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*Short Communication*

**Occurrence of South American fur seals *Arctocephalus australis* (Zimmermann, 1783) in San Matías Gulf, Patagonia, Argentina**

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**ABSTRACT.** The South American fur seal, *Arctocephalus australis* (SAFS) population suffered a drastic reduction due to commercial exploitation during the XVIII and XIX centuries. In the last decades a population recovery was detected in the Atlantic region. However, in this region, many aspects of the ecology of the SAFS, such as the post-reproductive dispersal of individuals, the location of feeding areas, and the movements of individuals between colonies on the boundaries of its distribution, are still unknown. Here, we report for the first time the occupation of San Matías Gulf (SMG, northern Patagonia, Argentina) by this species. We found that more than 1,600 SAFS used SMG between May and October (post-reproductive season) and detected a non-reproductive colony on Islote Lobos (41°24'S, 65°03'W). The presence of SAFS in SMG is recent and would be associated with an increase of the population on the Atlantic. The importance of SMG in the ecology of SAFS seems to lie on three factors: the strategic location in the geographic context of potential movements of individuals between distant colonies, the physical environment suitable for coastal settlements, and the availability of food resources.

**Keywords:** *Arctocephalus australis*, distribution, settlement, population expansion, San Matías Gulf, Argentina.

**Presencia del lobo marino de dos pelos *Arctocephalus australis* en el golfo San Matías, Patagonia, Argentina**

**RESUMEN.** La población del lobo marino de dos pelos sudamericano *Arctocephalus australis* (SAFS) sufrió una drástica reducción durante los siglos XVIII y XIX. En las últimas décadas se observó la recuperación poblacional en su distribución en la región Atlántica. Sin embargo, en esta región todavía se desconocen muchos aspectos sobre la ecología de los SAFS tales como la distribución post-reproductiva de los individuos, ubicación de las zonas de alimentación y desplazamientos de individuos entre los apostaderos que se ubican en los límites de su distribución geográfica. En este trabajo se registra por primera vez la presencia de esta especie en el golfo San Matías (SMG, norte de Patagonia, Argentina). Se encontró que al menos 1.600 SAFS utilizan el SMG entre mayo y octubre (temporada post-reproductiva) y se detectó un apostadero no reproductivo en el Islote Lobos (41°24'S, 65°03'W). La presencia de los SAFS en el SMG es reciente y la misma estaría asociada al incremento de la población en la región Atlántica. La importancia del SMG en la ecología de los SAFS se debería a tres factores: ubicación estratégica en el contexto geográfico de potenciales movimientos de individuos entre apostaderos distantes, disponibilidad de ambiente físico apropiado para el asentamiento en tierra, y disponibilidad de recursos alimenticios.

**Palabras clave:** *Arctocephalus australis*, distribución, apostadero, población en expansión, golfo San Matías, Argentina.

The South American fur seal *Arctocephalus australis* (SAFS) population suffered a drastic reduction due to commercial exploitation during the XVIII and XIX centuries (Vaz-Ferreira, 1982). In the last decades, a population recovery was detected in the Atlantic region (Crespo *et al.*, 1999; Páez 2006; Tunez *et al.*, 2008). Also, some authors began to record an increasing frequency of fur seals in new places like the coastal waters of Buenos Aires province (Argentina) and in southern Brazil, during the post-reproductive season (Pinedo, 1990; Bastida & Rodríguez, 1994). This suggests an expansion of the spatial distribution of SAFS probably associated with the population recovery observed in the Atlantic.

