

KILLER WHALE (*Orcinus orca*): Eastern North Pacific Southern Resident Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have a cosmopolitan distribution, ranging from equatorial to polar waters, with highest densities found in coastal temperate waters (Forney and Wade 2006). Along the west coast of North America, killer whales occur along the entire Alaskan coast as far north as Barrow (George *et al.* 1994, Lowry *et al.* 1987, Clarke *et al.* 2013), in British Columbia and Washington inland waterways (Bigg *et al.* 1990), and along the outer coasts of Washington, Oregon, and California (Barlow and Forney 2007). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intra-coastal waterways of British Columbia and Washington State, where pods have been labeled as ‘resident,’ ‘transient,’ and ‘offshore’ (Bigg *et al.* 1990, Ford *et al.* 1994) based on aspects of morphology, ecology, genetics, and behavior (Ford and Fisher 1982, Baird and Stacey 1988, Baird *et al.* 1992, Hoelzel *et al.* 1998). Through examination of photographs of recognizable individuals and pods, movements of whales between Prince William Sound and Kodiak Island have been observed (Matkin *et al.* 1999) and whales identified in Southeast Alaska have been observed in Prince William Sound, British Columbia, and Puget Sound (Leatherwood *et al.* 1990, Dahlheim *et al.* 1997).

Genetic studies provide evidence that the ‘resident’ and ‘transient’ types are distinct (Stevens *et al.* 1989, Hoelzel 1991, Hoelzel and Dover 1991, Hoelzel *et al.* 1998, Morin *et al.* 2010). Analyses of complete mitochondrial genomes indicates that transient killer whales should be recognized as a separate species, and that, pending additional data, resident killer whales should be recognized as a separate subspecies (Morin *et al.* 2010). The genetic data results support previous lines of evidence for separation of the transient and resident ecotypes, including differences in 1) acoustic dialects; 2) skull features; 3) morphology; 4) feeding specializations; and 5) a lack of interbreeding between the two sympatric ecotypes (Krahn *et al.* 2004).

Most sightings of the Eastern North Pacific Southern Resident stock of killer whales have occurred in the summer in inland waters of Washington and southern British Columbia. However, pods belonging to this stock have also been sighted in coastal waters off southern Vancouver Island and Washington (Bigg *et al.* 1990, Ford *et al.* 2000, NWFSC unpubl. data). The complete winter range of this stock is uncertain. Of the three pods comprising this stock, one (J1) is commonly sighted in inshore waters in winter, while the other two (K1 and L1) apparently spend more time offshore (Ford *et al.* 2000). These latter two pods have been sighted as far south as Monterey Bay and central California in recent years. They sometimes have also been seen entering the inland waters of Vancouver Island through Johnstone Strait in the spring (Ford *et al.* 2000), suggesting that they may spend time along the outer coast of Vancouver Island during the winter. In June 2007, whales from L-pod were sighted off Chatham Strait, Alaska, the farthest north they have ever been documented (J. Ford, pers. comm.). Passive autonomous acoustic recorders have recently provided more information on the seasonal occurrence of these pods along the west coast of the U.S. (Hanson *et al.* 2013). In addition, satellite-linked tags were recently deployed in winter months on members of J, K, and L pods. Results were consistent with previous data, but provided much greater detail, showing

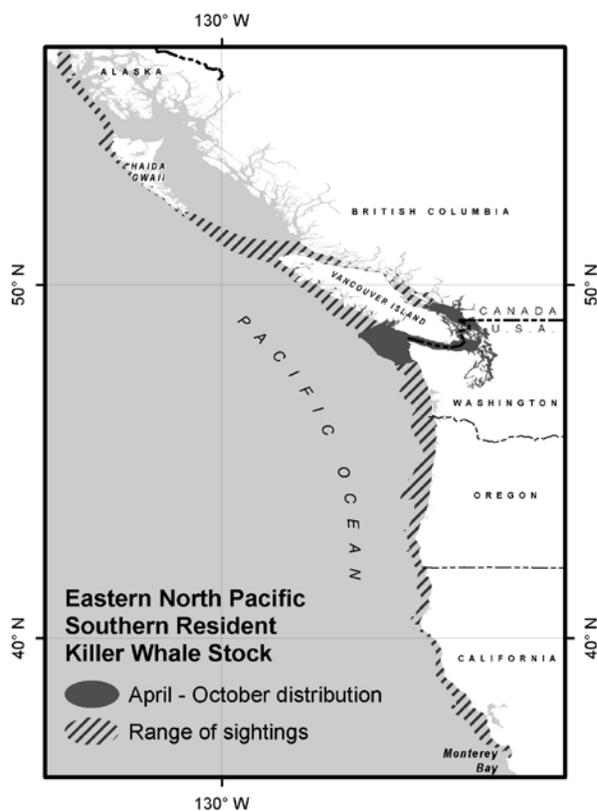


Figure 1. Approximate April - October distribution of the Eastern North Pacific Southern Resident killer whale stock (shaded area) and range of sightings (diagonal lines).

wide-ranging use of inland waters by J Pod whales and extensive movements in U.S. coastal waters by K and L Pods.

