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Site fidelity and behaviour of killer whales (*Orcinus orca*) at Sea Lion Island in the Southwest Atlantic

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Abstract: Using shore-based observations and photographic identification of killer whales (*Orcinus orca*) at Sea Lion Island (52°26'S, 59°05'W) in the Falklands/Malvinas archipelago, we identified a small group (6 to 12 animals) targeting a southern elephant seal (*Mirounga leonina*) breeding colony. Sightings during 2004-05 and photographic matches from the early 1990s suggest site fidelity. Behavioural observations revealed ambush and shallow water hunting techniques along rocky outcrops and two beaches used by elephant seal pups and juveniles. A single successful attack and three unsuccessful attempts were recorded.

Resumen: Observaciones y foto-identificación de orcas (*Orcinus orca*) en la Isla Sea Lion (52°26'S, 59°05'W) en el archipiélago de las Islas Malvinas/Falkland Islands, identificó a un pequeño grupo (6 a 12 animales) asechando y cazando una colonia reproductiva de elefantes marinos (*Mirounga leonina*). Avistamientos durante 2004-05 y comparaciones fotográficas de los 1990's revelan la fidelidad del sitio. Observaciones de su comportamiento revelaron técnicas de emboscada y caza en aguas costeras poco profundas, utilisadas por cachorros y juveniles. Fueron registrados cuatro ataques, de los cuales solo uno tuvo éxito.

Keywords: Killer whale, orca, *Orcinus orca*, Falkland Islands / Islas Malvinas, feeding strategy, ambush, photo-identification, site fidelity.

Introduction

Killer whales are the largest members of the Delphinidae family and have a cosmopolitan marine range, reaching the icepacks at both poles (Dahlheim and Heyning, 1999). There has been a large quantity of work published on this conspicuous species at several locations in the Northern (Bigg *et al.*,1987; Ford *et al.*,1998; Baird, 2001; Williams *et al.*, 2002; amongst others) and Southern (Lopez and Lopez, 1985; Guinet *et al.*, 2000; Visser, 2000; Pitman and Ensor, 2003; amongst others) Hemispheres but many populations remain undocumented. Grellier and Wilson (2003) state the need for studies of lesser-known concentrations of marine mammals; in their case, bottlenose dolphins (*Tursiops truncatus*) and the same can be said for killer whales. Current knowledge of killer whales off the coast of South America does not include the Falkland Islands / Islas Malvinas (here after referred to as Falkland Islands) (Lopez and Lopez, 1985; Capella *et al.*, 1999).

Sea Lion Island (52°26'S, 59°05'W; Figure 1), to the south of East Falkland, receives tourism during the austral summer but is closed during winter months. One of the tourist attractions is the chance of viewing killer whales close to shore. On the eastern side of the island, sandy beaches on the north and south coasts are the site of the largest elephant seal (*Mirounga leonina*) breeding colony in the Falklands, which produces around 500 pups per year (Galimberti and Boitani, 1999). Reproduction in elephant seals occurs over a three month period, starting in early September on Sea Lion Island with maximum presence on 20 October. Pups are born a few days after females arrive in the colony and nurse for three weeks. A complete description of breeding biology is detailed in Galimberti and Boitani (1999). After weaning, pups remain hauled out on rocky platforms and along the sandy beaches. The first exploratory trips in the water occur toward late November. A colony of South American sea lion (*Otaria flavescens*) also breeds during the austral summer along rocky outcrops on the south side of the island producing approximately 43 pups annually (Thompson *et al.*, 2004).

Although White *et al.* (2002) give a good account of the occurrence and distribution of cetaceans around the Falklands, it has limited effort from coastal waters away from Port Stanley. The numbers of killer whales found were very low and distribution was scattered around the shelf waters of West Falklands and oceanic waters to the north. Yates and Brickle (in press) and Nolan *et al.* (2000) also reported killer whales in oceanic waters up to 200km to the northeast of the Falklands. These studies originated from longline vessels targeting Patagonian toothfish (*Dissostichus eleginoides*) and discuss a conflict between the fishery and the cetaceans. The relationship between coastal and offshore individuals, such as those whales recorded at sea from fishing vessels, remains unknown.

Coastal sightings and records of any cetacean species from this area in the South Atlantic remain sparse and although anecdotal evidence points to considerable numbers of baleen whales (sei, *Balaenoptera borealis*) and dolphins (Peale's *Lagenorhynchus australis* and Commerson's *Cephalorhynchus commersonii*), systematic studies have yet to be conducted.

