

Orcinus orca (Linnaeus, 1758)

English: Killer whale

German: Schwertwal

Spanish: Orca

French: Orque

Family: Delphinidae

1. Description

The killer whale is the largest member of the dolphin family. Maximum body lengths are 9 m in males and 7.7 m in females. Males reach 6,600 kg, whereas female maximum weight is 4,700 kg (Ford, 2009). Killer whales are recognized by their distinctive black, white and grey coloration and a white eye patch, or spot, located just above and behind the eye. Just behind the dorsal fin there is a grey saddle patch. The whale's belly, lower jaw and the underside of the tail flukes are white. The rest of the body is black. The wide, tall dorsal fin is curved backwards in females and juveniles and upright and triangular in adult males. The head is rounded, with a barely distinguishable beak. The pectoral flippers are paddle-shaped. In addition to sexual size dimorphism, male appendages, especially the dorsal fin, are disproportionately larger than in females.

According to Black et al. (1997) and Ford (2009) there are at least three recognizable ecotypes of killer whales ("Residents," "Transients," and "Offshores") in the eastern North Pacific that do not associate with members of the other groups. The ecotypes exhibit different home ranges, vocalizations, dietary preferences, foraging patterns, morphological features, and genotypes. Residents prey mostly on fish, Transients prefer marine mammals and Offshores seem to feed on both types of prey but may specialize in sharks.

In the Residents, each local "community" of pods is largely endogamous, with mating between pods within the community. The ecotypes differ in both morphology and genetics, as well as in traditions such as migratory behaviour and prey choice. The communities within the resident ecotype can differ in dialects (Rice, 1998 and refs. therein).

Recently, three visually distinct forms of killer whales were described from Antarctic waters and designated as types A, B and C (Pitman and Ensor, 2003). These broadly sympatric but at least seasonally microallopatric forms show consistent differences in prey selection and habitat preferences, morphological divergence and apparent lack of interbreeding, which is also confirmed by genetic studies. However, a relatively low level of sequence divergence indicates that these evolutionary changes occurred relatively rapidly and recently (LeDuc et al. 2008). Pitman et al. (2007) with photogrammetry confirmed that the small ice-dwelling fish-eating form (type C) has a modal length of about 5-5.5 m, much smaller than more offshore whales. However, further studies are needed to ascertain whether these small whales deserve recognition as a separate species or subspecies (Ford, 2009).

Renner and Bell (2008) observed a white adult male killer whale off Adak Island, Aleutians. An open saddle and a rounded dorsal fin tip suggest that this whale belongs to the fish-eating ("resident") ecotype. A circular scar matching a cookie-cutter shark (*Isistius* sp.) bite mark suggested that the animal originated in warmer waters.

2. Distribution

<http://www.iucnredlist.org/apps/redlist/details/15421/0/rangemap>

Distribution of Orcinus orca: this species is found in all regions of the world (map mod. from Taylor et al. 2008; © IUCN).

This is probably the most cosmopolitan of all cetaceans and can be seen in literally any marine region. *O. orca* occurs throughout all oceans and contiguous seas, from equatorial regions to the polar pack-ice zones, and may even ascend rivers. However, it is most numerous in coastal waters and cooler regions where productivity is high (Jefferson et al. 1993; Dahlheim and Heining, 1999 and refs. therein).

In the Atlantic it ranges north to Hudson Strait, Lancaster Sound, Baffin Bay, Iceland, Svalbard, Zemlya Frantsa Iosifa, and Novaya Zemlya; its range includes the Mediterranean Sea. In the Pacific it ranges north to Ostrov Vrangelya, the Chukchi Sea, and the Beaufort Sea. In the Southern Ocean, the range extends south to the shores of Australia and the Philippines, South Africa, South America and Antarctica, including the Ross Sea at 78°S (Rice, 1998).

Data from the central Pacific are scarce. Killer whales have been reported off Hawaii but do not appear to be abundant in these waters (Barlow, 2003).

3. Population size

Although the available data are far from complete, abundance estimates for the areas that have been sampled provide a minimum worldwide abundance estimate of about 50,000 killer whales (Taylor et al. 2008). There are several recent population estimates for parts of the species range. In the eastern North Pacific, these are, for the different sub-populations:

Resident stocks:

In coastal waters of the western Gulf of Alaska and the Aleutian Islands, abundance estimates of resident killer whales are 991 (95% CI = 379-2,585) and 1,587 (95% CI = 608-4,140), respectively (Zerbini et al. 2007).

