

**Seasonal movements of the South American sea lion
(*Otaria flavescens*, Shaw)
off the Rio Grande do Sul coast, Brazil**

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Summary. – From 1977 to 1986, 292 dead specimens of *Otaria flavescens* (synonymy *O. byronia*) found between Hermenegildo (33°40'S) and Barra do Estreito (31°51'S) in southern Brazil were examined. From April 1985 to May 1986 observations were conducted on hauled-out individuals on the eastern jetty at Lagoa dos Patos (32°10'S). Sea lions apparently move north from rookeries in Uruguay after the breeding season. Most animals (81 %) were males, represented mainly by immature individuals. Females were mainly adults. The species is present on the Rio Grande do Sul coast in large numbers from April to June. The extremity of the eastern jetty is a resting area for males, with larger numbers being observed early in the morning, decreasing during the day and increasing again in the evening. Although females were observed on the jetty, no reproductive activity was noted. Of the 292 carcasses analysed, 29.8 % presented signs of interaction with fisheries. Instances of aggressive behaviour from fishermen towards sea lions were recorded.

Résumé. – De 1977 à 1986, 292 lions de mer, *Otaria flavescens*, trouvés morts sur la côte sud du Brésil, ont été examinés. D'avril 1985 à mai 1986, des observations ont été faites sur des individus pris dans des chaluts. Ces lions de mer se déplaçaient apparemment vers le nord, depuis les rookeries d'Uruguay, après la saison de reproduction. La plupart des animaux (81 %) étaient mâles, surtout des immatures. La plupart des femelles étaient adultes. L'espèce est présente en grand nombre d'avril à juin sur la côte du Rio Grande do Sul. L'extrémité orientale de l'estuaire est une zone de repos pour les mâles, beaucoup d'entre eux pouvant être observés tôt le matin, leur nombre décroissant pendant le jour et croissant à nouveau le soir. Bien que des femelles y aient été observées, on n'a noté aucune activité de reproduction. Sur les 292 carcasses examinées, 29,8 % présentaient des signes d'interactions avec les pêcheurs. On a pu noter des comportements agressifs de pêcheurs vis à vis des lions de mer.

INTRODUCTION

Otaria flavescens (Shaw, 1800) is the most common pinniped on the Rio Grande do Sul coast, particularly during the austral autumn and winter (Pinedo 1986). Its dis-

tribution extends along the coast of South America from 4°S in the Pacific Ocean (Vaz-Ferreira 1981, 1982; Vieira 1955) to 13°S in the Atlantic (Castello 1984). In Brazil, the only known haul-out areas are the eastern jetty at the mouth of the Lagoa dos Patos (32°10'S; 52°06'W), and Ilha dos Lobos (29°20'S; 49°43'W) (Mariano 1983; Vaz-Ferreira 1981, 1982), both areas located on the Rio Grande do Sul coast. This State, therefore, is considered to represent the northern limit of the species (Rosas 1989; Cappozzo and Rosas 1991), although individuals are occasionally sighted further north.

According to Vaz-Ferreira (1981, 1982), *O. flavescens* is not migratory, although seasonal movements by males may be significant. Vaz-Ferreira (1981) suggested that the northern limit of reproduction of this species is Isla Lobos de Tierra (06°30'S; 80°51'W, Peru) in the Pacific Ocean, and Ilha dos Lobos (29°20'S; 49°43'W, Brazil) in the Atlantic. The breeding season of the species on the Atlantic side extends from mid-December to mid-February (Campagna 1985).

This study provides data on seasonal movements of *O. flavescens* by sex and age of animals found dead along the southern Rio Grande do Sul coast from 1977 to 1986, as well as data on sea lion / fisheries interactions based on evidence revealed by the carcasses examined and by direct observations.

MATERIAL AND METHODS

The study area included 262 km of beach on the Rio Grande do Sul coast, between Barra do Estreito (31°51'S) and Hermenegildo (33°40'S). Due to the problem of surveying such a large area for stranded animals, it was subdivided into two areas: the Southern Area, between Hermenegildo and Farol de Sarita, and the Northern Area, between Farol de Sarita and Barra do Estreito (Fig. 1). From March 1977 until December 1986, one to three monthly surveys were conducted in the Northern Area. In the Southern Area, surveys were carried out every two months, from June 1985 until December 1986.

