

SPECIES in the SPOTLIGHT

Priority Actions 2021–2025



NOAA
FISHERIES



Southern
Resident killer
whales
(*Orcinus orca*)

Cover: Aerial photograph of a mother and new calf in SRKW J-pod, taken in September 2020. The photo was obtained using a non-invasive octocopter drone at >100 ft. Photo: Holly Fearnbach (SR3, SeaLife Response, Rehab and Research) and Dr. John Durban (SEA, Southall Environmental Associates); collected under NMFS research permit #19091.



Passengers aboard a Washington State Ferry view Southern Resident killer whales in Puget Sound, an example of low-impact whale watching. Photo: NWFSC.

The Species in the Spotlight Initiative

In 2015, the National Marine Fisheries Service (NOAA Fisheries) launched the *Species in the Spotlight* initiative to provide immediate, targeted efforts to halt declines and stabilize populations, focus resources within and outside of NOAA on the most at-risk species, guide agency actions where we have discretion to make investments, increase public awareness and support for these species, and expand partnerships. We have renewed the initiative for 2021–2025.

The criteria for *Species in the Spotlight* are that they are endangered, their populations are declining, and they are considered a recovery priority #1C (84 FR 18243, 4/30/2019). A recovery priority #1C species is one whose extinction is almost certain in the immediate future because of rapid population decline or habitat destruction, and because of conflicts with construction, development, or economic activity.

As of January 2021, the following nine species are our *Species in the Spotlight*.

- Atlantic salmon Gulf of Maine distinct population segment (DPS)
- Central California Coast coho salmon evolutionarily significant unit (ESU)
- Cook Inlet beluga whale DPS
- Hawaiian monk seal
- North Atlantic right whale (added in 2019)
- Pacific leatherback sea turtle
- Sacramento River winter-run Chinook salmon ESU
- Southern Resident killer whale DPS
- White abalone

For some of these species, their numbers are so low that they need to be bred in captivity; others are facing human threats that must be addressed to prevent their extinction. In most cases, we understand the limiting factors and threats to these species, and we know that the necessary management actions have a high probability of success. In some cases, we are prioritizing research to better understand the threats so we can fine-tune our actions for the maximum effect. We know we can't do this alone. A major part of the *Species in the Spotlight* initiative is to expand partnerships and motivate individuals to work with us to get these species on the road to recovery.

Priority Action Plans

The 5-year action plan is part of a strategy to marshal resources for species listed under the Endangered Species Act of 1973 (ESA) for which immediate, targeted efforts are vital for stabilizing their populations and preventing their extinction.

In its first 5 years, the *Species in the Spotlight* initiative has been successful at raising awareness, increasing

partnerships, and prioritizing funding—providing or leveraging more than \$113 million toward projects that will help stabilize these highly at-risk species.

We renewed the *Species in the Spotlight* initiative for 2021–2025, and have updated the priority action plans that outline what we need to do to prevent their extinction.

The 2021–2025 5-year action plans build upon existing action, recovery, or conservation plans and detail the focused efforts needed over the next 5 years to reduce threats and stabilize population declines. We will continue to engage our partners in the public and private sectors in actions they can take to support this important effort. We will report on our progress through the [Biennial Recovering Threatened and Endangered Species Report to Congress](#), and on our [Species in the Spotlight](#) web pages.

This strategy will continue to guide agency actions where we have the discretion to make critical investments to safeguard these most endangered species. The strategy will not divert resources away from the important and continued efforts to support all ESA-listed species under our authority. Many of our species have long-standing conservation programs supported by multiple partners. We remain committed to those programs.

This action plan builds on the success of the past 5 years and highlights the actions that can be taken by us, other federal and state resource agencies, environmental organizations, Native American tribes, and other partners to work toward turning the trend around for this species from a declining trajectory and toward recovery. We appreciate all of our current partners and collaborators, as the steps we need to take to stabilize these species would not be possible without them.

NOAA Fisheries Contact

If you are interested in working with us, or if you have questions about any of the priority actions contained in this plan, please contact:

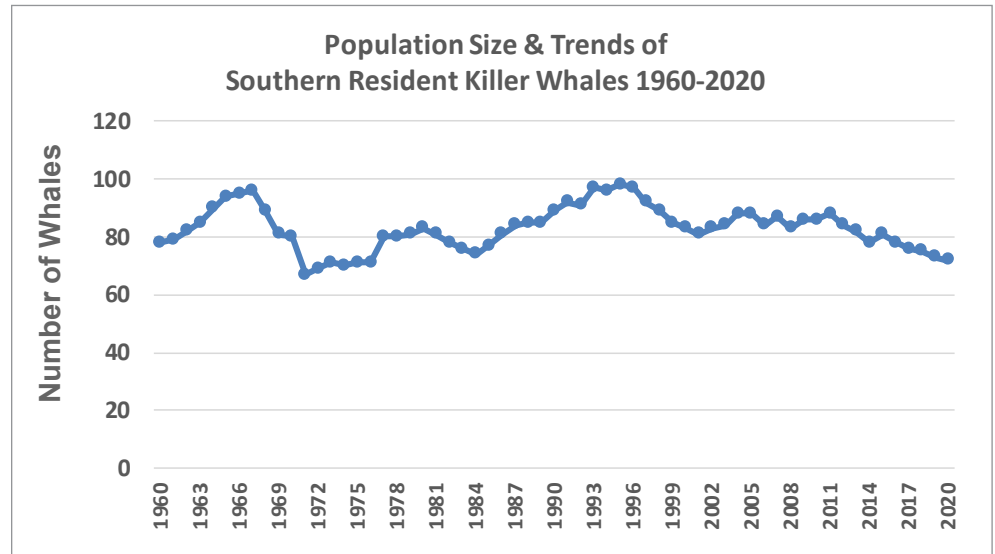
Lynne Barre, Southern Resident killer whale Recovery Coordinator, NMFS West Coast Regional Office (WCR), lynne.barre@noaa.gov, 206-526-4745.

Brad Hanson, Northwest Fisheries Science Center (NWFSC), brad.hanson@noaa.gov, 206-860-3220.

