

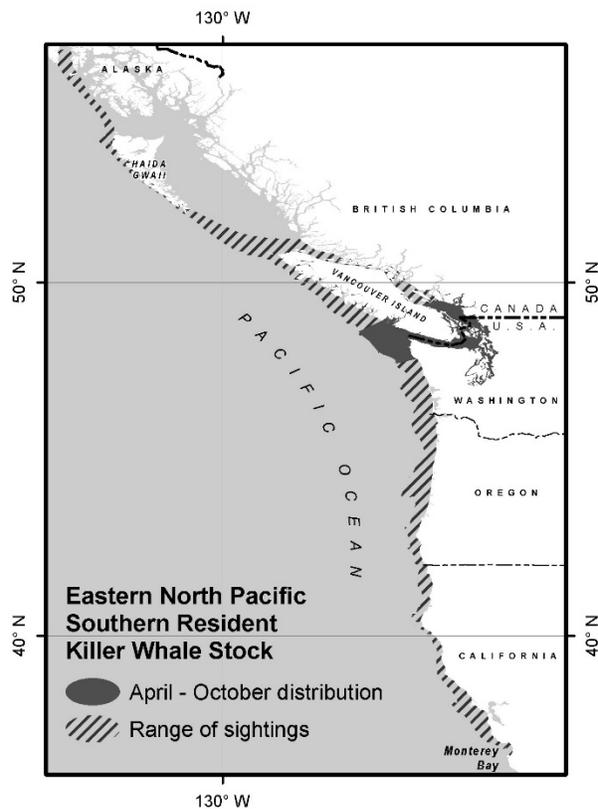
## KILLER WHALE (*Orcinus orca*): Eastern North Pacific Southern Resident Stock

### STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975, Forney and Wade 2006). Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982, Hamilton *et al.* 2009), in British Columbia and Washington inland waterways (Bigg *et al.* 1990), and along the outer coasts of Washington, Oregon and California (Hamilton *et al.* 2009). Seasonal and year-round occurrence have been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington, where three ecotypes have been recognized: '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, Morin *et al.* 2010, Ford *et al.* 2014). Genetic studies of killer whales globally suggest that residents and transient ecotypes warrant subspecies recognition (Morin *et al.* 2010) and each are currently listed as unnamed subspecies of *Orcinus orca* (Committee on Taxonomy 2018).

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 (J) is commonly sighted in inshore waters in winter, while the other two (K and L) 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 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



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

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 77 whales in 2017 (Fig. 2; Ford *et al.* 2000; Center for Whale Research 2017). 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 2016 through 1 July 2017 includes no new calves and the deaths of three post-reproductive age females, a young adult male, and a young reproductive age female and her dependent calf.

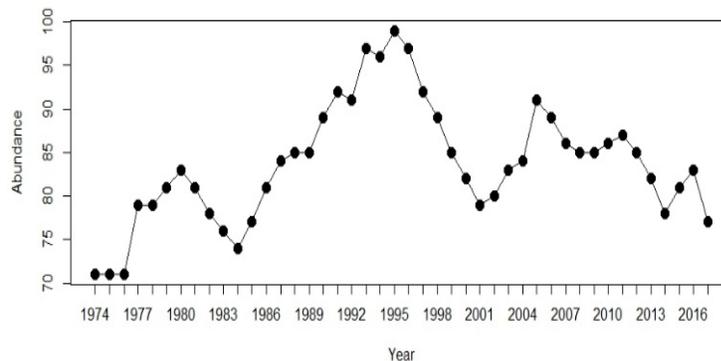
## Minimum Population Estimate

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 77 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-



**Figure 2.** Population of Eastern North Pacific Southern Resident stock of killer whales, 1974- 2017. 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 2017).

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 77 animals as of the 2017 census (Ford *et al.* 2000; Center for Whale Research 2017).

## 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 (77) 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 0.13 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 of southern resident killer whales were reported from non-fisheries sources during 2012-2016 (Carretta *et al.* 2018). 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 (2012-2016) 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 (0.13) 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 (0.13). 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, Ford *et al.* 2016). 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).

