

Report on the Progress of Recovery Strategy Implementation for the Transient Killer Whale (*Orcinus orca*) in Canada for the Period 2007-2012

Transient Killer Whale



2015

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Recommended Citation

DFO. 2015. Report on the Progress of Recovery Strategy Implementation for the Transient Killer Whale (*Orcinus orca*) in Canada for the Period 2007-2012. *Species at Risk Act* Recovery Strategy Report Series. Fisheries and Oceans Canada, Ottawa. v + 19 pp.

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Cover photograph: Transient Killer Whale by Graeme Ellis

Également disponible en français sous le titre
« Rapport sur les progrès de la mise en œuvre du programme de rétablissement de la tête carminée (*Notropis percobromus*) au Canada pour la période 2007-2012 »

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ISBN 978-0-660-02793-7
Catalogue no. En3-4/50-1-2015E-PDF

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This document was prepared by Erin Rechsteiner on behalf of Fisheries and Oceans Canada (DFO).

Acknowledgements

Fisheries and Oceans Canada would like to thank John Ford, Graeme Ellis, James Pilkington, Lisa Spaven, Sheila Thornton, Jonathan Thar, and Lourdes Nurse (DFO), Jared Towers, (DFO and Marine Education and Research Society; MERS), Christie McMillan (MERS), and Stephen Raverty (British Columbia Ministry of Agriculture and Lands) for their contributions to the development of this progress report.

Preface

Section 46 of the *Species at Risk Act* (SARA) requires the competent Minister 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.

Reporting on the progress of recovery strategy implementation requires reporting on the collective efforts of the competent Minister, provincial organizations and all other parties involved in conducting activities that contribute towards the species' recovery.

Executive Summary

West Coast Transients refer to the population of Transient Killer Whales that frequent Canadian Pacific waters. West Coast Transients were initially designated as *Threatened* by COSEWIC in 2001, and put on Schedule 1 of the *Species at Risk Act* (SARA) upon its inception (2002). In 2008, the population was again assessed as *Threatened* and remains on Schedule 1. West Coast Transients are comprised of two sub-populations: Inner Coast Transients, and Outer Coast Transients. Relatively little is known about the Outer Coast Transients due to the rarity of sightings of members of this sub-population. The Inner Coast Transients are more frequently encountered, and the bulk of the progress made towards the recovery of West Coast Transients has occurred with regard to the Inner Coast sub-population.

The major threats to West Coast Transient recovery include: 1) contaminants, 2) acoustic disturbance, 3) physical disturbance from vessels and aircraft, 4) collision with vessels, 5) toxic spills – including both hydrocarbon and non-hydrocarbon spills, and 6) changes in prey availability or quality.

This report summarizes the progress made towards Transient Killer Whale recovery for the period 2007-2012, including achievements made by Fisheries and Oceans Canada (DFO), and selected achievements of the broader scientific community.

Progress to date includes:

- An improved understanding of foraging habitat through the spatial analyses of sightings data combined with an analysis of West Coast Transient prey-capture locations and species predated;
- An improved understanding of range and seasonal distribution of West Coast Transients and their prey;
- Continued annual population census of Transient Killer Whales to track individuals across seasons, habitats, and years;
- Further understanding of population dynamics, including population growth rates, estimated carrying capacities and potential biological removal of West Coast Transients;
- Information relevant for the designation of Critical Habitat for Transient Killer Whales in Pacific Canada;
- An indication of which activities are most likely to destroy the habitat used by West Coast Transients;
- Amendments to the Marine Mammal Viewing Guidelines which provide further protection for Killer Whales;
- Progress on the assessment of contaminant levels in Transient Killer Whale prey.

While there has been measurable progress towards meeting the goals, objectives, and performance measures presented in the Recovery Strategy, further work is required to ensure the continued growth of knowledge around, and eventual recovery of Transient Killer Whales in Canadian Pacific waters.

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1. Background

1.1 COSEWIC Assessment Summaries

Common name:	Transient Killer Whale
Scientific name:	<i>Orcinus orca</i>
Legal listing (SARA):	Threatened
COSEWIC status:	Threatened
Assessment summary:	November 2008 ¹
Reason for designation:	This population has a very small number of mature individuals (~122). It is subject to threats from high levels of contaminants, acoustical and physical disturbance, and potential oil spills. However, the population has been increasing since the mid-1970s when monitoring began, and its prey base of pinnipeds and cetaceans is likely stable or increasing.
Occurrence in Canada:	Pacific Ocean
Status history:	Designated Special Concern in April 1999. Status re-examined and designated Threatened in November 2001 and in November 2008. Last assessment based on an updated status report.

1.2 Threats

1.2.1 Threats to the Species at Risk

Present threats to Transient Killer Whales (TKW) in Canadian Pacific waters are detailed in the Recovery Strategy (Fisheries and Oceans Canada, 2007) and summarized here. They include:

1. *Contaminants*

- a. Persistent bioaccumulating toxins (PBTs) as legacy contaminants (i.e., PCBs and dichloro-diphenyl trichloroethane (DDT))
- b. Persistent bioaccumulating toxins (PBTs) as emerging contaminants (i.e., Polybrominated diphenyl ethers (PBDEs))
- c. Biological pollutants (i.e., exotic and terrestrial diseases or diseases in their prey)
- d. Trace metals

2. *Acoustic disturbance*

- a. Chronic noise – typically associated with shipping and other vessel traffic
- b. Acute noise – typically associated with sonar and seismic surveys

¹ Assessment summary and population numbers are from COSEWIC 2008.