Following local reports of regular sightings of killer whales at Sea Lion Island, we initiated a shore-based pilot study during the first two weeks of November 2004 to document killer whales and observe their behaviours. This was followed up with a more intensive study in November 2005. This paper reports the results of our study.

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Material and Methods

Location

The study site, Sea Lion Island, is situated at 52°26'S, 59°05'W, approximately 14km from the mainland (Figure 1). The site, 2km x 6km in area, is a low lying island with sandy beaches and dunes at the east end, rocky cliffs and freshwater ponds in the west with a covering of grasses and shrubs. The beaches form a low lying neck to the island and two prominent rocky platforms at the west end. The island is owned by Falkland Islands Development Corporation with a tourist lodge, Sea Lion Island Lodge in private ownership of Mssrs Strachan Visick Ltd. The lodge staff are the only inhabitants of the island during summer months and during winter the island is uninhabited.

Observations

Daily observations were carried out in a pilot study from 31 October to 14 November 2004. Two observers performed shore-based observation by foot over the entire island. Searches for killer whales were made throughout the day with 10 x 42 binoculars and the naked eye. When whales were detected, observers attempted to obtain photographs, estimate group size and record behavioural observations and location relative to the island. Environmental data (wind direction, sea state and general weather conditions) were also noted.

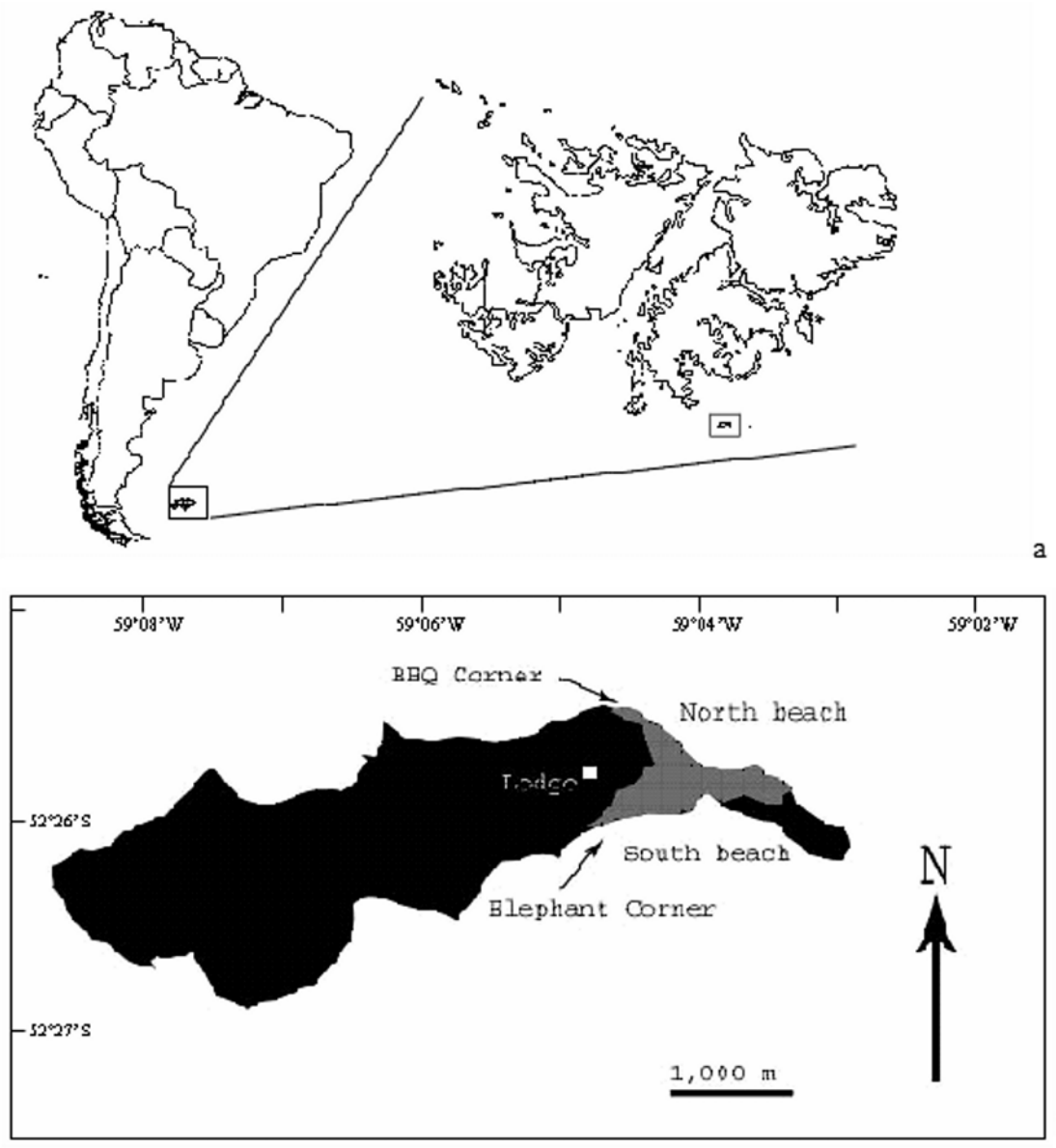

Figure 1. Map of the Falkland Islands/Islas Malvinas, with Sea Lion Island enhanced.

From 12-25 November 2005 observations were carried out between the hours of 0430 and 1730hs, with a one hour break for lunch. Observations were shore-based from three points, chosen for their proximity to areas of whale activity described in the pilot study: Elephant Corner, BBQ Corner and from sand dunes at the east end of the island (approx. 10m elevation). From the sand dunes both north and south beaches were visible, whereas from BBQ Corner and Elephant Corner only one location was visible. Observers typically started observations from the sand dunes and moved on foot to either the north beach (BBQ Corner) or south beach (Elephant Corner) when whales were detected. Data recorded followed the pilot study.

Photo-identification

A high-resolution (6.2 mega pixel) digital SLR camera with a 170-500mm zoom lens was used to obtain images of the animals. Identification of individuals was based on scars and nicks on the dorsal fin and saddle patch (Figure 2) as in Wilson *et al.* (1999). Photographs were graded as to quality: poor, good and excellent as in Wilson *et al.* (1999). 'Poor' quality photos were not used for matching.

