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SHORT NOTE

Killer whale predation on penguins in Antarctica

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Abstract We report here the first published observations of killer whales (*Orcinus orca*) feeding on penguins in Antarctica. The sightings took place in the Gerlache Strait off the western Antarctic Peninsula during February 2010. Two species of pygoscelid penguins were taken—gentoo (*Pygoscelis papua*, at least four individuals) and chinstrap (*P. antarctica*, 2). From remains left at the surface, it was clear that the killer whales fed mainly on the breast muscles, although some penguins may have been swallowed whole. The killer whales were ecotype B, which are purported seal specialists, but we also saw ecotype A, prey specialists on Antarctic minke whales *Balaenoptera bonaerensis*, chase, but not catch penguins. Because of their small relative size, if penguins are regularly targeted by killer whales in Antarctica, the impact on their populations could be significant.

Keywords Antarctic Peninsula · Chinstrap Penguin · Gentoo Penguin · Killer whale · *Orcinus orca* · Predation

Introduction

The role of penguins in the diets of Antarctic killer whales (*Orcinus orca*) requires clarification. Killer whales in general are known to kill seabirds, including penguins, and eat them (Condy et al. 1978; Ford et al. 1998; Guinet 1991, 1992; Heise et al. 2003; Vos et al. 2006), but they often just leave the carcasses floating at the surface (Rice and Saayman 1987; Williams et al. 1990; Baird and Dill 1996; Ford et al. 1998). In the northeast Pacific, seabirds constitute a negligible diet component for mammal-eating killer whales (Ford et al. 1998), but penguins are much larger seabirds in terms of individual biomass and could potentially be important prey for killer whales.

Currently, published reports of killer whales preying upon penguins are limited to observations near nesting colonies on subantarctic islands. Reported taken are king penguins (*Aptenodytes patagonicus*) and rockhopper penguins (*Eudyptes chrysocome*) at Marion Island (47°S, 37°E; Condy et al. 1978); king and unidentified crested penguins (*Eudyptes* sp.) in the Crozet Islands (46°S, 51°E; Guinet 1992; Guinet and Bouvier 1995); and king penguins at Macquarie Island (54°S, 159°E; Ainley et al. 2010). In addition, probable predation on Magellanic penguins (*Spheniscus magellanicus*) off Punto Tombo, Argentina, was reported by Jehl (1975).

Three distinct ecotypes of killer whales have been described from Antarctic waters based on differences in size, color patterning and prey specialization that may represent species level divergences (Pitman and Ensor 2003; Pitman et al. 2007; LeDuc et al. 2008; Morin et al. 2010). While in Antarctic waters, the nominal-looking form (type A) is a putative specialist on Antarctic minke whales (*Balaenoptera bonaerensis*); type B preys mainly on seals; and Ross Sea killer whale (type C) is a fish specialist (Pitman and Ensor 2003; Ainley et al. 2009). In addition, in the Antarctic Peninsula area, we have identified what appears to be two size variants of type B killer whales—a large form that wave-washes seals off ice floes (Visser et al. 2008) and takes an occasional Antarctic minke whale, and a smaller form that forages in more open water and has unknown prey preferences (RL Pitman and JW Durban personal observation). Our type B observations pertain to the smaller form.

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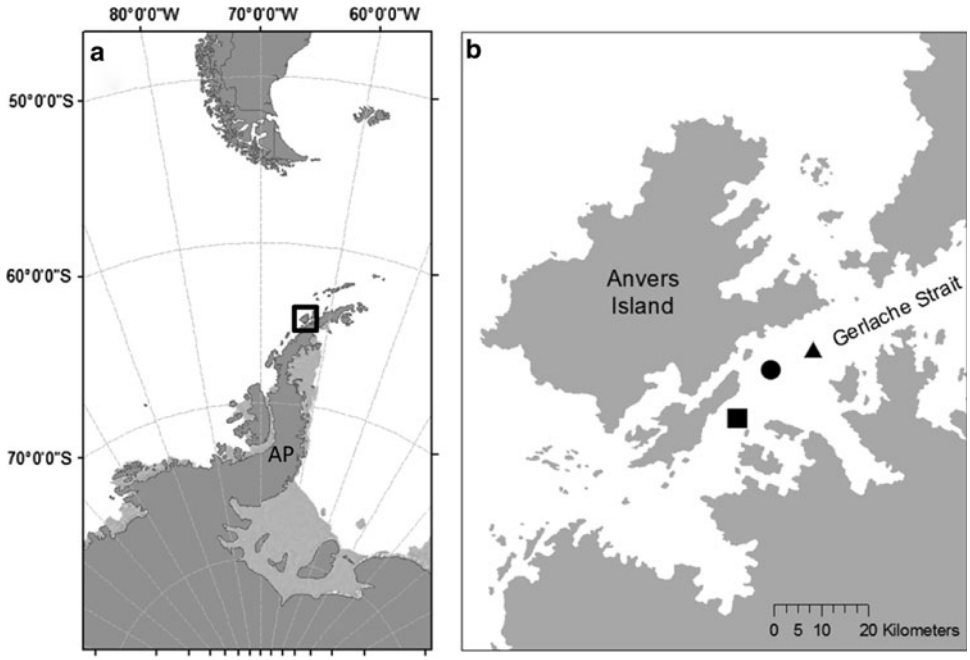

