POLISH POLAR RESEARCH
vol. 23, no. 2, pp. 153–159, 2002

Dynamics of male dominance of southern elephant seals (*Mirounga leonina*) during the breeding season at King George Island

Alejandro R. CARLINI[1], Sebastián POLJAK[1], Gustavo A. DANERI[2], Maria E.I. MÁRQUEZ[1] and Joachim PLÖTZ[3]

[1)] *Departamento de Ciencias Biológicas, Instituto Antártico Argentino, Cerrito 1248, (1010) Buenos Aires, Argentina*
< acarlini@dna.gov.ar>

[2)] *Departamento de Mamiferos, Museo Argentino de Ciencias Naturales "B. Rivadavia", Av. Angel Gallardo 470, (1045) Buenos Aires, Argentina*

[3)] *Alfred-Wegener-Institut für Polar- und Meeresforschung, 27515 Bremerhaven, Germany*

ABSTRACT: Southern elephant male seals (*Mirounga leonina* Linnaeus, 1758) were studied at King George Island (62°14´S, 58°40´W) from September to December 1999. The first males came ashore at the beginning of September. Twenty-five adults were immobilized, hot iron branded, and measured. Thirteen out of the 25 marked males spent an average of 66 (±8) days on land. Early arrival was positively correlated with the time spent ashore ($r = 0.88$, $P < 0.05$). Nine harems were formed in the study area. At the maximum haul-out of females (28 October) mean harem size was 32±42 females (range 3–107). During the course of harem development, 10 changes in male harem dominance were observed. These changes were more frequent during the early (1–20 October, $n = 6$) than during the mid (21 October – 10 November, $n = 2$) and late (11–29 November, $n = 2$) periods of harem development. Overall, there were 14 dominant males; five of these in two different harems and nine in one harem. Of the 25 marked males, 44% were resighted in the following breeding or moulting season, and 16% seemed to improve their potential breeding success.

Key words: male competition, southern elephant seal, *Mirounga leonina*, pinnipeds,

Introduction

Southern elephant seals spend most of the year at sea, hauling out on land in large numbers twice a year to breed and molt. Breeding occurs between August and December, with slight shifts in reproductive peak events among breeding grounds distributed widely across latitudes (Laws 1956a). The first adult males arrive at the start of the breeding season and begin to fight each other, thus establish-

ing a dominance hierarchy (Condy 1979, McCann 1980, 1981; Van Aarde 1980). Females begin to arrive 1–4 weeks later than the first males and form aggregations called harems. They give birth about 3–7 days after arrival at the breeding site and nurse their pups for a mean period of 23 days. During the last 3–4 days of the suckling period, the female is in estrus and may be mated several times by one or more males (Laws 1956 b, Condy 1979, Ling and Bryden 1981, Mc Cann 1980, 1983).

A social hierarchy among adult males becomes evident during the early stages in harem development in connection with the ability of males to remain near a female aggregation or to actively group with the recently arrived females. The highest-ranking males are those closely associated to the harems. They maintain their positions near females, keeping away the other males by trumpeting individual calls or by fighting if neither of the males retreats. The social rank reached by a male will thus be related to his reproductive success (Le Boeuf and Peterson 1969, Le Boeuf 1974, McCann 1981). This work reports preliminary results of the male breeding biology of southern elephant seals, emphasizing the changes that occur in male harem dominance throughout the breeding period at King George Island, South Shetland Islands.

Material and methods

The study was carried out at the Potter Cove Peninsula (Site of Special Scientific Interest No. 13) on King George Island (62˚14´S, 58˚40´W), from September to December 1999 (Fig. 1). The animals were resighted between October 2000 and January 2001. The breeding colony is located at the southernmost distribution range of this species. During the 1999 season 25 adult males were immobilized using ketamine hydrochloride (Carlini *et al*. 1997), hot iron branded (Ingham 1967), and measured for total length and axillary girth. Checks were carried out on foot every second to fourth day throughout the breeding season and the number of pups, adult males, and females was registered. An adult male was considered as principal or dominant if he had control of a harem for at least two days during its development, and as subordinate when he was unable to defend harems, remaining close to them in a peripheral position. For comparative purposes, the breeding season was divided into an early period (from the birth of the first pup until 20 October), middle period (21 October – 10 November) and late period (11 November onwards until the last females departed). During the 2000 breeding season, the study area was checked weekly in search of marked adult males. The positions of these males in the harems were registered.