The eastern North Pacific Northern Resident stock numbered 216 in 1998 (Ford et al. 2000). Sightings surveys conducted in the inshore coastal waters of the Inside Passage, between the British Columbia (BC)-Washington and the BC-Alaska borders, yielded an abundance estimate of 161 (95% CI = 45-574) northern resident killer whales (Williams and Thomas, 2007) in these waters.

The eastern North Pacific Southern Resident stock numbered 86 whales in 2007, 79 in 2001 and 99 in 1995 (Carretta et al. 2009). The population has fluctuated considerably over the past 35 years, due to a variety of reasons (Krahn et al. 2004).

Offshores:

Surveys conducted in 2001 (Barlow and Forney 2007) and 2005 (Forney 2007), estimated the total number of killer whales within 300 nmi of the coasts of California, Oregon and Washington to be 1,014 (CV= 0.29).

Transients:

Estimated transient killer whale abundance for the Gulf of Alaska and the Aleutian Islands, were 200 (95% CI = 81-488) and 251 (95% CI = 97-644) whales, respectively (Zerbini et al. 2007).

The West Coast Transient stock is a trans-boundary stock, including killer whales from British Columbia. In British Columbia and south-eastern Alaska, 219 whales were catalogued (Ford and Ellis 1999). Off the coast of California, 105 'transients' were identified (Black et al. 1997). These are the most recent estimates (Angliss and Outlaw, 2004).

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 430 (CV=0.72) killer whales (Barlow 2003).

On the Atlantic coast of the USA, the estimate of abundance for killer whales in oceanic waters of the northern Gulf of Mexico (2003 – 2004 data), was 49 (CV=0.77) (Mullin 2007).

In the North Atlantic, questionnaire surveys yielded 483-1,507 killer whales for Norwegian coastal waters (Dahlheim and Heining, 1999 and refs. therein). Sightings in the eastern North Atlantic gave rough estimates of around 3,100 killer whales for the area comprising the Norwegian and Barents Seas and Norwegian coastal waters and some 6,600 whales for Icelandic and Faroese waters (Reyes, 1991 and refs. therein).

Off the Japanese coast the estimate is 1,200 individuals north of 35°N and 700 south of 35°N (Dahlheim and Heyning, 1999 and refs. therein). Around Antarctica, the most recent estimate is 25,000 killer whales south of 60°S (Branch and Butterworth, 2001).

Locally, Poncet et al. (2002) reported a strong decline of *O. orca* in the coastal waters of Possession Island in the Southern Indian Ocean between 1988 and 2000. Williams et al. (2009) considered the conservation status of fish-eating killer whales in southern African waters to be 'vulnerable', because the populations are very small and are subject to both short- and long-term impacts from longline fisheries.

4. Biology and Behaviour

Habitat: Sightings range from the surf zone to the open sea, though usually within 800km of the shoreline. Large concentrations are sometimes found over the continental shelf. Generally, killer whales prefer deep water, but they can also be found in shallow bays, inland seas, and estuaries (but rarely in rivers). They readily enter areas of floe ice in search of prey (Carwardine, 1995). Resident killer whales in Pacific Northwest waters use regions of high relief topography along salmon migration routes, whereas transient whales forage for pinnipeds in shallow protected waters (Dahlheim and Heyning, 1999 and refs. therein). In the southwestern Atlantic Ocean, the majority of sightings per unit of effort occurred between 35° and 37° S, over depths of 200-3000 m. The presence of killer whales there coincides mainly with surface temperature fronts (Passadore et al. 2007).

Reproduction: In the Pacific Northwest, calving occurs in non-summer months, from October to March. Similarly, in the Northeast Atlantic, it occurs from late autumn to mid-winter (Jefferson et al. 1993). Gestation lasts 15 to 18 months and is first observed in females 12-14 years old. Intervals between calves average 5 years, and the reproductive life span is around 25 years long. Mean life expectancy is 50 years and longevity up to 90 years (Ford, 2009).

