

KILLER WHALE (*Orcinus orca*): AT1 Transient Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters, killer whales occur at higher densities in colder and more productive waters of both hemispheres, with the greatest densities found at high latitudes (Mitchell 1975, Leatherwood and Dahlheim, 1978, and Forney and Wade, 2006). Killer whales are found throughout the North Pacific. Along the west coast of North America, killer whales occur along the entire Alaskan coast (Braham and Dahlheim 1982), in British Columbia and Washington inland waterways (Bigg et al. 1990), and along the outer coasts of Washington, Oregon, and California (Green et al. 1992; Barlow 1995, 1997; Forney et al. 1995). Seasonal and year-round occurrence has been noted for killer whales throughout Alaska (Braham and Dahlheim 1982) and in the intracoastal waterways of British Columbia and Washington State, where pods have been labeled as 'resident,' 'transient,' and 'offshore' (Bigg et al. 1990, Ford et al. 2000) 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, 2002; Barrett-Lennard 2000). Through examination of photographs of recognizable individuals and pods, movements of whales between geographical areas have been documented. For example, whales identified in Prince William Sound have been observed near Kodiak Island (Matkin et al. 1999b) 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). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994).

Several studies provide evidence that the 'resident,' 'offshore,' and 'transient' ecotypes are genetically distinct in both mtDNA and nuclear DNA (Hoelzel and Dover 1991; Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Genetic differences have also been found between populations within the 'transient' and 'resident' ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000).

Until recently, transient killer whales in Alaska had only been studied intensively in southeastern Alaska and in the Gulf of Alaska (from Prince William Sound, through the Kenai Fjords, and around Kodiak Island). In the Gulf of Alaska, Matkin et al. (1999) described two communities of transients which were never found in association with one another, the so-called 'Gulf of Alaska' transients and 'AT1' transients. Neither of these communities associates with transient killer whales that range from California to southeastern Alaska, which has been termed the 'west coast' community. 'Gulf of Alaska' transients are seen throughout the Gulf of Alaska, including occasional sightings in Prince William Sound. AT1 transients are primarily seen in Prince William Sound and in the Kenai Fjords region, and are therefore partially sympatric with 'Gulf of Alaska' transients. Transients that associate with the 'Gulf of Alaska' community have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 communities. Members of the AT1 community share a single mtDNA haplotype. Transient killer whales from the 'west coast' community have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three communities have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis et al. (2005) described acoustic differences between 'Gulf of Alaska' transients and AT1 transients. For these reasons,

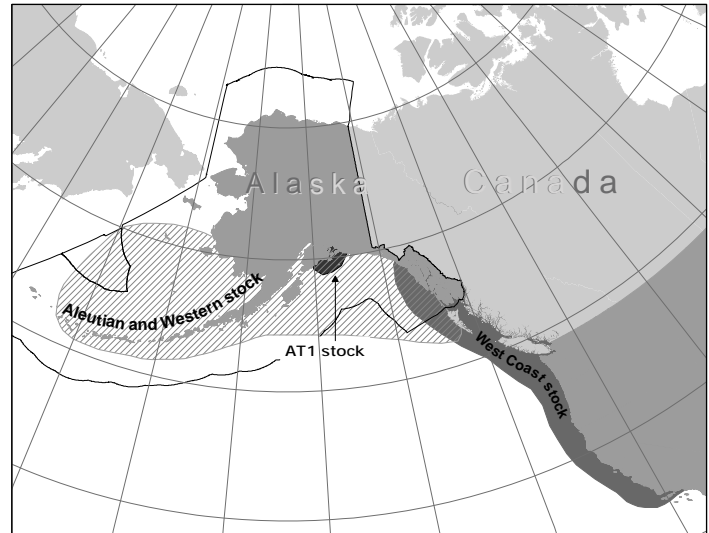


Figure 24. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

the 'Gulf of Alaska' transients are considered part of a population that is discrete from the AT1 population, and both of these communities are considered discrete from the 'west coast' transients.

