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KILLER WHALE (*Orcinus orca*): West Coast 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, 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 whales have been labeled as 'resident,' 'transient,' and 'offshore' type killer whales (Bigg et al. 1990, Ford et al. 2000; Dahlheim et al. 2008) 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; Dahlheim et al. 2008). 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. 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). Movements of killer whales between the waters of Southeast Alaska and central California have also been documented (Goley and Straley 1994; Black et al. 1997; Dahlheim and White 2010).

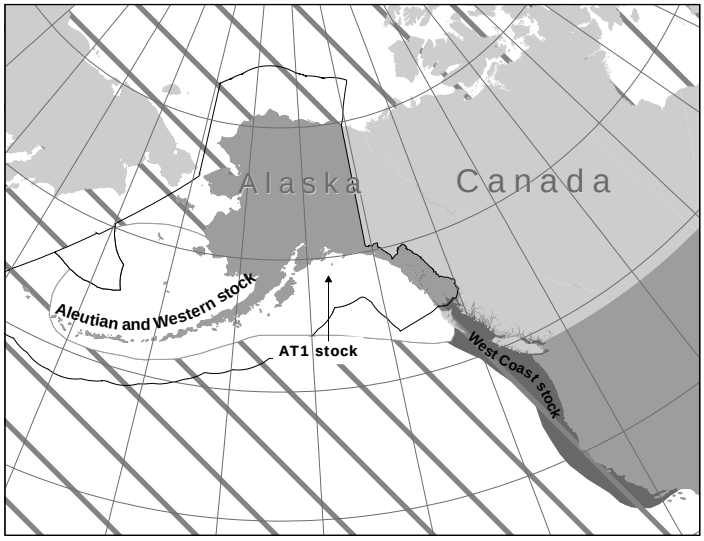

Figure 25. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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). A recent global genetic study of killer whales using the entire mitochondrial genome found that some killer whale ecotypes represent deeply divergent evolutionary lineages and warrant elevation to species or subspecies status (Morin et al. 2010). In particular, estimates from mitogenome sequence data indicate that transient killer whales diverged from all other killer whale lineages ~700,000 years ago. In light of these differences, the Society for Marine Mammalogy's Committee on Taxonomy currently recognizes the resident and transient North Pacific ecotypes as un-named *Orcinus orca* subspecies (Committee on Taxonomy 2012). In recognition of its status as an un-named subspecies or species, some researchers now refer to transient-type killer whales as Bigg's killer whales (e.g., Ford 2011; Riesch et al. 2012), in tribute to the late Dr. Michael Bigg.

Based on data regarding association patterns, acoustics, movements, and genetic differences, eight killer whale stocks are now 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 Washington State 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 southeastern Alaska 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, 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.

Until recently, transient killer whales in Alaska had only been studied intensively in Southeast 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 populations of transients which were never found in association with one another, the so-called 'Gulf of Alaska' transients and 'AT1' transients. Gulf of Alaska' transients are documented 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. Recently members of the Gulf of Alaska transient population have been seen in association with the transient killer whales that range from California to southeastern Alaska, the west coast transients, which are identified by a unique mtDNA haplotype. Recent data have identified 14 out of 217 whales considered "outer coast" transients in British Columbia as photographed in Alaskan waters and considered Gulf of Alaska transients (Ford et al. 2013). Transients within the 'Gulf of Alaska' population have been found to have two mtDNA haplotypes, neither of which is found in the west coast or AT1 populations. Members of the AT1 population share a single mtDNA haplotype. Transient killer whales from the 'west coast' stock have been found to share a single mtDNA haplotype that is not found in the other communities. Additionally, all three populations have been found to have significant differences in nuclear (microsatellite) DNA (Barrett-Lennard 2000). Acoustic differences have been found, as well, as Saulitis (1993) and Saulitis et al. 2005 described acoustic differences between 'Gulf of Alaska' transients and AT1 transients. For these reasons, 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.

Biopsy samples from the eastern Aleutians and south side of the end of the Alaska Penninsula have produced the same haplotypes as killer whales in the northern Gulf of Alaska, however nuclear DNA analysis strongly suggest they belong to a separate population (Parsons et al. in prep). Samples from the central Aleutian Islands and Bering Sea have identified mtDNA haplotypes not found in Gulf of Alaska transients, suggesting additional population structure in western Alaska. At this time, 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 observed in the northern Bering Sea and Beaufort Sea that have the physical characteristics of transient type whales, 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, Parsons et al. in prep) confirm 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.