The unit of effort used was the distance in kilometers of beach surveyed. In order to eliminate seasonal effects, the mean numbers of animals found in each area during the same period of the year were calculated. Data for all years were pooled and stratified by sex, age, and season (Summer = January-March; Autumn = April-June; Winter = July-September; Spring = October-December).

Sex of specimens was anatomically determined whenever carcass conditions permitted. In very decomposed animals, rostral and mandibular indices, or canine crown angles were used to assign sex according to Crespo (1984). Age was estimated by counting growth-layer groups (GLG) in longitudinally sectioned teeth of 134 males and 41 females (Rosas *et al.* 1993). For purposes of age composition, five to six-year-old males were considered subadults and females of age four or older were considered adults (Hamilton 1934, 1939; Vaz-Ferreira 1981; Ximenez 1976). Carcasses were carefully examined for evidence of net marks and gunshot wounds. A total of 143 skulls were collected, cleaned and examined for signs of broken bones. These skulls were deposited in the collection of the Marine Mammals Laboratory of Universidade do Rio Grande. Net marks, gunshot wounds and broken bones were used as a measure of interaction of the species with the fisheries.

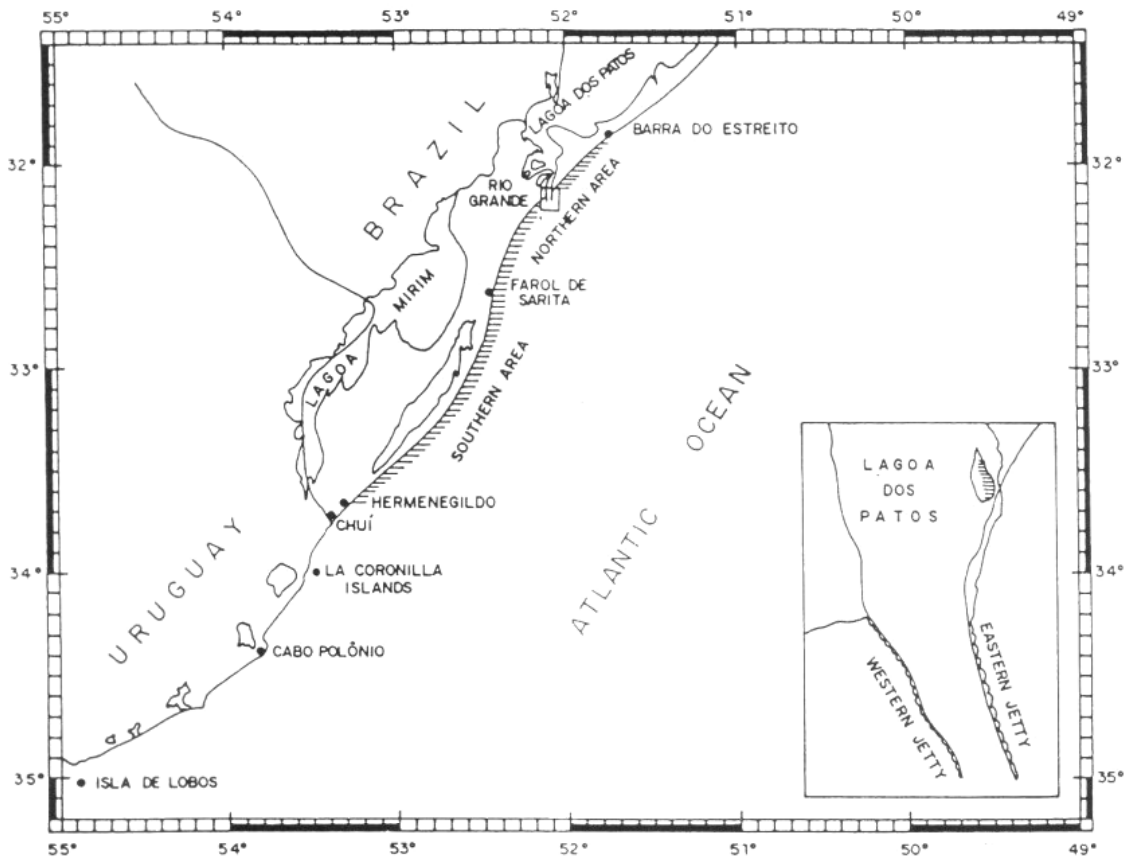


Fig. 1. – Map of the study area. Insert shows detail of the jetties at the mouth of Lagoa dos Patos.

