

# The spectacled porpoise (*Phocoena dioptrica*) in Antarctic waters

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## ABSTRACT

Most knowledge on the biology and ecology of the spectacled porpoise (*Phocoena dioptrica*) has been obtained from stranded specimens, with less than fifteen confirmed sightings in the sea. Published photographs of live animals in their natural environment are also very rare. In this study, 28 live sightings are summarised, from Antarctic and sub Antarctic waters (mainly from the 1978–2004 IWC-IDCR/SOWER cruises). These sightings supported the suggested circumpolar and offshore distribution of this species; however, this was extended further south than previously thought, into Antarctic waters. The sea surface temperature recorded at the time of each sighting ranged from 0.9–10.3°C, with most of the sightings (52.0%) in waters 4.9–6.2°C. Group size was small, averaging 2.0 (SD=0.92) animals per group. A total of six cow-calf pairs were observed and all such pairs were accompanied by one or two additional adults, always including a mature male. Based on observations at sea and new photographs of live animals, a pale ‘saddle’ around the dorsal fin was noticed and is described for the first time. The porpoises generally showed fast swimming behaviour when the vessel approached, resembling the swimming behaviour of harbour porpoises.

KEYWORDS: SPECTACLED PORPOISE; SOUTHERN OCEAN; ANTARCTIC; SCHOOL SIZE; SURVEY-VESSEL; DISTRIBUTION; COLOURATION

## INTRODUCTION

The spectacled porpoise (*Phocoena dioptrica*, Lahille, 1912) is one of the cetacean species about which least is known. Its limited biological data are based mainly on opportunistic records of stranded specimens, while the understanding of its distribution is based on only a few sightings at sea (Goodall and Schiavini, 1995 and also see below). No studies have been carried out on this species in the wild and only a few photographs of live animals are known of a live stranded calf (Goodall and Schiavini, 1995); one animal at sea (Read, 1999 and also see below); two live strandings at South Georgia (Goodall, pers. comm.); and one adult male at sea (Bastida and Rodriguez, 2005).

Despite the lack of live sightings, stranding records indicate that the spectacled porpoise has a widespread distribution in the Southern Ocean and may be more common in some regions than previously thought. Confirmed osteological remains or strandings have been recorded from the coasts of Uruguay, Argentina, the Falkland Islands (Islas Malvinas) and South Georgia in the Atlantic Ocean; southern Chile and the Auckland Islands in the Pacific Ocean, southern Australia and Tasmania in the Tasman Sea; and the Macquarie and Heard Islands in the Indian Ocean (Baker, 1977; Brownell, 1975; Brownell and Clapham, 1999; Brownell *et al.*, 1989; Evans *et al.*, 2001; Fordyce *et al.*, 1984; Fraser, 1968; Goodall, 1978; Goodall and Cameron, 1979; Goodall and Schiavini, 1995; Guiler *et al.*, 1987; Hamilton, 1941; Lahille, 1912; Marelli, 1922; Pagnoni and Saba, 1989; Perrin *et al.*, 2000; Pinedo *et al.*, 2002; Praderi, 1971). Despite the wide geographic

distribution of these records, most strandings have been concentrated between the Atlantic coast of Tierra del Fuego and the coast of southern Argentina, with more than 270 records to date (Goodall, pers. comm.).

In comparison with the number of osteological/stranding records reported for this species, sightings of live spectacled porpoises at sea are very rare. Goodall and Schiavini (1995, table 3) summarised fifteen known live sightings at sea or from shore: one sighting from South Georgia; six off the south-eastern coast of South America; two from the Drake Passage; five off the Auckland Islands; and one off the Kerguelen Islands (Fordyce *et al.*, 1984; Frost and Best, 1976). Most of the sightings involved solitary individuals, however, some included up to five individuals.

Overall, based on stranding and sighting information, it was inferred that spectacled porpoises inhabit cold, temperate waters (5.5–9.5°C) of the Southern Ocean, with a circumpolar distribution at sub-Antarctic latitudes (33–58°S), from near-shore to deep offshore waters (Brownell and Clapham, 1999; Goodall, 2002; Goodall and Schiavini, 1995; Pinedo *et al.*, 2002).

