Species at Risk Act
Recovery Strategy Report Series

Report on the Progress of Recovery Strategy Implementation for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada for the Period 2009 - 2014

Resident Killer Whale

2016

Canada

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Preface

Section 46 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA) requires the competent minister(s) to report on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives within five years of the date when the recovery strategy was placed on the Species at Risk Public Registry, and in every subsequent five-year period until its objectives have been achieved or the species' recovery is no longer feasible.

Reporting on the progress of recovery strategy implementation requires reporting on the collective efforts of the competent minister(s), provincial organizations and all other parties involved in conducting activities that contribute towards the species' recovery. Recovery strategies identify broad strategies and approaches that will provide the best chance of recovering species at risk. Some of the identified strategies and approaches are sequential to the progress or completion of others; and not all may be undertaken or show significant progress during the time frame of a Report on the Progress of Recovery Strategy Implementation (Progress Report).

The Minister of Fisheries and Oceans and the Minister responsible for Parks Canada Agency are the competent ministers under SARA for the Northern and Southern Resident Killer Whales, and have prepared this Progress Report.

As stated in the preamble to SARA, success in the recovery of species at risk depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in a recovery strategy and will not be achieved by Fisheries and Oceans Canada, or any other jurisdiction alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the "Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada" (Recovery Strategy), for the benefit of the species and Canadian society as a whole.

Acknowledgments

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Executive Summary

Two distinct populations of Killer Whales (*Orcinus orca*), known as the Northern and Southern Residents, occupy Canadian Pacific waters. In 2001, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Southern Resident Killer Whales as Endangered, and Northern Resident Killer Whales as Threatened. Both populations are listed in Schedule 1 of the *Species at Risk Act* (SARA). The "Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada" was finalized and published on the Species at Risk Public Registry in 2008, then amended in 2011.

The main threats identified for Northern and Southern Resident Killer Whales include: environmental contaminants, reduced prey availability, and physical and acoustic disturbance.

The Recovery Goal for Northern and Southern Resident Killer Whales is as follows:
Ensure the long-term viability of Resident Killer Whale populations by achieving and maintaining demographic conditions that preserve their reproductive potential, genetic variation, and cultural continuity.

In order to achieve this goal, the Recovery Strategy identified four principal Recovery Objectives: 1) ensure that Resident Killer Whales have an adequate and accessible food supply to allow recovery; 2) ensure that chemical and biological pollutants do not prevent the recovery of Resident Killer Whale populations; 3) ensure that disturbance from human activities does not prevent the recovery of Resident Killer Whales; and 4) protect critical habitat for Resident Killer Whales and identify additional areas for critical habitat designation and protection.

This report documents the progress of Recovery Strategy implementation for the Northern and Southern Resident Killer Whales in Canada for the period 2009-2014. Progress to date includes:

- continued monitoring of Northern and Southern Resident Killer Whales, through ongoing annual censuses of both populations;
- improved understanding of winter distribution of Resident Killer Whales, through several methods including cetacean surveys, sightings networks, and passive acoustics;
- further research into the prey requirements of Resident Killer Whales, through identification of prey species and stocks, energetic modeling, and assessing body condition using aerial photogrammetry;
- bilateral (Fisheries and Oceans Canada/National Oceanographic and Atmospheric Administration) workshops held to assess the effects of salmon fisheries on Southern Resident Killer Whale recovery;
- ocean noise workshops and reviews of current mitigation measures for seismic activities, to better understand and mitigate the threat of acoustic disturbance to Resident Killer Whales; and
- progress toward understanding some of the sources and health effects of PCBs and other pollutants for Resident Killer Whales.

Although there has been significant progress made toward meeting many of the objectives and strategies outlined in the Recovery Strategy, ongoing work is required to better understand the threats to Northern and Southern Resident Killer Whales, and support the recovery of these populations.

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1 Introduction

This document reports the progress towards meeting the objectives listed in the Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada (Recovery Strategy) from 2009 to 2014 and should be considered as one of a linked series of documents for these populations, including: the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report (COSEWIC 2008), a Recovery Strategy (Fisheries and Oceans Canada (DFO) 2009, amended in 2011), and an Action Plan (DFO 2016).

Section 2 of the progress report reproduces or summarizes key information on the challenges the species is facing, the population goal for achieving its recovery, approaches for meeting this goal, and performance measures to gauge the progress of recovery. For more detail, readers should refer back to the Recovery Strategy. Section 3 reports the progress of activities identified in the Recovery Strategy supporting the recovery goal and objectives. Section 4 summarizes the progress made and the outcome of the recovery effort through 2014.

2 Background

2.1 COSEWIC Assessment Summary

Northern and Southern Resident Killer Whales were initially assessed and designated as Threatened by COSEWIC in 1999 (Baird 1999). In 2001, COSEWIC re-examined and confirmed the status of Northern Resident Killer Whales as Threatened, while changing the status of Southern Resident Killer Whales to Endangered (Trites and Barrett-Lennard 2001). The listing of Northern and Southern Resident Killer Whales in 2001 that led to the development and publication of the Recovery Strategy was based on the information provided in the COSEWIC Status Report Addendum on Killer Whales (*Orcinus orca*) (Trites and Barrett-Lennard 2001).

In 2008, COSEWIC re-examined and confirmed the status of Southern Resident Killer Whales as Endangered and Northern Resident Killer Whales as Threatened (http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_killer_whale_0809_e.pdf; COSEWIC 2008).

Assessment Summary – November 2008

Common name
Killer Whale - Southern Resident population

Scientific name
Orcinus orca

Status
Endangered

Reason for designation
The population is small and declining, and the decline is expected to continue. Southern Residents are limited by the availability of their principal prey, Chinook Salmon. There are forecasts of continued low abundance of Chinook Salmon. Southern Residents are also threatened by increasing physical and acoustical disturbance, oil spills and contaminants.

Occurrence
Pacific Ocean

Status history
The “North Pacific resident populations” were given a single designation of Threatened in April 1999. Split into three populations in November 2001. The Southern Resident population was designated Endangered in November 2001. Status re-examined and confirmed in November 2008. Last assessment based on an update status report.

Assessment Summary – November 2008

Common name
Killer Whale - Northern Resident population

Scientific name
Orcinus orca

Status
Threatened

Reason for designation
The population is small, and is limited by the availability of its principal prey, Chinook Salmon. It is also at risk from physical and acoustical disturbance, oil spills and contaminants. However, this population has been increasing slowly but steadily since monitoring began in 1975.

Occurrence
Pacific Ocean

Status history
The “North Pacific resident populations” were given a single designation of Threatened in April 1999. Split into three populations in November 2001. The Northern Resident population was designated Threatened in November 2001. Status re-examined and confirmed in November 2008. Last assessment based on an update status report

2.2 Threats

This section summarizes the information found in the Recovery Strategy on threats to survival and recovery of Resident Killer Whales, and threats to their critical habitat.

2.2.1 Threats to the Northern and Southern Resident Killer Whale

Table 1 summarizes the threats to Northern and Southern Resident Killer Whale recovery. Please refer to Section 2.2 of the Recovery Strategy for more information on these threats.

Table 1: Summary of the threats identified for Northern and Southern Resident Killer Whales, based on the Recovery Strategy.

Threat	Description
Environmental contaminants	Chemical pollutants, including PCBs, DDT, PBDEs, dioxins, and other POPs can lead to reproductive impairment, immunosuppression, endocrine disruption, cancer, and other health effects in Resident Killer Whales. Biological pollutants, including pathogens and antibiotic-resistant bacteria resulting from human activities or exotic species, may also threaten the health of Resident Killer Whales, their habitat or their prey.
Reduced prey availability	While winter prey of Resident Killer Whales is still not well understood, Resident Killer Whale mortality rates (Ford *et al.* 2010a) and fecundity (Ward *et al.* 2009) are correlated with coast-wide Chinook abundance. Chum Salmon are also seasonally important to Resident Killer Whale populations. Factors such as habitat degradation and poor marine survival continue to negatively affect wild salmon populations.
Disturbance	Both physical and acoustic disturbance, from chronic or acute sources, can affect Killer Whales, though the long-term effects of disturbance are unknown. Vessel traffic (both commercial and recreational), industrial activities (including dredging, drilling, and construction), seismic testing and military sonar all have the potential to disturb Resident Killer Whales.
Oil spills	The impact of a spill on the small populations of Resident Killer Whales could be catastrophic. Killer Whales do not appear to avoid oil; exposure to hydrocarbons through inhalation or ingestion may cause behavioural changes, inflammation of mucous membranes, lung congestion, pneumonia, liver disorders and neurological damage.