Statistics are presented as mean and standard deviations. Student´s t-tests were conducted to analyze differences between the means of independent samples. Pearson product-moment correlation was used to measure the strength of association between pairs of variables.

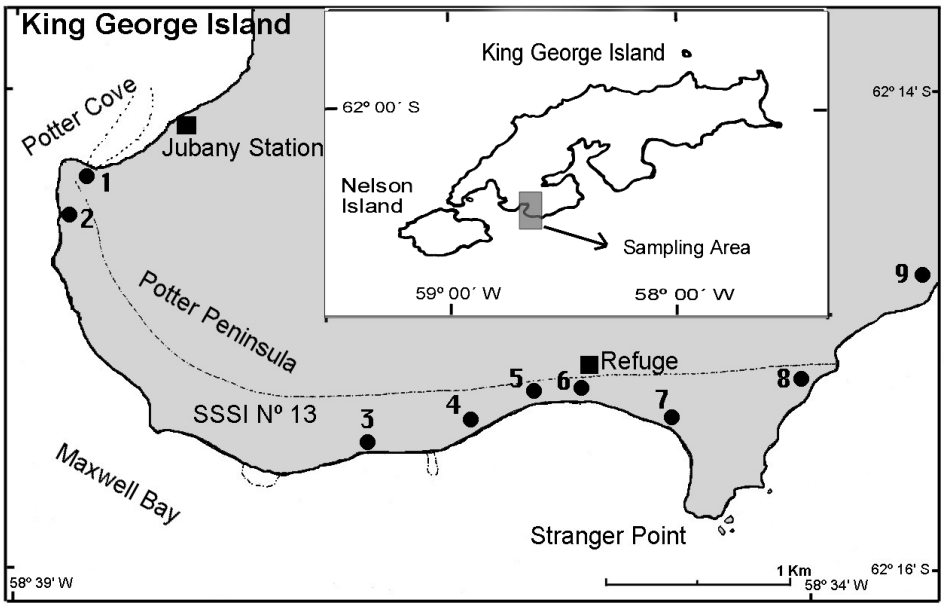

Fig. 1. Study area and its geographic location. Harems (marked with numbers 1–9) formed in the study area during 1999 breeding season.

Results and discussion

The first males came ashore on 16 September, while the first females did so on 24 September, reaching the haul-out peak on 28 October. Females formed nine harems located along the 7 km of coast (Fig. 1), with a mean harem size of 32 ± 42 females (range 3–107) at maximum haul-out (Fig. 2). Until females arrived at the breeding site, interaction among males in order to defend specific positions on the beach was scarce; males were frequently observed lying on the beach and changed their positions from one census day to the next. As the first females arrived, competition between *males* was more frequent, however, only three males were observed taking part in the development of the harem, actively grouping females as soon as they arrived at the breeding beach. During the early part of the breeding season (1 October – 20 October) the greatest number of changes (n = 6) in male harem dominance was registered (Fig. 3). Some of these changes were accompanied by interactions between males and a succession of replacements in which the previously dominant male retreated and became dominant in another smaller harem, as was the case with the male sequence ST2, ST3, ST7 (Fig. 3). Additionally, during this early stage some males left their dominance positions without engaging in antagonistic encounters, leaving their "original" harem without a male. These movements occurred in female groups when they had less than five females and were observed, for example, in males ST2,

