NATURALIST GUIDE TO
SOUTHERN RESIDENT ORCA
RECOVERY EFFORTS

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Naturalist Guide to Southern Resident Killer Whale Research and Conservation

In 2014, NOAA produced a 10 year summary report that highlighted accomplishments based on a decade of funding to support research and management of endangered Southern Resident killer whales. This guide adapts information from that report and incorporates information on additional recovery efforts by partners in the U.S. and Canada to assist marine naturalists in communicating with whale watchers and wildlife viewers. The messages in this guide are intended to complement the biological and behavioral information shared by naturalists and to provide more detail on recent scientific findings and how those findings have contributed to conservation. For more specific information on NOAA's management and research efforts you can refer to the full report at http://www.nwfsc.noaa.gov/news/features/killer_whale_report/. This guide also provides a list of actions people can take to support recovery of the whales and conservation of their habitat. Marine naturalists are in a unique position to raise awareness about the whales, the threats they face, and to foster stewardship through key messages that accompany an inspiring experience of seeing whales.

INTRODUCTION

The endangered Southern Resident killer whale (*Orcinus orca*) is an icon of the Pacific Northwest and inspires widespread public interest, curiosity, and awe around the globe. These striking black and white mammals are recognized for their cultural and spiritual importance to coastal tribes and communities, their value as a keystone species in the marine ecosystem, and their starring role in our region's ecotourism industry. But the Southern Residents are also among the most contaminated marine mammals in the world. Scarcity of their preferred food – salmon – poses serious threats to this endangered population, as does noise from vessel and shipping traffic. Over the last decade, we have come a long way in our understanding and ability to protect this unique population.

NOAA Fisheries along with a variety of partners have used new findings to increase protections for the whales. Although many key questions have been answered, the population continues to struggle and is not recovering. Consequently, this research has inspired new questions, such as whether competition with other marine mammals might be limiting the population's recovery. The research has also shown that some of the most important factors affecting the population, such as lack of adequate prey, cannot be addressed through simple actions, but instead will require a long-term commitment to rebuilding and enhancing depleted salmon stocks. In this guide you will find a summary of research and conservation accomplishments and plans for future actions to protect the Southern Resident killer whales.

Time

1962
First known capture of a Southern Resident orca for public display.

1970s
PCBs and DDT are banned in the United States.

1976
Capture of orcas in Washington State ends. Ken Belcomb begins the Orca Survey, creating a foundation for The Whale Museum and the Center for Whale Research.

1980s
PCBs and DDT are banned in Canada.

1990s
Whale Watch Operators Association Northwest (Pacific Whale Watch Association) is formed.

1993
The Soundwatch Boater Education Program through The Whale Museum begins.

2001
Center for Biological Diversity and others petition NOAA to list the SRKW under the Endangered Species Act after an almost 20% decline in the population in 6 years.

2002
NOAA determines that Southern Residents are ineligible for protection under the ESA.

2003
Southern Residents are declared 'depleted' under the Marine Mammal Protection Act.
Court orders NOAA to reconsider eligibility of Southern Residents for ESA listing.

2004
Washington State designates the SRKW in Washington State as endangered.
Canada lists Southern Residents as endangered under the Species at Risk Act (SARA).

2005

Southern Resident killer whale distinct population segment is listed as endangered under ESA.

2006

Southern Resident critical habitat is designated in inland Washington waters.

2007

NOAA requests public input on potential vessel regulations.

2008

United States Southern Resident Killer Whale Recovery Plan is completed.
Canada's Recovery Strategy for Northern and Southern Resident Killer Whales is completed.
Canada passes regulations to prohibit PBDEs.

2009

New vessel regulations are proposed to protect killer whales. NOAA and The Whale Museum co-host a trans-boundary SRKW Naturalist workshop to learn about management efforts and research results.

2010

Killer Whale Response Plan was added to the Northwest Area Contingency Plan for oil spill response.

2011

5-year Status Review results in no change in endangered status. NOAA announces new vessel regulations to protect killer whales. Washington State completes gradual ban of PBDEs.

2012

NOAA and DFO complete a series of workshops to Evaluate Effects of Salmon Fisheries on Southern Residents.

2013

NOAA finds that a petition to delist the Southern Residents under the ESA is not warranted and the orcas retain their endangered status. NOAA accepts a petition to include the killer whale known as Lolita in the Endangered Species Act listing of Southern Resident killer whales.

2014

NOAA accepts a petition and will consider revising critical habitat to include coastal areas.
NOAA announces a 12-month finding and proposed rule to revise the endangered listing of the Southern Resident killer whale distinct population segment to include Lolita.

POPULATION DECLINE

Scientists estimate the historical population size of Southern Residents was at least 140 animals. Public opinion toward killer whales in the past was very negative and they were sometimes shot by fishermen. The Canadian Fisheries Department even installed a land based machine gun to shoot at orcas but fortunately it was never fired. Beginning in the late 1960s, a live-capture fishery removed nearly 50 whales for display at marine parks and resulted in an immediate steep decline in the population. The decline was steepest among the juveniles in the population because smaller animals were targeted for capture. By 1971, the population consisted of 67 whales. Live captures ended in the 1970s, and since that time the population has gone through several periods of growth and decline. Using photo-identification of individual saddle patch markings, the Center for Whale Research conducts an annual census to track the exact number of whales in the population. This long-term census provides the foundation for understanding the status of the population. In the mid-1980s, Southern Residents entered an 11- year growth period peaking at 98 animals in 1995. From 1996 to 2001, the population experienced a decline of almost 20% and was reduced to 80 whales. In 2004 the population was listed as endangered in Canada under the Species at Risk Act (SARA). In 2005 they were listed as an endangered distinct population segment (DPS) under the U.S. Endangered Species Act. The major threats to the population's survival identified at the time of listing were prey availability, pollution and contaminants, and effects from vessels and sound. In addition, small population size and vulnerability to oil spills and disease were identified as significant concerns. The Southern Resident killer whale population increased to 88 whales in 2005, but by August 2014 the population had decreased again to 78 whales.

MAJOR THREATS

1. **Prey Availability:** Southern Residents are fish-eating whales. Chinook salmon, primarily from Canada's Fraser River, make up a majority of their summer diet. In the fall and spring the whales eat a wider variety of salmon species, including coho, chum, and steelhead. Their winter diet remains relatively unknown, but recent investigations by NOAA Fisheries and collaborating scientists suggest it also consists largely of Chinook salmon. In the Pacific Northwest, many Chinook salmon populations have declined substantially from historical levels of abundance and are listed as threatened or endangered under the ESA. Ensuring that salmon populations are healthy and sustainable is a crucial part of achieving recovery for the whales.
2. **Contaminants:** Southern Resident killer whales are long-lived, top predators in the marine ecosystem which makes them vulnerable to

pollutants that can accumulate up the food chain and negatively affect their health. This endangered population is exposed to contaminants from urban areas such as Puget Sound, where they and their prey spend much of their time. Chemical pollutants of concern for killer whales include the pesticide DDT and chemicals found in industrial coolants and lubricants known as PCBs, both of which were banned in the U.S. in the 1970s and in Canada in the 1980s. The flame-retardants PBDEs are a newly emerging contaminant of concern. A large body of evidence links pollutant exposure to disease and reproductive problems in marine mammals. Reducing chemical contamination in the whales' habitat and food will help slow the accumulation of these chemicals in the whales over their long lives, benefiting their health and helping their long-term prospects of survival.

3. **Vessel Effects:** The inland waters of Washington State and British Columbia are highly urbanized areas with significant vessel traffic from container ships, ferries, tugboats, recreational boats, and fishing vessels, and are also where the whales spend much of their time in the summer and fall. Southern Resident killer whales are also the focus of considerable recreational and commercial whale watching. The cumulative impacts from vessels may interfere with the whales' ability to communicate and find food, affecting their health and survival. Quantifying the amount and types of marine traffic, as well as the whales' responses to vessels, has helped us understand the effect of vessels on killer whale behavior and determine the best ways to protect whales while also allowing for human uses of the marine environment.

ENDANGERED LISTING

United States Endangered Species Act

When a species is listed as endangered several protections are put in place. NOAA must designate critical habitat and develop and implement recovery plans, conduct a review at least every 5 years, and issue regulations as deemed necessary. 'Take' (to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such content) is prohibited without a permit. Permits that include terms and conditions to minimize impact can be issued for scientific research or to enhance the survival of the species, or for takes that are incidental to a lawful activity, such as pile driving. Under Section 7 of the ESA federal agencies must ensure that actions are not likely to jeopardize the listed species or modify its critical habitat. NOAA designated critical habitat for Southern Residents for their summer range in the inland waters of Washington in 2006. They completed a Recovery Plan in 2008 and conducted a review in 2011 which determined that no change in status was warranted and the whales remain listed as endangered.