Recent research in western Alaska, particularly along the south side of the Alaska Peninsula and in the eastern Aleutian Islands, have identified transient killer whales that use acoustic calls similar to and mtDNA haplotypes identical with the Gulf of Alaska transients (NMML unpublished, NGOS unpublished), however their connection with Gulf of Alaska transients is equivocal considering there has been little documented interchange between these areas and nuclear DNA analysis has not been completed. AT1 haplotypes are also found in western Alaska, but nuclear DNA analysis indicates there is no recent connection with the AT1 population. However, samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting the possibility there is some population structure in western Alaska. At this point, there are insufficient data to resolve transient population structure in western Alaska. Therefore, transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes 'Gulf of Alaska' transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales.

In summary, within the transient ecotype, association data (Ford et al. 1994, Ford and Ellis 1999, Matkin et al. 1999), acoustic data (Saulitis 1993, Ford and Ellis 1999) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) confirms that at least three communities of transient whales exist and represent three discrete populations: 1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, 2) AT1 transients, and 3) West Coast transients.

Based on data regarding association patterns, movements, acoustics, genetic differences and potential fishery interactions, eight killer whale stocks are recognized within the Pacific U.S. EEZ: 1) the Alaska Resident stock - occurring from southeastern Alaska to the Aleutian Islands and Bering Sea, 2) the Northern Resident stock - occurring from British Columbia through part of southeastern Alaska, 3) the Southern Resident stock - occurring mainly within the inland waters of Washington State and southern British Columbia, but also in coastal waters from British Columbia through California, 4) the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock - occurring mainly from Prince William Sound through the Aleutian Islands and Bering Sea (see Fig. 24), 5) the AT1 Transient stock - occurring in Alaska from Prince William Sound through the Kenai Fjords, 6) the West Coast Transient stock - occurring from California through southeastern Alaska, 7) the Offshore stock - occurring from California through Alaska, and 8) the Hawaiian stock. 'Transient' whales in Canadian waters are considered part of the West Coast Transient stock. The Stock Assessment Reports for the Alaska Region contain information concerning all the killer whale stocks except the Hawaiian and Offshore stocks.

AT1 killer whales were first identified as a separate, cohesive group in 1984, when 22 transient-type whales were documented in Prince William Sound (Leatherwood et al. 1984, Heise et al. 1991), though individual whales from the group had been photographed as early as 1978. Once the North Gulf Oceanic Society began consistent annual research effort in Prince William Sound, AT1 killer whales were re-sighted frequently. In fact, AT1 killer whales were found to be some of the most frequently sighted killer whales in Prince William Sound (Matkin et al. 1993, 1994). Gulf of Alaska transients are seen less frequently in Prince William Sound, with periods of several years between resightings not uncommon.

AT1 killer whales have never been seen in association with sympatric resident killer whale pods or with Gulf of Alaska transients (Matkin et al. 1999b). As discussed above, the AT1 group were found to be acoustically and genetically different from other transient killer whales in the North Pacific (Saulitis et al. 2005, Barrett-Lennard 2000). AT1 killer whale transients are considered a population that is discrete from 'Gulf of Alaska' transients, which are part of the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock.

The AT1 transients appear to have a more limited geographic range than do other transients. Though seen mostly in Prince William Sound, some AT1s were photographed between Prince William Sound and Resurrection Bay in 1992 (K. Heise, Vancouver Aquarium, pers. comm. in Matkin and Saulitis 1994). It is now known that they can be seen in Prince William Sound and Resurrection and Aialik Bays of the Kenai Fjords year-round (Saulitis et al. 2000). However, they are not known to travel east of Prince William Sound or west of Kenai Fjords, Alaska, an apparent range of at least 200 miles (Matkin et al. 1999b).