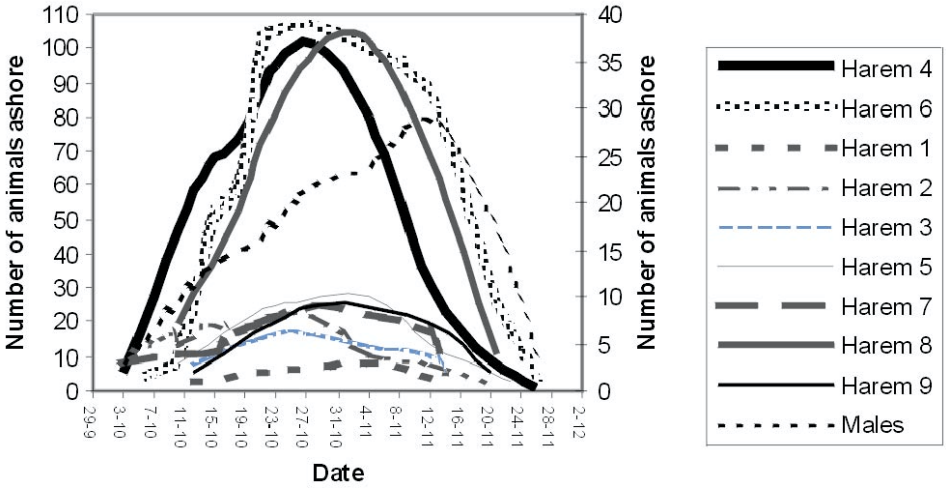

Fig. 2. Number of adult females and males associated with some harems (as dominant or subordinate) throughout the breeding period. Harem numbers 4 and 6 are shown on the left Y axis, while harem numbers 1, 2, 3, 5, 7, 8, 9 and males are shown on the right Y axis.

ST3, ST5 and ST7, which competed for bigger female groups. In those cases when a male lost his fight, he returned to his "original" harem, taking up again the principal position (see Fig. 3, dotted lines). Therefore, during the early stages, when no or very few females could have been in estrus, males moved from one harem to another in an attempt to settle in bigger ones, which offered a higher possibility of mating. During the middle period (21 October – 10 November) there were two changes in male harem dominance (Fig. 3). These changes may have had a greater effect in male reproductive success since a large portion of the total number of females at the peak haul-out were present at this stage. This was observed in harems number 7 and 8 before and after the peak haul-out of females, respectively. In the latter case 90% of the females were still present. In contrast to the behaviour observed in the early part of the breeding season, when deposed males frequently took principal positions in smaller harems (Fig. 3), the deposed males in the middle period remained for 4–7 days as subordinate in the same harem (ST9) or in another harem (ST8). After this 4–7 day period these males left the harems, remaining on the beach until the end of the breeding season (28 November). The two changes observed at the end of the breeding period involved harems 2 and 4, which had been previously left by dominant males ST5 and ST2 respectively. In addition, the two dominant bulls ST1 and ST10, from harem numbers 1 and 7 moved to other female groups when the last females in their "original" group departed (Fig. 3). ST1 and ST10 were observed in their new harems (numbers 2 and 4 respectively) for a period of eight days until the last females from these harems departed. It is probable that most females from harem

