL HISTORY

Behavior. Sea otters are nearshore marine mammals that rarely come on land except in remote areas or when sick or injured. When not foraging beneath the surface, they typically float on their backs while resting, grooming their fur, or consuming prey obtained during their foraging dives. Sea otters have no insulating blubber, thus they depend on air trapped in their fur for insulation and floatation. Approximately 20 percent of their time is spent grooming vigorously and meticulously to maintain the protective qualities of their fur (Kenyon 1969, Estes 1980). Sea otters frequently squeeze water from the fur and blow air into it. After eating, sea otters commonly roll onto their sides to wash scraps of food from their fur (Kenyon 1969, Estes 1980). Laidre et al. (2009) reported that on average, Washington sea otters spend 41 percent of their time foraging and 45 percent resting. When resting, the forepaws are held together on the chest and the hind feet are held above the surface of the water to avoid heat loss through the unfurred footpads. Often, sea otters wrap a piece of kelp around their bodies when resting to avoid drifting with the tides (Kenyon 1969).

Although sea otters are frequently solitary, they regularly rest and socialize in large rafts, which can consist of three or four to a few hundred animals. During the 2016 and 2017 surveys, a large raft containing over 600 individuals was spotted that included both sexes and dependent pups (Jeffries et al. 2016b, 2017; S. Jeffries pers. comm. 2018). Sex and age cohorts within sea otter populations are usually segregated (Kenyon 1969). Males of all ages (except pups under maternal care) tend to occupy small areas with shallow and relatively rough seas; numbers can be dense. Females rarely enter those areas, and instead occur in lower densities in much broader and less discrete areas between those occupied by males. Adult males enter areas occupied by females to mate with them (Estes 1980). Males defend territories that include female rafts. They generally do not tolerate other males in those areas (Calkins and Lent 1975, D. Lynch pers. comm. 2017).

Habitat requirements. Sea otters generally inhabit shallow nearshore coastal ecosystems within 1 to 2 km of shore, beyond the high tide line and up to 32 km offshore in some areas (Riedman and Estes 1990). In Washington, they may be found near islands more than 2 km offshore (Lance et al. 2004, D. Lynch pers. comm. 2017). They are often found in rocky marine habitats where there is a high abundance of kelp canopy, but also occur at lower densities in soft-sediment areas (Riedman and Estes 1990, DeMaster et al. 1996). Kelp canopy is an important habitat element used for resting and foraging, however habitats that contain kelp are not necessary (Kenyon 1969). Areas near reefs, islets, or points of land that provide feeding and resting areas sheltered from waves are attractive to sea otters. Occasionally they will haul out on offshore rocks and islands, and less often on mainland beaches (Lance et al. 2004). Sea otters are typically found in water depths averaging about 36 m, but sometimes occur farther offshore in depths of between 40 and 60 m and more rarely in deeper areas with an abundance of food (Riedman and Estes 1990). Sea otter habitat in Washington is characterized by rocky areas with moderate kelp beds, reefs and rocky substrate or by mixed sandy or rocky substrates with some kelp. Historical habitat from Point Grenville to the Columbia River mouth was comprised mostly of sandy substrate with exposed beaches lacking kelp and rocky substrate (Laidre et al. 2002).

Reproduction, breeding behavior and mortality. Females become sexually mature at about 4 years, whereas males attain reproductive ability at 5 to 6 years but may not become territorial or reproductively successful for another 2 or 3 years (Kenyon 1969, Riedman and Estes 1990). Males have multiple female partners and are territorial during the breeding season. Although individual males may not be reproductively active at all times, populations contain some reproductively active males year-round (Estes 1980). Based on pups being present year round, copulation may occur at any season, although activity may be greater during some seasons (Kenyon 1969). Ovulation may be induced by copulation. As with many mustelids, implantation is delayed, but the duration of delay for sea otters is unknown (Sinha et al. 1966). The period from mating to birth, including delayed implantation, typically requires one year (Kenyon 1969), with females usually giving birth to a single pup at two-year intervals. Females usually do not enter estrus until after the pup becomes independent (Kenyon 1969, Estes 1980).

Pups may be born at any time of year in Washington, but nearly half are born in late winter and early spring (Lance et al. 2004). Twins are known to occur, but in such cases it is rare for either pup to survive (Jameson and Bodkin 1986). Pups are born in the water. They are nursed and given solid food shortly after birth and quickly learn to swim. Pups are dependent upon maternal care for about 6 months (Jameson and Johnson 1993). Much of their early life is spent lying on the female's chest. They begin diving for food at 2 months. If a pup dies, a female may adopt one that has been orphaned (Kenyon 1969).

Females are estimated to live up to 20 years, and males up to 15 years (Riedman and Estes 1990). Sea otters die from a variety of causes, including disease, parasites, emaciation, predation, and human-caused mortality (see Factors Affecting Continued Existence). Between 2002 and 2015, 323 dead or dying sea otters were reported in Washington and 10 in Oregon. Sixty-six percent of these were adults. Ninety-three necropsies were conducted. Infectious diseases, including *Sarcocystis neurona*, leptospirosis, and canine distemper virus, were the primary cause of death in 53 cases. Additional causes of death included trauma from unknown cause, drowning due to net entanglement, and dilated cardiomyopathy. In 12 cases, the cause of death could not be determined (White et al. 2018). Of 17 individuals from Washington necropsied in 2013 and 2014, about 80 percent were adults and 20 percent were pups or subadults. Causes of death included bacterial septicemia, neoplasia, emaciation, clostridia and a gunshot wound. The latter two had not been previously documented in Washington (Jeffries and Lynch 2015).

On average, the U.S. Fish and Wildlife Service (USFWS) receives 24 stranding reports per year. 2016 had the highest number of strandings to date (48 strandings). Stranding information is limited by the complexity and remoteness of Washington's coastline (D. Lynch, pers. comm. 2017).

Diet and foraging behavior. Sea otters feed on a wide variety of marine invertebrates including clams, mussels, sea urchins, marine snails and crabs (Estes 1980, Laidre and Jameson 2006).

However, individual otters often demonstrate a preference for just a few specific prey types (Estes et al. 2003). Sea urchins and several species of clam are preferred prey (Laidre and Jameson 2006). Removal of urchins promotes the growth of kelp and kelp-associated communities. In soft sediment substrate, sea otters prey on burrowing bivalves such as razor clams. As preferred prey items become scarce, sea otters will expand their foraging area (Laidre and Jameson 2006).

Sea otters must consume the equivalent of 20 to 30 percent of their body weight per day to maintain their high metabolic rate (Costa and Kooyman 1982) and are known to spend 41 percent of their time foraging (Laidre et al. 2009). Sea otters commonly forage in nearshore waters shallower than 30 m (Kenyon 1969, Riedman and Estes 1990), but have been recorded diving to 100 m (Newby 1975, Bodkin et al. 2004). Sea otters use a variety of strategies for finding their food. Their whiskers and sensitive forepaws with retractable claws help them to detect and capture prey underwater. Food is located largely by touch, captured between the forepaws, and brought to the surface in a loose flap of skin in the armpit (Kenyon 1969). Rocks may be used as tools for opening prey. The rock rests on the otter's stomach and is used as an anvil on which to pound the prey. An otter will often keep a particular rock through a series of food-gathering dives by tucking it under an armpit (Kenyon 1969). They forage more often during morning and evening hours, but may dive for food at any time of the day or night (Shimek and Monk 1977). Sea otters typically remain under water for 50 to 90 seconds while finding and securing prey (Laidre 2004, Laidre and Jameson 2006). Length and frequency of dives depend upon the type of prey (Estes 1980).