## REFERENCES

- Angliss, R. P., and K. L. Lodge. 2002. Alaska marine mammal stock assessments, 2002. U.S. Dep. Commer., NOAA Technical Memorandum NMFS-AFSC-133. 224 pp.
- Baird, R. W., and P. J. Stacey. 1988. Variation in saddle patch pigmentation in populations of killer whales (*Orcinus orca*) from British Columbia, Alaska, and Washington State. *Canadian Journal of Zoology* 66:2582-2585.
- Baird, R. W., P. A. Abrams, and L. M. Dill. 1992. Possible indirect interactions between transient and resident killer whales: implications for the evolution of foraging specializations in the genus *Orcinus*. *Oecologia* 89:125-132.
- Barlow, J. and K.A. Forney. 2007. Abundance and population density of cetaceans in the California Current ecosystem. *Fishery Bulletin* 105:509-526.
- Bigg, M. A., P. F. Olesiuk, G. M. Ellis, J. K. B. Ford, and K. C. Balcomb III. 1990. Social organization and genealogy of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. Pp. 386-406, *In*: Hammond, P. S., S. A. Mizroch, and G. P. Donovan (eds.), *Individual Recognition of Cetaceans: Use of Photo-identification and Other Techniques to Estimate Population Parameters*. Rep. Int. Whal. Commn. Special Issue 12.
- Braham, H. W., and M. E. Dahlheim. 1982. Killer whales in Alaska documented in the Platforms of Opportunity Program. Rep. Int. Whal. Commn. 32:643-646.
- Brault, S., and H. Caswell. 1993. Pod-specific demography of killer whales (*Orcinus orca*). *Ecology* 74(5):1444-1454.
- Carretta, J.V., V. Helker, M.M. Muto, J. Greenman, K. Wilkinson, D. Lawson, J. Viezbicke, and J. Jannot. 2018b. Sources of human-related injury and mortality for U.S. Pacific West coast marine mammal stock assessments, 2012-2016. Document PSRG-2018-06 reviewed by the Pacific Scientific Review Group, March 2018. La Jolla, CA.
- Center for Whale Research. 2017. Accessed 31 Dec 2017.
- Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A. and Ponirakis, D., 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. *Marine Ecology Progress Series*, 395, pp.201-222.
- Clarke, J.T., C.L. Christman, A.A. Brower, and M.C. Ferguson. 2013. Distribution and Relative Abundance of Marine Mammals in the Northeastern Chukchi and Western Beaufort Seas, 2012. Annual Report, OCS Study BOEM 2013-00117. National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, F/AKC3, Seattle, WA 98115-6349.
- Dahlheim, M. E., D.K. Ellifrit, and J.D. Swenson. 1997. Killer whales of Southeast Alaska: a catalogue of photoidentified individuals. National Marine Mammal Laboratory, AFSC, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115. 79 pp.
- Erbe, C., 2002. Underwater noise of whale-watching boats and potential effects on killer whales (*Orcinus orca*), based on an acoustic impact model. *Marine Mammal Science*, 18(2), pp.394-418.
- Erstad, P., S.J. Jeffries, and D.J. Pierce. 1996. 1994 Report for the Puget Sound fishery observer program in management areas 10/11 & 12/12B: nontreaty chum gill net fishery. Final Report, Washington Dept. Fish and Wildlife, Olympia, WA. 14 pp.
- Ford, J.K.B. Pacific Biological Station, Department of Fisheries and Oceans, Nanaimo, BC V9R 5K6.
- Ford, J.K.B., and H. D. Fisher. 1982. Killer whale (*Orcinus orca*) dialects as an indicator of stocks in British Columbia. Rep. Int. Whal. Commn. 32:671-679.
- Ford, J.K.B., G. M. Ellis, and K. C. Balcomb. 1994. Killer Whales: The Natural History and Genealogy of *Orcinus orca* in British Columbia and Washington State. University of British Columbia Press, Vancouver, BC, and University of Washington Press, Seattle. 102 pp.
- Ford, J.K., Ellis, G.M., Barrett-Lennard, L.G., Morton, A.B., Palm, R.S. and Balcomb III, K.C., 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. *Canadian Journal of Zoology*, 76(8), pp.1456-1471.
- Ford, J.K.B., G. M. Ellis, and K. C. Balcomb. 2000. Killer Whales: The Natural History and Genealogy of *Orcinus orca* in British Columbia and Washington. 2nd edition. University of British Columbia Press, Vancouver, BC, and University of Washington Press, Seattle. 104 pp.
- Ford, J.K.B., and G.M. Ellis. 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. *Marine Ecology Progress Series*, 316:185-199.