2.2.2 Threats to Critical Habitat

Critical habitat for Northern and Southern Resident Killer Whales has been identified, to the extent possible, in Section 3 of the Recovery Strategy. Table 2 provides examples of activities that are likely to result in destruction of critical habitat (i.e. threats to critical habitat). The list of activities provided in this table is neither exhaustive nor exclusive, and their inclusion has been guided by the relevant threats to habitat described in the Recovery Strategy. For more details

on the activities likely to result in the destruction of critical habitat, consult the Recovery Strategy.

Table 2: Activities likely to result in the destruction of critical habitat of Northern and Southern Resident Killer Whales.

Threat	Activities
Geophysical Disturbance	• Industrial activities (construction, pile driving, pipe-laying, dredging) • Fisheries using nets that contact the seafloor • Vessel anchors • Physical structures (wharves, net pens for aquaculture)
Acoustic Degradation	• Seismic surveys • Military and commercial sonars • Vessel noise • Construction and dredging
Chemical and Biological Contamination	• Chemical contaminants from historic and current industrial activities • Pets, livestock, climate change and other anthropogenic sources of pathogens • Introduction of exotic species • Oil spills
Diminished Prey Availability	• Reduction of the quantity, quality, and availability of salmon • Presence of fishing vessels

2.3 Recovery

This section summarizes the information found in the Recovery Strategy on the recovery goal and objectives necessary for the recovery of Northern and Southern Resident Killer Whales and on performance measures that provide a way to define and measure progress toward achieving the recovery goal and objectives.

2.3.1 Recovery Goal and Objectives

Recovery Goal:

Ensure the long-term viability of Resident Killer Whale populations by achieving and maintaining demographic conditions that preserve their reproductive potential, genetic variation, and cultural continuity.

The recovery goal reflects the complex social and mating behavior of Resident Killer Whales and the key threats that may be responsible for their decline. In order to achieve this goal, the Recovery Strategy identified four Recovery Objectives. These include:

Objective 1: Ensure that Resident Killer Whales have an adequate and accessible food supply to allow recovery.

Objective 2: Ensure that chemical and biological pollutants do not prevent the recovery of Resident Killer Whale populations.

Objective 3: Ensure that disturbance from human activities does not prevent the recovery of Resident Killer Whales.

Objective 4: Protect critical habitat for Resident Killer Whales and identify additional areas for critical habitat designation and protection.

2.3.2 Performance Measures

Section 5.5 of the Recovery Strategy provides examples of Performance Measures that may be used to define and measure progress toward achieving the Recovery Objectives. Table 3 lists the Recovery Objectives, followed by the associated Performance Measure, as well as the activities undertaken in support of the objective. In addition to the Performance Measures identified in the Recovery Strategy, other metrics of progress were identified during technical workshops and are included in this report.

3 Progress towards Recovery

Progress on actions undertaken in support of the Recovery Objectives is documented in section 3.1. Section 3.2 reports on the activities identified in the schedule of studies to identify critical habitat. Section 3.3 reports on the progress on meeting the performance indicators and other commitments (e.g. action plan and Critical Habitat Order) identified in the Recovery Strategy, and information obtained through implementing the Recovery Strategy.

3.1 Activities supporting Recovery

Table 3 below provides information on the performance measures identified in Table 5 of the Recovery Strategy, and the implementation of activities undertaken in support of recovery. Each performance measure has been assigned one of four statuses (in column 3 below):

1) *Not met:* the performance measure has not been met, and little to no progress has been made;
2) *Not met, underway:* the performance measure has not been met, but there has been moderate to significant progress made;
3) *Met:* the performance measure has been met and no further action is required; or
4) *Met, ongoing:* the performance measure has been met, but efforts will continue until such time the population is considered to be recovered (i.e. the measure will be reported against in the next five-year progress report).

Each activity has been assigned one of four statuses (in column 5 below):

1) *Completed:* the planned activity has been carried out and concluded;
2) *In progress:* the planned activity is underway and has not concluded;
3) *Not started*: the activity has been planned but has yet to start; or
4) *Cancelled*: the planned activity will not be started or completed.

Table 3: Status of performance measures and activities undertaken to address the Recovery Objectives and strategies outlined in the Recovery Strategy.

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
	Recovery Goal: Achieve and maintain demographic conditions that preserve the reproductive potential, genetic variation, and cultural continuity of Northern and Southern Resident Killer Whales				
Monitor population dynamics and	Completion of annual censuses	**NRKW**			
		Met, ongoing	- Annual censuses for Northern Resident Killer Whales (NRKW) are ongoing with efforts to	In progress	**DFO**

[1] An asterisk beside a performance measure indicates a measure that was developed during technical workshops that occurred subsequent to the finalization of the Recovery Strategy.
[2] Lead participants are listed on top and in bold; other participants are listed alphabetically. Not all activities have specific participants identified.

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
demography			photograph every individual in the population each year; as of 2014, the NRKW population numbered 290 individuals and had experienced an average annual growth rate of 2.2% over the past 40 years (Towers *et al.* 2015). - Photo identification catalogues for NRKW continue to be maintained and updated.		
		SRKW			
		Met, ongoing	**-** Annual censuses for Southern Resident Killer Whales (SRKW) are ongoing with efforts to photograph every individual in the population each year; the SRKW population numbered 78 individuals in 2014 (Cogan 2014). SRKW has undergone periods of growth and decline, ranging from 70 animals (1974) to a peak of 98 animals (1995). - Photo identification catalogues for SRKW continue to be maintained and updated (Center for Whale Research 2015).	In progress	**NOAA** **ENGOs**
	Genetic sampling and analyses completed	**NRKW**			
		Not met, underway	- Five NRKW biopsy samples were collected and archived in 2009; there has been no further genetic sampling or analysis for NRKW over the past five years (Abernethy pers. comm. 2015).	In progress	**DFO**
		SRKW			
		Not met, underway	- Biopsy sampling and analysis of samples from SRKW is ongoing (e.g. Hanson *et al.* 2010a; NMFS 2013).	In progress	**NOAA** ENGOs

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
	Evaluation of population status to ensure growth	Not met, underway	- Updated stock assessments for NRKW and SRKW were completed: potential biological removal estimated at 1.96 whales per year for NRKW (Allen and Angliss 2013) and at 0.14 whales per year for SRKW (Carretta *et al.* 2014).	In progress	**NOAA** DFO
Develop population models	Models developed that incorporate social and genetic structure and explain population trends	Met, ongoing	- Effects of the death of Resident Killer Whale (RKW) mothers on the survival of their offspring were modeled. Survival of adult male offspring was affected to a greater degree than female offspring survival; increase in mortality risk was most pronounced in males >30 years old. Indicates an adaptive benefit of the long post-reproductive lifespan of female Killer Whales (Foster *et al.* 2012a).	Completed	**Academia** DFO ENGOs
			- Stage-structured models based on 25 years of demographic data predicted vital rates, population growth rates, and extinction risk for NRKW and SRKW. NRKW expected to experience a 1.58% annual increase and an extinction risk of 0, while SRKW expected to experience a 0.91% annual decrease and an extinction risk of 49% over a 100-year period (Velez-Espino *et al.* 2014a).	Completed	**DFO**
		SRKW			
		Met, ongoing	- Bayesian modeling was used to assess the effect of different levels of social organization on survival of SRKW. Pod membership had a greater effect on survival of individual SRKW	Completed	**NOAA** ENGOs

