MARINE MAMMAL SCIENCE, 12(1):138–147 (January 1996)

SITE FIDELITY AND DISPERSION OF SOUTHERN ELEPHANT SEALS FROM PATAGONIA

Southern elephant seals, *Mirounga leonina*, marked at Península Valdés, Argentina, have been occasionally resighted from southern Brazil to the Falkland (Malvinas) Islands (Laws 1960, Daciuk 1974, Castello 1984). However, data on site fidelity and dispersion during the breeding and molting periods have never been reported for this population, the only one of the species known to have increased in size in the last 20 yr (Campagna and Lewis 1992).

Adult elephant seals have an annual cycle composed of two terrestrial periods (breeding and molt haul-outs) and two pelagic phases (Le Boeuf and Laws 1994). Seals breed in Patagonia from late August to early November and molt from mid-December to March (Campagna *et al.* 1993). About 10,000 southern elephant seals are born each year along 200 km of coastline at Península Valdés (Fig. 1; Campagna and Lewis 1992).

As part of behavioral and demographic studies of elephant seals, serially numbered plastic tags (Jumbo Rototags, Dalton Supplies, England) were placed in the interdigital webbing of one or both hind flippers of 2,309 animals during the period August 1990–November 1994 (Table 1). When an individual was double tagged (n = 281 seals; Table 1) each tag carried a different number. Males older than six years were considered adults (age estimated based on morphological features; Laws 1953). Underyearlings of both sexes (*i.e.*, weaned, fully molted pups; Wilkinson and Bester 1990) were branded in 1968–1970 by Daciuk (1973) and in 1981–1983 by Lewis (1989) (Table 1). Seals were tagged or branded during breeding periods. The age and place of birth of seals tagged as adults were unknown. Site fidelity was defined as returning to the place where an animal was tagged or branded. Dispersion was the changing distribution during the life of a tagged or branded seal (Nicholls 1970).

Efforts to recover tagged seals were concentrated during four breeding (August–November 1991–1994) and four molt periods (December–February 1992–1995). Time invested searching for tagged seals was comparable during the latter breeding and molt periods. Searching efforts for tagged seals during the 1991 molt were concentrated in January and were restricted to Punta Norte, Punta Cantor and Punta Delgada (Fig. 1). Most resights resulted from daily surveys of study sites carried out on foot. We also conducted 2–3 surveys of beaches other than the study sites distributed along the entire rookery around the peak of the breeding period (Campagna and Lewis 1992, Campagna *et al.* 1993). We covered about 20%–30% of the coastline and surveyed 1,500–2,500 females during the breeding period, depending on the year (~20% of the breeding females). About 10% of the coastline was covered during the molt, 1,000–1,500 females (~20% of the molting females). Areas surveyed during the molt overlapped with those of the breeding periods.

