Southern Resident Killer Whale Imminent Threat Assessment

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1. Background

This document assesses the threats to the Southern Resident Killer Whale (SRKW), using the best available information, with the aim of informing an opinion as to whether or not this species faces imminent threats to its survival or recovery in Canada, as per section 80 of the Species at Risk Act (SARA or 'the Act'). In 2001, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated SRKW as endangered. This population is listed in Schedule 1 of SARA. This imminent threat assessment has been developed by Fisheries and Oceans Canada (DFO) with Environment and Climate Change Canada (ECCC), Transport Canada (TC), and the Parks Canada Agency (PCA).

Under section 80 of SARA, an emergency protection order (EPO) must be recommended to the Governor in Council (GiC) if the competent minister is of the opinion that a listed wildlife species is facing imminent threats to its survival or recovery. A recommendation for an EPO is not required if the competent minister is of the opinion that equivalent measures have been taken under another act of parliament to protect the species. As the SRKW is found throughout the coastal waters of southern British Columbia including the waters that are part of national park reserves, so both the Minister of Fisheries, Oceans, and the Canadian Coast Guard (MFO), and the Minister responsible for the Parks Canada Agency acting in her role as Minister of the Environment under SARA, are competent ministers for this species.

In January 2018, the Ministers received a letter from EcoJustice, representing World Wildlife Fund, Natural Resources Defence Council, Georgia Strait Alliance, Raincoast Conservation Foundation and the David Suzuki Foundation, asking that the Ministers recommend to the GiC an emergency order to provide for the survival and recovery of the SRKW. EcoJustice requested that the Ministers form the opinion that the species is facing imminent threats from reduced prey availability, physical and acoustic disturbance and environmental contaminants.

According to SARA, the Ministers' opinions are based on an assessment of the potential imminent threats to the listed species; however, imminence is not further defined within the Act. A section 80 Order requires the assessment of threats to both survival and recovery of the species. In the context of this imminent threat assessment (ITA), imminent threat could be considered such that decisions and actions are required to be made on a more expedited timeframe than would ordinarily be required through 'normal' processes. Specifically, 'normal' processes, for example, for the protection of critical habitat, would follow typical legislative timelines and provide time and opportunity for comprehensive consultations on proposed actions. Should it be found that the SRKWs are facing imminent threat to their survival and/or recovery, then action by way of an emergency order would be required. Various factors, including Indigenous rights, are considered when developing an emergency order.

Since recovery actions should be implemented as they are identified, imminence could be considered if survival or recovery of the population requires timely implementation of recovery actions so as to ensure the potential for survival and recovery.

Answers to the following questions will help the Ministers to form their opinion on whether or not the SRKW is facing imminent threat:

1. is the species currently facing threats that might impact survival or recovery of the species?
2. will the effect of the current threats make survival of the species unlikely or impossible?
3. will the effect of the current threats make recovery of the species unlikely or impossible?
4. do the threats require immediate intervention?

This threat assessment considers the population and distribution objectives set out in the final federal recovery strategy for the species. It takes into account information on the biology and ecology of the species, threats to its survival and recovery, and its population and habitat status and trends. An analysis of existing measures that protect the species against threats is also provided.

The information used to develop this ITA has been drawn from DFO publications on SRKW including the Recovery Strategy for the Northern and Southern Resident Killer Whales (*Orcinus orca*) in Canada (DFO 2011), the COSEWIC Assessment and Update Status Report on the Killer Whale *Orcinus orca* in Canada (COSEWIC 2008), the Action Plan for the Northern and Southern Resident Killer Whale (*Orcinus orca*) in Canada (DFO 2017a), and the Review of the Effectiveness of Recovery Measures for Southern Resident Killer Whales (DFO 2017b). EcoJustice also provided supporting documentation in their letter to the competent ministers dated January 30, 2018. No new science advice was generated specifically to inform the assessment nor was the interpretation of the information or the conclusions reached in the assessment the subject of a scientific peer-review process.

Socio-economic impacts were not considered in the assessment, as they are not relevant to determining whether or not a wildlife species is facing imminent threats. Socio-economic considerations would inform a GiC decision, further to a recommendation by the competent ministers.

Indigenous consultation was not specifically done to support this ITA. However, from October 10 to 12, 2017, DFO held a Southern Resident Killer Whale symposium in Vancouver. Indigenous groups provided a review of the linkages between threats, and expressed that the complexity and importance of Killer Whales and their relationship to First Nations is fundamental to cultural traditions and teachings.

2. Overview of the SRKW

The Killer Whale is the largest member of the dolphin family, Delphinidae. They are long-lived, upper trophic-level predators. Their size, striking black and white colouring and tall dorsal fin are the main identifying characteristics. Killer Whales are mainly black above and white below, with a white oval eye patch, and a grey saddle patch below the dorsal fin. Each Killer Whale has a uniquely shaped dorsal fin and saddle patch, and most animals have naturally acquired nicks and scars. Individual Killer Whales are identified using photographs of the dorsal fin, saddle patch, and sometimes eye patches (Ford et al. 2000). They are sexually dimorphic. Maximum recorded lengths and weights for male Killer Whales are 9.0 m, and 5568 kg respectively, whereas females are smaller at 7.7 m and 4000 kg (Dahlheim and Heyning 1999). The tall triangular dorsal fin of adult males is often as high as 1.8 m, while in juveniles and adult females it reaches 0.9 m or less. In adult males, the paddle-shaped pectoral fins and tail flukes are longer and broader and the fluke tips curl downward (Bigg et al. 1987).

Three distinct forms, or ecotypes, of Killer Whale inhabit Canadian Pacific waters: Transient, Offshore and Resident. These forms are sympatric but socially isolated and differ in their dietary preferences, genetics, morphology and behaviour (Ford et al. 1998, 2000, Barrett-Lennard and Ellis 2001). Transient Killer Whales feed on marine mammals; particularly Harbour Seals, porpoises, and Sea Lions (Ford et al. 1998). They travel in small, acoustically quiet groups that rely on stealth to find their prey (Ford and Ellis 1999). Offshore Killer Whales are not as well understood as Residents and Transients. They feed primarily on elasmobranchs but have also been documented to prey on teleost fishes, including Chinook Salmon (Heise et al. 2003; Ford et al. 2014). They often travel in large acoustically active groups of 30 or more whales, using frequent echolocation and social calls (Ford et al. 2000).

Resident Killer Whales that share a common range and that associate at least occasionally are considered to be members of the same community or population. There are two communities of Resident Killer Whales in British Columbia, the Northern Residents and the Southern Residents. Despite having overlapping ranges, these two communities are acoustically, genetically, and culturally distinct. The Northern Resident community consists of three clans broken into 16 sub-groups, or pods; and the Southern Resident community consists of one clan and only three pods.

Resident Killer Whales are the best understood of the three ecotypes. They feed nearly exclusively on salmon, predominantly Chinook Salmon, although Chum Salmon are seasonally important in autumn months, and usually travel in acoustically active groups of 10 to 25 or more whales (Ford et al. 2000). The social organization of Resident Killer Whales is highly structured. Their fundamental unit is the matriline, comprising all surviving members of a female lineage. A typical matriline comprises an adult female, her offspring, and the offspring of her daughters. Both sexes remain within their natal matriline for life (Bigg et al. 1990). Social systems in which both sexes remain with their mother for life have only been described in one other mammalian species, the Long-Finned Pilot Whale (*Globicephala melas*; Amos et al. 1993). Bigg et al. (1990) defined pods as groups of closely related matrilines that travel, forage, socialize and rest with each other at least 50% of the time, and predicted that pods, like matrilines, would be stable over many generations. However, Ford and Ellis (2002) showed that inter-matriline association patterns in the Northern Residents have evolved over the past decade such that some of the pods identified by Bigg et al. (1990) now fail to meet the 50% criterion. Their analysis suggests that pods are best defined as transitional groupings that reflect the relatedness of recently diverged matrilines.

3. Population status and trends

Individual Killer Whales can be distinguished by scars and variations in pigmentation and dorsal fin shape. Life history parameters for the Resident populations in British Columbia have been estimated based on more than 30 years of photo-identification studies. Maximum longevity is 80 to 90 years for females and 40 to 50 years for males. Females give birth to their first calf between 12 to 17 years of age. The calving interval averages about five years for NRKW and six years for SRKW (unpublished data DFO-CRP). However, the interval is highly variable and ranges from two to 12 years. The generation time is 26 to 29 years. Females on average produce their last calf at age 39, at which point they become post reproductive (Olesiuk et al. 1990). This extended post-reproductive period, which may last up to 40 years (in females that live to 80 years) is extremely unusual in mammals. Resident Killer Whales are also exceptional among mammals in that there is no dispersal of individuals of either sex from the natal group.