Canada Species at Risk Act

Canada's Species at Risk Act is a key federal government commitment to prevent wildlife species from becoming extinct and to secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of their biological diversity. "Critical habitat" is defined under SARA as "the habitat that is necessary for the survival or recovery of a listed wildlife species that is identified in the recovery strategy or in an action plan for the species." Once critical habitat is identified by the Prime Minister, no person shall destroy any part of the critical habitat and the Minister must describe in the public registry how the critical habitat is legally protected. Southern Resident killer whales were listed as endangered under SARA in 2004.

RECOVERY PLANNING

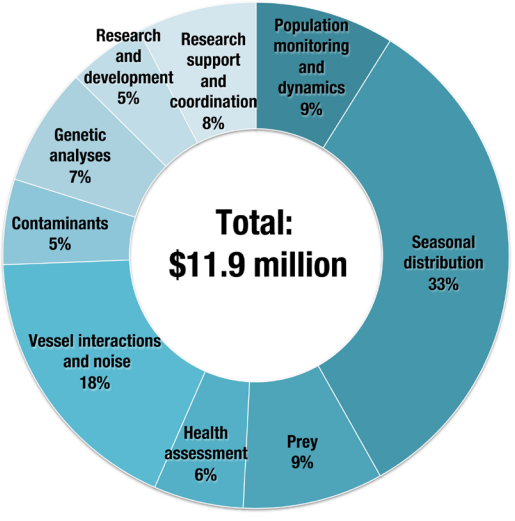
United States Recovery Plan for Southern Resident Killer Whales

With extensive input from the public, NOAA Fisheries completed a recovery plan for Southern Residents in January 2008. The plan identified the potential threats to address and important data gaps to fill and includes actions to address each of the threats. Efforts are underway by local and regional partners, state and federal groups, and coastal communities to address all of the threats and conserve and protect Southern Resident killer whales. Recovery is a long-term effort and will require cooperation, coordination, and dedication of resources in the years to come. Over the past decade, scientists have advanced our knowledge about the biology of the whales, the threats they face, and other information guiding conservation of this endangered species. But Southern Residents still face an uncertain future. Research and conservation activities remain important to the process of learning more about the whales and informing our actions to protect them.

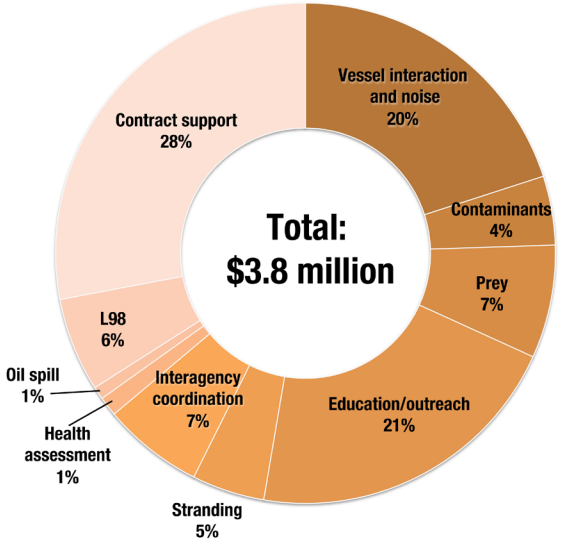
Recovery Strategy for Killer Whales in Canada

Canada's Department of Fisheries and Oceans completed a Recovery Strategy for Northern and Southern killer whales in 2008. The document lists historic threats as live captures, intentional shootings and acoustic harassment devices. Current threats are identified as environmental contaminants, reduced prey availability, acoustic disturbance, oil spills, and incidental mortality in fisheries. The goal of the resident killer whale recovery strategy is to ensure long-term viability by preserving their reproductive potential, genetic variation, and cultural continuity. Measures of recovery success include steady or increasing population size, sufficient males and females to ensure reproduction, and maintenance of matrilines comprised of multiple generations. DFO is currently developing an Action Plan for Northern and Southern Resident killer whales in Canada. A draft was released for public comment in March 2014 which identified specific actions to be taken to address threats and monitor recovery.

Total Funding for Science and Research 2003-2012 by Category



Total Funding for Management and Conservation Actions 2003-2012 by Category



U.S. Federal Funding: The pie charts include all expenses associated with each category, including supplies, equipment, travel, and federal and contracted labor and overhead costs. Federal labor costs were not tracked to the project level, but are applied proportionally across all categories.

RECOVERY EFFORTS

This guide summarizes 10 years of work, largely based on NOAA's 2014 10 year report and supplemented to include additional efforts. In the U.S. progress was possible largely through funds appropriated by the U.S. Congress to NOAA Fisheries which support a variety of collaborative projects. This ongoing work would not be possible without the hard work and expertise of many partners. Many of the projects, scientific discoveries, and management actions listed in this guide are the result of successful collaborations with multiple entities and many are transboundary involving U.S. and Canadian partners. In some cases NOAA provided funding to groups to conduct an action or research project; in others partners provided critical expertise, advice, or consultations. A list of all major partners is included in NOAA's full 10 year report. Regional partnerships are essential to build upon past success and recover Southern Resident killer whales together. The following eleven categories highlight some of the ongoing recovery efforts.

PREY AVAILABILITY

Recovery Goal: Rebuild depleted populations of salmon and other prey to ensure an adequate food base for the recovery of the Southern Residents.

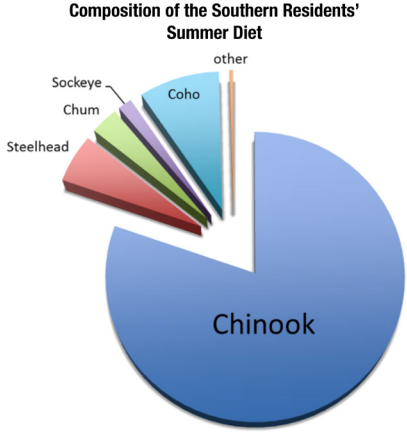
Science and Research: To better understand Southern Resident orca diet, NOAA researchers have collaborated with experts over the past 9 years, collecting fecal material and prey remains from the whales to determine what they eat.

Major Findings:

- Fraser River Chinook salmon make up the bulk of the whales' summer diet while they are in the Salish Sea. They also consume Chinook from Puget Sound, the Columbia, Sacramento, Klamath, and other coastal river systems.
- To a lesser extent the whales also consume other salmon species and groundfish such as halibut and lingcod. In Puget Sound, chum salmon appear to be a particularly important item during the late fall.
- The backscatter patterns (the scattering of particles) of fish air bladders are unique for each salmon species, and these unique patterns likely allow the whales to distinguish Chinook salmon from other species using echolocation.
- The daily energy requirements of the whales were estimated, and scientists calculated that the whales consume hundreds of thousands of adult salmon each year. It was determined that the west side of San Juan Island is a foraging "hot spot" for Southern Residents during the summer.
- Studies showed that the whales traveled over a greater area and their movement patterns were more complex in the late 1990s, when prey availability was low. Survival and birth rates in the Southern Resident killer whale population are correlated with coast-wide abundance of salmon.

- An analysis of hormones in the feces of Southern Residents showed that reduced prey availability has a greater effect on these whales than vessel traffic. During years of very poor food availability the presence of vessels could contribute to stress. Killer whale body size was estimated from photographs taken above whales using a helicopter. This novel method has promise for helping to understand how food availability impacts whale body condition and growth.

Management: Since the whales eat Columbia River and Sacramento River salmon, Southern Residents were included in NOAA's assessment of the Federal Columbia River Power System (FCRPS) and the state and federal water projects in California, which affect multiple species of ESA-listed salmon and steelhead. NOAA and the Department of Fisheries and Oceans Canada appointed an independent science panel to review salmon harvest and its effect on Southern Resident killer whale recovery. The science panel held three workshops in 2011 and 2012 and provided a final report in November 2012. They concluded that there was a great deal of uncertainty about whether current fisheries remove enough salmon to have a meaningful influence on the whales' status. The report will continue to be used to inform the management of salmon fisheries as part of the recovery programs for Southern Residents in the U.S. and Canada. The final report is available at: www.westcoast.fisheries.noaa.gov/.



Future Goals:

- Understand competition between other salmon predators including seals and sea lions, Northern Resident killer whales, and fisheries.
- Continue research on whale health related to diet.
- Continue to study SRKW winter diet.
- Investigate inter-year variability in killer whale diet.
- Continue to evaluate relationships between salmon abundance and whale health and minimize effects of actions that change salmon abundance.

CONTAMINANTS

Recovery Goal: Minimize pollution and chemical contamination in Southern Resident habitats.

Science and Research: U.S. and Canadian researchers first measured chemical pollution in the whales in the early 1990s. They found that the whales had high levels of PCBs but did not measure some other important contaminants such as DDT and flame-retardants. Over the past decade, NOAA Fisheries researchers have collected many more biopsy samples from the whales in order to measure current levels of a number of pollutants.

