

Seasonal distribution of killer whales (*Orcinus orca*) in Northern Patagonia, Argentina

Miguel A. Iñíguez

Fundación Cethus, Saavedra 468, (Z9310CAD), San Julián, Prov. Santa Cruz, Argentina

Abstract

Killer whales, *Orcinus orca*, have been studied since 1975 in Northern Patagonia, Argentina. In the present study from 1985 to 1997, individual animals were identified using photo-identification techniques. Boat and shore observations were conducted during both the austral summer-autumn season 1985–1997 and the austral winter season 1992–1993. Thirty killer whales have been identified in the study area since 1975 and some individuals use a 1000-km stretch of the Northern Patagonian coastline. A core group of 17 return to the area each year and were assigned to three groups based on association with other individuals. Prey has included South American sea lions (*Otaria flavescens*) and southern elephant seal (*Mirounga leonina*). The seasonal distribution of killer whales is correlated to the distribution of the South American sea lions and southern elephant seal in Northern Patagonia. Most encounters with the whales occurred in December and March–May (64.2% in 1995 and 69% in 1996) at Punta Norte, during the sea lions breeding cycle. Whales depart the area in May when pinnipeds migrate to winter rookeries. One pod, Patagonia Norte B (PNB) was photographed in Golfo San Jose on 9 January 1986 and in Punta Norte 1 day later, some 60 km apart. Larger pods (>three whales/pod) spent no more than five days in the same area, and smaller pods (\leq two whales/pods) stayed longer in the same area. Seasonal distribution of Patagonia Norte A and PNB pods was largely associated with the movement of South American sea lions, while Patagonia Norte C pod was more associated closer with the southern elephant seal movements.

Key words: killer whale, *Orcinus orca*, pinnipeds, seasonality, Argentina, southern elephant seal, South American sea lion.

Introduction

Killer whales are a cosmopolitan species (Heyning & Dahlheim, 1988; Ford *et al.*, 1994). They frequent

the waters off the coast of Argentina between Río de la Plata and Tierra del Fuego (Iñíguez, 1990, 1991). In addition, several killer whale strandings have occurred along this coastline, including two mass strandings, of four and 15 animals, respectively (Goodall, 1978). Killer whale studies have been undertaken in Punta Norte (42°05'S, 63°46'W), Península Valdés since 1975 and methods included photo-identification (see below) from which an identification catalogue was compiled (López & López, 1985; Hoelzel, 1991; Iñíguez, 1990, 1991, 1992). This paper presents data on the seasonal distribution of killer whales in Northern Patagonia, Argentina.

Materials and Methods

Study area and duration

The study area in Northern Patagonia covered the area from 40°S to 44°S and from 62°W to 65°W and includes Golfos San Matías, San Jose and Nuevo, which form Península Valdés (Fig. 1). The main study was undertaken at Punta Norte, Península Valdés, Argentina where the whales use a 5-km stretch of beach from 3.2 km west to Punta Norte Wildlife Reserve, to a tidal channel 1.8 km south of Punta Norte. Tidal amplitude ranges 5–6 m. Observations of killer whales were carried-out during February 1985, January 1986 at Golfo San Jose, February 1987, February–April 1992, March 1988–1991 and 1993–1997 at Punta Norte, July 1992–1993 and January–February 1993 along the Northern seashore of Golfo San Matías.

Methods

Killer whales can be individually identified from markings on the dorsal fin, eyepatch or saddle patch, which are clearly visible on high-resolution photographs. Whales were identified using the photographic technique described by Bigg (1982). Photographs were taken using a 35-mm motor-driven camera with 300-mm lenses, using Kodak Tri X and Ilford HP5 black and white, and

