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Aggression between females of the Southern Fur Seal (*Arctocephalus australis*) in Uruguay

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INTRODUCTION

The Southern Fur Seal (*Arctocephalus australis*) is a colonial breeding otariid species that ranges from the Atlantic coast of Uruguay and Argentina, around the Cape Horn, and north to the Pacific coast of Chile and Peru (Majluf, 1987). Harcourt (1992a) examined levels of female aggression at a Peruvian colony of *A. australis*, and found that it was several orders of magnitude higher than at any phocid colony, and significantly greater than in other otariid colonies.

The aims of this paper are to provide a description of female aggressive behaviour of *A. australis* on the Atlantic coast of South America (Uruguay), to examine the role of maternal aggression in the defence of offspring from conspecifics, in particular females, and to compare data with those obtained by Harcourt (1992a) in Peru. The types and frequency of occurrence of aggressive encounters are described and the aggression of females with and without pups are compared. Fur seals make daily movements from high and dry levels of the rookeries to cool off in wet areas or in the sea, and the fringe of wet rocks near the sea appears to be the optimal area for breeding females (Majluf, 1987; Vaz Ferreira & Ponce de León, 1984). Therefore, changes in levels of female aggression with time of the day and location were also investigated.

METHODS

A colony of *A. australis* was studied from 5 November to 17 December 1996, and between 17 and 30 December 1997, on the largest of the three Torres islands, Rasa island (≈ 65 000 m^2), located 500 m from Polonio Cape (34°24′S, 53°46′W), north-eastern Uruguay (Ximenez, 1973). Observations were conducted from the continental coast at the nearest point to the island (≈ 500 m), using a 60×-telescope and an audio tape-recorder. This fixed point allowed a clear view of the western half of the island, where the adult population in view numbered ≈ 2000 (M. H. Cassini, unpublished data).

Females were observed daily during two time periods: 11.30–15.00 hours and 17.00–19.00 hours. At each day, from two to ten (usually six) 10-min samples of the behaviour of females were collected. Pseudo-replication effects were precluded by the random selection, from many potential subjects, of focal females for each sample. A tripod with a vertical and a horizontal graduated scales was used. The telescope was pointed in a direction within the colony by selecting randomly the angles of observation, and the female located nearest to the centre of the visual field was observed. The record was excluded if the female moved more than one female length. By this method, I obtained a colony index of female aggressiveness at this site.

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The number of females located < 1 female length from the focal female was recorded at the beginning of each sample period. This value was considered as a relative index of female density for comparisons of different sites and times of the day. Absolute estimates of female density were not obtained because there were animals not seen due to deep ground.

The following categories of aggressive behaviour were continuously recorded (Martin & Bateson, 1986): 'open mouth' – the female orientated her head and open mouth toward her opponent; 'neck shake' – the female moved her head repeatedly with her mouth open near her opponent's mouth; and 'bite'. The opponents could be females, territorial males, juveniles or pups.

A female was considered 'with pup' if she positively interacted with a pup or when a pup was in contact with her without receiving aggressive acts from her. A female was considered 'without pup' if pups were not observed at < 1 female length from her or when she threatened pups located near her.

Females that received threats from the focal female were classified as 'residents' if they were observed in the vicinity of the female from the beginning of the sampling period and did not change locations, and 'transients' when they approached or passed near the focal female. Transient females were normally those that were heading towards or returning from the sea.

Female locations were classified according to vertical distance from the water: 'wet rocks' corresponded to the lowest level where the sea continuously wet the rocks, and 'dry rocks' corresponded to the highest level. At the latter level, females were followed only when they were located in the first meters nearest to the 'wet rocks'.

After each sampling period (i.e. once at midday and once in the evening), the number of moving adults in the total sampling area was scanned. In this way, two counts per day were obtained of the level of activity of the colony.

RESULTS

Focal females were observed during 179 sampling periods. The overall rate of aggression was 4.0 per 10 min (SE = 0.3). The most common type of aggression was 'open mouth' (mean rate = 3.21, SE = 0.25). 'Neck shake' was less frequent (mean rate = 0.69, SE = 0.10) and 'bites' were rare (mean rate = 0.11, SE = 0.03). Most threats by females were directed toward other females (mean rate = 2.30, SE = 0.22), followed by adult males (mean rate = 0.58, SE = 0.10). The overall rate of female–pup aggression was relatively low (mean rate = 0.22, SE = 0.05). The other aggressive acts were directed towards juveniles, sub-adults, *Otaria flavescens*, or no identified recipients.

