

A summary of interactions between orca (*Orcinus orca*) and other cetaceans in New Zealand waters

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Abstract

Interactions between orca (*Orcinus orca*) and other species of cetaceans in New Zealand waters are presented, involving six species, over a 36 year period. Forty four published ($n = 15$) and previously unpublished ($n = 29$) accounts are reviewed. The first Southern hemisphere accounts of orca attacking common dolphins (*Delphinus delphis*) are presented. Details are given of a dead sperm whale (*Physeter macrocephalus*) which had been attacked by orca.

Keywords: *Orcinus orca* - *Delphinus delphis* - *Tursiops truncatus* - *Lagenorhynchus obscurus* - *Physeter macrocephalus* - New Zealand - attack - interactions

Introduction

Orca have been reported hunting, attacking and eating a wide range of marine mammals (see Hoyt 1984, Jefferson *et al.* 1991 for reviews). Both large and small species of cetaceans are targeted, including the largest baleen whale, the blue (Cotton 1944, Tarpay 1979), and the largest toothed whale, the sperm (Best *et al.* 1984, Arnborn *et al.* 1987, Arnborn & Whitehead 1989).

In New Zealand orca forage on the benthos whilst hunting for rays (Visser 1999), or they target pelagic and reef fish (Visser unpub. data). Observations of orca attacking marine mammals in New Zealand are rare. To date there have been no reports of either pinniped species, New Zealand fur seal (Bonner 1981) or Hookers sea lion (Walker & Ling 1981) being taken.

Published records of attacks by orca on cetaceans in New Zealand waters are limited to 15 accounts in 8 documents (summarised in Table 1). This paper presents 29 further inci-

dents involving orca and other cetaceans in New Zealand waters. The first reports from the Southern hemisphere, of orca attacking common dolphins are presented. Also included is the first evidence of predation by orca on sperm whales in New Zealand.

Study Area And Methods

The observations reported here were collected as part of a long-term study (on-going since December 1992) of the orca population around New Zealand. All interactions occurred within 12 nautical miles of the coast.

Results

Forty four interactions between orca and six other species of cetaceans in New Zealand waters have been recorded from various sources, over a 36 year period. These interactions have ranged from no reaction by either prey or predator through to attacks where kills were recorded.

Non-predatory interactions

Non-predatory interactions between orca and other species of cetaceans have been recorded for four species: common, bottlenose and dusky dolphins, and sperm whales (Table 1), with non-predatory interactions between orca and dusky dolphins being the most common ($n=6$, Table 1).

Predatory interactions

Attacks by orca have been observed on most small cetacean species found around New Zealand. Notable exceptions are Hector's dolphins and southern right whale dolphins, despite orca being regularly sighted in areas that these species inhabit. Attacks on larger species of whale, such as humpback and sperm whales have also been reported (Table 1).

Attacks on common dolphin. The first Southern hemisphere accounts of orca attacking common dolphin are reported (Table 1 and Figure 1). Four accounts refer to either chases or attacks on common dolphins (Table 1) where two record the taking of dolphins (Table 1, #2 & #4). During account #6 (Table 1) the author approached three orca who were already pursuing a single common dolphin. After a chase of more than 17 min (Figure 1) the dolphin escaped and although a large group of the same species (approximately 100) were 2.5 km from the orca, no other dolphins were pursued.

Beach-cast sperm whale. On 22 December 1992, a dead female (9.84 m) sperm whale was found beach-cast (assumed washed up dead) near Tuatane Stream, Cape Turnagain (Lat 40° 60' S, Long 174° 50' E), on the southeast coast of the North Island. The animal was bleeding profusely from the mouth and the carcass was covered with parallel teeth rake marks. In addition, the tail flukes, pectoral fins, dorsal fin and cheeks had been extensively bitten and heavily lacerated by teeth rake marks (Figures 2 & 3). It was assumed to have been attacked by orca (Table 1 #41).

C. Duffy and H. Rook (Department of Conservation) boned out the skeleton (Mus. New

Zealand, Wellington, specimen NMNZ 2140). The chest cavity was full of blood and there was extensive bruising of the soft tissues around the neck, jaw and ribs. There was a large amount of blood in the abdominal cavity, but no internal organs were obviously damaged. The teeth marks on the whale were in parallel rows of three to five rake marks (Figure 4).

Discussion

Jefferson *et al.* (1991) reported interactions between orca and other species of cetaceans which can be classified into non-predatory and predatory interactions. Both types of interactions have been observed in New Zealand waters.