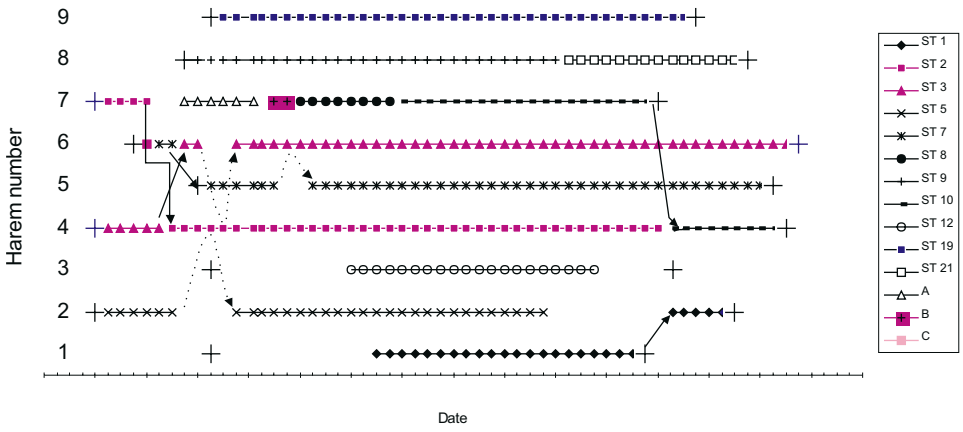

Fig. 3. Changes in male harem dominance during the course of the breeding season. (1–9) harem number; ST1, ST2 etc. dominant males; A, B, C dominant males who were not immobilized. (+) indicates the initial and final day for a given harem. Blank space: time when no male was associated to a given harem.

numbers 2 and 4 had copulated with the preceding harem bull. Therefore, dominating a new female group at the end of the breeding season may have offered little chance for the males to extend their own breeding success.

In this study, total body length instead of mass estimation was used to compare size among males, since measurements were taken throughout breeding and uxillary girth varies to a greater extent during that period due to the fasting associated with the breeding system in this species. Males which were dominant in some of the harems during the breeding period were longer than those which occupied only subordinate positions (4.88 ± 0.28; n = 11 vs. 4.63 ± 0.18 meters; n = 13, T-Test P = 0.02, df = 22). This is not unexpected, because dominance rank is determined primarily by fights that involve pushing and shoving on land so greater size should be advantageous (Le Boeuf 1974). However, the relation between length and dominance could be due to the fact that longer males were also older and more experienced, a fact that might help them to reach a high rank, as was demonstrated in the northern species *Mirounga angustirostris*, Gill 1866 (Le Boeuf and Reiter 1988, Clinton and Le Boeuf 1993). For instance, Clinton (1990) (quoted in Haley *et al*. 1994) did not find an association between dominance and standard length within known-age cohorts in the northern elephant seal.

In this study, arrival dates were known for 11 of the 14 males which took a dominant position at some time during the breeding season. The date of arrival of these males ranged between 16 September and 5 October, so all these males, who later became dominant males, were present at the breeding site when less than 10% of the maximum number of females were ashore. Early arrival implies a greater depletion of energy reserves. Since it is unexpected that the first females come into estrus before 20 September, the greater effort by males put into an early arrival

could be related to the benefit of prior residence at the beach. Early arrival at the breeding site seems to be a factor which helps males to attain a high dominance rank because of their prior resident status (Haley *et al*.1994); and a high dominance rank in turn leads to high reproductive success (Le Boeuf and Peterson 1969, McCann 1981, Haley *et al*. 1994, Galimberti and Boitani 1999). In our study, arrival date was also associated with time spent at the breeding beach, which was known for 8 of 14 dominant males ($r = 0.90$, $P < 0.05$, $n = 8$). Mean total time in the area (67 days) was similar to that reported for dominant males at Península Valdés (Campagna *et al*. 1993), Falkland Islands (Galimberti and Boitani 1999) and South Georgia (Fedak *et al*. 1994).

During the 2000 breeding season, seven of the 25 marked males came back to Stranger Point and four others were resighted after the end of breeding. Two of the males observed during breeding were present in the study area for less than three days. Four of the remaining five males seemed to improve their potential breeding success either by dominating greater harems (three males) or becoming a dominant bull during the season after being subordinate during 1999 (one male). The other male was deposed earlier during breeding and remained on the beach until the end of the breeding season. Therefore, for the five animals who actually remained throughout the breeding period, there seemed to be an increase in reproductive success from one season to the next, which is in agreement with observations made by Baldi *et al*. (1996) at Península Valdés. Moreover, Le Bouef (1974) showed that in the northern congener adult males were able to be dominant for two or three consecutive breeding seasons, dying shortly after their reproductive peak. Interestingly, the two males which had the highest rank during 1999 (this study) were not present on the beach during the breeding and moulting season of the next year.

