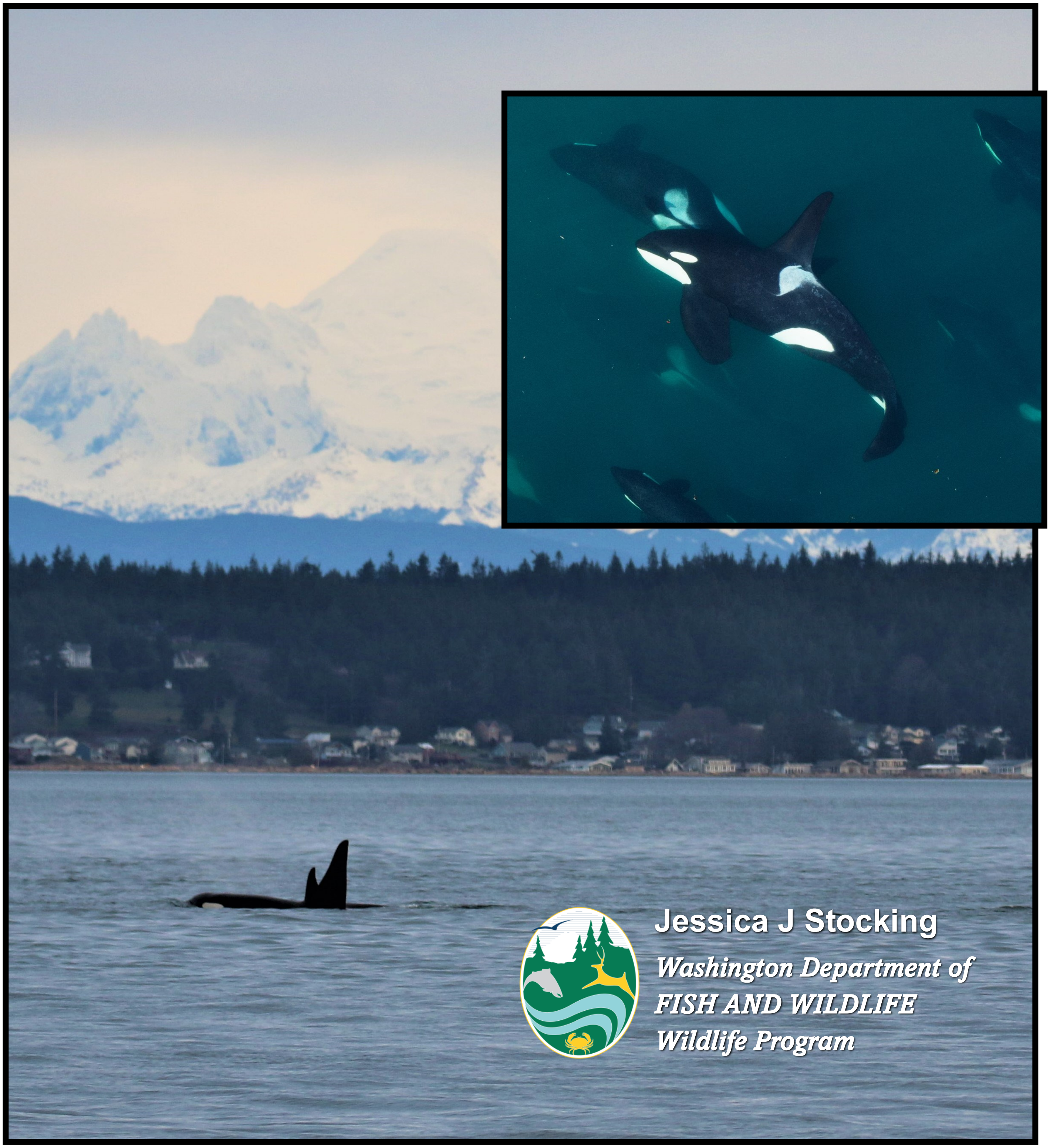
Periodic Status Review for the Orca



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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). The procedures include how species listings will be initiated, criteria for listing and delisting, a requirement for public review, the development of recovery or management plans, and the periodic review of listed species.

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

This is the Periodic Status Review for the Orca. It contains a review of information pertaining to the status of Orcas in Washington. It was available for a 90-day public comment period from 21 November 2023 through 18 February 2024. Comments received were considered during the preparation of the final periodic status review. The Department will present the results of this periodic status review to the Fish and Wildlife Commission at a meeting in March 2024.

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PERIODIC STATUS REVIEW FOR THE KILLER WHALE

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EXECUTIVE SUMMARY

Killer whales *(Orcinus orca)* are a large, black and white member of the dolphin family. The three ecotypes that frequent Washington waters, fish-eating Southern Residents, marine mammal-eating transients, and offshores, are distinguished primarily by prey selection and habitat use. Southern Resident killer whales (SRKW) were listed as federally endangered under the Endangered Species Act in 2005, and the species was listed as endangered in Washington State in 2004. As NOAA points out in its 5-year review for SRKW, some of the downlisting criteria have been met, but the population continues to shrink. As of the July 2023 census, only 75 individuals remain.

Many partners are acting to aid the recovery of SRKW. Primary stressors on the population include reduced prey availability and size, contaminants, disturbance from vessel noise and activity, and these have cumulative and interacting effects on the population. Additionally, small numbers of reproductively active individuals in the population over generations have led to inbreeding depression, which reduces the whales' resilience and has contributed further to population decline. Given the difficulty of isolating impacts from the multitude of stressors, efforts must be aggressive and multi-faceted. In 2018, Governor Inslee signed an executive order that included formation of a Southern Resident Orca Task Force to make recommendations for immediate and longer-term actions to ensure SRKW recovery. Those recommendations have helped galvanize support, partnerships, and funding, and management actions have increased as a result.