Non-Predatory interactions

In New Zealand waters at least 15 non-predatory interactions have been recorded. Attacks however, are much more spectacular and therefore more likely to be reported than non-predatory interactions. Of the non-predatory interactions, five types are described here: flight responses, movement into 'safe areas', movement towards orca, forming of groups and no response by either group.

Flight responses. Flight responses are the most common non-predator interactions reported in New Zealand and have been seen for common, bottlenose and dusky dolphins and sperm whales (Table 1). It should be noted that flight responses may occur in other situations, whether there are orca present or not (Schneider *et al.* 1998).

Movements into 'safe' areas. Movements of potential prey into 'safe' areas (usually closer into shore, or ice packs) to avoid detection by orca has been observed overseas for dusky dolphins (Würsig & Würsig 1980), bowhead whales (Mitchell & Reeves 1982), and beluga whales (Frost *et al.* 1992). In New Zealand dusky dolphins (Cipriano 1992) and common dolphins (pers. obs. Table 1, #1), have been observed moving closer to shore when orca are present.

Table 1 Summary of interactions between orca and other cetaceans in New Zealand waters.

| # | Date | Location | Details | Species | No. of orca | Source |
|----|------------|---|---|--------------------------------|-------------|---------------------------------|
| 1 | 28 Feb 93 | Kaikoura | 4 dolphins in amongst rocks near launching ramp, whilst orca in area. | <i>Delphinus delphis</i> | 8 | author |
| 2 | 12 Mar 94 | 'middle ground', Bay of Islands | dolphins attacked, at least one taken, calves present. | <i>Delphinus delphis</i> | not known | S. Whitehouse (pers. comm.) |
| 3 | 17 Aug 94 | 'inside passage', Bay of Islands | dolphins associated in close proximity to and within group of orca, no signs of predation or aggravation, remained with orca for approximately one hour. | <i>Delphinus delphis</i> | 12 | author |
| 4 | 1995 | 6 miles off Waikawa Point, Te Kaha | dolphins suddenly moved off, adult male orca hit dolphin from below, throwing it out of the water and grabbed it and took it underwater. | <i>Delphinus delphis</i> | 10 | P. Hamer (pers. comm.) |
| 5 | 18 Sep 95 | 'middle ground', Bay of Islands | orca chased large group of dolphins, but were not seen to catch any. | <i>Delphinus delphis</i> | 12 | T. Boulton (pers. comm.) |
| 6 | 23 July 97 | Poor Knights Islands | three orca attacked single dolphin, (group of approx 100, one mile to north), adult male orca seen to 'head butt' dolphin clear of water, all 3 orca took turns fast chasing, dolphin escaped (Figure 1). | <i>Delphinus delphis</i> | 3 | author |
| 7 | 30 Jan 94 | Cape Brett, Bay of Islands | orca travelling fast, came across group of fast travelling dolphins and caught at least one. | <i>Tursiops truncatus</i> | 6 | J. Whitehorn (pers. comm.) |
| 8 | 11 Sep 94 | 'inside passage', Bay of Islands | dolphins observed about 500 m from orca, when orca approached to within 400 m, dolphins began rapid porpoising away, no change in behaviour of orca. | <i>Tursiops truncatus</i> | 9 | author |
| 9 | 2 Jun 96 | Queen Charlotte Sound, Marlborough Sounds | orca reported on radio heading in direction of dolphins, dolphins came around corner of bay, fled in tight group out of bay. | <i>Tursiops truncatus</i> | 8 | L. & Z. Battersby (pers. comm.) |
| 10 | 10 Dec 86 | Otago coastal waters | orca were approached by boat, five dolphins were following the orca closely, dolphins came to bow ride, as did one orca. | <i>Lagenorhynchus obscurus</i> | 5+ | Hawke 1989 |
| 11 | Jan 1990 | Kaikoura | as boat approached group of dolphins group of five orca in wake of boat rushed out and bit off tails of three dolphins, water red from blood. | <i>Lagenorhynchus obscurus</i> | 5 | H. Posa (pers. comm.) |
| 12 | Jan 1990 | Kaikoura | group of dolphins divided, many with small calves went into shore, others headed out to sea, met group of five orca, three dolphins killed, one grabbed by adult male orca in mid air. | <i>Lagenorhynchus obscurus</i> | 5 | H. Posa (pers. comm.) |
| 13 | pre 1991 | Kaikoura | female orca seen approaching a carcass of dolphin (attack or kill not observed). | <i>Lagenorhynchus obscurus</i> | 1 | Todd 1991 |