Schooling: Pods of resident killer whales in British Columbia and Washington represent one of the most stable societies known among non-human mammals; individuals stay in their natal pod throughout life. Differences in dialects among sympatric communities appear to help maintain community discreteness. Most pods contain 1 up to 55 whales; resident pods tend to be larger than those of transients (Jefferson et al. 1993). Social organization can be classified into communities, pods, subpods, and matrilineal groups: a community is composed of individuals that share a common range and are associated with one another; a pod is a group of individuals within a community that travel together the majority of time; a subpod is a group of individuals that temporarily fragments from its pod to travel separately; and a matrilineal group consists of individuals within a subpod that travel in very close proximity. Matrilineal groups are the basic unit of social organization, and consist of whales from 2-3 generations. Membership at each group level is typically stable for resident whales, except for births and deaths (Dahlheim and Heining, 1999 and refs. therein).

Social organisation of mammal-eating transients is less well understood. Although the basic social unit is the matriline, offspring often disperse for extended periods or permanently, and the transient matrilines are smaller than those of residents. Transient group size is often only one, reflecting the hunting specialisation of these killer whales (Ford, 2009). Baird and Dill (1996) summarize that the typical size of transient killer whale groups is consistent with the maximisation-of-energy-intake hypothesis. Larger groups may form for the occasional hunting of prey other than harbour seals, for which the optimal foraging group size is probably larger than three, and for the protection of calves and other social functions.

Food: Killer whales are generalist predators on a global scale (Ford, 2009). However, local populations can exhibit remarkable specialisations with respect to their food preferences. The best studied example is that of resident, salmon-eating killer whales off the North American west coast, which show seasonal movements synchronised to their main prey, e.g. the fattiest salmon species *Oncorhynchus tshawytscha* (Washington and British Columbia) and *O. kisutch* (off Alaska).

Mammal-eating transient killer whales live in the same area, without undergoing seasonal migrations because their main prey, harbour seals (*Phoca vitulina*), harbour porpoises (*Phocoena phocoena*) and Dall's porpoises (*Phocoenoides dalli*) are present year round. These transient whales have never been observed to eat any species of fish (Ford et al. 1998). In the eastern Aleutian Islands, Alaska, the diet of transient killer whales in spring was primarily gray whales (*Eschrichtius robustus*) and in summer primarily northern fur seals (*Callorhinus ursinus*). Steller sea lions (*Eumetopias jubatus*) did not appear to be a preferred prey or major prey item during spring and summer (Matkin et al. 2007). In the Gulf of Alaska, transient killer whales feed on Steller sea lions, but because takes are lower than previously assumed, this seems to have only a minor effect on the recovery of populations (Maniscalco et al. 2007). Chemical tracer analysis also shows that these transients feed on other prey species as well (Krahn et al. 2007).

A third ecotype, genetically distinct from the other two (Barrett-Lennard, 2000) are the so-called Offshores. They are seldom encountered in the inshore waters of Washington and British Columbia and seem to prey on fish, including halibut and sharks (Ford, 2009). Chemical tracers show that offshores consume prey species that are distinctly different from those of sympatric resident and transient killer whales. These offshores forage as far south as California (Krahn et al. 2007).

In northern Norway, killer whales feed on herring (*Clupea harengus*). They co-operatively herd herring into tight schools close to the surface. During herding and feeding, the killer

whales swim around and under a school of herring, periodically lunging at it and stunning the herring by slapping them with the underside of their flukes while completely submerged (Domenici et al. 2000). The whales prefer to search out small patches of herring in the early morning, in shallow waters and near underwater seamounts, which aids in herding their prey. Killer whales are not capable of catching these fish unless they have stunned them first with tail slaps. However, the whales have also learned to follow the fishing fleet and feed on herring that fall from the nets when the catch is being pumped in (Similae, 2005).

Icelandic killer whales have developed another strategy. They can emit a 3-s, 680-Hz call that ends 1 s before the tail slap. The frequency of the call falls within the herring audiogram, but outside that of killer whales. This call seems suited for herding the herring into tighter groups, making it possible to debilitate more fish. However, the herring are not defenceless. The school can produce a flatulent bubble net that could hinder detection by killer whale biosonar (Miller et al. 2006).

In the waters between northern Scotland and Norway, killer whales are frequently observed in the vicinity of the Scottish pelagic fleet targeting mackerel (*Scomber scombrus*) and herring. They approach the vessels during retrieval of the net, and remain there until this is completed. There is no evidence that killer whales ever become entangled in the nets (Luque et al. 2006). Killer whales are known to follow fish-processing vessels for many miles, feeding on discarded fish. In the Bering Sea, the same pod of whales was reported to follow a vessel for 31 days for approximately 1,600 km (Dahlheim and Heyning, 1999 and refs. therein).