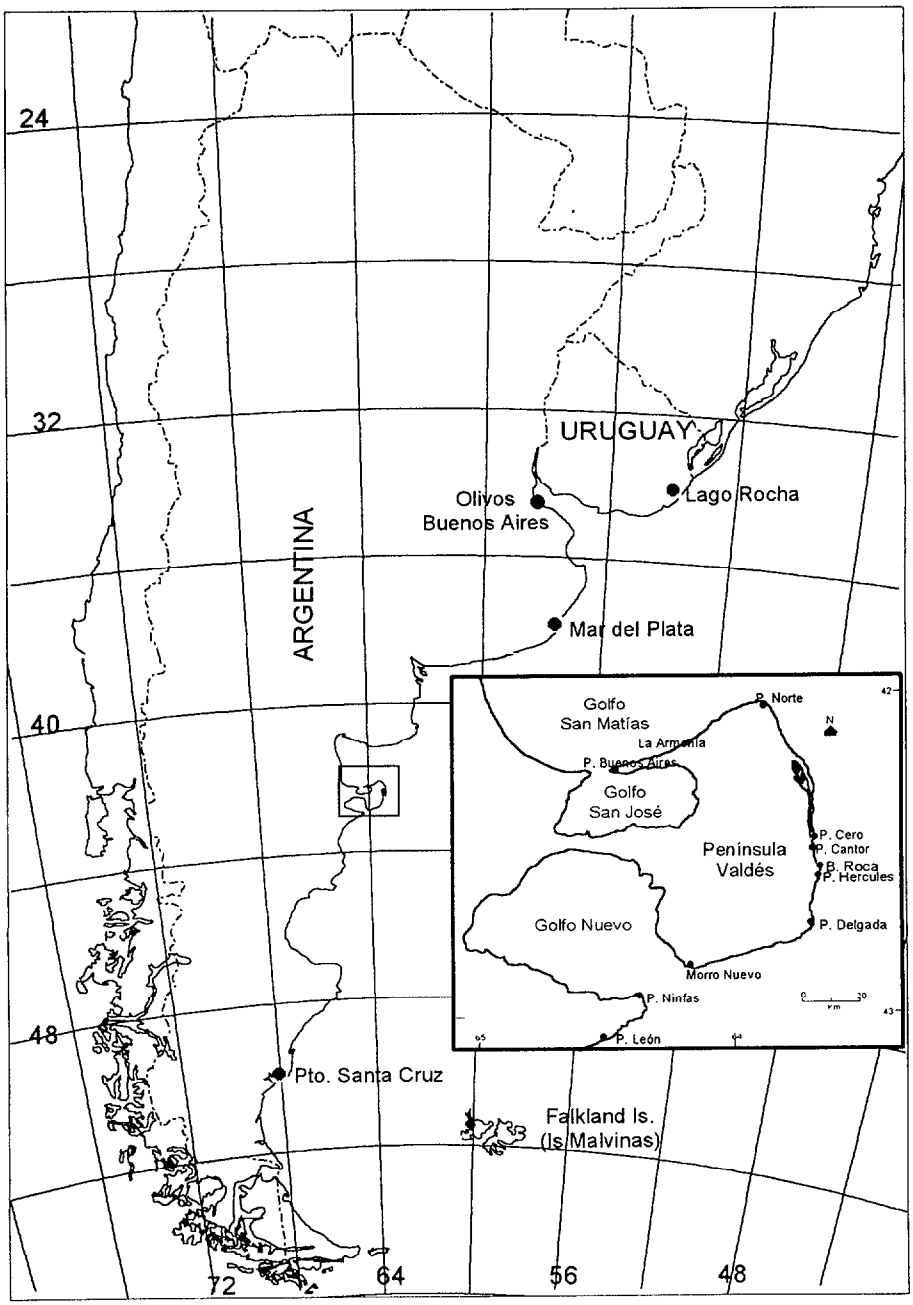

Figure 1. Geographic location of the study area and the places of resights.

Table 1. Number of tagged and branded seals by marking year, sex, and age category. All branded animals were underyearlings (Wilkinson and Bester 1990).

Year	Adult males tagged	Adult females tagged	Total weaned pups tagged (females)	Cumulative sum of tagged seals	Branded seals	Total animals tagged and branded
1968–70	0	0	0	0	500	500
1981–83	0	0	0	0	568	568
1990	33	244	91 (39)	368	0	368
1991	27	35	180 (84)	610	0	242
1992	16	18	34 (15)	678	0	68
1993	500	61	131 (49)	1,370	0	692
1994	118	443	378 (176)	2,309	0	939
TOTAL	694	801	814 (363)	2,309	1,068	3,377
% of the total with 2 tags	12.7	20.6	3.4	12.2	—	—

Seals of both sexes and different age categories marked at Península Valdés were resighted in the area during following breeding and molting periods (Table 2). From 2,309 tagged individuals, at least 30% (398 females, 219 males and 80 juveniles) returned to Valdés during 1–8 haul-out periods (breeding or molt) after being tagged (Table 2). Only adult females were resighted in more than five different periods. Table 3 lists the ten most resighted individuals. Two adult males were seen during four and five consecutive breeding periods including the year of tagging. Only one bull was resighted defending a harem during three consecutive breeding periods (see B4245 in Table 3). Marked weaned pups were rarely resighted as juveniles, but a few were recovered as adults.

The proportion of female resightings was similar for the breeding period and the molt: 26% of 295 tagged animals that could have been resighted during breeding periods *vs.* 25% of 434 animals for the molt (Table 4). From 398 resighted females, 83% were recorded during at least one breeding and one molting period after being tagged (not necessarily consecutive).