POPULATION SIZE

Using photographic identification methods, all 22 individuals in the population were completely censused for the first time in 1984 (Leatherwood et al. 1984). All 22 AT1s were seen annually or biannually from 1984 to 1988 (Matkin et al. 1999a). The *Exxon Valdez* oil spill occurred in spring of 1989. Nine individuals from the AT1 group have been missing since 1990 (last seen in 1989), and 2 have been missing since 1992 (last seen in 1990 and

1991). All 11 are presumed dead (Matkin et al. 2000). Three of the AT1s that presumably died (AT5, AT7, and AT8) were seen near the *Exxon Valdez* (with AT6) shortly after the spill (Matkin et al. 1993, 1994). One of the 11 was confirmed dead – AT19 was found dead on a beach in the spring of 1990 (Matkin et al. 1994). Two other carcasses of killer whales were found in Prince William Sound in 1990, and one was found in 1992. One was genetically determined to be of the AT1 population (Heise et al. 2003). Two of those three were confirmed as transients based on marine mammal parts found in their stomach (Matkin et al. 1994). A fifth killer whale carcass was found on Kayak Island 60 miles southeast of the sound, also with marine mammal parts in its stomach (date not reported) (Matkin et al. 1993). No other killer whale carcasses were found in the Prince William Sound region from 1983 through 1992 (Matkin et al. 1994). In addition, no strandings of killer whales were reported from Prince William Sound from 1975 to 1987 (Zimmerman 1991). In sum, these facts lead to the conclusion that the 11 whales missing since 1991 should be presumed dead, though only one whale was documented to have died.

In the AT1 group, all 11 individuals confirmed as alive after 1989 were seen nearly every year from 1990-92 (Matkin et al. 1994). The number of individuals seen in subsequent years was 8 in 1993, 5 in 1994, 11 in 1995, 9 in 1996, 6 in 1997, 8 in 1998, and 7 in 1999 (Matkin et al. 2000). Since 1993, only in 1995 was every individual whale seen in every year. However, when considering pairs of years, all 11 individuals were seen again in 1996-97, and all 11 individuals were seen again in 1998-99. Therefore, it can be concluded that no mortalities occurred between 1992 and 1998.

Using more current unpublished information, no births have occurred since 1999, and four additional individuals have not been seen for at least the past four years. Therefore, the population size as of the summer of 2004 is thought to be seven whales (C. Matkin, North Gulf Oceanic Society, pers. comm.).

Minimum Population Estimate

The abundance estimate of killer whales is a direct count of individually identifiable animals. Only 11 whales were seen between 1990 and 1999. Since then, 4 of those whales have not been seen in recent years, so the minimum population estimate is 7 whales. Fourteen years of annual effort have failed to discover any whales that had not been seen previously, so there is no reason to believe there are additional whales in the population. Therefore, this minimum population estimate may be the total population size.

Current Population Trend

The population counts have declined from a level of 22 whales in 1989 to 7 whales in 2006, a decline of 68%. Most of the mortalities apparently occurred in 1989-90.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Studies of 'resident' killer whale pods in the Pacific Northwest resulted in estimated population growth rates of 2.92% and 2.54% over the period from 1973 to 1987 (Olesiuk et al. 1990, Brault and Caswell 1993). Until additional stock-specific data become available, it is recommended that the cetacean maximum theoretical net productivity rate (R_{MAX}) of 4% be employed for this stock (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

Under the 1994 reauthorized Marine Mammal Protection Act (MMPA), the potential biological removal (PBR) is defined as the product of the minimum population estimate, one-half the maximum theoretical net productivity rate, and a recovery factor: $PBR = N_{MIN} \times 0.5R_{MAX} \times F_R$. The recovery factor (F_R) for this stock is 0.5, the value for cetacean stocks with unknown population status (Wade and Angliss 1997). Thus, for the AT1 killer whale stock, $PBR = 0$ animals ($7 \times 0.02 \times 0.5$).

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

The known range of the AT1 stock is limited to waters of Prince William Sound and Kenai Fjords. There are no federally managed commercial fisheries in this area. State managed commercial fisheries prosecuted within the range of this stock, such as the Prince William Sound salmon set and drift gillnet fisheries, and various herring fisheries, are not known to incur incidental serious injuries or mortalities of AT1 killer whales.