Fig. 1 **a** The study area on the west side of the Antarctic Peninsula, Antarctica; **b** Close-up view of the Gerlache Strait showing locations where we initially sighted killer whales attacking penguins on three separate days in 2010: 20 Feb (*filled square*), 23 Feb (*filled triangle*) and 25 Feb (*filled circle*)

In Antarctic waters, killer whales are known to chase and sometimes kill penguins, but to date there have been no published observations of them actually eating them. For example, Lauriano et al. (2007) reported type B killer whales pursuing Adélie penguins (*Pygoscelis adeliae*) in the southwestern Ross Sea, and one whale had a penguin in its mouth, but it could not be determined if the penguin was actually eaten. Similarly, Dalla Rosa et al. (2007) observed type B killer whales chasing gentoo penguins (*P. papua*) off the western Antarctic Peninsula and also saw a whale with a penguin in its mouth. They assumed that the penguin had been eaten but after the whales left the area a penguin was found floating at the surface with two puncture wounds in its chest: apparently, the killer whales had been 'playing' with it and left it for dead. This presumed play behavior was also reported for Ross Sea killer whales in McMurdo Sound, Ross Sea, where penguins are also sometimes killed but not eaten (Ballard and Ainley 2005). Additional inconclusive observations of killer whales harassing/attacking Adélie penguins have been reported in the Peninsula area by Castello et al. (1974) and Visser et al. (2008) and in McMurdo Sound (Richlen and Thomas 2008).

Here, we present firsthand observations of type B killer whales killing and eating two species of penguins in waters adjacent to the Antarctic Peninsula.

Methods

During 11–28 February 2010, we conducted research on killer whales while on board the 19.5-m motor sailboat M/V *Golden Fleece* working in and around the Gerlache Strait, off the west coast of the Antarctic Peninsula (Fig. 1). Observations were made from on top of the wheelhouse, 5 m above sea level, using handheld binoculars. During that time, we photographed over 200 individually identifiable killer whales, including type A (7 encounters; 41 individuals) and type B (all small form: 7 encounters; approximately 200 individuals). Each group had at least a few distinctively marked individuals that allowed us to identify individual groups when we saw them again. Once we found a group, we usually stayed with them as long as daylight and weather permitted. We followed traveling whales at a distance that did not seem to interfere with their normal behavior (>300 m), but when they were attacking penguins we usually closed to within 50–100 m.

Results and discussion

We observed killer whales attacking penguins on three separate days.

20 February. At 10:00 (all times local), we encountered a group of approximately 30–40 type B killer whales in the western Gerlache Strait near northern Anvers Island (Fig. 1). The observation conditions were excellent (Beaufort 1-2), and we followed the group for a total of 9.25 h. For the first 4.5 h, they traveled slowly southward in small subgroups scattered over approximately 2 km. During this time, there were Antarctic minke whales and Antarctic fur seals (*Arctocephalus gazella*) around, often swimming among or alongside the killer whales, but the killer whales seemed to ignore them. We also saw an occasional southern elephant seal (*Mirounga leonina*), but

we do not know if the whales would have been interested in them because they were never at the surface within 300 m of the whales. Occasionally, a single killer whale or a whole subgroup would turn abruptly and then mill around in a circle for a minute or two—they may have been feeding but there were no overt signs that they were chasing or catching anything (e.g., no fleeing prey or remains at the surface).