Little is known of the historic abundance of Killer Whales, except that they were “not numerous” (Scammon 1874). While there are no population estimates for Killer Whales in British Columbia prior to 1960, the SRKW is likely to be a naturally precarious[1] population in that even prior to significant effects

[1] For species that were historically precarious, recovery will be considered feasible if the extent of irreversible change is such that under the best achievable scenario it is technically and biologically feasible to improve the condition of the species to a point that it is approaching the historical condition. For these species, recovery is deemed not feasible if the extent of irreversible change is so great that it is not technically and biologically feasible to improve the condition of the species to approach the lower end of the historical condition. In such a case, survival of the species may be achieved by ensuring connectivity between the species Canadian population and other populations of the same species in other countries or other populations that are not at risk; and/or by

from human activity, the population is likely to have been small. Since the early 1970s, photo-identification studies have provided population estimates for Killer Whales in the near-shore waters of the northeastern Pacific (Washington, British Columbia, Alaska, and California). Population censuses for Killer Whales are now conducted annually using photo-identification of individuals.

The community of SRKW comprises a single acoustic clan, J clan, which is composed of three pods (referred to as J, K, and L) containing a total of 20 matrilines (Ford et al. 2000). Although the Southern Resident community was likely increasing in size in the early 1960s, the number of whales in the community dropped dramatically in the late 1960s and early 1970s due to live capture for aquariums (Bigg and Wolman 1975). A total of 47 individuals that are known or likely to have been Southern Residents were captured and removed from the population (Bigg et al. 1990). The population increased 19% (3.1% per year) from a low of 70 after the live-captures ended in 1973 to 83 whales in 1980, although the growth rate varied by pod (Figure 1). From 1981 to 1984 the population declined 11% (-2.7% per year) to 74 whales as a result of lower birth rates, higher mortality for adult females and juveniles (Taylor and Plater 2001), and lower numbers of mature animals, especially males, which was caused by selective cropping in previous years (Olesiuk et al. 1990). From 1985 to 1995, the number of Southern Residents increased by 34% (2.9% per year) to 99 animals. A surge in the number of mature individuals, an increase in births, and a decrease in deaths contributed to the population growth. Another decline began in 1996, with an extended period of poor survival (Taylor and Plater 2001; Krahn et al. 2002) and low fecundity (Krahn et al. 2004) resulting in a decline of 17% (-2.9% per year) to 81 whales in 2001. Since 2001, the population has fluctuated between 76 and 89 individuals. The number of Southern Residents increased slightly to 85 in 2003 (unpublished data DFO-Cetacean Research Program). The growth was in J and K pods, whereas L pod continued to decline. The population has not shown signs of recovery and consisted of 76 members in 2017 (unpublished data DFO-Cetacean Research Program). Collectively, the small population size and low number of individuals contributing to reproduction (termed the effective population) heighten the impact of any mortality or loss of reproductive potential to the population’s survival relative to their northern counterparts.

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actively intervening with the species and/or its habitat. If recovery is deemed not to be technically and biologically feasible, population and distribution objectives will be set to support survival of the species and the identification of critical habitat to the extent possible, in addition to the other requirements of subsection 41(2) of SARA.

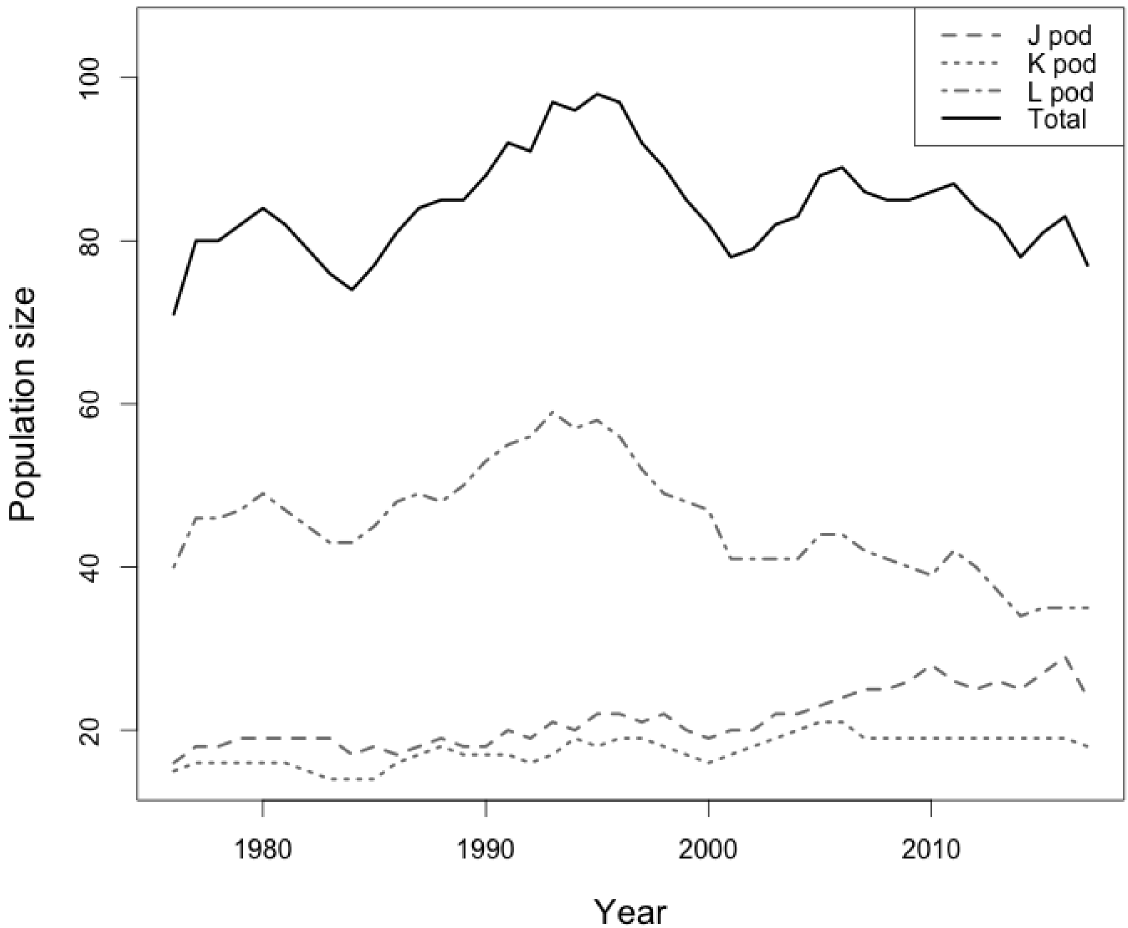

Figure 1. Population size and trends for Southern Resident Killer Whale from 1976 to 2017. Data source: Center for Whale Research (unpublished).

The SRKW population demographics have changed since 1979 (Table 1). The number of SRKW post-reproductive females has gone from 12% of the population to only 7%. To translate that to absolute numbers, the 7% represents just five individuals (Table 2). As of 2017, both J and K pods only had one post-reproductive female while L pod had three (DFO-Cetacean Research Program, unpublished data). It is possible that the presence of older females in a group increases the survival of offspring even if such individuals no longer contribute directly to population growth (COSEWIC 2008).

Table 1: Percent population demographics in 1979 and 2016 for Southern Resident Killer Whale.

	1979 (%)	2016 (%)
Reproductive Females (10 y to 42 y)	32	34
Adult Males (> 10 y)	27	18
Post-reproductive Females (> 42 y)	12	7
Juveniles (< 10 y)	38	30

Data source: Fisheries and Oceans Canada – Cetacean Research Program (unpublished).

Table 2: Population demographics from 1980 to 2017 in five year intervals for Southern Resident Killer Whale.