Southern Resident Killer Whale Status

The Southern Resident killer whale DPS was listed as endangered under the ESA in 2005 following a rapid ~20 percent decline in the population in the 1990s. NMFS identified Southern Residents as one of the most at-risk species because the population has relatively high mortality and low reproduction and is currently well below the population growth goals identified in its ESA Recovery Plan (NMFS 2008). Unlike other North Pacific killer whale populations, which have generally been increasing since federal protection was initiated in the 1970s, the Southern

Resident population remains small and vulnerable and has not had a net increase in abundance since the mid-1980s. Under the comprehensive recovery program for Southern Residents, collaboration is vital, and long-term engagement is required from numerous partners ranging from California to Alaska.



Population size and trends of Southern Resident killer whales, 1960-2020. Data from 1960-1973 are projections from Olesiuk et al (1990). Data from 1973-2020 from Center for Whale Research annual census data.

Southern Resident Killer Whale Key Conservation Efforts/Challenges

The three primary, interactive threats identified for Southern Resident killer whales are:

- Insufficient prey.
- High levels of contaminants (contaminant sources may include contaminated prey, wastewater treatment plants, sewer outfalls, pesticides, etc.).
- Impacts from vessels and sound that may affect their behavior and reduce their ability to successfully find and capture prey.

In 2018-2019, Governor Jay Inslee launched a Washington State Task Force that completed two final reports with recommendations and legislative changes to implement actions.

In concert with the primary threats, poor reproduction and survival are connected to the health of individuals and risk from anthropogenic threats (e.g., vessel strikes, fishery interactions). With such a small population size, the Southern Residents are also at risk of inbreeding depression.

Current management of the population is complex in part because one of their main sources of prey, Chinook salmon, are also important to tribal, commercial, and recreational fisheries and influenced by environmental and climate change. In addition, many runs of Chinook salmon are themselves listed as threatened or endangered under the ESA. Disturbance from vessels and sound can impact the behavior and feeding of the whales, increasing their energy expenditure, possibly reducing the effectiveness of their hunting techniques, and reducing the time they spend foraging. During times of nutritional stress, the effects of the high levels of contaminants in this

top predator may also compromise the health of the whales by impairing immune function and interfering with reproduction. The three main threats intersect to affect the whales' survival and reproduction. The Recovery Plan addresses each of the threats based on the best available scientific information and links the management actions to an active research and monitoring program to fill data gaps and assess effectiveness in meeting the goals of the plan.

The same threats and many of the same challenges remain, even with successful implementation of actions from the 2016-2020 Action Plan. Our most recent [Biennial Recovering Threatened and Endangered Species Report to Congress for 2017-2018](#) describes progress since the agency's inception of the *Species in the Spotlight* initiative. Examples of accomplishments from the first 5-year Action Plan for Southern Residents include:

- A review of the effectiveness of vessel regulations.
- New studies looking into nighttime behavior of the whales.
- Identification of priority prey stocks to inform salmon management and recovery.
- Updated management approaches for coastal salmon fisheries that incorporate the needs of the Southern Residents.
- Advancements in aerial drone photogrammetric monitoring of body condition.
- Cutting-edge genetic studies with international partners.
- New grant opportunities through the National Fish and Wildlife Foundation (NFWF).
- Transboundary collaboration.
- Expanded efforts through diverse partnerships to raise awareness and inspire action to conserve the whales; from 2015 to 2020 we participated in 66 Southern Resident Species in the Spotlight events with approximately 12,600 participants and reached many more people through websites, social media, distributing materials, and supporting our partners.

While the three new calves born since the summer census count in 2020 provide hope for population growth, challenges remain for the survival of those calves.

In 2018-2019, Governor Jay Inslee launched a Washington State Task Force that completed two final reports with recommendations and legislative changes to implement actions. Governor Inslee and the Task Force were recognized as our Partners in the Spotlight. Identification and implementation of complementary actions were also identified by the Washington State Task Force and supported in Washington State. In 2019-2020, we made additional progress in implementing the Action Plan and new scientific results were published.

While ongoing research programs are essential to inform recovery actions, we are coordinating with long-standing and new research partners to minimize the research footprint around the whales and potential impacts of research activities. An example of using science to support actions is our application of the latest scientific information gleaned from research results now available from several long-term projects, as well as public input, to propose a modification to the whales' critical habitat designated under the ESA. A proposed rule for modified critical habitat was published in 2019, public hearings were held, and a final rule is expected in 2021.

Unfortunately, even with new partnerships and actions, we have not yet seen the trajectory of the population change and, as of the 2020 annual summer census, there were only 72 whales in the population. While the three new calves born since the summer census count in 2020 provide hope for population growth, challenges remain for the survival of those calves.

Key Actions Needed 2021–2025

The list below includes a small number of targeted high-priority actions that NOAA Fisheries, partners, and the public can take in the next 5 years to promote recovery of the Southern Residents. These actions address threats directly to the whales and also support protection of the important features of their habitat. Beyond this list, cross-cutting actions are needed to incorporate the risks of multiple threats, including climate change, consider the interactions among the threats, and evaluate the trade-offs of different management scenarios that include adjustments to human activities. The partners identified below have indicated their interest in helping achieve the actions, but their identification in this plan does not obligate them to a specific activity or commitment of resources. We have identified several sources of recent or ongoing funding support and some information on remaining funding gaps for several key programs. This list is not

comprehensive of all actions planned for 2021–2025, resources needed, or potential partners that would contribute and participate in actions, and we welcome partnering with others not identified within this plan.

The key actions in this 5-year plan are:

- Protect Killer Whales from Harmful Vessel Impacts through Enforcement, Education, and Evaluation
- Target Conservation of Critical Prey
- Improve Our Knowledge of Southern Resident Killer Whale Health to Advance Recovery and Support Emergency Response
- Raise Awareness about the Recovery Needs of Southern Resident Killer Whales and Inspire Stewardship through Outreach and Education



Scientists aboard the NOAA Research Vessel, *Bell M. Shimada*, tracked Southern Residents along the West Coast, monitoring their foraging and collecting prey and fecal samples. Photo: NWFSC.

