



Southern Resident Killer Whale Vital Sign Gap Analysis and 2012 Marine Mammal Monitoring Program Inventory

Prepared by the PSEMP Marine Mammals Sub-Committee

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Sub-committee participants

Ken Balcomb (Center for Whale Research)
Lynne Barre (NOAA)
John Calambokidis (Cascadia Research)
Alan Chapman (Lummi)
Fred Felleman (Makah, Friends of the Earth, Whale Museum)
Nathalie Hamel (coordinator, Puget Sound Partnership)
Brad Hanson (NOAA)
Chris Harvey (NOAA)
Steve Jeffries (WDFW)
Jerry Joyce (Audubon)
Pete Schroeder, DVM (Straits Lead Integrating Organization)
Jonathan Scordino (Makah)

Charge to PSEMP workgroups

The Puget Sound Ecosystem Monitoring Program (PSEMP) is an independent collaboration of monitoring practitioners, researchers, and data users from across the region. PSEMP's goals are to evaluate progress toward ecosystem recovery, to improve the scientific basis of management actions, and to coordinate monitoring efforts. The program is directed by a Steering Committee, first convened in 2011. Since that time, the PSEMP commissioned eight technical topic-based workgroups to help implement the objectives of the program.

The Steering Committee recommends rather than directs workgroups to complete a monitoring inventory and gap analysis (PSEMP 2011) with tasks that include:

- Identify active, on-going monitoring programs,
- Identify data related to Vital Sign Indicators, regulatory mandates, and the Action Agenda,

- Evaluate gaps in monitoring, and as of November 2012, gaps related to the Vital Signs.
- Develop an approach to prioritize needs, gaps and programs.

The PSEMP steering committee commissioned a “Birds and Mammals” monitoring workgroup. The entire workgroup met seven times since December 2011. Starting in October 2012, the workgroup split into a birds sub-committee and a mammals sub-committee so they could each advance the tasks with some focus on their respective topic. The Mammal Monitoring Sub-Committee has met twice since October 2012 to review and update the inventory of mammal monitoring programs in Puget Sound, and to discuss the gaps analysis framework.

Included in this report are:

- 1) A brief summary and highlights of the 2012 Inventory of Marine Mammal Monitoring Programs developed by the Mammal Monitoring Workgroup.
- 2) The gap analysis of the southern resident killer whale Vital Sign indicator.
- 3) An excerpt of the inventory (Appendix 1).

Most records in the inventory were pieced together primarily from various pre-existing inventories including a report to the state Office of Financial Management on monitoring programs (DNR et al. 2006), a report to the Partnership on regional efforts to select provisional environmental indicators (O’Neill et al. 2008), the Stormwater Work Group inventory of monitoring programs (Stormwater Workgroup 2010), Chapter 1 of the Puget Sound Science Update (Levin et al. 2011), and a report on Washington State monitoring programs (Natural Resources Reform 2011). Although collectively these reports are fairly comprehensive, some monitoring efforts may still be missing. Therefore, the workgroup added entries based on their expert knowledge of individual monitoring efforts in the region. The workgroup recognizes that efforts may have been missed, particularly more localized monitoring, and that the inventory should periodically be updated. A copy of the full inventory is available on their website at <https://sites.google.com/a/psemp.org/psemp/birds-mammals>.

Vital Sign indicator under the purview of the workgroup

Number of Southern Resident Killer Whales (SRKW)

Vital Sign monitoring highlights and gaps

The workgroup believes this indicator is in relatively good shape in terms of data collection, spatial and temporal coverage, data management, data analysis and reporting because:

- Data quality is very good because all individuals in the population are accounted for during annual censuses and other projects providing sighting information that help to confirm and/or complete the census. Census data are collected by the Center for Whale Research (CWR). Multiple sightings networks report cetaceans almost in real time and year-round, making SRKW more easily encountered during the censuses.
- Census data and sightings are analyzed and reported continuously. The sightings are easily discoverable on the CWR website.