Year	Total	Reproductive females (10 years - 42 years)	Adult male (> 10 years)	Post-reproductive females (> 42 years)	Juveniles (< 10 years)
2017	Total: 76 - J Pod 23 - K Pod 18 - L Pod 35	Total: 27 - J Pod 10 - K Pod 6 - L Pod 11	Total: 24 - J Pod 4 - K Pod 8 - L Pod 12	Total: 5 - J Pod 1 - K Pod 1 - L Pod 3	Total: 20 - J Pod 8 - K Pod 3 - L Pod 9
2015	Total: 80 - J Pod 27 - K Pod 19 - L Pod 34	Total: 30 - J Pod 12 - K Pod 6 - L Pod 12	Total: 23 - J Pod 5 - K Pod 8 - L Pod 10	Total: 5 - J Pod 1 - K Pod 2 - L Pod 2	Total: 22 - J Pod 9 - K Pod 3 - L Pod 10
2010	Total: 84 - J Pod 26 - K Pod 19 - L Pod 39	Total: 30 - J Pod 10 - K Pod 7 - L Pod 13	Total: 17 - J Pod 4 - K Pod 3 - L Pod 10	Total: 9 - J Pod 2 - K Pod 1 - L Pod 6	Total: 28 - J Pod 10 - K Pod 8 - L Pod 10
2005	Total: 88 - J Pod 24 - K Pod 20 - L Pod 44	Total: 32 - J Pod 8 - K Pod 9 - L Pod 15	Total: 20 - J Pod 4 - K Pod 3 - L Pod 13	Total: 12 - J Pod 2 - K Pod 2 - L Pod 8	Total: 24 - J Pod 10 - K Pod 6 - L Pod 8
2000	Total: 77 - J Pod 19 - K Pod 16 - L Pod 42	Total: 28 - J Pod 6 - K Pod 7 - L Pod 15	Total: 11 - J Pod 1 - K Pod 1 - L Pod 9	Total: 12 - J Pod 2 - K Pod 3 - L Pod 7	Total: 26 - J Pod 10 - K Pod 5 - L Pod 11
1995	Total: 92 - J Pod 20 - K Pod 18 - L Pod 54	Total: 34 - J Pod 10 - K Pod 8 - L Pod 16	Total: 14 - J Pod 3 - K Pod 1 - L Pod 10	Total: 11 - J Pod 2 - K Pod 2 - L Pod 7	Total: 33 - J Pod 5 - K Pod 7 - L Pod 21
1990	Total: 87 - J Pod 18 - K Pod 16 - L Pod 53	Total: 33 - J Pod 9 - K Pod 8 - L Pod 16	Total: 17 - J Pod 4 - K Pod 3 - L Pod 10	Total: 11 - J Pod 2 - K Pod 1 - L Pod 8	Total: 26 - J Pod 3 - K Pod 4 - L Pod 19
1985	Total: 74	Total: 31	Total: 16	Total: 9	Total: 18

	- J Pod 17 - K Pod 14 - L Pod 43	- J Pod 7 - K Pod 7 - L Pod 17	- J Pod 3 - K Pod 3 - L Pod 10	- J Pod 2 - K Pod 2 - L Pod 5	- J Pod 5 - K Pod 2 - L Pod 11
1980	Total: 79 - J Pod 18 - K Pod 16 - L Pod 45	Total: 25 - J Pod 5 - K Pod 5 - L Pod 15	Total: 13 - J Pod 3 - K Pod 4 - L Pod 6	Total: 11 - J Pod 3 - K Pod 3 - L Pod 5	Total: 30 - J Pod 7 - K Pod 4 - L Pod 19

Data source: Fisheries and Oceans Canada – Cetacean Research Program (unpublished).

3.1. SRKW distribution

The known range of this community is from southeastern Alaska to central California (Ford et al. 2017). During summer, its members are usually found in waters off southern Vancouver Island and northern Washington State, where they congregate to intercept migratory salmon. The main area of concentration for Southern Residents is Haro Strait and vicinity off southeastern Vancouver Island (Figure 2), but they are commonly seen in Juan de Fuca Strait, and the southern Strait of Georgia (Ford et al. 2000). Of the three Southern Resident pods, J pod is most commonly seen in inside waters throughout the year, and appears to seldom leave the Strait of Georgia-Puget Sound- Juan de Fuca Strait region in most years (Ford et al. 2000). K and L pods are more often found in western Juan de Fuca Strait and off the outer coasts of Washington State and Vancouver Island. Unlike J pod, K and L pods typically leave inshore waters in winter and return in May or June. Their range during this period is poorly known, but they have been sighted as far south as Monterey Bay, California and as far north as Chatham Strait, southeastern Alaska (Ford et al. 2017).

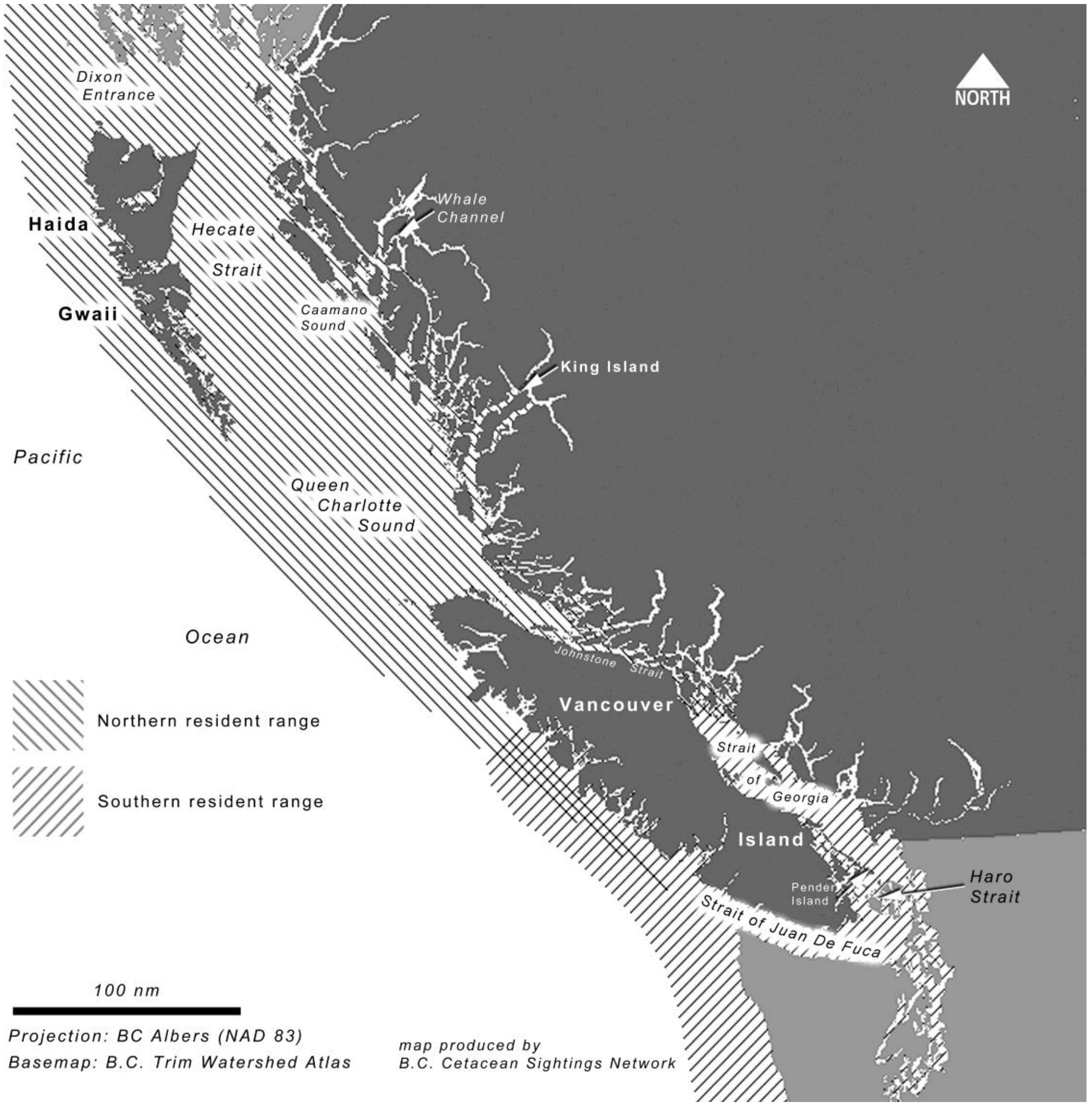

Figure 2. The coast of British Columbia and northwest Washington State showing the general ranges of Northern and Southern Resident Killer Whales.

3.2. Critical habitat

Critical habitat is defined in SARA (2002) section 2(1) as "…the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species."

SARA defines habitat for aquatic species at risk as "… spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced" [s. 2(1)].

Partial critical habitat was identified for both Northern and Southern Resident Killer Whales in the 2008 recovery strategy. Northern Resident Killer Whale critical habitat included the waters of Johnstone Strait and southeastern Queen Charlotte Strait (Figure 2), while SRKW critical habitat included the transboundary waters in southern British Columbia, including the southern Strait of Georgia, Haro Strait, and Juan de Fuca Strait (Figure 2). A SARA critical habitat order was put in place in 2009 to protect these area of critical habitat. In 2011, the recovery strategy was amended to provide additional clarification regarding this critical habitat.

An additional area was identified for consideration as critical habitat for SRKW in Ford et al. (2017). This area includes the waters on the continental shelf off southwestern Vancouver Island, including Swiftsure and La Perouse Banks . An amendment to the recovery strategy is currently underway to add this area of critical habitat.