Spectacled porpoises are known to be strongly sexually dimorphic. Adult males appear to be larger than females, as occurs in many odontocete species (Ralls, 2002). The largest male studied measured 224cm and the largest female measured 203.5cm (Goodall, 2002; Goodall and Schiavini, 1995). A further striking difference is the size and shape of the dorsal fin (Bruch, 1916; Fraser, 1968; Goodall and Schiavini, 1995). Adult males present a broad based, oval dorsal fin, which is significantly higher than the triangular dorsal fin of adult females.

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Nearly all other biological information is also based on information from strandings. The general external colouration is well reported from stranded animals, but to date there have been no detailed descriptions of the appearance and behaviour of live animals at sea. Since almost no behavioural observations have been reported to date, it is usually assumed that spectacled porpoises, like the other porpoises (except Dall's porpoise, *Phocoenoides dalli*), are normally rather undemonstrative.

In this paper, the at-sea distribution of spectacled porpoises is reviewed based largely on sightings made during International Whaling Commission (IWC)/International Decade of Cetacean Research (IDCR)/Southern Ocean Whale and Ecology Research (SOWER) cruises in Antarctica from 1978 to 2004. Furthermore, the sightings of this species in Antarctic and sub-Antarctic waters are discussed in regards to group composition, reproduction, external morphology and behaviour.

## MATERIALS AND METHODS

The majority of the sightings reported here were recorded during IWC IDCR/SOWER cruises. These cruises started in 1978 as the Southern Hemisphere minke whale assessment cruise (IDCR), which became the SOWER in 1996. By March 2004 a series of three circumpolar surveys have been completed. The histories and survey methodologies of these cruises have been reviewed elsewhere (Matsuoka *et al.*, 2003). In summary, the main sighting effort during surveys was conducted by two crew members at the top of the barrel (20m above sea level), and two other crew observers at the upper bridge (12m above sea level), all using 7×50 handheld binoculars. Additionally, three researchers and a further crew member also undertook sighting effort from the upper bridge. All cetacean sightings were confirmed and recorded by researchers on board.

During both the IDCR and SOWER cruises, the main surveys have focused their efforts in the Antarctic area south of 60°S, but also sighting surveys has been conducted during the transit period to/from home ports (35–55°S) and the main surveyed areas (see table 1 in Matsuoka *et al.* (2003) for list of home ports between 1978/79 and 2000/01 cruises). Hobart was the home port for cruises 2001/02 to 2003/04. Therefore, the surveys covered not only Antarctic waters but also the sub-Antarctic regions of cold temperate water north of the Polar Front, around 50–60°S (Gross, 1996; Orsi *et al.*, 1995; Shirihai, 2002).

All spectacled porpoises sighting information was extracted from the IWC database (part of the Database and Estimation Software System (DESS)). This contains all the information obtained during the IDCR and SOWER cruises between 1978/79 and 2003/04. Copies of all original sighting data sheets were examined. Additionally, data from the 2000–2004 SOWER cruises were complemented by our personal records, since most of the authors of this work participated in those cruises (Ensor *et al.*, 2001; 2002; 2004).

Only data from confirmed sightings of spectacled porpoises were used in this study. On most occasions, especially during the transit period, the vessels approached the animals to confirm the species identification. The sighting data considered here included: date, time, geographic position, sea surface temperature, school size, presence or absence of calf, closest distance to vessels, observation time, photographs taken and general behaviour. Photographs obtained during the SOWER 2001/02 and 2003/04 cruises were taken using a Single-Lens Reflex

(SLR) camera with a 75–300mm or 100–400mm zoom lens, and 400 or 200 ASA colour slide films. Video footage of swimming behaviour observed in record 24 was recorded using a Canon *Elura 40mc* digital video camcorder.

Three sightings considered in this paper were collected opportunistically during other cruises in Antarctica (by Seitre, Pitman and Findlay, onboard *M/V Bahia Paraiso*, *M/V Explorer* and *R/V Africana*, respectively).

## RESULTS

### Distribution

A total of 25 sightings, representing 54 individual spectacled porpoises (including 5 sightings of 11 individuals previously reported by Kasamatsu *et al.*, 1990), were extracted from DESS. The sightings were from IDCR and SOWER cruises from 1978/79 to 2003/04 (Table 1). Additionally, three sightings of one individual each were included (observed by Seitre, Pitman and Findlay respectively). The 2003/04 SOWER cruise had the highest number of sightings compared to the other cruises, with ten out of a total of 28 confirmed sightings.