Based on data regarding association patterns, acoustics, movements, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Eastern North Pacific Alaska Resident stock - occurring from Southeast Alaska to the Bering Sea, 2) the Eastern North Pacific Northern Resident stock - occurring from British Columbia through Alaska, 3) the Eastern North Pacific Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia but extending from central California into southern Southeast Alaska (see Fig. 1), 4) the West Coast Transient stock - occurring from Alaska through California, 5) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring from southeast Alaska to the Bering Sea, 6) the AT1 Stock – found only in Prince William Sound, 7) the Eastern North Pacific Offshore stock - occurring from Southeast Alaska through California, 8) the Hawaiian stock. The Stock Assessment Reports for the Alaska Region contain information concerning the Eastern North Pacific Alaska Resident, Eastern North Pacific Northern Resident and the Gulf of Alaska, Aleutian Islands, and Bering Sea, AT1, and Eastern North Pacific Transient stocks.

POPULATION SIZE

The Eastern North Pacific Southern Resident stock is a trans-boundary stock including killer whales in inland Washington and southern British Columbia waters. Photo-identification of individual whales through the years has advanced knowledge of this stock's structure, behaviors, and movements. In 1993, the three pods comprising this stock totaled 96 killer whales (Ford *et al.* 1994). The population increased to 99 whales in 1995, then declined to 79 whales in 2001, and most recently numbered 83 whales in 2016 (Fig. 2; Ford *et al.* 2000; Center for Whale Research 2016). The 2001-2005 counts included a whale born in 1999 (L-98) that was listed as missing during the annual census in May and June 2001 but was subsequently discovered alone in an inlet off the west coast of Vancouver Island. L-98 remained separate from L pod until 10 March 2006 when he died due to injuries associated with a vessel interaction in Nootka Sound. L-98 has been subtracted from the official 2006 and subsequent population censuses. The most recent census spanning 1 July 2015 through 1 July 2016 includes five new calves (three male, one female, one sex unknown) and the deaths of one of the calves (sex unknown), a post-reproductive age female, and young adult male reproductive age adult female (that was pregnant with a female neonate), and a calf of unknown sex. This does not include the mortality of two post-reproductive females, a reproductive age female and her dependent male calf, or a young adult male. Nor does this include a stillborn fetus that was observed being pushed at the surface by its presumed mother (Durban *et al.* 2016).

Minimum Population Estimate

The abundance estimate for this stock of killer whales is a direct count of individually identifiable animals. It is thought that the entire population is censused every year. This estimate therefore serves as both a best estimate of abundance and a minimum estimate of abundance. Thus, the minimum population estimate (N_{\min}) for the Eastern North Pacific Southern Resident stock of killer whales is 83 animals.

Current Population Trend

During the live-capture fishery that existed from 1967 to 1973, it is estimated that 47 killer whales, mostly immature, were taken out of this stock (Ford *et al.* 1994). Since the first complete census of this stock in 1974 when 71 animals were identified, the number of southern resident killer whales has fluctuated annually. Between 1974 and the mid-1990s, the Southern Resident stock increased approximately 35% (Ford *et al.* 1994), representing a net annual growth rate of 1.8% during those years. Following the peak census count of 99 animals in 1995, the population size has declined and currently stands at 83 animals as of the 2016 census (Ford *et al.* 2000; Center for Whale Research 2016).