| # | Date | Location | Details | Species | No. of orca | Source |
|----|-----------|----------|---|--------------------------------|-------------|--|
| 14 | pre 1992 | Kaikoura | move toward shore by dolphins when orca in area. | <i>Lagenorhynchus obscurus</i> | not stated | Cipriano 1992 |
| 15 | Nov 93 | Kaikoura | people swimming with group of 15 dolphins, orca rushed through swimmers and dolphins, who scattered, orca pursued, no catches made. | <i>Lagenorhynchus obscurus</i> | | H. Posa (pers. comm.) |
| 16 | Feb 94 | Kaikoura | orca amongst group of dolphins, no reactions visible. | <i>Lagenorhynchus obscurus</i> | 20 | H. Posa (pers. comm.) |
| 17 | 13 Nov 94 | Kaikoura | dolphins were observed to bow ride in front of orca (Figure 5). | <i>Lagenorhynchus obscurus</i> | . | S. Dawson (pers. comm.) |
| 18 | 16 Jan 96 | Kaikoura | when orca arrived dolphins initially scattered, then came back and stayed nearby, no adult male orca seen. | <i>Lagenorhynchus obscurus</i> | 5 | S. Yin (pers. comm.) |
| 19 | 28 Jun 96 | Kaikoura | two small scattered groups of dolphins, no avoidance behaviour by dolphins. | <i>Lagenorhynchus obscurus</i> | 8 | E. Slooten & S. Dawson (pers. comm.) |
| 20 | 4 Nov 96 | Kaikoura | two kills and another two chases of dolphins, by four orca. | <i>Lagenorhynchus obscurus</i> | 4 | Constantine & D. Buurman in (Constantine <i>et al.</i> 1998) |
| 21 | 9 Nov 96 | Kaikoura | one kill of a dolphin by one of four orca. | <i>Lagenorhynchus obscurus</i> | 4 | B. McFadden in (Constantine <i>et al.</i> 1998) |
| 22 | 11 Nov 96 | Kaikoura | one kill of a dolphin and another chase by three of the four orca. | <i>Lagenorhynchus obscurus</i> | 4 | R. Buurman in (Constantine <i>et al.</i> 1998) |
| 23 | 14 Nov 96 | Kaikoura | herding of dolphins, three kills of dolphins, involving four orca. | <i>Lagenorhynchus obscurus</i> | 4 | author & R. Baird in (Constantine <i>et al.</i> 1998) |
| 24 | 22 Nov 96 | Kaikoura | one adult male orca chases single dolphin in tight circle, dolphin accelerates and escapes, filmed from a helicopter. | <i>Lagenorhynchus obscurus</i> | 1 | author & TVNZ film crew |
| 25 | 25 Nov 96 | Kaikoura | orca passed group of dolphins, no apparent reaction by either group. | <i>Lagenorhynchus obscurus</i> | 5 | author |
| 27 | 4 Jan 97 | Kaikoura | orca pass group of dolphins which flee in fast 'run', no visible reaction from the orca. | <i>Lagenorhynchus obscurus</i> | 5 | author |
| 28 | 2-Mar 97 | Kaikoura | dolphins moving away fast from path of orca, no visible reaction from the orca. | <i>Lagenorhynchus obscurus</i> | 2 | R. Buurman (pers. comm.) |
| 29 | 29 Mar 97 | Kaikoura | orca chasing dolphins, two killed. | <i>Lagenorhynchus obscurus</i> | 4 | S. Yin (pers. comm.) |
| 30 | 2 Apr 97 | Kaikoura | one adult male orca came from underneath a group dolphins and took one, both left the water in rush, one female orca took a juvenile dolphin. | <i>Lagenorhynchus obscurus</i> | 4 | L. Baxter (pers. comm.) |