Movements. Home ranges of sea otters vary in size, shape, and amount of overlap with other individuals based on sex, age, season, and the availability of food and other resources (Kenyon 1969, Laidre et al. 2009). In Washington, linear home range sizes can extend along 50 km of coastline for males and 38 km for females (Kenyon 1969, Laidre et al. 2009). Adult territorial males may have two distinct territories connected by a travel corridor, ranging in size from 40 ha and 1.1 km coastline length to 78 ha with a coastline length of 2.16 km (Jameson 1989). Sea otters frequently travel within linear home ranges and have been known to move 50 km within less than 2 weeks (Laidre 2004). On average, adult males travel an average of 85 km per year, and females travel 104 km (Laidre 2004). Subadults travel slightly less than adults (Laidre 2004). Sea otters are capable of moving 400 km. Evidence exists for genetic exchange between the Washington and British Columbia populations, which are separated by 120 km (Larson et al. 2012; S. Larson, pers. comm. 2017) (see ***Small population size and isolation***).

Sea otters may permanently disperse in response to population density (Kenyon 1969). Adult and subadult males expand their movement more freely than females, and are often the first to discover new feeding grounds. Males will reside in new areas for extended periods if they find sufficient prey, followed by females, and the cycle repeats itself when each new group reaches carrying capacity. In the late 1990s, sea otters moved nearly 40 km east into the Strait of Juan de Fuca during the winter and spring, but did not establish a population (Jameson and Jeffries 2002, Laidre 2004). Otters will sometimes move seasonally to areas with plentiful prey and shelter to avoid exposure to rough seas and high winds (Kenyon 1969, Laidre et al. 2009).

POPULATION STATUS AND TREND

Global population. Once estimated at 150,000 to 300,000 animals throughout their range (Doroff and Burdin 2015), sea otters were hunted extensively for their fur between 1741 and 1911, causing the world population to fall to just 1,000 to 2,000 individuals living in a fraction of their historical range (Riedman and Estes 1990). Because of reintroductions in Washington, British Columbia and southeastern Alaska and subsequent protective measures, the worldwide population rebounded to an estimated 125,831 otters between 2004 and 2012, with about two-thirds of the former range being reoccupied (Doroff and Burdin 2015).

Washington past. The historical Washington sea otter population was extirpated by commercial hunters by 1910 (Bowlby et al. 1988). The size of Washington's original sea otter population has never been ascertained. Archaeological evidence reveals that prehistoric Native Americans hunted sea otters along the northwest coast of Washington (Bowlby et al. 1988, U.S. District Court 2015). Historic fur-trading company accounts mention "herds" of between 50 to 400 individuals (Bowlby et al. 1988).

Washington present. Sea otters were reintroduced to the state in 1969 and 1970, when 59 animals were translocated from Amchitka Island, Alaska to two Washington sites at Point Grenville and LaPush (Kenyon 1970). Nearly half of the otters released in 1969 perished. The current Washington sea otter population is descended from between 10 to 43 individuals that survived the two initial reintroductions (Jameson et al. 1982). The population numbered 208 animals in 1989 and has steadily grown since then at an overall growth rate of 9.5 percent per year, reaching 2,058 individuals in 2017 (Figure 4, Appendix A). The 3-year running average population estimate for 2015 through 2017 is 1,753 otters (Jeffries et al. 2017). The population's increase is attributed to pup production. From 2001 through 2017 the percentage of pups in the population has ranged from 2.7 to 8.8 percent, with a 3-year average of 5.4 percent for 2015 through 2017 (Appendix A, Jeffries et al. 2017).

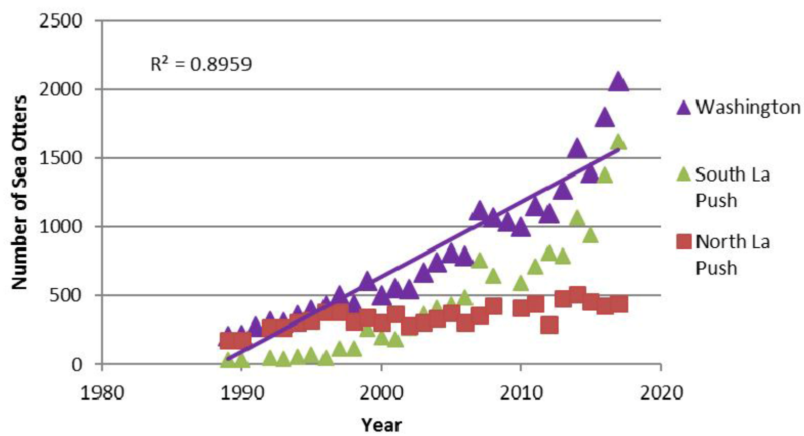

Figure 4. Growth patterns for Washington's sea otter population between 1989 and 2017 (Jeffries et al. 2017).

The population consists of two discernible groups: a northern segment situated north of LaPush and east to Pillar Point, and a southern segment located south of LaPush to Destruction Island to Willoughby Rock (Jameson and Jeffries 2003, Jeffries et al. 2017). These segments are a survey construct and do not represent separate populations. After reintroduction, most otters moved north of the release point at LaPush. In the early 2000's, the ratio of northern individuals to southern individuals began to change after a group of males settled at Destruction Island (Figure 5, Appendix A). During 2017 sea otter surveys (Jeffries et al. 2017), 79 percent of the Washington sea otter population had moved south, filling in a 74-kilometer stretch of rocky habitat south of LaPush. The combination of rocky, sandy and mixed habitat offers different forage opportunities and is currently enabling rapid population growth (D. Lynch, pers. comm. 2016). Twenty-one percent of the population is in areas north of LaPush (Figure 5, Appendix A). Numbers in the southern segment have doubled since 2012 (Jeffries et al. 2017), whereas the northern segment's overall growth rate has slowed and been negative 2 out of the last 5 years (Jeffries et al. 2017). It is possible that the northern segment may have reached carrying capacity, or that some other unknown factor or factors is constraining growth (Jeffries et al. 2017). Suitable habitat for expansion is available along the Strait of Juan de Fuca and north to Vancouver Island. There is also potential for range expansion south into unoccupied habitat such as Grays Harbor and Willapa Bay (Laidre et al. 2009), although anthropogenic habitat alteration in those areas may curtail movement (Lance et al. 2004). Currently there appears to be no consensus on why sea otters are not clearly expanding into available habitat (Lance et al. 2004, Figures 3a and 3b).