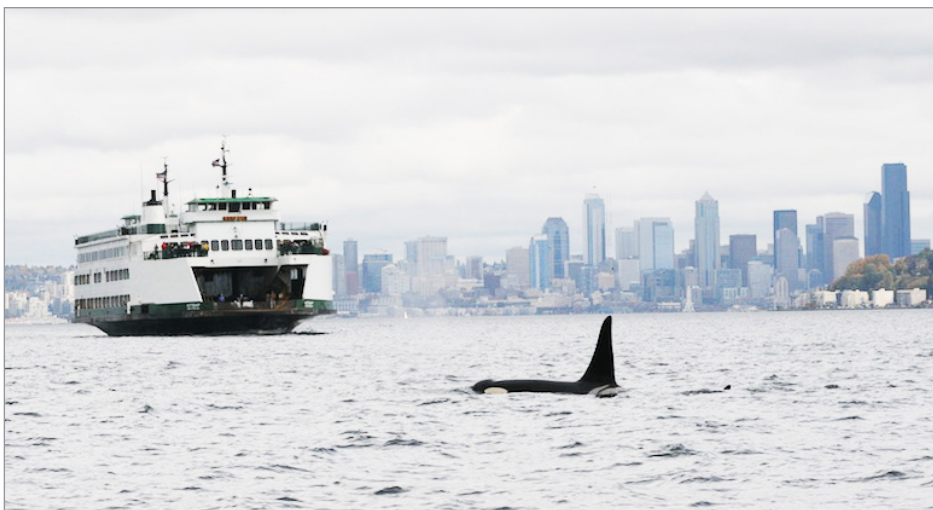
Protect Killer Whales from Harmful Vessel Impacts through Enforcement, Education, and Evaluation

Description and Background: Southern Resident killer whales rely on echolocation and communication to support their critical foraging and social needs; however, physical and acoustic disturbance from vessels can impair these functions. Since NOAA Fisheries finalized regulations to protect Southern Resident killer whales from vessel impacts in 2011, we have reviewed their effectiveness (Ferrara et al. 2017) and have been working with outreach, enforcement, and industry partners to educate boaters and achieve high rates of compliance to minimize impacts from sound and vessel disturbance. We have also worked with Canada, Washington State, and San Juan County as they have updated or developed additional protective regulations and voluntary guidelines, including a new licensing program for commercial whale watching. We need to continue adapting and expanding these partnerships to increase protection for the whales and find alignment where possible to support education, outreach, compliance, and improvements for the whales. Ongoing research projects, like the

Northwest Fisheries Science Center acoustic tagging (Dtag) program in partnership with Department of Fisheries Canada, continue to provide results to inform protective measures. The results have guided updates to regulations and guidelines, such as support for the speed regulations adopted by Washington State (Houghton et al. 2015) and initial indicators to support guidelines for limiting use of echosounders near the whales. Research and additional long-term vessel monitoring programs, such as the Soundwatch Boater Education Program (are also needed to help us continue evaluating the effectiveness of various protections so we can adapt and contribute to protections at the county, state, and international levels. Building on our partnership with the Canadian ECHO (Enhancing Cetacean Habitat and Observation) Program, and as recommended by the Task Force, over the next 5 years we plan to expand our focus on vessel impacts to include large ships transiting through our waters through a new Quiet Sound program and specific projects like broader application of the Whale Report Alert System in U.S. waters. Monitoring the



The Soundwatch Boater Education Program, led by The Whale Museum, educates recreational boaters on the least intrusive ways to watch whales in the wild, passes out Be Whale Wise viewing guidelines, and monitors vessel activity near the whales. Photo: Soundwatch.



Southern Resident killer whales frequent the urban waters of Puget Sound, a rare example of an endangered species living in close proximity to millions of people. Photo: NWFSC.

soundscape in key parts of the range of the Southern Residents is needed to support evaluation of efforts to reduce acoustic disturbance. In recent years, there has been a shift in the whales' summer range to increased use of coastal waters, particularly near the west entrance to the Strait of Juan de Fuca, a busy shipping lane used by all commercial vessel traffic visiting the ports of Seattle, Tacoma and Vancouver, BC. We plan to continue acoustic monitoring, supported in recent years by a partnership with the Navy, to better understand changing habitat use by the whales and potential anthropogenic impacts in these more remote areas of their range.

Expected Benefits to the Species: Monitoring data from Soundwatch has shown increased compliance with the regulations and guidelines when enforcement vessels, from NOAA Fisheries and Washington Department of Fish and Wildlife (WDFW), are present (Soundwatch 2018, 2019). We expect expanded enforcement and education/outreach presence on the water to further reduce vessel impacts to the whales' behavior, foraging, and communication, as well as decreasing the risk of vessel strikes, which can be fatal. Working toward alignment of state, federal, and international protections to achieve consistency throughout the transboundary habitat of the whales will also support boater education efforts and improve compliance leading to a reduction in vessel disturbance. Ongoing data collection and analysis of vessel activities, whale responses, and

effectiveness of our regulations and guidelines will inform our evaluation of the need for updates to the federal regulations, as well as efforts to coordinate regulatory and voluntary protections and make annual improvements to the transboundary Be Whale Wise guidelines to ensure we are using the most effective methods to protect the whales based on the best available science. Soundscape ambient sound monitoring and acoustic monitoring of the whales in key locations will inform us about how the acoustic environment is changing over time, especially with approvals

of regional projects that may increase overall vessel traffic. Ongoing monitoring of the habitat use of the whales increases our understanding of how human activities like vessel traffic, as well as environmental and climate changes that drive salmon distribution and abundance of salmon, may result in changing patterns of distribution and risk for the whales.

Source: This effort will contribute to the following recovery plan actions:

- Management Measure - 1.3 Minimize disturbance of Southern Resident killer whales from vessels. (Priority 2-3)
- Management Measure - 2.3 Use agency coordination and Marine Mammal Protection Act mechanisms to minimize potential impacts from human activities involving sound sources. (Priority 2)
- Management Measure - 3.2.1 Expand the on-water educational efforts of Soundwatch and enforcement agencies (Priority 2)
- Management Measure - 5.3 Inter-jurisdictional enforcement cooperation and coordination (Priority 3)
- Research and Monitoring - B.6.2.1 Determine vessel characteristics that affect Southern Residents
- Research and Monitoring - B.6.2.2 Determine the extent that vessels disturb or harm the Southern Residents

Partners: WCR, NWFSC, NOAA's Office for Law Enforcement, WDFW, Soundwatch, Straitwatch, Quiet Sound, Pacific Whale Watch Association, DFO, Transport Canada, ECHO, Industrial Economics, Inc., San Juan County, and NFWF.

Current Status: Enforcement, boater education and coordination are ongoing. Research on sound conditions and impacts of vessels and sound on the whales are ongoing. New commercial whale watch licensing program is scheduled for 2021. Quiet Sound is expected to launch in 2021.