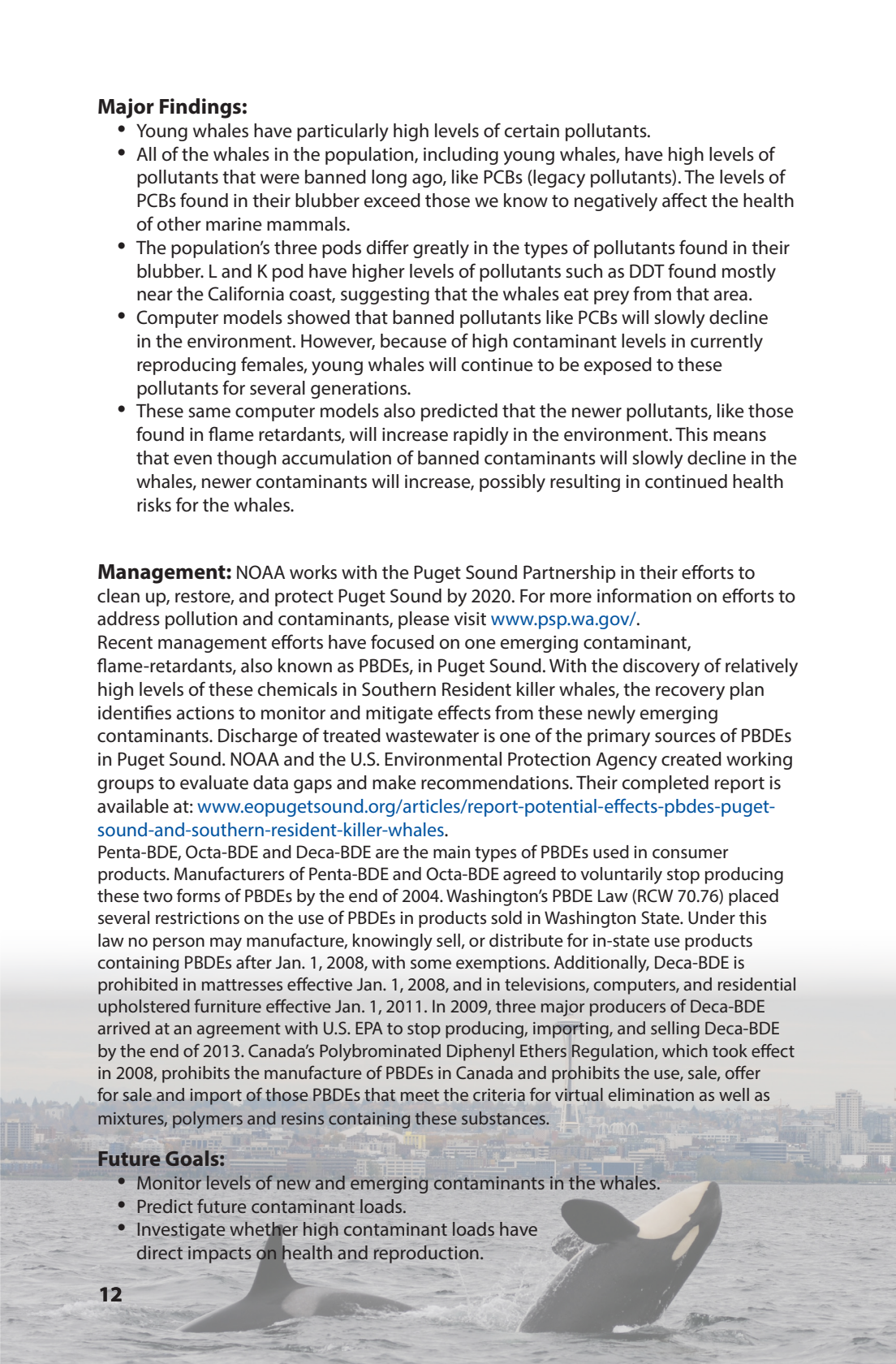
Major Findings:

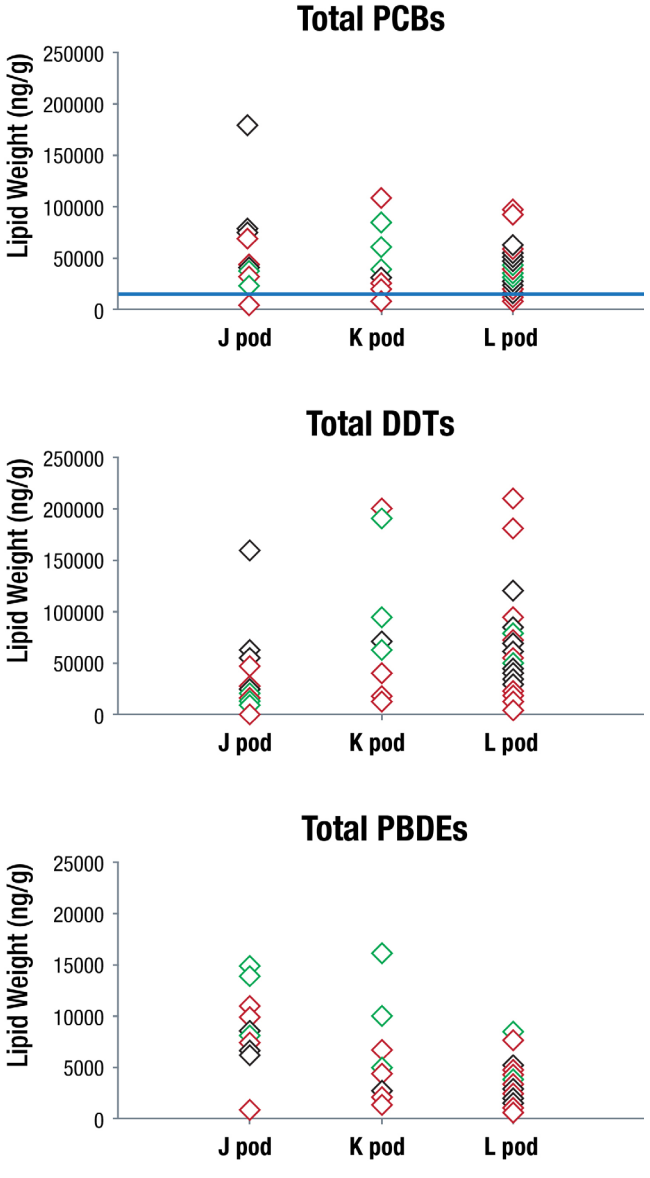
- Young whales have particularly high levels of certain pollutants.
- All of the whales in the population, including young whales, have high levels of pollutants that were banned long ago, like PCBs (legacy pollutants). The levels of PCBs found in their blubber exceed those we know to negatively affect the health of other marine mammals.
- The population's three pods differ greatly in the types of pollutants found in their blubber. L and K pod have higher levels of pollutants such as DDT found mostly near the California coast, suggesting that the whales eat prey from that area.
- Computer models showed that banned pollutants like PCBs will slowly decline in the environment. However, because of high contaminant levels in currently reproducing females, young whales will continue to be exposed to these pollutants for several generations.
- These same computer models also predicted that the newer pollutants, like those found in flame retardants, will increase rapidly in the environment. This means that even though accumulation of banned contaminants will slowly decline in the whales, newer contaminants will increase, possibly resulting in continued health risks for the whales.

Management: NOAA works with the Puget Sound Partnership in their efforts to clean up, restore, and protect Puget Sound by 2020. For more information on efforts to address pollution and contaminants, please visit www.psp.wa.gov/.
Recent management efforts have focused on one emerging contaminant, flame-retardants, also known as PBDEs, in Puget Sound. With the discovery of relatively high levels of these chemicals in Southern Resident killer whales, the recovery plan identifies actions to monitor and mitigate effects from these newly emerging contaminants. Discharge of treated wastewater is one of the primary sources of PBDEs in Puget Sound. NOAA and the U.S. Environmental Protection Agency created working groups to evaluate data gaps and make recommendations. Their completed report is available at: www.eopugetsound.org/articles/report-potential-effects-pbdes-puget-sound-and-southern-resident-killer-whales.
Penta-BDE, Octa-BDE and Deca-BDE are the main types of PBDEs used in consumer products. Manufacturers of Penta-BDE and Octa-BDE agreed to voluntarily stop producing these two forms of PBDEs by the end of 2004. Washington's PBDE Law (RCW 70.76) placed several restrictions on the use of PBDEs in products sold in Washington State. Under this law no person may manufacture, knowingly sell, or distribute for in-state use products containing PBDEs after Jan. 1, 2008, with some exemptions. Additionally, Deca-BDE is prohibited in mattresses effective Jan. 1, 2008, and in televisions, computers, and residential upholstered furniture effective Jan. 1, 2011. In 2009, three major producers of Deca-BDE arrived at an agreement with U.S. EPA to stop producing, importing, and selling Deca-BDE by the end of 2013. Canada's Polybrominated Diphenyl Ethers Regulation, which took effect in 2008, prohibits the manufacture of PBDEs in Canada and prohibits the use, sale, offer for sale and import of those PBDEs that meet the criteria for virtual elimination as well as mixtures, polymers and resins containing these substances.