| # | Date | Location | Details | Species | No. of orca | Source |
|----|-----------|--|--|--|-------------|---|
| 31 | Nov 64 | off Napier | orca rounded up the dolphins into a tight group, three or four orca entered the group killed "some", the unhurt dolphins left, water red with blood. | not stated (called them 'dolphins') | 3 or 4 | Robson 1979 |
| 32 | 25 Sep 75 | Waitemata Harbour | orca seen swimming with dolphins, no reactions from either group. | not stated | 9 | Project Jonah Whale Rescue Group records (# 258) |
| 33 | 8 Jun 76 | 30 miles South East of Chatham Islands | seen with 100 dolphins, no further comments. | not stated | not stated | Project Jonah Whale Rescue Group records (# 368) |
| 34 | 21 Jan 77 | Waikanae, west coast of Wellington | seen with 30 dolphins, no further comments. | not stated | 5 | Project Jonah Whale Rescue Group records (# 370) |
| 35 | Dec 66 | Flat Rock, Mahia, Hawkes Bay | orca attacked "blackfish", two orca cornered a "blackfish" and ate it. | 'blackfish' possibly <i>Globicephala melas</i> | 6 | Evening Post, 5 Dec 66 |
| 36 | Dec 61 | North Cape | orca seen to attack a humpback, orca 'jumped' onto head and tail of humpback. | <i>Megaptera novaeangliae</i> | 3 | Evening Post, 29 Dec 1961 |
| 37 | 1961 | New Zealand | killer whales harassing a wounded sperm whale. | <i>Physeter macrocephalus</i> | not stated | Gaskin 1972 |
| 38 | June 90 | Kaikoura | adult male sperm whale known as 'Hoon' surfaced & spy-hopped, turning 360°, moved next to whale watch boat, then dived. Orca reported 1 mile away on radio. | <i>Physeter macrocephalus</i> | 12 | R. Oliver (pers. comm.) |
| 39 | April 92 | Kaikoura | orca passing through area, group of 5 sperm whales gathered together and sunk just below surface, then exhaled large bubbles below surface. | <i>Physeter macrocephalus</i> | | H. Posa (pers. comm.) |
| 40 | Dec-92 | Kaikoura | sperm whales 'raft up' and move off shore at the surface at approximately 5 knts. | <i>Physeter macrocephalus</i> | 5 | R. Oliver (pers. comm.). |
| 41 | 22 Dec 92 | Tuatane Stream, Cape Turnagain | beach-cast (freshly dead) female sperm whale, bitten on cheeks, flukes and pectoral fins, teeth rake marks on rest of body. Figures 2, 3, and 4. | <i>Physeter macrocephalus</i> | not known | H. Rook & C. Duffy (pers. comm.), & this report |
| 42 | 28 Feb 93 | Kaikoura | adult male sperm whale tail lobbed for over 1 1/2 hours, orca known to be in area, moving north at approx 15 knts, other sperm whales came to surface and formed group, crowded around whale watch boat. | <i>Physeter macrocephalus</i> | 5 | author |
| 43 | 29 Dec 94 | Kaikoura | orca passed through area where sperm whales were present, no visible reaction from sperm whales on surface (passed within 500 m of one sperm whale). | <i>Physeter macrocephalus</i> | 5 | author |
| 44 | 30 Dec 94 | Kaikoura | one juvenile orca bowriding on pressure wave of adult sperm whale. | <i>Physeter macrocephalus</i> | 1 | B. Würsig (pers. comm.) & (Constantine et al. 1998) |



Figure 1 Adult male orca chasing a common dolphin (*Delphinus delphis*) which escaped (photo by author).



Figure 2 Wounded tail flukes of dead sperm whale (*Physeter macrocephalus*)(photo by Hans Rook).