Southern Resident killer whale and whale watch boat, in Puget Sound. Photo: NWFSC.

Resources and Funding

Action/Partners	Current funding	Source	Additional funding needed
WDFW grant for adaptive management, enforcement, and Soundwatch support	\$773,075 for 2019-2021	NMFS ESA Section 6 grant to WDFW	\$679,224 grant request for 2021-2024
Soundwatch support for education, vessel monitoring and evaluation of vessel protections	\$50,000-\$100,000 per year	NMFS	Yes, contingent on annual budget
NMFS Dtag program	\$102,000 for 2021	DFO	\$150,000 per year to increase the sample size and conduct detailed and coordinated data analyses comparing Southern and Northern Resident datasets
Expand Dtag deployments to additional areas, like the west entrance to the Strait of Juan de Fuca			\$90,000 per year
San Juan County improving compliance with recreational boaters	\$52,812	NFWF grant	
Ocean Wise Conservation Association programs to reduce disturbance from vessel traffic	\$100,000	NFWF grant	
Economic and NEPA analysis support for potential updates to federal regulations			\$100,000
Launch and implement the Quiet Sound program			\$200,000-\$250,000 per year
Soundscape monitoring in Puget Sound to build infrastructure for baseline data collection on ambient noise	\$75,000 per year through 2021	NOAA Ocean Acoustics program	\$100,000 per year to maintain and refocus acoustic recorders to assist with evaluating any management measures to reduce anthropogenic sound and additional funding for analysis 2021-2025
Maintain several coastal passive acoustic recorder moorings	\$180,000 per year through 2021	Navy	TBD, contingent on annual budgets
Ocean-class vessel survey work in coastal waters to fill seasonal gaps related to whale distribution and overlap with vessels			\$125,000 per year

Target Conservation of Critical Prey

A new analysis of Southern Resident prey published in early 2021 found that the whales prey primarily on Chinook salmon in inland waters of Puget Sound during the summer. They diversify their diet to include steelhead and marine species when they move to the outer coast in winter.

Description and Background: Southern Residents are fish-eating whales that rely on Pacific salmon as their most important prey. Research indicates that a single species—Chinook salmon—makes up most of their summer diet and remains an important component throughout the year, although the relative importance of specific stocks is still under investigation. Research results document consumption of a portfolio of Chinook salmon that originate from many watersheds along our coast from California to British Columbia, Canada (Hanson et al. 2021). In the Pacific Northwest and California, most Chinook salmon populations are well below historical abundance levels, though some are in higher abundance than others. Some Chinook salmon stocks are abundant enough to support important commercial, recreational, and tribal fisheries. Other Chinook salmon are listed as threatened or endangered under the ESA. Many Chinook salmon also have long-term declining trends in body size. Targeting actions that will increase the abundance of all Chinook salmon will benefit the Southern Resident killer whales and is, therefore, a high priority. NOAA Fisheries will work with many tribal, federal, state, and local partners to implement a variety of actions toward this goal. For ESA-listed Chinook salmon, the focus is on strategies identified in ESA Recovery Plans and by local watershed organizations. First we will continue efforts to identify the salmon stocks, runs, or geographic distribution that is most important to the whales. We will then target critical prey and prioritize actions with our partners that contribute the most to the prey base of the whales.

Drought and fire conditions across much of the West Coast in recent years, combined with unusually warm ocean conditions, may lead to a significant downturn in salmon abundance in the near future, so we will prioritize increasing depleted populations of salmon to ensure an adequate food base for the whales' recovery. Focusing on diet and health condition studies during this time period is particularly important.

Research results document consumption of a portfolio of Chinook salmon that originate from many watersheds along our coast from California to British Columbia, Canada.

In 2018 NOAA Fisheries and WDFW identified and ranked priority Chinook salmon for the whales based on diet, whale and salmon distributions, and body condition information. We intend to update that list with new data on the whales and Chinook salmon, as well as using input from partners. The updated list will better inform salmon management and actions to increase their populations. The priority prey report also informs implementation of initiatives under the Pacific Salmon Treaty to support salmon habitat restoration and hatchery production to



Spring Chinook salmon. Photo: Lance Kruzic, NOAA Fisheries.

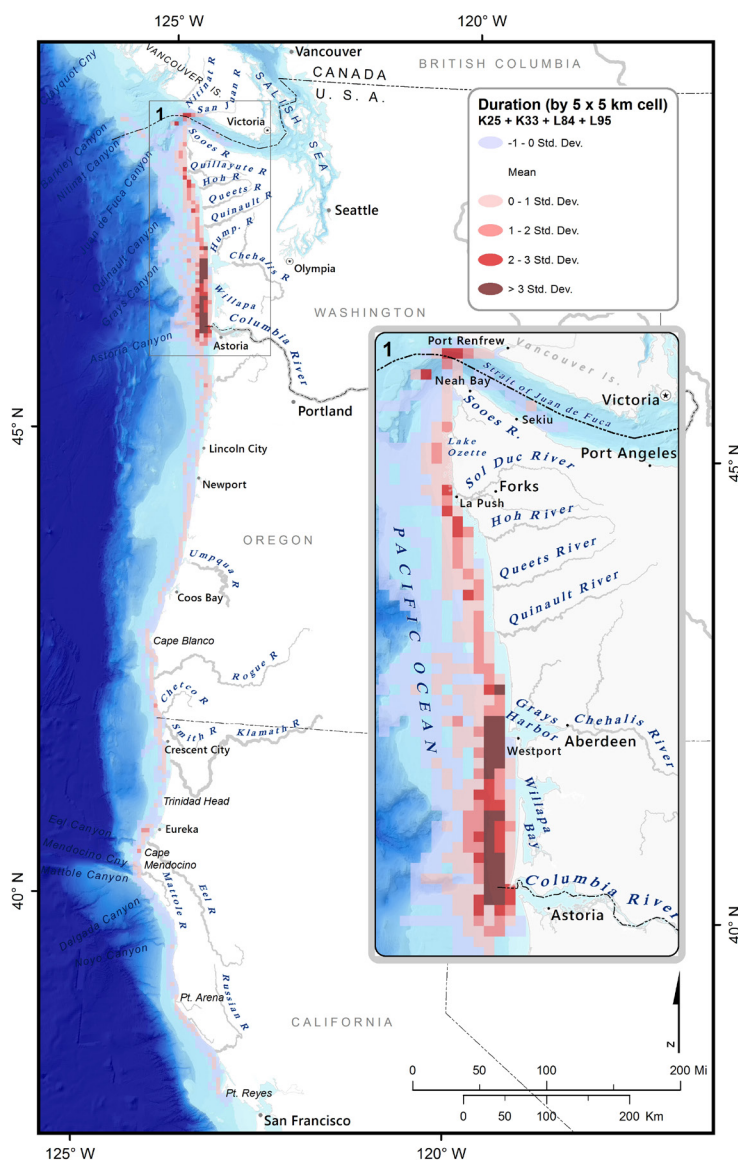
benefit the Southern Residents. To evaluate potential impacts of coastal salmon fisheries, the Pacific Fishery Management Council formed a Workgroup including the WCR, NWFSC, and SWFSC along with state, tribal, and industry members. The Workgroup completed a risk assessment to describe relationships between killer whale population measures and the abundance of Chinook salmon (PFMC 2020), which in the coming years will inform management of the ocean salmon fisheries, as well as other actions that change salmon abundance. Efforts are also ongoing to improve data inputs into the models that investigate not only killer whale and salmon connections, but include other salmon predators and fisheries as well, building on initial modelling efforts (Chasco et al. 2017). Priority actions needed to inform