Future Goals:

- Monitor levels of new and emerging contaminants in the whales.
- Predict future contaminant loads.
- Investigate whether high contaminant loads have direct impacts on health and reproduction.





The concentrations of PCBs, DDTs, and PBDEs found in the whales' blubber vary by pod, sex, age, and pollutant, but all of the whales in the population, including young whales, have high levels of pollutants that were banned long ago (known as legacy pollutants), like PCBs. The levels of PCBs found in their blubber exceed the levels we know to cause poor health effects in other marine mammals. Figure generated using data from Krahn et al. 2007, Krahn et al. 2009 and NWFSC unpublished data.

VESSEL EFFECTS

Recovery Goal: Minimize disturbance of Southern Resident killer whales from vessels.

Science and Research: Working with partners, NOAA completed studies providing insights into the trends in vessel activity and how the whales react to vessels. The results helped the agency create new regulations for vessel activities in areas frequented by Southern Resident killer whales.

Major Findings:

- Monitoring data from the Soundwatch Boater Education Program indicate recreational boaters are the most common vessel type observed out of compliance with the whale watch guidelines and regulations.
- In the San Juan Islands there is a higher vessel presence on weekends and holidays and a small increase in overall vessel traffic in 2010 compared to a similar 2006 study.
- A detailed survey of the whale watching industry was conducted to evaluate how future regulations might affect employment and participation in this important tourist activity.
- Average noise levels in Haro Strait are strongly influenced by large vessels such as commercial ships.
- Noise from motoring vessels at distances of up to 400 meters has the potential to affect echolocation abilities of foraging whales.
- Ambient noise levels increase as the number of vessels increase.
- NOAA studies documented particularly high noise levels experienced by whales in close proximity to certain types of vessels such as small recreation and commercial whale watch boats.
- Research demonstrates that killer whales spend a greater proportion of time traveling and less time foraging in the presence of vessels, including kayaks.
- Results from research show that Southern Residents modify their behavior by increasing surface activity (breaches, tail slaps, and pectoral fin slaps) and swimming in more erratic paths when vessels are close.
- Southern Resident killer whales increase the amplitude (loudness) of their calls when noise levels in their environment are high.
- NOAA estimated the potential energetic impact of increased surface activity and louder calls in wild killer whales by quantifying the energetic cost of the same activities in trained bottlenose dolphins.

Management: ***Regulations in the United States***- In April 2011, NOAA Fisheries announced new regulations to protect killer whales in Washington State from vessel impacts. The rule prohibits vessels from approaching any killer whale closer than 200 yards, and prohibits vessels from intercepting or parking within 400 yards of the path of the whales. These regulations were developed and informed by public input, scientific results from research, and data from the Soundwatch Boater Education Program that monitors boat activity around the whales. NOAA also considered the potential costs of the regulations to various stakeholder groups, including the whale watching industry and fishing communities.

The regulations strike a balance by providing protection for endangered Southern Resident killer whales while still allowing for educational and economically viable whale watching. In 2013, the Washington Department of Fish and Wildlife received a NOAA endangered species grant to support enforcement. For more information on the U.S. regulations and the transboundary "Be Whale Wise" guidelines for the U.S. and Canada, please visit: www.bewhalewise.org/. In addition to their commitment to follow regulations and guidelines, the Pacific Whale Watch Association also has Best Practices Guidelines specific to industry operations to manage their vessels responsibly in support of conservation.

Marine Mammal Regulations in Canada- Section 7 of the Marine Mammal Regulations (MMR) in Canada prohibits the disturbance of marine mammals. Efforts are currently underway to amend the MMR to elaborate on specific activities such as marine mammal watching. The proposed regulations would include conservation and protection objectives, introduce a minimum approach distance of 100 meters to all cetaceans with some commercial vessels exempted, introduce alternative approach distances tailored to accommodate unique regional or local needs, and prohibit aircraft from disturbing marine mammals. The regulations would also introduce a provision allowing for licenses to conduct research that may disturb marine mammals but could contribute to conservation and protection or assist animals in distress such as those that are entangled or stranded. www.dfo-mpo.gc.ca/acts-lois/rules-reglements/rule-reglement05-eng.htm

Future Goals:

- Investigate whether noise and vessels prevent whales from finding enough food.
- Use data from innovative acoustic suction cup tags (Dtags) to construct models to better understand the impacts of behavior change due to vessel presence and noise.
- Conduct field studies and use monitoring data to evaluate effectiveness of new vessel regulations.
- Quantify sources of human-generated noise throughout the Southern Resident killer whales' range and assess their impacts.
- Continue to enforce vessel regulations.

OIL SPILL PREVENTION AND RESPONSE

All of the Southern Residents are periodically in the same location at the same time (known as a "superpod"), making the whales very vulnerable to a catastrophic event like an oil spill during such times. Many efforts are underway to prevent oil spills, but in the event they do occur, NOAA and DFO are working on plans to reduce their impacts. NOAA Fisheries worked closely with partners to develop a killer whale-specific oil spill response plan. Together with the University of California at Davis, they hosted a workshop with researchers, oil spill responders, and oil industry representatives and developed a draft oil spill response plan for killer whales. Working with the Washington Department of Fish and Wildlife, the Region 10 Regional Response Team and the Northwest Area Committee, the plan was adopted in 2010 as part of the Northwest Area Contingency Plan and is also available to inform transboundary spill response.

STRANDING RESPONSE

We can protect the whales by rescuing sick or injured whales and by learning about what may be causing death in the animals that wash up on our shores. Responding to stranded killer whales is an important data source for learning about the threats to the whales. Members of the West Coast Marine Mammal Stranding Network are prepared for and respond to stranded killer whales. They follow a specific stranding protocol for killer whales, and partners developed a detailed Killer Whale Necropsy and Disease Testing Protocol to gather information about the potential cause of death for animals washed up on our shores. In partnership with University of California at Davis there is funding support to ensure prompt and thorough examinations of every stranded killer whale carcass. To report a dead or stranded marine mammal call1-866-767-6114.

WINTER DISTRIBUTION

Prior to 2003, data on the whales' winter distribution and movement patterns were limited to a handful of sightings off the West Coast over several decades. This was a large information gap, since the whales spend well over 50% of their time on the outer coast where they are difficult to observe. Understanding more about the whales' coastal habitat has helped us learn what they are eating, what threats they face in this part of their habitat, and how to protect this important part of their range.

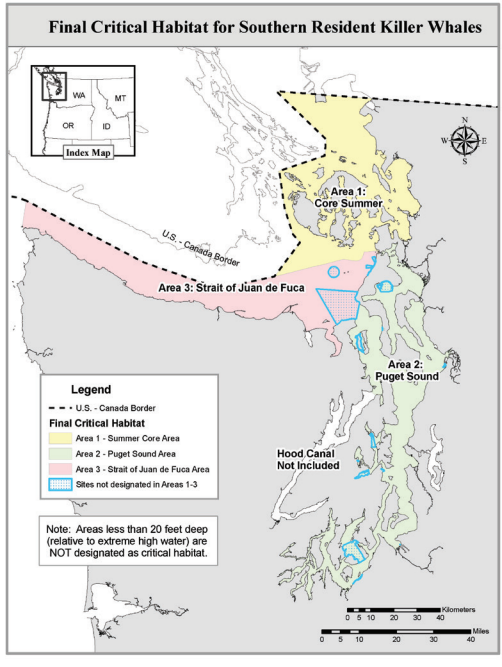
Science and Research: To determine where the whales spend their time outside of the inland waters of Washington and British Columbia, researchers use a variety of technologies, including passive acoustic monitoring, a land-based sighting network, coastal research cruises, and most recently satellite-linked tags.

Major Findings:

- NOAA located and recorded the location of Southern Residents off the Washington and Oregon coasts on 6 of 7 cruises to study the whales since 2004.
- The sighting network in inland Washington waters and along the West Coast was expanded.
- Passive acoustic recorders deployed at 7 sites off the West Coast detected dozens of Southern Resident calls, providing an improved understanding of where the whales go along the coast.
- NOAA implemented a satellite-linked tagging program to directly determine whale movements. They collected 93 days of winter location information for K pod in 2013 and a month of locations for J pod in 2014.
- In 2013, researchers used satellite tagging information to follow the whales along the coast for 8 days, allowing nearly continuous investigations of behavior and habitat use. Scientists also collected numerous prey and fecal samples to learn more about winter diet, and oceanographic data helped them understand features of their environment on the outer coast of Oregon.
- Prey and fecal samples collected during coastal cruises suggest that Southern Residents consume Chinook, steelhead, chum, lingcod, and halibut during winter and spring months.