With the acceptance of a picture into the dataset, it was cross-referenced against all the other pictures of that side (right or left flank) in the collection. Animals that had previously been identified were categorised as a re-capture event. Animals that had not been identified were recorded as a new individual. Photographs of the animals were cross-referenced against the number of animals estimated to be in the group from visual counts to gauge whether all individuals had been successfully identified. Additionally, several photographs taken in the early 1990's and displayed at Sea Lion Island Lodge were cross-checked with current photographs (2005 data) to investigate historical matches.

The animals were allocated codes of KLW (killer whale), a letter denoting pod (A, B, C) and a sequential number for that pod, generating codes of KLWA01, 02 etc. As the Falkland Islands Fisheries Department had allocated KLWA01 to 06 for killer whales observed at sea to the north of the zone, the Sea Lion Island whales were given KLWB01 to 07.

Results

Observer effort

In November 2004, during 14 days and approximately 168 hours of observations around Sea Lion Island, 65 sightings of killer whales were recorded. Sightings were brief (<5 minutes) and whales tended to remain too far offshore for photographs. However, in November 2005, during 13 days and approximately 136 hours of observations, 17 sightings of killer whales were made (one sighting per eight hours). On seven of those, encounters were close enough (<100m) for photography of individual animals. The 2005 encounters lasted, on average, 58 minutes with a maximum and minimum encounter time of 100 and 10 minutes, respectively.

Figure 2. Markings on the saddle patch of an adult killer whale from Sea Lion Island.

Approximately 14.6 hours were spent directly observing the whales, which constituted 10.7% of the observation effort.

Photographs were possible during 421 minutes (7hrs) of the observation time in 2005, suggesting that approximately 48% of the time whales were encountered was useful for obtaining identification shots. From this limited opportunity a total of 549 photographs were taken of the killer whales at close range, of which 243 (44.3%) were of good or high quality.

Group structure and composition

In the 2004 pilot study, two groups were catalogued. Group B consisted of six individuals; three adult females, two juveniles and a calf. Group C was recorded on a single occasion and consisted of two adult males and three females, although no photographs were obtained of the females.

In the 2005 study, six individuals were catalogued, initially forming two groups of three animals and subsequently a single group of six. Five of the six whales matched photographs from group B individuals identified in 2004 (Table 1). The sixth, a calf with foetal folds and a bent dorsal fin, was a new record. A single individual (KLWB04) from Pod B was photographed in 2004 but not identified in 2005. No group C whales were recorded in 2005.

Three individuals from group B were recorded on 11 of the 13 days in 2005, three distinct individuals arrived on the next-to-last day of the study, at which point the two groups joined. Several (<10) photographs from the lodge taken in the early 1990s matched an individual (KLWB02) from pod B. Photographs and descriptions (J. Luxton, pers. comm.) also revealed a live stranding incident of a juvenile whale on the south beach. The whale was assisted back into the water by tourists and lodge staff where it rejoined the pod; no measurements were taken.