Southern Resident killer whale catching a salmon. Photo: NWFSC.

all of these efforts include: collecting samples and filling key seasonal and geographic gaps regarding whale diet and whale distribution, completing and updating risk assessment models with annual Southern Resident census and salmon abundance information, estimating the ocean distributions of specific Chinook salmon stocks (i.e., spring runs), conducting analyses to quantify the contribution of specific salmon hatchery programs and production increases to the Southern Resident killer whale prey base, and evaluating whether the whales' seasonal diet changes during periods of variable salmon abundance. We will also continue to work with a variety of partners to increase communication and coordination between the killer whale and salmon recovery communities to leverage resources, prioritize actions, and build public support.

Expected Benefits to the Species: Ensuring that salmon populations throughout the whales' geographic range are healthy and sustainable is an important part of achieving recovery for the whales. Identifying priority prey also contributes to our regulatory and management efforts to protect and restore not only the Southern Residents and their critical habitat, but also important habitats for Chinook salmon, like nearshore areas and estuaries, which support critical prey for the whales. Updates and improvements to the Priority Stock Report will better inform actions, including implementation of initiatives under the Pacific Salmon Treaty and NFWF grant programs to support salmon habitat restoration and hatchery production to benefit the Southern Residents. Improved understanding of the food web is critical for us



Duration of occurrence model output showing “hot spots” for Southern Resident habitat use along the West Coast using data from K and L pod satellite tag deployments. From NMFS 2019.

to make informed killer whale and salmon management and conservation decisions that affect the fishing industry, tribes, and the overall health of the ecosystem. Evaluating the effectiveness of the actions being taken will help further refine and prioritize our actions, keeping in mind the needs of the whales, our treaty trust responsibilities, and our communities.

Source: This effort will contribute to the following recovery plan actions. (Additional needs are identified in Hilborn et al. 2012).

- Management Measure - 1.1 Rebuild depleted populations of salmon and other prey to ensure an adequate food base for recovery (Priority 2)
- Research and Monitoring - B.2.1 Determine diet of the Southern Residents (Priority 1)
- Research and Monitoring - B.2.3 Determine the importance of specific prey populations to the diet (Priority 1)
- Research and Monitoring - B.6.1 Assess the effects of changes in prey populations (Priority 1)

Ensuring that salmon populations throughout the whales' geographic range are healthy and sustainable is an important part of achieving recovery for the whales.

- Research and Monitoring - B.6.1.3 Determine whether the Southern Residents are limited by critical periods of scarce food resources (Priority 1)

Partners: WCR, NWFSC, SWFSC, NOAA Restoration Center, states, tribes, Puget Sound Partnership, DFO, Cascadia Research, Center for Whale Research, University of Washington, and NFWF.

Current Status: Research to fill data gaps and inform critical prey identification is ongoing. Long-term collaborations and grant programs to support salmon recovery activities are ongoing with specific funding under the new Pacific Salmon Treaty starting in FY 2020.

Resources and Funding

Action/Partners	Current funding	Source	Additional funding needed
Pacific Salmon Treaty funding initiative for habitat restoration projects and increased hatchery production	FY 20 funding \$13.5 million for habitat and \$5.6 million for hatcheries	Federal budget	Yes, contingent on annual budget. Washington State has also made investments to support increased hatchery production coming out of the Task Force recommendations
NMFS small boat surveys to fill data gaps in the Strait of Juan de Fuca in the spring of 2021 and 2022.	\$198,000	NFWF grant	
Fall diet in coastal waters remains a data gap and would require ocean-class vessel surveys			\$125,000 per year
Acoustic tagging projects for adult Chinook salmon and acoustic detections of whales	\$200,000 through 2021	Navy	TBD, for ongoing analysis of new and past data, such as coded wire tag data, to better understand salmon distribution and overlap with Southern Residents
Shoreline, estuary and channel habitat restoration	Grants awarded for \$141,020, \$200,000 and \$200,000	NFWF grants	
Restore fish passage	Grants awarded for \$30,000 and \$84,797	NFWF grants	
Forage fish habitat restoration	Grants for \$30,000 and \$84,797	NFWF grants	
Evaluate hatchery practices	Grants for \$147,001 and \$176,959	NFWF grants	
Address pinniped predation	Grant for \$152,538	NFWF grant	
Investigate spring prey selection	Grant for \$183,000	NFWF grant	
Prey stock identification	Grant for \$113,269	NFWF grant	

Improve Our Knowledge of Southern Resident Killer Whale Health to Advance Recovery and Support Emergency Response

Description and Background: Understanding killer whale health is essential to identifying the mechanisms for reduced survival and reproduction in the declining Southern Resident population compared to other increasing or stable populations of killer whales. Health studies needed over the next 5 years include continuing photo-identification for the annual census, collecting expanded detailed observations of physical condition of individual whales, photogrammetric monitoring (taking measurements from aerial photos), collecting contaminant and health biomarker samples (feces, breath), expanding stranding investigations and disease testing, evaluating the role that inbreeding depression plays in the population's performance, and continuing to improve a database to house all data on individual killer whales and create and track health profiles.

veterinarians, researchers, and other experts to mount an emergency response to provide remote medical treatment for J50, a juvenile with very poor body condition. While unsuccessful in saving J50, we learned about her condition, reviewed tools and techniques for response, and identified gaps in our capabilities. Building on our recent experience, past cases, and input from experts around the world we are continuing to develop response plans for strandings, entanglements, and other circumstances so we can continue to learn about the whales and build our response capacity.