In the Strait of Gibraltar, killer whales prey on migrating bluefin tuna *Thunnus thynnus*. Their strategy is to chase their prey for up to 30 min at a relatively high sustained speed (3.7 m/s) prior to capture, pushing medium-sized tuna (< 1,5 m long) beyond their aerobic limits until exhaustion. Larger tuna may be inaccessible to killer whales unless they use cooperative hunting techniques or benefit through depredation of fish caught on long lines, drop lines or trap nets (Guinet et al. 2007). Off southern Brazil (Secchi and Vaske, 1998; Rosa and Secchi, 2007) and in many other areas world wide, killer whales have learned to prey on fish hooked to longlines. In the Southern Ocean e.g., longline fisheries for Patagonian toothfish (*Dissostichus eleginoides*) suffer catch rate decreases of more than 50% when killer whales occur close to longline vessels (Kock et al. 2006).

Off the coast of Chubut, Argentina, killer whales attack sevengill sharks (*Notorhynchus cepedianus*). The same animals were observed to feed on pinnipeds in Peninsula Valdes. Therefore some killer whale groups in the southwestern Atlantic may regularly feed on both fish and marine mammals (Reyes et al. 2004). In New Zealand waters, killer whales were found to capture and eat thresher (*Alopias vulpinus*) and smooth-hammer-head (*Sphyrna zygaena*) sharks; ten species of elasmobranchs are now recorded as prey for this population (Visser 2005).

In Antarctic type “C” killer whale populations profiles of individual chemical tracers are consistent with a fish diet (Krahn et al. 2008). While type “B” killer whales feed on pinnipeds in loose pack-ice, the larger type “A” killer whales are open water marine mammal hunters specialising on minke whales (*Balaenoptera bonaerensis*) (Pitman and Ensor, 2003).

Mehta et al. (2007) suggested that most killer whale attacks on baleen whales target young animals, probably calves on their first migration from low-latitude breeding and calving areas to high-latitude feeding grounds. Their results imply that adult baleen whales are not an important prey source for killer whales in high latitudes.

5. Migration

Based on photo-identification studies, year-round and seasonal occurrences are recorded for the waterways of British Columbia and Washington State, where pods are known to range approximately 370 nautical miles (Reyes, 1991). However, numerous individual whales and/or pods have also been documented to move between Puget Sound (Washington)/British Columbia and southeastern Alaska; between southeastern Alaska and Prince William Sound; and between Prince William Sound and Kodiak Island. On an international level, whale movements from Alaska (USA) and British Columbia (Canada) to California (USA), from California to Mexico, and from Mexico to Peru have been documented. In most geographical regions, killer whale movements may be related to movements of their prey. Orcas may travel 125–200 km per day while foraging (Dahlheim and Heyning, 1999 and refs. therein; Guerrero-Ruiz et al. 1998).

In the Beaufort, Chukchi and northern Bering Seas, killer whales move south with the advancing pack ice, performing long-range movements. Similar movements are reported for the western North Atlantic. Killer whales approach the Chukotka coasts in June and leave the area in November or even as late as December (Reyes, 1991 and refs. therein).

Killer whales present in off-shore Norwegian waters appear to arrive there from Icelandic waters, following the migration of herring. Similae and Christensen (1992) photoidentified killer whales around the Lofoten and Vesteralen Islands northern Norway during fall-winter (October-February) and summer (June-August) in 1990 and 1991. Based on a capture-recapture estimate, they determined that about 500 killer whales are present in these overwintering areas of the herring. Most of the whales leave the study area in January when herring migrate to the spawning grounds 700 km farther south (Similae et al. 2002). Based on the seasonal distribution, killer whale groups can be divided into three different types; whales present in fall-winter (25 groups), whales present both in fall and summer (12 groups) and whales present in summer (six groups).

In Northern Patagonia the seasonal distribution of killer whales is correlated with the distribution of South American sea lions (*Otaria byronia*) and southern elephant seals (*Mirounga leonina*). Most encounters with the whales at Punta Norte occurred in December and March-May, during the sea lions' breeding cycle. Whales depart the area in May when pinnipeds migrate to winter rookeries. One pod, Patagonia Norte B (PNB) was photographed in Golfo San José on 9 January 1986 and in Punta Norte 1 day later, some 60 km distant (Iniguez, 2001).