Foraging behaviour

The whales were observed along the shore lines of the north and south beaches and at rocky platforms to the west of each beach. A total of four feeding events were witnessed, one at close range on 15 November 2005, which resulted in the capture of an elephant seal pup in the shallows of the north beach. The three other incidents were witnessed at distances of 0.5-1.0km, accompanied each time by feeding bird flocks around the whales with some form of social activity (breaching, tail-slapping) following. The birds were predominantly southern giant petrels, *Macronectes giganteus*, but kelp gulls, *Larus dominicanus* and black-browed albatross, *Thalassarche melanophris* were also present. Numbers of scavenging birds were not recorded but may have numbered in the hundreds.

The one observed attack at close range was on north beach. One whale (KLWB01) patrolled the beach approximately 6m from the waters edge, where the sand drops into deeper water. Two other whales (KLWB02 and KLWB05) moved parallel to KLWB01 but further out, around 100m from the beach. Their motion was obvious with regular breaths. The movements of KLWB01 were slow and few breaths were taken during the patrol, just the tip of the dorsal fin occasionally protruding from the water. An elephant seal pup entered the water west of the whales' position and swam in the shallows. At 10:17hs KLWB01 disappeared from view and was then observed to lunge in the shallow water at the elephant seal. As the first whale attacked, the other two moved rapidly into shallower water. The elephant seal momentarily escaped into the shallows (<1m) but was quickly washed back by the waves. The seal had clearly been severely injured by KLWB01 and was bleeding heavily. The three whales spent 20 minutes apparently searching for the carcass before activity in the kelp approximately 20 – 30m from shore suggested they found it. Several minutes of social activity including breaching and tail slapping followed between KLWB02 and KLWB05, where as KLWB01 remained motionless at the edge of the kelp.

Table 1. Summary of individuals recorded at Sea Lion Island during 2004 and 2005.

INDIVIDUAL	SEX / MATURITY	NUMBER OF CAPTURES	RIGHT SIDE	LEFT SIDE	CAPTURED IN 2004	RECAPTURED IN 2005
KLWB01	♀ / 3	12	x	x	x	x
KLWB02	♀ / 3	14	x	x	x	x
KLWB03	♀ / 3	7	x	x	x	x
KLWB04	? / 2	5	x	x	x	
KLWB05	? / 2	4	x	x	x	x
KLWB06	? / 1	6		x	x	x
KLWB07	? / 1	2	x	x		x
KLWC01	♂ / 3	4	x		x	
KLWC02	♂ / 3	2	x	x	x	

Maturity scale: 1 to 3, calf, juvenile, mature respectively. An x indicates a positive result.

Slow patrolling by the large female (KLWB01) in shallow water up and down the sand beaches was a typical behaviour. Patrols were made within 15m of the shore and covered approximately 500m to 1km along the north and south beaches. KLWB03 repeatedly waited submerged at rocky platforms where elephant seals haul out. KLWB01 patrolled the rocky platforms but was not observed waiting submerged as did KLWB03. Water depth at these platforms of approximately 5m allowed the individual to remain submerged motionless, or slowly patrol the border (<1m from the rocks). Other individuals in the group tended to move along in the same direction and similar speed but 100m off the beach or rocks. As the whales spent extended periods around the rocky haul out sites, this area provided the best views of the animals and gave the best chances of photographing the whales.

Two of the unsuccessful attacks were observed at one of these rocky platforms, Elephant Corner on 16 November 2005. The first, at 05:37 hs, was witnessed from the sand dunes at the eastern end of the island (approx. 1.5km). The presence of bird activity, mainly southern giant petrels and kelp gulls, around the rocks of Elephant Corner alerted observers to the presence of the whales. Observers moved to Elephant Corner on foot, arriving at 05:55hs to observe the activity. By this time the whales had moved approximately 200m further offshore, and were completely surrounded by giant petrels and kelp gulls. Observation of whale behaviour was impossible due to the numbers of birds shrouding the scene. Typical scavenging behaviour of the giant petrels suggested that there was food in the water. The whales appeared from time to time with the birds following closely. By 06:15hs KLWB01 moved away from the area and remained motionless for 30 minutes in the kelp bed, approximately 150m from Elephant Corner. The other two whales (KLWB02 and KLWB05) were more active, moving around the area and slapping the water with their flukes. At 06:50hs the three whales moved slowly away to the east.