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			than matriline membership; L pod had a lower median life expectancy than J and K pods (Ward *et al.* 2011).		
Quantitative framework for understanding effects of threats on population dynamics	Models completed that incorporate threats into population dynamic models	Met, ongoing	- Bayesian modeling was used to explore impacts of various intrinsic and extrinsic risk factors on fecundity of SRKW and NRKW. - Fecundity of these populations is strongly correlated with Chinook Salmon abundance (Ward *et al.* 2009).	Completed	**NOAA** ENGOs
			- Actual survival and reproductive rates were compared to expected rates for NRKW and SRKW, to look for correlations with Chinook and Chum Salmon abundance indices and determine population-level effects of prey shortage. Mortality indices of both RKW populations were strongly correlated with changes in Chinook abundance (Ford *et al.* 2010a).	Completed	**DFO** ENGOs
			- Linkages between RKW vital rates and Chinook Salmon abundance were modeled, to consider how changes in Chinook abundance may affect the population dynamics of NRKW and SRKW. Results indicated several significant interactions between abundance of Chinook Salmon stocks and RKW vital rates; however, the effects of these interactions on RKW population dynamics were relatively small (Vélez-Espino *et al.* 2014b)	Completed	**DFO**
Studies to identify role of	Peer-reviewed publications on	**NRKW**			
		Met, ongoing	- Digital acoustic recording tags (DTAGs) were	Completed	**Academia**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
culture in foraging ecology and sociobiology	role of culture in Killer Whale foraging		used to determine acoustic and kinematic behaviour of NRKW while foraging. - NRKW used specialized foraging behaviours to successfully target and catch Chinook Salmon (Wright 2014).		**DFO**
			- Prey sharing events between NRKW were examined. Although all age classes participated in prey sharing, adult female NRKW were significantly more likely to share prey than adult males or subadults, and almost 90% of prey sharing occurred within matrilines (Wright *et al.* 2016).	Completed	**DFO**
			- Modeling exercises are underway to describe matriline fission and fusion in the NRKW population, and to determine drivers of matriline splitting (Stredulinsky pers. comm. 2015).	In progress	**DFO** **Academia** ENGOs
		SRKW			
		Met, ongoing	- Social structure and changes in sociality of SRKW were assessed. Persistent social clusters within both matrilines and pods were found; however, all pods demonstrated changes in social cohesion over time, with increased social fluidity during times of population decline (Parsons *et al.* 2009).	Completed	**NOAA** DFO ENGOs
			- The relationship between Chinook Salmon abundance and the social structure of SRKW was examined; SRKW had a more interconnected social network when prey availability was higher (Foster *et al.* 2012b)	Completed	**Academia** ENGOs NOAA

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			- Video footage of SRKW was reviewed to determine group leadership during directional travel. Post-reproductive females were more likely than adult males and reproductive-aged females to lead groups, and at times of low salmon abundance (Brent *et al.* 2015).	Completed	**Academia** ENGOs
Studies to identify role of culture in maintaining genetic diversity	Biopsy samples collected and analyzed to identify paternity	**SRKW**			
		Met, ongoing	-Biopsy samples were collected from SRKW and analyzed for paternity; indicated that reproductive success increased with male age and size. Within-pod mating was not uncommon, but there was no evidence of mating between close relatives (Ford *et al.* 2011).	Completed	**NOAA** ENGOs Academia
Broad Strategy 1: Ensure that Resident Killer Whales have an adequate and accessible food supply to allow recovery					
Determine seasonal/ annual diet/ energetic requirements	Prey fragment samples collected year-round for multiple years	**NRKW**			
		Not met, underway	- Sampling of prey fragments is ongoing; samples have been collected from NRKW during all months except December (Towers pers. comm. 2015).	In progress	**DFO**
		SRKW			
		Not met, underway	- Winter prey sampling of SRKW is ongoing (e.g. Hanson *et al.* 2010a; NWFSC 2013). Prey fragment samples (24) were collected in March 2013 from SRKW (K and L pods) off Washington and Oregon (NWFSC 2013).	In progress	**NOAA** ENGOs
			- Between 2005 and 2009, SRKW prey and fecal samples were collected from October to January in critical habitat; winter prey fragment	Completed	**NOAA**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			samples were all salmonids, with Chum as the most prevalent species (4:1), followed by Chinook; fecal samples contained primarily Chum and Chinook in roughly equal proportions, as well as small amounts of Sole, Lingcod, and Coho, one Steelhead, and one Halibut (Hanson *et al.* 2010b).		
	Alternative diet sampling methods tested to confirm diet	Met, ongoing	- In addition to prey fragment sampling, fecal sampling (e.g. Hanson *et al.* 2010a, NWFSC 2013) and stomach content analysis from stranded Killer Whales are used to confirm diet.	In progress	**NOAA** **DFO**
	*Energetic models to estimate prey requirements	**NRKW**			
		Met	- Swimming speeds and respiration rates of wild NRKW, and oxygen consumption of captive Killer Whales, were used to estimate cost of transport for these whales (Williams and Noren 2009).	Completed	**Academia** NOAA
		SRKW			
		Met	- Body mass, field metabolic rate, and daily prey energy requirements were estimated for each member of the SRKW population; daily energy requirements ranged from 41,376-269,458 kcal/d for males, and 41,376–217,775 kcal/d for females (Noren 2011)	Completed	**NOAA**
			- Modeled RKW energy requirements were combined with demographic and diet data, and calorific value of salmon, to predict the quantity of salmon required to maintain and recover the SRKW population. Based on summer	Completed	**Academia** ENGOs NOAA

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			occupancy and proportion of the diet that is estimated to come from Chinook Salmon, the estimated summer (May to September) prey requirements for the SRKW population is ~59,000 Chinook (Williams *et al.* 2011).		
	*Photo-grammetry studies to assess nutritional status	**NRKW**			
		Met, ongoing	- Aerial photogrammetry studies using unmanned aerial vehicles are underway to determine Killer Whale nutritional status by assessing body condition; 80 NRKW were assessed in 2014. Future plans include assessing all SRKW and considering seasonal changes in body condition (Barrett-Lennard *et al.* 2015).	In progress	**NOAA** **ENGOs**
		SRKW			
		Met, ongoing	- Length, head width, and breadth of 69 SRKW were measured using helicopter-based photogrammetry in 2013; body condition of whales was compared to condition of SRKW in 2008 (see Fearnbach *et al.* 2011). - A decline in body condition was noted in 2013 compared to 2008; of the 12 SRKW identified as pregnant based on breadth measurements in 2013, only 2 were subsequently seen with a calf (Fearnbach *et al.* 2015).	Completed	**NOAA** **ENGOs**
	*Stress hormones used to determine nutritional status	**SRKW**			
		Met	- Fecal thyroid and glucocorticoid hormone levels were tested from SRKW fecal samples to assess the threats of prey limitation and	Completed	**Academia** ENGOs NOAA