Observations of hauled-out sea lions were conducted for two consecutive days every 15 days, at the mouth of Lagoa dos Patos, from April 1985 until May 1986. Sea lions were hauled out at the extreme point of a 4 km long, granite-boulder jetty, that extends seaward from the east side of the estuary mouth (Fig. 1). On each field trip, animals were observed from 10h00 until nightfall, and on the following day from sunrise to approximately 15h00. Sex ratio of the group and presence of natural markings are recorded. Aggressive attitudes towards the animals on the jetty by fishermen in boats were recorded as a measure of the fisheries interaction intensity.

Whenever possible, the males on the jetty were visually classified as juveniles (young animals without any sign of mane), subadults (body slimmer than adults, and although a mane is present it is not very big), and adults (presence of a very huge mane). A total of 405 hours of observations were conducted on the jetty during the 13-month study period. During this time, for purposes of identification, 20 animals were colour marked by one of two methods: 1) chicken-egg shells filled with commercial oil paints; 2) pellets, especially designed for animal marking. Eggs were thrown at the animals by hand, and pellets were propelled with a slingshot. Sex, date of marking, and colours used were recorded for each marked animal, along with sketches of location and shape of marks on the body. Whenever possible, artificially-marked animals or those with natural marks (e.g., depigmentation, nail inflammation on the hind limbs, scars) were photographed using a 35 mm camera equipped with a 200 mm lens.

RESULTS

The average number of dead animals recovered per kilometer was significantly higher ($P < 0.05$) in the Southern Area ($\bar{x} = 0.047$ individual per km) than in the Northern Area ($\bar{x} = 0.012$ individual per km) (a four-fold difference).

Sex was identified in 263 of 292 stranded animals, 81 % being males. The predominance of males was statistically significant from April to December in the Northern Area ($P < 0.001$) and from January to March in the Southern Area ($P < 0.01$) (Table 1).

During winter, both sexes showed greater frequencies per kilometer surveyed in the Northern Area. In the Southern Area, the maximum frequency of males occurred in summer, with a secondary peak in winter. Females in this area showed the greatest frequency in winter, but they were absent in summer (Fig. 2).

TABLE 1. – Results of Chi-square test using the Yates correction for continuity (X^2) applied to the proportion of male and female *O. flavescens* observed seasonally in the Northern and Southern survey areas

Seasons	Northern Area		Southern Area	
	Male : Female	χ^2	Male : Female	χ^2
Summer	3 : 2		12 : 0	10.083**
Autumn	19 : 3	10.227***	14 : 5	3.368 ns
Winter	67 : 11	38.782***	15 : 14	0.000 ns
Spring	68 : 7	48.000***	15 : 8	1.565 ns
TOTAL	157 : 23	98.272***	56 : 27	9.446**

ns = $P > 0.05$ (not significant)

** = $0.01 > P > 0.001$

*** = $0.001 > P$

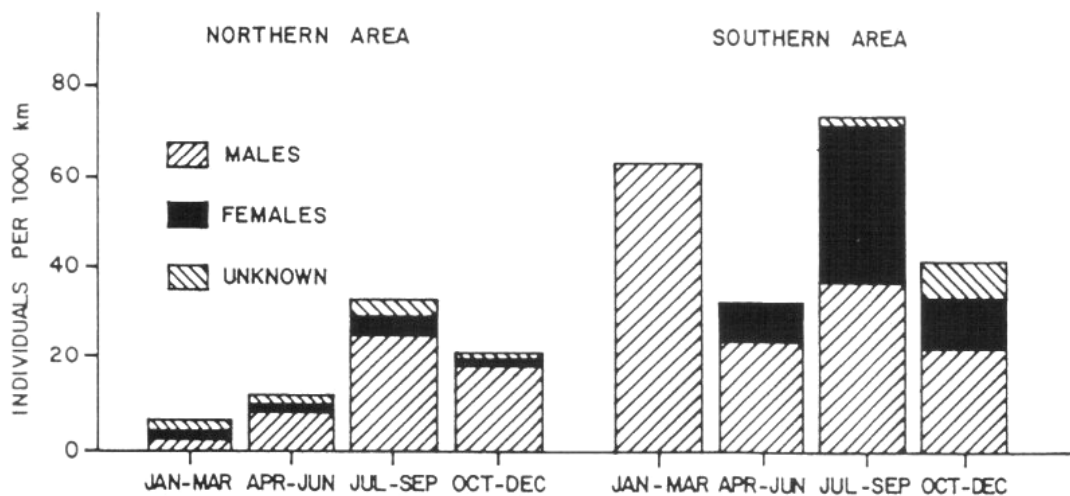


Fig. 2. – Frequency distribution of males, females and unsexed *O. flavescens* per 1000 kilometers of beach, by seasons, in the Northern and Southern areas.