However, the main threats persist, some are increasing, and recovery won't be evident for years to decades. In addition, there are the growing stressors of climate change and human population growth on the ecosystem. Due to the small population of Southern Resident killer whales, long maturation and recruitment times, and continued threats, we recommend the species maintain endangered status in Washington.

INTRODUCTION

This periodic status review summarizes the biology, population status, threats, and recent management actions directed at the three main populations of killer whales (*Orcinus orca)* occurring in Washington's marine waters. It also assesses whether the species should retain its current endangered status under state law. This document is a consolidated update to the 2016 periodic status review (Wiles 2016), with substantial updates regarding research on local animals and expanded management activities.

This document therefore serves as the support for WDFW's listing recommendation to the Fish and Wildlife Commission, which issues final listing decisions, and is not intended to be a comprehensive species account. Washington State assesses status at the species level, not at the Distinct Population Segment (DPS) level, as in the federal Endangered Species Act. Because of the precarious Southern Resident killer whale (SRKW or Southern Resident) population and the ongoing threats, we recommend that this species retain its endangered status in Washington.

DESCRIPTION AND LEGAL STATUS

Killer whales are the world's largest dolphin and have a striking black-and-white appearance. Males average 6-8 m in length and 3,600-5,400 kg in weight; females average 5-7 m and 1,300-2,700 kg. Males have larger dorsal fins, pectoral flippers, and tail flukes than females. More detailed descriptions appear in Shirihai and Jarrett (2006) and Jefferson et al. (2008).

Figure 1. Killer whales. Photo courtesy NOAA.

Three ecotypes of killer whale occur in the northeastern Pacific Ocean: resident, transient, and offshore, differing in genetics, behavior, diet, appearance, and habitat (Dalheim et al. 2008, Riesch et al. 2012, Ford and Ellis 2014). A global genetic study of the species found evidence for divergent lineages warranting subspecies designation (Morin et al. 2010). At the time of this report, the resident and transient ecotypes in the eastern North Pacific are considered unnamed subspecies (Committee on Taxonomy 2022). Additionally, multiple discrete populations (also referred to as stocks) are recognized for those two ecotypes (Allen and Angliss 2015, Carretta et al. 2022, Muto et al. 2022). The ecotypes can be distinguished through morphometrics, especially the shapes of the dorsal fin and eyepatch, and to a lesser degree the saddle patch (Emmons et al. 2018). While the ecotypes share some habitat, they exhibit resource partitioning (Emmons et al. 2021) and are not known to interbreed. This report addresses Southern Resident, West Coast Transient (also known as Bigg's killer whales), and Eastern North Pacific offshore stocks. The Northern Resident killer whale population typically uses waters of British Columbia and Southeast Alaska (Ford et al. 2000), and is listed in Canada as threatened. These animals are observed infrequently in Washington (but see Emmons et al. 2021) and are not a focus of this report.

The species has been listed as state endangered in Washington since 2004. Federally, the species is protected under the Marine Mammal Protection Act, and the Southern Resident DPS is the only population of the species listed as endangered under the Endangered Species Act (NMFS 2005). This report leans heavily toward discussion of the Southern Resident population, as it is the primary determinant of this recommendation and previous listing decisions for the species in Washington State.

DISTRIBUTION

Killer whales have a cosmopolitan distribution, giving the species the largest geographic range of any marine mammal. They are generally more common in coastal locations and at higher latitudes than in pelagic waters and tropical regions (Forney and Wade 2007). The Southern Residents are found coastally from central Southeast Alaska to central California (NMFS 2008, Carretta et al. 2022), and the West Coast Transients (hereafter, transients) occur from Southeast Alaska to southern California (Muto et al. 2022). Both the Southern Residents and transients regularly use the inner marine waters of Washington and British Columbia, whereas offshores rarely do so (Ford and Ellis 1999, Ford et al. 2000). Offshore killer whales range from the eastern Aleutian Islands to southern California and probably into Mexico, the largest range of any killer whale population in the northeastern Pacific (Dahlheim et al. 2008, Ford et al. 2014).

NATURAL HISTORY

Killer whales are highly social marine mammals with complex social dynamics. Matrilines are the basic social unit within most populations and contain a female and her descendants of both sexes from up to three subsequent generations. Pods are comprised of groups of related matrilines and commonly hold from 2 to 35 individuals, but may occasionally reach 50 or more animals depending on the population (Dahlheim and Heyning 1999, Baird 2000, Ford et al. 2000). Larger aggregations of up to several hundred whales from multiple pods of the same ecotype (referred to as super pods) sometimes form temporarily, usually near seasonal concentrations of prey, during which time social interaction increases (Olsen et al. 2020). Vocal communication is particularly advanced in killer whales and is an essential element of the species' complex social structure (Riesch et al. 2012).

Diet and foraging. Killer whales are a top predator of marine ecosystems. The species as a whole is versatile in its prey selection, with more than 120 species of fish, marine mammals, cephalopods, and sea turtles consumed (Ford and Ellis 2006). However, regional ecotypes usually possess specialized foraging strategies that focus on particular prey species, especially marine mammals or certain fish (Ford and Ellis 2014). To serve as a major type of prey for an ecotype, the prey must be reliably encountered and have a relatively high energy value.

Southern Residents. All populations of resident killer whales are fish-eaters, generally preferring salmonids, and use echolocation to find prey. Chinook salmon (*Oncorhynchus tshawytscha*) is the primary prey item for Southern Residents year-round, accounting for nearly 100% of their diet during the spring (Hanson et al. 2021) and early summer (Ford et al. 2016), then declining to around 50% by late summer and fall when other salmonid and non-salmonid fishes dominate the diet (Ford et al. 2016, Warlick et al. 2020, Hanson et al. 2021). Chinook salmon consumption includes fish from several stocks, with four river systems accounting for more than 90% of the samples from whales foraging along the outer coast from northern California to northern Washington (Hanson et al. 2021). When Chinook salmon are less abundant, SRKW diet is more diverse (Hilborn et al. 2012, Ford et al. 2016, Hanson et al. 2021).