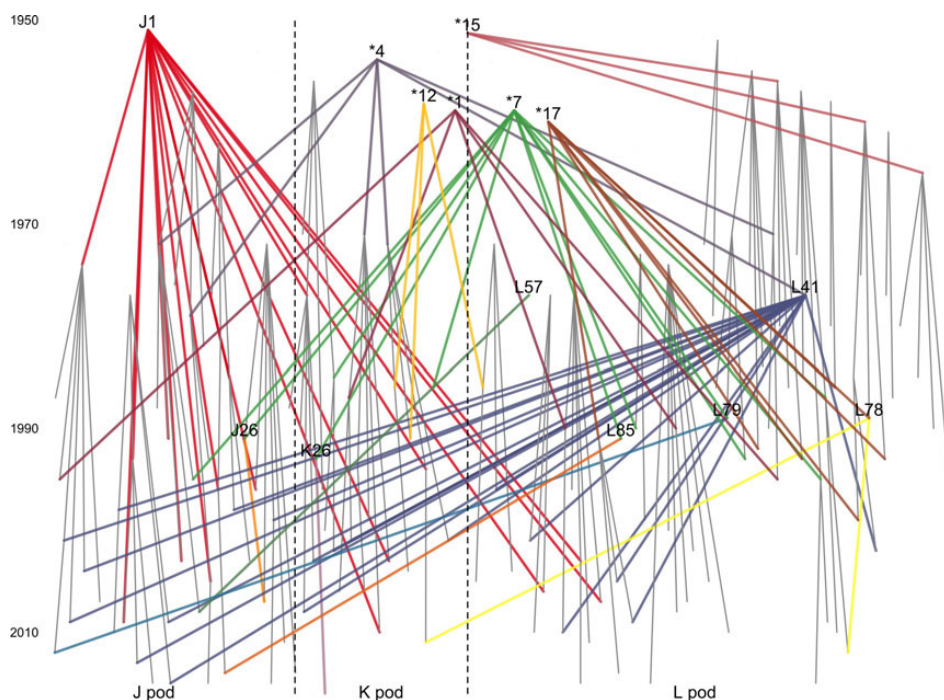
Expected Benefits to the Species: By assembling data from multiple research and monitoring projects and increasing the data collected to populate a whale health database, we can identify patterns of health and

Several ongoing research programs are poised to reach significant milestones over the next 5 years, including estimating the relationship between body condition and successful reproduction.

Several ongoing research programs are poised to reach significant milestones over the next 5 years, including estimating the relationship between body condition and successful reproduction. Ongoing health sample collection and analysis has given us a clearer picture of pathogens and what microbiomes (i.e., microorganisms in the digestive or respiratory systems) look like for the Southern Residents and will also give us the capacity to identify any emerging infectious pathogens. With such a small number of whales remaining, we need to continue to build our health sampling for the Southern Residents, for comparison populations that are increasing in abundance, and for specific individuals showing signs of declining health. In recent years, we have developed protocols to guide emergency response for individual whales with compromised health who can be medically treated. In 2018 we worked with



NWFSC works with research partners to collect breath samples of whales using petri plates positioned into the exhaled plume when an orca surfaces to exhale. Breath samples are analyzed for bacteria, fungi, and viruses. Photo: NWFSC under research permit #21438.



Southern Resident pedigree focusing on paternal relationships, shown by the colored lines linking the inferred father to the offspring. The endpoints show the birth years and the whales are grouped by pod (from Ford et al. 2018).

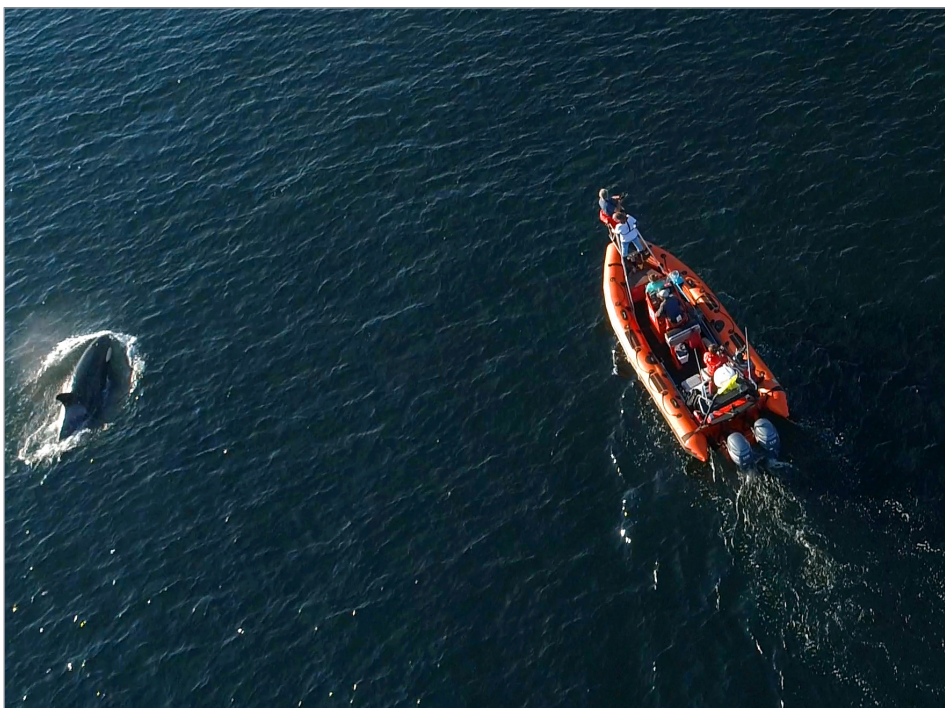
reproductive output of breeding age females and potential causes of mortality to guide our recovery actions. Recent reviews of past killer whale stranding events identified a variety of causes of mortality for West Coast killer whales, including diseases, genetic defects and human-caused deaths such as ship strikes and fishery entanglements (Raverty et al. 2020). Increased sampling will allow us to monitor for emerging diseases, and continued communication and coordination with stakeholder groups such as vessel operators, whale watchers, and the fishing community will help to avoid or minimize harmful interactions. To inform how we might consider or respond to the health of Southern Resident killer whales, we can compare findings with other killer whale populations to isolate the sources of reduced reproduction and identify and prioritize conservation actions. Contaminant levels are one of the key concerns for Southern Residents, and additional information on direct links between contaminant levels and physiological impacts will support recovery actions to reduce contaminant inputs into Southern Resident killer whale habitat. Improving our knowledge of health and contaminants will inform consultations on actions that affect water quality and guide implementation of recommendations from a joint NOAA Fisheries and EPA report regarding the effects of flame retardant chemicals on the whales (EPA and NMFS 2013, Gockel 2014). As we better understand disease and immune response, we can consider developing a conservation medicine program to prepare for and address threats we might find in the future. It may be that a response for an individual could have benefits for the entire population, particularly if we can support survival of reproductive females, or if we learn about threats, develop new tools, or discover treatments that can be applied to the whole population.