The most frequent ages were 3 and 5 years for males, and 3 and 4 years for females. Young individuals of 0 to 2 years were recorded only in the winter and spring. Although present throughout the year, males older than 3 years were more frequent during the spring (Fig. 3). Females older than 3 years were also present throughout the year, but were most frequent during the winter and spring (Fig. 3).

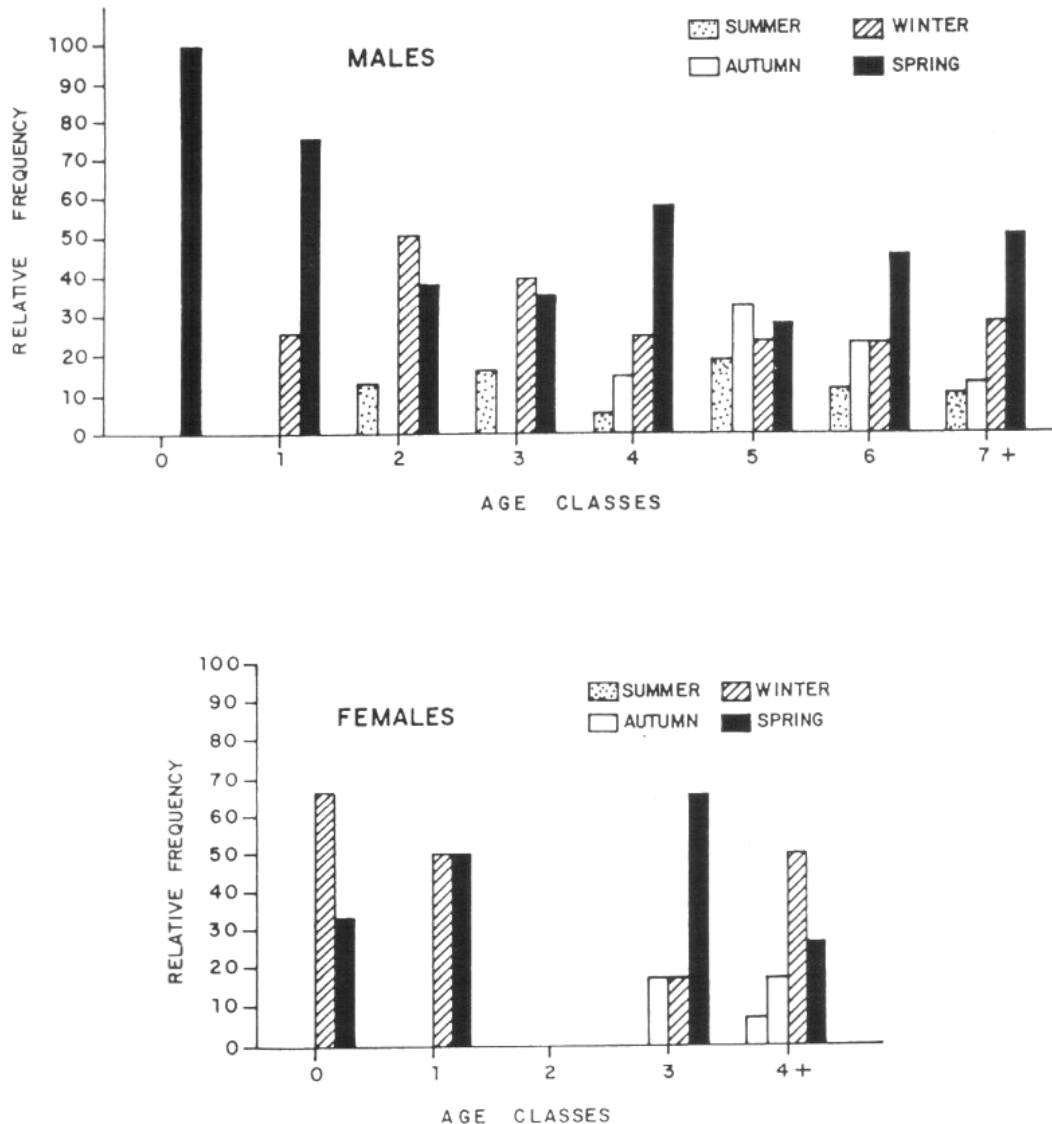


Fig. 3. – Seasonal frequencies of stranded male and female *O. flavescens* in the study area. The adult stages of each sex are grouped.