All sightings were distributed in the vicinity of the Polar Front (Fig. 1). The northernmost sighting was at 48°30.35'S (record 7, Table 1) and the southernmost sighting was 64°33.5'S (record 26). Sightings revealed a circumpolar distribution; however, longitudinally they were somewhat concentrated in the Pacific Ocean sector (60°W–130°E) of the Antarctic. Fifteen records (53.6%) were from the region between New Zealand and the Ross Sea. These clumped sightings were recorded on three different cruises and five different vessels. Most of these sightings ( $n=10$ ) were recorded during the 2003/04 SOWER cruise (Table 1). The sea surface temperature (SST) recorded at the time of each sighting ranged between 0.9°C and 10.3°C (mean=4.7°C, SD=2.52); however, the most frequent ranked temperatures were between 1.0–1.9°C and 5.0–5.9°C, which were recorded in half (52%) of the sightings.

### Group size and composition

Group sizes of the 28 sightings were small, averaging 2.0 (SD=0.92) individuals (ranging 1–4 individuals). The most frequent group size was one ( $n=10$ ), followed by three ( $n=9$ ), two ( $n=8$ ), and four individuals ( $n=1$ ).

A calf was present in six of the sightings (21.4%). Cow-calf pairs were always accompanied by either one or two other adults (records 2, 13, 14, 16, 17 and 27). The size of a calf was approximately one half to two thirds of the size of the closest associated animal (a cow, based on proximity, behaviour and dorsal fin morphology). If one other adult was present in the group ( $n=6$ ), it was a mature male, based on size and dorsal fin morphology (Bruch, 1916; Fraser, 1968; Goodall and Schiavini, 1995). On one occasion when two adults were present, the second animal was a female (record 16).

Groups including a calf were only temporarily stable. For record 6, the group dispersed at the end of the 16min observation. For records 13 and 14, groups also dispersed at the end of the observation (41min and 26min, respectively), the male left the group, but the cow-calf pair stayed together until the end of the observation. During the 22min observation of record 17, the trio was initially very close; keeping the calf in the centre of the group (Fig. 2), however, the adult male left the group at the end of the encounter. For record 27, the male left the group while the vessel approached within 20m; the cow-calf pair remained in close proximity during the 25min observation.

Table 1  
Sighting data of spectacled porpoise (*Phocoena dioptrica*) observed in the Southern Ocean.