Most adult females (86% of 398) were resighted within 0–3 km from where they had been tagged. At least 15 females marked as weaned pups reproduced within 1 km from the place where they were born (two overlapped with their mothers). Ten of them were recorded breeding for the first time (three at age 3 and seven at age 4). Five females branded as underyearlings molted or bred as adults within 1 km of the place where they had been marked 12–20 yr before. The oldest branded female observed breeding was 19 yr old. One male branded as an underyearling in 1983 reproduced at the same beach as a harem male in 1994.

Local movements along Península Valdés ranged up to 120 km from the tagging site, but some seals dispersed more than 1,000 km away from Patagonia (Table 5). Six branded and 19 tagged or dye-marked seals were reported molting in the Falkland Islands. One tagged harem bull bred twice at Península Valdés and subsequently molted twice in the Falkland Islands for two consecutive years,

Table 2. Individuals resighted during 1991–1995 breeding and molting periods from 2,309 tagged seals. Juveniles include tagged weaned pups resighted as yearlings. Each recovered animal was included only in one resight category (*e.g.*, animals seen during eight periods were included exclusively in the "8 resight" category). In parentheses: number of tagged seals expected to be resighted (*e.g.*, for the "only 1 resight" category we recovered 259 adult females from 801 that were tagged and could have been resighted for the first time). The difference between actual and expected resightings reflects mortality, tag loss, and limited searching effort in space and time.

	Resight category								
	Indiv. resighted	Only 1 resight	2	3	4	5	6	7	8
Females	398	259 (801)	48 (358)	29 (358)	24 (297)	20 (297)	11 (279)	4 (279)	3 (244)
Males	219	162 (694)	51 (576)	5 (576)	1 (76)	0 (76)	0 (60)	0 (60)	0 (33)
Juveniles	80	68 (814)	12 (436)	0 (436)	0 (305)	0 (305)	0 (271)	0 (271)	0 (91)
Total	697	489 (2,309)	111	34	25	20	11	4	3

Table 3. The 10 most resighted seals by year tagged and period during which they were recovered. The first seven animals are adult females. The last three are adult males. Note that the number of resights does not include the year of tagging. Data summarized in Table 2 were based on a list similar to the one presented below, including all tagged seals.

Seal	B90	M91	B91	M92	B92	M93	B93	M94	B94	M95	No. of resights
B4038	TAG	X	X		X	X	X	X	X	X	8
B4063	TAG		X	X	X	X	X	X	X	X	8
B4105	TAG		X	X	X	X	X	X	X	X	8
B4286	TAG		X	X	X	X	X	X		X	7
B4024	TAG	X	X	X	X	X	X	X			7
VK190	TAG		X	X	X	X	X	X		X	7
VK197	TAG	X	X		X	X	X		X	X	7
B3853	TAG		X		X		X		X		4
B4245	TAG		X		X		X				3
B8208			TAG		X		X	X			3

Table 4. Resightings of tagged females by period of the annual cycle (B: breeding; M: molt). The number of tagged females indicates the sample size from which the resights were drawn. In parentheses: proportion of females resighted from females tagged.

	Period										Mean	Mean
	B90	M91[1]	B91	M92	B92	M93	B93	M94	B94	M95	B	M
No. of tagged females	244	244	244	279	279	297	297	358	358	801	295 ± 48	434 ± 247
No. of females resighted (%)	—	25	68	65	90	62	82	103	57	202	74 ± 15	108 ± 65
		(10)	(28)	(23)	(32)	(21)	(28)	(29)	(16)	(25)	(26) ± 7	(25) ± 3
% same individuals as previous period	—	100	12	55	40	68	38	49	56	92	37 ± 18	66 ± 19

[1] Survey efforts restricted to a small area (data not included in the mean).

Table 5. Dispersion of individuals that showed low site fidelity (see Fig. 1 for the location of the areas).