Transients. Transient killer whale diet is comprised of a variety of marine mammal species and squid. Harbor seals (*Phoca vitulina*) represent about half or more of the prey captured or attacked in British Columbia, Washington, and Southeast Alaska (Baird and Dill 1996, Ford et al. 1998, 2007, London 2006). Steller sea lions (*Eumetopias jubatus*), California sea lions (*Zalophus californianus*), Dall's porpoises (*Phocoenoides dalli*), harbor porpoises (*Phocoena phocoena*), and Pacific white-sided dolphins (*Lagenoryhncus obliquidens*) are other regular parts of the diet (Ford et al. 1998, 2007, Ternullo and Black 2002, Dahlheim and White 2010). Large whale calves (e.g., gray whale [*Eschrichtius robustus*] and minke whales [*Balaenoptera acutorostrata*]) are occasionally killed (Ford and Ellis 1999, Ford et al. 2005), as are squid (Hanson and Walker 2014) and seabirds (Ford et al. 1998). Transients vocalize minimally while foraging to avoid detection by their marine mammal prey (Barrett-Lennard et al. 1996, Deecke et al. 2005).

Offshores. Evidence suggests that offshore killer whales feed primarily on sharks (Dahlheim et al. 2008, Ford et al. 2011, Raverty et al. 2020) and preferentially on the high-fat liver (Ford et al. 2014). Pacific sleeper sharks (*Somniosus pacificus*) are the most frequently documented prey, along with other sharks and teleost fishes a smaller portion of the diet.

Home range and movements. Many killer whale populations inhabit relatively large year-round home ranges that can approach or exceed 100,000 km^2 in size (Baird 2000). Pods commonly travel extensively over the course of a year, but frequently inhabit relatively small core areas for periods of a few weeks or months where favored prey concentrate seasonally (e.g., Olson et al. 2018). Animals can travel up to 160 km per day when swimming between areas (Erickson 1978, Baird 2000).

Southern Residents have historically spent summer months in the central Salish Sea, moving southward in Puget Sound during fall and winter, coinciding with increased foraging on chum salmon (*Oncorhynchus keta*) during that time (Olson et al. 2018; Hanson et al. 2021). In some recent years, however, summer sightings in the Salish Sea have been reduced and delayed, leading to speculation that the habitat is becoming less suitable as prey availability decreases (Shields et al. 2018; Ettinger et al. 2022). Less is known about the winter activity of SRKW, although one study predicted extensive use of coastal WA (Hanson et al. 2018).

Dalheim et al. (2008) documented 81 photographic matches of individual offshore killer whales using waters of Alaska and California. Two individual animals traveled over 4300 km one-way between Dutch Harbor, Alaska and southern California, and the ecotype is presumed to range much more widely than resident and transient killer whales (Dalheim et al. 2008).

Reproduction and survival. The species is long-lived and has a low reproductive rate, with an eighteen-month gestation period and one calf per birth. Mating is polygamous (Dahlheim and Heyning 1999). On average, resident killer whale females produce their first surviving calf around 10 years of age, and the interval between calves averages about 5-6 years (Olesiuk et al. 2005). Females stop reproducing typically by their 40s but can live into their 90s (Olesiuk et al. 1990). Males attain sexual maturity on average at 12-13 years, and their reproductive success increases with age (Ford et al. 2018). As many as two-thirds of SRKW pregnancies are not successful, with failures often occurring late in gestation or immediately after birth (Wasser et al. 2017). Post-reproductive females may provide benefit to offspring (Tennessen et al. 2023) and grandoffspring, particularly in years of low to moderate salmon abundance (Nattrass et al. 2019). Body condition can be an early indicator of survival, with individuals in the lowest 20th percentile having mortality probabilities 2-3 times higher than whales in better condition (Stewart et al. 2021).

POPULATION AND HABITAT STATUS

Photo-identification is the preferred method of surveying killer whale populations around the world. Individual animals can be identified through distinguishing physical characteristics, resulting in precise information on population size, demographic traits, and social behavior (Hammond et al. 1990).

Southern Residents. Southern Resident killer whales had a minimum historic population of 140 individuals. After live-captures for captive display in the 1970s, the population was dramatically reduced. Since that time, the trajectories of the three pods have differed, with J- and K-pods relatively consistent and L-pod more variable and declining. Recently, photogrammetry has become a valuable tool for measuring health of individuals over time – to track body condition, nutritional stress, and pregnancy, and as a management tool for identifying whales that may need additional protections (Fearnbach et al. 2019, Stewart et al. 2021). In 2020, over two-thirds of the population was evaluated for body condition, with J- and K-pods generally demonstrating improved body condition and L-pod declining since 2017-2018 (H. Fearnbach, pers. comm.).