In the Atlantic, SAFS colonies show a patchy distribution and breeding activity occurs mainly in the northernmost colonies (Vaz-Ferreira, 1982; Crespo *et al.*, 1999; Tunez *et al.*, 2008). Also, most of the population is concentrated in Uruguay, at 35°S (Fig. 1a), with an estimated population of 300,000 individuals (Páez, 2000), while other 20,000 individuals are found further south than 43°S (Crespo *et al.*, 2009). In a preliminary study, using mitochondrial DNA analysis, it was found that SAFS of southern and central Argentine Patagonian colonies constitutes a single Atlantic population with those of Mar del Plata and Uruguayan colonies (Crespo *et al.*, 2009; Abreu, 2011). In that study it was proposed that the single population results from an ancient gene flow that is sustained by movements of individuals among breeding colonies. Therefore the interchange of individuals between the northern and southern colonies, separated by 3,000 km, would be an important factor in the dynamics of the population, and the availability of favorable habitat a determinant for their dispersal.

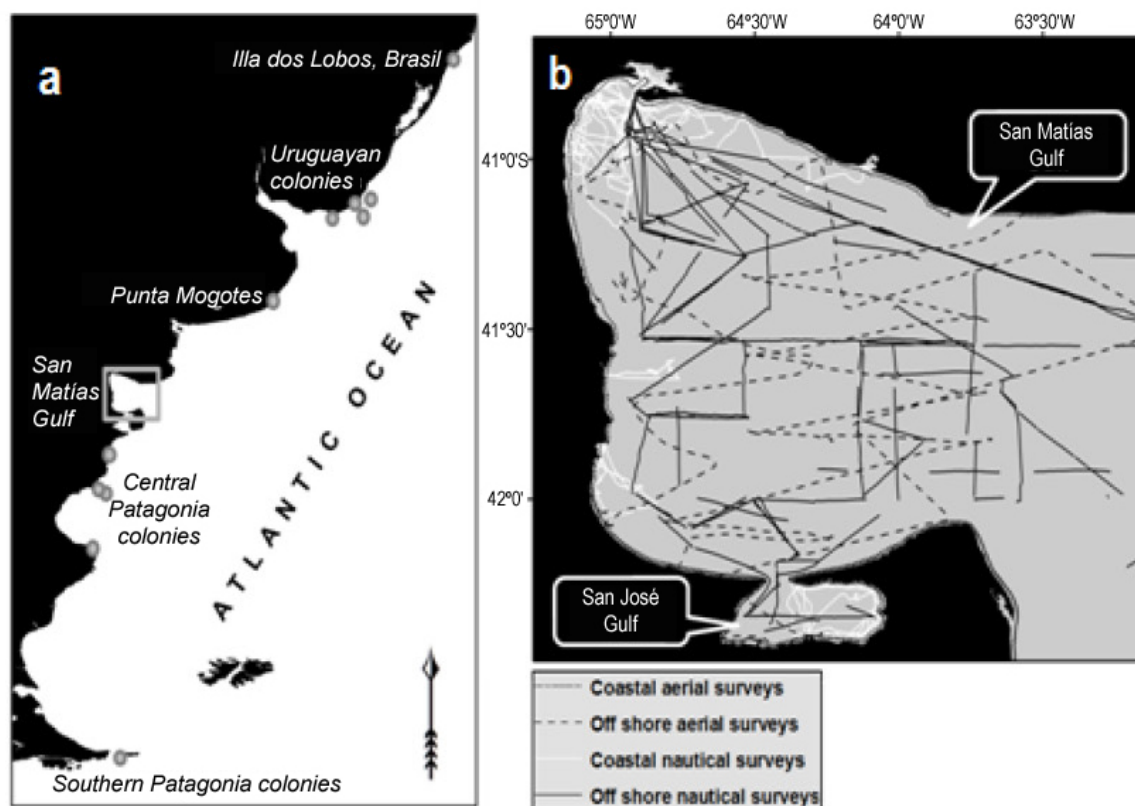
However, little is known about the post-reproductive dispersal of individuals and the movements of individuals between the northern and the southern, less populated, colonies. Along this 3,000 km, several important and productive systems could be offering feeding opportunities as well as resting areas. Among them, San Matías Gulf, in northern Argentine Patagonia (Fig. 1b), is an important ecosystem exploited by fisheries and also inhabited by the South American sea lion *Otaria flavescens*, and several cetacean species like the southern right whale *Eubalaena australis*, the dusky dolphin *Lagenorhynchus obscurus*, the common dolphin *Delphinus delphis* and the bottlenose dolphin *Tursiops truncatus* (Dans *et al.*, 2004; Svendsen *et al.*, 2008; Romero *et al.*, 2012). In this gulf, SAFS were scarce until beginning of this century and the gulf was not considered to be occupied by this species (Carrara, 1952; Crespo *et al.*, 1999; Tunez *et al.*, 2008).