The habitat of special importance under consideration as critical habitat off southwest Vancouver Island includes the Canadian portions of Swiftsure Bank, where acoustic monitoring between August 2009 and July 2011 indicated considerable habitat use by both Southern and Northern Resident Killer Whales over much of the year. Additionally, it encompasses several other relatively shallow banks, including La Pérouse Bank which, like Swiftsure Bank, is among the most productive fishing areas for Chinook Salmon on the west coast of North America. During this acoustic monitoring, all three SRKW pods were detected in this area, with L pod being the most frequently documented (Ford et al. 2017). The area is important for SRKW, both during summer, when groups of whales spend time west of the critical habitat area in the transboundary waters in southern British Columbia, and in winter, when whales are mostly absent from the southern British Columbia critical habitat area, but were detected frequently off southwestern Vancouver Island (DFO 2017c).

The transboundary waters of southern British Columbia and Washington State (Figure 3) represent a very important concentration area for SRKW. This area includes waters under both Canadian and U.S. jurisdiction. Analyses of existing data on coast-wide occurrence patterns of SRKW have been completed by the National Oceanic and Atmospheric Association (NOAA) as part of the Endangered Species Act designation of critical habitat in collaboration with DFO (NMFS 2006a). This assessment provided quantitative documentation of the importance of these transboundary areas to these whales and forms, along with previously published information, the basis for the critical habitat identification.

This critical habitat area is utilized regularly by all three Southern Resident pods during June through October in most years (Osborne 1999; Wiles 2004). J pod appears to be present in the area throughout much of the remainder of the year, but two Southern Resident pods, K and L, are typically absent during December through April. This critical habitat is clearly of great importance to the entire Southern Resident community as a foraging range during the period of salmon migration, and thus has been designated as critical habitat under SARA.

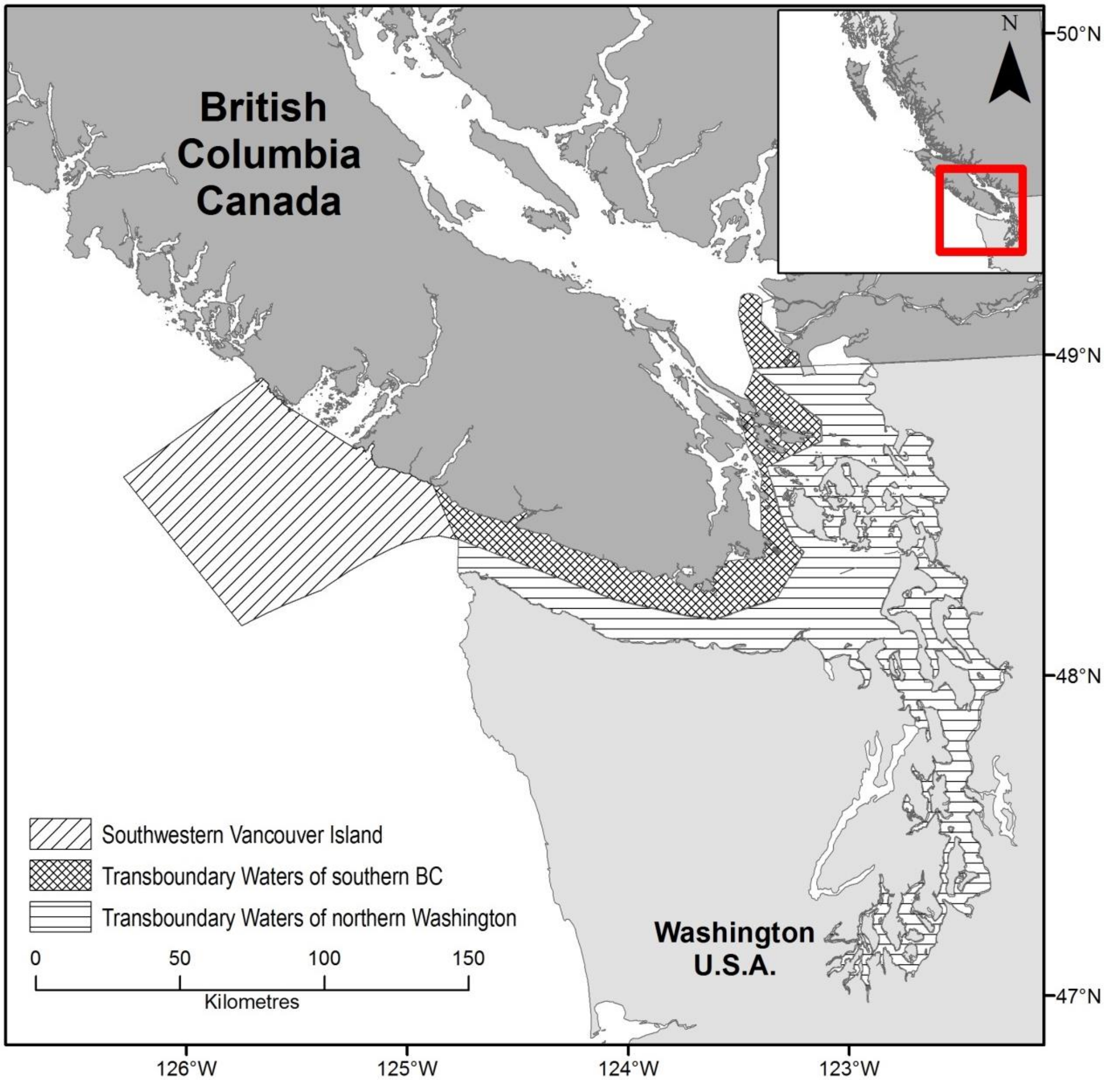

Figure 3: The critical habitat areas for Southern Resident Killer Whale and proposed future areas of critical habitat in Canada and in the transboundary waters of northern Washington. The area identified as southwestern Vancouver Island is the proposed future area of critical habitat and the existing critical habitat is identified as the Transboundary Waters of southern British Columbia.

3.3. Recovery goal

The objective established in the recovery strategy for the SRKW set out the basis for achieving a recovered state for the species. Accordingly, the assessment of imminent threat to recovery considers whether any of the threats to SRKW would render its recovery impossible or unlikely without intervention.

The recovery goal for SRKW is to "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."

Killer Whales are top-level predators, and as such will always be far less abundant than most other species in their environment. In addition, they are segregated into small populations that are closed to immigration and emigration, such as the Northern and Southern Resident communities. Furthermore, their capacity for population growth is limited by a suite of life history and social factors, including late onset of sexual maturity, small numbers of reproductive females and mature males, long calving intervals, and dependence on the cultural transmission of ecological and social information. Unfortunately, little is known concerning the historic sizes of Killer Whale populations, or the factors that ultimately regulate them. Genetic diversity is known to be low in both populations, particularly the Southern Residents. In light of these inherent characteristics and uncertainties, the following were identified as interim measures of recovery success:

a) long-term maintenance of a steady or increasing size for populations currently at known historic maximum levels and an increasing size for populations' currently below known historic maximum levels

b) maintenance of sufficient numbers of females in the population to ensure that their combined reproductive potential is at replacement levels for populations at known historic maximum levels and above replacement levels for populations below known historic maximum levels

c) maintenance of sufficient numbers of males in the population to ensure that breeding females have access to multiple potential mates outside of their own and closely related matrilines

d) maintenance of matrilines comprised of multiple generations to ensure continuity in the transmission of cultural information affecting survival

3.4. Threats

Five threats to the recovery of SRKW were identified in the recovery strategy. These are reduced prey availability, acoustic and physical disturbance, environmental contaminants, oil spills, and incidental mortality in fisheries. Subsequently an additional threat, ship strikes, was identified in the SRKW science-based review (DFO 2017b) conducted under the Oceans Protection Plan. Note that this assessment will focus only on the three main threats to SRKW (reduced prey availability, acoustic and physical disturbance, environmental contaminants).

Prey availability

SRKWs are highly specialized predators and prey primarily on Chinook Salmon. This selectivity is particularly evident during the months of May through September in the Salish Sea, when they forage almost exclusively on Chinook Salmon in Juan de Fuca Strait, Puget Sound, the southern Strait of Georgia and off southwest Vancouver Island (Ford et al. 1998; Ford and Ellis 2005, 2006; Ford et al. 2010b; Hanson et al. 2010b; M. Ford et al. 2016; J. Ford et al. 2017). During October and November, SRKWs increase their use of Puget Sound, and feed on migrating Chum Salmon as well as Chinook Salmon . By December, most of the SRKW community have left their summer core areas in the Salish Sea. In particular K and L pods are mostly absent from December to May. Much less is known of SRKW diet in winter and early spring, sightings and acoustic recordings indicate that they range widely along the mainland US coast and off the west coast of Vancouver Island (Wiles 2004; Zamon et al. 2007 Hanson et al. 2013; Ford et al. 2017). Their occurrence off the mouth of the Columbia River and in Monterey Bay, California, appears to be associated with local concentrations of Chinook Salmon (Wiles 2004; Zamon et al. 2007; Hanson et al. 2010b).