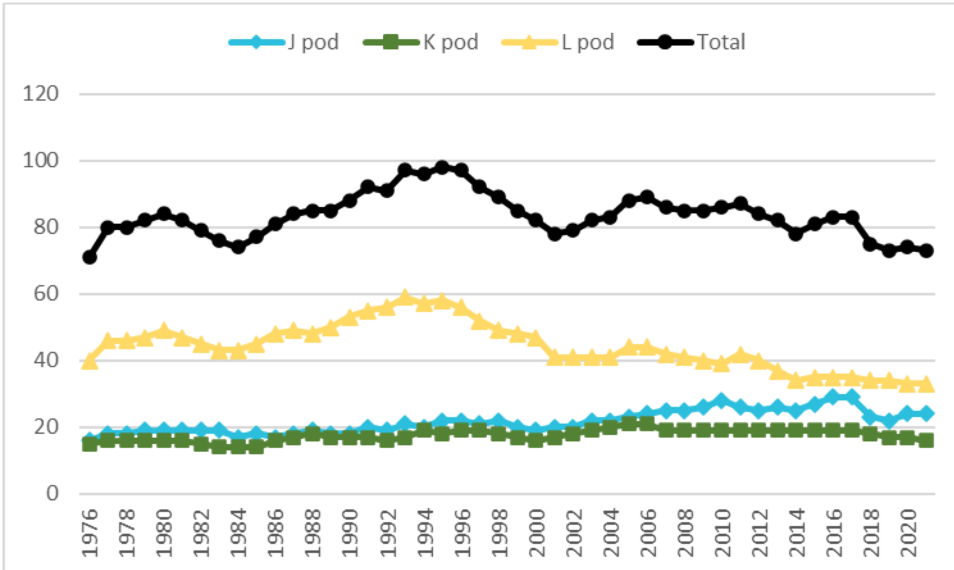

Figure 2. Population size of Southern Resident killer whales, 1974-2021. Data were obtained through photo-ID surveys and provided by Brad Hanson at NOAA (July 2022).

Transients. The West Coast Transient stock of killer whale ranges along the west coast of the United States and Canada from the Gulf of Alaska to California. Its minimum population estimate is 349 (Muto et al. 2022). There is evidence that the transient population is increasing its use of the Salish Sea in recent years (Shields et al. 2018).

Offshores. The most recent photo-ID mark-recapture effort for the offshore population was conducted between 1998 and 2012 and estimated 300 whales and a stable population trend (Ford et al. 2014).

FACTORS AFFECTING CONTINUED EXISTENCE

As SRKW constitute the population of concern for this species in Washington, this section will focus exclusively on them, acknowledging that some factors may also impact other ecotypes. SRKW are affected by three primary threats: inadequate prey availability (particularly Chinook salmon; see Diet and Foraging), elevated levels of environmental contaminants, and vessel noise and disturbance (NMFS 2008; 2021b). Oil spills, disease, inbreeding depression and climate change pose substantial additional risks. Slow maturation and low reproductive rate of killer whales means the species is slow to recover from human-related mortality and other impacts (Matkin et al. 2014, Lacy et al. 2017, Murray et al. 2021).

Adequacy of Regulatory Mechanisms

All populations in Washington receive protection under the federal 1972 Marine Mammal Protection Act (MMPA), which generally prevents the harassing, hunting, capturing, killing (or attempting to harass, hunt, capture, or kill) of these animals (NMFS 2008). Additionally, SRKW constitute a Distinct Population

Segment that was listed as endangered under the federal Endangered Species Act in 2005 (70 FR 69903, November 18, 2005), while the transient and offshore populations are not federally listed. Washington State evaluates listing decisions at the species level, not at smaller units, such as populations, subspecies or DPSs, and killer whales were listed as endangered in Washington State in 2004 (WAC-232-12-014). State law also prohibits the hunting, possession, malicious harassment, and killing of the species (RCW 77.15.120). Killer whales also receive protection under WAC 232-12-064, which prohibits the capture, importation, possession, transfer, and holding in captivity of most wildlife in the state. In September 2021, NOAA's National Marine Fisheries Service (NMFS) announced an expansion of the SRKW Critical Habitat to include 15,910 square miles (41,207 square kilometers) of coastal habitat from the US-Canada border to southern California (86 FR 41668).

Canada's federal Species at Risk Act (SARA) classifies Southern Resident killer whales as endangered and the transient and offshore populations as threatened. Under this regulation, the killing, harassment, and possession of killer whales are prohibited. Critical habitat has been established for the Southern Residents in Canada (DFO 2018) and has been recommended for the transients (Ford et al. 2013).

In spring 2021, NOAA released their Species in the Spotlight Action Plan, highlighting a subset of recovery plan actions for the 2021-2025 window. Included in those actions are continued protection from vessel impacts, targeted conservation of priority prey stocks, improved health monitoring, and increasing public awareness (NMFS 2021a). In January 2022, NMFS published its five-year review for the SRKW DPS (NMFS 2021b). The review details progress of the SRKW relative to the downlisting and delisting criteria set forth in the 2008 Recovery Plan for the population (NMFS 2008) and complements this status review, providing detail for much of what is addressed briefly here. Despite some of the downlisting criteria having been met, NMFS recommends retaining the endangered classification for the SRKW DPS (NMFS 2021b).

Overall, regulatory mechanisms have not yet been sufficient for Southern Resident recovery (See Population and Habitat Status, NMFS 2021b). Many large whale species in the North Pacific and elsewhere rebounded after passage of the MMPA, but Southern Residents have not shown a similar response, suggesting additional recovery actions are necessary. Recovery will require long-term efforts, and population-level effects of recovery actions would not be confirmed for many years (Murray et al. 2021). It is recognized that all of the threats to killer whales cross political borders, and transboundary management partners (e.g., NOAA, TC, DFO, WA state agencies) are cooperating to align recovery actions where practicable.

Other Factors

Washington's Governor Inslee issued an executive order in 2018, directing state resources toward SRKW recovery. The order also assembled the Southern Resident Orca Task Force, bringing together tribal, federal, state, and local representatives with members of private and non-profit sectors. That two-year effort resulted in a comprehensive report detailing 49 recommendations (Recommendations; Southern

Resident Orca Task Force 2019), targeting the three main categories of threats identified in the 2008 Recovery Plan (NMFS 2008). Progress on the Recommendations can be tracked through the Governor's Salmon Recovery Office at orca.wa.gov.