3. *Physical disturbance from vessels and aircraft*
4. *Collision with vessels*
5. *Toxic spills – including both hydrocarbon and non-hydrocarbon spills*
6. *Changes in prey availability or quality*

1.2.2 Activities Likely to Destroy Critical Habitat

Critical habitat for Transient Killer Whales was not identified in the Recovery Strategy (Fisheries and Oceans Canada, 2007). The Recovery Strategy outlined a schedule of studies that would allow for the identification of Critical Habitat over a 5-year timeframe. The progress and outcomes of the studies outlined in the Recovery Strategy have been summarized in the Canadian Science Advisory Secretariat research document and an accompanying Science Advisory Report, entitled “Information in support of the identification of Critical Habitat for Transient Killer Whales (*Orcinus orca*) off the West Coast of Canada” (DFO 2013a; Ford et al. 2013).

2. Recovery

2.1 Recovery Goals and Objectives

Recovery Goals and Objectives, as stated in The Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada (the Recovery Strategy; Fisheries and Oceans Canada, 2007) are as follows:

Recovery Goals

To attain long-term viability of the West Coast Transient Killer Whale population by providing the conditions necessary to preserve the population’s reproductive potential, genetic variation, and cultural continuity.

Population Objectives

- The population size, averaged over the next five years, will remain at or above the current level.
- The number of breeding females in the population, averaged over the next five years, will remain at levels that will provide a neutral or positive growth rate.
- Studies will be undertaken to determine numerical and demographic population objectives that represent long-term viability for this population.

Distribution Objectives

- Transient Killer Whales will continue to utilize their known range.
- Prey will be available, in quantities adequate to support recovery, throughout the

currently known range of Transient Killer Whales.

- Studies will be undertaken to determine how the range is utilized at a population and sub-population level.

Recovery Objectives

- Minimize the exposure to Transient Killer Whales to legacy and emergent pollutants.
- Minimize the risk of prey population reductions from anthropogenic activities, until precise prey needs can be determined.
- Current measures to protect Transient Killer Whales from vessel disturbance will be maintained or modified, if determined necessary from further studies.
- Minimize the exposure of Transient Killer Whales to acute or chronic sound levels in excess of those considered to cause behavioural or physical harm in cetaceans.
- The quantity, quality and distribution of Transient Killer Whale prey necessary to sustain or increase the current population level will be determined.
- A greater understanding of the impacts of contaminants and other biological and non- biological pollutants on Transient Killer Whales will be developed.
- The effects of vessel disturbance on Transient Killer Whales will be evaluated.
- A more comprehensive understanding of the impacts of chronic and acute noise on Transient Killer Whales will be developed.

2.2 Performance Measures

Performance measures were implicitly stated within the detailed recovery objectives – which were grouped into broad categories (Fisheries and Oceans 2007) and are reported on in Section 3.3.

3. Progress towards Recovery

Much of the progress made thus far in achieving the goals identified in The Recovery Strategy has been documented in Ford et al. (2007), DFO (2009a), DFO (2013a) and Ford et al. (2013). This section summarizes the achievements to date.

3.1 Research and Monitoring Activities

The Recovery Strategy recommended a schedule of studies to enable the classification of critical habitat (Fisheries and Oceans, 2007). This schedule of studies included five broad objectives: 1) spatial analysis of existing Transient Killer Whale (TKW) sightings data; 2) spatial analysis of existing data with respect to the distribution of the prey of TKWs; 3) spatial analysis of TKW kill locations with respect to the ambient noise environment; 4) year-round surveys to determine range and seasonal movements of TKWs; and 5) year-

round surveys to determine the spatial and temporal distribution and abundance of small cetaceans. Details on the progress in meeting the five objectives are provided below.

Spatial analysis of existing sighting data

A spatial analysis of existing sightings data was conducted using an extensive database of photo-identifications of individual killer whales collected during 3,528 encounters between 1958 and 2011 (Ford et al. 2013). Analysis of these data revealed two putative TKW populations frequenting Canadian Pacific waters – inner and outer West Coast Transients (WCTs). Locations of all TKW encounters from both sub-populations were assessed and combined with described foraging behaviours, biophysical functions, features, and habitat attributes.

Spatial analysis of existing TKW sightings data was also conducted by the BC Cetacean Sightings Network (BCCSN), which collaborates with DFO to collect and archive killer whale (and other cetacean and sea turtle) sightings submitted by volunteer and opportunistic observers. Through the BCCSN, predictions of areas of seasonally high Killer Whale densities in BC waters were made after the development of a model to estimate observer effort (Smith et al., 2006; Rechsteiner et al., 2013).

Spatial analysis of existing data with respect to the distribution of the prey of Transient Killer Whales

Observations of TKW predation events with confirmed prey species (421 predation events) were spatially analyzed (Ford et al. 2013). Geographic locations of successful predation events of the four most common prey were recorded and used in a spatial analysis, which showed that all four species were consumed throughout the range of nearshore waters of the BC coast typically used by TKWs (Ford et al. 2013). This phenomenon reflects the general distribution patterns of major prey items; for example, Harbour Seals, which are ubiquitous in nearshore coastal waters (Olesiuk 2010), and Harbour Porpoise, which prefer waters <100 m in depth, limiting their offshore distribution (Ford et al. 2013).

Spatial analysis of Transient Killer Whale kill locations with respect to ambient noise environment

Spatial analysis of TKW kill locations has not been undertaken with respect to the ambient noise environment.

Several studies are working on compiling ambient noise environments throughout Canadian Pacific waters. In particular, recent work depicts oceanic noise levels in the Canadian Pacific resulting from ship traffic (Erbe et al. 2012). High levels of acoustic energy coincide with critical habitats for endangered Resident Killer Whales, and also appear to overlap with much of the habitat recommended for consideration as TKW critical habitat by DFO (2013a).