The survival and recovery of SRKW appears to be strongly linked to Chinook Salmon abundance. Ford et al. (2010b) showed that mortality rates of both SRKWs and NRKWs were negatively correlated with Chinook Salmon abundance over a 25-year period, from 1979 to 2003. In particular, a sharp decline in Chinook Salmon abundance that persisted for four years during the late 1990s was associated with mortality rates up to 2 to 3 times greater than expected and resulted in population declines in both Resident Killer Whale populations. Ward et al. (2009) demonstrated a significant association between Chinook Salmon abundance and reproductive rates in the SRKW population.

Due to their relatively large size and high lipid content, Chinook Salmon are highly profitable prey for SRKWs and provide a high caloric gain for the energy expenditure of foraging (Ford and Ellis 2005, 2006). They have also been, at least historically, a reliable prey source. Unlike many species of salmon that spend large portions of their lifecycle on the high seas only returning to coastal waters to spawn, Chinook Salmon are available year-round in coastal waters. Killer Whales appear to preferentially select four to five-year-old Chinook Salmon, which have mean body masses of 8 to 13 kg (Ford and Ellis 2005). These Chinook Salmon are considerably larger than mature Chum Salmon (4.0 to 5.5 kg), which become more prominent in the diet in the fall, and are more than double the size of a typical Coho or Pink Salmon, which are seldom consumed by Resident Killer Whales (Ford et al. 1998).

A 2013, photogrammetry study assessed SRKW body condition in 43 SRKWs and demonstrated a decline in body condition of 11 animals including seven reproductive age females compared to their condition in 2008 when 43 animals were also assessed. In the 2013 study, 12 SRKWs were identified as pregnant, based on breadth measurements from these aerial photos. However, only two of these animals were subsequently seen with a calf, suggesting that poor body condition is a likely factor that contributes to reproductive failure (Fearnbach et al 2015). In 2017, a review of recent research on SRKW was undertaken to detect evidence of poor body condition in the population (Matkin et al. 2017). This review examined evidence from sightings data (photo-identification and mortality), aerial photogrammetry, necropsy data, and fecal hormone analyses. The independent science panel that conducted the review concluded that there were multiple lines of evidence that indicated the presence of poor body condition in SRKW, and that this was associated with loss of fetuses, calves and adults.

Acoustic and physical disturbance

Killer Whales use sound for communication, prey detection, and to acquire information about their environment. They produce a variety of sounds including echolocation clicks for foraging and navigation and pulsed calls and whistles during social interactions. Call production is believed to serve important roles in the social dynamics of groups that travel and forage together (Ford 1989). Resident Killer Whales appear to make extensive use of echolocation to locate and capture prey, though vision may also play a role at close ranges (Ford 1989; Barrett-Lennard et al. 1996). Studies of echolocation click structure and the sound energy content of the clicks in NRKWs suggest that they should be able to detect Chinook Salmon at ranges of about 100 m in average conditions and that these distances decrease as ambient underwater noise increases (Au et al. 2004).

It is estimated that ambient (background) underwater noise levels have increased an average of 15 dB (note a 3dB increase represents a doubling of noise levels) in the past 50 years throughout the world's oceans (NRC 2003). Shipping noise is the dominant source of ambient noise between 10 to 200 Hz but, ships also produce significant amounts of higher frequency noise in the audible range of Killer Whales (600Hz to 114kHZ) with the greatest sensitivity in the range of 5kHz to 81kHz (Branstetter et al. 2017). Noise received from ships at ranges less than 3 km in the relatively narrow passage of Haro Strait, an area frequented by SRKWs, extend upward into frequencies used by SRKWs (Veirs et al. 2015). It is widely recognized that commercial shipping has increased dramatically in recent years. Currently in the

Salish Sea one large ship transits the area, on average, every hour of every day of every year, with three transits per hour observed at the busiest times (Erbe et al. 2012 Williams et al. 2014a). Within the Salish Sea, commercial shipping is the dominant source of overall sound energy, but smaller craft (recreational, fishing, whale watching boats) are a substantive contribution in certain sub-areas of the Salish Sea (ECHO 2016).

Whale watching and recreational boating activity has also increased as a result of increasing interest in ecotourism, and a growing human population around the Salish Sea. Commercial whale watching in the Canadian and U.S. portions of the Salish Sea increased from a few boats in the 1970s to about 80 boats in 2003 and in 2016 to 100 boats; this estimate does not include the recreational boaters (Holt 2017). Non-commercial boats include kayaks, sailboats and powerboats. Whale watching activities have the potential to disturb marine mammals through both the physical presence and activity of all types of watercraft, as well as the increased underwater noise levels that boat engines generate (DFO 2011).

Erbe (2002) modelled the noise of whale-oriented boat traffic in the vicinity of SRKWs and showed that the noise of fast boats could mask their calls within 14 km, could elicit a behavioural response within 200 m, and could cause a temporary threshold shift (TTS) in hearing of 5 dB after 30 to 50 min within 450 m. Boat speed was a significant factor in determining the amount of noise generated. Slowing speed, which results in less noise, masked signals at 1 km from the boat. However, there are typically many boats in the vicinity of SRKWs, so modelled noise levels associated with a number of boats around the whales were found to be close to the critical noise threshold assumed to cause a permanent hearing loss over prolonged exposure.

Numerous studies since 2002 have demonstrated behavioural response and changes in acoustic signalling by SRKWs living and foraging in the Salish Sea that strongly suggest an energetic cost and potential stress to SRKWs associated with the increased noise levels. Specifically, SRKWs significantly increased the duration of their calls when boats were present and increased the amplitude of their calls as background noise level increased as a result of the number of vessels nearby (Foote et al. 2004; Holt et al. 2009; 2011).

SRKWs were observed to be within 400 m of a vessel most of the time during daylight hours from May through September, largely as a result of whale-watching oriented vessels approaching and following them. Studies of SRKW behaviour in the vicinity of whale-watching oriented vessels in the Salish Sea showed that SRKWs were significantly less likely to be foraging and significantly more likely to be traveling when boats were around and that SRKWs were displaced short distances by the presence of vessels (Lusseau et al. 2009). Behavioural responses to close approaches of boats include an increase in surface active behaviour which may have increased energetic costs (Noren et al. 2009).

Environmental contaminants

The threat of environmental contaminants encompasses chemical, particularly bio-accumulating contaminants and biological pollutants. These latter contaminants may be pathogens that enter SRKW habitat from coastal runoff and through wastewater from urban and agricultural areas and possibly through airborne transport. The Salish Sea is surrounded by increasing urban development and industrialization. There are local regional and global inputs of contamination. The issue is also made more complex because Canada and the U.S. have different regulations to address this transboundary threat and an effective solution will require greater collaboration and harmonization.

Killer Whales are vulnerable to accumulating high concentrations of Persistent Organic Pollutants (POPs) because they are long-lived animals that feed high in the food chain and pass on a portion of their contaminant burden to their offspring (Ross et al. 2000, 2002, Rayne et al. 2004, Ross 2006). POPs are persistent, they bio-accumulate in fatty tissues, and are known to affect reproductive and immune function in Killer Whales. Resident Killer Whales prey, primarily on Chinook Salmon and several stocks of importance to SRWKs reside in Salish Sea and in other coastal marine areas for a considerable amount of their life cycle. Chinook Salmon in the range of SKRW are relatively contaminated with POPs due to biomagnification from marine food-webs during their time at sea (O'Neill et al. 1998; Ewald et al 1998).

Biological pollutants, including pathogens and antibiotic-resistant bacteria resulting from human activities, may threaten the health of SRKWs, their habitat or their prey. Due to the small size of the SRKW population and the gregarious social nature of these animals, introduction of a highly virulent and transmissible pathogen has the potential to catastrophically affect the long-term viability of the population through reduced reproductive success and survival (Gaydos et al. 2004). Furthermore, although age may be a confounding factor, it has been suggested that there is an association between cetacean exposure to polychlorinated biphenyls (PCBs) and mortality due to infectious diseases (O'Hara and O'Shea 2001). Pathogens and antibiotic-resistant bacteria can enter the marine environment by means of coastal run-off and wastewater discharges.

4. Imminent threat assessment

The competent minister must recommend the making of an EPO if he or she is of the opinion that a listed wildlife species faces imminent threats to its survival or recovery. A recommendation for such an order is not required if the competent minister is of the opinion that equivalent measures have been taken under another act of parliament to protect the species. In the case of an aquatic species, an EPO may identify habitat that is necessary for the survival or recovery of the species in the area to which the emergency order relates. It may also include provisions requiring the doing of things that protect the species and that habitat, or provisions prohibiting activities that may adversely affect the species and that habitat.