Prey availability. Southern Resident killer whales have experienced widespread reductions in their primary prey, Chinook salmon, throughout much of their range since the mid-19th century due primarily to degradation of aquatic ecosystems resulting from modern land use, overharvesting, hatchery production, and other causes (National Research Council 1996, Gustafson et al. 2007, Myers 2011, Ward et al. 2013). Several stocks of salmon found in SRKW diet are also compromised, many listed under the Endangered Species Act. Reductions in Chinook salmon abundance have been greatest in the Columbia River and California's Central Valley, and less severe but still significant elsewhere in the range, including the Fraser River and Puget Sound (Myers 2011). Chinook originating in these four river systems make up over 90% of diet samples collected from SRKW in coastal areas (Hanson et al. 2021).

In addition to declines in abundance, many Chinook populations across the West Coast have experienced long-term reductions in body size – and thus caloric value – and age and altered timing of runs (NMFS 2008, Myers 2011, Ohlberger et al. 2019). This has further contributed to both the lower availability of prey biomass and changes in seasonal prey occurrence for SRKW. Both Northern and Southern Residents appear to preferentially prey on larger Chinook (Ford and Ellis 2006, Ohlberger et al. 2019). Recent work found that abundances of Chinook in Fraser River and Salish Sea stocks were most closely correlated with J-pod body condition, while L-pod body condition was weakly correlated with Puget Sound Chinook abundance (Stewart et al. 2021). The same study found that K-pod body condition was relatively constant and was not predicted by any Chinook abundance parameters.

Contaminants. Like other marine mammals, killer whales are susceptible to a variety of environmental contaminants that bioaccumulate upward through marine food webs to high-level predators. Southern Resident, transient, and offshore killer whales are among the world's most contaminated marine mammals (Ross et al. 2000, Ylitalo et al. 2001, Krahn et al. 2007, Alonso et al. 2014, Lawson et al. 2020). This reflects the high trophic levels of the three populations, their more urbanized distributions along the West Coast, and their long lifespans. Contaminants include organochlorines (especially polychlorinated biphenyls [PCBs] and dichloro-diphenyl trichloroethane [DDT] and its derivatives), polybrominated diphenyl ethers (PBDEs), trace metals (e.g., mercury, copper, selenium, zinc), and other "contaminants of emerging concern," or CECs (O'Shea 1999, O'Hara and O'Shea 2001, Mongillo et al. 2016, Lee et al. 2023). Organochlorines and PBDEs enter marine ecosystems through atmospheric transport, runoff, and point source pollution; they persist in the environment for very long periods and accumulate in fatty tissues. High levels of organochlorines and PBDEs in marine mammals can interfere with reproduction, immune and endocrine function, and gene expression, whereas elevated concentrations of metals can variously produce neurotoxic effects and harm organ function (O'Hara and O'Shea 2001, Buckman et al. 2011, Mongillo et al. 2016). Resulting effects from contaminants are typically chronic and sublethal, but nevertheless may have population-level impacts. Risk in killer whales is probably highest during periods of food scarcity, when animals draw upon blubber reserves, thereby releasing fat-soluble contaminants into the full body and perhaps causing a decline in immune function

(Krahn et al. 2009, Lundin et al. 2016). As in other marine mammals, female killer whales transfer much of their fat-soluble contaminant burden to their calves (especially firstborn calves) during nursing and therefore generally have lower to much lower levels than their weaned offspring or adult males of similar age (Ross et al. 2000, Ylitalo et al. 2001, Krahn et al. 2009, Mongillo et al. 2016, Hall et al. 2018). Finally, the possibility of synergistic effects of toxics, while not well understood, cannot be discounted (Mongillo et al. 2016).

Exposure to petroleum hydrocarbons released into the marine environment via oil spills and other discharge sources represents another potentially serious health threat for killer whales in the northeastern Pacific. Oil spill risk in Washington's marine habitats (including Haro Strait, an area frequently used by Southern Residents) is expected to increase in the next several decades with tanker traffic due to expanded oil and natural gas production in the interior of North America and as offshore oil and gas development likely begins off Vancouver Island. Specifically, substantial increases in Salish Sea marine traffic are anticipated in association with the Transmountain Pipeline and multiple port expansion projects in Canada.

Environmental pollutants may also affect the Southern Residents by damaging prey populations. Research has linked elevated concentrations of metals, PBDEs, DDTs, PCBs, petroleum hydrocarbons and other contaminants in urban runoff to reduced growth, increased susceptibility to disease, and reduced survival of Chinook and other salmon (e.g., Meador et al. 2006, Arkoosh et al. 2010, Incardona et al. 2015, Meador 2014, Spromberg et al. 2016, Arkoosh et al. 2018, Peter et al. 2018, Peter et al. 2020, Lundin et al. 2021). Recent identification of an antioxidant compound in vehicle tires was recently identified as the responsible agent for massive acute mortality events in coho salmon (*Oncorhynchus kisutch*); Tian et al. 2020]) and Chinook (Lo et al. 2023) salmon, and research is being done to further understand the threats.

The degree to which microplastics may be a concern for killer whales is largely unknown. Modeled microplastics accumulation overlaps SRKW high-use areas (Sorensen 2021), and microplastics have been found in killer whale feces (Harlacher 2020); however, the potential for trophic magnification may be low (Alava 2020, Miller et al. 2020).