- Ford, J.K.B., G.M. Ellis, P.F. Olesiuk, and K.C. Balcomb. 2009. Linking killer whale survival and prey abundance: food limitation in the oceans' apex predator? *Biol. Lett.* published online before print September 15, 2009.
- Ford, J.K.B., Stredulinsky, E.H., Ellis, G.M., Durban, J.W., Pilkington, J.F., 2014. Offshore Killer Whales in Canadian Pacific Waters: Distribution, Seasonality, Foraging Ecology, Population Status and Potential for Recovery. DFO Canadian Science Advisory Secretariat Research Document 2014/088. p. vii + 55.
- Ford M.J., J. Hempelmann, M.B. Hanson, K.L. Ayres, R.W. Baird, C.K. Emmons, J.I. Lundin, G.S. Schorr, S.K. Wasser, L.K. Park. 2016. Estimation of a Killer Whale (*Orcinus orca*) Population's Diet Using Sequencing Analysis of DNA from Feces. *PLoS ONE* 11(1): e0144956.
- Forney, K.A. and P. Wade. 2006. Worldwide distribution and abundance of killer whales. Pages 145-162 In: "Whales, whaling and ocean ecosystems", J.A. Estes, R.L. Brownell, Jr., D.P DeMaster, D.F. Doak, and T.M. Williams (eds), University of California Press. 418p.
- Gearin, P. J., S. R. Melin, R. L. DeLong, H. Kajimura, and M. A. Johnson. 1994. Harbor porpoise interactions with a chinook salmon set-net fishery in Washington State. *Rep. Int. Whal. Commn. Special Issue* 15:427-438.
- Gearin, P. J., M. E. Goshko, J. L. Laake, L. Cooke, R. L. DeLong, and K. M. Hughes. 2000. Experimental testing of acoustic alarms (pingers) to reduce bycatch of harbour porpoise, *Phocoena phocoena*, in the state of Washington. *J. Cetacean Res. Manage.* 2(1):1-9.
- George, J.C., L.M. Philo, K. Hazard, D. Withrow, G.M. Carroll and R. Suydam. 1994. Frequency of killer whale (*Orcinus orca*) attacks and ship collisions based on scarring on bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort seas stock. *Arctic* 47(3): 246-255.
- Guenther, T. J., R.W. Baird, R.L. Bates, P.M. Willis, R.L. Hahn, and S.G. Wischniowski. 1995. Strandings and fishing gear entanglements of cetaceans on the west coast of Canada in 1994. Paper SC/47/O6 presented to the International Whaling Commission, May 1995 (unpublished). 7 pp.
- Hanson, M.B., R.W. Baird, J.K.B. Ford, J. Hempelmann-Halos, D. M. Van Doornik, J.R. Candy, C. K. Emmons, G. S. Schorr, B. Gisborne, K. L. Ayres, S. K. Wasser, K. C. Balcomb, K. Balcomb-Bartok, J. G. Sneva, and M. J. Ford. 2010. Species and stock identification of prey consumed by endangered "southern resident" killer whales in their summer range. *Endangered Species Research* 11:69-82.
- Hanson, M.B., C.K. Emmons, E.J. Ward, J.A. Nystuen, and M.O. Lammers. 2013. Assessing the coastal occurrence of endangered killer whales using autonomous passive acoustic recorders. *J. Acoust. Soc. Am.* 134 (5): 3486-3495.
- Hoelzel, A.R. 1991. Analysis of regional mitochondrial DNA variation in the killer whale; implications for cetacean conservation. *Rep. Int. Whal. Commn. Special Issue* 13:225-233.
- Hoelzel, A.R., and G. A. Dover. 1991. Genetic differentiation between sympatric killer whale populations. *Heredity* 66:191-195.
- Hoelzel, A. R., M. E. Dahlheim, and S. J. Stern. 1998. Low genetic variation among killer whales (*Orcinus orca*) in the Eastern North Pacific, and genetic differentiation between foraging specialists. *J. Heredity* 89:121-128.
- Krahn, M.M., M.J. Ford, W.F. Perrin, P.R. Wade, R.P. Angliss, M.B. Hanson, B.L. Taylor, G. Ylitalo, M.E. Dahlheim, J.E. Stein, and R.S. Waples. 2004. 2004 Status review of Southern Resident killer whales (*Orcinus orca*) under the Endangered Species Act. U.S. Dep. Commer., NOAA Tech. Memo NMFS-NWFSC-62. 73 pp.
- Krahn, M.M., M.B. Hanson, R.W. Baird, R.H. Boyer, D.G. Burrows, C.K. Emmons, J. K.B. Ford, L. L. Jones, D. P. Noren, P. S. Ross, G. S. Schorr, T.K. Collier. 2007. Persistent organic pollutants and stable isotopes in biopsy samples (2004/2006) from Southern Resident killer whales. *Mar. Poll. Bull.* 54 (2007) 1903-1911.
- Krahn, M.M., M.B. Hanson, G.S. Schorr, C.K. Emmons, D.G. Burrows, J.L. Bolton, R.W. Baird, G.M. Ylitalo. 2009. Effects of age, sex and reproductive status on persistent organic pollutant concentrations in "Southern Resident" killer whales. *Marine Pollution Bulletin* 58: 1522-1529.
- Leatherwood, J. S., and M. E. Dahlheim. 1978. Worldwide distribution of pilot whales and killer whales. Naval Ocean Systems Center, Tech. Rep. 443:1-39.
- Leatherwood, S., C.O. Matkin, J.D. Hall, and G.M. Ellis. 1990. Killer whales, *Orcinus orca*, photo-identified in Prince William Sound, Alaska 1976 to 1987. *Can. Field Nat.* 104:362-371.
- Lowry, L.F., R.R. Nelson, and K.J. Frost. 1987. Observations of killer whales, *Orcinus orca*, in western Alaska: Sightings, strandings, and predation on other marine mammals. *The Canadian Field Naturalist* 101:6-12.
- Matkin, C., G. Ellis, E. Saulitis, L. Barrett-Lennard, and D. Matkin. 1999. Killer Whales of Southern Alaska. North Gulf Oceanic Society. 96 pp.
- Matkin, C.O., Ward Testa, J., Ellis, G. M. and Saulitis, E. L. 2014. Life history and population dynamics of southern Alaska resident killer whales (*Orcinus orca*). *Marine Mammal Science*, 30: 460-479.
- Morin P. A., F. I. Archer, A. D. Foote, J. Vilstrup, E. E. Allen, P. R. Wade, J. W. Durban, K. M. Parsons, R. Pitman, L. Li, P. Bouffard, S. C. Abel Nielsen, M. Rasmussen, E. Willerslev, M. T. P. Gilbert, T. Harkins. 2010.