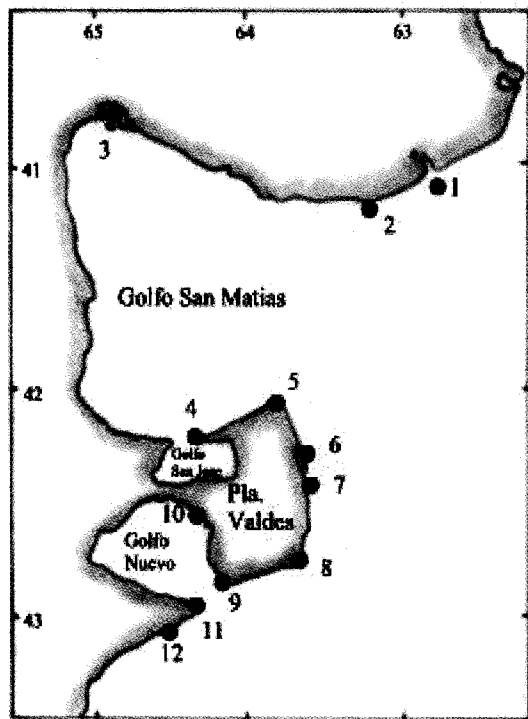


Figure 1. Location of the study area: (1) Rio Negro estuary; (2) Punta Bermeja; (3) San Antonio Oeste; (4) Punta Buenos Aires; (5) Punta Norte; (6) Caleta Valdés; (7) Punta Cerro; (8) Punta Delgada, (9) Morro Nuevo; (10) Punta Pirámides; (11) Punta Ninfas, and (12) Punta León.

Fujichrome 200 ASA film shot at 500 or 1000 speed. When identified, animals were provisionally assigned to pods based on their association with other identified individuals. A Pod was defined as whales that are seen more than 50% of the time together (Bigg, 1982) and they were named alphabetically using three letters; PN to indicate Patagonia Norte and A to D to distinguish pods. Individuals were designated numbers in ascending order, as they were photo-identified. They were assigned to age/sex categories using the characteristics, definitions and assumptions detailed in Bigg (1982) and Leatherwood *et al.* (1984). Hoelzel (1991) described a pod he designated as PNA; however, based on our long-term observations (Table 1) we proposed some changes in this pods composition (Iñiguez, unpublished data). PNB Pod was previously described (Hoelzel, 1991) and was first observed at Punta Norte by López and López (1985). Part of PNC Pod was also described by Hoelzel (1991). The duration of the study was March 1995–February 1997, and for the purposes of this study a year was considered to run from March to February.

Seasonal distributional data were analyzed separately for Northern Patagonia, Punta Norte, and by Pods. The pod PNB comprised of a single adult male killer whale (who was only sighted once in 1984), and therefore this pod was not considered for analysis.

PNB Pod had two whales prior to 1993 and after 1993 PNB1 was no longer sighted and therefore, the original PNB pod (after 1993) consisted of only one killer whales (PNB2), and this animal was analysed as a separate pod from the original PNB pod.

To determine the total number of days that killer whales stay at Punta Norte, we just considered the observation period between mid-February and the end of April. We also considered the total number of killer whales seen together.

Seasonal distribution of pinnipeds

South American sea lions (SASL)—Important breeding areas for SASL are concentrated at both Punta León and Peninsula Valdés (Punta Buenos Aires, Punta Norte, and Punta Pirámides), (Crespo & Pedraza, 1991). During the first half of December (the start of the breeding season), adult male and female SASL arrive at the breeding rookeries of Northern Patagonia (Campagna, 1985). Between 9–12 February, 3–4 week old pups enter the water for the first time (Campagna, 1985). From mid-February through April, the SASL rookery at Punta Norte begins to relocate 500 m to the south-east (Campagna, 1985). At the end of the breeding season, most mother and pups migrate to rookeries and in some of them the total number of sea lions doubles during winter months (e.g., Punta Quiroga, Isote Lobos, Caleta de los Loros, Punta Bermeja, Morro Nuevo, Punta Delgada and Punta Loma) (Lewis & Ximénez, 1983; Crespo & Pedraza, 1991). At Punta Norte, Campagna (1985) recorded numbers of SASL during four consecutive breeding seasons (December to February, 1980–1984) and found the population varied between 850–940 individuals (all ages and sexes). By August of each season, the overall numbers had dropped and just 150–200 SASL (mostly females and pups) were located 1000–1500 m to the south east from the main breeding site. Northern Patagonian SASL populations have increased 1.3% annually since 1990 and 2.9% annually since 1996 (Crespo & Pedraza, 1991; Dans *et al.*, 1996). The estimated number of SASL along the Northern Patagonia coast was approximately 37,800 animals (Dans *et al.*, 1996). Punta Norte has a breeding SASL rookery with 3,043 animals and the Punta Bermeja rookery contains some 1,431 non-breeding individuals of which 129 were pups in summer 1994 (Dans *et al.*, 1996). In the following year, the number of pups was similar ($n=116$), but by 1996 the numbers

Table 1. Details of individual killer whale pods identified in Punta Norte between 1985–1997.