Evidence of seasonality is also observed in the southern part of the northeastern Atlantic. In the southern hemisphere, killer whales are found in warm waters in winter and migrate into high latitudes in the summer. This migration appears to be related to the migration of prey species, in particular the Antarctic minke whale (Reyes, 1991 and refs. therein). However, Gill and Thiele (1997) reported sighting killer whales in Antarctic sea ice in August, i.e. in late winter, indicating that some individuals may be resident year-round.

Transient whales appear to cover a more extensive range than residents. A distance traversed of over 2,600 km (California to Alaska) was reported for a transient group of three individuals photographed in Monterey Bay, California, that had previously been identified off Alaska. (Forney and Barlow 1998). However, Californian killer whales may also move to the southern hemisphere. Guerrero et al (2005) reported photo-identifying a male killer whale in Magdalena Bay, Baja California, Mexico in 1988, in La Paz Bay in 1994 and finally ca. 148

km off Pucusana, Peru in 2001. The minimum distance between these sites is 5,500 km, extending the known maximum range that killer whales are able to travel, and raising questions in relation to population structure and interactions.

6. Threats

Direct catch: Killer whales have been exploited at low levels in several regions world-wide (Jefferson et al. 1993). Norwegian whalers in the eastern North Atlantic took an average of 56 whales per year from 1938 to 1981. The Japanese took an average of 43 whales per year along their coastal waters from 1946 to 1981. The Soviets, whaling primarily in the Antarctic, took an average of 26 animals annually from 1935 to 1979, but took 916 animals in the 1979/80 Antarctic season (Dahlheim and Heyning, 1999 and refs. therein; Reyes, 1991).

After 1976, Iceland was involved in live-captures of killer whales for export. During the period 1976–1988, 59 whales were collected, of which 8 were released, 3 died and 48 (an average 3.7 per year) were exported (Reyes, 1991 and ref. therein). In 1991, the Icelandic Government announced that after expiry of existing permits for live capture, no new ones would be issued (Jefferson et al. 1993). Live-captures of killer whales have also taken place in Japanese waters (Reyes, 1991 and ref. therein). Because individuals play various roles in maintaining social integrity of mammalian populations, not all individuals are equal, and historic live-captures are likely to have broken matriline networks into isolated groups (Williams and Lusseau, 2006). Killer whales are still taken in small numbers in coastal fisheries off Japan, Greenland, Indonesia and the Caribbean Islands (Reeves et al. 2003).

Incidental catch: Incidental takes during fishing operations occur but are considered rare (Dahlheim and Heyning, 1999 and refs. therein). Baker et al. (2006) reported on the results of molecular monitoring of 'whalemeat' markets in the Republic of (South) Korea based on nine systematic surveys from February 2003 to February 2005, which revealed meat from killer whales. In southern Brazil, killer whales prey on longline-caught tuna (*Thunnus* spp.) and swordfish (*Xiphias gladius*), and cetacean by-catch is an issue in these fisheries (Rosa and Secchi, 2007).

Culling: Fishermen in many areas see killer whales as competitors, and shooting of whales is known to occur. This problem has been especially serious in Alaska, where conflicts with longline fisheries occur (Jefferson et al. 1993). Although much reduced, some such persecution continues today in Alaska and in the Strait of Gibraltar (Ford, 2009).

Pollution: High levels of PCBs and DDT (250 ppm and 640 ppm, respectively) were reported in the blubber of an adult male transient killer whale in Washington State and 38ppm PCB and 59ppm DDE wet weight levels in a resident male (Dahlheim and Heyning, 1999 and refs. therein). Ross et al. (2000) reported that total PCB concentrations were surprisingly high in three killer whales communities (2 resident and 1 transient population) frequenting the coastal waters of British Columbia, Canada. Transient killer whales were particularly contaminated. Toxic equivalents in most killer whales surpassed adverse effects levels established for harbour seals, suggesting that the majority of free-ranging killer whales in this region are at risk from toxic effects. The southern resident and transient killer whales of British Columbia can be considered among the most contaminated cetaceans in the world (Ross et al. 2000). Estimated concentrations in both the northern and the more contaminated southern resident populations have declined gradually in recent years. Projections suggest that the northern resident population could largely fall below health effects threshold concentrations by 2030 while the endangered southern residents may not do so until at least 2063 (Hickie et al. 2007).