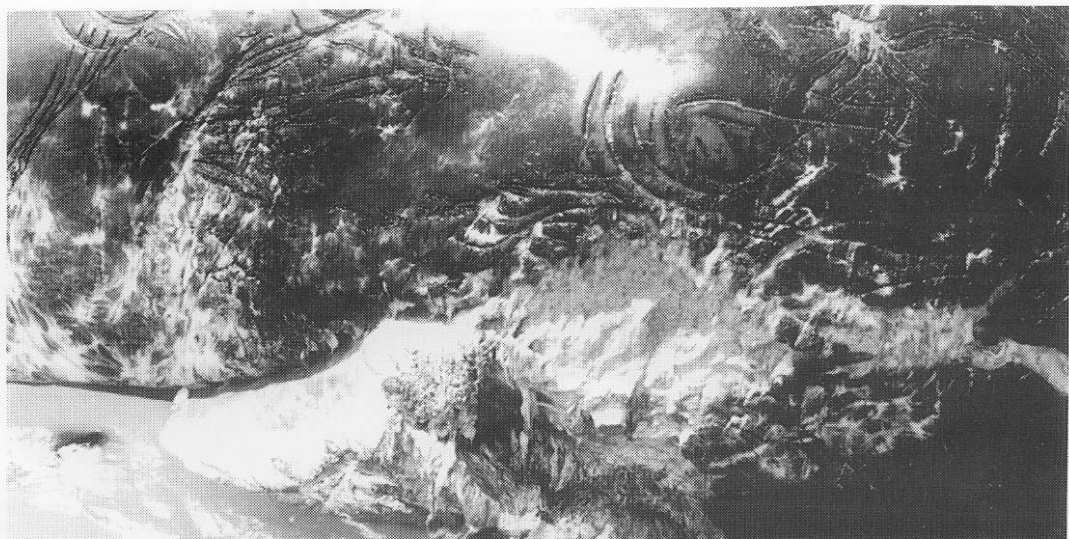


Figure 3 Extensively bitten cheek area of dead sperm whale. As the jaw is buried in the sand only the tip of one tooth can be seen protruding (photo by Hans Rook).

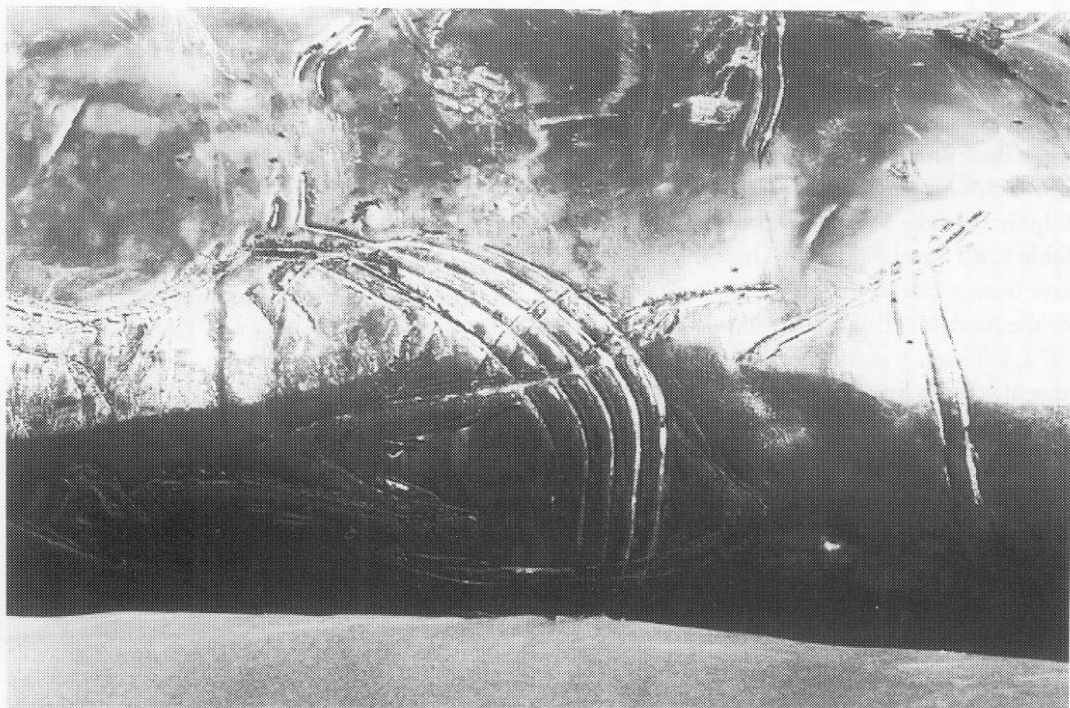


Figure 4 Teeth marks on a dead sperm whale, in parallel row of three to five rake marks (photo by Hans Rook).



Figure 5 Dusky dolphins (*Lagenorhynchus obscurus*) which had moved towards orca and remained in their proximity (photo by Steve Dawson).

Movement towards orca. In New Zealand, movement of cetaceans towards orca and remaining in their proximity has been observed for common dolphin (pers. obs., Table 1, #3) and dusky dolphin (Hawke 1989, S. Dawson, pers. comm., Table 1, # 17 and Figure 5). These instances may have been a case of the prey showing a curiosity for the predator (Estes & Goddard 1967, Kruuk 1972, Jefferson *et al.* 1991) or safety in the knowledge of where a predator is. Only one non-predatory, direct interaction, between orca and sperm whales has been reported (Table 1, # 44). In this instance a juvenile orca was seen bowriding on the pressure wave of an adult male sperm whale.