Pod	No. whales (1985–1993)	Sighting frequency	Number of times sighted/photographed (*)	Comments
PNA	6	Regular	$n=63$	PNA4 disappeared in 1988.
PNB	2	Regular	$n=179$	PNA1 & PNA2 disappeared in 1992.
PNC	9	Rare	$n=14$	PNB1 disappeared in 1993
Total	17			

Pod	No. whales (1994–1997)	Sighting frequency	Number of times sighted/photographed	Comments
PNB2	1 (PNB2)	Regular	$n=97$	PNB1 disappeared in 1993
PNAC	9	Rare	$n=64$	Comprised of PNA3+PNA5+PNC pod.
Total	10			

*Regular=photographed in 80% or more of the years

*Rare=photographed in less than 50% of the years.

had nearly doubled ($n=232$) (Dans *et al.*, 1996). In July 1992, between 1,895–2,052 individuals (of which 552–598 were pups) were censused at this same rookery (González & Iñiguez, unpublished data). Dans *et al.* (1996) reported an increased in the number of SASL pups at Punta Bermeja, Punta Quiroga, Punta León, Islote Lobos, Punta Pirámides and Morro Nuevo rookeries. Only males (of all ages) have been recorded at Punta Hércules (Crespo & Pedraza, 1991).

Southern elephant seals (SES)—Adult SES have an annual cycle composed of two terrestrial periods (breeding and molt) and two pelagic phases (post-breeding and post-molt) (Campagna *et al.*, 1993; Le Boeuf & Laws, 1994). Breeding season begins when adult males arrive at Peninsula Valdés beaches, generally at the begin of September, although earliest males and females arrive by the third week of August (Campagna *et al.*, 1993). In 1995, 71% of the SES females (Campagna *et al.*, 1996) were distributed between Punta Cero and Morro Nuevo (southwest of Peninsula Valdés). Approximately 10,000 SES are born each year along 200 km of coastline at Peninsula Valdés (Campagna & Lewis, 1992). In 1982, 58% of the SES births occurred between Punta Buenos Aires and Punta Cero (northeast of Peninsula Valdés), as against 36% in 1990 and 28% in 1995 (Campagna *et al.*, 1996). Despite the overall annual 3.4% increase of SES births, their number decreased at Punta Norte (Campagna *et al.*, 1996). SES molt from mid December to March (Campagna *et al.*, 1993). SES juveniles wean and haul-out to molt in late November and December, whereas adult females return to

molt from December to mid-January. Later adult and subadult males return to molt until the end of March (Lewis, 1996). During the molt season, the number and distribution of adult females were similar to during the breeding season (Lewis, 1996).

Results

Individual identification

A total of 30 killer whales have been photo-identified in the study area since 1975 (Lopez & Lopez, 1985; Hoelzel, 1991; Iñiguez 1990, 1991, 1992), with a core group of 17 returning to the area each year (Table 1). Based on association of individuals, they were divided into 3 different pods consisting of six, two, and nine animals (Table 1). PNB pod was seen most frequently ($n=179$).

Number of observations

During the 12 year study (1985–1997) along northern Patagonia, killer whale observations were made on 408 days. During a 2-year period at Punta Norte, between March 1995 and Feb 1996, killer whales were observed on 67 days. Between March 1996 and Feb 1997, they were observed on 58 days. Killer whales were observed each month between March 1995–Feb 1997 (Fig. 2). The majority of encounters are from March–May (53.7% in 1995, 55.2% in 1996), the balance being outside this period (Fig. 2).