Record no.	Date	Time (hrs)	Position			School size	SST (°C)	Sea condition			Notes	Data source
			Latitude	Longitude	Sea state			Sightability	Swell			
1	22 Dec. 1985	13:55	54°54' S	167°12' E	1	6.0	Good	2	-	A female/juvenile?	IDCR 85/86	
2	19 Feb. 1986	09:48	56°12' S	174°36' W	3	8.4	Moderate	2	-	One adult male and a cow-calf pair, photos	IDCR 85/86	
3	19 Feb. 1986	14:33	55°41' S	175°14' W	2	10.3	Moderate	0	-	A male and a female, photos	IDCR 85/86	
4	28 Dec. 1986	18:40	58°02' S	62°19' W	3	5.5	Moderate	1	-	Possibly all females. In 1.2m TL, photograph taken	IDCR 86/87	
5	28 Dec. 1986	19:28	58°05' S	62°09' W	2	5.5	Moderate	1	-	At the edge of Antarctic Convergence	IDCR 86/87	
6	10 Dec. 1987	-	About middle of Drake Passage		1	-	Excellent	Calm	V. low	One photo published by Read (1999)	Seitre, pers. data	
7	31 Mar. 1990	09:54	48°30' S	15°50' W	1	-	-	Calm	-	6 knot wind	Findlay, pers. data	
8	1 Jan. 1991	17:30	58°03' S	175°16' W	2	6.2	Moderate	2	-	Possibly a female. Dive pattern recorded	IDCR 90/91	
9	1 Jan. 1991	17:48	58°05' S	175°14' W	1	6.2	Moderate	2	-	A female or juvenile based on rounded dorsal fin	IDCR 90/91	
10	23 Jan. 2001	11:44	60°33' S	135°15' W	1	1.9	Good	2	Low		SOWER 00/01	
11	23 Jan. 2001	15:03	60°01' S	135°00' W	2	2.8	Good	2	Low		SOWER 00/01	
12	24 Jan. 2001	08:37	61°42' S	134°03' W	2	2.0	Moderate	2	Low	One male and a female	SOWER 00/01	
13	22 Dec. 2001	13:50	50°53' S	142°46' E	3	9.5	Moderate	2	Low	One male and a cow-calf pair, photos	SOWER 01/02	
14	24 Dec. 2001	09:41	58°51' S	136°09' E	3	1.6	Moderate	1	V. low	One male and a cow-calf pair. Fig. 5	SOWER 01/02	
15	24 Dec. 2001	09:41	58°51' S	136°09' E	2	1.6	Moderate	1	V. low		SOWER 01/02	
16	24 Dec. 2001	10:49	58°55' S	136°05' E	4	1.8	Moderate	2	V. low	One male, one female and one cow-calf pair	SOWER 01/02	
17	25 Dec. 2001	09:10	60°55' S	133°18' E	3	1.4	Good	2	V. low	One male and a cow-calf pair. Figs 2 and 3	SOWER 01/02	
18	5 Jan. 2003	-	58°04' S	65°48' W	1	-	-	3-4	-		Pitman, pers. data	
19	24 Dec. 2003	10:01	60°23' S	170°56' E	2	5.0	Poor	2	V. low		SOWER 03/04	
20	24 Dec. 2003	12:34	60°36' S	171°30' E	2	4.9	Moderate	2	V. low		SOWER 03/04	
21	24 Dec. 2003	12:46	60°36' S	171°32' E	3	4.9	Moderate	2	V. low	One male, one juvenile, one other, photos	SOWER 03/04	
22	24 Dec. 2003	06:17	57°50' S	172°21' E	3	5.4	Moderate	2	Low	Photos	SOWER 03/04	
23	24 Dec. 2003	07:10	57°55' S	172°36' E	3	5.7	Good	2	Low		SOWER 03/04	
24	24 Dec. 2003	12:19	58°17' S	173°51' E	1	5.0	Good	1	Low	A female or juvenile. Video. Fig. 4	SOWER 03/04	
25	24 Dec. 2003	14:44	58°25' S	174°15' E	1	5.5	Good	1	Low		SOWER 03/04	
26	6 Jan. 2004	08:11	64°34' S	176°19' E	1	0.9	Good	2	Low		SOWER 03/04	
27	8 Jan. 2004	12:00	61°40' S	177°18' W	3	3.6	Good	2	Low	One male and a cow-calf pair. Fig. 6	SOWER 03/04	
28	2 Mar. 2004	11:09	58°25' S	162°00' E	1	5.4	V. poor	5	Moderate		SOWER 03/04	

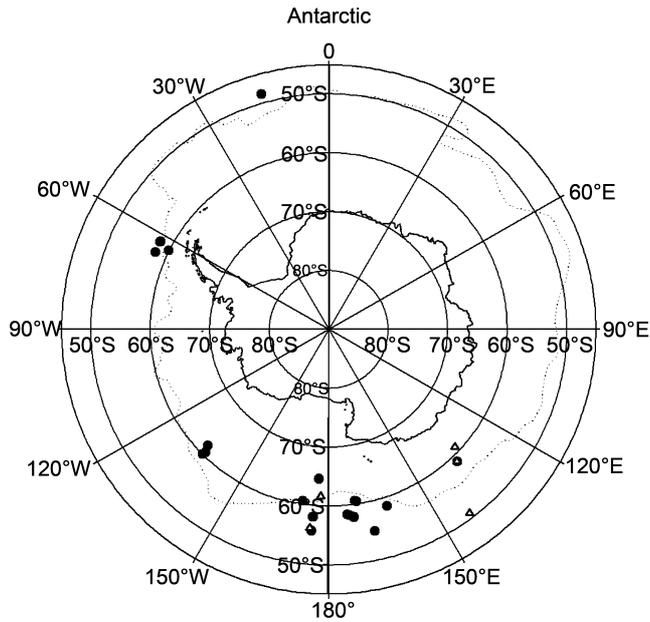


Fig. 1. Distribution of spectacled porpoise sightings in the Southern Ocean. Black circles indicate each sighting position and hollow triangles indicate a group with a calf. The dotted line shows the Polar Front.



Fig. 2. A group of three spectacled porpoises observed on 25 December 2001 at  $60^{\circ}54.58'S$ ;  $133^{\circ}18.34'E$ . The group contained an adult male (background), showing the prominent dorsal fin, a cow and a calf (Photo Sekiguchi).