Maximum number of sea lions present at any one time on the jetty was 27, observed on 16 September 1985. The following day, however, only seven sea lions were counted, indicating a great variation in numbers from one day to the next. The number of sea lions hauled out also varied over the course of the day. Numbers were highest early in the morning, decreased during the day and increased again at the end of the day (Fig. 4).

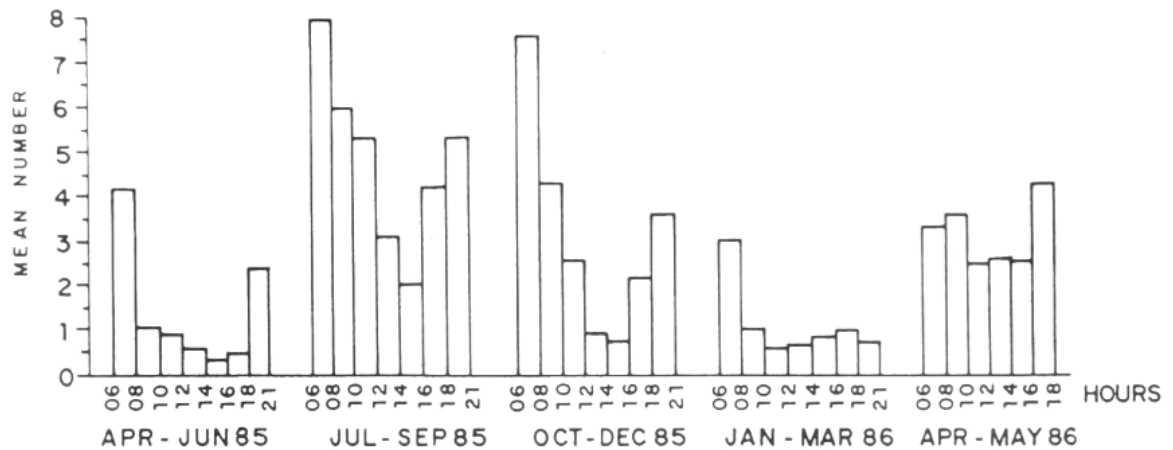


Fig. 4. — Mean number of sea lions observed on the eastern jetty at different times of the day, 1 seasons.

Eight (30 %) of the 27 sea lions with natural marks recorded were resighted on the jetty : three on the day immediately following the first sighting and the remainder 42 to 345 days later. Seven (35 %) of the 20 artificially-marked animals were resighted. Most of these were seen on the day after having been marked. Marks produced by pellets and eggs were not resighted longer than 14 and 8 days, respectively.

Five out of ten sea lions paint-marked on the first day of the survey reappeared on the jetty the following day. The resighting of natural marks was less reliable, since some of them were not easily recognized in the field. Only three of 19 sea lions identified on the first day of a survey were reidentified the following day.

Most animals identified on the jetty were subadult and adult males. Presence of females was recorded on five occasions only, and no reproductive activity was observed. On 67 instances, fishermen were observed interacting with animals resting on the jetty. They were seen throwing stones and other objects, and on two occasions shooting at the animals. When inquired about these aggressive attitudes, fishermen referred to the behaviour of the species of frequently damaging fishing nets while trying to capture entangled fish.

Sea lion / fisheries interactions were recorded throughout the year. Of the 292 sea lion carcasses, 29.8 % ($n = 89$) presented net marks, gunshot wounds, or broken skulls. The deformation of skulls suggested they may have been caused by paddles. Males represented 85 % of the affected animals, 10.4 % were females and 4.6 % were of undetermined sex. Signs of fisheries interactions were not evident in the only four carcasses younger than one year of age. A chi-square test did not detect any significant difference between ages ($P > 0.05$) for animals older than one year.