Seasonal distribution of killer whales

When comparing the monthly distribution of killer whales (data from this study), SASL (data from Campagna, 1985, Dans *et al.*, 1996) and SES (data

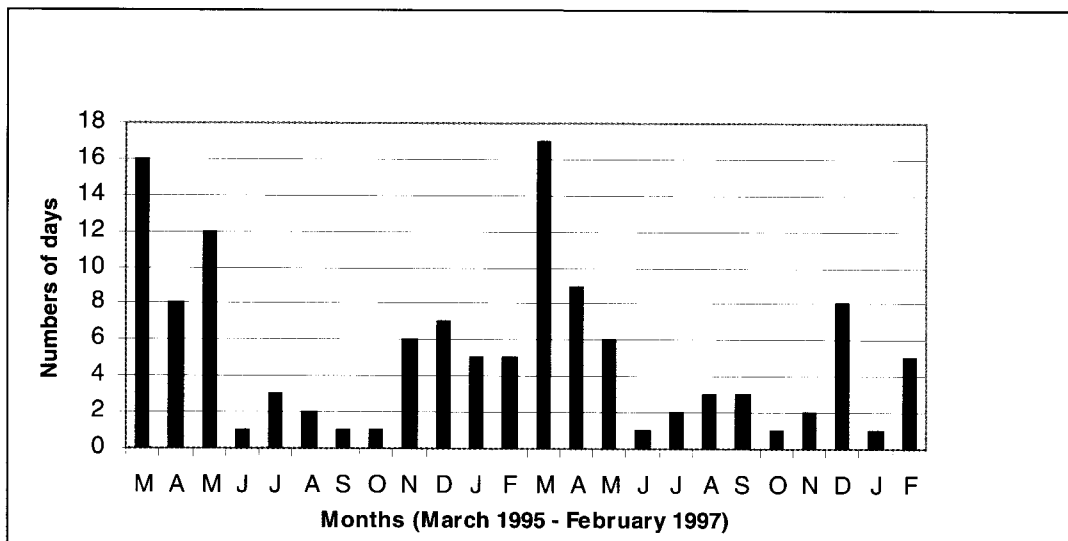


Figure 2. Number of day killer whales were observed (per month) at Punta Norte (March 1995–February 1997).

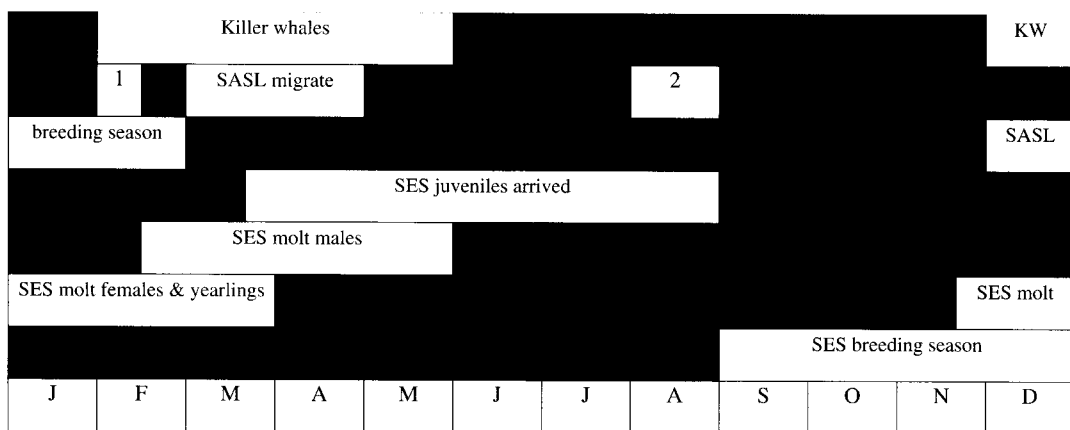


Figure 3. Killer whales presence (this paper) compared with SASL and SES movements at Punta Norte and Peninsula Valdés, respectively (adapted from Campagna, 1985; Campagna *et al.*, 1993; Lewis, 1996). Key: (1) 3–4 week old pups enter the water for the first time, (2) 150–200 SASL at Punta Norte.

from Campagna *et al.*, 1993; Le Boeuf & Laws, 1994; Lewis, 1996), there is a correlation between the three during the austral summer–autumn (Fig. 3).