- The SRKW census is expected to continue in the future, pending funding from the Northwest Fisheries Science Center (NWFSC) to the CWR. The funding is specifically for a May-June census to allow the NWFSC to meet stock assessment obligations under the Marine Mammal Protection Act. However, NWFSC cuts in 2012 and 2013 to other SRKW-focused programs led by CWR potentially compromises the amount of time the crews spend on the water to observe whales at other times of year. The additional whale sightings can help to confirm and complete the census and provide year-round and near real-time census status reports. Incomplete censuses introduce uncertainty in the numbers of whales reported for the Vital Sign and potentially represent a decrease in data quality, a gap that may eventually warrant further investigation.

Strengths and weaknesses of SRKW indicator

The majority of workgroup members understand that the Vital Signs are a relatively small but meaningful group of indicators that should reflect the collective impact of actions on recovering the health of Puget Sound. The workgroup further understands that at least some indicators were chosen for their public appeal. SRKW are certainly one of those “socially resonant” indicators and a logical vehicle for raising awareness about Puget Sound recovery.

Southern resident killer whales were chosen as an indicator because they are top-level predators, feed, give birth, rest and socialize in Puget Sound. The population is threatened by some of the pressures on the Sound, such as declining salmon runs, toxic pollution, noise pollution, and vessel disturbance. Puget Sound is federally designated as their critical habitat. Their status integrates multiple aspects of Puget Sound to some degree. The SRKW is an iconic species and an important economic and cultural resource in Puget Sound. Killer whale numbers is also a transboundary indicator. The SRKW is federally-listed as an endangered species both in the US and Canada.

Not all members of the sub-committee see the need to continue using SRKW numbers as a Vital Sign indicator. However, the majority of workgroup members recognize that there is value in reporting the number of SRKW as a Vital Sign. Although a robust orca population is an important recovery goal at the state, federal and international level, there may be limits to how much the orca indicator tells us about the overall health of Puget Sound due to their life history.

The workgroup has discussed at least two weaknesses of this indicator:

- **Insensitivity:** SRKW are long-lived, slow reproducing, and thus their numbers cannot respond quickly in response to recovery actions. On the other hand, their population could decrease quickly in the event of catastrophic events such as acute oil spills.
- **Lack of specificity to Puget Sound:** Population trends of SRKW may not fully reflect the ecological conditions in Puget Sound due to their wide-ranging habits. In addition to Puget Sound, the range of SRKW also encompasses the coasts of California and Alaska (Ford et al. 2000, Krahn et al. 2002; http://www.nwfsc.noaa.gov/research/divisions/cbd/marine_mammal/satellite_tagging.cfm). The SRKW occur inside of Puget Sound (including San Juan Islands and the Strait of Juan de Fuca) less than half the year (Hanson and Emmons 2010). Furthermore, the amount of time encountered in Puget Sound varies by pod, with J pod sighted more frequently than the other pods (Hanson and

Emmons 2010). Furthermore, the pods that spend the least time in Puget Sound have the slowest population growth rate (K and L pods; Hilborn et al. 2012). This suggests that the whales may be impacted by conditions outside of Puget Sound. Therefore, SRKW population dynamics – and, by extension, the current Vital Sign indicator - cannot be fully linked to the health and recovery of Puget Sound.

The majority of sub-committee members think that trends in the number of SRKW should remain as Vital Sign indicator but that other indicators should be considered as complements. The sub-committee plans to develop proposals for additional indicators of Puget Sound using marine mammals in 2013.

Preliminary ideas on potential supplemental indicators

The workgroup plans to continue developing ideas for supplemental indicators that emerged during past discussions. For instance, harbor seals are thought to be a good indicator species because they have strong fidelity to Puget Sound, they are relatively easy to research, and they are well-studied.

The following ideas for supplemental indicators emerged during discussions of the workgroup and warrant further evaluation. Other indicators will certainly continue to emerge.

- Annual number of SRKW in J pod, as the pod that spends the most time in Puget Sound.
- Occupancy/residency: Number of days of the year that each SRKW pod is seen.
- Abundance of harbor seals.
- Persistent organic pollutants in harbor seals (EPA transboundary indicator).
- Harbor porpoise abundance.
- Fecundity of SRKW.
- Number of transient killer whales seen per year.