Question 1: Is the species currently facing threats that might impact survival or recovery of the species?

The key threats to SRKW are reductions in the availability or quality of prey, physical and acoustic disturbances, and environmental contaminants. Individually these threats, especially prey availability, have been demonstrated to limit or reverse the recovery of SRKW. The cumulative effect of these threats is unknown but they may work synergistically. Each threat independently impacts the health or the foraging ability of SRKW. Acoustic and physical disturbance, both acute and chronic effects, may affect the success of foraging. The synergistic effects of the combination of threats may exacerbate the impacts of each threat and shorten the timeframe for population impacts.

Summary

The species is currently facing threats that might be impacting survival and/or recovery.

Question 2: Will the effect of the current threats make survival of the species unlikely or impossible?

COSEWIC assessed the SRKW as endangered because it met criterion C2a(i,ii); D1 (COSEWIC 2008). This means that, when it was assessed in 2006, the population possesses a small number of mature individuals (48) that has been declining over the last 10 to 15 years and was expected to continue to do so in the foreseeable future.

According to the Species at Risk Policies - Policy on Survival and Recovery [Proposed] (2016), a species at risk can be considered more likely to survive when it can be brought to the point where it possesses the characteristics outlined below. The more characteristics the species possesses, the higher its likelihood of continued survival. This means that in order for the SRKW to be considered no longer at risk, the population would need to be:

- stable or increasing over a biologically relevant time frame; and
- resilient: sufficiently large to recover from periodic disturbance and avoid demographic and genetic collapse; and
- widespread or has population redundancy: there are multiple (sub) populations or locations available to withstand catastrophic events and to facilitate rescue if necessary; and
- connected: the distribution of the species in Canada is not severely and unnaturally fragmented; and
- protected from anthropogenic threats: non-natural significant threats are mitigated; and / or
- as appropriate to its specific life history and ecology in Canada, persistence is facilitated by connectivity with populations outside Canada, and/or habitat intervention for species that are naturally below a survival threshold in Canada

Population stability

While the SRKW population may have been stable in the past, at this time it cannot be considered such. In 1974, the first SRKW population census identified 71 individuals. Over the ensuing decades, it has been assessed annually and the population has fluctuated from the low of 71 animals in 1974 to a high of 97 in 1996. Beginning in 1996, an extended period of poor survival (Taylor and Plater 2001; Krahn et al. 2002) and low fecundity (Krahn et al. 2004) resulted in a decline of 17% (-2.9% per year) to 81 whales in 2001. The period of poor survival and low fecundity has been associated with low Chinook Salmon availability (Ford, Ellis and Olesiuk, 2005; Ford et al. 2010). Since 2001, the population has fluctuated between 76 and 89 individuals. From 1974 to 2006 the maximum number of mature individuals (1993) was 72, the minimum number (1985) was 42. When last assessed by COSEWIC in 2008, the population consisted of 87 individuals, including 48 mature individuals, based on 2006 data. In 2017, the population consisted of 76 members including 51 reproductive individuals (see Table 2).

Since 1974 the size of the SRKW population has been quite variable but the fluxuations have been within a certain overall population range. Combining the small population size, small effective populations and poor survival of neonates, heightens the implications of any mortality and resulting loss of reproductive potential. This negatively affects the ability of the population to stabilize and reverse its recent decline. (See Section 2 for more detailed discussion of population status and trends).

Resilience

Although the current population of SRKW is small, fluctuations in the population from 71 individuals in 1974 to a high of 97 in 1996 suggests some degree of population resilience and that it should be capable of increasing its population from the current number of 76, if the demographics and conditions for successful reproduction are present.

In general, small populations have an increased likelihood of inbreeding and lower reproductive rates, which can lead to low genetic variability, reduced resilience against disease and pollution, reduced population fitness, and elevated extinction risks due to catastrophic events. If the population continues to decline, they may be faced with a shortage of suitable mates. Among the Southern Residents, L pod females may be particularly vulnerable to this scenario because of the small number of reproductive males in J and K pod thus reducing the potential for genetic exchange between pods. Even under ideal conditions, the population will recover slowly because Killer Whales calve relatively infrequently (six years for SRKW). Cultural aspects of Killer Whales must also be considered in assessing population resilience. In animals with highly matrilineal societies a breakdown in social structure may occur if the population becomes too small (Williams and Lusseau 2006; Matkin et al. 2008). However, other cultural aspects of the SRKW may contribute to population resilience. Until recently it was believed that Inbreeding would be less of a risk for Resident Killer Whales than might be expected based on the small size of their populations as they may avoid inbreeding and its inherent risks through non-random mate selection by selecting mates from outside their natal pod (Barrett-Lennard and Ellis 2001). However, Ford et all (2018) showed that “only two adult males sired 52% of the sampled progeny born since 1990”, potentially negatively impacting resilience.

Population redundancy and connectivity

The SRKWs are not widespread, nor do they have population redundancy or connectivity with other populations of Killer Whales. There is a single population and they are not known to interbreed with other Killer Whale populations. This is not expected to change in the future owing to their cultural distinctiveness and separation from other Killer Whale populations.

Protected from anthropogenic threats

The three main threats of reduced prey availability, physical and acoustic disturbance, and contaminants are anthropogenic in nature and ongoing. Although actions have been taken, and additional measures are being planned to reduce the impacts of these threats, the threats are not fully mitigated. Even if factors that have caused the decline of a Killer Whale population are reduced or eliminated, the time required for recovery will be long, because on average, females produce a calf only every 5 to 6 years.

Predicted population trajectories

Population viability analyses (PVA) have been used to estimate the extinction risk of SRKW (Taylor and Plater 2001; Krahn et al. 2002, 2004). These models predict that if the mortality and reproductive rates of the 1990s persist, there is a 6 to 100% probability that the population will be extinct within 100 years, and a 68 to 100% risk that the population will be extinct within 300 years. When the mortality and reproductive rates of the entire 1974 to 2000 period are used, the risk of the population going extinct declines to 0 to 55% over 100 years and 2 to 100% over 300 years. Extinction of the Southern Resident population can be regarded as inevitable in these scenarios under the assumptions of the analyses. Catastrophic events, such as oil spills, would hasten its demise. A more recent PVA model predicted survival and recovery rates of SRKW based on sex-structured models and high-quality demographic data that encompassed one Killer Whale generation (25 years; 1987 to 2011). These models predicted an annual decline of 0.91% for this population, with an extinction risk of 49% over a 100-year period (Velez-Espino et al. 2014). Another recently published PVA model indicated that the current population is fragile, with no growth projected under current conditions, and decline expected if new or increased threats are imposed (Lacy, 2017).

Summary

Given the above considerations, threats to the survival of the SRKW population could be considered imminent.

Question 3: Will the effect of the current threats make recovery of the species unlikely or impossible?

The objective established in the recovery strategy for the SRKW set out the basis for achieving a recovered state for the species. Accordingly, the assessment of imminent threat to recovery considers whether any of the threats to SRKW would render its recovery impossible or unlikely without intervention.

The recovery goal for SRKW is to:

> "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."

This recovery goal reflects the complex social and mating behaviour of Resident Killer Whales and the key threats that may be responsible for their decline; it is linked to maintenance of the current population and structure.

Killer Whales are top-level predators, and as such will always be far less abundant than most other species in their environment. They can therefore be considered naturally precarious. In addition, they are segregated into small population units that are closed to immigration and emigration. Furthermore, their capacity for population growth is limited by a suite of life history and social factors, including late onset of sexual maturity, small numbers of reproductive females and mature males, long calving intervals, and dependence on the cultural transmission of ecological and social information.

Unfortunately, little is known concerning the historic sizes of Killer Whale populations, or the factors that ultimately regulate them. Genetic diversity is known to be particularly low in the Southern Resident population. In light of these inherent characteristics and uncertainties, the following were identified as interim measures of recovery success in the recovery strategy:

a) long-term maintenance of a steady or increasing size for populations currently at known historic maximum levels and an increasing size for populations currently below known historic maximum levels

b) maintenance of sufficient numbers of females in the population to ensure that their combined reproductive potential is at replacement levels for populations at known historic maximum levels and above replacement levels for populations below known historic maximum levels

c) maintenance of sufficient numbers of males in the population to ensure that breeding females have access to multiple potential mates outside of their own and closely related matrilines

d) maintenance of matrilines comprised of multiple generations to ensure continuity in the transmission of cultural information affecting survival

Population

As noted above, the SRKW is small and declining. The population size is very close to the minimum recorded in 1974 of 71 animals; the known historic maximum since surveys began in 1974 is 97, which was in 1996. The presence of poor body condition in SRKW has been associated with the loss of fetuses, calves and adults. A 2013, photogrammetry study assessed SRKW body condition in 43 SRKWs and demonstrated a decline in body condition of 11 animals including 7 prime-age females compared to their condition in 2008 when 43 animals were also assessed. A review of recent research in 2017 concluded that there were multiple lines of evidence that indicated the presence of poor body condition in SRKW.