Subsistence/Native Harvest Information

There are no reports of a subsistence harvest of killer whales in Alaska or Canada.

Other Mortality

Collisions with boats may be an occasional source of mortality. One mortality due to a ship strike occurred in 1998, when a killer whale struck the propeller of a vessel in the Bering Sea groundfish trawl fishery. There have been no known mortalities of AT1 killer whales due to ship strikes.

STATUS OF STOCK

The AT1 Transient stock of killer whales was designated as “depleted” under the MMPA. Therefore, the AT1 Transient stock of killer whales is classified as a strategic stock. Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level (0) does not exceed 10% of the PBR (0) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. At least 11 animals were alive in 1998, but it appears that as of 2006, only 7 individuals may be alive. Therefore, the AT1 group has been reduced to at least 50% (11/22) of its 1984 level, and has likely been reduced to 32% (7/22) of its 1984 level. The AT1 Transient stock of killer whales is not listed as “threatened” or “endangered” under the Endangered Species Act.

REFERENCES

- 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. *Can. J. Zool.* 66 (11):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. 1995. The abundance of cetaceans in California waters. Part I: Ship surveys in summer and fall of 1991. *Fish. Bull.*, U.S. 93:1-14.
- Barlow, J. 1997. Preliminary estimates of cetacean abundance off California, Oregon and Washington based on a 1996 ship survey and comparisons of passing and closing modes. Administrative Report LJ-97-11, Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 25 pp.
- Barrett-Lennard, L. G. 2000. Population structure and mating patterns of killer whales as revealed by DNA analysis. Doctoral thesis. Univ. British Columbia, Vancouver, BC, Canada.
- 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. Comm. 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. Comm. 32:643-646.
- Brault, S., and H. Caswell. 1993. Pod-specific demography of killer whales (*Orcinus orca*). *Ecology* 74(5):1444-1454.
- Dahlheim, M. E., D. Ellifrit, and J. Swenson. 1997. Killer Whales of Southeast Alaska: A Catalogue of Photoidentified Individuals. Day Moon Press, Seattle, WA. 82 pp. + appendices.
- Ford, J. K. B., and G. M. Ellis. 1999. Transients: Mammal-Hunting Killer Whales of British Columbia, Washington, and Southeastern Alaska. University of British Columbia Press, Vancouver, BC. 96 pp.
- 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. Comm. 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. B., G. M. Ellis, and K. C. Balcomb. 2000. Killer whales: The natural history and genealogy of *Orcinus orca* in British Columbia and Washington State. Second edition. University of British Columbia Press, Vancouver, BC, Canada.