### External morphology

Spectacled porpoises were readily identifiable by their small size, black and white pigmentation and, especially the remarkable dimorphism in the size and shape of the dorsal fin (Figs 2-4). The dorsal fin of an adult female (i.e. attending a calf) was lower and triangular in comparison with an adult male, with the apex placed near the trailing edge of the fin; both the leading and trailing edge of the fin appeared to be slightly convex (Fig. 2 foreground) as Goodall and Schiavini (1995) described. The massive, almost oval-shaped dorsal fin of the adult male was unmistakable as it was substantially larger than that of the female or juvenile, being both broader and taller (Figs 2 and 3); (Bruch, 1916; Fraser, 1968; Goodall, 2002; Goodall and Schiavini, 1995). One individual had a dorsal fin larger than that of an adult female, but smaller than that of a matured adult male; therefore, it might have been an immature male (Fig. 4).



Fig. 3. Another view of the adult male on 25 December 2001 at  $60^{\circ}54.58'S$ ;  $133^{\circ}18.34'E$  (Photo Sekiguchi).



Fig. 4. A single spectacled porpoise (an adult female or a juvenile male) sighted on 24 December 2003,  $58^{\circ}17.21'S$ ;  $173^{\circ}51.98'E$ . Note the light colour saddle around the base of the dorsal fin (Photo Sekiguchi).

In overcast conditions, body colour appeared to be mainly dark or even black (Figs 2 and 3). At very close range, the white ventral colouration, including above and below the black lips, and the white 'spectacles' were evident (Fig. 5). Under good lighting conditions, females and juveniles appeared lighter in colour; more grey (Fig. 4) than adult males (Fig. 6). When viewed from above, the tail stock appeared lighter on the sides as well as the dorsal side of the fluke, joining with the white colouration of the ventral part and along the sides of the tail stock (Fig. 5). A pale area was evident around the dorsal fin, which appeared to form a saddle (Figs 4-6). This saddle was only visible at a short distance, especially through the clear water column (Fig. 5). One mature male, which accompanied a cow-calf pair (record 27, Fig. 6), showed this cape clearly. Two lighter grey stripes from the blowhole to the apex of the melon were visible in a female (Fig. 5), forming a part of the 'bridle' as discussed by Perrin (1997).

Based on our observations, photographs and video at sea, the external morphology and colouration of spectacled porpoises shown in Fig. 7 were proposed.



Fig. 5. A female spectacled porpoise seen through the sea surface on 22 December 2001 at 50°53.16'S; 142°45.88'E. Note the white ventral surface, white lips and 'spectacles'. The light colour of 'the saddle' around the dorsal fin is clearly visible through the water (Photo Olson).



Fig. 6. An adult male showing a broad dorsal fin observed on 8 January 2004 at 61°39.49'S; 177°17.69'W. Note the light colour 'saddle' around the dorsal fin (Photo Sekiguchi).

*Phocoena dioptrica*

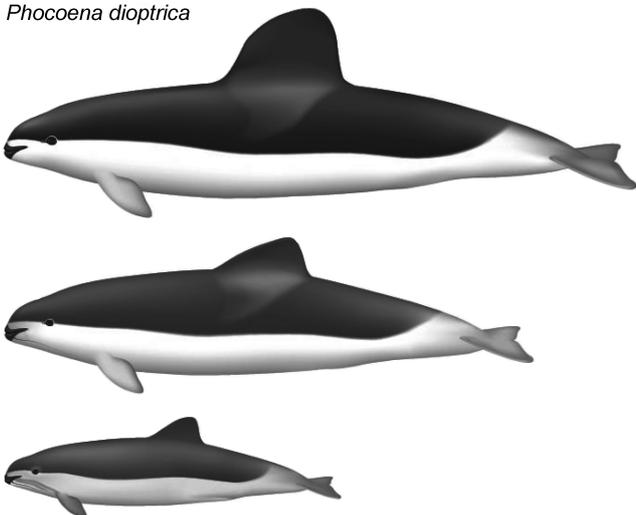


Fig. 7. Proposed external morphology and colouration of spectacled porpoise. Lateral views of an adult male, an adult female and a calf (Illustrated by Gorter).