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			disturbance on this population. Hormone levels indicated that prey availability and nutritional stress outweighed impacts of psychological stress from vessels for SRKW (Ayres *et al.* 2012).		
Identify key prey populations and feeding areas	Complete diet sampling of all members of population and during all seasons	**NRKW**			
		Not met, underway	- 292 prey samples were collected from NRKW in 2009-2014; samples were collected during all months except December. Summer, fall, and winter prey samples were collected from all three clans; however, winter/spring G clan samples were collected only in January, February, and May, and winter R clan samples were collected only in February (Towers pers. comm. 2015).	In progress	**DFO**
		SRKW			
		Not met, underway	- Ongoing efforts underway to collect prey samples from SRKW year-round. Winter samples include two prey samples collected from L pod in March 2009 (Hanson *et al.* 2010a), and 24 prey fragment samples and 21 fecal samples collected from K and L pods in March 2013 (NWFSC 2013).	In progress	**NOAA** ENGOs
	Prey identified to stock, not just species	Met, ongoing	- Scale and tissue samples were collected from predation events by NRKW and SRKW in all months except April; the stock regions for 474 Chinook samples were identified. - 58% of Chinook consumed were from Fraser River stocks; other important stocks included east coast (10%) and west coast (8%)	Completed	**DFO**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			Vancouver Island region stocks (Ford *et al*. 2010b).		
		SRKW			
		Met, ongoing	- Fecal samples and scales and tissue from SRKW predation events were collected in May through September to identify species and the spawning region of Chinook consumed; 80-90% of Chinook originated from the Fraser River. Chinook stocks were consumed roughly in proportion to their relative abundance (Hanson *et al.* 2010b).	Completed	**NMFS** DFO ENGOs NOAA WSDFW
Monitoring prey populations to detect changes in abundance or availability	Population assessment completed for all stocks identified as important prey for Resident Killer Whales	Met, ongoing	- Majority of prey for both NRKW and SRKW originated in the Fraser River (Ford *et al*. 2010b; Hanson *et al.* 2010b). Fraser River Chinook stocks are assessed each year through in-season abundance models based on test fishery catch and post-season assessments, using a variety of methods including mark-recapture, electronic counters, fence counts, and visual surveys (DFO 2014). - Stocks from the west coast of Vancouver Island region identified as important to NRKW are assessed using selected rivers as indicators of escapement, and Robertson Creek Hatchery Chinook as indicators of marine survival (DFO 2012). - Stocks from east coast Vancouver Island region also assessed using specific runs as indicators of marine survival and adult escapement (DFO 2015a).	In progress	**DFO**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
		SRKW			
		Met, ongoing	- Puget Sound Chinook Salmon were also indicated as important prey for SRKW (Hanson *et al.* 2010b); these stocks are listed as threatened under the US ESA and are assessed regularly by NOAA/NMFS (National Marine Fisheries Service 2011a).	In progress	**NOAA**
Protect access to important feeding areas	Guidelines developed for human activities in important whale feeding areas	**NRKW**			
		Met, ongoing	The Robson Bight Marine Warden program reduces the incidence of NRKW disturbance in the Robson Bight-Michael Bigg Ecological Reserve by informing vessel operators of reserve boundaries, and provides on-water education and stewardship (Fournier pers. comm. 2016).	In progress	**ENGOs** BC MoE DFO ECCC
			The North Vancouver Island Marine Plan provided recommendations for management of human activities in an area that includes important NRKW feeding areas, using an ecosystem-based management approach (Marine Planning Partnership Initiative 2015).	Completed	**FNs** **BC MoF**
		SRKW			
		Met, ongoing	NMFS established regulations under the US ESA and MMPA to prohibit vessels from approaching Killer Whales within 200 yards and from positioning within 400 yards of the path of KW when in inland waters of Washington State (Protective Regs KW 2011).	Completed	**NOAA**
Protection of	Incorporation of	**SRKW**			

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
prey populations	Killer Whale predation into fisheries management plans	Not met, underway	- Series of workshops held in 2011/2012 to assess the impacts of Chinook Salmon fisheries on SRKW recovery. The Independent Science Panel found strong evidence of RKW dependence on Chinook during summer; however, they are skeptical that reduced Chinook salmon harvesting would have a large impact on the abundance of Chinook salmon available to SRKW. - Recommended future research to focus on further exploring the relationship between SRKW and Chinook (Hilborn *et al.* 2012).	In progress	**NOAA** **DFO**
			- Salmon harvest regimes are examined under the US ESA to ensure that they do not jeopardize the populations of salmon or RKW, or their respective critical habitat areas (National Marine Fisheries Service 2011b).	In progress	**NOAA**
Broad Strategy 2: Ensure that chemical and biological pollutants do not prevent the recovery of Resident Killer Whale populations.					
Investigate effects of contaminants on health and reproductive capacity of Killer Whales	Peer reviewed publication on contaminants in Resident Killer Whales	**NRKW**			
		Met, ongoing	- Blubber biopsy samples from NRKW were analyzed to consider the effects of PCBs on mRNA transcripts related to RKW health, and found PCB-related increases in the expression of five of these gene targets (Buckman *et al.* 2011).	Completed	**DFO** Academia
		SRKW			
		Met, ongoing	- Atmospheric dispersion modeling was used to estimate SRKW exposure to exhaust gases from whale watching vessels; threshold doses	Completed	**Academia** ENGOs

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			of these gases were estimated for SRKW. - Results indicated that there are situations where concentrations of pollutants inhaled by SRKW may be causing adverse health effects (Lachmuth *et al.* 2011).		
	Develop and apply tests to measure the health of Killer Whales	**SRKW**			
		Not met, underway	- A series of workshops were conducted in 2013; topics included PBDE modeling in Puget Sound and the need to establish a PBDE toxicological threshold for SRKW. - Knowledge gaps toward establishing this threshold were identified and recommendations were made for future research to address these gaps (Gockel and Mongillo 2013).	In progress	**NOAA** **US EPA** Academia BC MoE ENGOs WSDE
Monitor pollutants, diseases, pathogens, parasites and pathologies in Killer Whales	Extensive sampling of populations to establish baseline contaminant levels	**NRKW**			
		Not met, underway	- Five biopsy samples were collected from NRKW in 2009 and were archived; there has been no more recent sampling of live NRKW (Abernethy pers. comm. 2015).	In progress	**DFO**
		SRKW			
		Not met, underway	- Biopsy sampling of SRKW is ongoing (e.g. Hanson *et al.* 2010a; NWFSC 2013).	In progress	**NOAA** ENGOs
	Completed analyses of contaminants in samples	Not met, underway	- A review of pathology data of all Killer Whales that have stranded between 2002 and 2014 is underway (Raverty pers. comm. 2015).	In progress	**BC MoA** ADEC ENGOs NOAA
		NRKW			

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
		Not met	- No recent analysis of contaminants in biopsy samples collected from live NRKW (Ford pers. comm. 2015).	Not started	
		SRKW			
		Not met, underway	- A peer-reviewed publication reviewed findings from analyses of SRKW biopsy samples and found that levels of some POPs were higher in juveniles than in adult males, and that almost all sampled SRKW exceeded the threshold for PCB-related health effects for marine mammals (Krahn *et al.* 2009)	Completed	**NOAA** ENGOs
			- SRKW exhaled breath samples have been analyzed to identify normal microbial flora, as well as pathologies in the respiratory tracts of these whales (Raverty pers. comm. 2015).	Completed	BC Ministry of Agriculture Academia NOAA
	Compete necropsies of stranded Killer Whales	Met, ongoing	- The British Columbia Marine Mammal Response Network and West Coast Marine Mammal Stranding Network respond to reports of stranded Killer Whales. Eight necropsies were conducted on stranded RKWs between 2009 and 2014; four on NRKW and four on SRKW (Raverty pers. comm. 2016)	In progress	**DFO** **NOAA**
			- In a review of Killer Whale strandings along the west coast of North America from 2005-2010, disease was not identified as the cause of death for any RKWs; however, two Killer Whales (one Offshore and one Transient) were diagnosed with bacterial infections (Gaydos and Raverty 2010)	Completed	**ENGOs** **BC MoA**
			- Necropsy protocols for Killer Whales have	Completed	**BC MoA**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			been updated; goals of the revised protocols include improving understanding of disease in Killer Whales and of the effects of contaminants and heavy metals on Killer Whale health (Raverty *et al.* 2014).		ENGOs NOAA
	*Predict future bioaccumulation of PCBs and PBDEs in individual Killer Whales	**SRKW**			
		Met	- Current and historical concentrations of PCBs and PBDEs were modeled in individual SRKW; future concentrations of these contaminants were predicted. - PCB concentrations not predicted to increase significantly over time, but PBDEs were predicted to increase over time and with age, with a doubling time of 3-4 years. - J pod had highest predicted concentrations of both PCBs and PBDEs (Mongillo *et al.* 2012).	Completed	**Academia** DFO NOAA USGS
Identify and prioritize key chemical and biological pollutants	Completed sampling and analyses of contaminants in Killer Whale prey	Met, ongoing	- POP concentrations in Chinook Salmon from British Columbia (BC) and WA were measured; the more southerly Chinook sampled had the highest concentrations of PCBs, PCDDs, PCDFs, and DDT. One of the four stocks sampled exceeded CCME tissue residue guidelines for the protection of mammalian wildlife consumers of aquatic biota, and another stock was approaching these guidelines (Cullon *et al.* 2009).	Completed	**DFO** Academia HC WSDFW
			- Eight Fraser River Chinook Salmon samples were analyzed and measured for a wide variety of priority pollutants in 2014 (Ross pers. comm. 2015).	Completed	**DFO** **ENGOs**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
Identify and prioritize key sources of chemical and biological pollutants	Water quality sampling in areas throughout range of Resident Killer Whales	Not met, underway	- Water quality sampling to identify levels and types of chemical and biological pollutants was undertaken in Burrard Inlet in 2009 and 2010 (Ministry of Environment 2013).	Completed	**BC MoE**
		SRKW			
		Not met, underway	- Surface runoff in waters that flow into Puget Sound were sampled in 2009 and 2010 as part of a study to understand the timing and sources of contaminant loading in Puget Sound (Ecology 2011).	Completed	**WSDE**
Reduce introduction of chemical pollutants into environment	Measurable decline in contaminant levels in environment (prey, sediments etc.)	Met, ongoing	- Sediment samples collected from disposal at sea sites at Point Grey and Sand Heads in 2010 were analyzed for PCBs, PBDEs, PCDDs, PCDFs, providing a baseline for future assessments (Ross *et al.* 2011).	Completed	**DFO**
		SRKW			
		Met, ongoing	- NOAA's National Status and Trends Program has been monitoring PCBs and other contaminants in mussels and oysters along the US coastline since 1986, including 17 sites along the WA coast (NOAA 2015).	In progress	**NOAA**
			- Analyses of contaminants in blubber samples from harbour seals in Puget Sound indicated that concentrations of PCBs, PCDEs and PCNs declined by 81%, 71%, and 98%, respectively, between 1984 and 2003. PBDE concentrations doubled every 3.1 years in this time period, but appeared to decline in 2009 (Ross *et al.* 2013).	Completed	**DFO** Academia ENGOs WSDFW

