

**KILLER WHALE (*Orcinus orca*): Eastern North Pacific
Northern Resident 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, resident type whales identified in Prince William Sound have been observed in southeastern Alaska and lower Cook Inlet. (Matkin et al. 2010) Movements of transient type 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).

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). 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.

Genetic differences have also been found between populations within the ‘transient’ and ‘resident’ ecotypes (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000). Within the resident ecotype, association data were initially used to describe three separate communities in the North Pacific (Bigg et al. 1990; Ford et al. 1994, 2000; Matkin et al. 1999). The Southern Resident population is found in summer primarily in waters of Washington state and southern British Columbia. The Northern Resident population is found in summer primarily in central and northern British Columbia. Alaska resident whales are found in marine waters of southern and southwestern Alaska. Acoustic data (Ford 1989, 1991; Yurk et al. 2002) and genetic data (Hoelzel et al. 1998, 2002; Barrett-Lennard 2000) have confirmed that these three units represent discrete populations.

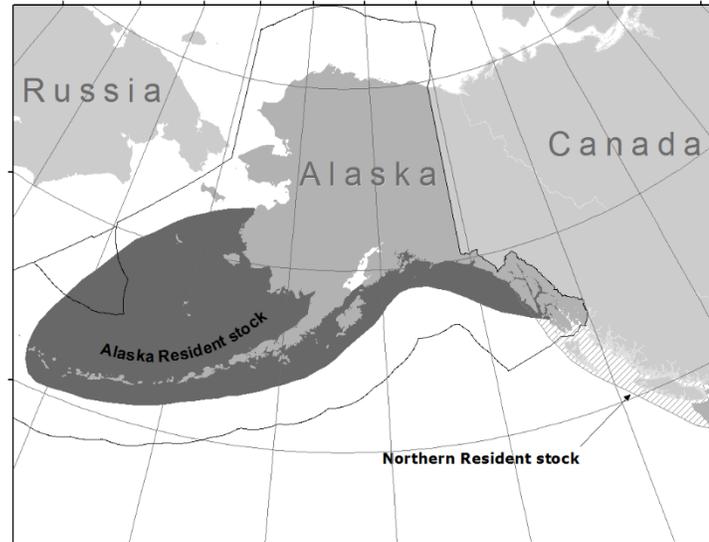


Figure 1. Approximate distribution of killer whales in the eastern North Pacific (shaded area). The distribution of the eastern North Pacific Resident and Transient stocks are largely overlapping (see text).

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.

The Eastern North Pacific Northern Resident stock is a transboundary stock, and includes killer whales that frequent British Columbia, Canada and southeastern Alaska (Dahlheim et al. 1997; Ford et al. 2000). They have been seen infrequently in Washington state waters.

POPULATION SIZE

Photo-identification studies since 1970 (Ford et al. 2000) have catalogued every individual belonging to the Eastern North Pacific Northern Resident stock (note that individual whales that have been matched between geographical regions and missing animals likely to be dead have been subtracted). In 1998, the photo catalog included 216 whales (Ford et al. 2000). The photo-identification catalogue was updated in 2011 summarizing individual identifications made between 1974 and 2010. At the conclusion of the 2010 field season, the population was composed of three clans representing a total of 261 whales (plus four missing and possibly dead). The population is twice the size it was in 1974, representing an average annual increase of 2.1% (Ellis et al. 2011).

Table 1. Numbers of animals in each pod of killer whales belonging to the Eastern North Pacific Northern Resident stock of killer whales.

| British Columbia | Ford et al. 1994 | Ford et al. 2000 | Ellis et al. 2011 |
|-------------------------|-------------------------|-------------------------|--------------------------|
| A1 | 15 | 16 | 22 |
| A4 | 11 | 11 | 16 |
| A5 | 12 | 13 | 13 |
| B1 | 9 | 7 | 6* |
| C1 | 13 | 14 | 17* |
| D1 | 7 | 12 | 12 |
| H1 | 8 | 9 | 5 |
| I1 | 10 | 8 | 18* |
| I2 | 7 | 2 | 3 |
| I18 | 19 | 16 | 24 |
| G1 | 28 | 29 | 34* |
| G12 | 11 | 13 | 16 |
| I11 | 18 | 22 | 26 |
| I31 | 10 | 12 | 10 |
| R1 | 23 | 29 | 38 |
| W1 | 3 | 3 | 1 |
| Total | 204 | 216 | 261 |

Note: * indicates that one whale may be missing/ dead

Minimum Population Estimate

The technique used for estimating abundance of killer whales is a direct count of individually identifiable animals. Other estimates of the overall population size (i.e., N_{BEST}) and associated $CV(N)$ are not currently available. Because this population has been studied for such a long time, each individual is well documented, and except for births, no new individuals are expected to be discovered. Therefore, the estimated population size of 261 animals can also serve as a minimum count of the population.