Given the small population size and low number of individuals contributing to reproduction, poor survival of neonates, it is unlikely the population will increase unless the body condition of the SRKW population improves.

Sufficient numbers of reproductive females

Although the SRKW population is declining, there are as many reproductive females as there were in 1979 (Table 1). In 2017 of the three pods, K pod had the fewest number of reproductive females at 6. In 1980 K pod had just 5 reproductive females and achieved a high of 9 in 2005 (Table 2). This would suggest that there may likely be sufficient females at present to support recovery should conditions permit. It should be noted that this assumes that all females of reproductive age are reproductively viable which may not be the case.

Sufficient numbers of adult males

Although the SRKW population overall is declining, there has been an increase in the number of adult males since 1979 from 18 to 29 (Table 1). This would suggest that there may be sufficient males at present to support recovery should conditions permit. It should be noted that this assumes that all adult males are reproductively viable which may not be the case.

Maintenance of matrilines

Small populations are particularly vulnerable to population-level effects from the loss of even one individual. Many of the older individuals from all three pods have died over the last 20 years and the overall percentage of post-reproductive females has gone from 12% to 7%. Both J and K pods have only one post-reproductive female and L pod only has three. Although it is possible that there could still be multiple generations present in the matriline without the post-reproductive females, these few individuals likely play a key role in each pod.

Summary

Given the above considerations, threats to the recovery of the SRKW population could be considered imminent.

Question 4: Do the threats require intervention?

Actions to mitigate threats and support recovery of SRKW have been underway for many years; however, these efforts have yet to result in detectable signs of recovery of the population. Although the overall population size is still above the low point in 1974, the current demographic distribution of the population does not support the recovery goals identified in the 2011 Recovery Strategy. The complexity of the SRKW social structure requires the presence of older matriarchs. The maximum lifespan of a female Killer Whale is about 80 years but currently there is only one remaining whale born before 1971.

Ongoing and anticipated mitigation to address the ongoing threats

DFO’s Science-based whale review (DFO 2017b) confirmed that the main threats to the SRKW population are the lack of prey availability, acoustic and physical disturbance, and bio-accumulation of contaminants. The action plan (2017a) identified numerous management and research oriented recovery measures anticipated to help abate human pressures on this population.

Critical habitat

An additional area was identified as habitat of special importance for SRKW in Ford et al. (2017); an amendment to the recovery strategy is currently underway to add this area of critical habitat. This area includes the waters on the continental shelf off southwestern Vancouver Island, including Swiftsure and La Perouse Banks (Figure 3). The inclusion in a revised recovery strategy of these additional areas as critical habitat should support recovery of SRKW.

Prey availability

DFO's Science-based whale review (DFO 2017b) identified two priority actions to directly abate reduced prey availability:

- plan and manage salmon fisheries in ways that will reduce anthropogenic competition for SRKW prey in important foraging areas during key times (for example, create protected areas; implement fishery area boundary adjustments and/or closures) or when there are indications of population nutritional stress; among other things, this will require the formation and formalization of a transboundary working group of science and management representatives from DFO, NOAA, and other technical experts to ensure that SRKW prey needs are incorporated consistently in the management of salmon fisheries for transboundary stocks (for example, Canada's Policy for Conservation of Wild Salmon, Pacific Salmon Treaty)
- during years of poor Chinook Salmon returns, implement a more conservative management approach than would be used in typical years to further reduce or eliminate anthropogenic competition for Chinook Salmon and other important prey in key SRKW foraging areas during key times

Current actions to address this threat:

Work has been undertaken to address this threat to the SRKW. Numerous technical science-based workshops have been held by DFO and NOAA since 2011 including: the Independent Science Panel of the Bilateral Scientific Workshop Process to Evaluate the Effects of Salmon Fisheries on Southern Resident Killer Whales (Hillborn et al. 2012) and the follow up joint DFO-NOAA Prey Availability Technical Workshop held at the University of British Columbia in November 2017 (Trites and Rosen 2018). A discussion paper including information on proposed management measures and areas under consideration for implementation of salmon fishing or finfish closures was released to the public and externally consulted on. The focus of this discussion paper was on salmon fisheries, contained in the Southern Salmon Integrated Fisheries Management Plan (IFMP), and through this process fisheries management measures. The primary objective of these measures is to improve Chinook Salmon availability for SRKW in key foraging areas by decreasing potential fishery competition, as well as minimizing physical and acoustic disturbance to the extent possible. Options are currently being considered by the Minister for action starting in the 2018/19 fishing season.

The effectiveness of the proposed salmon fishery measures will depend upon the broad efforts designed to reduce the physical and acoustic disturbance in key foraging areas to the extent possible. In addition, the potential to increase low Chinook Salmon abundance in SRKW foraging areas may be limited given low exploitation rates in fisheries seaward of SRKW foraging areas and current low returns expected for many Fraser Chinook Salmon populations. The identified key Killer Whale foraging areas are located within the Canadian portion of proposed and existing legally-designated SRKW critical habitat and are therefore protected against destruction. Additional foraging areas have been identified in new areas proposed as SRKW critical habitat, which is in the process of being designated and protected as such.

As these management measures are new, there is no evidence yet available that the efforts will result in successful abatement of the threats associated with prey availability to promote survival and recovery. Consequently, this threat is still considered to be acting on the population and does require the type of intervention that is proposed.

Acoustic and physical disturbance

Measures to address the threat from acoustic and physical disturbance from vessels fall largely under the responsibility of TC but are reliant on science advice and support from DFO.

DFO's Science-based whale review (DFO 2017b) identified four priority actions to directly abate the threat of acoustic and physical disturbance:

- increase the distance between SRKWs and pleasure crafts and whale-watching vessels
- implement area-specific vessel regulations (for example, speed restriction zones, rerouting vessel traffic, altering vessel traffic scheduling to create convoys) that reduce the overall acoustic impact on SRKWs in their habitat, particularly in the Salish Sea
- implement incentive programs and regulations that result in reduced acoustic footprints of the vessels habitually travelling in and near important SRKW habitat (for example, through changes in vessel maintenance, application of quieting technologies) and the elimination of the noisiest vessels
- identify candidate acoustic refuge areas within foraging and other key areas of SRKW habitat, and undertake actions for their creation

Current actions to address this threat:

Measures are being taken to address the threat posed by vessels that approach the whales. The proposed Marine Mammal Regulations (MMR) identify a 100 m minimum approach distance for all marine mammals, and a 200 m approach distance for all Killer Whales. In the interim, the commercial whale watching sector has committed to voluntarily implementing the 200 m minimum approach distance.

TC currently lacks the necessary legislative and regulatory authority to mandate vessel operations for the purpose of protecting marine mammal and ecosystem. TC is proposing legislative amendments to the Canada Shipping Act (CSA) 2001.

The results of the 2017 Haro Strait voluntary vessel slowdown trial, led by the Vancouver-Fraser Port Authority's Enhancing Cetacean Habitat and Observation (ECHO) program, demonstrate important reductions in noise for every knot reduction in speed. Further analysis of the data is currently underway to better inform future actions. TC is currently working with ECHO, and industry stakeholders in support of a voluntary trial for the summer of 2018 to further understand the benefits of any additional actions.

DFO has identified the need for discussions with other sectors, including whale watching, to understand activity levels within key foraging areas and what potential additional voluntary measures may be taken to minimize physical and acoustic disturbance in identified Killer Whale foraging areas to the extent possible. Discussion of potential voluntary measures that align with any implemented fishery area closures in key foraging areas through engagement, communications and stewardship is anticipated. At present, it is unclear whether and if the appropriate federal regulatory tools exist to exclude non-fishing vessel-based activities from feeding areas, or whether authorities exist under provincial jurisdiction. As well, vessel exclusion zones can be difficult to enforce, especially for small recreational crafts.

DFO (2017b) found that source-based mitigation measures, such as ship design and/or retrofit, can have a long-term and global effect but these can only be applied incrementally as ships are modified or replaced. Operation-based mitigation measures, such as vessel slow down and convoys, could improve acoustic environments but there is more uncertainty in the effectiveness of these measures as more knowledge is required on whale behaviour, presence, and distribution. Under the Whales Initiative there may be a recommendation to develop guidelines for quiet design and retrofits. Requirements could be made mandatory through regulation. This is a long term action since design criteria and/or standards will need to be developed.