Management: NOAA Fisheries designated critical habitat for Southern Resident killer whales in 2006. Three specific areas were designated which together comprise approximately 2,560 square miles (6,630 square kilometers) of marine habitat in inland waters of Washington:

1. **Summer Core Area in Haro Strait and waters around the San Juan Islands.**
2. **Puget Sound.**
3. **Strait of Juan de Fuca.**



At the time, areas off the coast were not included because of the limited information regarding the whales' distribution along the coast. In January 2014, the Center for Biological Diversity submitted a petition to NOAA Fisheries requesting an expansion of the critical habitat to include offshore waters of the Pacific Ocean. New information from the current research activities will inform future consideration of critical habitat along the coast.

As part of the Canadian Recovery Strategy, critical habitat under the Species at Risk Act is identified for Southern Residents in Haro Strait, Boundary Pass, the Strait of Georgia, and the Strait of Juan de Fuca adjoining critical habitat areas in U.S. waters.

Future Goals:

- Address questions about SRKW life during the winter (diet, behavior, threats) to assess which risk factors may be impacting the whales in this portion of their range.
- Evaluate expanding critical habitat areas to include waters along the west coast where they range.

GENETICS AND MATING PATTERNS

In its listing of the Southern Resident killer whales under the ESA, NOAA Fisheries determined that the whales are a distinct population within a sub-species of killer whales consisting of fish-eating resident killer whales of the North Pacific Ocean. The taxonomy of killer whales remains uncertain, however.

Science and Research: NOAA Fisheries has funded and conducted research on the genetic relationships of different groups of killer whales in the Pacific and worldwide. They have also used genetic information to evaluate patterns of mating and

inbreeding within the Southern Resident population. This information is useful for evaluating whether the population is suffering adverse effects from inbreeding.

Major Findings:

- Genetic analysis of historical samples from museum collections revealed that the historical range of Southern Residents was similar to what it is today.
- Working with collaborators, genetic data was used to discover that the resident and transient killer whale ecotypes in the North Pacific diverged from each other at least 20,000 years ago, and possibly much earlier, with almost no interbreeding between the ecotypes.
- Paternity analysis revealed that the oldest and largest males are the most successful breeders in the population.
- This paternity analysis also showed that sometimes Southern Residents mate with whales in their own pod, a behavior not seen in other killer whale populations. Despite this mating within pods, the overall level of inbreeding within the population appears to be low.

Management: In 2012 NOAA received a petition asking to remove the Southern Resident killer whales from the list of endangered species. Based on the best available information, including new genetic information released since the ESA listing in 2005, they reaffirmed that the North Pacific residents are likely a sub-species and that the Southern Residents are a distinct population segment of that sub-species. In 2013 they found that delisting was not warranted and the Southern Residents maintained their endangered status under the ESA.

Future Goals:

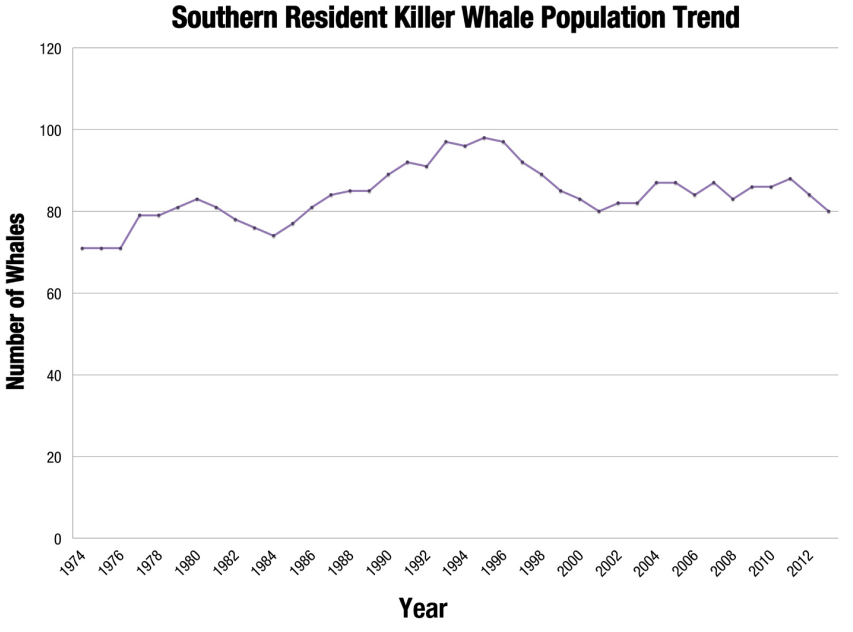
- Continue to collect and analyze data to inform killer whale taxonomy and breeding patterns.
- Collect data needed to estimate historical abundance.
- Use taxonomic and genetic information to assess the status of population and recovery criteria during reviews of listing status and in response to petitions.

DEMOGRAPHICS AND HEALTH

One of the most important methods for assessing the status of this endangered population is the annual census, which has been conducted by The Center for Whale Research every year since 1976. NOAA Fisheries has funded the annual survey from 2003 to 2014. The data collected provides managers with current information on Southern Resident population status and trends, updates to photo-identification guides, relationships among individual whales, and valuable data for advancing scientific research that help predict population-level responses to environmental change.

Major Findings and Milestones from Studies using the Census Data:

- The ongoing census provided accurate demographic information, including births, deaths, and the numbers of whales by age and sex.
- Census studies showed that the small size of the population makes it difficult to forecast how alterations in Chinook salmon fishing might impact the population.



- Despite an overlapping range and a similar diet, annual survival and birth rates of Southern Residents are depressed compared to Northern Residents. For example, over her full reproductive lifetime, a Northern Resident female produces on average one more calf than a Southern Resident female.
- Data from the annual census helped confirm that individual whales prefer to spend most of their time with their own pods and close relatives, although the amount of time varies annually.
- The whales spend less time in large social groups during times of population decline and potentially low prey abundance. This suggests that their environment influences their social structure, and such changes in social groups can affect other behaviors such as patterns of mating, group foraging, and social care of calves.

Future Goals:

- Continue to monitor population size and response to changes in salmon abundance.
- Improve estimates of the carrying capacity of the environment for the whales.
- Develop an ecosystem model that predicts how the population may change with changes in diet due to seasons and availability, and competition with other predators.
- Conduct new nutritional studies and breath analyses to understand conditions that may contribute to killer whale mortality.
- Investigate stranded animals and other samples to understand the risk disease poses to these animals.
- Use health assessment and stranding investigation results to help prioritize recovery actions.

EDUCATION AND OUTREACH

Education and outreach about the recovery of Southern Resident killer whales raises public awareness and knowledge about the whales, the threats they face, and stewardship actions people can take to support recovery. Many organizations strive to inform the public about the whales. Here we present a few examples of education and outreach programs and links to learn more information about organizations and programs:

The Whale Museum Naturalist Class at the Center for Whale Research

The Whale Museum on San Juan Island was founded in 1979. Dedicated to the recovery of the Southern Resident killer whales, the museum's mission is to promote stewardship of whales and the Salish Sea ecosystem through education and research. They accomplish this through their Orca Adoption Program, Soundwatch Boater Education Program, San Juan County Marine Mammal Stranding Network, Whale Hotline, Marine Naturalist Training Program, Salish Sea Association of Marine Naturalists, public lectures and workshops, and Exhibit Hall tours and programs for all ages. www.whalemuseum.org

The Whale Museum's **Soundwatch** and Cetus Research & Conservation Society's **Straitwatch** programs monitor vessel activity around Southern Resident killer whales. They work co-operatively to provide on-the-water education to boaters about the killer whales, the threats that they face and how to modify boating behavior to minimize impacts on the whales. Soundwatch and Straitwatch also collect detailed data on the numbers and types of vessels in the vicinity of whales, and on incidents of non-compliance with the 'Be Whale Wise' laws and marine wildlife guidelines. They engage and educate local communities about how they can observe marine mammals in their natural environment while minimizing disturbance. www.whalemuseum.org/pages/soundwatch-boater-education- program. www.cetussociety.org/marine-stewardship-programs/straitwatch/

NOAA Fisheries' Education Program works with NOAA experts and partner organizations to develop and distribute science-based materials and activities for students and teachers. The materials also help students, teachers, and the interested public better understand the agency's diverse mission which includes the management and stewardship of the nation's marine resources and their habitats, sustainable seafood, and the recovery of protected marine species. The high school curricula on orca recovery aligns with state learning requirements and is available for use in Washington State public schools. www.westcoast.fisheries.noaa.gov/education/killerwhale.html

The **Salish Sea Association of Marine Naturalists** (SSAMN) is affiliated with The Whale Museum. Its members are active and aspiring naturalists from the United States, Canada and beyond. The mission is to promote education and stewardship of the Salish Sea ecosystem through a network of professional naturalists. SSAMN is involved in ongoing efforts to raise awareness and help in the recovery of Southern Resident orcas and their ecosystem. ssamn.whalemuseum.org