- Forney, K. A., J. Barlow, and J. V. Carretta. 1995. The abundance of cetaceans in California waters. Part II: Aerial surveys in winter and spring of 1991 and 1992. *Fish. Bull.*, U.S. 93:15-26.
- Forney, K. A., and P. R. Wade. 2006. World-wide abundance and density of killer whales. Pp. 143-160. *In* J. A. Estes, D. P. DeMaster, D. F. Doak, T. M. Williams, and R. L. Brownell, Jr. (eds.), *Whales, Whaling, and Ocean Ecosystems*. University of California Press.
- Goley, P. D., and J. M. Straley. 1994. Attack on gray whales (*Eschrichtius robustus*) in Monterey Bay, California, by killer whales (*Orcinus orca*) previously identified in Glacier Bay, Alaska. *Can. J. Zool.* 72:1528-1530.
- Green, G. A., J. J. Brueggeman, R. A. Grotefendt, C. E. Bowlby, M. L. Bonnell, and K. C. Balcomb. 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Pp. 1-100 *In* Brueggeman, J. J. (ed.), *Oregon and Washington Marine Mammal and Seabird Surveys*. Final Rep. OCS Study MMS 91-0093.
- Heise, K., G. Ellis, and C. Matkin. 1991. A catalogue of Prince William Sound killer whales. North Gulf Oceanic Society, Homer, AK, 51 pp.
- 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.
- Hoelzel, A. R., A. Natoli, M. Dahlheim, C. Olavarria, R. Baird and N. Black. 2002. Low Worldwide genetic diversity in the killer whale (*Orcinus orca*): implications for demographic history. *Proc. Ro. Soc. London* 269: 1467-1473.
- 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., A. E. Bowles, E. Krygier, J. D. Hall, and S. Ingell. 1984. Killer whales (*Orcinus orca*) in Southeast Alaska, Prince William Sound, and Shelikof Strait: a review of available information. *Rep. Int. Whaling Comm.* 34:521-530.
- 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.
- Matkin, C. O., M. E. Dahlheim, G. Ellis, and E. Saulitis. 1993. Vital rates and pod structure of resident killer whales following the *Exxon Valdez* oil spill. *In Exxon Valdez Oil Spill Trustee Council, Exxon Valdez oil spill symposium abstract book*, February 2-5, 1993, Anchorage, Alaska, p. 303-307.
- Matkin, C. O., G. M. Ellis, M. E. Dahlheim, and J. Zeh. 1994. Status of killer whales in Prince William Sound, 1985-1992. *In* T. R. Loughlin (ed.), *Marine mammals and the Exxon Valdez*, p. 141-162. Academic Press, San Diego, CA.
- Matkin, C. O., and E. L. Saulitis. 1994. Killer whale (*Orcinus orca*) biology and management in Alaska. Report to the Marine Mammal Commission, Contract T75135023, 46 pp. (Available from Marine Mammal Commission, 1825 Connecticut Ave. NW, Washington, DC 20009).
- Matkin, C. O., G. Ellis, L. Barrett Lennard, H. Jurk, D. Sheel, and E. Saulitis. 1999a. Comprehensive killer whale investigation. *Exxon Valdez Oil Spill Restoration Project, Annual Report (Restoration Project 98012)*. North Gulf Oceanic Society, Homer, AK, 52 pp.
- Matkin, C., G. Ellis, E. Saulitis, L. Barrett-Lennard, and D. Matkin. 1999b. Killer whales of southern Alaska. North Gulf Oceanic Society, Homer, AK, 96 pp.
- Matkin, C. O., G. Ellis, L. Barrett Lennard, H. Jurk, and E. Saulitis. 2000. Photographic and acoustic monitoring of killer whales in Prince William Sound and Kenai Fjords, Alaska. *Exxon Valdez Oil Spill Restoration Project, Annual Report (Restoration Project 99012)*. North Gulf Oceanic Society, Homer, AK, v.p.
- Mitchell, E. D. 1975. Report on the meeting on small cetaceans, Montreal, April 1-11, 1974. *J. Fish. Res. Bd. Can.* 32:914-916.
- 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. Comm. Special Issue* 12:209-242.
- Saulitis, E., C. Matkin, L. Barrett-Lennard, K. Heise, and G. Ellis. 2000. Foraging strategies of sympatric killer whale (*Orcinus orca*) populations in Prince William Sound, Alaska. *Mar. Mamm. Sci.* 16(1): 94-109.
- Saulitis, E., C. O. Matkin, and F. H. Fay. 2005. Vocal repertoire and acoustic behavior of the isolated AT1 killer whale subpopulation in Southern Alaska. *Can. Jour. Zool.* 83:1015-1029.

- Wade, P. R., and R. 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.
- Zimmerman, S. T. 1991. A history of marine mammal stranding networks in Alaska, with notes on the distribution of the most commonly stranded cetacean species, 1975-1987. Pp. 43-53 *In* Reynolds, J. E. and Odell, D. K. (eds.), Marine mammal strandings in the United States: proceedings of the Second Marine Mammal Stranding Workshop; 3-5 December 1987, Miami, Florida. U.S. Dep. Comm., NOAA Tech. Rep. NMFS 98.