Overall distribution along Northern Patagonia (1985–1997)—Killer whales were identified at 13 locations (Fig. 4). At eight of these locations, the whales were observed traveling, and at the remaining five the whales were observed feeding. Killer whales have previously been reported feeding on South American sea lions and southern elephant seals at Punta Norte by Lopez & Lopez (1985) and Hoebel (1991). In December and March–May, killer whales were present in Punta Norte; however, most

leave Punta Norte after May (Fig. 2). In June–August killer whales were observed in the northern part of Golfo San Matías (Punta Bermeja and Rio Negro estuary) and very occasionally around Peninsula Valdés (six sightings in both 1995 and 1996).

Distribution at Punta Norte (1995–1997)—Most killer whales occurred at Punta Norte in December and March–May (64.2% in 1995 and 69% in 1996, Fig. 2). The number of killer whales fell sharply to one record by June in both years, and remained between one and three records between July and November. The exception was an increase in November 1995 ($n=6$), at the end of the SES

	RN	PB	SAO	PBA	GSJ	PN	CV	PD	MN	PP	GN	PNi	PL
PNA	--	--	--	--	--	65	2	--	--	1	--	--	--
PNB	--	48	--	1	1	220	8	--	1	2	--	1	--
PNC	--	--	--	--	3	33	14	--	--	1	--	--	--
Unk	2	--	1	--	1	--	29	3	--	6	3	1	4

Figure 4. Numbers of times each pod seen at Rio Negro estuary (RN), Punta Bermeja (PB), San Antonio Oeste (SAO), Punta Buenos Aires (PBA), Golfo San José (GSJ), Punta Norte (PN), Caleta Valdés (CV), Punta Delgada (PD), Morro Nuevo (MN), Punta Pirámides (PP), Golfo Nuevo (GN), Punta Ninfas (PNi), and Punta León (PL).

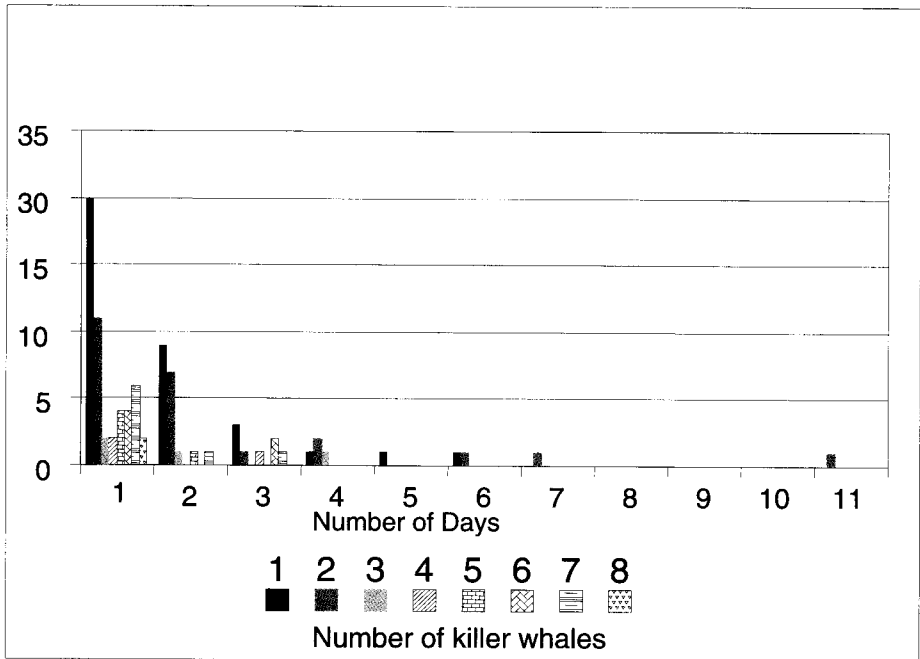


Figure 5. The number of consecutive days killer whales seen in Punta Norte.

season. Records of killer whales increased gradually in both years in January and February, except for January 1997, which had just one record.