The Whale Trail is a series of more than 50 sites along the west coast of the US and Canada to view orcas and other marine mammals from shore. The Whale Trail's goals are to connect visitors to orcas and other marine wildlife; inspire stewardship and build community; and promote land-based whale watching. The Whale Trail is led by a core team of partners including NOAA Fisheries, Washington Department of Fish and Wildlife, Olympic Coast National Marine Sanctuary, The Seattle Aquarium and The Whale Museum. www.thewhaletrail.org

Founded in 1967, the **American Cetacean Society** (ACS) is the oldest whale conservation organization on the planet. Their mission is to protect cetaceans and their habitats through research, education, and conservation actions. The Puget Sound Chapter of ACS is centered in Seattle, Washington, where members from all parts of the Northwest join together to work to protect whales, dolphins, porpoises, and their habitats. They support critical research by awarding grants to scientists and students. They also provide educational outreach programs for both children and adults, and have an excellent Speaker Series featuring world-renowned scientists, authors and educators. www.acspugetsound.org

Orca Network is dedicated to raising awareness of the whales of the Pacific Northwest, and the importance of providing them healthy and safe habitats. They connect whales and people in the Pacific Northwest through educational programs, the annual Ways of Whales workshop, the Free Lolita Campaign, the Central Puget Sound Marine Mammal Stranding Network and the Whale Sighting Network. The purpose of the sighting network is to encourage observation and increase awareness and knowledge about the Southern Resident Community of orcas and to foster a stewardship ethic. Orca Network's Langley Whale Center celebrates and shares the lives of gray whales, orcas and other marine mammals of the Salish Sea. www.orcanetwork.org

The Seattle Aquarium opened in 1977 and sees over 800,000 visitors each year. Biologists at the Aquarium conduct critical research on a variety of Puget Sound species including sixgill sharks and sea otters in an effort to contribute to the health of our local marine environment. The Aquarium convened a Marine Conservation Network focused on building stronger awareness and action to protect Puget Sound and the oceans. They help accomplish their mission to inspire conservation of our marine environment through their Orca Family Activity Center and Southern Resident killer whale trading cards. www.seattleaquarium.org

Killer Whale Tales is an environmental education program that uses storytelling and field based science to inspire students to take an active role in the conservation of Pacific Northwest killer whales and their habitat. Students are transformed into researchers for the day as they participate in hands-on, interactive activities. After class, students use their knowledge and inspiration for a purpose. The Kids Making a Difference Now! activity challenges students and their families to understand, monitor, and finally reduce their ecological footprints at home for the benefit of the orcas. www.killerwhaletales.org

Whale Scout connects trained naturalists with the public, sharing their knowledge about the local whale population in Puget Sound, assisting them in sightings from shore, and offering everyday tips on what people can do to help with conservation. The mission is to protect Pacific Northwest whales through land-based conservation experiences and through restoration events and cleanups aimed at making our streams and shorelines healthier and more productive to support local fish populations including salmon. www.whalescout.org

The Port Townsend Marine Science Center is devoted to understanding and conserving our marine and shoreline environment. They inspire conservation of the Salish Sea through exhibits, programming, citizen science and their Orca Project and as part of the Salish Sea Hydrophone Network. The Orca Project was created after the body of a female transient killer whale stranded on the Olympic Peninsula in 2002. 'Hope' is now a new exhibit and educational program at the PTMSC. The project was established to raise awareness of killer whales, the threats they face, and things we can do to help them survive. www.ptmsc.org

The Pacific Whale Watch Association consists of dedicated whale watching and ecotourism businesses committed to research, education, and responsible wildlife viewing. All members of the PWWA have a great respect and admiration for the Pacific Northwest and its magnificent wildlife, regarding them as family. Many of the captains and naturalists are marine scientists and educators, and consider their boats to be classrooms on the water. They are also committed to direct conservation, using their extraordinary access to these sensitive populations of marine mammals to help protect them for generations to come. www.pacificwhalewatchassociation.org

The Shaw Ocean Discovery Centre is located on the waterfront in Sidney, on Vancouver Island. The aquarium's exhibits and programs are focused entirely on the amazing ecosystem and marine wildlife of the Salish Sea. The aquarium's vision is to be a champion for the Salish Sea and inspire all generations to explore, respect, and take action for ocean wildlife. www.oceandiscovery.ca

The Saturna Island Marine Research & Education Society was established in 2012. The mission of SIMRES is to attract scientific research and educational programs to Saturna through partnerships with universities, aquariums, parks, scientists, educators and other environmental organizations; be a center for marine research and education, to encourage the development of citizen science and environmental stewardship; and bring all people closer to an understanding of and appreciation for the intricate web of the marine ecosystem through presentations, workshops and hands-on experiences. www.saturnamarineresearch.ca

Friends of Lime Kiln Society (FOLKS) is a group of islanders dedicated to supporting and sustaining Lime Kiln Point State Park. This 36-acre park, located on the western shoreline of San Juan Island, Washington, is considered to be one of the most revered places on the planet to view orca whales from land. FOLKS" mission is to provide a unique experience for visitors through support and development of educational programs and activities related to Lime Kiln Point State Park's extraordinary location, diverse ecosystems, and historic structures. www.folkssji.org

RESEARCH

There is an active research program including many federal, state and private organizations that often work collaboratively to answer the remaining questions about Southern Residents. Many of the research programs also support education and outreach. Here we list just a few of the groups leading a variety of research programs focused on killer whales.

Tucker the whale scat sniffing canine

The University of Washington **Center for Conservation Biology** has been using their Conservation Canines to comprehensively monitor the physiological health of Southern Resident killer whales since 2006. The program combines the precision and efficiency of detection dogs to readily locate wildlife scat (feces) samples. These samples enable scientists to assess stress, reproductive and nutritional health as well as toxin loads of individually identified whales, all in relation to the environmental pressure(s) the whales encounter. Their most recent findings indicate high rates of late term miscarriages in the whales that appear to be linked to poor nutrition and may also have a toxicologic signal. www.conservationbiology.uw.edu

The mission of NOAA's **Northwest Fisheries Science Center** is to conduct the science necessary to conserve marine and anadromous species and their habitats off the Washington, Oregon and northern California coasts and in freshwater rivers of Washington, Oregon and Idaho. Their research provides reliable, relevant and credible information to help decision-makers and natural resource managers build sustainable fisheries, recover endangered and threatened species, maintain healthy ecosystems, and protect human health. The Center is also dedicated to enhancing public awareness, education and stewardship of our marine resources. www.nwfsc.noaa.gov

The mission of **Washington Department of Fish and Wildlife (WDFW)** is to preserve, protect and perpetuate fish, wildlife and ecosystems while providing sustainable fish and wildlife recreational and commercial opportunities. They created the Washington State Status Report for the Killer Whale and placed SRKW on the State endangered species list in 2004. WDFW is currently in the process of updating the killer whale status report to determine whether the species warrants its current listing or deserves to be reclassified or delisted. www.wdfw.wa.gov

Center for Whale Research (CWR) is dedicated to the study and conservation of the Southern Resident killer whale population in the Pacific Northwest. Orca Survey is a long-term photo-identification study of the Southern Resident killer whales, initiated by Principal Investigator, Kenneth Balcomb in 1976 to ascertain the population size

of the killer whales in the Greater Puget Sound environs of Washington State. Today the mission remains the same: to conduct benign studies of regional killer whales for the purpose of conserving populations and informing both the government and the public of their ecosystem needs. www.whaleresearch.com

Starting in 2003 **Cascadia Research Collective** began a variety of research efforts focused on killer whales, most in collaboration with the Northwest Fisheries Science Center of NOAA Fisheries. Current projects focus on studying the underwater acoustics and behavior of Southern Resident killer whales using DTAGs, diving behavior and movement patterns of mammal-eating killer whales, and a study of diet and behavioral cues of predation in fish-eating killer whales. This latter project was begun in 2002 in collaboration with the Northwest Fisheries Science Center and involves collecting fecal samples (for genetic analysis of diet) and prey remains left behind foraging whales. www.cascadiaresearch.org

The Sea Doc Society works to protect the health of marine wildlife and their ecosystems through science and education. Founded in 1999, they conduct and sponsor scientific research in the Salish Sea. Sea Doc has been working on killer whale health for over a decade and published an early paper looking at what is known about diseases in killer whales. They also have coordinated killer whale stranding response in the North Pacific Ocean, published a paper on historical killer whale stranding trends, helped create a killer whale necropsy protocol and are working with collaborators on identifying causes of mortality for killer whales. www.seadocsociety.org

Dr. Stephen Raverty is an adjunct professor with the University of British Columbia and a board certified veterinary pathologist with the British Columbia Ministry of Agriculture and Land in Abbotsford. Dr. Raverty participates in the post-mortem examination of stranded marine mammals off the coast of B.C. He investigates underlying health issues the animals might have had, and what they might reveal about the health of our ecosystems, particularly the transfer of terrestrial pathogens to the marine environment. www.fisheries.ubc.ca/faculty-staff/stephen-raverty

Dr. Bob Otis is a Professor of Psychology Emeritus with Ripon College in Wisconsin. Since 1990 he, along with interns and volunteers, has been taking data from Lime Kiln Point State Park. He documents several variables in his study area, including individual whales present, numbers of boats, whale behavior and social patterns. He also takes acoustic recordings for further analyses. What has resulted is a long-term data set that can be used by other scientists and students to evaluate trends and behavior of Southern Resident killer whales.