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			The Puget Sound Partnership's Action Agenda includes targets for reducing the contaminants and toxic chemicals in fish and marine sediments in Puget Sound, as well as strategies to achieve these targets by 2020 (Puget Sound Partnership 2009).	In progress	**NOAA** **EPA** **FNs** **ENGOs**
	*Stewardship programs aimed at reducing chemical and biological pollutants	Not met, underway	- Outreach and stewardship programs, including Killer Whale Tales (http://killerwhaletales.org), school curricula and the Pacific Region Contaminants Atlas (http://www.pacifictoxics.ca) raise awareness of the threat of contaminants to Killer Whales, and provide members of the public with ways to reduce the introduction of pollutants into the marine environment.	In progress	**ENGOs** **DFO** **NOAA**
Mitigate impacts of currently used pollutants	Evaluation of effectiveness of legislation completed	Met, ongoing	- A review of research documenting some of the sources and properties, as well as the persistence and toxicity of PBDEs was published in 2009; this report contributed to the decision to ban deca-PBDEs in Canada (Ross *et al.* 2009).	Completed	**DFO**
			- Regulations prohibiting the manufacture of all seven PBDEs came into effect in Canada in July 2009 (Environment and Climate Change Canada 2015).	Completed	**ECCC**
			- Action Plan for PBDEs in the US finalized in December 2009 (U.S. Environmental Protection Agency 2009).	Completed	**EPA**
		SRKW			

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
		Met, ongoing	- An oil spill response plan specific to Killer Whales was developed during a workshop held in 2007; plan has now been adopted as part of the Northwest Area Contingency Plan (Region 10 Regional Response Team and Northwest Area Committee 2015).	Completed	**NOAA** **Academia** WSDFW
Mitigate impacts of 'legacy' pollutants	PCB sources identified	Not met, underway	- A document was prepared to guide the RKW Recovery Team toward the contaminant types, sources, and trends that pose possible risk to RKWs and to provide information about current legislation and responsible agencies (Garrett and Ross 2010)	Completed	**ECCC** **DFO**
			- The major sources of several chemical pollutants in Puget Sound, including PCBs, were identified as part of the Department of Ecology's Assessment of Selected Toxic Chemicals in Puget Sound Basin (Ecology and King County 2011).	Completed	**WSDE** **KCDNRP**
	Evaluation of effectiveness of legislation completed	Met	- Current Ocean Disposal Rejection/Screening Limits were evaluated to determine if they are sufficient to protect RKW critical habitat, and whether there are areas of RKW critical habitat where PCBs in deposited materials may increase impacts to RKW. Current CEPA Action Level exceeds the PCB levels recommended to protect RKWs from bioaccumulation of PCBs. - A sediment concentration range was derived that would protect 95% of RKWs (Lachmuth *et*	Completed	**DFO** Academia

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			al. 2010).		
			- A PCB food web bioaccumulation model was developed that allowed for evaluation of current sediment quality criteria in BC; indicated that current standards are not protective of Killer Whales (Alava *et al.* 2012).	Completed	**Academia** DFO
Reduce introduction of biological pollutants	Evaluation of effectiveness of legislation completed	Met, ongoing	- Legislation increasing water quality protection was introduced in Canada in 2012 through the Wastewater System Effluent Regulations (Government of Canada 2012).	Completed	**GoC**
			- The US EPA reviews industrial effluent guidelines and produces a biennial Effluent Guidelines Plan identifying areas for further study and regulation (EPA 2015).		**EPA**
Broad Strategy 3: Ensure that disturbance from human activities does not prevent the recovery of Resident Killer Whales					
Investigate short-term effects of chronic forms of disturbance	Controlled studies of whale/boat interactions completed	**NRKW**			
		Met, ongoing	- Behavioural responses of NRKW to ship transits were modeled using a dose-response function; found that NRKW showed a moderate reaction to large ships, but that behavioral responses were best explained by a model that also included time, age of the whale, number of ships, and the broadband noise level received by the whale (Williams *et al.* 2014a).	Completed	**Academia**
		SRKW			
		Met, ongoing	- Peer-reviewed publication completed that considered the impacts of vessel traffic on activity states of SRKW.	Completed	**Academia**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			- Vessels within 100-400m had a significant impact on the probability of SRKW transitioning between activity states, and whales tended to spend significantly more time traveling and less time foraging when boats were present within 100m (Lusseau *et al.* 2009).		
			- Assessment undertaken to determine whether vessel presence impacted surface active behavior (SAB) of SRKW. - Highest frequency of SAB occurred when nearest vessel was within 75-99m (2005), and 125-149m (2006) of focal whale and 70% of SAB occurred when closest vessel was within 224m of the whale (Noren *et al.* 2009).	Completed	**NOAA** Academia
			- DTAGs were used to estimate the relationship between vessel characteristics and number of vessels to the noise levels received by tagged SRKW. - Based on multiple regression analysis, vessel speed was the most significant predictor of received noise level (Houghton *et al.* 2015).	Completed	**Academia** NOAA USGS
Investigate short-term effects of acute forms of disturbance AND Investigate	Complete controlled study of marine mammals in areas where seismic exploration is active	Met, ongoing	- Several studies have been undertaken to consider the behavioural reactions of marine mammals to seismic activity; however, reactions tend to be variable. - Cetaceans in some areas have been displaced by seismic activity (e.g. Castellote *et al.* 2012), and have increased calling frequency during times of seismic activity (e.g. Di Iorio and Clark 2010), while in other areas	In progress	**Academia**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
long-term effects of acute forms of disturbance			no strong reactions were noted (e.g. Miller *et al.* 2009). - Extensive studies are underway in Australia to assess the effects of seismic activity on the behavior of migrating humpback whales (Cato *et al.* 2013).		
Investigate long-term effects of chronic forms of disturbance	Complete model that incorporates effects of increasing ambient noise levels on communication signals of Resident Killer Whales	Met, ongoing	- Ocean noise levels were measured at 12 sites along the BC coast, including sites within SRKW and NRKW critical habitat. - SRKW living in the noisiest sites in BC lose up to 97% of their acoustic communication space in the frequencies used for social communication calls (Williams *et al.* 2014b).	Completed	**Academia**
		SRKW			
		Met, ongoing	- Based on measurements of background noise and KW call source levels, amplitude of SRKW calls increased with increases in ambient noise level (Holt *et al.* 2009; 2011)	Completed	**NOAA** **Academia**
Develop measures to reduce physical disturbance	Revised whale watching guidelines, and/ or regulations that reflect most recent understanding of effects of chronic physical disturbance	Not met, underway	- Amendments to the Canadian Marine Mammal Regulations have been drafted and are pending approval (Cottrell pers. comm. 2015).	In progress	**DFO**
			- Implementation of the Whale Watch flag in 2010 and subsequent use and promotion of this initiative minimizes physical and acoustic disturbance by raising awareness of the presence of whales and indicating areas where vessels should reduce speed (North Island Marine Mammal Stewardship Association 2012).	In progress	**ENGOs** **Industry**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			- Tourism industry associations operate according to updated codes of conduct/Best Practices Guidelines to ensure responsible viewing of wildlife (North Island Marine Mammal Stewardship Association 2012; Pacific Whale Watch Association 2014).	In progress	**Industry**
		SRKW			
			- New vessel regulations around Killer Whales in the inland waters of Washington State were implemented in 2011. These regulations prohibit vessels from approaching within 200 yards of Killer Whales and from positioning within 400 yards of the path of Killer Whales (Protective Regs for KW 2011)	Completed	**NOAA**
Determine baseline ambient and anthropogenic noise profiles	Complete acoustic profiles of vessels most likely to be encountered by Resident Killer Whales	Not met, underway	- A basic tool to derive large-scale maps of ocean noise was developed and assessed, and cumulative shipping noise for all of Pacific Canada's EEZ was modeled (Erbe *et al.* 2012).	Completed	**Academia**
			- Propagation of underwater noise from shipping traffic and weighted received levels by audiograms specific to marine mammal species including KW were modeled; Juan de Fuca and Haro Straits were identified as noise hotspots. Further hotspots included Johnstone Strait and the waters off Prince Rupert (Erbe *et al.* 2014).	Completed	**Academia**
		SRKW			
		Not met, underway	- One year of ship traffic data was paired with hydrophone recordings in Puget Sound (critical	Completed	**Academia** NOAA