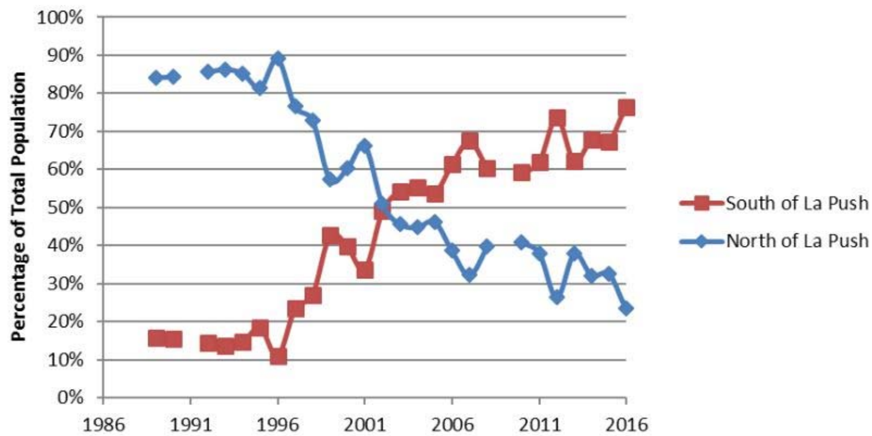

Figure 5. Comparative distribution of sea otters in Washington between the north and south survey segments, 1989-2017 (Jeffries et al. 2017).

FACTORS AFFECTING CONTINUED EXISTENCE

Conservation issues for the species range-wide include vulnerability to oil pollutants, conflicts with fisheries, disease, population isolation, climate change, and predation.

Adequacy of existing regulatory mechanisms. Historically, sea otters first received protection in 1911 when the species was included under the Treaty for the Preservation and Protection of Fur Seals, which was signed by Japan, Russia, the United Kingdom (Canada) and the United States. This afforded protection in international waters at least three miles offshore (USFWS 1982). In 1966, the Fur Seal Act of 1966 provided protection in pelagic waters. All sea otter populations in the United States are protected under the federal Marine Mammal Protection Act (MMPA). With few exceptions, this law prevents the taking (defined as harassing, hunting, capturing, killing, or attempting to harass, hunt, capture or kill) and importation of these animals and products derived from them (16 U.S.C. 1361 et seq.). Sea otters in the Washington population are not protected under the federal Endangered Species Act.

Under Washington state law, sea otters were listed as endangered in 1981 (WAC 220-610-010) due to their small population size, restricted distribution, and vulnerability (Lance et al. 2004). This prohibits the hunting, possession, malicious harassment, and killing of the species (RCW 77.15.120). Under the Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) program, sea otters are considered a priority species. However, specific management recommendations under this program have never been developed for this species.

Oil spills. Oil spills pose a risk to sea otters throughout their global range, as demonstrated during the *Exxon Valdez* spill in Alaska, in which half the otters in Prince William Sound were exposed to oil, and as many as 40 percent of that exposed population were killed outright (Ballachey et al. 1994, *Exxon Valdez* Oil Spill Trustee Council 2017). Sea otters can receive exposure to spilled oil at sea or through contaminated prey. Sea otters are particularly vulnerable because of their high metabolism and dependence upon their dense fur for warmth and flotation. When their fur becomes oiled, they lose their thermal protection and ability to forage, both of which can quickly lead to hypothermia and death. When sea otters groom and clean oiled fur, they ingest and inhale oil, which has detrimental effects on their liver, kidneys and lungs (Mulcahy and Ballachey 1994, Brancato et al. 2009).

Washington experienced seven significant oil spills ranging from 0.1 to 2.3 million gallons along the outer coast, the Strait of Juan de Fuca, and the lower Columbia River between 1964 and 1991 (Neel et al. 2007). It is unknown whether any of these affected the Washington sea otter population, but the two largest ones occurred either before sea otters were reintroduced (a United Transportation barge, 1 million gallons in 1964) or immediately after the reintroductions (*General M. C. Meiggs*, 2.3 million gallons in 1972). The 1991 *Tenyo Maru* spill, which originated at the mouth of the Strait of Juan de Fuca, is known to have killed one sea otter found at Rialto Beach in Olympic National Park (N. Thomas, National Wildlife Health Research Center, Madison, Wisconsin, necropsy report in Lance et al. 2004).

Increased safety measures and prevention programs since the 1990s have helped reduce the number and scale of vessel spills globally, as well as in Washington. Although no spills exceeding 100,000 gallons have occurred in the state since 1991 (Etkin and Neel 2001, Neel et al. 2007), the sheer volume of shipping traffic makes oil spills a persistent threat (Van Dorp and Merrick 2015, WDFW 2015, WSDOE 2017), and smaller spills have occurred. Shipping routes for major ports in Seattle, Tacoma, and Vancouver, B.C., as well as several major oil refineries and the third largest naval base in the U.S., all pass near waters occupied by sea otter populations in Washington and British Columbia. More than 6,800 marine vessel transits occurred in the state in 2016, with hundreds of tank ships and tanker barges annually transporting more than 15 billion gallons of crude oil, fuel, and other chemicals (Etkin and Neel 2001, Puget Sound Action Team 2005, Neel et al. 2007, WSDOE 2017).

The risk of spills in sea otter habitat in Washington is expected to increase by a factor of four in the next several decades as tanker traffic from ports in British Columbia and possibly Washington increases due to expanded oil and natural gas production in the interior of North America (Van Dorp and Merrick 2015, WDFW 2015). Barges, freighters, container ships, ferries, naval vessels, and large fishing and recreational craft also carry oil and fuel in volumes large enough to produce a significant spill (WDFW 2015, WSDOE 2017). Places where spills are most likely to occur include the Strait of Juan de Fuca and Salish Sea, where sea otter distribution is spotty or rare (Van Dorp and Merrick 2015). However, oil spill risk will grow steadily along the outer coast, where the majority of sea otters occur, if oil shipments through this area increase as forecast (Van Dorp and Merrick 2015, WDFW 2015).

Preliminary modeling (using NOAA's GNOME model) of a hypothetical spill of 1 million gallons of crude oil at the entrance of Strait of Juan de Fuca, with a constant 7-knot wind out of the northwest, indicates potential for oil to disperse southward along the outer coast to Cape Alava, 25 linear km south of Cape Flattery, within 72 hours and possibly farther south in the following days (Figures 3a and 3b, D. Noviello pers. comm. 2017). A spill of this type could conceivably impact 70 to 90 percent of the sea otters in Washington, 50 percent at minimum, with current distribution (D. Noviello, pers. comm. 2017). Mortality estimates are difficult to pinpoint, partly because deceased individuals may sink or be carried by currents to inaccessible areas (Hlady et al. 1993, Huggins et al. 2015). Washington's sea otter population is particularly vulnerable to oil spills because nearly 80 percent is concentrated along a 74-kilometer stretch of coastline. Overall, numerous factors can affect the severity of spills and their impacts on sea otters, including time of year, location, volume and type of oil spilled, weather conditions, current patterns, the logistics of response efforts, and sea otter distribution at the time (D. Noviello pers. comm. 2017).

Destruction Island and the surrounding vicinity has been the largest sea otter concentration area for the past decade and contains a raft of females and pups on the western end of the island (see annual reports 2006-2016). Accordingly, this area might serve as a source for repopulating other areas along the Olympic Peninsula where sea otters become significantly reduced. However, Destruction Island and all the offshore rocks and islands occurring off the Olympic Peninsula are logistically difficult areas to conduct spill response and wildlife rescue operations (WDFW 2015).