DISCUSSION

Studies on the movements of *O. flavescens* have reported a decrease in number of animals on rookeries after breeding, especially during the winter (Hamilton 1934, 1939 ; Vaz-Ferreira 1982). Sea lions marked as young on the rookeries of Uruguay were later sighted 835 km south of their birth places (Vaz-Ferreira 1982). The northern

movements along the Brazilian coast observed during this study, and the southern movements observed by Vaz-Ferreira (1982), corroborate a dispersal pattern of the *O. flavescens* population after the breeding season.

Similar movements were reported by Burton (1985) for southern elephant seals, *Mirounga leonina*. Males, especially immature ones, migrate annually and have been found at great distances from their breeding grounds. Burton (1985) suggests that the occurrence of non-breeding male elephant seals in distant places may be related to the limitation of food or overcrowding in the areas near the breeding grounds.

At present, no breeding area for *O. flavescens* is known in Brazil. Uruguayan rookeries at approximately 300 km south of the Rio Grande area, may be the origin of sea lions on the coast of Rio Grande do Sul, as already mentioned by Pinedo (1986). According to Vaz-Ferreira (1982), *O. flavescens* in Uruguay lives and breeds on La Coronilla Islands (33°56'S ; 53°29'W), on the islands in front of Cabo Polonio (34°24'S ; 3°46'W), and on Isla de Lobos (35°01'S ; 54°52'W) (Fig. 1). Large numbers of males recorded in southern Brazil indicate that movements of females are more restricted, as has been suggested by Pinedo (1986). Higher incidences of females in the Southern Area, which is closer to the Uruguayan rookeries, appear to support this suggestion.

Numerical predominance of males over females in the carcass samples could be due to absence of parental duties by males, which allows them to migrate greater distances than females, after the breeding season. Females usually remain with their pups until weaning. Young weaned animals are less proficient at swimming, which limits their movements to short distances. This is supported by the small number of individuals younger than three years in southern Brazil, as well as by limited movements of females observed by Vaz-Ferreira (1982) in Uruguay.

The eastern jetty appears to be a male hauling-out area. Sea lions rest there during their northward foraging trips probably from the coast of Uruguay in winter and spring. Rapid disappearance of artificial marks used to identify animals did not allow an accurate estimate of the period of time sea lions spent on the jetty. They apparently use the jetty for several days at a time, alternating resting periods with trips to the sea.

At present, information on numbers of *O. flavescens* on Ilha dos Lobos in Brazil is sparse. In December 1985 approximately 10 subadult or adult males were seen on this site (J.N. Cardoso, pers. comm.). Local fishermen noted that sea lions are more abundant during winter, suggesting that the island has shifted from a breeding area (Vaz-Ferreira 1981) to a resting site.

Young males *Otaria* seem to precede the colonization of areas which eventually become breeding grounds of the species (Crespo 1988). Large numbers of immature males in southern Brazil may therefore indicate a tendency in re-establishing breeding grounds. Nevertheless, this trend is likely to be affected by human disturbance.

Fisheries interactions of *O. flavescens* have been mentioned by Hamilton (1934), Vaz-Ferreira (1982), Northridge (1985), and Pinedo (1986). According to our observations, local fishermen view sea lions as competitors. Based on the aggressive attitude shown by fishermen, it seems probable that most *O. flavescens* deaths on the coast of Rio Grande do Sul are due to the interactions of the species with the local fisheries, directly caused by fishermen or fishing gear.

Except for the animals less than one year, the absence of a significant relation between sea lions with some kind of aggression marks and the ages, suggests that animals of all ages are exposed in the same way to the aggressions. However, it is not possible to know from this study whether all age-classes interact with fisheries similarly or whether the fishermen do not discriminate the focus of their aggressions.

Marine mammals in Brazil are protected under environmental legislation by Edict nº N-11 of 1986. The situation described in this paper constitutes a violation of the law, which prohibits chasing, hunting, fishing or capturing cetaceans, pinnipeds or sirenians within national waters. It also stresses the need for greater law enforcement and for the establishment of a sea lion sanctuary on the eastern jetty.

ACKNOWLEDGEMENTS

We thank K.K. Lehti, M.D. Scott, A.R. Martin and I.G. Colares for their comments and critical review on the first drafts of the manuscript. Universidade do Rio Grande funded the beach surveys. Additional funding was provided by FAPERGS, CNPq and CAPES.

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