Forming of Groups. Off the coast of Kaikoura sperm whales are generally distributed singularly or occasionally in pairs (Childerhouse *et al.* 1995). During encounter # 42 (Table 1) the sperm whales formed a group. Norris & Dohl (1980) describe such a formation as a defensive strategy and the sperm whales may have been

grouping up 'just in case' rather than for actual defence. Behaviour similar to the sperm whales 'crowding' around the boat (as in Table 1, # 38 & # 42) has been reported for other marine mammals under threat (Jefferson *et al.* 1991).

No reaction. No reaction by either group of cetaceans (i.e., predator or prey) has also been recorded in New Zealand (see Table 1, #16, #19, #25, #32, #43). With regards to pinnipeds, observations by the author suggest that New Zealand fur seals are at least aware of the orca, as they will intently watch orca from haul-outs, or put their heads underwater to observe the orca passing close by (pers. obs.).

Predatory interactions

At least 22 accounts of predatory interactions are reported. Attacks are recorded on at least six different species of cetaceans (common, bottlenose and dusky dolphins, pilot, humpback and sperm whales, Table 1).

Attacks on common dolphins. Jefferson *et al.* (1991) record three attacks on common dolphin by orca. All three were in the Northern hemisphere and only one of those records a kill. The four accounts of orca chasing, attacking or killing common dolphins in New Zealand waters are the first records of attacks by orca on this species in the Southern hemisphere.

Attacks on sperm whales. Jefferson *et al.* (1991) suggest that orca are not a serious threat to sperm whales as they list at least 39 encounters between sperm whales and orca and note that not one of them involved a documented kill, and only six involved attacks. However, there have been a number of other reports that describe attacks on sperm whales, not reported in Jefferson *et al.* (1991). These include Murphy (1947), Brennan & Rodriguez (1994), Dufault & Whitehead (1995), Pitman (1999), and unpublished attacks including one off California and two in the Caribbean in recent years (T. Pusser, pers. comm.). The sperm whale carcass (Table 1, # 41) clearly shows teeth rake marks matching those reported by Best *et al.* (1984) on a sperm whale calf attacked by orca. Many sperm whales show teeth rake marks presumed to be from orca, e.g. 21% of Galápagos sperm whales (Arnbom & Whitehead 1989) and 65.3% of Antarctic sperm whales (Shevchenko 1975). Similar teeth rake marks have been attributed to orca and reported on bowhead whales (Finley 1990, George *et al.* 1994), narwhal (Campbell *et al.* 1988), Gray whale (Rice & Wolman 1971, Lowry *et al.* 1987), humpback whales (Katona & Whitehead 1981), Dalls porpoise (Morejohn 1979) and bottlenose dolphins (Lockyer & Morris 1985). They are also similar to those reported by Scheffer (1969), Shevchenko (1975), Lockyer (1979) and Visser (1998) on other orca. All of these rake marks resemble, and are consistent with, those on the beach-cast sperm whale reported here.

Although the sperm whale reported here was found dead, it can not be ascertained that the whale was killed by orca. The profuse bleeding in the chest and abdominal cavities and the se-

vere bruising of the soft tissue in the neck, jaw and rib area could have been a result of the carcass washing ashore. The pattern of damage to the flukes, pectoral fins, dorsal fin and cheek areas is consistent with the hypothesis of an orca attack. Also, it seems likely that the whale was alive during the attack, since the pattern of damage does not fit the explanation of orca scavenging off a dead carcass. The lack of scavenging by sharks supports the idea that the carcass had not been dead long, and also suggests that it may have either died close to shore or soon after washing up. Blue sharks are abundant off this coast at this time of year, and most cetacean carcasses afloat for any period of time bear numerous shark bites, (C. Duffy, pers. comm). As the tongue in a sperm whale is small (Berzin 1971) and was not damaged in this carcass, it is unlikely that orca were attempting to gain access to it, as has been reported for baleen whales (Mead 1986).

In conclusion, the 44 interactions observed and documented over the 36 year period suggest that the cetaceans encountered by New Zealand orca may be considered as prey items, but not necessarily a primary food source.