Beam Reach Marine Science and Sustainability School is an off-campus adventure that lets advanced undergrads and recent graduates live the life of a marine biologist. They emphasize passive acoustics – listening to ambient underwater sound with hydrophones. Beam Reach students develop and answer their own scientific questions – from initial hypothesis through data collection and analysis to final presentation of their results. www.beamreach.org

The **Salish Sea Hydrophone Network** consists of a series of underwater microphones (hydrophones) throughout the Salish Sea, and is an experiment in sharing real-time underwater sounds. The partnership consists of The Whale Museum, Colorado College and Beam Reach Marine Science and Sustainability School. The goal of this network is to detect orca sounds and measure ambient noise levels present in the habitat of the

endangered Southern Resident orcas. Over the years, a growing coalition of scientists, educators and citizens has been working together to expand this network of hydrophones. www.orcasound.net

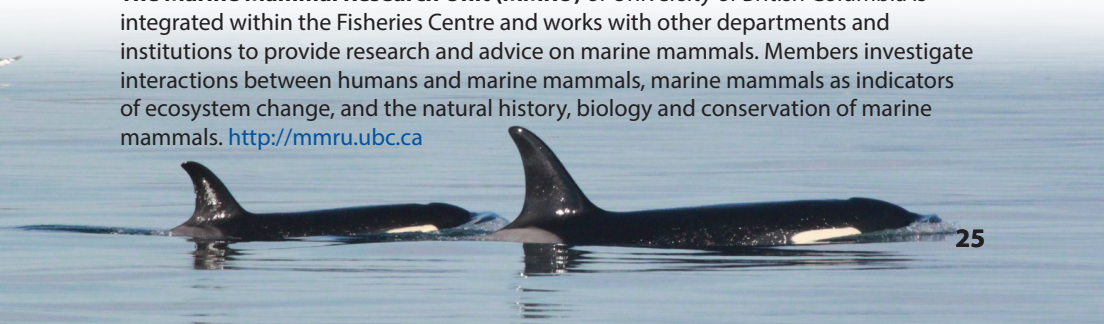
SMRU Marine was set up in 2006 as a commercial spin off of the Sea Mammal Research Unit (SMRU) at the University of St Andrews (Scotland). The US (SMRU USA) and Canadian (SMRU Canada) companies have conducted a number of research projects to help inform potential impacts of marine renewable and infrastructure projects on SRKW and other marine mammal species. These have included acoustic research (auto-detection of calls and clicks, localization, ambient noise and ship noise measurements, etc.), analyses of habitat use based on voluntary sightings, behavioral responses to noise and the potential population consequences of disturbance. www.smru.co.uk

The Pacific Biological Station (PBS) in Nanaimo, BC was established in 1908. It is the oldest fisheries research centre on the Pacific coast and forms part of a network of major scientific facilities operated by Fisheries and Oceans Canada. The Cetacean Research Program at the PBS conducts scientific studies on whales, dolphins and porpoises in waters off Canada's west coast. It was established in 2001, when the Station's long-term research on killer whales was expanded to include other cetaceans considered Endangered or Threatened under the new Species-at-Risk Act. Research projects include long-term monitoring of killer whale populations in British Columbia, acoustic communication and social evolution of killer whales, foraging specializations of killer whales, and coordination of incident response for cetaceans, pinnipeds, sea otters and sea turtles. www.pac.dfo-mpo.gc.ca/science/facilities-installations/pbs-sbp/index-eng.html

The Vancouver Aquarium is dedicated to affecting the conservation of aquatic life through display and interpretation, education, research and direct action. They have been part of the world's longest continuous study of killer whales, which includes photo identification, acoustic and DNA analysis. Current research focuses on long-term monitoring and photo ID, killer whale mating patterns, social systems and population structure based on DNA analysis. The Vancouver Aquarium also recently began the Ocean Pollution Research Program which focuses on the sources and consequences of ocean pollution, and on identifying practical solutions. www.vanaqua.com

The B.C. Cetacean Sightings Network is a research and conservation program of the Vancouver Aquarium, in collaboration with Fisheries and Oceans Canada. Their goal is to increase public awareness of British Columbia's whales, dolphins, porpoises and sea turtles, and the threats to their survival. Wild Whales works to both gather data on the occurrence of whales, dolphins and porpoise in BC waters and to educate boaters and coastal citizens about the threats these species face. www.vanaqua.org/conservationinaction/killerwhales/network.htm

The Marine Mammal Research Unit (MMRU) of University of British Columbia is integrated within the Fisheries Centre and works with other departments and institutions to provide research and advice on marine mammals. Members investigate interactions between humans and marine mammals, marine mammals as indicators of ecosystem change, and the natural history, biology and conservation of marine mammals. http://mmru.ubc.ca



SALMON RECOVERY EFFORTS

There are many efforts underway to support salmon recovery throughout the region. These are just a few examples of organizations and specific programs that naturalists can share with whale watchers to give them an idea of the scope of issues and efforts associated with recovering salmon populations and restoring habitat to support salmon recovery.

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established by Congress in 2000 to reverse the declines of Pacific salmon and steelhead, supporting conservation efforts in California, Oregon, Washington, Idaho, and Alaska. The program is essential to preventing the extinction of the 28 listed salmon and steelhead species on the west coast and, in many cases, has stabilized the populations and contributed to their recovery course. With this funding states and tribes have undertaken over 11,000 projects, resulting in significant changes in salmon habitat conditions and availability. Since 2000, over 1 million acres of spawning and rearing habitat has been restored and protected for salmon, and access to 8,000 miles of previously inaccessible streams has been re-established. www.westcoast.fisheries.noaa.gov

The **Puget Sound Partnership** is a Washington state agency serving as the backbone organization for Puget Sound recovery. In 2007 the Partnership was designated as the regional salmon recovery organization for Puget Sound salmon species, except Hood Canal summer chum. The Partnership is working with local stakeholders and communities, native tribes, businesses, and state and federal agencies to identify, sequence, prioritize, and implement projects and programs to recover salmon. Projects and programs include habitat protection and restoration, integration of harvest and hatchery management and public education. www.psp.wa.gov

Save our Wild Salmon is a diverse, nationwide coalition working to restore wild salmon and steelhead to the rivers, streams and marine waters of the Pacific Northwest for the benefit of our region's ecology, economy and culture. They focus their efforts on the Columbia and Snake River Basin and include a campaign to restore the lower

Snake River by removing four dams and reconnecting endangered wild salmon to more than 5,500 stream miles in the pristine, protected wilderness and wild lands of central Idaho, eastern Oregon and Washington. www.wildsalmon.org

The Elwha Ecosystem Restoration Project is a project of the U.S. National Park Service to remove two dams on the Elwha River on the Olympic Peninsula in Washington State and restore the river to a natural state. It is the largest dam removal project in history and the second largest ecosystem restoration project in the history of the National Park Service. Dam removal began in September 2011 and was completed in September 2014. Biologists are monitoring and radio tagging salmonids to gather information about recolonization of the river. www.nps.gov/olym/naturescience/elwha-ecosystem-restoration.htm

Long Live the Kings (LLTK) is a nonprofit organization committed to restoring wild salmon and steelhead to the waters of the Pacific Northwest. It was founded in 1986 by a group of salmon enthusiasts alarmed by declines in wild salmon runs. The **Pacific Salmon Foundation** was established in 1987 as an independent, non-governmental, charitable organization to protect, conserve and rebuild wild Pacific salmon populations in British Columbia and the Yukon Territory. Together Long Live the Kings and the Pacific Salmon Foundation are overseeing a project called the **Salish Sea Marine Survival Project**. Over 40 organizations are working together on this massive transboundary effort to determine the primary factors driving current low survival of juvenile salmon and steelhead in the Salish Sea. The outcomes of this extensive international effort will be instrumental in informing and prioritizing management decisions to advance the recovery of salmon and steelhead, increase sustainable fishing opportunities, and improve the health of the Salish Sea. A large focus of the Canadian salmon recovery efforts are with Fraser River Chinook which will ultimately benefit Southern Resident killer whales. www.marinesurvivalproject.com

The Northwest Indian Fisheries Commission (NWIFC) is a support service organization for 20 treaty Indian tribes in western Washington. The NWIFC was created following the U.S. v. Washington ruling (Boldt Decision) that re-affirmed the tribes' treaty-reserved fishing rights and established them as natural resources co-managers with the State of Washington. The commission provides direct services to tribes in areas such as biometrics, fish health and salmon management. Some examples of salmon habitat restoration projects led by native nations include: public awareness and knowledge about the whales, the threats they face, and actions people can take to support recovery. www.nwifc.org

- **The Jamestown S'Klallam Tribe** removed two six-foot culverts and 600 feet of road to open 37 acres of estuary habitat to summer chum and Chinook salmon.
- On the Elwha River where two dams have been removed, the **Lower Elwha Klallam Tribe** installed 11 logjams to slow the river and create habitat for salmon, removed invasive weeds, moved logs and tree root wads from the shoreline to denuded sites, and planted 14,000 native plants and trees.
- **The Nooksack Indian Tribe** installed more than 30 logjams in the north fork of the Nooksack River to protect forested islands in the main channel and increase the number and depth of pools for salmon spawning and rearing.
- **The Stillaguamish Tribe** installed six logjams on the Stillaguamish River and bought 126 acres of floodplain forest on the river's north fork. *From Indian Country Today Media Network*, author Richard Walker.