The Cetacean Research Program (CRP, DFO Pacific) conducts passive acoustic monitoring (PAM) using submersible recorders (PATC, SM2M, and AURAL) for deployments ranging from six months to one year. These PAMs are complimented by

acoustic data collected by the VENUS and NEPTUNE projects (www.neptunecanada.ca; accessed October 25th 2013). The CRP also has nine deployment sites for land-based hydrophones, including Langara Island, Caamaño Sound, and lower Johnstone Strait. Hydrophone and PAM data are used to determine presence of cetaceans, but may also reveal patterns in ambient noise. Analysis to determine ambient noise levels in these data has not yet occurred.

Year-round surveys to determine range and seasonal movements of Transient Killer Whales

Surveys to determine the range and seasonal movements of TKWs have been conducted through dedicated small vessel surveys, and as part of multi-species ship-based surveys. From 2002-2010 the CRP completed over 2,000 hours of dedicated ship-based surveys targeting multiple cetacean species in the Canadian Pacific, traversing nearly 40,000 km of track-lines. Survey efforts were roughly equivalent for 2011 and 2012, and data analysis is ongoing.

Researchers at DFO, the Vancouver Aquarium, and at universities also deploy small research vessels to survey BC waters for Killer Whale research. When TKWs are encountered, the location is logged, photo IDs are obtained, and the data are compiled along with the ship-based survey data and housed in a Transient Killer Whale Encounters database maintained by DFO.

DFO also works with whale watch operators and community members along the BC coast, who survey their local waters periodically or regularly throughout the year. Several CRP contractors monitor TKWs year-round – particularly in the Johnstone Strait area, and off south and southwestern Vancouver Island.

Year-round surveys to determine the spatial and temporal distribution and abundance of small cetaceans

The DFO multi-species cetacean surveys also record small cetacean occurrence. When small cetaceans are located on these surveys, species are identified, individuals are counted, and location is recorded.

DFO conducts aerial surveys for cetaceans off the west coast of Vancouver Island (2005-07, 2012-13); aerial surveys were not undertaken from 2008-2012. Locations of small cetacean sightings are recorded during aerial surveys, as well as an estimate of group-size and identification of species.

Observations on small cetaceans were also recorded during DFO's aerial shark surveys in nearshore waters off Vancouver Island (Hesquiat Peninsula to Barkley Sound and associated inlets) each summer from 2007-2011.

In addition to visual surveys, the passive acoustic monitoring work undertaken by DFO and others records the occurrence of Pacific White-Sided Dolphins (Harbour and Dall's Porpoise do not vocalize within the detectable range of the devices currently used).

The BCCSN works with DFO to collect year-round opportunistic sightings records of small cetaceans from volunteer observers. Although these data are not survey-based, recent spatial analyses of observer patterns has generated a model to adjust sightings for observer effort, and yield predictions of small cetacean distribution in BC waters in both winter and summer seasons (Smith et al., 2006; Rechsteiner 2012; Rechsteiner et al., 2013). Seasonal occurrence of Pacific White-Sided Dolphins were assessed in the nearshore waters of the Central Coast of BC based on DFO survey data collected from 2002-2010 (Rechsteiner 2012).

Hall (2011) surveyed year-round distribution of Harbour Porpoise in portions of Juan de Fuca Strait and the Haro Strait, both off southern Vancouver Island. Harbour Porpoise were present in highest numbers during their reproductive season (April – October), when a three-fold increase in density occurred. An expanded study area including larger portions of Juan de Fuca Strait and Haro Strait, as well as the southern Strait of Georgia was surveyed to determine seasonal and yearly occurrence of harbour and Dall's Porpoise (1991 to 2008).

Abundance of some small cetacean species in parts of their range has been estimated in recent years. Mark-recapture methods generated from a long-term year-round photo identification data set were used to estimate Pacific White-Sided Dolphin abundance in the Broughton Archipelago (Ashe 2007). Abundance estimates were generated for Harbour Porpoise, Dall's Porpoise, and Pacific White-Sided Dolphins in coastal waters from the eastern shores of Haida Gwaii and Vancouver Island eastward, using systematic line-transect surveys conducted in spring and summer months (2004-2005; Williams and Thomas 2007).

Formal and informal sightings network for TKW and small cetaceans

DFO maintains a Nanaimo-based telephone line that connects the public directly to the Cetacean Research Program at DFO's Pacific Biological Station in Nanaimo for reports of Killer Whale sightings in the local waters around Nanaimo, BC. DFO also collaborates with the Vancouver Aquarium to operate the BCCSN, which maintains a database of over 70,000 cetacean sightings. This formal sightings network covers the entire BC coast, and outreach activities include a focus on recruiting observers in areas where coverage is low. The Haida Gwaii Marine Stewardship Group worked with the BCCSN from 2008-2012 to encourage Haida Gwaii residents and visitors to report sightings of Killer Whales and other cetaceans.

The Orca Network established a sightings telephone line in 2001, and maintains a database of sightings of Killer Whales and other cetaceans sighted primarily in the Salish Sea, especially in the southern Strait of Georgia, San Juan Islands, and Puget Sound.

Orcalab, founded in 1970, monitors a network of hydrophones off northeastern Vancouver Island to collect acoustic detections of Killer Whales and other cetaceans. These acoustic detections are recorded and shared with DFO. Observers at their base on Hanson Island, as well as at nearby Cracroft Point also collect visual sightings of Killer Whales as they pass through the area, and communicate with researchers and whale watchers in real-time

to assist with locating animals. Orcalab sightings were collected during 2008-2012 and are ongoing.