Fishing activity. Sea otters can be accidentally killed or injured in different commercial or recreational fisheries when they become entangled in gillnets or other gear (Riedman and Estes 1990). Rare instances of sea otter mortality have occurred in the salmon gillnet fisheries conducted by Makah tribal fishermen along the northern Washington coast and into the Strait of Juan de Fuca (Lance et al. 2004, USFWS 2008). Makah and NMFS biologists have monitored these fisheries, with 11 otters taken from 1988 through 2001, two animals taken in 2004 and two more in 2011 (USFWS 2008, D. Lynch, pers. comm. 2017). Mortality during these fisheries is estimated at a minimum of two deaths annually when there is fishing effort. Additional information provided by NMFS and the Makah Tribe is not sufficient to provide a more accurate estimate (USFWS 2008).

Other fisheries within the potential range of the Washington sea otter population include treaty and non-treaty gillnet fisheries in the Strait of Juan de Fuca, Puget Sound, and Grays Harbor. All of these fisheries are self-reporting and have been without marine mammal observer coverage since 1994, making it difficult to accurately estimate the amount of sea otter take. Sea otter densities along the Strait of Juan de Fuca are low during the summer and fall when these fisheries are commonly underway, so few entanglements are expected (USFWS 2008). Additional fisheries occur in the range of the sea otter in Washington, however mortality or serious injury is doubtful (USFWS 2008).

Trap or pot gear, such as that used in Dungeness crab fisheries, also poses a danger to sea otters. Sea otters have been taken in various traps and pots used in Alaska and California (Newby 1975, Hatfield pers. comm., *in* Lance et al. 2004), but none have yet been reported in Washington. Now that the southern segment of Washington's sea otter population has moved south into important Dungeness crab habitat, the potential for incidental take in crab pots will increase (Lance et al. 2004, Jeffries et al. 2016b). Overall, a maximum of 78,600 crab pots are deployed in December/January at the beginning of the fishery, dropping off as the season progresses with a minimum of 7,300 pots in the summer, before the end of the fishery on September 15 (D. Ayres, pers. comm. 2017). Similarly, range expansion of the northern sea otter population segment east along the Strait of Juan de Fuca would bring animals into contact with invertebrate fisheries such as sea urchin and geoducks (Gerber and VanBlaricom 1999, USFWS 2008).

As the Washington sea otter population continues to grow, the possibility of fishery interactions may increase (Gerber and VanBlaricom 1999, USFWS 2008). In the late 1990s, a group of Washington sea otters ventured into the Strait of Juan de Fuca during the winters and impacted a Makah tribal urchin fishery (Lance et al. 2004). No other interactions with fisheries in Washington have yet been recorded. A study conducted in southeast Alaska found that the growing sea otter population there eats a significant amount of shellfish and can be linked to depletion of some commercially valuable species (Carswell et al. 2015, Hoyt 2015).

Toxins, disease and parasites. Various parasites, diseases, and biotoxins reported in Washington sea otters include paralytic shellfish poisoning, domoic acid, leptospirosis, and pneumonia. Leptospirosis in Washington sea otters was diagnosed only in 2002 (Lance et al. 2004, White et al. 2013, White et al. 2018). Exposure can occur through a number of processes expected to increase in the future, including climate change and related changes in ocean conditions. These factors include runoff from terrestrial sources such as stormwater, sewage outflow, and agriculture, which can introduce pathogens from terrestrial mammals; and toxins ingested via diverse contaminated prey resources. Human overharvest of preferred or typical prey can result in diet shifts to a greater variety of invertebrates, thus exposing them to certain diseases like acanthocephalan parasites, toxoplasmosis, and *Sarcocystis* parasites. Protozoal meningoencephalitis due to *Sarcocystis neurona* has been found in Washington sea otters (White et al. 2013, 2018).

Exposure to novel diseases and parasites is an emerging concern, particularly given that nearly 80 percent of Washington's sea otter population is concentrated along 74 kilometers of shoreline. Seventy percent of the Washington sea otters recently examined have tested positive for the same H1N1 flu virus that caused a world-wide pandemic in 2009 (Li et al. 2014). None of the otters showed signs of illness, but the presence of antibodies indicates previous exposure to influenza (Li et al. 2014). One highly virulent disease that has reached the North Pacific since 2000 is phocine distemper virus, which previously caused two epidemics that killed large numbers of harbor seals in northern Europe and has now been discovered in sea otters in Alaska (Goldstein et al. 2009). This virus, canine distemper virus, and cetacean morbillivirus are morbilliviruses, and can mutate easily and become more infectious in certain species. Canine distemper virus has been found in Washington sea otters, and all three morbilliviruses pose a potential risk to Washington's sea otter population (White et al. 2018, J. Gaydos, pers. comm. 2017). Miller et al. (2010) linked the deaths of 21 California sea otters to a new threat called microcystin, produced by freshwater cyanobacteria that can move into the marine environment and be aggregated by filter-feeding bivalves. There has been one case of histoplasmosis found in an Alaskan sea otter in 2005 (Burek et al. 2014).

Small population size and isolation. The vast overharvest of sea otters during the fur trade has caused an overall loss of genetic variation in modern populations (Larson et al. 2002b, 2012), potentially resulting in reduced fertility, higher juvenile mortality, slower overall growth rates, and increased vulnerability to stochastic events (Ralls et al. 1983).

Washington's small founder population contained just 19 otters when first surveyed in 1977 (Jameson et al. 1986), but may have numbered as few as 10 animals immediately after the translocations (Bowlby et al. 1988). Despite this population bottleneck and overall loss of genetic diversity as a whole, Bodkin et al. (1999) and Larson et al. (2002a) both detected relatively high genetic diversity in the Washington population.

During roughly the same time as the Washington reintroductions, 89 individuals from Amchitka and Prince William Sound were reintroduced to the west coast of Vancouver Island in British Columbia. The Washington and British Columbia sea otter populations are separated by approximately 120 km, well within recorded dispersal distance (see ***Movements***). Recent analyses of microsatellite nuclear variation clearly indicate that genetic signatures formerly considered unique to British Columbia otters are now present in Washington animals, suggesting some unknown level of interchange (S. Larson, pers. comm. 2017). Similarly, testing of mitochondrial DNA in Washington sea otters in 2011 found a haplotype common to Prince William Sound otters that was not present in the Washington animals in the late 1990s and could only have come from genetic mixing with the British Columbia population (S. Larson, pers. comm. 2017). The level of interchange between these populations is unknown (S. Larson, pers. comm. 2017), as is the level of interchange needed to avoid loss of genetic diversity (Vucetich and Waite 2000). No numeric data on movement is available at present.