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			habitat for SRKW) to assess ambient noise and quantify contribution of vessel traffic. Commercial vessel traffic accounted for more than 90% of sound energy budget, with container ships as the greatest contributor (Bassett *et al.* 2012).		
Develop measures to reduce acoustic disturbance	Establishment of acoustic sanctuaries in critical habitat areas	**NRKW**			
		Not met, underway	The Robson Bight-Michael Bigg Ecological Reserve is recognized as a sanctuary for Killer Whales and the Robson Bight Marine Warden program continues to reduce acoustic disturbance for NRKW in this area by informing vessel operators of reserve boundaries and ways to minimize human impacts (Fournier pers. comm. 2016).	In progress	**ENGOs** BC MoE DFO ECCC
		SRKW			
		Not met, underway	The whale watch industry in southern BC/WA has established guidelines that include “special operating areas” and voluntary no-go zones within SRKW critical habitat (Pacific Whale Watch Association 2014).	In progress	**Industry**
			- A candidate MPA within SRKW critical habitat was suggested based on habitat use and behaviour data from SRKW, and interviews with experts to estimate the size of an area that could be effectively closed to vessel traffic. The proposed area is located along the southwest shoreline of San Juan Island (Ashe *et al.* 2010).	Completed	**Academia** NOAA

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
	* Land-based and boat-based stewardship programs	Not met, underway	Land-based stewardship programs implement measures to reduce acoustic and physical disturbance to NRKW and SRKW through presentations, community events, brochures, signs, decals, online resources and other products aimed at educating targeted audiences about whale watching guidelines and regulations.	In progress	**ENGOs** **FNs** BC MoE DFO ECCC NOAA
			On-water boater education programs implement measures to reduce acoustic and physical disturbance by informing vessel operators of whale watching guidelines and regulations in SRKW and NRKW critical habitats.	In progress	**ENGOs** BC MoE ECCC DFO NOAA
	*Workshop focused on ocean noise	Met	- Workshop held in 2012 to further the understanding and management of ocean noise on the Pacific coast. - Actions identified included establishing baseline ocean noise levels and scenarios of possible change, integrating hydrophone networks and informing placement for further hydrophones, and providing policy recommendations for noise mitigation (Heise and Alidina 2012).	Completed	**ENGOs** Academia DFO NOAA Stakeholders
	*Public outreach regarding underwater sound	Met, ongoing	- Hydrophone networks in WA and BC allow underwater sound to be transmitted to the public in real time; this increases public awareness of how vessel noise can impact marine mammals.	In progress	**ENGOs** **FNs**
	*Initiatives	Met, ongoing	- The ECHO initiative is focused on	In progress	**Industry**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
	aimed at understanding and mitigating effects of shipping noise		understanding and mitigating the impacts of commercial vessel activities on at-risk whales off the southern BC coast. - Goals include identifying vessel source levels and developing mitigation measures such as voluntary slow zones (Port of Vancouver 2015).		DFO ENGOs FNs NOAA
Develop measures for reducing disturbance to high energy sources of sound	Revised protocols for seismic and military sonar that reflect most recent understanding of physiological and behavioural responses to noise	Not met, underway	- The Statement of Canadian Practices with respect to the Mitigation of Seismic Sound in the Marine Environment (SOCP, DFO 2008) was reviewed in 2014 to determine its adequacy for avoiding prohibited impacts on SARA-listed cetacean species. - Potential sound exposure metrics to determine thresholds to avoid these impacts were examined, several recommendations were made for methods to increase the effectiveness of current mitigation measures (DFO 2015b).	In progress	**DFO**
			- Acoustic threshold levels for avoiding temporary and permanent hearing threshold shifts were updated for marine mammals in American waters in 2013 (NOAA Fisheries 2013).	Completed	**NOAA**
Broad Strategy 4: Protect critical habitat for Resident Killer Whales and identify additional potential areas for critical habitat designation and protection.					
Year-round surveys to identify	Winter distribution of Resident Killer	Not met, underway	- DFO's Cetacean Research Program conducted 17 ship-based cetacean surveys between 2009 and 2014; four of these surveys	In progress	**DFO**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
important areas for Killer Whales	Whales well understood		took place during winter (Nichol pers. comm. 2015). - The surveys had a multispecies focus, and all Killer Whale sightings were logged.		
			- 30 aerial surveys were conducted by the DFO Cetacean Research Program between 2012 and 2014 (Nichol pers. comm. 2015) - The surveys had a multispecies focus, and all Killer Whale sightings were logged.	Completed	**DFO**
			- Sightings networks including the BCCSN and the Orca Network further understanding of year-round distribution of SRKW and NRKW through compiling sightings of these whales from researchers, mariners, coastal residents, and other contributors. - BCCSN received 10,542 reports of Killer Whale sightings between 2009-2014, 2701 of which were confirmed to be SRKW and 1168 of which were confirmed to be NRKW (Danelesko pers. comm. 2015).	In progress	**ENGOs**
			- DFO's Cetacean Research Program completed 46 acoustic deployments that focused on habitat use of RKWs off the coast of BC in 2009-2014. - 16 of these data sets have been analyzed thus far; deployments from Langara Island had particularly high levels of NRKW presence, especially from March to May (Pilkington pers. comm. 2016).	In progress	**DFO**
			- Passive acoustics were used to determine year-round distribution of NRKW and SRKW at	Completed	**Academia** DFO