Thus, the minimum population estimate (N_{MIN}) for the Northern Resident stock of killer whales is 261 animals, which includes animals found in Canadian waters (see PBR Guidelines (Wade and Angliss 1997) regarding the status of migratory transboundary stocks). This approach is consistent with the recommendations of the Alaska Scientific Review Group (DeMaster 1996). Information on the percentage of time animals typically encountered in Canadian waters spend in U. S. waters is unknown.

Current Population Trend

From the mid 1970s to the mid 1990s, the northern resident killer whale population grew steadily at an annual rate of 2.6% (i.e., from 122 whales in 1974 to 218 in 1997). A decline was reported during the 1998 -2001 period at a rate of 7%. That period coincided with a significant reduction in Chinook salmon (Ford et al. 2010). Then after 2001, the growth was positive with the population increasing at an average rate of 3.1% per year (2001 – 2010). At the end of the 2010 field season, 261 whales were catalogued. This represents an average annual increase of 2.1% over the 36-year time series (Ellis et al. 2011).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Studies of northern ‘resident’ killer whale pods in British Columbia and Washington waters 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). Analyses of photographic data collected from 1974 through 2010 indicated a population growth from 122 individuals to 261 whales. This represents an average annual increase of 2.1% over the 36-year period (Ellis et al. 2011). The period from 2001 to 2010 was a period of maximum growth for this population when it grew at an average rate of 3.1% per year. Therefore, the maximum net productivity rate (R_{MAX}) is estimated to be 3.1% (Ellis et al. 2011, Olesiuk et al. 2005).

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: $PBR = N_{\text{MIN}} \times 0.5R_{\text{MAX}} \times F_R$. 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 Eastern North Pacific Northern Resident killer whale stock, $PBR = 1.96$ animals ($261 \times 0.015 \times 0.5$).

ANNUAL 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

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 interaction of resident killer whales with the sablefish longline fishery accounts for a large proportion of the commercial fishing/killer whale interactions in Alaska waters. Such interactions have not been reported in Canadian waters where sablefish are taken via a pot fishery. Interactions have been reported between northern resident killer whales in the British Columbia halibut longline and salmon troll fisheries (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 or bycatch 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).

Subsistence/Native Harvest Information

Killer whales are not harvested for subsistence in Alaska or Canada.

Other Mortality

Collisions of killer whales with vessels occur occasionally. One mortality of a northern resident killer whale (C21) in Prince Rupert, BC was reported in 2006 (Williams and O'Hara 2010). The shooting of killer whales in Canadian waters has been a concern in the past. However, in recent years the Canadian portion of the stock has been researched so extensively that evidence of bullet wounds would have been noticed if shooting was prevalent (G. Ellis, Pacific Biological Station, Canada, pers. comm.).

Other Issues

In U.S. waters, there is considerable interaction between killer whales and fisheries aside from incidental take. Interactions between killer whales and longline vessels, specifically predation by killer whales on sablefish catch, have been well documented (Dahlheim 1988, Yano and Dahlheim 1995, Sigler et al. 2002). In Canada, northern resident killer whales have been reported to depredate fish from both commercial salmon trollers and recreational sportfishers, as well as halibut longliners. Most reports occur in the northern half of the coast, especially Dixon Entrance, and early in the season (April to June), although some are scattered throughout the summer (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 3 December 2012).

STATUS OF STOCK

The Northern Resident 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 northern resident killer whales in British Columbia as “threatened” and listed in Schedule 1 of the Species at Risk Act (SARA) for Canada. Resident killer whales in British Columbia are considered to be at risk based on their small population size, low reproductive rate, and the existence of a variety of anthropogenic threats that have the potential to prevent recovery or to cause further declines (DFO, 2008). Monitoring of fisheries in BC over the past decade has been quite extensive and likely at the same level as in U.S. waters. No incidental killer whale mortalities from fishery interactions have been reported or observed (J. Ford, pers. comm., Department of Fisheries and Oceans, British Columbia, Canada, 30 January 2013).

Based on currently available data, the estimated annual U. S. commercial fishery-related mortality level is zero, which does not exceed 10% of the PBR (0.20) and therefore is considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury (0) is not known to exceed the PBR (2.0). Therefore, the eastern North Pacific Northern Resident stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its Optimum Sustainable Population size are currently unknown.

HABITAT CONCERNS

Ford et al. (2005) showed that a sharp drop in coast-wide Chinook salmon abundance during the late 1990s was correlated with a significant decline in resident whale survival. They noted that the whales' preference for chinook salmon is likely due to this species' relatively large size, high lipid content and, unlike other salmonids, its year-round presence in the whales' range. They further note that resident killer whales may be especially dependent on chinook during winter, when this species is the primary salmonid available in coastal waters, and the whales may be subject to nutritional stress leading to increased mortality if the quantity and/or quality of this prey resource declines.

Vessel traffic, particularly increased whale-watching activity, is another potential concern for this stock.

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