Climate change. Limited information is available regarding the response of sea otters to climate change, but as ocean temperature and other conditions respond, it seems likely that otters will be affected. Their sensitivity will be primarily due to changes in prey abundance (e.g., red urchins, clams, bivalves), particularly since otters require large amounts of prey to meet their metabolic needs (Kenyon 1969, Doroff and Burdin 2015). Prey abundance may be negatively affected by increasing ocean acidity and possibly increasing water temperatures, (Miller et al. 2013) but sea otters may be able to switch between prey species may increase their adaptive capacity to respond to shifts in climate and prey distribution patterns (Walker et al. 2008). Additionally, increasing sea temperatures could promote survival of marine bacterial pathogens that infect otters and cause mortality, though there are high levels of uncertainty regarding this concern (Burek et al. 2008). Climate change could also bring increased winter storm intensity and resulting high surf conditions that could cause higher otter mortality (Burek et al. 2008).

Predation. Known natural predators of sea otters include transient killer whales (*Orcinus orca*), great white sharks (*Carcharodon carcharias*), bald eagles (*Haliaeetus leucocephalus*), coyotes (*Canis latrans*), and brown bears (*Ursus arctos*) (Keyes 1975, Riedman and Estes 1990). In Washington, predation is not considered high/frequent enough to prevent the continued growth of the otter populations (Lance et al. 2004). In 1975, a great white shark tooth was found embedded in a sea otter carcass recovered at Cape Alava (Keyes 1975), suggesting that sharks at least occasionally kill some otters in Washington. Interactions with killer whales throughout the sea otters' global range differ. Killer whale predation was hypothesized to be a significant limiting factor on otter populations across the

Western Gulf of Alaska and Aleutian Islands, and there is one report of killer whales preying on sea otters off Vancouver Island (Watson 1993), but in other locations the two species appear to coexist without interacting. Killer whales observed in the vicinity of a sea otter group in Washington elicited no apparent reaction from the otters (R. Jameson, pers. comm. *in* Lance et al. 2004). Bald eagles occasionally prey on young otter pups in Alaska, but there are no records of this for Washington (R. Jameson *in* Lance et al. 2004). There have been anecdotal observations of bald eagles attempting to take sea otter pups. Given the number of bald eagles along the coastline, it is likely that they get at least a few unattended pups (D. Lynch, pers. comm. 2017).

MANAGEMENT ACTIVITIES

Recovery plan. A state recovery plan for sea otters was written in 2004 (Lance et al. 2004). A number of strategies were recommended and are being implemented under the plan as described in the following sections.

Translocations. Since the reintroductions to Washington and British Columbia, translocations have been used as a management tool elsewhere to re-establish sea otter populations where they have been extirpated and to influence the distribution of sea otters throughout historical ranges (Jameson et al. 1982). For example, between 1987 and 1990, 140 sea otters were translocated from the central California coast to San Nicolas Island in southern California to redistribute the population and minimize the chance that a stochastic event such as an oil spill would eliminate the entire population (Rathbun et al. 1990, Hatfield 2003). Further research needs to be done on this topic. The USFWS recently declared this translocation a failure (USFWS 2012).

Surveys and monitoring. Since 1989, researchers from the Washington Department of Fish and Wildlife (WDFW) and USFWS have conducted annual surveys of Washington's sea otter population along with other government agencies, NGOs and volunteers.

Research. WDFW, the U.S. Geological Survey, USFWS, OCNMS and others have conducted a number of studies of sea otter ecology in Washington. These have examined causes of mortality, contaminant loads, activity budgets, diet, movements, diseases and pathogens, genetic diversity, prey availability, and changes in benthic communities (Kvitek et al. 1998, Laidre 2004, Brancato et al. 2009, Laidre et al. 2009, Larson et al. 2012, White et al. 2013, White et al. 2018).

Oil spill risk reduction and response. State and federal agencies, industry, tribes, and other stakeholders continue efforts to protect Washington's wildlife and other natural resources (including sea otters) from oil spills. Response planning and participation in oil spill drills are ongoing. Among the safety measures instituted to prevent marine oil spills in Washington since the 1990s is the establishment of an Area to Be Avoided (ATBA) within the OCNMS off the northwestern coast, which encourages large vessels to stay well offshore during transit along the coast (WSDOE 2017). Additional risk mitigation is provided by a rescue tug stationed in Neah Bay that is able to respond quickly to impaired vessels near the entrance to the Strait of Juan de Fuca. An oil spill response handbook specific to seas otters was recently written and provides guidance on the preferred methods for locating, recovering, and rehabilitating sea otters injured by contact with oil during an oil spill (WDFW 2009, 2015). Use of single-hull tanker vessels, including barges, was completely phased out and replaced by double-hulled vessels in the U.S. in January 2015. In 1979, the Canadian and United State Coast Guards established the Cooperative Vessel Traffic System (CVTS) for the Strait of Juan de Fuca region. The purpose of the CVTS is to provide for the safe and efficient movement of vessel traffic while minimizing the risk of pollution by preventing collisions and groundings. Areas falling under the agreement include the offshore approaches to the Juan de Fuca Strait and along the Washington coastline from 48 degrees north, Canadian and US waters of Juan de Fuca Strait and US waters of Haro Strait, Boundary Passage, and the lower Georgia Straits (US Coast Guard 2017). Canada has also instituted regulations and measures to minimize the risk of accidental spills (e.g., Transportation of Dangerous Goods Act). In 2017, Canada introduced "Canada's Oceans Protection Plan", which pledges to invest $1.5 billion over 5 years in coastal protections, along with an action plan for the coming decade (OPM 2017).

Beach strandings. Sea otter stranding responses fall under the authority of USFWS or WDFW under section 109h of the MMPA. The USFWS established a toll-free reporting line to aid in reporting. There is cooperation between the West Coast Marine Mammal Stranding Network and USFWS and WDFW regarding sea otter strandings, but all responses are coordinated and conducted under the authority of USFWS or WDFW (D. Lynch pers. comm. 2017). Sea otters recovered alive are sent to the Seattle Aquarium or Point Defiance Zoo and Aquarium to provide short-term holding or care on a case-by-case basis (Lance et al. 2004). Sea otter carcasses in good condition are sent for necropsy to the National Wildlife Health Center in Wisconsin. Reports and retrievals of sea otter carcasses are infrequent, however, since much of the outer Washington coast is remote (Bowlby et al. 1988, D. Lynch, pers. comm. 2016).

CONCLUSIONS AND RECOMMENDATION

Washington's sea otter population is restricted to a roughly 130-kilometer stretch of outer coast along the Olympic Peninsula, with nearly 80 percent of the population occurring in the southern 74 kilometers of their current range. The population has shown strong growth, averaging 9.5 percent per year since 1989 and has increased to a 3-year running average of 1,753 individuals from 2015 through 2017. This exceeds the downlisting objective in the 2004 Recovery Plan of 1,640 sea otters over a 3-year period.

Range expansion is another objective of the 2004 Recovery Plan. The southern range has expanded from Destruction Island to Point Grenville since the Recovery Plan was written, however the Washington sea otter population has not expanded to its full historical southern range, nor has it established permanent occupancy in the Strait of Juan de Fuca, despite seasonal excursions in the 1990s. It is possible that the northern group has reached carrying capacity. Suitable habitat for expansion is available along the Strait of Juan de Fuca and north to Vancouver Island. There is also potential for range expansion south into unoccupied habitat such as Grays Harbor and Willapa Bay, although anthropogenic habitat alteration in those areas may curtail movement. Currently there is no consensus on why sea otters are not clearly expanding into available habitat.