Informal sighting networks also exist - primarily in areas where whale watching companies operate at high densities. For example, in Johnstone Strait a VHF radio-channel is dedicated to reports of all cetaceans and tends to focus on Killer Whale locales. A pager-network in the waters surrounding southern Vancouver Island and the San Juan Islands is subscribed to by most whale watch companies, and sightings are transmitted throughout the community. In 2009-2010, the Haisla First Nation operated an AFSAR (Aboriginal Funds for Species at Risk)-funded informal sightings network that requested notification of observations of whales in Haisla traditional territory.

3.2 Management Activities

Two mitigation standards have been put in place to reduce the threat of noise to marine mammals: 1) the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (DFO 2008a); and 2) the Maritime Commanding Order: Marine Mammal Mitigation Procedures (DND 2008).

Departmental science and fisheries management staff regularly review development and research proposals for the potential effects of noise and pollution on TKWs, making specific mitigation requirements or recommendations in the context of risk to the animals from proposed activities. In the Pacific Region, each proposed seismic survey is reviewed by DFO marine mammal experts and mitigation measures are developed (DFO 2009a).

3.3 Summary of Progress towards Recovery

A summary of the progress made towards the recovery of TKWs was documented using the performance measures identified in the Recovery Strategy (Fisheries and Oceans Canada, 2007). The questions addressed below were initially posed in Table 2. *Recovery Planning Table: Recommended approaches to meet recovery objectives* (Fisheries and Oceans Canada 2007).

Population size and demographic monitoring

1. *Were directed surveys conducted to complete annual population census, size and demographics?*

Yes. DFO has undertaken an annual directed population census of TKWs from 1974 to present. Population census involves acoustic and visual search of areas known as TKW habitat, or as potential TKW habitat, and is conducted from DFO research vessels by dedicated cetacean research biologists. In recent years, directed surveys undertaken by the DFO research vessels have been complemented by multi-species cetacean surveys (directed in part at locating TKWs) conducted off large Coast Guard ships (2002-2013). Surveys based on the large ships go out in all seasons, and cover both nearshore and offshore areas.

2. *Did collaborations with other Transient Killer Whale researchers occur to complete annual population census, size, and demographics?*

Yes. Photo identification studies conducted by DFO and collaborators since 1958 have resulted in over 15,000 whale identifications (all Killer Whale ecotypes) which are used to monitor population size and demographics. Of these encounters, ~70% were made by DFO and other research or government organizations or institutions, and ~30% were made by natural history tour and whale watch operations (Ford et al. 2013).

Recently, an updated catalogue of individual photographs of TKWs from coastal BC, northern Washington and southeastern Alaska was produced (Towers et al. 2012). Identification photographs were collated from DFO researchers, as well as colleagues from southeastern Alaska, BC, Washington, Oregon, and California.

Collaborations occurred with First Nations in BC through the AFSAR funding program. From 2008-2012, more than 30 systematic surveys were conducted in Gitga'at traditional territory, including year-round monthly surveys of habitat. The Heiltsuk First Nation also completed data collection, including photographing individual TKWs in their traditional territory from 2008 – 2012, and are continuing their work in 2013. From 2009-2012, the Haisla First Nation monitored cetacean use of their territory, including photographing TKWs and submitting photographs of individuals encountered to DFO. DFO also collaborated with researchers in Alaska and California to monitor individual occurrence and habitat use by TKWs outside of Canadian waters.

3. *Were formal and informal sightings networks including opportunistic photo-identification utilized to complete annual population census, size, and demographics?*

Yes. The CRP recruits TKW sightings through a hotline, and opportunistic sightings of Killer Whales reported by the public contributed to the annual population census data (DFO 2009a).

The BC Cetacean Sightings Network (BCCSN) also maintains sightings recruitment via public outreach and advertising of a 1-800 number, web form, and log book that citizens use to record sightings of TKWs.

4. *Were numerical and demographic population modeling techniques used to monitor population size and demographics?*

Yes. In 2006, TKW abundance was estimated at 243 animals by the capture-recapture model, which concurred with estimates derived from demographic analyses (~240 animals). The capture-recapture model is a density-dependent stochastic logistic model, indicating that Transient Killer Whales are prey-limited (Ford et al. 2007; DFO 2009a).

Setting demographic and population objectives

5. *Were numerical and demographic population modeling techniques used to set demographic and numerical population objectives?*

No. Numerical and demographic population objectives have not been explicitly set. TKWs have an estimated carrying capacity of 250-300 animals in BC waters, and a potential biological removal was assessed at 1.6 animals a year (Ford et al., 2007, DFO, 2009a).

Monitoring range utilization

6. *Were directed surveys conducted to monitor TKW range-use?*

Yes. The directed surveys detailed in *Section 3.3* were also used to monitor range use.

7. *Were collaborations with other transient researchers used to monitor range use?*

Yes. The collaborations with other researchers detailed in *Section 3.3* were also used to monitor range use.

8. *Were formal and informal sightings networks used to monitor range use?*

Yes. The BC Cetacean Sightings Network (BCCSN) conducted a spatial analysis based on the sightings submitted through their formal sightings network.

Monitoring prey distribution

9. *Were pinniped surveys completed to monitor prey distribution?*

Yes. Aerial surveys have been conducted by DFO since the 1970s to monitor Harbour Seal distribution, abundance, and population trends (DFO 2010, Olesiuk 2010). Harbour Seal distribution and abundance was also assessed in the waters east of the eastern shoreline of Haida Gwaii and Vancouver Island, in the summers of 2004 and 2005 (Williams and Thomas, 2007).

Ten province-wide aerial surveys have been conducted by DFO since the early 1970s to monitor Steller Sea Lion distribution and abundance. Surveys are conducted at four-year intervals and allow for estimates of pup production and counts of juveniles and adults; distribution and demographic data were recently collated in a report (DFO 2008b, Olesiuk 2008) and an updated report is expected for 2014.