Source: This effort will contribute to the following recovery plan actions (as well as actions identified during Southern Resident killer whale health workshops (NMFS 2015)):

- Management Measure- 1. Protect the Southern Resident population from factors that may be contributing to its decline or reducing its ability to recovery (Priority 1)
- Management Measure- 1.2 Minimize pollution and chemical contamination in Southern Resident Habitats (Priority 2)
- Research and Monitoring - B.3.3. Evaluate reproductive patterns (Priority 2)
- Research and Monitoring - B.4.1. Assess the health of population members (Priority 2)
- Research and Monitoring- B.6.3.4 Determine the effects of elevated contaminant levels on survival, physiology, and reproduction (Priority 1)
- Research and Monitoring - B.10. Improve research techniques and technology (Priority 3)
- Research and Monitoring - B.11. Research support and coordination. (Priority 2)



Northwest Fisheries Science Center team attaches a DTag suction cup. Photo: NWFSC under research permit # 21438.



Researchers observe the health condition of individual Southern Residents and collect fecal and breath samples to learn about pathogens and diseases. Photo: NWFSC under research permit #21348.

Partners: WCR, NWFSC, SWFSC, UC Davis, Marine Mammal Foundation, SR3, Vancouver Aquarium, Center for Whale Research, University of Washington, DFO, NFWF, EPA, Puget Sound Partnership, killer whale researchers in Canada and Alaska, and stranding network members.

Current Status: The Center for Whale Research conducts an annual census. Health sampling is ongoing by NWFSC and University of Washington. Photogrammetry studies on Southern and Northern Resident killer whales are in progress/ongoing by SR3 and DFO with analysis ongoing at SWFSC. A stranding analysis was published in December 2020 by UC Davis, SeaWorld, NFWSC, Canada, and other partners (Raverty et al. 2020), pulling together data from all stranded killer whales in the North Pacific.

Resources and Funding

Action/Partners	Current funding	Source	Additional funding needed
Center for Whale Research annual census	\$105,000 per year	NMFS	Yes, contingent on annual budget
Killer whale stranding response	\$15,000 in some years	NMFS and general stranding network support through Prescott grant program	Yes, contingent on annual budget
UC Davis and Marine Mammal Foundation killer whale health database development			Requests submitted for additional \$50,000 in grants
SR3 SeaLife Response, Rehabilitation and Research photogrammetry data collection and analysis	\$160,000	NFWF grant	Requests submitted for additional \$200,000 in grants
Pacific Marine Mammal Center project assessing indicators of changes in health	\$54,000	NFWF grant	
Ocean Wise project analyzing contaminant data from sediment, salmon, and killer whales	\$132,742	NFWF grant	
Salmon-Safe program working with developers to increase water quality	\$75,000	NFWF grant	
Regular health assessments of physical condition of individual whales			Requests submitted for \$50,000 in grants
NMFS analysis of killer whale genome data			\$80,000
NMFS genetic identification and pathogen screening from health samples			\$85,000 per year
Health studies for Southern Residents and other marine mammal comparison populations remain an evolving area of research and development, including sample collection methodologies, lab analysis techniques, building sample sizes in multiple, comparative killer whale populations, and interpretation of results across populations			\$100,000 per year

Raise Awareness about the Recovery Needs of Southern Resident Killer Whales and Inspire Stewardship through Outreach and Education

Description and Background: Public attitudes are a major part of the success or failure of conservation efforts for endangered species, especially those occurring near major population centers. We work closely with museums and aquariums, non-profit groups, researchers, and schools to raise awareness and educate the public about the whales and how individuals and organizations can contribute to conservation. We will continue these activities and seek to expand them with new partners to reach a broader audience using creative approaches and new platforms.

Expected Benefits to the Species: Education and outreach about recovery of Southern Resident killer whales raises public awareness and knowledge about the whales, the threats they face, and actions people can take to support recovery. Education and outreach partners are inspiring students, families, and concerned citizens to contribute to recovery, and several have shown tangible results from changes in behavior that benefit the whales and their prey, such as hands-on habitat restoration and reducing water, electricity, and pesticide use. In recent years, programs have expanded to reach audiences throughout the range of the Southern Residents. New programs, new audiences, and inspiring a variety of actions will lead to measurable benefits for the whales.

Source: This effort will contribute to the following recovery plan actions:

- Management Measure – 3.1 Enhance public awareness of Southern Resident status and threats (Priority 2-3)

- Management Measure – 3.3 Educate public on positive actions they can take to improve the current condition for Southern Residents killer whales (Priority 2)

Partners: WCR, Seattle Aquarium, The Whale Museum, Killer Whale Tales, Orca Network, The Whale Trail, Whale Scout, Port Townsend Marine Science Center, NOAA National Marine Sanctuaries, Pacific Whale Watch Association, Pacific Fishery Management Council, and other education and outreach programs.

Current Status: NOAA works with partners along the West Coast range of the whales to raise awareness and inspire conservation through a variety of activities including exhibits, special events, brochures, websites, lectures, curricula, classroom activities, and other programs. June is Orca Awareness/Action Month in West Coast states, which serves as opportunity for events, outreach, and coordination among the many partners. In 2020 we launched a new Southern Resident Connections channel to post engaging content to provide updates on newsworthy topics, ecological connections, opportunities for public engagement, and the science behind our decisions.