The first direct evidence of feeding was at 14:41, shortly after the whales had turned and begun to travel northwards. A group of six whales (two adult females, one calf, one smaller juvenile and two larger juveniles) caused a disturbance at the surface and created an oil slick that attracted a few Wilson's storm-petrels (*Oceanites oceanicus*) and a pair of brown skuas (*Stercorarius antarcticus*). These birds are scavengers, and in Antarctic Peninsula waters, they usually show up when killer whales are dismembering their prey (RL Pitman and JW Durban unpublished observation). During the next several surfacings, the killer whales left a trail of slicks at the surface that attracted more storm-petrels, indicating that they had probably caught something, but we did not see any remains.

At 14:43, we saw this same group begin chasing and catching penguins. Initially, they caused a commotion at the surface for about 30 s. After they moved away, we approached the area and found the remains of a freshly killed gentoo penguin. It was in three parts: two were patches of skin with the feathers attached, and the third included skin from most of the rest of the body with one of the legs and tail still attached. The head, entire pectoral girdle (including flippers) and the axial body were missing.

The whales continued to chase penguins: at 14:46, one of the juveniles chased a gentoo that apparently escaped; at 14:55, a juvenile chased another gentoo that also escaped. At 15:02, the group chased a gentoo, and an adult female surfaced with flesh in her mouth. At 15:11, the group chased another penguin and an adult female surfaced with a gentoo in her mouth; she was holding the penguin by its flipper. At 15:19, an adult female chased a chinstrap penguin (*P. antarctica*, Fig. 2) and later surfaced with it in her mouth. We did not find any remains of these last three captured penguins—they may have been consumed whole or they may have been carried away and eaten later. At 15:24, there was an aborted chase of an unidentified penguin, and at 17:40, the group chased a gentoo penguin which tried unsuccessfully to jump onto our boat. The whales quit chasing the last penguin when it came over to our vessel.

At 18:19, a juvenile from the same group caught another gentoo. The whale spy-hopped (lifted its head vertically out of the water) with the penguin dangling from its mouth. At that point, another juvenile spy-hopped beside it and

Fig. 2 An adult female type B killer whale (small form) chases a chinstrap penguin in Gerlache Strait, Antarctica on 20 February 2010, which she caught a few moments later; the white patch underwater is another killer whale. Photo: R. Pitman

appeared to help dismember the bird (Fig. 3). We examined the remains left behind; they consisted of the entire lower half of the body with the entrails, legs and tail intact—the head, pectoral girdle and flippers were all missing.

During each chase, the targeted penguin porpoised out of the water in front of the pursuing killer whale(s) and erratically changed directions between surfacings (Fig. 2). After about 1–2 min, one of the killer whales would surface with the penguin in its mouth, or the whole group would just swim away, leaving the live penguin behind.

23 February. At 16:45, we located a group of approximately 35 small-type Bs in a long scattered line of small subgroups, moving slowly southward along the east side of the Gerlache Strait near the mouth of Anvoord Bay. The group included individuals from the previous (20 February) sighting, as well as some new individuals. As we approached the whales, one of the subgroups created a disturbance at the surface that attracted several Wilson's storm-petrels, brown skuas and giant petrels (*Macronectes* sp.); the birds were squabbling over the remains of a freshly killed chinstrap penguin that we examined (Fig. 4). It was in

Fig. 3 Two juvenile type B killer whales (small form) pull apart a gentoo penguin that they had just captured in the Gerlache Strait, Antarctica, on 20 February 2010. Photo: R. Pitman

Fig. 4 Remains of a freshly killed chinstrap penguin left floating at the surface by killer whales at the mouth of Andvoord Bay, Antarctica on 23 February 2010. The killer whales apparently wanted only the breast meat: the pectoral girdle was removed and the rest of the carcass was discarded. Photo: E. White

three separate parts, including the head, which was intact except for what appeared to be two superficial bite holes on either side of the skull; a patch of skin from the breast with the feathers still attached; and the intact, entire lower portion of the body. Only the pectoral girdle, including the sternum, breast muscles and both flippers, was missing.

25 February. We followed a group of 20 type A killer whales in the Gerlache Strait for 9 h from 0930 to 1830; these whales were part of a larger group that had killed and fed on an Antarctic minke whale on 14 February. We saw no obvious predation attempts while we followed the widely scattered subgroups, except for a juvenile that thrashed around briefly in a circle at the surface. For the next 5 min, it traveled along with its presumed mother and they left an oil slick each time as they surfaced together. These slicks attracted Wilson's storm-petrels, suggesting that a small prey item, perhaps a penguin, had been taken. Less than 10 min later, two juvenile killer whales from that same subgroup broke off for less than 2 min and approached a small iceberg where they vigorously chased a penguin around for 10–15 s. The penguin got away—or perhaps they let it go; we could not identify the species of penguin, but by its size it appeared to be a gentoo. It was not clear if this was a predation attempt or just harassment.