Despite a steady increase in numbers and density, the Washington sea otter population is at risk of losing significant numbers should a catastrophic event such as a large oil spill occur off

Washington's coast. Sea otters also remain at risk from disease, toxins, and effects of climate change.

Since the Recovery Plan was published, studies have found that genetic exchange between the British Columbia and Washington sea otter populations is occurring, but to an unknown degree. Interbreeding between the Washington and British Columbia populations may lessen the impact of a catastrophic event by contributing to repopulation and through an increase in overall genetic fitness of the remaining Washington population.

Given the steady and substantial increase in numbers and evidence of genetic exchange with the British Columbia sea otter population, the sea otter is no longer "*seriously threatened with extinction throughout all or a significant portion of its range within the state,*" which is the definition of an endangered species. It is recommended that the sea otter be reclassified to state threatened in Washington. A threatened species is "*likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats.*"

REFERENCES CITED

The references cited in the *Periodic Status Review for the Sea Otter* 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 March 2017.

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
Ballachey, B. E., J. L. Bodkin and A. R. DeGange. 1994. An overview of sea otter studies. Marine mammals and the Exxon Valdez, pp.47-59.	i
Bodkin, J. L., B. E. Ballachey, M. A. Cronin and K.T. Scribner. 1999. Population demographics and genetic diversity in remnant and translocated populations of sea otters (*Enhydra lutris*). Conservation Biology 13(6):1378-1385.	i
Bodkin, J. L., G. C. Esslinger and D. H. Monson. 2004. Foraging depths of sea otters and implications to coastal marine communities. Marine Mammal Science 20(2): 305-321.	i

Bowlby, C. E., B. L. Troutman and S. J. Jeffries. 1988. Sea otters in Washington: distribution, abundance, and activity patterns. Final report prepared for National Coastal Resources Research and Development Institute, Hatfield Marine Science Center, Newport, Oregon. 133 pp.	vi
Brancato, M. S., L. Milonas, C. E. Bowlby, R. Jameson and J. W. Davis. 2009. Chemical contaminants, pathogen exposure and general health Status of live and beach-cast Washington sea otters (*Enhydra lutris kenyoni*). Marine Sanctuaries Conservation Series ONMS-08-08. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 181 pp.	i
Burek, K. A., F. M. D. Gulland and T. M. O'Hara. 2008. Effects of climate change on arctic marine mammal health. Ecological Applications 18:S126–S134.	i
Burek, K. A., V. Gill and D. S. Bradway. 2014. Locally acquired disseminated histoplasmosis in an Alaskan wild sea otter (Enhydra lutris). Journal of Wildlife Diseases. 50(2). DOI: 10.7589/2013-11-288.	i
Calkins, D. and P. O. Lent. 1975. Territorialist and mating behavior in Prince William Sound sea otters. Journal of Mammalogy. 56(2):528-529.	i
Carswell, L. Pl., S. G. Speckman and V. A. Gill. 2015. Chapter 12 – Shellfish fishery conflicts and percentions of sea otters in California and Alaska. Pages 333-268 *in* Sea Otter Conservation. Academic Press. http://doi.org/10.1016/B978-0-12-801402-8.00012-3	i
Costa, D. P. and G. L. Kooyman. 1982. Oxygen consumption, thermoregulation, and the effect of fur oiling and washing on the sea otter *Enhydra lutris*. Canadian Journal of Zoology 60:2761-2767.	i
Cronin, M. A., J. Bodkin, B. Ballachey, J. Estes and J. C. Patton. 1996. Mitochondrial-DNA variation among subspecies and populations of sea otters (*Enhydra lutris*). Journal of Mammalogy 77:546-557.	i
DeMaster, D. P., C. Marzin and R.J. Jameson. 1996. Estimating the historical abundance of sea otters in California. Endangered Species Update 13(12):79-81.	i
Doroff, A. and A. Burdin. 2015. *Enhydra lutris*. The IUCN Red List of Threatened Species 2015: e.T7750A21939518. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T7750A21939518.en.	i
Estes, J. A. 1980. *Enhydra lutris*. Mammalian Species 133: 1-8.	i
Estes, J. A. and D. O. Duggins. 1995. Sea otters and kelp forests in Alaska: generality and variation in a community ecological paradigm. Ecological Monographs 65:75-100.	i
Estes, J. A., M. L. Riedman, M. M. Staedler, M. T. Tinker and B. E. Lyon. 2003. Individual variation in prey selection by sea otters: patterns, causes and implications. Journal of Animal Ecology 72:144-155.	i
Etkin, D. S. and J. Neel. 2001. Investing in spill prevention - has it reduced vessel spills and accidents in Washington state? Pages 47-56 in Proceedings of 2001 International Oil Spill Conference. American Petroleum Institute, Washington, D.C.	i
Exxon Valdez Oil Spill Trustee Council. 2017. Status of restoration: sea otters. Anchorage, Alaska. http://www.evostc.state.ak.us/index.cfm?FA=status.seaotter. Accessed June 5, 2017.	viii
Gerber, L. R. and G. R. VanBlaricom. 1999. Potential fishery conflicts involving sea otters (*Enhydra lutris* [L.] in Washington state waters. Final Report to the Marine Mammal Commission, Contract T30917202, Marine Mammal Commission, Washington, D.C. 79 pp.	vi
Goldstein, T., J. A. K. Mazet, V. A. Gill, A. M. Doroff, K. A. Burek, and J. A. Hammond. 2009. Phocine distemper virus in northern sea otters in the Pacific Ocean, Alaska, USA. Emerging Infectious Diseases. 8 pp. DOI:10.3201/eid1506.090056.	i