Summary of the 2012 inventory

There are roughly 37 species of marine mammals in the Salish Sea ecosystem (Gaydos and Pearson 2011). Yet, only a small fraction of these species are regularly monitored. Therefore, with the exception of a few species most notably SRKW, relatively little is known about population size status and trends, distribution, diet, reproduction and other basic aspects of their ecology of the majority of species that use Puget Sound. According to our inventory of marine mammal monitoring programs, 28 programs currently collect some kind of data about marine mammals in Puget Sound (see Appendix).

Most of the ongoing programs each focus on a single species, including the SRKW, harbor seal, gray whale, minke whale, and harbor and Dall's porpoise. However, many of the programs may also opportunistically record data on other species, particularly during boat-based and aerial surveys.

The minimum estimate of costs of these ongoing programs is approximately \$1.5 million annually. However, not all monitoring is conducted every year. In reality, the necessary funding varies every year. Additionally, funding for some of these long-term programs is uncertain. About one third of the total estimated cost is for monitoring studies of SRKW, a federally endangered species. This funding supports various monitoring programs such as the annual census of the whales, contaminant, distribution and interactions with vessels and genetics. Volunteer-based sighting networks directly support this effort.

Nearly one quarter of the marine mammal monitoring programs in Puget Sound utilize volunteers. A large proportion of the data are collected by volunteers. Volunteers report sightings of animals seen in the water or heard through hydrophones, or of animals seen stranded on beaches. The estimate of cost in previous paragraph does not take into account all of the time invested by volunteers. We estimated that volunteers collectively spend about 18,000 hours per year collecting data. Using WDFW's conversion for the monetary value of these efforts, volunteer hours translate into about \$375,000.

The most common type of assessment across all ongoing monitoring programs is status and trends of population size. Other data assessments include contaminants, diet, whale sounds, strandings, predator-prey interactions, microbiology, and vessel interactions.

Inventory highlights

Population status

- 12 programs
- Section 117 of the Marine Mammal Protection Act requires assessments of marine mammal stocks in Puget Sound
- Status review required of listed species every 5 years under the ESA
- Marine mammal population assessments that include monitoring in Puget Sound are SRKW (annually, 36 years), harbor and Dall's porpoise (periodically, 21 years), harbor seal (periodically, 40 years), gray whale and humpback whale (periodically, 25 years), minke whale (35 years).

Population condition

- 12 programs
- These focus on distribution, contaminants, vessel interactions, disease, strandings/mortality, basic biology/life history, genetics, microbiology

Food webs

- 2 programs
 - Diet: SRKW, harbor seals, harbor and Dall's porpoise
 - Predator-prey interactions: harbor seals impact on rockfish

Costs

- ~ \$1.5 million across all programs – can vary annually
- ~ \$500,000 dedicated to SRKW only

Citizen-science or volunteer-based programs

- At least 6 of the 29 programs are volunteer-based, and most of these are managed by non-governmental agencies.
- Type of programs: "sighting" networks with volunteers scattered throughout Puget Sound.
- Report on mammals seen in the water, strandings on shorelines, vessel interactions, or heard via underwater hydrophones.
- Contribution of volunteer is roughly 18,800 hours per year, or \$395,000, based on WDFW's conversion (21\$/hour).

Types of organizations

- Vast majority of programs are collaborative and conducted in partnership between governmental agencies, non-governmental organizations, tribes, universities.
- 16 programs managed by government agencies (NOAA (National Marine Mammal Lab, Northwest Fisheries Science Center), WDFW, US EPA, DOE) or co-led by government agencies in partnership with non-governmental organizations.
- 11 solely managed by non-governmental organizations or universities.
- 1 program managed by a tribe (Makah).

Legal mandates

- Endangered Species Act
- Marine Mammal Protection Act, requiring stock assessment for all marine mammals.
- International Whaling Commission
- Treaty rights.

Funding

- Bureau of Indian Affairs
- Department of Ecology
- Environmental Protection Agency
- Makah Tribe
- National Science Foundation
- NOAA (main funder)
- Private donations
- WDFW

What are data used for?

- Stock assessment reports that inform management of human activities including fisheries.
- Southern resident killer whale recovery actions.
- Regulation of pollution.
- Public outreach, education.
- Ecotourism industry.
- Meet legal mandates of MMPA and ESA.
- Integrated ecosystem assessment.