### Behaviour

When undisturbed, spectacled porpoises were observed swimming in a slow rolling motion, without any splash, similar to that of harbour porpoises (*P. phocoena*). However, when disturbed by the approach of the vessel they attempted to avoid it in a very distinctive fast swim, completely submerged but just under the sea surface, producing almost continuous 'fluke prints' on the surface, which were easy to follow by the vessel. When conditions were extremely good, the black and white colouration of the flukes and tail stock was clearly visible under the water as the tail beat rapidly (Fig. 5). After travelling for around 100 to 200m, the animal would reduce speed, then follow this with a slow roll at the surface, perpendicular to the original direction of travel, as if turning back to determine if it was being pursued. After one or more slow rolls, it would submerge again and continue to swim rapidly away from the vessel.

During only one encounter (record 14) 'porpoising' behaviour was observed, which was just before the group dispersed. No association with bow riding behaviour was noted in any record.

### DISCUSSION

The 23 new confirmed sightings in this study (Table 1) double the previously reported number of sightings at sea (Goodall, 2002). These new sightings corroborate previous assumption that the spectacled porpoise has a circumpolar distribution around the Antarctic (Brownell and Clapham, 1999; Goodall, 2002; Goodall and Schiavini, 1995) in the vicinity of the Polar Front and that it inhabits mainly oceanic waters (Barnes, 1985; Kasamatsu *et al.*, 1990). The new data extends the distribution of this species south more than 400 n.miles than from previously known information, to 58°02'S (Goodall, 2002). The southernmost sightings also expand the range of SST that this species was known to inhabit (i.e. 0.9-10.3°C).

Spectacled porpoises are very difficult to sight at sea, mainly because of their small body and group sizes and inconspicuous behaviour. Almost all sightings of spectacled porpoises were recorded close to the vessels (ranging 0.03-1.5 n.miles) and under excellent survey condition (96.3% under Beaufort sea state 2). Thus, the paucity of sightings is considered to occur mainly due to the typically rough conditions in the vicinity of the Polar Front.

The concentration of sightings during IDCR and SOWER cruises, limited to the area of the Southern Pacific Ocean into Antarctic waters (60°W-130°E), may seem inconsistent with the distribution of most of the strandings, which were concentrated along the eastern coast of South America, especially Tierra del Fuego (Goodall, 2002). We believe that the geographical concentrations of live porpoises may reflect the real porpoise distribution, south of New Zealand during December to January, although they may reflect also the greater survey effort in that area. Despite the even coverage around Antarctica by the IWC cruises, the coverage of survey area during transits was longitudinally rather poor, compared with the main survey area (south of 60°S).

Despite a similar oceanic distribution to Dall's porpoise (Barnes, 1985), the behavioural observations of the spectacled porpoise at sea show greater similarity to the harbour porpoise, which is of the same genus *Phocoena* (Rosel *et al.*, 1995). The average group size was small (2.0 animals on average) and typical swimming behaviour was slow rolling, like a harbour porpoise.

The dorsal saddle observed has not previously been reported, although some field researchers have noticed this light colouration around the dorsal fin (R. Rowlett, pers. comm.), as well as a relatively light (grey/brown) dorsal body colour on some animals. This saddle has not been noted for stranded specimens, probably because this kind of subtle body colouration often disappears soon after death (Evans *et al.*, 2001). It was not clear from our observations if the calves had this 'saddle'. Similarly, the harbour porpoise has a complex external colour pattern but the animal looks plain grey and white in the field at a distance or after stranding (Reeves *et al.*, 2002).

A total of six small calves accompanied by a cow (22% of the total sightings) were sighted during late December to mid February. These observations indicate that birth may occur in late spring to summer (November to February) as suggested by Goodall and Schiavini (1995). Each of the cow-calf pairs sighted was accompanied by one or two other adults, which always included a mature male and, in one case, another female. It is unlikely that attendant males were biological fathers of the calves because no male parental care is known to exist in marine mammals (Mesnick and Ralls, 2002). These males might be suitors who were guarding females, as seen in bottlenose dolphins, *Tursiops truncatus* (Connor *et al.*, 1992; Wells, 1991) and humpback whales, *Megaptera novaeangliae* (Mesnick and Ralls, 2002).

The IDCR and SOWER cruises have provided excellent opportunities to observe rarely sighted spectacled porpoises at sea. The sighting data in this study suggest a concentration of spectacled porpoises to the south of Auckland Island, although effort biases might have arisen through sighting or oceanographic conditions. Intensive research in this region would provide more data for this little known cetacean species.

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