	Sex	Age category	No. of individuals	Period[1]	Place of resighting	Distance[2]
Within Península Valdés	M	Adult	4	M	P. Delgada	80
	M	Adult	1	B	Caleta Valdés	50
	F	Adult	3	M	La Armonia	40
	F	Adult	2	M	P. León	70
	F	Adult	1	M	Caleta Valdés	90
	F	Adult	1	B and M	P. Delgada	80
	F	Adult	1	B	P. Norte	40
	F	Adult	1	M	Caleta Valdés	50
	F	Adult	1	B	Bco. Roca	60
	—	Juveniles	11	B and M	P. Hércules	70
	—	Juveniles	6	B and M	Caleta Valdés	50
	M	Juvenile	1	M	P. Buenos Aires	35
	M	Juvenile	2	M	P. Norte	40
	M	Juvenile	1	M	P. León	70
	M	Juvenile	1	M	P. León	120
	F	Juvenile	1	B	P. Norte	40
Outside Península Valdés	M	Adults	15	M	Falkland Islands	>1000
	M	Juveniles	2	M	Falkland Islands	>1000
	F	Adults	2	M	Falkland Islands	>1000
	—	Juveniles	6	M	Falkland Islands	>1000
	M	Adult	1	M	L. Rocha (Uruguay)	≈1200
	M	Adult	1	M	Pto. Santa Cruz	800
	M	Adult	1	M	Mar del Plata	650
	F	Adult	1	M	Olivos (Bs. As.)	1000

[1] M: molting; B: breeding.
[2] Distance from the tagging/branding site in km.

each time at the same beach in both places. One adult male was recorded at a beach in Uruguay (35°S, 55°W), and one female was reported on the coast of Río de la Plata (Olivos, Buenos Aires Province, Fig. 1).

In summary, seals marked at Península Valdés breed and molt close to the place where they were born, tagged, or branded. The low resighting rate of weanlings may be explained by the tendency of juveniles to haul out in places other than their birth site (Bester 1989, Wilkinson and Bester 1990). However, mortality, tag loss, limited area covered, and limited searching time contribute to decreasing the probability of resightings. Postmolt and postbreeding adult females and males travel long distances from the Patagonian coast to their foraging areas (up to 1,800 km; Campagna *et al.*, in press, and unpublished observations). There may be an important link between Península Valdés and the Falkland Islands. However, tagged seals from the Falklands have never been recorded in Valdés, and seals from Valdés have never been seen breeding in the Falklands. No evidence was found that the Valdés population is linked to the large colony of South Georgia Island (see Hoelzel *et al.* 1993).

Our data suggest that some females from Patagonia may show a degree of site fidelity similar to those from Macquarie Island and to their northern counterpart, *M. angustirostris*. A high proportion (77%) of female southern elephant seals branded at Macquarie Island were resighted breeding within a few kilometers of their birth site, showing strong philopatry (Nicholls 1970, Hindell and Little 1988). Likewise, 70% of the northern elephant seal females at Año Nuevo, California, give birth at the same beaches were they copulated the previous year (Reiter *et al.* 1981). Southern elephant seals from populations other than Valdés have also been recorded molting and breeding several hundred kilometers away from their marking site (Laws 1956; Burton 1985; Bester 1988, 1989; Hindell and Little 1988; Guinet *et al.* 1992).

Acknowledgments

We are indebted to Dr. M. N. Bester, Dr. B. J. Le Boeuf, and M. Wainstein for comments on the manuscript; F. Galimberti and M. Wainstein for their help tagging seals during the 1993 and 1994 breeding periods, respectively; the Government of the Province of Chubut for permits to work at Península Valdés; and S. Machinea, E. Prado, Centro Nacional Patagónico and Fundación Patagonia Natural for logistical support. Special thanks to the many colleagues, field assistants, tourist guides, and park rangers who reported tagged seals, especially R. Baldi, F. Galimberti, J. C. López, and R. Kirkwood. Sightings from the Falkland Islands were reported by C. Duck and D. Thompson (Sea Mammal Research Unit, Cambridge, England) and that from Uruguay by G. Praderi. The study was partially funded by grants from Wildlife Conservation Society and the National Geographic Society.

Literature Cited

Bester, M. N. 1988. Marking and monitoring studies of the Kerguelen stock of southern elephant seal *Mirounga leonina* and their bearing on biological research in the Vestfold Hills. Hydrobiologia 165:269–277.

BESTER, M. N. 1989. Movements of southern elephant seals and subantartic fur seals in relation to Marion Island. Marine Mammal Science 5:257–265.

BURTON, H. R. 1985. Tagging studies of male southern elephant seals (*Mirounga leonina*) in the Vestfold Hills area, Antarctica, and some aspects of their behaviour. Pages 19–30 *in* J. K. Ling and M. M. Bryden, eds. Studies of sea mammals in south latitudes. South Australian Museum, Adelaide, Australia.