Since the late 1990s, collaborators at universities have monitored portions of Steller Sea Lion range in BC via boat-based surveys. These surveys target Steller Sea Lions, but also record numbers of California Sea Lions and Northern Elephant Seals when encountered. (*Dr. A. Trites, Director, Marine Mammal Research Unit, Fisheries Centre, University of British Columbia, Vancouver BC, pers. comm.*).

10. *Were formal and informal sightings networks used to monitor prey distribution?*

No. Cetacean sightings data from sightings networks have not yet been compiled in a central database or mapped, and pinniped sightings have not been recruited.

Reducing contaminants in Transient Killer Whales and their prey

11. *Was existing prohibition on regulated PBTs and other non-PBT chemicals maintained and enforced?*

Yes. PCBs and other legacy PBTs continue to be regulated through the Canadian Environmental Protection Act (CEPA) 1999.

12. *Was the need for and efficacy of prohibitions on use of unregulated PBDEs and other non-PBTs that affect Transient Killer Whales or their prey evaluated? Were mitigation measures implemented as necessary?*

Yes. Regulations prohibiting the manufacture of all seven PBDEs (TetraBDE, PentaBDE, HexaBDE, HeptaBDE, OctaBDE, NonaBDE, and DecaBDE) were assessed under the Canadian Environmental Protection Act (CEPA) 1999, and came into effect on July 8, 2009.

13. *Did international cooperation and collaboration occur, to reduce PBTs used outside Canada that contribute to Canadian contaminant levels?*

Yes. REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) came into force June 7, 2007 to improve the former legislative framework on chemicals in the EU. REACH makes industry responsible for managing and assessing the risks posed by the chemicals that they use, and for providing safety information to their users. (http://ec.europa.eu/enterprise/sectors/chemicals/reach/index_en.htm; accessed October 26, 2013). The United Nations Economics Commission for Europe Executive Body adopted the Aarhus Protocol on Persistent Organic Pollutants (POPs) in 1998, which focuses on eliminating the 16 most high-risk substances – including eleven pesticides, two industrial chemicals, and three contaminants. In 2009, parties to the Protocol on POPs included seven new substances to the protocol.

14. *Were government and non-government education and stewardship programs for industrial and private use of PBT and non-PBT compounds including currently used pesticides provided?*

Yes. The Pacific Region Contaminants Atlas (PRCA) is a project formed through consultations with Environment Canada, DFO, BC Ministry of Environment, Community Mapping Network, and the BC Conservation Foundation. The goals of the PCRA include making scientific and technical information about contaminants in BC, including legacy PBT compounds, emerging PBT compounds, and currently used pesticides available to the public through an online resource tool (<http://www.pacifictoxics.ca/>; accessed October 26, 2013). In addition, The Northern Contaminants Program is a Government of Canada program that allocates funding for research related to the education, research and monitoring of contaminants in the diets of humans living in northern areas of Canada.

A lesson plan for grade 7 students was developed as part of the Stream to Sea program, which is a DFO initiative focused on using an ecosystem approach to education. This lesson plan used Killer Whales in British Columbia as a case study to learn about PBT compounds and bioaccumulation.

15. *Did monitoring via a dedicated sampling program for Transient Killer Whale contaminants occur?*

In progress. Biopsy samples continue to be collected from TKWs during dedicated Killer Whale surveys, during opportunistic sightings of TKWs by CRP researchers, and while on multi-species cetacean surveys, and tissue samples from fresh-dead, healthy, robust and non-emaciated TKWs have also been collected.

16. *Did monitoring via a dedicated sampling program for Harbour Porpoise contaminants occur?*

No. Monitoring via a dedicated sampling program for contaminants in live Harbour Porpoise in the Canadian Pacific has not been conducted.

17. *Were benchmark contaminant studies for other prey species (other pinnipeds and cetaceans) conducted?*

Yes. A baseline toxicity reference value (TRV) was generated for the protection of marine mammal health by analysing POP and PCB levels and associated effects on Harbour Seals (Mos et al. 2010). Ross et al. (2013) assessed PCB, PBDE, PCDE, and PCN trends in Harbour Seals of the Salish Sea (BC and WA). Biopsy samples were collected from live Steller Sea Lions in the Strait of Georgia, BC (Alava et al. 2012).

18. *Was sediment sampling and monitoring conducted to assess contaminants?*

Yes. Sediment sampling and monitoring were conducted at four sites in the Canadian Pacific. Samples and monitoring occurred at Disposal at Sea sites at Brown Passage and Douglas Channel (Ross et al. 2012), and at Point Grey and Sand Heads (Ross et al. 2011).

19. *Were stranded Transient Killer Whales necropsied to evaluate possible exposure to contaminants, biological pollutants, and pathogens?*

Yes. From May 2007 to April 2013, seven TKWs were necropsied through DFO's Marine Mammal Response Program.

Protecting prey populations

20. *Were current harvest restrictions on pinnipeds maintained, and was it ensured that research, nuisance seal, or other authorized removals did not cause pinniped population level reductions?*

Yes. Harvest restrictions on pinnipeds were maintained, and population-level increases for both Harbour Seals and Steller Sea Lions in Canadian Pacific waters have been recorded.

21. *Were harvest restrictions and programs to protect small cetaceans from anthropomorphic threats maintained?*

Yes. Harvest restrictions on small cetaceans were maintained. Reducing the risks of entanglement and habitat degradation are essential for effective management of Harbour Porpoise (Fisheries and Oceans Canada 2009), and by-catch in fishing nets poses a risk to the small cetaceans of the Canadian Pacific (Williams et al. 2008).

Protection from vessel disturbance

22. *Were the proposed Marine Mammal Regulation amendments of the Fisheries Act implemented?*

No. The proposed amendments were not implemented in the 2006-2012 period.