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Appendix 1. Overview of ongoing marine mammal monitoring programs in Puget Sound based on the 2012 Marine Mammal Monitoring Program Inventory)

Monitoring Program Name	Lead Agency/Organization	Partners	Start year
Southern Resident Killer Whale - vessel interactions	NOAA	NWFSC, DFO, UW	2003
Southern Resident Killer Whale - Orca Survey	Center for Whale Research (CWR)	DFO, NOAA, Orca Network and others	1976
Southern Resident Killer Whale - health and injury monitoring	CWR)	None	2007
Southern Resident Killer Whale - genetics	NOAA	NWFSC, DFO, WDFW, UW, CWR	2003
Southern Resident Killer Whale - distribution	NOAA and CWR	NWFSC, DFO, WDFW, SWFSC, CWR and Orca Network	2003
Southern Resident Killer Whale - diet	NOAA and DFO	NWFSC, DFO, WDFW, CWR, UW	NWFSC since 2003; CWR and DFO since 1976
Southern Resident Killer Whale - contaminants	NOAA	NWFSC, DFO, WDFW, UW, CWR	2003
Southern Resident Killer Whale - body condition	CWR)	SWFSC	2009
Southern Resident Killer Whale - acoustic environment	NOAA	NWFSC, DFO, UW, Scripps Institute, CWR	2003
Southern Resident Killer Whale - microbiology	NOAA	NWFSC and Animal Health Center, BC Ministry of Agriculture	2006

Soundwatch	The Whale Museum	NOAA	1998
Salish Sea Hydrophone Network	Beamreach	Beam Reach Marine Science and Sustainability School, Colorado College Physics and Environmental Science Departments, The Whale Museum of Friday Harbor	2007
PSAMP/PSEMP	WDFW	None	1993
Pacific Coast Feeding Group Gray whale Monitoring	NMML/Cascadia Research	In Salish Sea: the Makah Tribe, Brian Gisborne Independent Consultant, Cascadia and others	Northern Puget Sound since 1986, but range wide around 1998.
Orca Network	Orca Network	Various	2001
NW Marine Mammal Stranding Network	NOAA	Seattle Marine Mammal Stranding Network, Seal Sitters Marine Mammal Stranding Network, MaST Center Stranding Team, East Jefferson County, Port Townsend Marine Science Center, Vashon, Maury Islands, Wolftown, Whatcom Marine Mammal Stranding Network, Juan de Fuca Marine Mammal Stranding Network, WDFW Marine Mammal Investigations, Cascadia Research Collective, Dungeness National Wildlife Refuge Protection Island, Central Puget Sound, Marine Mammal Stranding Network, NOAA, Makah Stranding Network, OCNMS	1970's
Northeast Pacific Minke Whale Project	San Fransisco State	Whale Museum, Center for Whale Research, Cascadia	1980s

		Research Collective, Orca Network, Marine Mammal Research Unit, BC Sightings Network	
N Puget Sound gray whales - ID	Cascadia Research	Orca Network	1986
Marine Mammal Disease	WDFW	Cascadia, Steve Raverty Ministry of Agr, Stranding Network members	samples going back to decades
Makah Fisheries Marine Mammal Monitoring	Makah Tribe	NOAA - National Marine Mammal Laboratory	2004
Humpback whale photo-ID	Cascadia Research	NOAA	1986
Harbor seal stock assessment report	NMML and WDFW	WDFW and NMML	1970's
Harbor seal life history studies	WDFW and NMML	WDFW and NMML	1996
Harbor seal impact on rockfish recovery	WDFW and WWU	WWU, WDFW, NWFSC and DFO	2008
Harbor Porpoise Project	Pacific Biodiversity Institute	Skagit County Beach Watchers at Washington State University, Cascadia Research Collective, Dr. Jason Wood at SMRU Ltd., WDFW and the SeaDoc Society	2007
Harbor and Dall's porpoise small cetacean stock assessment report	NOAA	WDFW, Cascadia, NMML and NWFSC	1991
Fate and effect of contaminants in PS harbor seals	WDFW, DFO and Cascadia Research	EPA, DOE, NMML	every 4-6 years since 1976
Contaminants in cetaceans	Cascadia, NWFSC	Makah Tribe	1986