Left: Jeff Hogan of Killer Whale Tales shares details of Southern Resident and other types of killer whales with students. Photo courtesy Killer Whale Tales.



Resources and Funding

Action/Partners	Current funding	Source	Additional funding needed
Education and outreach grants to partners	\$50,000-75,000 per year	NMFS	Yes, contingent on annual budget
New partnership programs			\$50,000-75,000 per year

References

- Chasco, B., I. C. Kaplan, A. Thomas, A. Acevedo-Gutiérrez, D. Noren, M. J. Ford, M. B. Hanson, J. Scordino, S. Jeffries, S. Pearson, K. N. Marshall, and E. J. Ward. 2017. Estimates of Chinook salmon consumption in Washington State inland waters by four marine mammal predators from 1970 to 2015. *Canadian Journal of Fisheries and Aquatic Sciences*. 74(8): 1173–1194.
- EPA and NMFS. 2013. Potential Effects of PBDEs on Puget Sound and Southern Resident Killer Whales A Report on the Technical Workgroups and Policy Forum. http://www.eopugetsound.org/sites/default/files/features/resources/PBDEs_Puget_Sound_Report.pdf
- Ferrara, G. A., T. M. Mongillo, and L. M. Barre. 2017. Reducing Disturbance from Vessels to Southern Resident Killer Whales: Assessing the Effectiveness of the 2011 Federal Regulations in Advancing Recovery Goals. December 2017. NOAA Technical Memorandum NMFS-OPR-58.
- Ford, M. J., M. B. Hanson, J. A. Hempelmann, K. L. Ayres, C. K. Emmons, G. S. Schorr, R. W. Baird, K. C. Balcomb, S. K. Wasser, K. M. Parsons, and K. Balcomb-Bartok. 2011. Inferred paternity and male reproductive success in a killer whale (*Orcinus orca*) population. *Journal of Heredity*. 102(5): 537–553.
- Hanson, M. B., C. K. Emmons, M. J. Ford, M. Everett, K. Parsons, L. K. Park, J. Hempelmann, D. M. Van Doornik, G. S. Schorr, J. Jacobsen, M. F. Sears, M. S. Sears, J. G. Sneva, R. R. W. Baird, and L. Barre. 2021. Endangered predators and endangered prey: seasonal diet of Southern Resident killer whales. *PLoS ONE* 16(3): e0247031. <https://doi.org/10.1371/journal.pone.0247031>
- Hilborn, R., S.P. Cox, F.M.D. Gulland, D.G. Hankin, N.T. Hobbs, D.E. Schindler, and A.W. Trites. 2012. The Effects of Salmon Fisheries on Southern Resident Killer Whales: Final Report of the Independent Science Panel. Prepared with the assistance of D.R. Marmorek and A.W. Hall, ESSA Technologies Ltd., Vancouver, B.C. for National Marine Fisheries Service (Seattle, WA) and Fisheries and Oceans Canada (Vancouver, BC).
- Houghton, J., M. M. Holt, D. A. Giles, M. B. Hanson, C. K. Emmons, J. T. Hogan, T. A. Branch, and G. R. VanBlaricom. 2015. The relationship between vessel traffic and noise levels received by Killer Whales (*Orcinus orca*). *PLoS ONE*. 10(12): 1-20.
- Gockel, C. 2014. Recommendations on a Monitoring Scheme for Polybrominated Diphenyl Ethers (PBDEs) in Puget Sound. Report to Puget Sound Ecosystem Monitoring Program Toxics Workgroup and Birds and Mammals Workgroup). <http://www.eopugetsound.org/sites/default/files/PBDE%20Recommendations.pdf>
- NMFS. 2008. Recovery Plan for Southern Resident killer whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.
- NMFS. 2015. Priorities Report from a Workshop to Assess Causes of Decreased Survival and Reproduction in Southern Resident Killer Whales.
- NMFS. 2019. Proposed Revision of the Critical Habitat Designation for Southern Resident Killer Whales Draft Biological Report. September 2019.
- Olesiuk, P. F., M. A. Bigg, and G. M. Ellis. 1990. Life History and Population Dynamics of Resident Killer Whales (*Orcinus orca*) in the Coastal Waters of British Columbia and Washington State. *IWC Special Issue* 12: 209-244.
- PFMC. 2020. Pacific Fishery Management Council Salmon Fishery Management Plan Impacts to Southern Resident Killer Whales. Risk Assessment. March 2020. SRKW Workgroup Report 1.
- Raverty S., J. St. Leger, D.P. Noren, K. Burek Huntington, D.S. Rotstein, F.M.D. Gulland, J.K.B. Ford, M. Bradley Hanson, D.M. Lambourn, J. Huggins, M.A. Delaney, L. Spaven, T. Rowles, L. Barre, P. Cottrell, G. Ellis, T. Goldstein, K. Terio, D. Duffield, J. Rice, J.K. Gaydos. 2020. Pathology findings and correlation with body condition index in stranded killer whales (*Orcinus orca*) in the northeastern Pacific and Hawaii from 2004 to 2013. *PLoS ONE* 15(12): e0242505. <https://doi.org/10.1371/journal.pone.0242505>
- Soundwatch. 2018. Soundwatch Program Annual Contract Report. <http://whalemuseum.org/pages/soundwatch-boater-education-program>
- Soundwatch. 2019. Soundwatch Program Annual Contract Report. <http://whalemuseum.org/pages/soundwatch-boater-education-program>

Back cover: Aerial photograph of a mother and new calf in SRKW J-pod, taken in September 2020. The photo was obtained using a non-invasive octocopter drone at >100 ft. Photo: Holly Fearnbach (SR3, SeaLife Response, Rehab and Research) and Dr. John Durban (SEA, Southall Environmental Associates); collected under NMFS research permit #19091.



U.S. Secretary of Commerce
Gina M. Raimondo

Deputy Under Secretary for
Operations Performing the duties of
Under Secretary of Commerce for
Oceans and Atmosphere
Benjamin Friedman

Acting Assistant Administrator
for Fisheries
Paul Doremus

MARCH 2021

www.fisheries.noaa.gov

OFFICIAL BUSINESS

National Marine
Fisheries Service
1315 East West Highway
Silver Spring, MD 20910