In 2017, the Government of Canada released the Oceans Protection Plan and committed to "take action to better understand and address the cumulative effects of shipping on marine mammals such as SRKW....this includes work to better establish baselines for noise and consideration of options to mitigate these effects." DFO has evaluated the scientific evidence related to mitigation measures that could be applied to reduce shipping-related noise within identified and proposed SRKW critical habitat. A range of mitigation measures were evaluated; including source- and operation-based measures (DFO 2017d).

Activities to address the recommendations above are ongoing by the Government of Canada but as with abating threats associated with prey availability, the current actions are relatively new and their success in reducing and eliminating the threats posed by acoustic and physical disturbance have not been evaluated for their effectiveness in promoting survival and recovery for the SRKW. Consequently, this threat is still considered to be acting on the population and does require immediate intervention.

Environmental contaminants

Measures to address the threat from environmental contaminants are part of the legislative responsibility of ECCC. The Whale Review (DFO 2017b) identified four priority actions to directly abate the presence of environmental contaminants (in no particular order):

- adequately enforce Canadian regulations aimed at reducing toxic chemical compound discharges at the source
- accelerate the rate of compliance with the Canadian Wastewater System Effluent Regulation (2012) in wastewater treatment facilities that border the Salish Sea
- review policies and best management practices for ocean dredging and disposal at sea and modify them to include an examination of polybrominated diphenyl ethers (PBDEs) as well as any other necessary modifications to minimize SRKW contaminant exposure
- identify programs that mitigate small scale and/or chronic contaminant spills and leaks and provide support to them ; if none exist, design and implement an ongoing program that focuses on this mitigation

Current and planned actions to abate this threat:

Many of the POPs found in whales, such as dichlorodiphenyltrichloroethane (DDT) and PCBs, are legacy contaminants used historically and now banned. The Chemicals Management Plan (CMP) was created in 2006 to help ensure that substances currently in use, or being considered for use as new substances, do not become the POPs of the future. ECCC implements the CMP collaboration with Health Canada to assess and manage substances that are toxic to the environment and human health. Under this program the department has put in place regulations to prohibit, restrict, or control toxic substances, including some of those known to affect whales.

For other toxic substances known or suspected to be affecting whales, there are plans to review existing controls and consider how to strengthen them. This will include, for example, further evaluation of prohibitions on the use of flame retardants such as PBDEs, and water, oil and grease repellants such as PFCAs; and, assessing whether to expand regulatory controls for chlorinated alkanes, to include certain types (medium and long chain) which are not addressed in the existing regulations.

Under the Fisheries Act, ECCC administers the Metal Mining Effluent Regulations (MMER) and the Pulp and Paper Effluent Regulations (PPER). These regulations manage threats to fish, fish habitat, and human health from fish consumption by governing the deposit of deleterious substances from mining and pulp and paper mills into waters frequented by fish. ECCC is considering expanding its enforcement activities to specifically target offenders posing the highest risk to whale populations and their prey.

Wastewater releases are a known source of contaminants in the Salish Sea. The Capital Regional District (CRD) plant in Victoria and Vancouver's Lions Gate and Iona Island wastewater treatment plants collectively release about 700 million litres of untreated and under treated effluent every day into the Salish Sea. ECCC's Wastewater System Effluent Regulations require wastewater facilities to upgrade to at least secondary treatment, which can remove approximately 90% of contaminants such as flame retardants (and 95% of conventional pollutants). Victoria (CRD) has until the end of 2020 to stop discharging untreated wastewater, and Metro Vancouver Lions Gate and Iona Island wastewater treatment plants have until the end of 2020 and 2030, respectively.

ECCC will put in place more protective measures under the Disposal at Sea (DaS) regulations to ensure that PCBs in sediment in marine environments do not increase as a result of disposal of dredged materials. This includes increased sampling at DaS sites to help establish protective limits for disposal at sea, to ensure that we do not increase contaminants (specifically PBDEs) in whale habitat.

Specifically regarding spills, under the Ocean Protection Plan, ECCC is supporting the Canadian Coast Guard and Fisheries and Oceans on the development of a legislative and operational framework to permit the use of the most effective response techniques for ship source spills. ECCC is also supporting legislative changes (amendments to the Canadian Shipping Act and the Canadian Environmental Protection Act, 1999), development of an operational framework on use of alternate response measures, and completing scientific research on the use of response techniques. ECCC is also enhancing its emergency response capacity with new environmental emergency officers on the Pacific and Atlantic coasts, and additional enforcement officers in British Columbia, wildlife biologists, 24/7 oil spill modelling and emergency communications capacity.

While DFO will conduct research to quantify key contaminants founds in whales, ECCC's research efforts will focus on identifying the sources of contaminants and how they are entering aquatic environments, in order to better manage them. This research will include air monitoring to measure concentrations of contaminants in air, and the contribution of air pollution from urban centres to whale habitat; increased freshwater sampling to understand the extent to which the Fraser River and other rivers that discharge directly into SRKW habitat are contributing contaminants that are impacting the whales or their prey; sampling of leachate from landfills located close to critical whale habitat to assess the presence of contaminants. Additionally, contaminants of emerging concern such as recycled plastics containing flame retardants and microplastics will be investigated to understand their effects and potential contribution to contaminants found in whales and their prey. The findings from these various research efforts will be used to assess the effectiveness of existing management measures and to identify potential areas where new actions are required.

Many of the activities to address the recommendations are ongoing by the Government of Canada but others are planned for the future. The success of these actions in reducing contaminants in the environment will require long term monitoring and research. Consequently, this threat is still considered to be acting on the population and does require intervention.

Summary

Despite ongoing and planned mitigation measures, the key threats affecting the SRKW population are, to date, not being fully abated; further, the effectiveness of these actions has not yet been evaluated, which can take many years. Given the long life-span of the species, recovery is a long-term goal and effects of reducing the threats on the population to ensure survival and advance recovery would not occur over the short term.

5. Conclusions

In terms of imminency of threat to species at risk, each case must be considered on its own merit owing to the broad range of species and threats that act on them. The opinion of the Ministers must be formed based on the best available information. What is an imminent threat for one species may not necessarily apply to another. This ITA considered the application of imminent threat to the SRKW population only.

When forming an opinion as to the existence of imminent threats, the Ministers should consider factors including whether the threats are of sufficient proximity, taking into account the recovery objectives identified in the recovery strategy for the species if there is one, and whether the threats to the survival or recovery of SRKW are more than a mere possibility or potential future outcome. The more likely the threats are, the more weight they will merit in the Ministers' assessment of the imminence of the threats. However, the threats need not be guaranteed to materialize and the precautionary principle should guide the Ministers in forming their opinion. The impact of the threats should be considered over a biologically appropriate timescale for SRKW; whether it would render the SRKW recovery or survival impossible or unlikely without intervention should also be considered.

The three primary threats to SRKW that are described in this document are present, have ongoing impacts to this population and must be considered.

Threats acting on the SRKW population are not new and may be considered chronic in that they have been acting on the population for many years and cannot be eradicated by any one action or activity. However, it is recognized that these threats and the impacts they may be having on the population are also likely increasing. At the present time, due to the current status of the population and the criteria established for recovery, the threats, although chronic and not necessarily immediate, can be considered imminent. Intervention (through current and proposed measures and/or through additional measures) is needed now in order to preserve the current population to allow the SRKW the best chance for survival and recovery.

In light of their inherent characteristics, including life history and social factors, the population was likely historically small compared to other cetacean populations, even in the absence of impacts from human activities. However, the current population is considered small, not stable and declining. It does not exhibit population redundancy or connectivity with other Killer Whale populations and it continues to face anthropogenic threats that may be increasing. As described above, there are new measures underway, such as reducing commercial Chinook Salmon harvest and reducing noise, that are expected to help mitigate these threats to SRKW, but the effectiveness of these additional measures in abating the threat and contributing to the survival and recovery of the population will take time to evaluate. The maximum lifespan of a female SRKW is approximately 50 to 80 years and a generation is considered to be 26 to 29 years; the effectiveness of threat mitigation actions can be expected to take many years to come to fruition.

Therefore, in following the precautionary approach committed to by the Government of Canada, and the information presented above, the following recommendations are made:

Imminent threat to survival

Based on the information reviewed and analysis undertaken as part of this assessment, it is considered that SRKW are likely facing imminent threat to survival. Unless mitigated, the current threats may make survival of the population unlikely or impossible.

Imminent threat to recovery

Based on the information reviewed and analysis undertaken as part of this assessment, it is considered that SRKW are likely facing imminent threat to recovery. Unless mitigated, the current threats may make recovery of the population unlikely or impossible.

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