Observations of individual pods at Punta Norte

Considering the total number of killer whales sighted in a day at the same time at Punta Norte ($n=97$), it seems that larger pods (> three whales/pod) spent between one and four days in the same area (Fig. 5), with an exception on May 1995 when seven killer whales remained seven days.

Seasonal distribution for each Pod

PNA Pod (1985–1991)—This pod ($n=6$) was recorded as a group between 1985 and 1993 on 63 occasions (Table 1), after which PNA3 and PNA5 mixed with other pods (see below). PNA pod were

frequent visitors at Punta Norte during December and between February–April. Most observations occurred during the last week of March and the first week in April (see above for SASL distribution during this time). The whales spent no more than five days per week in the area. Between 1989 and 1991, two adult females killer whales (PNA1 and PNA2) were no longer sighted, and have not been seen since January 1992.

PNA3, PNA5 and PNA6 (1992–1993)—In 1992 PNA3, PNA5, and PNA6 were observed on 14 days in both January ($n=11$, 78.6%) and February ($n=3$, 21.4%), and on eight days in March. This is earlier than previous sightings of PNA pod, when A1 and A2 were still observed in the pod. PNA6 has not been sighted since January 1992. During February

encounters, PNA3 and PNA5 were associating with PNB and PNC members. Since 1994, these two killer whales have only been sighted with PNC pod, suggesting they may have joined the group on a more permanent basis.

PNB pod (1985–1997)—This pod was identified at 8 locations over a 1000-km stretch of coastline (400,000 km² area) between Punta Ninfas and Rio Negro estuary (Fig. 4). They were observed traveling a distance of 450 km in 5 days (minimum average speed = 3.75 km/h). PNB1 was photographed in Golfo San José on 9 January 1986 and in Punta Norte 1 day later. Based on a direct route distance of 60 km, this equates to a minimum average speed of 2.5 km/h. Observations carried-out between 1985–1993 showed that between mid-February and mid-April, PNB1 and PNB2 were frequently sighted ($n=110$) at Punta Norte and sporadically sighted ($n=1$) at the Punta Pirámides SASL rookery. Every year between 1985–1993 between April and August PNB pod were observed at Punta Bermeja and the northern part of Golfo San Matias ($n=48$), and during September and October between Punta Norte and Caleta Valdés. For the remainder of the year, they were observed both inshore and offshore off San Matias and Peninsula Valdés. The minimum average speed estimated for PNB pod varied between 2.5 km/hr and 3.75 km/hr. After 1993, PNB1 was no longer sighted.

PNB2 (1994–1997)—This adult male was observed on 97 occasions (Table 1). PNB2 appears to have a different seasonal distribution when accompanied by PNB1, as his sightings then tend to be later in the season (i.e., seven sightings in May–June 1996 when alone, compared to no sightings in May–June 1991 when with PNB1).

PNC pod (1985–1993)—PNC pod was observed on 14 occasions at four locations (Table 1). Although only seen once in November, two times in February, twice in March and once in April between 1985–1993 (off Punta Norte), they were frequently seen in this area before 1985 (J.C. Lopez, pers. comm.).

PNAC pod (1994–1997)—Since the surviving members of PNA pod and PNC pod were first seen together in 1994, they have been sighted together on 64 occasions (Table 1). Despite now being considered a single pod (i.e., PNAC), the integrity of the two separate pods is maintained in the identification catalogue by designation of sub-pod status; PNAC1 (six members) and PNAC3 (three members). PNAC pod was identified at 4 locations and seems to be a year round visitor to Peninsula Valdés (Fig. 4).