In the second incident, on the same day between 18:30 and 20:00hs the same three whales approached Elephant Corner and KLWB01 patrolled the rocks, within a metre of the rock platform as earlier. An elephant seal pup entered the water approximately 4m from the whale. No attack followed until KLWB01 raised her head from the water, appeared to see the seal and then lunged. The seal was washed out of the water back onto the rocks and the attack was unsuccessful.

Photographic catalogue

The local NGO, Falklands Conservation, holds a record of the data obtained at Sea Lion Island. The catalogue includes left and right side identification photographs of dorsal fins and saddle patch markings. Nine individuals are recorded (KLWB01 to 07 and KLWC01 and 02) plus associated data detailed above. The dataset is linked to Falkland Conservations Cetacean Watch, which is a compilation of sighting information based on visitor observations and records from local enthusiasts.

Discussion

Our observations of killer whales at Sea Lion Island coincided with the period elephant seal pups began to enter the water. Before this point in mid-November, as in the pilot study of 2004, the whales stayed further offshore. The hunting behaviour described left little doubt as to the reason the killer whales are present in the area at this time. The sea lion colony breeding season is in early February and the killer whales may also target these animals. However, no effort has been possible at this time of year so no conclusions can be made. Similar shallow-water hunting behaviour by killer whales has been reported in Argentina, where some individuals intentionally strand to capture sea lions (Lopez and Lopez, 1985) and in the Crozet Islands (Guinet *et al.*, 2000). At Sea Lion Island no intentional stranding was observed although the stranding of the juvenile whale in the early 1990's may suggest that this behaviour does occur but has yet to be properly documented.

Hunting at rocky haul-out platforms by killer whales has also been observed, but on grey seals (*Halichoerus grypus*) in the Shetland Islands (A. Black, pers. obs.). In Shetland the killer whales patrol rocky haul out sites in relatively deep water as described here for the Sea Lion Island killer whales. At Sea Lion Island an ambush hunting technique was observed, which has not been reported previously. By remaining motionless and submerged in the water by the rocky platform, certain individuals waited for seals to enter the water before lunging at the prey. The behaviour of a single individual leading attacks and sharing with other animals agrees with observations in Argentina by Hoelzel (1991). In the Sea Lion animals, initial evidence suggests two individuals using slightly different hunting techniques within the pod, one using shallow water hunting along the beach, the other ambush predation at rocky platforms.

What the animals feed on during periods of low seal abundance and during winter is unknown. However, the Sea Lion Island killer whales were observed in sub-pods of three animals before joining to form a pod of six individuals, a behaviour that has been reported in killer whales previously to maximise foraging efficiency (Hoelzel, 1993), although at Sea Lion Island this could also be for social reasons. Further study would help highlight this split in the group and identify if it occurs regularly and for how long.

Sightings recorded by tourists and staff at the lodge for Falklands Conservation's Cetacean Watch suggest killer whales are present during the entire austral summer season, from September to March (Falklands Conservation, unpublished data). From our 2004 and 2005 data and considering the few useful photographs

available from Sea Lion Island Lodge, the group of killer whales identified in this study have demonstrated site fidelity by returning to Sea Lion Island on at least three occasions since the early 1990s. Site fidelity has been reported in killer whale populations to take advantage of seasonal prey species (Lopez and Lopez, 1985; Hoelzel, 1993 amongst others) and it is likely that the Sea Lion Island whales also use this seasonal strategy. As the lodge is not open year-round and access is not possible during winter months, there are no sighting records for this period. We suggest therefore that the killer whales reported here are either regular visitors to the area, or part of a resident population. Year-round data are required for a proper assessment.

A B-pod juvenile photographed in 2004, which associated closely with an adult female, was not photographed again in 2005. As killer whales have high incidence of natural mortality in their first years (up to 42%, Bain, 1990) and young animals tend to remain close to the parent for several years (Lopez and Lopez, 1985; Bigg *et al*., 1987) it was assumed the juvenile had not survived. However, the presence of a new individual with foetal folds and bent dorsal fin, markings consistent with a neonate calf, shows that the small group is reproductively active.

Following descriptions of three forms of killer whales in Antarctica (Pitman and Ensor, 2003), the Sea Lion Island individuals fit the description of the A-type whales. They have large horizontal ocular patches, completely lack a dorsal cape and show no signs of pigmentation as detailed in Pitman and Ensor (2003).

Considering the infrastructure of the island, the small group size and localised, relatively predictable hunting behaviour, these killer whales offer an excellent opportunity to further study social behaviour and hunting techniques in the South Atlantic.

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