LEARNING FROM LUNA AND SPRINGER

NOAA has worked with Canada and many partners to respond to two lone killer whales that were separated from their families.

LUNA

Luna (L-98) was born in 1999 near San Juan Island. In the spring of 2001 he was declared missing from L Pod but later was seen alone in Nootka Sound off Vancouver Island. People began flocking to the area to see the young whale who had begun interacting with boaters. However some of the exchanges became dangerous and not everyone felt affection for Luna. Stewardship organizations, including The Whale Museum's Soundwatch Boater Education Program, attempted to intervene and educate the public in an effort to avoid problems and injury. Plans were made to return him to the Salish Sea in the hopes that he would rejoin the Southern Resident orcas, but with such a complicated issue and contrasting ideas on how best to reunite him with his family, the efforts failed.

On March 10, 2006 Luna was tragically killed in a tugboat accident. Luna's story has been memorialized in the movies *Saving Luna* and *The Whale* and in the book *The Lost Whale*.

SPRINGER

Springer (A73) was first seen in July 2000 with her mother. In 2001 neither she nor her mother returned to Johnstone Strait with the rest of their pod and it was thought that they had died. In January 2002, Springer was spotted alone in Puget Sound near the Vashon Island ferry. She was underweight and suffering from a skin condition. Springer began approaching boats and seeking attention, causing concern amongst researchers and environmental groups. NOAA Fisheries relocated the young whale to a seapen near Seattle and began medical treatment and rehabilitation. On July 13th she was taken by boat to a seapen in Johnstone Strait, where she soon reintegrated with family members. Today Springer appears to be a normal, healthy killer whale. Her first calf A104 (Spirit) was born in 2013.

These unique situations provided new insight into the challenges these whales face in their environment. Working with Springer taught us successful reintroduction strategies for young orcas with an absent mother and gave us useful health insights through disease and blood screenings. The experience with Luna highlighted risks of solitary killer whales interacting with boats and humans. The diverse transboundary partnerships formed as a result of these efforts continue to benefit recovery efforts for Northern and Southern Resident killer whale populations.

LOOKING AHEAD

After 10 years of funding, collaboration, and ingenuity there is much better information to guide decisions. However, the key threats remain challenging to understand and manage. Some of the most important threats facing the whales, such as prey limitation and high contaminant levels, cannot be addressed without a long-term commitment. Recovery of threatened salmon is a monumental task in itself and is expected to take many years. The threat of contaminants is also challenging, particularly considering that the whales remain contaminated by chemicals that were banned decades ago. There are also mysteries that persist. For example, will increases in salmon abundance benefit the Southern Residents, or will any increases be consumed by other populations such as the Northern Residents? Are there health issues, like disease, which have not yet been uncovered? New threats and actions must be considered as we look to a future with climate change, new alternative ocean energy projects, and continuing development along our coasts and in our ports. In the next 5 to 10 years, there are several high priority projects planned to help answer these remaining questions and inform management actions to advance recovery. New technologies are being developed to better understand disease threats, assess individual body condition and understand the health effects of carrying large contaminant burdens. New information on coastal distribution and habitat use will inform designation of additional critical habitat for the whales. Seasonal health assessments, habitat use, and potential times and places with prey limitations or vessel impacts will be taken into consideration when determining the need for additional conservation actions, such as a protected area. Recovery of the Southern Residents and their preferred salmon prey, as well as protection of their broad and diverse habitat, is a long-term process that requires support over a large geographic area, from California to Southeast Alaska. Recovery criteria are built around a time frame of 14 to 28 years based on the biology of these long-lived animals. It will take at least that long to evaluate the effectiveness of the protective measures put in place in the last several years. The last 10 years of federal funding and effort have secured a strong foundation of research and conservation, which we can build on to secure recovery of this iconic species for future generations.

STEWARDSHIP ACTIONS

Everything is connected! No matter where in the world your visitors live, their actions can make a difference. Here are some suggested stewardship actions you can offer.

REDUCE POLLUTION AND CHEMICALS IN THE MARINE ENVIRONMENT:

- **REDUCE, REUSE, RECYCLE**
- **GO ORGANIC**
- **USE BIODEGRADABLE CLEANING SUPPLIES**
- **USE STAINLESS STEEL WATER BOTTLES AND REUSABLE SHOPPING BAGS**
- **PLANT A RAIN GARDEN OR NATIVE VEGETATION IN YOUR YARD**
- **MANUALLY PULL WEEDS IN YOUR YARD INSTEAD OF USING CHEMICALS**
- **WASH YOUR CAR AT A CAR WASH OR ON YOUR LAWN INSTEAD OF ON THE STREET**
- **USE SLS (SODIUM LAURYL SULFATE) FREE ALTERNATIVES**
- **MAKE SURE YOUR CAR ISN'T LEAKING FLUIDS - THEY COULD END UP IN OUR WATERWAYS**
- **CHANGE YOUR BRAKES TO NON-COPPER ONES - COPPER IS TOXIC TO FISH**
- **CARPOOL OR BIKE TO WORK WHEN POSSIBLE**
- **KEEP OIL AND PAINT OUT OF STORM WATER DRAINS**
- **SHOP LOCAL TO REDUCE THE USE OF FOSSIL FUELS**
- **GET INVOLVED IN YOUR OWN CLEAN UP EFFORTS**

HELP IN SALMON RECOVERY EFFORTS:

- **PURCHASE SEAFOOD ONLY FROM SUSTAINABLE FISHERIES**
- **USE A SEAFOOD WATCH CARD OR SEA CHOICE CARD OR APP**
- **DON'T EAT FARMED ATLANTIC SALMON**
- **KEEP LIVESTOCK AND PETS AWAY FROM SALMON STREAMS**
- **GET INVOLVED IN LOCAL SALMON HABITAT RESTORATION PROJECTS**

BE WHALE WISE:

- **GET EDUCATED ABOUT BEST PRACTICES FOR WHALE WATCHING BY REVIEWING THE BE WHALE WISE GUIDELINES AND KAYAKERS CODE OF CONDUCT**
- **CHOOSE TO GO WHALE WATCHING WITH A COMPANY THAT BELONGS TO THE PACIFIC WHALE WATCH ASSOCIATION WHO FOLLOWS ESTABLISHED REGULATIONS AND GUIDELINES**
- **CHOOSE TO GO WHALE WATCHING WITH A COMPANY THAT HIRES PROFESSIONAL NATURALISTS SO YOU CAN BE EDUCATED ABOUT SOUTHERN RESIDENTS AND THE ISSUES THEY FACE**
- **WHALE WATCHING CAN ALSO BE DONE FROM SHORE - CONSIDER INCLUDING LAND BASED VIEWING IN YOUR PLANS**

GENERAL BEST PRACTICES:

- **REDUCE ENERGY USE BY UNPLUGGING THINGS WHEN NOT IN USE, USE ENERGY EFFICIENT APPLIANCES OR INSTALL SOLAR PANELS**
- **REDUCE WATER USE BY TAKING SHORTER SHOWERS OR COLLECTING RAIN WATER FOR YOUR GARDEN AND CLEANING NEEDS**
- **STAY INFORMED ABOUT THE ISSUES AND GET INVOLVED ANY WAY YOU CAN**
- **SPREAD THE WORD!**

LINK TO PUBLICATIONS: A list of NOAA's Southern Resident killer whale research publications as well as other publications related to Southern Resident killer whale research and recovery can be found here: www.whalemuseum.org/pages/publications. For a full list of partners and NOAA publications refer to 10 Years of Research and Conservation: http://www.nwfsc.noaa.gov/news/features/killer_whale_report/

NOAA FISHERIES

THE WHALE MUSEUM
EDUCATION • RESEARCH

This guide was a collaboration between The Whale Museum and NOAA and was printed on recycled paper. Special thanks to the photographers listed below.

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