Hatfield, B. B. 2003. The translocation of sea otters to San Nicolas Island: an update. Pages 473-475 *in:* Garcelon, D. K. and C. A. Schwemm, Eds. Proceedings of the Sixth California Islands Symposium. Ventura, California. December 1-3, 2003.	i
Hlady, D. A. and A. E. Burger. 1993. Drift-block experiments to analyze the mortality of oiled seabirds off Vancouver Island, British Columbia. Marine Pollution Bulletin 26:495-501.	i
Huggins, J. L., J. Oliver, D. M. Lambourn, J. Calambokidis, B. Diehl and S. Jeffries. 2015. Dedicated beach surveys along the central Washington coast reveal a high proportion of unreported marine mammal strandings. Marine Mammal Science 31:782-789.	i
Hoyt, Z. N. 2015. Resource competition, space use and forage ecology of sea otters, *Enhydra lutris*, in southern southeast Alaska. Doctoral dissertation.	i
Integrated Taxonomy Information System (ITIS). 2017. http://www.itis.gov. Retrieved February 6, 2017.	viii
Jameson, R.J. 1989. Movements, home range, and territories of male sea otters off central California. Marine Mammal Science 5:159-172.	i
Jameson, R. J., K. W. Kenyon, A. M. Johnson and H. M. Wight. 1982. History and status of translocated sea otter populations in North America. Wildlife Society Bulletin. 10:100-107.	i
Jameson, R. J. and J. L. Bodkin. 1986. An incidence of twinning in the sea otter (*Enhydra lutris*). Marine Mammal Science 2: 305-309.	i
Jameson, R. J. and A. M. Johnson. 1993. Reproductive characteristics of female sea otters. Marine Mammal Science 9: 156-167.	i
Jameson, R. J. and S. J. Jeffries. 2002. Results of the 2002 survey of the reintroduced sea otter population in Washington state. Washington Department of Fish and Wildlife, Lakewood, Washington. 5 pp.	vi
Jameson, R. J. and S. J. Jeffries. 2003. Results of the 2003 survey of the reintroduced sea otter population in Washington state. Washington Department of Fish and Wildlife, Lakewood, Washington. 6 pp.	vi
Jameson, R. J. and S. J. Jeffries. 2010. Results of the 2010 survey of the reintroduced sea otter population in Washington state. Washington Department of Fish and Wildlife, Lakewood, Washington. 7 pp.	vi
Jeffries, S. J. and D. K. Lynch. 2015. The Washington sea otter population update: distribution, status and sources of mortality. Page 10 *in:* Sea Otter Conservation Workshop IX, March 27-29, 2015, Conference Proceedings. Seattle Aquarium, Seattle, Washington.	i
Jeffries, S., D. Lynch, S. Thomas and S. Ament. 2017. Results of the 2017 survey of the reintroduced sea otter population in Washington state. Washington Department of Fish and Wildlife, Lakewood, Washington. 12 pp.	vi
Jeffries, S., D. Lynch and S. Thomas. 2016a. Results of the 2015 survey of the reintroduced sea otter population in Washington state. Washington Department of Fish and Wildlife, Lakewood, Washington. 11 pp.	vi
Jeffries, S., D. Lynch and S. Thomas. 2016b. Results of the 2016 survey of the reintroduced sea otter population in Washington state. Washington Department of Fish and Wildlife, Lakewood, Washington. 10 pp.	vi
Kenyon, K. W. 1969. The sea otter in the eastern Pacific Ocean. North American Fauna 68:1-352.	i
Kenyon, K. W. 1970. Sea otters translocated from Alaska to Washington and Oregon on 18 July 1970. Bureau of Sport Fisheries and Wildlife, Seattle, Washington.	i

Keyes, M. C. 1975. Shark attacks sea otter. International Association for Aquatic Animal Medicine News 7:2.	viii
Kvitek, R. G., P. J. Iampietro and C. E. Bowlby. 1998. Sea otters and benthic prey communities: a direct test of the sea otter as keystone predator in Washington state. Marine Mammal Science 14:895-902.	i
Laidre, K. L. 2004. Movements, habitat use, and foraging patterns of sea otters (*Enhydra lutris*) in Washington. Final contract report to WDFW, contract #CAPS 03-1450 - DOCS 39040341. 48 pp.	vi
Laidre, K. L., R. J. Jameson, S. J. Jeffries, R. C. Hobbs, C. E. Bowlby and G. R. VanBlaricom. 2002. Estimates of carrying capacity for sea otters in Washington state. Wildlife Society Bulletin 30(4):1172-1181.	i
Laidre, K. L. and R. J. Jameson. 2006. Foraging patterns and prey selection in an increasing and expanding sea otter population. Journal of Mammalogy. 87(4):799-807.	i
Laidre, K. L., R. J. Jameson, E. Gurarie, S. J. Jeffries and H. Allen. 2009. Spatial habitat use patterns of sea otters in coastal Washington. Journal of Mammalogy. 90(4):906-917.	i
Lance, M. M., S. Richardson and H. Allen. 2004. Washington state recovery plan for the sea otter. Washington Department of Fish and Wildlife, Olympia, Washington. 103 pp.	i
Larson, S., R. Jameson, J. Bodkin, M. Staedler and P. Bentzen. 2002a. Microsatellite DNA and mitochondrial DNA variation in remnant and translocated sea otter (*Enhydra lutris*) populations. Journal of Mammalogy 83(3):893- 906.	i
Larson, S., R. Jameson, M. Etnier, M. Fleming and P. Bentzen. 2002b. Loss of genetic diversity in sea otters (*Enhydra lutris*) associated with the fur trade of the 18th and 19th centuries. Molecular Ecology 11:1899-1903.	i
Larson S., R. Jameson, M. Etnier, T. Jones and R. Hall. 2012. Genetic diversity and population parameters of sea otters, *Enhydra lutris*, before fur trade extirpation from 1741–1911. PLoS ONE 7(3): e32205. doi:10.1371/journal.pone.0032205	i
Li, Z-N., H. S. Ip, J. F. Trost, C. L. White, M. J. Murray, P. J. Carney, X-J. Sun, J. Stevens, M. Z. Levine and J. M. Katz. 2014. Serologic evidence of influenza A(H1N1) pdm09 virus infection in northern sea otters. Emerging Infectious Diseases 20(5). www.cdc.gov/eid.	i
Miller M. A., R. M. Kudela, A. Mekebri, D. Crane, S. C. Oates, M. T. Tinker, M. Staedler, W. A. Miller, S. Toy-Choutka, C. Dominik, D. Hardin, G. Langlois, M. Murray, K. Ward and D. A. Jessup. 2010. Evidence for a novel marine harmful algal gloom: cyanotoxin (microcystin) transfer from land to sea otters. PLoS ONE 5(9): e12576. DOI:10.1371/journal.pone.0012576.	i
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. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 238 pp.	i
Mulcahy, D. M. and B. E. Ballachey. 1994. Hydrocarbon residues in sea otter tissues. Pages 313-330 *in* T. R. Loughlin, editor. Marine mammals and the Exxon Valdez. Academic Press, San Diego.	i
Neel, J., C. Hart, D. Lynch, S. Chan and J. Harris. 2007. Oil spills in Washington state: a historical analysis (revision of 1997 report). Publication No. 97-252, Washington State Department of Ecology, Olympia, Washington. 51 pp.	i
Newby, T. C. 1975. A sea otter (*Enhydra lutris*) food dive record. Murrelet 56: 19.	i
OPM (Office of the Prime Minister). 2017. Canada's Oceans Protection Plan. Office of the Prime Minister. Ottawa, Canada.	i