Aggression toward transient females (mean rate = 1.40, SE = 0.17) was significantly more frequent (Wilcoxon rank test, $Z = 2.45$, $P = 0.01$) than toward resident females (mean rate = 0.90, SE = 0.11). Female–female aggression by females without pups (mean rate = 1.85, SE = 0.21) was significantly lower (Mann–Whitney test, $Z = -1.99$, $P < 0.05$) than by females with pups (mean rate = 3.19, SE = 0.51).

At midday, Fur Seals located at the high and dry levels of the rookery moved to the low and wet areas or to the sea. As a consequence, the number of Fur Seals changing locations was significantly higher (Mann–Whitney *U*-test, $Z = -9.45$, $P < 0.0001$) at midday ($n = 72$, mean = 15.6, SE = 0.5) than in the evening ($n = 77$, mean = 7.0, SE = 0.3). Consequently, the rate of female–female aggression at midday ($n = 94$, mean = 3.1, SE = 0.3) was significantly higher (Mann–Whitney *U*-test, $Z = -4.09$, $P < 0.0001$) than in the evening ($n = 85$, mean = 1.4, SE = 0.2).

The fringe of wet rocks near the sea was expected to be an area where competition for space was high during the hottest hours of the day. Table 1 shows the correlations between

Table 1. Spearman rank correlations between female aggression and density

Area of rookery	Time	r_s	P
High, dry	11.30–15.00	–0.12	0.38
	17.00–19.00	0.04	0.75
Low, wet	11.30–15.00	0.47	0.003
	17.00–19.00	–0.16	0.42

female aggression rates and female density at different sites and times of the day. Female–female aggression was positively correlated with female density in low-level areas at midday, but no significant correlations were found at high levels or in the evening.

DISCUSSION

The female aggression rate that I recorded for *A. australis* in Uruguay (4 threats per 10 min) was similar to the rate recorded in Peru (5.5 threats per 15 min, Harcourt, 1992a). As occurs in Peru, Uruguayan Female Fur Seals made daily movements from high and dry levels of the rookeries to thermoregulate in low and wet areas or in the sea. Consequently, female movements and density in wet areas increased during the hottest hours of the day. I found that female aggression increased at midday in association with these thermoregulatory activities. In contrast, no significant changes on female aggression during the day were found in high and dry areas of the rookery.

In summary, female aggression towards conspecifics appears to have similar functions and intensities at different colonies of *A. australis*. On the contrary, differences were found in the role of female aggression in the defence of pups from Sea Lion (*Otaria flavescens*) attacks: while in Peru it was found that females rarely defended their pups from raiding Sea Lions (Harcourt, 1992a), in Uruguay females attempted to recover the pup in 31% of the attacks by Sea Lions and exhibited aggression toward the abductor (Cassini, 1998). Cassini (1998) associated this difference with the fact that in Uruguay both species use the same islands for reproduction while in Peru they reproduce allopatrically.

In colonial breeding pinnipeds, pup mortality is known to be density-dependent (Anderson *et al*., 1977; Doidge, Croxall & Baker, 1984; Fowler, 1987; Harcourt, 1992b; LeBoeuf & Briggs, 1977). Deaths of pups occur mainly when social events separate them from their mothers, and consequently they starve, are crushed by territorial males, or suffer aggression from alien females. In this social context, the function of aggression in female pinnipeds is expected to be related to the protection of new-born pups from conspecifics. I found that female–female aggression was related to the defence of offspring in *A. australis* on Rasa Island. A similar function of female–female aggression was previously described for the same species in Peru (Harcourt, 1992a) and for most colonial pinnipeds (Rand, 1967; Marlow, 1975; Christenson & LeBoeuf, 1978; Boness *et al*., 1982; McCann, 1982; Vilá & Cassini, 1990; Carey, 1992). In conclusion, female–female aggression appears to be a generalized behavioural expression of competition between females for maximizing their offspring's survival during the breeding season.

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