23. *Were government and non-government education and stewardship programs aimed at reducing vessel disturbance undertaken?*

Yes. The BCCSN, the DFO Cetacean Research Program and the DFO Marine Mammal Response Program all distribute awareness pamphlets detailing the Marine Mammal Viewing Guidelines and threats of vessel disturbance to Killer Whales. Additionally, all programs provide public outreach, including information on what the public can do to promote species recovery and assist in mitigation of Killer Whale vessel disturbance.

Cetus Research and Conservation Society conducts community education, outreach, and stewardship activities in the waters and coastal communities around Vancouver Island, which are focused on promoting the 'Be Whale Wise' guidelines and educating the public about the risks of vessel disturbance to Killer Whales. The Marine Education and Research Society, in collaboration with the North Island Marine Mammal Stewardship Association, launched a poster campaign outlining the importance of the Marine Mammal Viewing Guidelines and highlighting the risks of vessel and whale collisions, and talked to the public about ways to prevent collisions.

The Gitga'at First Nation operates a territorial stewardship program that includes regular vessel-based patrols. Gitga'at Watchmen provided outreach and stewardship interpretive talks for recreational boat operators and ecotour operators and clients, educating the public about appropriate marine mammal viewing behaviour. The Haida First Nation has conducted public awareness campaigns to educate the public about the risks that marine mammals face, including the risks of vessel disturbance. The Nuu-Chal-Nulth First Nation conducted outreach activities regarding species at risk, and highlighting risks to marine mammals due to vessel disturbance.

24. *Were specific guidelines for viewing of Transient Killer Whales amended as necessary?*

Ongoing. Viewing of Transient Killer Whales is guided by the same guidelines that apply to viewing all marine mammals. Amendments were made to these guidelines periodically from 2006-2012.

25. *Were enforcement and monitoring programs directed to compliancy with guidelines and regulations continued and modified as necessary?*

Yes. The DFO Conservation and Protection (C&P) program facilitates public compliance with the Fisheries Act, including enforcement of the Marine Mammal Regulations. C&P monitors vessel compliance with the Marine Mammal Viewing Guidelines in Canadian Pacific waters.

The Straitwatch Program, operated by Cetus Research and Conservation Society, monitors marine vessel and Killer Whale interactions, and records and reports harassment and non-compliance incidents in the waters around Vancouver Island.

The Gitga'at First Nation operates the Coastal Guardian Watchmen Program which records harassment and non-compliance incidents. Violations are reported to DFO.

26. *Was the efficacy of enforcement and education programs evaluated, and were new approaches and protocols developed as necessary?*

Ongoing. Straitwatch, through Cetus Research and Conservation Society, analyzed the types of vessels typically non-compliant with the Marine Mammal Viewing Guidelines, and made efforts to target such groups with outreach and education. In 2009, a program was launched to target kayak groups in heavy-use areas such as Johnstone Strait. In addition, Straitwatch expanded their vessel patrols to include coastal waters surrounding Bamfield, Port Alberni, Tofino, Ucluelet, and Campbell River in times of the year when boating traffic is most frequent and when incident reports were elevated.

Protection from acute and chronic sound exposure

27. *Were mitigation measures for all seismic surveys conducted throughout British Columbia's Transient Killer Whale range reviewed, developed, and implemented to prevent disturbance or injury?*

Yes. The Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment (DFO 2008a) formalizes and standardizes mitigation measures in Canada with respect to the conduct of seismic surveys in the marine environment. Departmental science and fisheries management staff regularly review development (including seismic) and research proposals for the potential effects of noise and pollution on TKWs, making specific mitigation requirements or recommendations in the context of risk to the animals from proposed activities. In the Pacific Region, each proposed seismic survey is reviewed by DFO marine mammal experts, and mitigation measures are developed specific to the type of seismic survey and species of marine mammals exposed (DFO 2009a).

28. *Did the development and implementation of adequate National Defence sonar protocols to minimize risk of exposure of transients to intense sounds sources occur?*

Yes. The Maritime Commanding Order: Marine Mammal Mitigation Procedures (DND 2007) is intended to minimize impacts of tactical sonar noise on marine mammals by avoiding transmission of sonar any time a marine mammal is observed within a defined mitigation avoidance zone which is established specific to each type of sonar. Ship's personnel receive training in marine mammal identification and detection.

Determining prey needs

29. *Did opportunistic prey sampling occur during dedicated population census surveys?*

Yes. During TKW population census surveys, attempts were made to collect prey samples and/or photograph prey whenever predation events were observed.

Additionally, while on large vessel multi-species cetacean surveys, small boats were deployed to collect photographs for identification purposes, as well as to collect prey samples from TKWs whenever time and weather conditions allowed (Ford et al. 2010).

30. *Were directed surveys conducted to determine diet of transients in offshore waters?*

No. There have been no dedicated surveys to collect prey samples from TKWs in offshore waters.

31. *Were population abundance surveys of cetacean prey species completed?*

Yes. Ship-based DFO multi-species cetacean surveys, conducted between 2002-2012, have been focused on determining habitat use and relative abundance of cetaceans off the coast of BC. Abundance estimates were generated for most of the frequently encountered marine mammal species in BC in coastal waters in summer, including all of the TKW cetacean prey species (Williams and Thomas, 2007).

32. *Were opportunistic observations through formal and informal sightings networks made?*

Yes. Photographs and observations of predation events from opportunistic sources, including whale watchers, other researchers, and the collaborators form a significant portion of the TKW predation event data housed in the Transient Killer Whale Predation Database maintained by DFO.