Vessels. Regulation to reduce vessel impacts has been identified as a critical piece of SRKW recovery (Ferrara et al. 2017). Boats can cause direct and indirect disturbance to killer whales. One study found evidence of human interaction in all age classes of 53 stranded killer whales between 2004 and 2013, and six individuals had traumatic injury consistent with vessel strikes (Raverty et al. 2020). In addition to the potential for direct strikes, killer whales in the northeastern Pacific are exposed to increasing levels of underwater disturbance from vessels and numerous other anthropogenic sources (e.g., sonar from depth finders and military training activities, seismic surveys, and marine construction; NMFS 2008). Underwater noise can cause stress by three mechanisms: behavior, disruption of activities such as resting and foraging; communication, impacting socialization and coordinated hunting; and echolocation, reducing foraging efficiency. (NMFS 2008, Heise et al. 2017). Vessels as far as 400 meters (437.4 yards) from the whales have the potential to reduce echolocation efficacy, altering foraging activity and success for adults of both sexes (Holt 2009, Lusseau et al. 2009, Williams et al. 2009, Holt et al. 2021a, Holt et al. 2021b). Several studies have documented reduced foraging and increased traveling and surface-active behaviors in the presence of motorized and non-motorized vessels, which increases energetic costs to the whales (Holt et al. 2009, Lusseau et al. 2009, Noren et al. 2009, Williams et al. 2009, Bubac et al. 2021). A recent study found that females switched from foraging behavior to traveling behavior more often than males in the presence of vessels (Holt et al. 2021a), which could have population-level effects. In addition to the number of vessels and their distance to whales, speed plays an important role in the amount of noise received by the whales (Houghton et al. 2015; Holt et al. 2017; Holt et al. 2021b).

Large ships also emit sounds that overlap killer whale echolocation frequencies (Veirs et al. 2016), which can reduce foraging probabilities (Williams et al. 2021). Accordingly, models predict that strategically decreasing ship speeds in SRKW habitat can reduce lost foraging time (Joy et al. 2019). Ships in Canada showed a high level of compliance with slowdown zones, exclusion areas, and rerouting of large ships (Burnham et al. 2021). On the contrary, recreational boaters around killer whales have a high level of non-compliance (Fraser et al. 2020), often self-reportedly attributed to lack of awareness of the laws (Seely et al. 2016, Frayne 2021).

Climate change. Climate change is expected to compound the stressors already impacting marine mammals, including killer whales. Ocean warming and acidification alter biotic and abiotic processes, including food webs, in turn potentially altering whale distribution, phenology and body condition. Increasing temperatures may be associated with increases in infectious diseases (Burek et al. 2008) and disease spread. Harmful algal blooms (McCabe et al. 2016) are predicted to increase in frequency and intensity (Khangaonkar et al. 2019), and while the toxins are known to bioaccumulate, potential effects on killer whales are not yet well understood.

Small population size. Small population size, inbreeding and demographic stochasticity could affect Southern Residents. The number of reproductively viable females in the population is small, limiting reproductive potential. Ford et al. (2018) found that two males sired 52% of the sampled offspring between 1990 and 2017. Shorter life spans associated with highly inbred SRKW females has reduced the average lifetime number of offspring produced from 2.6 to 1.6 (Kardos et al. 2023). Inbreeding is therefore a positive feedback loop, causing the small SRKW population to be less resilient and limiting recovery capacity.

MANAGEMENT ACTIVITIES

Management activity in Washington focuses primarily on Southern Residents, although many actions will benefit other populations of killer whales and cetaceans more broadly. This section focuses on management actions targeting SRKW recovery. Because killer whales are a long-lived top predator, many pathways influence populations, and demographic changes are infrequent and difficult to attribute to any action, potential recovery will require a sustained, multi-faceted approach. Partners across agencies, tribal governments, local governments, and non-governmental organizations have poured resources into recovery efforts. In summer 2021, a Washington State Orca Recovery Coordinator position was created in the Governor's Salmon Recovery Office (GSRO) to track and support activities across state agencies and beyond. One goal of that position is to report on the progress of the Task Force's Recommendations. Several aspects of the expansive and coordinated recovery efforts are ongoing and dynamic, and an attempt to publish specific progress here would become quickly outdated. This report highlights broad efforts implemented or expanded since 2016; for greater detail and updated progress on recovery actions, refer to the NMFS 5-year review (NMFS 2021b) and the GSRO website.

Prey availability. Much of the recovery strategy focuses on supporting increased prey availability, i.e., Chinook salmon. Many stocks of salmonids that occur in the SRKW range and could serve as prey are also threatened or endangered, and salmon have cultural and economic value beyond their importance to SRKW. The state has focused on producing more fish, emphasizing habitat restoration and protection, supporting the salmon's food web, and measuring and limiting other predation threats to salmon.

NOAA and WDFW, with input from tribal governments and other partners, developed a list of priority prey stocks for SRKW (NOAA and WDFW 2018), which drives prioritization and funding of recovery efforts toward those stocks most likely to benefit SRKW. Funding sources, such as the Salmon Recovery Funding Board, have then been able to target increased investments toward important SRKW Chinook stocks. Additionally, in 2019, the Pacific Fishery Management Council (PFMC) formed a workgroup including tribal, federal, state, and industry partners to assess the potential impacts of PFMC salmon fisheries on SRKW (PFMC 2020). This resulted in Amendment 21 of the Pacific Salmon Fishery Management Plan, approved by NFMS in August of 2021, which limits potential effects of fisheries on SRKW prey availability through quotas and closures triggered by indicators of low Chinook abundance (86 FR 51017).

State and federal partners have worked to increase spring spill over dams in the Columbia River to enhance salmon survival. Hatchery production has increased dramatically following the Task Force Recommendations. Hatchery fish likely contribute substantially to the SRKW prey base (Hanson et al. 2010) and can be a mitigating force while other recovery actions take effect.