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			Swiftsure Bank and Cape Elizabeth. - Swiftsure Bank was identified as a RKW hotspot with year-round presence of SRKW; NRKW spend more time in southern parts of their range than previously thought (Riera 2012).		
			Hydrophone networks in place in BC and WA allow for year-round acoustic monitoring and better understanding of Killer Whale distribution.	In progress	**ENGOs** **FNs**
			Several organizations conduct surveys for RKWs and/or collect sightings to provide to DFO/BCCSN to aid in determining year-round distribution of RKWs.	In progress	**ENGOs** **FNs** BC MoE DFO ECCC
		SRKW			
		Not met, underway	- NOAA conducts annual winter/spring ship-based surveys aimed at better understanding winter habitat use by SRKW (Hanson *et al.* 2010; NWFSC 2013; NOAA Fisheries 2014; Barre pers. comm. 2015).	In progress	**NOAA** ENGOs
			- Passive acoustic monitoring detections at seven sites between Cape Flattery, WA and Pt. Reyes, CA were used to look at winter and spring distribution of SRKW over a 4-year period. - All SRKW spent a relatively large proportion of time off the WA coast, but detections of J pod were almost exclusively farther north than	Completed	**NOAA**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			K and L pods. K and L pods were briefly detected off CA in 2011 (Hanson *et al.* 2013).		
			- Five SRKW have been satellite tagged to provide further information about winter distribution. Tags have indicated winter travel by K pod as far south as Pt. Reyes CA, as well as extensive use of the Salish Sea in winter by J pod (NWFSC 2013).	In progress	**NOAA** ENGOs
Identify key feeding areas and other critical habitat	Winter prey of Resident Killer Whales identified	**NRKW**			
		Not met, underway	- Winter prey samples have been collected from all NRKW clans; however, there are still few samples during winter and spring, particularly from G and R clans (Towers pers. comm. 2015). - Analysis of samples indicates that NRKW continue to feed primarily on Chinook Salmon during winter.	In progress	**DFO**
		SRKW			
		Not met, underway	- Winter prey sampling of SRKW is ongoing (e.g. Hanson *et al.* 2010a; NWFSC 2013).	In progress	**NOAA** ENGOs
			- Prey and fecal samples collected from SRKW in critical habitat from October to January 2005-2009 were analyzed. - Prey fragment samples were all salmonids, with chum most prevalent species (4:1), followed by Chinook. Fecal samples contained primarily chum and Chinook in roughly equal proportions, as well as small amounts of Sole,	Completed	**NOAA**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			Lingcod, and Coho, one Steelhead, and one Halibut (Hanson *et al.* 2010b).		
Protect access of whales to critical habitat	Sanctuaries within critical habitat established	**NRKW**			
		Not met, underway	**-** The Robson Bight-Michael Bigg Ecological Reserve continues to provide a sanctuary from most vessel traffic within NRKW critical habitat.	In progress	**ENGOs** BC MoE DFO ECCC
		SRKW			
		Not met, underway	- The whale watch industry in southern BC/WA has established guidelines that include "special operating areas" and voluntary no-go zones within SRKW critical habitat (Pacific Whale Watch Association 2014).	In progress	**Industry**
			- A candidate MPA within SRKW critical habitat was suggested based on habitat use and behaviour data from SRKW, and interviews with experts to estimate the size of an area that could be effectively closed to vessel traffic. The proposed area is located along the southwest shoreline of San Juan Island (Ashe *et al.* 2010).	Completed	**Academia** NOAA
			-- Initial proposal for the NMFS Protective Regulations for KW (2011) included a no-go zone prohibiting vessels from entering an area along the west side of San Juan Island (within SRKW critical habitat) from May 1- Sept. 30 (NMFS 2011b); however, this rule was not implemented and will be re-visited following a review of existing regulations (Barre pers.	In progress	**NOAA**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			comm. 2015).		
Protect critical habitat from contamination and physical disturbance	Measurable reduction in contaminants in critical habitat	**SRKW**			
		Met, ongoing	- Analyses of contaminants in blubber samples from Harbour Seals in Puget Sound showed that concentrations of PCBs, PCDEs and PCNs declined by 81%, 71%, and 98%, respectively, between 1984 and 2003. PBDE concentrations doubled every 3.1 years in this time period, but appeared to decline in 2009 (Ross *et al.* 2013).	Completed	**DFO** Academia ENGOs W SDFW
Ensure sufficient prey available to whales in critical habitat	Key prey populations in critical habitat areas	Not met, underway	- Body condition and nutritional status of Killer Whales within SRKW and NRKW critical habitat have been assessed through photogrammetry studies; these studies provide information about whether sufficient prey is available to these populations (Fearnbach *et al.* 2011; 2015; Barrett-Lennard *et al.* 2015)	In progress	**NOAA** **ENGOs**
			- Salmon stock composition is included as one of the criteria for additional areas in Canada important to the survival and recovery of RKWs (Ford pers. comm. 2015).	In progress	**DFO**
		SRKW			
		Not met, underway	- Modeling exercises undertaken during workshops held in 2011/2012 to assess the	Completed	**NOAA** **DFO**

Objective	Performance Measure[1]	Performance Measure Status	Activity Description and Results	Activity Status	Participants[2]
			effects of Chinook Salmon fisheries on SRKW provide information about the prey and energetic requirements of NRKW and SRKW (Hilborn *et al.* 2012).		
			- Salmon harvest regimes are examined under the US ESA to ensure that they do not jeopardize salmon or Killer Whale populations or their respective critical habitat areas (National Marine Fisheries Service 2011b).	In progress	**NOAA**
Ensure trans-boundary cooperation in identification and protection of critical habitat	Formal identification of critical habitat recognized by international agreement	Not met	A formal international agreement has not been implemented; however, NOAA and DFO have collaborated on several studies and workshops focused on RKW recovery including the workshops focused on assessing the effects of salmon fisheries on SRKW recovery in 2011/2012.	In progress	**DFO** **NOAA**

3.2 Activities supporting the Identification of Critical Habitat

Table 4 provides information on the implementation of the research outlined in the Schedule of Studies to Identify Critical Habitat in the Recovery Strategy. Each study has been assigned one of four statuses:

1) *Completed:* the study has been carried out and concluded,
2) *In progress:* the planned activity is underway and has not concluded,
3) *Not started*: the activity has been planned but has yet to start, or
4) *Cancelled*: the planned activity will not be started or completed.

Table 4: Progress of implementation of the schedule of studies to identify critical habitat outlined in the Recovery Strategy.

Study	Current Status	Details	Participants[3]
Year-round comprehensive surveys to identify areas of occupancy	In progress	- The DFO Cetacean Research Program conducted 17 ship-based cetacean surveys between 2009 and 2014 (Nichol pers. comm. 2015).	**DFO**
	Completed	- 30 aerial surveys were conducted by the DFO Cetacean Research Program between 2012 and 2014 (Nichol pers. comm. 2015).	**DFO**
	In progress	- Sightings networks including the BC Cetacean Sightings Network and the Orca Network further understanding of year-round distribution of SRKW and NRKW through compiling sightings of these whales from researchers, mariners, coastal residents, and other contributors.	**ENGOs**
	In progress	- The DFO Cetacean Research Program completed 46 acoustic deployments that focused on habitat use of RKWs off the coast of BC between 2009-2014. - 16 of these data sets have been analyzed by DFO to date; deployments from Langara Island had particularly high levels of NRKW presence, especially from March – May (Pilkington pers. comm. 2016).	**DFO**
	Completed	- Passive acoustics were used to determine year-round distribution of NRKW and SRKW at Swiftsure Bank and Cape Elizabeth. - Swiftsure Bank identified as a RKW hotspot with year-round presence of SRKW; NRKW spend more time in southern parts of their range than	**Academia** DFO

[3] Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically. Not all studies have specific participants identified.

Study	Current Status	Details	Participants[3]
		previously thought (Riera 2012).	
	In progress	- Hydrophone networks in BC and WA, including within SRKW and NRKW critical habitat, allow for year-round acoustic monitoring and better understanding of Killer Whale distribution.	**ENGOs** **FNs**
	In progress	- Several organizations conduct surveys for RKWs and/or collect sightings to provide to DFO/BCCSN, to aid in determining year-round distribution of Killer Whales.	**ENGOs** **FNs** BC Parks ECCC
	SRKW		
	In progress	- NOAA conducts annual winter/spring ship-based surveys aimed at better understanding winter habitat use by SRKW (Hanson *et al.* 2010a; NWFSC 2013; NOAA Fisheries 2014; Barre pers. comm. 2015).	**NOAA** ENGOs
	Completed	- Passive acoustic monitoring detections at seven sites between Cape Flattery, WA and Pt. Reyes, California used to look at winter and spring distribution of SRKW over a 4-year period (Hanson *et al.* 2013).	**NOAA**
	In progress	- Five SRKW have been satellite tagged to provide further information about winter distribution. Tags have indicated winter travel by K pod as far south as Pt. Reyes, as well as extensive use of the Salish Sea in winter by J pod (NWFSC 2013).	**NOAA** ENGOs
Identify key feeding areas throughout the year to determine whether they should be proposed as additional critical habitat	In progress	- Ongoing prey sampling by DFO, NOAA, and collaborators during ship-based surveys and other dedicated and opportunistic Killer Whale research trips continues to provide information about important prey and foraging areas for RKWs.	**DFO** **NOAA**
	Completed	- Average duration of passive acoustic detections at Swiftsure Bank suggested that this may be an important foraging area for SRKW in summer and winter, and for NRKW particularly during the fall (Riera 2012).	**Academia** **DFO**
	SRKW		
	In progress	- Five SRKW were satellite tagged to provide further information about	**NOAA**