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References

- Arnbom, T., Papastavrou, V., Weilgart, L.S. & Whitehead, H. (1987). Sperm whales react to an attack by killer whales. *Journal of Mammalogy* 68: 450-453.
- Arnbom, T. & Whitehead, H. (1989). Observations on the composition and behaviour of groups of female sperm whales near the Galápagos Islands. *Canadian Journal of Zoology* 67: 1-7.
- Berzin, A.A. (1971). *Kashalot*. Izdatel 'stvo 'Pishchevaya Promyshlennost', Moskva.
- Best, P.B., Canham, P.A.S. & Macleod, N. (1984). Patterns of reproduction in sperm whales *Physeter macrocephalus*. *Reports of the International Whaling Commission Reproduction of whales, dolphins and porpoises*: 51-78.
- Bonner, N.W. (1981). Southern fur seals, *Arctocephalus* (Geoffroy Saint-Hilaire and Cuvier, 1826). In *Handbook of Marine Mammals*, vol. 1: The Walrus, Sea Lions, Fur Seals and Sea Otter (ed. S. H. Ridgway and R. J. Harrison), pp. 161-208. Academic Press, London.
- Brennan, B. & Rodriguez, P. (1994). Report of two orca attacks on cetaceans in Galápagos. *Noticias de Galápagos* 54: 28-29.
- Campbell, R.R., Yurick, D.B. & Snow, N.B. (1988). Predation on narwhals, *Monodon monoceros*, by killer whales, *Orcinus orca*, in the eastern Canadian Arctic. *The Canadian Field-Naturalist* 102: 689-696.
- Childerhouse, S.J., Dawson, S.M. & Slooten, E. (1995). Abundance and seasonal residence of sperm whales at Kaikoura, New Zealand. *Canadian Journal of Zoology* 73: 723-731.
- Cipriano, F. (1992). Behavior and occurrence patterns, feeding ecology, and life history of dusky dolphins (*Lagenorhynchus obscurus*) off Kaikoura, New Zealand. Ph.D thesis, University of Arizona, Tucson.
- Constantine, R., Visser, I., Buurman, D., Buurman, R. & McFadden, B. (1998). Killer whale (*Orcinus orca*) predation on dusky dolphins (*Lagenorhynchus obscurus*) in Kaikoura, New Zealand. *Marine Mammal Science* 14: 324-330.
- Cotton, B.C. (1944). Killer whales in South Australia. *The Australian Zoologist* 10: 293-294.
- Dufault, S. & Whitehead, H. (1995). An encounter with recently wounded sperm whales (*Physeter macrocephalus*). *Marine Mammal Science* 11: 560-563.
- Estes, R.D. & Goddard, J. (1967). Prey selection and hunting behavior of the African wild dog. *Journal of Wildlife Management* 31: 52-70.
- Finley, K.J. (1990). Isabella Bay, Baffin Island: An important historical and present-day concentration area for the endangered bowhead whale (*Balaena mysticetus*) of the Eastern Canadian Arctic. *Arctic* 43: 137-152.
- Frost, K.J., Russell, R.B. & Lowry, L.F. (1992). Killer whales, *Orcinus orca*, in the southeastern Bering Sea: Recent sightings and predation on other marine mammals. *Marine Mammal Science* 8: 110-119.
- Gaskin, D.E. (1972). *Whales dolphins and seals, with special reference to the New Zealand region*. Heinemann Educational Books Ltd, London.
- George, J.C., Philo, L.M., Hazard, K., Withrow, D., Carroll, G.M. & Suydam, R. (1994). Frequency of killer whale (*Orcinus orca*) attacks and ship collisions based on scarring on bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort seas stock. *Arctic*