Most of the transient whales photographed in the inland waters of Southeast Alaska share the west coast transient haplotype and have been seen in association with British Columbia/Washington State transients. Transients most often seen off California have also share the West Coast Transient (WCT) haplotype and have been observed in association with transients in Washington and British Columbia.The West Coast Transient Stock is therefore considered to include transient killer whales from California through southeastern Alaska. However, it should be noted that Fisheries and Oceans Canada recently decided to exclude whales from California from their assessment of the "West Coast Transient (WCT) Population" (DFO, 2007). They noted that 100 or so transient killer whales identified off the central coast of California (Black et al. 1997) were in the past considered to be an extension of this population because of acoustical similarities and occasional mixing with WCT individuals in BC waters (Ford and Ellis 1999), but that a recent reassessment indicated that the available evidence was insufficient to warrant inclusion of those whales in the WCT population (DFO 2009). Canadian researchers have now identified 46 individual whales in British Columbia that are known from California (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). They also noted that the Gulf of Alaska transients are seen occasionally within the range of WCTs (in southeastern Alaska and off British Columbia) but have only been observed to travel in association with WCTs on one occasion (DFO 2007, Matkin et al. 2012). For the purposes of this stock assessment report, the West Coast Transient Stock continues to include animals that occur in California, Oregon, Washington, British Columbia and southeastern Alaska.

POPULATION SIZE

The west coast transient stock is a trans-boundary stock, including killer whales from British Columbia. Preliminary analysis of photographic data resulted in the following minimum counts for 'transient' killer whales belonging to the west coast transient stock. Over the time series from 1975 to 2012, 521 individual transient killer whales have been identified. Of these, 217 are considered part of the poorly known "outer coast" subpopulation and 304 belong to the well-known "inner coast" population. However of the 304, the number of whales currently alive is not certain (see Ford et al. 2013). A recent mark-recapture estimate that does not include the "outer coast" subpopulation or whales from California for the west coast transient population resulted in an estimate of 243 (95% probability interval = 180-339) in 2006 (DFO 2009). This estimate applies to the population of west coast transient whales that occur in the inside waters of southeastern Alaska, British Columbia, and northern Washington. Given that the California transient numbers have not been updated since the publication of the catalogue in 1997 (Black et al. 1997), the total number of transient killer whales reported above should be considered as a minimum count for the west coast transient stock.

Minimum Population Estimate

The abundance estimate of killer whales is a direct count of individually identifiable animals. However, the number of cataloged whales does not necessarily represent the number of live animals. Some animals may have died, but whales can not be presumed dead if not resighted because long periods of time between sightings are common for some 'transient' animals. The connection of the outer coast whales with the west coast transient population of inshore waters is not well established, and the photographic catalogue from California has not been updated in 15 years. Estimates of the overall population size (i.e., N_{BEST}) and associated CV(N) that include the "outer coast" whales are not currently available. Thus, the minimum population estimate (N_{MIN}) for the West Coast Transient stock of killer whales is derived from the recent mark-recapture analysis for West Coast transient population whales from the inside waters of Alaska and British Columbia of 243 whales (95% probability interval = 180-339) in 2006 (DFO 2009) , which includes animals found in Canadian waters (see PBR Guidelines regarding the status of migratory trans-boundary stocks, Wade and Angliss 1997). Information on the percentage of time animals typically encountered in Canadian waters spend in U.S. waters is unknown. However, as noted above, this minimum population estimate is considered conservative. This approach is consistent with previous recommendations of the Alaska Scientific Review Group (DeMaster 1996).