Study	Current Status	Details	Participants[3]
		winter habitat use and important winter feeding areas. Tags allowed for observation of winter predation and collection of winter prey samples (NWFSC 2013).	ENGOs
Identify activities other than foraging that may be important functions of critical habitat	Not started	- Activities other than foraging were not explicitly included when considering whether additional areas should be proposed as critical habitat in Canada.	
	SRKW		
	In progress	- In addition to prey quality, quantity, and availability, NOAA includes water quality to support growth and development, and passage conditions to allow for migration, resting, and foraging in consideration of critical habitat for SRKW (National Marine Fisheries Service 2011b).	**NOAA**
Identify sources of acoustic disturbance that may negatively impact or affect access to critical habitat	Completed	- A workshop was held in 2012 to further the understanding and management of ocean noise on the Pacific coast, including within SRKW and NRKW critical habitat (Heise and Alidina 2012).	**ENGOs** Academia DFO Industry NOAA
	Completed	- A study of the acoustic quality and sources of ocean noise in areas including SRKW and NRKW critical habitat determined that the long-term spectral averages in Haro Strait were dominated by sound characteristic of ship engines and that Killer Whales may lose up to 97% of their acoustic communication space in this noisy area (Williams *et al.* 2014b).	**Academia**
	SRKW		
	Completed	- One year of ship traffic data was paired with hydrophone recordings in Puget Sound (critical habitat for SRKW) to assess ambient noise and quantify contribution of vessel traffic. Commercial vessel traffic accounted for more than 90% of the sound energy budget, with container ships as the greatest contributor (Bassett *et al.* 2012).	**Academia** NOAA
Identify sources	In progress	- Vessel traffic has been identified as a source of disturbance to RKWs in	**Academia**

Study	Current Status	Details	Participants[3]
of physical disturbance that may negatively impact or affect access to critical habitat		critical habitat. Whales tended to spend less time foraging when boats were in close proximity (Lusseau *et al.* 2009).	
Identify sources of biological and chemical contaminants that may negatively impact critical habitat	**SRKW**		
	Completed	- The major sources of several chemical pollutants in Puget Sound, including PCBs and PDBEs, were identified as part of the Assessment of Selected Toxic Chemicals in Puget Sound Basin (Ecology and King County 2011).	**WSDE** **King County** **Dept of Natural Resources**
	Completed	- Atmospheric dispersion modeling indicated that exposure to exhaust gases from whale watching vessels may be negatively affecting SRKW within their critical habitat (Lachmuth *et al.* 2011).	**Academia** ENGOs
Identify factors that may negatively affect an adequate and accessible supply of prey in areas of critical habitat	**SRKW**		
	In progress	- The series of workshops held in 2011/2012 to evaluate the effects of Chinook Salmon fisheries on SRKW included modeling exercises on how various levels of fishing effort may affect prey availability for SRKW (Hilborn *et al.* 2012). - Also identified other predators (e.g. seals and sea lions) as possible factors that could affect the availability of prey for SRKW, including within critical habitat.	**NOAA** **DFO**

3.3 Summary of Progress towards Recovery

3.3.1 Status of Performance Measures

Forty performance measures from the Recovery Strategy are identified in Table 3, column 2; an additional eight performance measures suggested during technical workshops are also listed, and are marked with an asterisk. Of the 48 performance measures identified, 27 have been met (56%), actions to achieve another 20 measures are underway but not completed at this time (42%), and activities in support of one performance measure have not yet commenced (2%).

3.3.2 Completion of Action Plan

The Action Plan for the Northern and Southern Resident Killer Whales (*Orcinus* orca) in Canada is planned to be completed in 2016.

3.3.3 Critical Habitat Identification and Protection

When the Recovery Strategy was completed, critical habitat for Northern and Southern Resident Killer Whales was identified to the extent possible. The document also stated that there are likely other areas important to Killer Whales at various times, but these areas have not yet been studied in sufficient detail to be identified with confidence. Existing critical habitat for Northern and Southern Resident Killer Whales is protected in Canadian waters under SARA, and the portion of Southern Resident Killer Whale critical habitat in American waters is protected under the United States' Endangered Species Act.

Additional information regarding the coast-wide distribution and habitat use of Northern and Southern Resident Killer Whales has led to the identification of habitat important to the survival and recovery of Resident Killer Whales in both Canadian and U.S. waters. These areas were identified from data collected through cetacean surveys, acoustic methods, photo-identification, and satellite tagging, and prey studies. In Canada, these areas include waters along the southwest coast of Vancouver Island extending out to the shelf edge, and waters off the northern end of Haida Gwaii (Ford pers. comm. 2015).

In January 2014, the United States' National Marine Fisheries Service (NMFS) received a petition from the Center for Biological Diversity requesting that NMFS revise Southern Resident Killer Whale critical habitat to include Pacific Ocean waters off the coasts of Washington, Oregon, and California. On February 24, 2015, NMFS announced their intent to proceed with a revision to the critical habitat designation.

3.3.4 Recovery Feasibility

As stated in the Recovery Strategy, Northern and Southern Resident Killer Whale populations are not likely to see a rapid increase; however, the recovery of both populations to a more robust size is feasible. Although the small size of these populations - especially the Southern Resident Killer Whales - makes them particularly vulnerable to threats, the many studies and

initiatives outlined in Sections 3.1 and 3.2 of this report demonstrate progress toward better understanding of these threats, and steps toward more effective mitigation.

4 Concluding Statement

Significant progress has been made toward meeting many of the objectives and strategies outlined in the Recovery Strategy, including progress toward better understanding the year-round distribution, habitat use, and prey requirements of Resident Killer Whales, as well as the impacts of threats to their populations. Photo identification catalogues have been updated and annual censuses are ongoing, allowing for close monitoring of population dynamics and demography. Population models have been updated for both Northern and Southern Resident Killer Whales, and a greater understanding of the demographics, interactions, and interdependencies between and within matrilines has been achieved. A transboundary effort was undertaken to examine the relationship between indices of Chinook salmon abundance and Resident Killer Whale populations; investigations into seasonal and annual dietary requirements are ongoing.

Identification of contaminant levels in Killer Whales, their prey, and in sentinel species such as the Harbour Seal provided an overall picture of the interaction between the species and its environment, and informed the development of a PCB food web bioaccumulation model. Evaluation of the Killer Whale acoustic environment, including noise maps and sound signatures for various vessel classes, has provided invaluable information about the quality of Killer Whale acoustic environment in different areas. Studies using DTAGs provide information on potential acoustic impacts to Killer Whales, and inform ongoing efforts toward the development of thresholds and effective mitigation protocols. These examples serve to illustrate the efforts undertaken to understand threats, characterize impacts, and develop effective mitigation in pursuit of Resident Killer Whale recovery.

The effects of the recovery effort on a long-lived species are not likely to be immediately evident. Over the last 40 years, the Northern Resident Killer Whale population has experienced an average growth rate of 2.2%,,while the Southern Resident population has undergone periods of growth and decline, ranging from 71 animals (1974) to a peak of 98 animals (1995; 2015 population is 84 animals). Based on their low reproductive rate, recovery of Northern and Southern Resident Killer Whales can be expected to take multiple generations. Fisheries and Oceans Canada maintains an ongoing commitment toward the recovery of this species.

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6 Appendix A: Abbreviations

ADEC = Alaska Department of Environmental Conservation
Office of the State Veterinarian (State of Alaska Division of Environmental Health)
BC MoE = British Columbia Ministry of Environment
BCCSN = British Columbia Cetacean Sightings Network
CCME = Canadian Council of Ministers of Environment
CEPA = Canadian Environmental Protection Act
DDT = dichlorodiphenyl trichloroethane
DFO = Fisheries and Oceans Canada
ECCC = Environment and Climate Change Canada
ECHO = Enhancing Cetacean Habitat and Observation Program
EEZ = Exclusive Economic Zone
MPA = Marine Protected Area
NMFS = National Marine Fisheries Service
NOAA = National Oceanographic and Atmospheric Administration
NWFSC = Northwest Fisheries Science Center
PBDEs = polychlorinated diphenylethers
PCBs = polychlorinated biphenyls
PCDDs = polychlorinated dibenzo-*p*-dioxins
PCDFs = polychlorinated dibenzofurans
PCNs = polychlorinated naphtalenes
POPs = persistent organic pollutants
EPA = U.S. Environmental Protection Agency
USGS = U.S. Geological Survey
WSDE = Washington State Department of Ecology
WSDFW = Washington State Department of Fish and Wildlife