The Brian Abbott Fish Barrier Removal Board evaluates fish passage projects, expanding access for migrating salmon. Reports in 2020 and 2021 cited over 2500 potential barriers to priority prey stocks of Chinook salmon passage; those locations may be targeted for restoration. Habitat restoration permitting has been streamlined and received additional staffing capacity, in hopes of speeding restoration projects. Funding has been appropriated for restoration activities targeting key Chinook runs and other salmonid populations. Several large habitat restoration projects are currently planned or underway, including in the Snohomish and Nisqually watersheds. Finally, Puget Sound Partnership's Puget Sound Acquisition and Restoration Fund and WDFW's Estuary and Salmon Restoration Program provides funding and technical assistance to organizations working to acquire and restore shoreline and nearshore habitats that are important to salmon and other species in Puget Sound. Other grant programs include the cross-agency Habitat Strategic Initiative and PSNERP, a partnership with the U.S. Army Corps of Engineers.

Because salmonids themselves are predators, efforts further down the food chain could also contribute to recovery of Chinook and other salmonids. Washington Department of Natural Resources (WDNR) and WDFW have recently increased focus on forage fish – a catch-all term for small, schooling fishes – as well as their prey, zooplankton. Survey efforts are increasing, as are protections for shorelines, critical spawning habitat for forage fish. Extensive restoration activity has been focused on nearshore beach habitat where forage fish spawn.

Recent studies have focused on predation of salmonids by other piscivores, especially pinnipeds (e.g., seals and sea lions). Initial modeling efforts estimated a large proportion of salmon eaten by pinnipeds relative to other sources of mortality such as killer whale predation and fishing (Chasco et al. 2017, Thomas et al. 2017). Subsequent research has challenged the assumptions of the early studies, refining our understanding of the effect of predation on fish populations (Nelson et al. 2021). WDFW has also adopted rules to increase suppression of fish predators and competitors, including non-native bass, walleye, channel catfish, and northern pike.

Contaminants. Harmful contaminants can enter the water through direct discharge, wastewater and importantly, stormwater runoff. The Puget Sound Partnership has included five Indicators for contaminants in fish and shellfish in their Vital Signs program, including one each for adult and juvenile salmon. The Washington Department of Ecology (WDOE) was directed through the Pollution Prevention for Healthy People and Puget Sound Act of 2019 (RCW 70A.350.900) to protect people and the environment from toxic chemicals in consumer products. To this end, WDOE has partnered with researchers at University of Washington (UW) Tacoma to identify contaminants of emerging concern. Additionally, WDOE, Washington Department of Transportation, along with UW and Washington State University researchers, are working to identify priority areas affected by 6PPD or similar chemicals and develop management practices to reduce impacts. WDOE is responsible for reporting to the legislature and determining and implementing appropriate regulatory actions. The Products Replacement Program has received funding to provide incentives to Washington businesses to reduce or replace toxic chemicals through technology, disposal programs, and guidelines. In 2016, The Washington State Attorney General's Office filed a lawsuit against Monsanto Corporation for the production and release of PCBs, resulting in a $95 million settlement that the Attorney General recommended be used for mitigation and remediation. Using funds from this Monsanto settlement, the Washington State Legislature subsequently directed WDOE and WDFW to work together to identify sources of PCBs to the Puget Sound ecosystem, and make recommendations for expediting PCB remediation to help recover the health of killer whales and their food web as quickly as possible.

To reduce the likelihood and impacts of an oil spill across the Strait of Juan de Fuca, Washington law was amended in 2019 to require tug escorts for small oil-transport vessels (RCW 88.16.190). Additionally, the Northwest Wildlife Response Plan has a section specifically for killer whale response: identifying partners, resources and the practicality of available measures. Trainings and spill response drills are ongoing and include a hazing plan to deter killer whales from approaching the area of a spill. Finally, WDNR works to clean up derelict and abandoned vessels and structures that can release hazardous substances into the marine environment.

SRKW were threatened with exposure to diesel oil sheens following the sinking of the fishing vessel *Aleutian Isle* in August 2022. The vessel sunk in the center of the SRKW historical summer range in the Haro Strait just off the west side of San Juan Island near Sunset Point. For several weeks significant surface sheen of diesel oil periodically escaped from the fuel tanks of the submerged vessel. After activation of the Wildlife Branch for oil spill response the position of SRKW were extensively monitored with assistance of Soundwatch, Orca Network, Pacific Whale Watch Association and U.S. and Canadian hydrophone networks. Joint US and Canadian deterrence teams consisting of multiple vessels were trained and deployed to deter any approaching killer whales from the sheen areas. Fortunately, SRKW were never observed entering the sheen areas and no exposure is suspected from the event. There is a task force in place to make recommendations on deterrence efforts in the future (T. Galuska, pers. comm.).

Vessel disturbance. Vessel disturbance has been identified as a stressor that can be lessened with immediate benefit to the whales. In 2019, the Washington State Legislature established new laws for operating vessels around SRKW. These included increasing the distance required between vessels and SRKW, as well as instituting a 7-knot speed limit within a half nautical mile. Additionally, WDFW was tasked with developing a Commercial Whale Watching Licensing Program and associated rules around the viewing of SRKW. This program was implemented in 2021 and includes rules designed to increase the number of foraging hours without commercial whale-watching presence. Limits are placed on the number of vessels around SRKW and the viewing hours per day and months in the year. Additionally, young calves and adults determined to be otherwise vulnerable (e.g., pregnant or malnourished) are excluded from commercial viewing opportunities at closer than one-half nautical mile. WDFW is required to evaluate the success of the vessel regulations around SRKW, in terms of compliance, vessel behavior, and whale behavior, and provide reports and recommendations to the state legislature in late 2022, 2024, and 2026. The 2022 report was submitted to the legislature in November. It compiled the best available science, feedback from stakeholder focus groups, and responses from a public survey, ultimately recommending that all vessels be restricted from operating within one-half nautical mile of SRKW. NMFS has begun the scoping process to evaluate the adequacy of regulations surrounding SRKW in inland WA waters (84 FR 57015).