Understanding the effects of contaminants and biological pollutants

33. *Were methods developed to measure the contaminant effects on Transient Killer Whale health using biopsy?*

In progress. Biopsy samples continue to be collected from TKWs during dedicated Killer Whale surveys, during opportunistic sightings of TKWs by DFO, and while on multi-species surveys. However, new methods to look at contaminant effect on TKW health using these biopsies have not been developed.

34. *Was demographic data explored to evaluate possible population-level impacts of contaminants and pollutants?*

No. Research to determine possible demographic-specific effects of contaminants and pollutants in TKWs and the population-level impacts of susceptibility of specific demographic groups to contaminants pollutants has not been conducted.

35. *Were controlled studies undertaken on surrogate species (i.e. laboratory animals or more abundant species such as Harbour Porpoise) to predict the effects of contaminants on Transient Killer Whales?*

In progress. Biopsies of Harbour Seals have been conducted for contaminant analysis and may be useful in predicting the effects of contaminants on TKWs.

36. *Were analyses of existing and new necropsy data conducted to assess contaminants and pollutants?*

In progress. Blubber samples were collected opportunistically during necropsies performed on TKWs over the past 5 years, and previously collected samples continue to be housed with DFO.

Understanding vessel disturbance effects

37. *Did dedicated studies of foraging behaviour and predation rates in the presence of vessels occur?*

No. Further dedicated studies relating foraging behavior and predation rates to the presence of vessels have yet to be conducted.

Understanding the effects of acute and chronic sound exposure

38. *Were the effects of high levels of chronic and acute industrial underwater noise on behaviour and foraging success determined?*

No. Effects of high levels of chronic and acute industrial underwater noise on behaviour and foraging success of TKWs have not been determined.

39. *Was existing data compiled to evaluate the impact of chronic and acute sound exposure?*

Yes. In 2012, World Wildlife Fund sponsored an underwater noise workshop in Vancouver, resulting in the summary report *Ocean Noise in Canada's Pacific*. Nearly 40 participants attended, including representatives from DFO, NGOs, academics, port authorities, and consulting companies. The objectives of the workshop were to: 1) obtain a picture of ocean noise and its sources in the region, including monitoring, research, and science capacity, 2) identify the potential effects of anthropogenic ocean noise and related conservation concerns relevant to this region, 3) identify the kinds of knowledge and information needs that are most useful for advancing

management of noise in the region, and 4) discuss the short- to medium-term work needed to fill gaps in knowledge and generate products useful for noise management (Heise and Alidina 2012).

4. References

- Alava, J.J., Lambourn, D., Olesiuk, P., Lance, M., Jeffries, S.J., Gobas, F.A.P.C., and Ross, P.S. 2012. PBDE flame retardants and PCBs in migrating Steller sea lions (*Eumetopias jubatus*) in the Strait of Georgia, British Columbia, Canada. *Chemosphere*. 88: 855-864.
- Ashe, E. 2007. Survival and abundance of Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) in the inshore coastal waters of British Columbia, Canada. M.Res. Thesis. University of St. Andrews, St. Andrews, Scotland, UK.
- COSEWIC. 2008. COSEWIC assessment and update status report on the Killer Whale *Orcinus orca*, Southern Resident population, Northern Resident population, West Coast Transient population, Offshore population and Northwest Atlantic / Eastern Arctic population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 65 pp. (www.sararegistry.gc.ca/status/status_e.cfm).
- DFO. 2008a. Statement of Canadian practice on the mitigation of seismic noise in the marine environment. <http://www.dfo-mpo.gc.ca/oceans/management-gestion/integratedmanagement-gestionintegree/seismic-sismique/information-eng.asp> (Accessed October 15th 2013)
- DFO. 2008b. Population Assessment: Steller Sea Lion (*Eumetopias jubatus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/047.
- DFO. 2009a. Recovery Potential Assessment for West Coast Transient Killer Whales. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/039.
- DFO. 2009b. Management Plan for the Offshore Killer Whale (*Orcinus orca*) in Canada. *Species at Risk Act* Management Plan Series. Fisheries and Oceans Canada, Nanaimo. v + 49pp.
- DFO. 2010. Population Assessment Pacific Harbour Seal (*Phoca vitulina richardsi*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/011.
- DFO. 2013a. Information in Support of the Identification of Critical Habitat for Transient Killer Whales (*Orcinus orca*) off the West Coast of Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/025.
- DFO. 2013b. Report on the Progress of Recovery Strategy Implementation for Blue, Fin and Sei Whales (*Balaenoptera musculus*, *B. physalus* and *B. borealis*) in Pacific Canadian Waters for the Period 2006-2011. *Species at Risk Act* Recovery Strategy Report Series. Fisheries and Oceans Canada, Ottawa. v + 10 pp.