These observations confirm that type B killer whales (at least the small form) prey on penguins in Antarctica, and that type A probably does so as well. The chases lasted only a minute or two, during which a killer whale either caught the penguin or it escaped, the latter because either the whales terminated the chase or the penguin eluded them. The chases involved 1–4 killer whales, usually with the whales taking turns chasing the penguin when more than one whale was involved. From photographs, we were able to determine that a second whale sometimes joined the chase underwater (Fig. 2). Although juveniles and adults caught penguins, we saw only juveniles feeding on them; it is not known if the adult females (the presumed mothers) also ate penguins or if they fed them to their calves.

Although the killer whales appeared to feed on only the breast muscles, captured penguins were sometimes not seen again and those may have been consumed whole. Similarly, Condy et al. (1978) assumed that king penguins taken by killer whales at Marion Island were swallowed whole because they never saw any skin or feathers at the surface but, like ours, these might have been carried off before they were consumed. The fact that most of the carcass was sometimes left floating at the surface could also account for reports of killer whales killing and leaving whole penguins behind (e.g., Ballard and Ainley 2005).

Relative to the killer whales, the penguins taken were very small. Mean mass of an adult chinstrap penguin is approximately 4 kg and of a gentoo is 6 kg, Adélie penguins, which may also be taken by type B killer whales (Lauriano et al. 2007), weigh 5 kg (Williams 1995). These whole-body weights amount to less than 0.2% of the body mass of an adult female killer whale that probably weighs at least 3,000 kg (Dahlheim and Heyning 1999).

The benefit to killer whales in taking such small prey, especially when they consume only part of each penguin, is unclear. But if penguins are a useful source of protein and nutrients for growing calves or lactating mothers, then the energetic costs of hunting them could be offset somewhat if they are efficiently caught and processed. For example, during the course of 3.6 h on 20 February, one group of six whales caught at least five penguins and chased at least four others that escaped (the latter due in part to the presence of our vessel). The chase time for each penguin was $\leq$2 min, and it is possible that other penguins were caught and eaten that we missed.

Because the killer whales fed on only part of a relatively tiny prey species, they were necessarily meticulous with their prey handling (Fig. 4). It appeared that they removed the pectoral girdle and also pealed off the skin and feathers to expose the breast muscles, and that this was sometimes done cooperatively (Fig. 3). We assume that they then stripped the breast muscles off the sternum and discarded the remainder, including the flippers, which would have sunk. This 'wasteful' prey consumption was similar to what we observed for type B killer whales (large form)

feeding on Weddell seals (*Leptonychotes weddellii*) in the Peninsula area in 2009 (RL Pitman and JW Durban personal observation). They also carefully dismembered (or 'butchered') their prey, apparently so that they too could feed on only the most desirable parts.

Due to their small size, if penguins are regular prey of some killer whales in Antarctica, then there is a potential for significant impact on penguin populations. For example, although there is only anecdotal evidence that killer whales feed on emperor penguins (*Aptenodytes forsteri*; Murphy 1936; Prevost 1961), it was recently suggested that killer whale predation may have been responsible for a 50% decline in an emperor population in Adélie Land, eastern Antarctica during the late 1970s (Ainley et al. 2007). However, Barbraud and Cotte (2008) countered that this was not possible because none of the 444 killer whale stomachs examined by Soviet whaling researchers from that same area during the same time period contained any penguin remains. But, if killer whales routinely breast their penguin prey and discard the telltale skin and bones, then any penguin remains in the diet could easily have been overlooked (see also Ainley et al. 2010). The possibility that killer whales prey on emperor penguins was recently given some additional credence when satellite-tracked type B whales in the western Ross Sea spent a considerable amount of time near the two largest known emperor penguin colonies in the world (Andrews et al. 2008). Given that killer whales find it worthwhile to prey upon 4–6 kg *Pygoscelis* penguins, then a 30–35 kg emperor penguin (Williams 1995) would seem to be even more suitable prey. Focal follows of the different killer whale ecotypes will be necessary to determine the extent and significance of killer whale predation on penguins in Antarctica.

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