- 47: 247-255.
- Hawke, D.L. (1989). Dusky dolphins *Lagenorhynchus obscurus* on the continental shelf near Otago Peninsula, South-East New Zealand. *New Zealand Natural Sciences* 16: 113-116.
- Hoyt, E. (1984). *Orca: The whale called killer*. Camden House Publishing Ltd, Ontario.
- Jefferson, T.A., Stacey, P.J. & Baird, R.W. (1991). A review of killer whale interactions with other marine mammals: Predation to co-existence. *Mammal Review* 21: 151-180.
- Katona, S.K. & Whitehead, H.P. (1981). Identifying humpback whales using their natural markings. *Polar Record* 20: 439-444.
- Kruuk, H. (1972). Surplus killing by carnivores. *Journal of Zoology, London* 166: 233-244.
- Lockyer, C. (1979). Response of orcas to tagging. *Carnivore* 2: 19-21.
- Lockyer, C. & Morris, R.J. (1985). Body scars of a resident, wild bottlenosed dolphin (*Tursiops truncatus*): information on certain aspects of his behaviour. *Aquatic Mammals* 11: 42-45.
- Lowry, L.F., Nelson, R.R. & Frost, K.J. (1987). Observations of killer whales, *Orcinus orca*, in western Alaska: sightings, strandings, and predation on other marine mammals. *The Canadian Field-Naturalist* 101: 6-12.
- Mead, T. (1986). *Killers of Eden: The killer whales of Twofold Bay*. Vantage Press.
- Mitchell, E.D. & Reeves, R.R. (1982). Factors affecting abundance of bowhead whales, *Balaena mysticetus* in the Eastern Arctic of North America, 1915-1980. *Biological Conservation* 22: 59-78.
- Morejohn, V.G. (1979). The natural history of Dall's porpoise in the North Pacific Ocean. In *Behavior of Marine Animals*, vol. 3: Cetaceans (ed. H. E. Winn and B. L. Olla), pp. 45-83. Plenum Press, New York, NY.
- Murphy, R.C. (1947). *Logbook for Grace: Whaling Brig Daisy 1921-1913*. Time Inc, New York.
- Norris, K.S. & Dohl, T.P. (1980). The structure and function of cetacean schools. In *Cetacean behavior: Mechanisms and functions* (ed. L. M. Herman), pp. 211-261. John Wiley & Sons, New York.
- Pitman, R.L. & Chivers, S.J. (1999). Terror in Black and White. *Natural History* 107: 26-29.
- Rice, D.W. & Wolman, A.A. (1971). The life history and ecology of the Gray whale (*Eschrichtius robustus*). *American Society of Mammalogists Special Publication* No. 3.
- Robson, F.D. (1979). *Thinking dolphins, talking whales*. A H & A W Reed, Wellington.
- Scheffer, V.B. (1969). Marks on the skin of a killer whale. *Journal of Mammalogy* 50: 151.
- Schneider, K., Baird, R.W., Dawson, S., Visser, I. & Childerhouse, S. (1998). Reactions of bottlenose dolphins to tagging attempts using a remotely-deployed suction-cup tag. *Marine Mammal Science* 14: 316-324.
- Shevchenko, V.I. (1975). Kharakter vzaïmootnoshenii dastok i drugikh kitoobranznykh (The nature of the interrelationships between killer whales and other cetaceans). *Morskije Mlekopitayuchchie Chast* 2: 173-174.
- Tarpy, C. (1979). Killer whale attack! *National Geographic* 155: 542-545.
- Todd, B. (1991). *Whales & Dolphins of Kaikoura, New Zealand*. Nature Downunder and Craig Potton Publishing, Nelson.
- Visser, I.N. (1998). Prolific body scars and collapsing dorsal fins on killer whales in New Zealand waters. *Aquatic Mammals* 24: 71-81.
- Visser, I.N. (1999). Benthic Foraging on sting-rays by killer whales (*Orcinus orca*) in New Zealand waters. *Marine Mammal Science* 15: 220-227.
- Walker, G.E. & Ling, J.K. (1981). New Zealand sea lion *Phocarctos hookeri* (Gray, 1844). In *Handbook of Marine Mammals*, vol. 1: The Walrus, Sea Lions, Fur Seals and Sea Otter (ed. S. H. Ridgway and R. J. S. Harrison), pp. 25-38. Academic Press, London.
- Würsig, B. & Würsig, M. (1980). Behavior and

ecology of the dusky dolphin, *Lagenorhynchus obscurus*, in the South Atlantic. *Fishery Bulletin* 77: 872-890.

Appendix 1

List of common names in the order they appear in the text, with corresponding latin names.

| | |
|------------------------------|--------------------------------|
| Orca (killer whale) | <i>Orcinus orca</i> |
| Blue whale | <i>Balaenoptera musculus</i> |
| Sperm whale | <i>Physeter macrocephalus</i> |
| New Zealand fur seal | <i>Arctocephalus forsteri</i> |
| Hookers sealion | <i>Phocarcos hookeri</i> |
| Common dolphin | <i>Delphinus delphis</i> |
| Bottlenose dolphin | <i>Tursiops truncatus</i> |
| Dusky dolphin | <i>Lagenorhynchus obscurus</i> |
| Hectors dolphin | <i>Cephalorhynchus hectori</i> |
| Southern right whale dolphin | <i>Lissodelphis peronii</i> |
| Humpback whale | <i>Megaptera novaeangliae</i> |
| Bowhead whale | <i>Balaena mysticetus</i> |
| Beluga | <i>Delphinapterus leucas</i> |
| Pilot whale | <i>Globicephala melas</i> |
| Narwhal | <i>Monodon monoceros</i> |
| Gray whale | <i>Eschrichtius robustus</i> |
| Dalls porpoise | <i>Phocoenoides dalli</i> |
| Blue shark | <i>Prionace glauca</i> |