Discussion

It is likely, given the correlation between sightings of killer whales and pinnipeds in the area, that seasonal distribution of killer whales is linked to the breeding cycle of the pinnipeds. Most encounters and sightings of killer whales occurred in December and March–May (up to 69% of sightings per year) at Punta Norte, during the SASL pupping and the time that pups first enter the water. Monthly sightings of PNA and PNB Pod showed a similar distribution to the monthly distribution of SASL, while those of PNC pod seem to be related to the distribution of SES. The known distances traveled by killer whales in this study (i.e., 60 km and 450 km) are well below those reported for killer whales within other areas; e.g., 520 km (Leatherwood *et al.*, 1984) and 750 km (Matkin *et al.*, 1997) off Alaska, 700 km off Norway (Lyrholm, 1988) and 3900 km and 4200 km, (Visser, 2000), and 15,600 km (Visser, 1999) off New Zealand. In addition the minimum average speed calculated for one pod in this study (PNB) varied between 2.5 km/hr and 3.75 km/hr, and both these calculations are below those reported for other areas; e.g., 5.1 km/hr for killer whales off Alaska (Matkin *et al.*, 1997) and 4.6 km/hr (Visser, 1999) to 7 km/hr (Visser, 2000) for killer whales off New Zealand. Differences in the distance traveled and traveling speed by killer whales in Northern Patagonia could be explained by prey availability and accessibility to hunting areas. Dans *et al.* (1996) reported Northern Patagonia SASL populations have increased 2.9% annually since 1996. They also reported an increased in the number of SASL pups at Punta Bermeja, Punta Quiroga, Punta León, Islote Lobos, Punta Pirámides, and Morro Nuevo rookeries. On the other hand, the whales frequent the study area only during the breeding season of their pinniped prey (Hoelzel, 1991). At the end of the SASL breeding season, mothers and pups migrated to winter rookeries and the total number of SASL's doubled in some rookeries (Lewis & Ximénez, 1983; Crespo & Pedraza, 1991). Due to this seasonal migration the number of SASL at Punta Buenos Aires, Punta Norte, Punta Pirámides and Punta León decreased, resulting in reduced prey availability for the killer whales.

It is possible the increased availability of prey, during the austral summer and autumn, allows the killer whales in this study to remain in localized areas and to cover their hunting grounds at moderate speeds. However, this summer—autumn behaviour does not preclude these same killer whales traveling larger distances and at increased speeds, during the austral winter, when the SASL are not concentrated at the breeding colonies. Increased

observations during the austral winter could support this hypothesis.

Observation of killer whales were made throughout the year along the Northern Patagonia coastline. At Punta Norte (Fig. 2), killer whales were observed most frequently during December and March–May (up to 69% of sightings per year), when they preyed predominantly on pup and small juvenile SASL and SES. Of note is that in 1995 our first November observation of killer whales, in the Punta Norte region, occurred ($n=6$). This timing corresponds to the end of the SES breeding season, when the pups are about to enter the water (Campagna *et al.*, 1993; Le Boeuf & Laws, 1994; Lewis, 1996). The shift in occurrence of killer whales (i.e., new observations in November) could be explained by a change in the spatial distribution of the SEL seals at Peninsula Valdés. In 1995, 71% of the SES females were distributed between Punta Cerro and Morro Nuevo (southwest of Peninsula Valdés) (Campagna *et al.*, 1996). In 1982, 58% of SES births occurred between Punta Buenos Aires and Punta Cerro (northeast of Peninsula Valdés), as against 36% in 1990 and 28% in 1995 (Campagna *et al.*, 1996). Despite the overall annual 3.4% increase of SES births, their number decreased at Punta Norte (Campagna *et al.*, 1996).

Although only seen once in November, two times in February, twice in March, and once in April between 1985–1993 (off Punta Norte), they were frequently seen in this area before 1985 (J. C. Lopez, pers. comm.).

There could be a link between the new elephant seal distribution and PNC pod seasonal distribution.

The killer whale distribution at Punta Norte (1995–1997) has remained consistent throughout the study period (with the exception of the observations in November 1995). This distribution may be indicative of movements for each subsequent year; however, continuing data collection would show if this trend is consistent.

Comparing all pods, I conclude that larger pods (>three whales/pod) spend no more than 5 days in the same area; by contrast, smaller groups (=two whales/pods) stay longer in the same area. Hoelzel (1991) suggested that killer whales at Punta Norte are social and hunt together and provision each other. Northern Patagonia killer whales group size is associated with foraging (Hoelzel, 1991). Larger pods patrolling pinniped rookeries over multiple day periods may reduce the number of capture rate. The longer periods and higher killer whale counts increase the pinnipeds ability to recognize and avoid danger.

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