Recent studies from other parts of the world have produced similar results. Killer whales in northern Norway are among the most polluted arctic animals. Average total polychlorinated biphenyl (PCB) and pesticide levels were similar, approximately 25 µg/g lipid, and polybrominated diphenyl ethers (PBDEs) were approximately 0.5 µg/g, exceeding the already very high levels in polar bears. The levels in Norwegian killer whales are more than 20 times higher than those found in beluga whales (*Delphinapterus leucas*) (Wolkers et al. 2007).

In eastern Hokkaido, Japan DDTs were the predominant contaminants, with concentrations ranging from 28 to 220 µg/g on a lipid-weight basis, followed by PCBs and other organochlorine pesticides. Japanese killer whales also had high hepatic residue levels of butyltins (from 13 to 770 ng/g wet weight) reflecting their extensive use as antifouling paint (Kajiwara et al. 2006).

Noise pollution:

Killer whales use sound for echolocation, social communication, and passive listening. Anthropogenic noise including sonar, acoustic harassment devices, vessel traffic, and construction noise has the potential to interfere with bioacoustics. In the northwestern USA, the endangered Southern Resident killer whales are suffering from noise pollution in their environment (Holt, 2008).

From a sound propagation and impact model, Erbe (2002) deduced that fast boats are audible to killer whales for over 16km, mask killer whale calls over 14 km, elicit a behavioral response over 200m, and cause a temporary threshold shift (TTS) in hearing of 5 dB after 30-50 min within 450m. For boats cruising at slow speeds, the predicted ranges were 1km for audibility and masking, 50m for behavioral responses, and 20 m for TTS. Superposed noise levels of a number of boats circulating around or following the whales were close to the critical level assumed to cause a permanent hearing loss over prolonged exposure. From a study on the effects of acoustic harassment devices, Morton and Symonds (2002) deduced that whale displacement resulted from the deliberate introduction of noise into their environment.

Williams et al. (2002) investigated whether the current guidelines for whalewatchers are sufficient to minimise disturbance to northern resident killer whales in Johnstone Strait, British Columbia, Canada. Local guidelines request that boaters approach whales no closer than 100m. Additionally, boaters are requested not to speed up when close to whales in order to place their boat in a whale's predicted path: a practice known as "leapfrogging". Williams et al. (2002) found that leapfrogging is a disruptive style of whalewatching and should be discouraged; as the experimental boat increased speed to overtake the whale's path, the source level of engine noise increased by 14-dB. Assuming a standard spherical transmission loss model, the fast-moving boat would need to be 500m from the whale for the received sound level to be the same as that received from a slow-moving boat at 100m. Whale-watching guidelines should therefore encourage boaters to slow down around whales and not to resume full speed while whales are within 500m.

Habitat degradation: Habitat disturbance may be a matter for concern in areas inhabited by killer whales and supporting whale-watching industries (Reyes, 1991). Visser (1999) e.g. reports on propeller scars observed on killer whales and their possible cause of mortality. Vessel traffic may have contributed to southern resident killer whales becoming endangered. Lusseau et al. (2008) observed a reduction in time spent foraging, confirming an effect also previously observed in northern resident killer whales. Each school was within 400 m of a vessel most of the time during daylight hours from May through September. If reduced

foraging effort results in reduced prey capture, this would result in decreased energy acquisition and biological fitness (Lusseau et al. 2008).

After the 1989 'Exxon Valdez' oil spill in Alaska, the resident AB Pod and the transient AT1 group suffered losses of 33 and 41%, respectively, in the year following the spill. By 2005, AB Pod had not recovered to pre-spill numbers. Moreover, its rate of increase was significantly less than that of other resident pods that did not decline at the time of the spill. The AT1 Group, which lost 9 members following the spill, continued to decline and is now listed as depleted under the U.S. Marine Mammal Protection Act (Matkin et al. 2008).

Overfishing: Some populations of killer whales could be affected by reduction of their food supply. For example, coastal Norwegian populations reportedly feed mainly upon herring, a fish heavily exploited in the area (Reyes, 1991 and refs. therein). In Alaska, anthropogenic effects on the ecosystem are thought by some to be responsible for killer whale predation on sea-otters and associated ecological implications (Estes et al. 1998). In British Columbia, Canada, and Washington State, US, salmon stocks have significantly declined as an effect of overfishing, habitat degradation and reduced ocean survival. This is likely to affect fish-eating resident killer whales in that area (Ford, 2009).