- DND (Department of National Defence). 2007. Maritime Command Order: Marine Mammal Mitigation Procedures [MARCORD]. Unpublished. 46-13 (3A). 10 pp.
- Erbe, C., MacGillivray, A., Williams, R. 2012. Mapping cumulative noise from shipping to inform marine spatial planning. *Journal of the Acoustical Society of America, JASA Express Letters*. 132(5): 423-428
- Fisheries and Oceans Canada. 2007. Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada. *Species at Risk Act Recovery Strategy Series*. Fisheries and Oceans Canada, Vancouver, vi + 46 pp.
- Fisheries and Oceans Canada. 2009. Management Plan for the Pacific Harbour Porpoise (*Phocoena phocoena*) in Canada. *Species at Risk Act Management Plan Series*. Fisheries and Oceans Canada, Ottawa. v + 49 pp.
- Ford, J.K.B., Ellis, G.M., and Durban, J.W. 2007. An assessment of the potential for recovery of West Coast transient killer whales using coastal waters of British Columbia. *DFO Can. Sci. Advis. Sec. Res. Doc.* 2007/088. Iv + 34 pp
- Ford, J.K.B., Abernethy, R.M., Phillips, A.V., Calambokidis, J., Ellis, G.M., and Nichol, L.M. 2010. Distribution and relative abundance of cetaceans in western Canadian waters from ship surveys, 2002-2008. *Can. Tech. Rep. Fish. Aquat. Sci.* 2913: v + 51 p.
- Ford, J.K.B., Stredulinsky, E.H., Towers, J.R., and Ellis, G.M. 2013. Information in Support of the Identification of Critical Habitat for Transient Killer Whales (*Orcinus orca*) off the West Coast of Canada *DFO Can. Sci. Advis. Sec. Res. Doc.* 2012/155. v + 46 p.
- Garrett, C., and Ross, P.S. 2010. Recovering resident killer whales: A guide to contaminant sources, mitigation, and regulations in British Columbia. *Can. Tech. Rep. Fish. Aquat. Sci.* 2894: xiii + 224 p.
- GoC (Government of Canada). 2012. Regulations Amending the Marine Mammal Regulations. *Canada Gazette Part I* 146(1):783-797. Web site: <http://www.gazette.gc.ca/rp-pr/p1/2012/2012-03-24/pdf/g1-14612.pdf>
- Hall, A. 2011. Foraging behaviour and reproductive season habitat selection of northeast Pacific porpoises. Ph.D. Thesis. University of British Columbia, Vancouver, British Columbia, Canada.
- Heise, K., and Alidina, H. M. 2012. Summary Report: Ocean Noise in Canada's Pacific Workshop, January 31 - February 1st 2012, Vancouver, Canada. WWF-Canada.
- Lusseau, D., Bain, D.E., Williams, R., and Smith, J.C. 2009. Vessel traffic disrupts the foraging behavior of southern resident killer whales *Orcinus orca*. *Endangered Species Research*. 6: 211-221.
- Mos, L., Cameron, M., Jeffries, S.J., Koop, B.F., and Ross, P.S. 2010. Risk-based analysis of PCB toxicity in harbor seals. *Integrated Environmental Assessment*

and Management 6(4): 631-640.

- Olesiuk, P.F. 2008. Abundance of Steller sea lions (*Eumetopias jubatus*) in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2008/063. vi + 33 p.
- Olesiuk, P.F. 2010. An assessment of population trends and abundance of harbour seals (*Phoca vitulina*) in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/105. vi + 157 p.
- Rechsteiner, E.U. 2012. Resting metabolism, energetics, and seasonal distribution of Pacific white-sided dolphins. M.Sc. Thesis. University of British Columbia, Vancouver, British Columbia, Canada.
- Rechsteiner, E.U., Birdsall, C.F.C., Sandilands, D., Smith, I.U., Phillips, A.V., and Barrett-Lennard, L.G., 2013. Quantifying observer effort for opportunistically-collected wildlife sightings. *BC Cetacean Sightings Network: Technical Report*, 43 pp. Vancouver Aquarium, 845 Avison Way, Vancouver B.C., V6G 3E2.
- Ross, P.S., Harris, K.A., Dangerfield, N.J., Crewe, N.F., Dubetz, C.P., Fischer, M.B., Fraser, T.L., and Ross, A.R.S. 2011. Sediment concentrations of PCBs, PBDEs, PCDDs and PCDFs from disposal at sea sites at Point Grey and Sand Heads, British Columbia in 2010. *Can. Data Rep. Fish. Aquat. Sci.* 1239: vii + 115 p.
- Ross, P.S., Frouin, H., Dangerfield, N.J., Crewe, N.F., Dubetz, C., Fischer, M.B., Fraser, T.L., and Ross, A.R.S. 2012. Sediment concentrations of PCBs, PBDEs, PCDDs and PCDFs from disposal at sea sites at Brown Passage and Douglas Channel, British Columbia in 2011. *Can. Data Rep. Fish. Aquat. Sci.* 1243: ix + 113 p.
- Ross, P.S., Noel, M., Lambourn, D., Dangerfield, N., Calambokidis, J., Jeffries, S. (in press) Declining concentrations of persistent PCBs, PBDEs, PCDEs, and PCNs in harbor seals (*Phoca vitulina*) from the Salish Sea. *Progress in Oceanography*. (2013), <http://dx.doi.org/10.1016/j.pocean.2013.05.027>
- Smith, I., Phillips, A.V., Sandilands, D., and Barrett-Lennard, L.G. 2006 Quantifying observer effort for opportunistically-collected wildlife sightings records. *BC Cetacean Sightings Network: Technical Report*, 28 pp. Vancouver Aquarium, 845 Avison Way, Vancouver B.C., V6G 3E2.
- Tabuchi, M., N. Vedhoen, N. Dangerfield, S. Jeffries, C.C. Helbing, and P.S. Ross. 2006. PCB-related alteration of thyroid hormones and thyroid hormone receptor gene expression in free-ranging harbour seals (*Phoca vitulina*). *Environmental Health Perspectives* 114(7): 1024-1031.
- Towers, J.R., Ellis, G.M., and Ford, J.K.B. 2012. Photo-identification catalogue of Bigg's (transient) killer whales from coastal waters of British Columbia, northern Washington, and southeastern Alaska. *Can. Data Rep. Fish. Aquat. Sci.* 1241: v + 127 p.

Williams, R. and Thomas, L. 2007. Distribution and abundance of marine mammals in the coastal waters of British Columbia. *Journal of Cetacean Research and Management* 9(1): 15-28.

Williams, R., Hall, A., and Winship A. 2008. Potential limits to anthropogenic mortality of small cetaceans in coastal waters of British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 65(9): 1867-1878.