- Complete mitochondrial genome phylogeographic analysis of killer whales (*Orcinus orca*) indicates multiple species. *Genome Research*, 20:908-916.
- NOAA West Coast Region.
- NOAA. 2014. Wild animal mortality investigation: Southern Resident Killer Whale L-112 final report.
- Northwest Indian Fisheries Commission (NWIFC). 1995. Monitoring of marbled murrelet and marine mammal interactions with 1994 tribal gillnet fisheries in northern Puget Sound, Hood Canal, and the Strait of Juan de Fuca. Final Report to NMFS, Contract No. 52ABNF400087, and U.S. Fish and Wildlife Service. Unpubl. report. 41 pp. Available at NWIFC, 6730 Martin Way E, Olympia, WA 98516.
- Olesiuk, P.F., M.A. Bigg, and G.M. Ellis. 1990. Life history and population dynamics of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. *Rep. Int. Whal. Commn. Special Issue* 12:209-242.
- Pierce, D. J., W. P. Ritchie, and R. Kreuziger. 1994. Preliminary findings of seabird interactions with the non-treaty salmon gill net fishery: Puget Sound and Hood Canal Washington. Unpubl. report. Washington Dept. Fish and Wildlife, Olympia, WA. 39 pp. Available at WDFW, 600 Capitol Way N, Olympia, WA 98501.
- Pierce, D. J., M. Alexandersdottir, S.J. Jeffries, P. Erstad, W. Beattie, and A. Chapman. 1996. Interactions of marbled murrelets and marine mammals with the 1994 Puget Sound sockeye gill net fishery. Final Report, Washington Dept. Fish and Wildlife, Olympia, WA. 21 pp.
- Reeves, R.R., W.F. Perrin, B.L. Taylor, C.S. Baker, and S.L. Mesnick. 2004. Report of the workshop on shortcomings of cetacean taxonomy in relation to needs of conservation and management, April 30 – May 2, 2004, La Jolla, California. U.S. Department of Commerce NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-363. 94pp. Available from Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA. 92037.
- Stevens, T.A., D. Duffield, E. Asper, K. Hewlett, A. Bolz, L. Gage, and G. Bossart. 1989. Preliminary findings of restriction fragment differences in mitochondrial DNA among killer whales (*Orcinus orca*). *Can. J. Zool.* 67:2592-2595.
- Wade, P.R., and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: report of the GAMMS workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
- Ward, E.J., E.E. Holmes, and K.C. Balcomb. 2009. Quantifying the effects of prey abundance on killer whale reproduction. *Journal of Applied Ecology*, 46(3):632-640.
- Yano, K., and M.E. Dahlheim. 1995. Killer whale, *Orcinus orca*, depredation on longline catches of bottomfish in the southeastern Bering Sea and adjacent waters. *Fish. Bull.* 93:355-372.