Other factors: In the southern Indian Ocean, the strong decline reported by Poncelet et al. (2002) for the coastal waters of Possession Island between 1988 and 2000 may be attributed to several factors: i) a low and decreasing fecundity, possibly impacted by a density dependence (Allee effect); ii) the decline of the main preys (large baleen whales due to past whaling and southern elephant seals (*Mirounga leonina*) from the 1970 to 1990 which remained in low numbers up to at least 1997; iii) the possible mortality induced by recent interactions with the Patagonian toothfish (*Dissostichus eleginoides*) longline fishery; and iv) the possible dispersion of individuals or groups from coastal waters. A preliminary toxicological study indicates that PCB levels are considerably lower than in British Columbia transients, however the burdens are not negligible (Ross, pers. com.) and the effects of PCBs on health at the observed concentrations are unknown. Poncelet et al. (2002) feared that the killer whales of Possession Island might disappear, losing unique genetic diversity and social culture, like AT1 transients in Alaska.

7. Remarks

Range states (Taylor et al. 2008) :

Albania; Algeria; American Samoa; Anguilla; Antarctica; Antigua and Barbuda; Argentina; Aruba; Australia; Bahamas; Bangladesh; Barbados; Belize; Benin; Bermuda; Brazil; British Indian Ocean Territory; Brunei Darussalam; Cambodia; Cameroon; Canada (Newfoundland); Cape Verde; Cayman Islands; Chile; China; Cocos (Keeling) Islands; Colombia; Comoros; Congo; Congo, The Democratic Republic of the; Cook Islands; Costa Rica; Côte d'Ivoire; Cuba; Denmark; Djibouti; Dominica; Dominican Republic; Ecuador (Galápagos); El Salvador; Equatorial Guinea; Falkland Islands (Malvinas); Faroe Islands; Fiji; France; French Guiana; French Polynesia; French Southern Territories (the) (Kerguelen); Gabon; Gambia; Ghana; Gibraltar; Greenland; Grenada; Guadeloupe; Guam; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Heard Island and McDonald Islands; Honduras; Iceland; India; Indonesia; Iran, Islamic Republic of; Ireland; Israel; Italy; Jamaica; Japan; Kenya; Kiribati; Liberia; Madagascar; Malaysia; Maldives; Marshall Islands; Martinique; Mauritania; Mexico; Micronesia, Federated States of; Monaco; Morocco; Mozambique; Myanmar; Namibia; Nauru; Netherlands; Netherlands Antilles; New Caledonia; New Zealand; Nicaragua; Nigeria;

Niue; Northern Mariana Islands; Norway; Oman; Pakistan; Palau; Panama; Papua New Guinea; Peru; Philippines; Pitcairn; Portugal; Puerto Rico; Russian Federation; Saint Helena; Saint Kitts and Nevis; Saint Lucia; Saint Pierre and Miquelon; Saint Vincent and the Grenadines; Samoa; Senegal; Sierra Leone; Singapore; Solomon Islands; Somalia; South Africa; South Georgia and the South Sandwich Islands; Spain; Sri Lanka; Suriname; Svalbard and Jan Mayen; Taiwan, Province of China; Tanzania, United Republic of; Thailand; Timor-Leste; Togo; Tonga; Trinidad and Tobago; Tunisia; United Arab Emirates; United Kingdom; USA (including Aleutian Is., Hawaiian Is.); USA Minor Outlying Islands; Uruguay; Vanuatu; Venezuela; Viet Nam; Virgin Islands, British; Virgin Islands, U.S.; Wallis and Futuna; Western Sahara; Yemen

Orcinus orca is listed in Appendix II of CITES and in Appendix II of CMS. The species is categorised as "Data Deficient" by the IUCN. Some regional populations are small or highly specialised and may be threatened by habitat deterioration. This is the case in the critically threatened small Strait of Gibraltar population, which suffers declines in numbers and prey availability; as well as in the southern resident community of Washington and British Columbia, which is listed as Endangered under the US Endangered Species Act and the Canada Species at Risk Act (Ford, 2009).

8. Sources

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