CASTELLO, H. P. 1984. Registros del elefante marino, *Mirounga leonina,* Carnivora, Phocidae, en las costas del Atlántico S.O. fuera del área de cría. Revista del Museo Argentino de Ciencias Naturales 13:325–243.

CAMPAGNA, C., AND M. LEWIS. 1992. Growth and distribution of a southern elephant seal colony. Marine Mammal Science 8:387–396.

CAMPAGNA, C., M. LEWIS AND R. BALDI. 1993. Breeding biology of southern elephant seals in Patagonia. Marine Mammal Science 9:34–47.

CAMPAGNA, C., B.J. LE BOEUF, S.B. BLACKWELL, D.E. CROCKER AND F. QUINTANA. In press. Diving behavior and foraging location of female southern elephant seals from Patagonia. Journal of Zoology, London.

DACIUK, J. 1973. Notas faunísticas y bioecológicas de la Península Valdés y Patagonia. X. Estudio cuantitativo y observaciones del comportamiento de la población del elefante marino del sur *Mirounga leonina* (Linne) en sus apostaderos de la Provincia de Chubut (República Argentina). Physis C 32:403–422.

DACIUK, J. 1974. Notas faunísticas y bioecológicas de Península Valdés y Patagonia. XIII. Observaciones bioecológicas generales del elefante marino del sur *Mirounga leonina* (Linne) en su apostadero de Punta Norte (Península Valdés, Provincia del Chubut, República Argentina). Physis C 33:203–214.

GUINET, C., P. JOUVENTIN AND H. WEIMERSKIRCH. 1992. Population changes, movements of southern elephant seals on Crozet and Kerguelen Archipelagos in the last decades. Polar Biology 12:349–356.

HINDELL, M. A., AND G. J. LITTLE. 1988. Longevity, fertility and phylopatry of two female southern elephant seals *Mirounga leonina* at Macquarie Island. Marine Mammal Science 4:168–171.

HOELZEL, A. R., J. HALLEY, S. J. O'BRIEN, C. CAMPAGNA, T. ARNBOM, B. LE BOEUF, K. RALLS AND G. A. DOVER. 1993. Elephant seal genetic variation and the use of simulation models to investigate historical population bottlenecks. The Journal of Heredity, 84:443–449.

LAWS, R. M. 1953. The elephant seal (*Mirounga leonina* Linn.) I. Growth and age. Falkland Islands Dependencies Survey. Scientific Report (London) No. 8. 66 pp.

LAWS, R. M. 1956. The elephant seal (*Mirounga leonina* Linn.). II. General, social and reproductive behaviour. Falkland Islands Dependencies Survey. Scientific Report (London) No. 13. 87 pp.

LAWS, R. M. 1960. The southern elephant seal (*Mirounga leonina*) at South Georgia. Norsk Hvalfangst-tidende 10 & 11:466–476, 520–542.

LE BOEUF, B. J. AND R. M. LAWS 1994. An introduction to the genus. Pages 1–26 *in* B. J. Le Boeuf and R. M. Laws, eds. Elephant seals: Population, ecology, behavior and physiology. University of California Press, Berkeley, CA.

LEWIS, M. 1989. Dinámica de la población del elefante marino del sur *Mirounga leonina*, en la Península Valdés. Ph.D. thesis. Facultad de Ciencias Veterinarias, Universidad Nacional de La Plata, Argentina. 107 pp.

NICHOLLS, D. G. 1970. Dispersal and dispersion in relation to the birthsite of the southern elephant seal, *Mirounga leonina* (L.), of Macquarie Island. Mammalia 34: 598–616.

REITER, J., K. J. PANKEN AND B. J. LE BOEUF. 1981. Female competition and reproductive success in northern elephant seals. Animal Behaviour 29:670–687.

WILKINSON, I. S. AND M. N. BESTER. 1990. Duration of post-weaning fast and local dispersion in the southern elephant seal, *Mirounga leonina,* at Marion Island. Journal of Zoology, London. 222:591–600.

MIRTHA LEWIS,[1] CLAUDIO CAMPAGNA[1,2] AND FLAVIO QUINTANA,[1] [1]Centro Nacional Patagónico, 9120 Puerto Madryn, Chubut, Argentina; [2]Wildlife Conservation Society, New York, New York 10460, U.S.A. Received 29 August 1994. Accepted 15 May 1995.