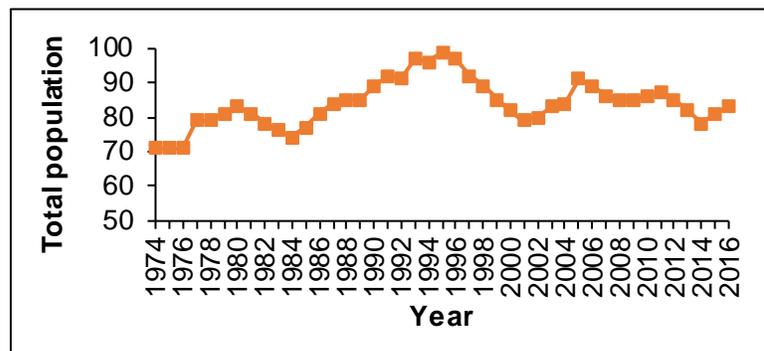


Figure 2. Population of Eastern North Pacific Southern Resident stock of killer whales, 1974-2016. Each year's count includes animals first seen and first missed; a whale is considered first missed the year after it was last seen alive (Ford *et al.* 2000; Center for Whale Research 2016).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Matkin *et al.* (2014) estimated a maximum population annual growth rate of 1.035 for southern Alaska resident killer whales. The authors noted that the 3.5% annual rate estimated for southern Alaska residents is higher than previously measured rates for British Columbia northern residents (2.9%, Olesiuk *et al.* 1990) and “probably represents a population at r-max (maximum rate of growth).” In the absence of published estimates of R_{\max} for southern resident killer whales, the maximum annual rate of 3.5% found for southern Alaska residents is used for this stock of southern resident killer whales. This reflects more information about the known life history of resident killer whales than the default R_{\max} of 4% and results in a more conservative estimate of potential biological removal (PBR).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (83) times one-half the maximum net growth rate for *Alaska* resident killer whales ($\frac{1}{2}$ of 3.5%) times a recovery factor of 0.1 (for an endangered stock, Wade and Angliss 1997), resulting in a PBR of 0.14 whales per year, or approximately 1 animal every 7 years.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Salmon drift gillnet fisheries in Washington inland waters were last observed in 1993 and 1994 and no killer whale entanglements were documented, though observer coverage levels were less than 10% (Erstad *et al.* 1996, Pierce *et al.* 1994, Pierce *et al.* 1996, NWIFC 1995). Fishing effort in the inland waters drift gillnet fishery has declined considerably since 1994 because far fewer vessels participate today (NOAA West Coast Region). Past marine mammal entanglements in this fishery included harbor porpoise, Dall’s porpoise, and harbor seals. Coastal marine tribal set gillnets also occur along the outer Washington coast and no killer whale interactions have been reported in this fishery since the inception of the observer program in 1988, though the fishery is not active every year (Gearin *et al.* 1994, Gearin *et al.* 2000, Makah Fisheries Management).

An additional source of information on killer whale mortality and injury incidental to commercial fishery operations is the self-reported fisheries information required of vessel operators by the MMPA. No self-report records of killer whale mortality have been reported.

Due to a lack of observer programs, there are few data concerning the mortality of marine mammals incidental to Canadian commercial fisheries. Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. However, in 1994 one killer whale was reported to have contacted a salmon gillnet but did not entangle (Guenther *et al.* 1995). Data regarding the level of killer whale mortality related to commercial fisheries in Canadian waters are not available.

The known total fishery mortality and serious injury for this stock is zero.

Other Mortality

No human-caused killer whale mortality or serious injuries were reported from non-fisheries sources in 2011-2015 (Carretta *et al.* 2017). In 2012, a moderately decomposed juvenile female southern resident killer whale (L-112) was found dead near Long Beach, WA. A full necropsy was performed and the cause of death was determined to be blunt force trauma to the head, however the source of the trauma (vessel strike, intraspecific aggression, or other unknown source) could not be established (NOAA 2014). There was documentation of a whale-boat collision in Haro Strait in 2005 which resulted in a minor injury to a whale. In 2006, whale L98 was killed during a vessel interaction. It is important to note that L98 had become habituated to regularly interacting with vessels during its isolation in Nootka Sound. The annual known level of non-fishery human-caused mortality for this stock over the past five years (2010-2014) is zero animals per year. In spring 2016, a young adult male, L95, was found to have died of a fungal infection that may have been related to a satellite tag deployment approximately 5 weeks prior to its death. In fall 2016 another young adult male, J34, was found dead in the northern Georgia Strait. The necropsy indicated that the whale died of blunt force trauma to the head and the source of trauma is still under investigation.

STATUS OF STOCK

Total annual fishery mortality and serious injury for this stock (0) is not known to exceed 10% of the calculated PBR (0.14) and, therefore, appears to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury of zero animals per year does not exceed the PBR (0.14). Southern Resident killer whales were formally listed as “endangered” under the ESA in 2005 and consequently the stock is automatically considered as a “strategic” stock under the MMPA. This stock was considered “depleted” (68 FR 31980, May 29, 2003) prior to its 2005 listing under the ESA (70 FR 69903, November 18, 2005).

Habitat Issues

Several potential risk factors identified for this population have habitat implications. The summer range of this population, the inland waters of Washington and British Columbia, are home to a large commercial whale watch industry, and high levels of recreational boating and commercial shipping. Potential for acoustic masking effects on the whales’ communication and foraging due to vessel traffic remains a concern (Erbe 2002, Clark *et al.* 2009). In 2011 vessel approach regulations were implemented to restrict vessels from approaching closer than 200m. This population appears to be Chinook salmon specialists (Ford and Ellis 2006, Hanson *et al.* 2010, Ford *et al.* 2016), although other species, such as chum, pink, and coho salmon also appear to be important elements of the diet (Ford *et al.* 1998). There is evidence that changes in Chinook abundance have affected this population (Ford *et al.* 2009, Ward *et al.* 2009). In addition, the high trophic level and longevity of the animals has predisposed them to accumulate levels of contaminants that are high enough to cause potential health impacts. In particular, there is recent evidence of extremely high levels of flame retardants in young animals (Krahn *et al.* 2007, 2009).

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