Acknowledgements. — We want to thank R. Montiel, M. Gasco and M. Alcalde for field assistance, and two anonymous reviewers for their valuable comments on the manuscript.

References

BALDI R., CAMPAGNA C., PEDRAZA S., and LE BOEUF B.J. 1996. Social effects of space availability on the breeding behaviour of elephant seals in Patagonia. — Animal Behaviour, 51: 717–724.

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

CARLINI A.R., DANERI G.A., MARQUEZ M.E.I., SOAVE G.E. and POLJAK S. 1997. Mass transfer from mother to pups and mass recovery during the post-breeding foraging period in southern elephant seals (*Mirounga leonina*) at King George Island. — Polar Biology, 18: 305–310.

CLINTON W.L. and LE BOEUF B.J. 1993. Sexual selection´s effects on male life history and pattern of male mortality. — Ecology, 74: 1884–1892.

CONDY P.R. 1979. Annual cycle of the southern elephant seal *Mirounga leonina* (Linn.) at Marion Island. — South African Journal of Zoology, 14: 95:102.

FEDAK M.A., ARNBOM T.A., MCCONELL C., CHAMBERS C., BOYD I.L., HARWOOD J. and MCCANN T.S. 1994. Expenditure, investment and acquisition of energy in southern elephant seals. — *In*: Le Boeuf B.J. and Laws R.M. (eds.), *Elephant eeals, Population Ecology Behavior and Physiology*. University of California Press, Berkeley; 354–373.

GALIMBERTI F. and BOITANI L. 1999. Demography and breeding biology of a small, localized population of southern elephant seals (*Mirounga leonina*). — Marine Mammal Science, 15: 159–178.

HALEY P.H., DEUTSCH C. and LE BOEUF B.J. 1994. Size, dominance and copulatory success in male northern elephant seals, *Mirounga angustirostris.* — Animal Behaviour, 48: 1249–1260.

INGHAM S.E. 1967. Branding elephant seals for life-history studies. — Polar Record, 13: 447–449.

LAWS R.M. 1956a. The elephant seal (*Mirounga leonina* Linn.) II General, social and reproductive behaviour. — Falkland Islands Dependencies Survey Scientific Reports, No. 13: 1–88.

LAWS R.M. 1956b. The elephant seal (*Mirounga leonina* Linn.) III The physiology of reproduction. —Falkland Islands Dependencies Survey Scientific Reports, No. 15: 1–66.

LE BOEUF J.B. 1974. Male-male competition and reproductive success in elephant seals. — American Zoologist, 14: 163–176.

LE BOEUF J.B. and PETERSON S. 1969. Social status and mating activity in elephant seals. — Science, 163: 91–93.

LE BOEUF B.J. and REITER J. 1988. Lifetime reproductive success in northern elephant seals. — *In*: Clutonn-Brock T.H. (ed.), *Reproductive success*. University of Chicago Press. Chicago; 344–362.

LING J.K. and BRYDEN M.M. 1981. Southern elephant seal *Mirounga leonina* Linnaeus, 1758. — *In*: Ridgway S.S. and Harrison R.J. (eds.), *Handbook of Marine Mammals. Vol. 2, Seals*. Academic Press, London; 297–327.

MCCANN T.S. 1980. Population structure and social organization of southern elephant seals, *Mirounga leonina* (L.). — Biological Journal of the Linnean Society, 14: 133–150.

MCCANN T.S. 1981. Aggression and sexual activity of male southern elephant seals, *Mirounga leonina*. — Journal of Zoology, 195: 295–310.

MCCANN T.S. 1983 Activity budget of southern elephant seals, *Mirounga leonina*, during the breeding season. — Zeitschrift für Tierpsychologie, 61: 111–126.

VAN AARDE R.J. 1980. Harem structure of the southern elephant seal *Mirounga leonina* at Kerguelen Island. — Revue d'Ecologie (La Terre et la Vie), 34: 31–44.

Received September 5, 2001
Accepted January 29, 2002