Transport Canada has been testing out and refining restrictions on small vessel activity to benefit SRKW. At the time of this publication, the restrictions have taken the form of interim measures, reviewed and modified annually. These include interim sanctuary zones in which vessel activity is prohibited in key foraging areas from June to November, reduced fishing opportunities, and a sustainable whale watching agreement in which commercial operators agree not to approach SRKW in exchange for a relaxed distance rule around transient killer whales.

Much of the challenge of regulating vessel activity around SRKW or any marine mammal involves alerting vessel operators to the presence of an animal, so that the regulations can be effective at reducing disturbance to the animals. San Juan County Marine Resources Committee introduced a Whale Warning Flag for boaters to indicate to one another when whales are nearby. Several efforts are underway to collate SRKW sightings and transfer information to ferries and large ships in order to reduce impacts and collision risk. The Whale Report Alert System (WRAS) was developed by the Ocean Wise Research Institute for that purpose, and it has been extended and adopted by Washington State Ferries and Puget Sound Pilots. Reporting SRKW locations to the WRAS via the WhaleReport app is a requirement for commercial whale watching license holders, and WDFW is training on-the-water staff to contribute sightings as well. Additionally, its use is under consideration by the U.S. Navy.

The ECHO program in Canada and sister Quiet Sound program in U.S. waters focus on reducing disturbance and risk from ships transiting through SRKW Critical Habitat. Voluntary slow-downs of large ships in Canada have shown reductions in ambient noise within the frequencies that overlap SRKW communication (Joy et al. 2019, MacGillivray et al. 2019, Burnham et al. 2021), which is predicted to increase SRKW foraging activity (Williams et al. 2021). Quiet Sound oversaw a voluntary slow-down program for large commercial vessels in Puget Sound in the fall/winter of 2022-23, which saw a high level of participation and resulted in an average 45% reduction in noise pollution, including a reduction in noise in the frequencies used for killer whale echolocation and communication (R. Aronson, pers. comm.).

The Be Whale Wise campaign, established in 2001 and coordinated through The Whale Museum in Friday Harbor, WA, provides guidance for boaters in the presence of marine mammals. There was an increase in communications of the Be Whale Wise guidance in summer 2021 to raise recreational boater and non-boating public awareness, particularly around changes in laws and protective measures, as well as whale health and reproductive status (e.g. pregnancies, births). Associated on-the-water programs to provide outreach materials and document boater and whale behavior during the core summer boating season include Soundwatch (U.S.) and Straitwatch (Canada). Additionally, Washington State Parks added orca protection to their boater education curriculum and associated testing in 2021.

Finally, the Washington Department of Ecology, in conjunction with GSRO and Puget Sound Partnership, are developing an optional checklist and guidance document to supplement the State Environmental Protection Act checklist to include potential impacts to SRKW.

Strandings. The partners involved in the West Coast Marine Mammal Stranding Network determine causes of morbidity and mortality, track new and existing diseases and parasites, and monitor toxins and contaminants in marine mammals. This group organizes oil spill response, preparedness, and trainings and responds to entanglements and strandings, including for Southern Resident killer whales.

RECOMMMENDATION

There has been much focus on killer whale recovery since the 2016 status review, with the Governor's Southern Resident Orca Task Force and resulting efforts to implement its recommendations. However, due to the continued depleted state of the Southern Resident population, as well as the ongoing threats in all categories, we recommend retaining killer whale as Endangered.

REFERENCES CITED

The references cited in the Periodic Status Review for the Orca 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.

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:

i	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

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PERSONAL COMMUNICATIONS

Tara Galuska
Orca Recovery Coordinator
Governor's Salmon Recovery Office
Recreation and Conservation Office

APPENDIX A: PUBLIC COMMENT

WDFW received 130 comments during the public comment period (November 21, 2023 through February 18, 2024). One hundred nineteen expressed support for our listing recommendation. One comment expressed support for listing the Southern Resident population but not the other populations found in the state. At this time, Washington does not have a mechanism to support a DPS separately (WAC 220-610-110). Ten comments did not directly address the listing recommendation.

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

Periodic Status Reviews

2024 Northern Spotted Owl
2024 Mardon Skipper
2023 Western Gray Squirrel
2023 Woodland Caribou
2023 Columbian White-tailed Deer
2022 American White Pelican
2022 Brown Pelican
2022 Snowy Plover
2022 Cascade Red Fox
2021 Ferruginous Hawk
2021 Oregon Vesper Sparrow
2021 Steller Sea Lion
2021 Gray Whale
2021 Humpback Whale
2021 Greater Sage-grouse
2020 Mazama Pocket Gopher
2019 Tufted Puffin
2019 Oregon Silverspot
2018 Grizzly Bear
2018 Sea Otter
2018 Pygmy Rabbit
2017 Fisher
2017 Blue, Fin, Sei, North Pacific Right, and Sperm Whales
2017 Sandhill Crane
2017 Western Pond Turtle
2016 Canada Lynx
2016 Marbled Murrelet
2016 Peregrine Falcon

Conservation Plans

2013 Bats

Status Reports

2021 Oregon Vesper Sparrow
2019 Pinto Abalone
2017 Yellow-billed Cuckoo
2015 Tufted Puffin
2007 Bald Eagle
2005 Aleutian Canada Goose
1999 Northern Leopard Frog
1999 Mardon Skipper
1999 Olympic Mudminnow
1998 Margined Sculpin
1998 Pygmy Whitefish
1997 Aleutian Canada Goose

Recovery Plans

2020 Mazama Pocket Gopher
2019 Tufted Puffin
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

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