Current Population Trend

Recent analyses of the inshore west coast transient population indicate that this segment grew rapidly from the mid-1970s to mid-1990s as a result of a combination of high birth rate, survival, as well as greater immigration of animals into the nearshore study area (DFO 2009). The rapid growth of the west coast transient population in the mid-1970s to mid-1990s coincided with a dramatic increase in the abundance of the whales' primary prey, harbor seals, in nearshore waters. Population growth began slowing in the mid-1990s and has continued to slow in recent years (DFO 2009). Given population estimates are based on photo identification of individuals and considered minimum estimates, no reliable estimate of trend is available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this stock of killer whales. Analyses in DFO (2009) estimated a rate of increase of about 6% per year in this population from 1975 to 2006, but this included recruitment of non-calf whales into the population, at least in the first half of the time period, interpreted as either a movement of some whales into nearshore waters from elsewhere, or from better spatial sampling coverage. The population increased at a rate of approximately 2% for the second half of the time period, when recruitment of new individuals was nearly exclusively from new-born individuals (DFO 2009). 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) and an observed growth rate of 3.1% was observed in northern resident killer whales and used in calculations of R_{MAX} for that stock. However, until additional data become available for this stock of transient type killer whales, 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 with a mortality rate CV ◂ 0.80 (Wade and Angliss 1997). Thus, for the West Coast Transient killer whale stock, PBR = 2.4 animals (243 × 0.02 × 0.5). The proportion of time that this trans-boundary stock spends in Canadian waters cannot be determined (G. Ellis, Pacific Biological Station, Canada, pers. comm.)

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an "*injury that is more likely than not to result in mortality*." Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

Fisheries Information

NMFS observers monitored the California/Oregon thresher shark/swordfish drift gillnet fishery from 1994 to 2003 (Julian 1997, Julian and Beeson 1998, Cameron and Forney 1999, Carretta 2002, Carretta and Chivers 2003, Carretta and Chivers 2004). The observed mortality in this fishery, in 1995, was a transient whale as determined by genetic testing (S. Chivers, NMFS-SWFSC, pers. comm.). Overall entanglement rates in the California/Oregon thresher shark/swordfish drift gillnet fishery dropped considerably after the 1997 implementation of a Take Reduction Plan, which included skipper education workshops and required the use of pingers and minimum 6-fathom extenders (Barlow and Cameron 1999). Because the California/Oregon thresher shark/swordfish drift gillnet fishery is observed and has not incurred incidental serious injuries or mortalities of killer whales between 1999-2003, the estimate of fishery-related take for this fishery is zero. Thus, the mean annual mortality rate for this stock is zero. Additional fisheries that could interact with the Eastern North Pacific Transient stock of killer whales are listed in Appendix 3.

The estimated minimum mortality rate incidental to recently monitored U.S. commercial fisheries is zero animals per year.

All Canadian trawl and longline fisheries are monitored by observers or video; salmon net fisheries are not observed (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). The sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. However, transient killer whales typically are not involved in these interactions. Resident killer whales are well documented to interact with the longline fishery. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Canada has a Marine Mammal Response Network to track human interaction incidents such as entanglements (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013). Since 1990, there have been no reported fishery-related strandings of killer whales in Canadian waters. In 1994, one killer whale was reported to have contacted a salmon gillnet, but it did not entangle (Guenther et al. 1995).

Subsistence/Native Harvest Information

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

Other Mortality

The shooting of killer whales in Canadian waters has been a concern in the past. However, in recent years there have been no reports of shooting incidents in Canadian waters. In fact, the likelihood of shooting incidents involving 'transient' killer whales is thought to be minimal since commercial fishermen are most likely to observe 'transients' feeding on seals or sea lions instead of interacting with their fishing gear (G. Ellis, Pacific Biological Station, Canada, pers. comm.).

Collisions with boats are another source of mortality. Killer whales interacting with trawl vessels are occasionally struck by the propeller; there were 4 incidents of mortality and serious injury in the Bering Sea/

Aleutian Islands flatfish trawl and Bering Sea/ Aleutian Islands rockfish trawl fisheries between 2007-2011. Stock identification for these occurrences is unknown; however, this area is outside of the known range for this stock. There have been no reported mortalities of killer whales from this stock due to vessel collisions.

STATUS OF STOCK

The West Coast transient killer whale stock is not designated as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. In 2001, the Committee on the Status of Endangered Wildlife in Canada designated west coast transient killer whales in British Columbia as "threatened" under the Species at Risk Act (SARA) for Canada. Human-caused mortality may have been underestimated, primarily due to a lack of information on Canadian fisheries, and that the minimum abundance estimate is considered conservative (because researchers continue to encounter new whales and provisionally classified whales from Southeast Alaska and off the coast of California were not included), resulting in a conservative PBR estimate. Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level (0) does not exceed 10% of the PBR (0.2) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (0 animals per year) does not exceed the PBR (2.4). Therefore, the West Coast Transient stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population (OSP) level are currently unknown.

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