Puget Sound Action Team. 2005. State of the Sound 2004. Puget Sound Action Team, Olympia, Washington.	i
Ralls, K., J. Ballou and R. L. Brownell, Jr. 1983. Genetic diversity in California sea otters: Theoretical considerations and management implications. Biological Conservation 25:209-232.	i
Rathbun, G. B., R. J. Jameson, G. R. VanBlaricom and R. L. Brownell. 1990. Reintroduction of sea otters to San Nicolas Island, California: Preliminary results for the first year. Pages 99-114 *in* P. J. Bryant and J. Remmington (eds.). Endangered Wildlife and Habitats in Southern California. Memoirs of the Natural History Foundation of Orange County, Vol. 3.	i
Riedman, M. L. and J. A. Estes. 1990. The sea otter (*Enhydra lutris*): Behavior, ecology, and natural history. U.S. Fish and Wildlife Service Biological Report 90(14). 126 pp.	vi
Scheffer, V. B. 1940. The sea otter on the Washington coast. Pacific Northwest Quarterly 10:370-388.	i
Shimek, S. J. and A. Monk. 1977. Daily activity of sea otter off the Monterey Peninsula, California. The Journal of Wildlife Management. 41(2):277-283.	i
Sinha, A. A., C. H. Conaway and K. W. Kenyon. 1966. Reproduction in the female sea otter. The Journal of Wildlife Management. 30(1):121-130.	i
US Coast Guard. 2017. Purpose and objective: Canada/United States Co-cooperative Vessel Traffic System Agreement. US Coast Guard, Seattle, WA. https://www.uscg.mil/d13/cvts/purposeandobjective.asp. Accessed June 5, 2017.	i
US District Court Western District of Washington at Seattle. 2015. Findings of fact and conclusions of law and memorandum order. United States of America et al. v. State of Washington et al., Case 2:70-cv-09213-RSM, Document 21063. 83 pp.	v
USFWS (United States Fish and Wildlife Service). 1982. Southern sea otter recovery plan. 66 pp.	i
USFWS (United States Fish and Wildlife Service). 2008. Sea Otter (*Enhydra lutris kenyoni*) Washington Stock. Pages 413-419 *in* Carretta, J. V., E. Oleson, D. W. Weller, A. R. Lang, K. A. Forney, J. Baker, Brad H., K. Martien, M. M. Muto, M. S. Lowry, J. Barlow, D. Lynch, L. Carswell, R. L. Brownell, Jr., D. K. Mattila and M. C. Hill. 2013. U.S. Pacific marine mammal stock assessments: 2012. NOAA Technical Memorandum NMFS-SWFSC-504, Southwest Fisheries Science Center, San Diego, California.	i
USFWS (United States Fish and Wildlife Service). 2012. Endangered and Threatened Wildlife and Plants; Termination of the Southern Sea Otter Translocation Program; Final Rule. Federal Register / Vol. 77, No. 244 / Wednesday, December 19:75265-75297.	i
Van Dorp, J. R. and J. Merrick. 2017. VTRA 2015 final report, updating the VTRA 2010: a potential oil loss comparison of scenario analyses by four spill size categories. George Washington University, Washington, D.C., and Virginia Commonwealth University, Richmond, Virginia.	vi
Vucetich, J. A. and T. A. Waite. 2000. Is one migrant per generation sufficient for the genetic management of fluctuating populations? Animal Conservation 3(3):261-6.	i
Walker, K. A., J. W. Davis and D. A. Duffield. 2008. Activity budgets and prey consumption of sea otters (*Enhydra lutris kenyoni*) in Washington. Aquatic Mammals 34:393–401.	i
Watson, J. C. 1993. The effects of sea otter (*Enhydra lutris*) foraging on shallow rocky communities off northwestern Vancouver Island, British Columbia. Ph.D. Dissertation, University of California, Santa Cruz. 169 pp.	i
Watson, J. C. 2000. The effects of sea otters (*Enhydra lutris*) on abalone (*Haliotis* spp.) populations. Pages 123-132 *in*: workshop on rebuilding abalone stocks in British Columbia. Ed. A. Campbell. Canadian Special Publication of Fisheries and Aquatic Sciences. 130 pp.	i

WDFW (Washington Department of Fish and Wildlife). 2009. Washington Oiled Sea Otter Response Handbook, http://wdfw.wa.gov/publications/00302/wdfw00302.pdf	ii
WDFW (Washington Department of Fish and Wildlife). 2015. Protecting Washington's coastal population of sea otters from the increasing risk of oil spills. Unpubl. Rept., WDFW Habitat Program Oil Spill Team, Olympia, WA.	ii
White, C. L., K. L. Schuler, N. J. Thomas, J. L. Webb, J. T. Saliki, H. S. Ip, J. P. Dubey and E. R. Frame. 2013. Pathogen exposure and blood chemistry in the Washington, USA population of northern sea otters (*Enhydra lutris kenyoni*). Journal of Wildlife Diseases. 49(4):887-899.	i
White, C. L., E. W. Lankau, D. Lynch, S. Knowles, K. L. Schuler, J. P. Dubey, V. I. Shearn-Bochsler, M. Isidoro-Ayza and N. J. Thomas. 2018. Mortality trends in northern sea otters (*Enhydra lutris kenyoni*) collected from the coasts of Washington and Oregon (2002-15). Journal of Wildlife Diseases. 54(2). DOI; 10.7589/2017-05-122.	i
WSDOE (Washington State Department of Ecology). 2017. Vessel entries and transits for Washington waters, VEAT 2016. Publication 17-08-001, Washington State Department of Ecology, Olympia, Washington.	i

PERSONAL COMMUNICATIONS

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APPENDIX A. Population counts by year and segment of sea otters in Washington, 2000 to 2017[1].

	LaPush South Survey Segment			LaPush North Survey Segment			Combined				
Year	Independent	Dependent	Total	Independent	Dependent	Total	Independent	Dependent	Total	Comments	Pct. Dep.[2]
2000	200	0	200	304	0	304	504	0	504		
2001	184	3	187	326	42	368	510	45	555		8.82
2002	267	3	270	251	30	281	518	33	551		6.37
2003	364	1	365	290	17	307	654	18	672		2.75
2004	410	0	410	310	23	333	720	23	743		3.19
2005	432	5	437	329	48	377	761	53	814		6.96
2006	475	10	485	288	17	305	763	27	790		3.54
2007	749	15	759	322	39	366	1071	54	1125		5.04
2008	608	38	646	385	42	427	993	80	1073		8.06
2009	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No surveys, poor weather	n/a
2010	588	7	595	376	33	409	964	40	1004		4.15
2011	700	14	714	411	29	440	1111	43	1154		3.87
2012	800	12	812	276	17	293	1076	29	1105		2.70
2013	780	10	790	435	47	482	1215	57	1272		4.69
2014	1067	29	1038	506	44	462	1573	73	1646		4.64
2015	924	15	939	412	43	455	1336	58	1394		4.34
2016	1337	43	1380	365	61	426	1702	104	1806		6.11
2017	1560	58	1618	383	57	440	1943	115	2058		5.92

[1]Records obtained from annual Washington sea otter population survey reports from 2000 through 2017 (e.g. Jeffries et al. 2017).
[2]Dependents (pups) as a percentage of combined population count.

APPENDIX B. WDFW responses to public comments received during the 90-day public review period for the draft Periodic Status Report for the Sea Otter in Washington conducted from February 6 to May 9, 2018. The comments presented here are summaries of the remarks provided by one or more people.

Report Section	Comment and Response
General comments	1. I would like to see the sea otters continue to be protected.
	As outlined in Washington Administrative Code (WAC) 220-200-100, state threatened species remain protected wildlife.
	2. Sea otters should retain state endangered status. They are vulnerable to a number of factors that could impact a significant portion of Washington's population.
	WDFW believes that sea otters should be reclassified as state threatened for the reasons given in the periodic status review.

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

Periodic Status Reviews

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

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
1997 Aleutian Canada Goose
1997 Gray Whale
1997 Olive Ridley Sea Turtle
1997 Oregon Spotted Frog

Recovery Plans

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

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