The objectives of this study were to report the actual occupation of SAFS in SMG and to propose hypotheses about the causal ecological processes of this occupation. To carry out these objectives we characterized the seasonal pattern of the relative abundance of this species at sea and on land, and compared this pattern with available bibliography about the ecology of SAFS.

The study area covers a total surface of 23,700 km<sup>2</sup>, which includes SMG and San Jose Gulf (SJG). Records of fur seals on land were obtained from the historical database of the Marine Mammal Laboratory of the Centro Nacional Patagónico (CENPAT-CONICET), Argentina. This database contains surveys of sea lion rookeries and haul-out sites but also other pinniped species that were sighted. Records of fur seals at sea were obtained from different nautical and aerial surveys conducted between June 2006 and January 2011 (Table 1). In all surveys, observations were made in good sea conditions (sea state  $\leq 3$  Beaufort scale). The geographic position and the number of individuals were recorded for each sighting.

The seasonal pattern on the abundance of fur seals in the study area was analyzed using both the individuals counted on land and the individuals sighted at sea. In the first case, seasonality was studied by plotting the mean number of fur seals on land for each month between 1990 and 2009. In the second case, a mean encounter rate and the total observational effort were plotted for each month. The encounter rate was calculated as the number of SAFS individuals sighted in single survey divided by the distance (km) traveled (searching for SAFS) in that survey. Then, all encounter rates calculated for each month were averaged for that month considering the total study period (2006-2011).

For the study area, the historical database has records only of SAFS on Islote Lobos (41°25'S, 65°03'W, Fig. 2). This place was surveyed in 1990, 1993-1996, 2000, 2002 and 2005-2009, and censuses were carried out mainly in January and February (Dans *et al.*, 2004). SAFS were observed for the first time on Islote Lobos in February 1995, this observation being the first report of the species in SMG. Fur seals were observed every year in which Islote Lobos was surveyed in January, whereas fur seals were observed only in two of the six surveys (years) conducted in February. The number of individuals counted in winter and spring (one survey in August and one survey in October) was always higher than that counted in summer (Fig. 3). In all the censuses conducted on Islote Lobos, individuals were



**Figure 1.** a) Distribution of South American fur seal (*Arctocephalus australis*) colonies reported for the Southwest Atlantic (Illa dos Lobos and Punta Mogotes are holdouts areas and not breeding colonies), b) study area and marine mammal surveys (transects) conducted between June 2006 and January 2011.

adults or juveniles, and newborn pups were never observed.

A total of 14,335 km of transects and 379 h of observation at sea were performed in the study area from June 2006 to January 2011 (Table 1). The observational effort was concentrated in coastal areas particularly in SJG and in the northwest of SMG. A total of 176 groups of 1 to 40 SAFS were sighted at sea. About 87.5% of these were observed during the coastal nautical surveys in the northwest of SMG, 10.2% during the coastal aerial surveys north of parallel 42°S (north and west coast of SMG), and 2.3% during the off shore nautical surveys (three sightings in SMG and only one in SJG; Table 1, Fig. 2). No fur seals were sighted during the coastal flights south of parallel 42°S or during the off shore flights (Table 1). Almost the whole set of groups (97%) were observed in coastal waters (depths lower than 50 m, Fig. 2).

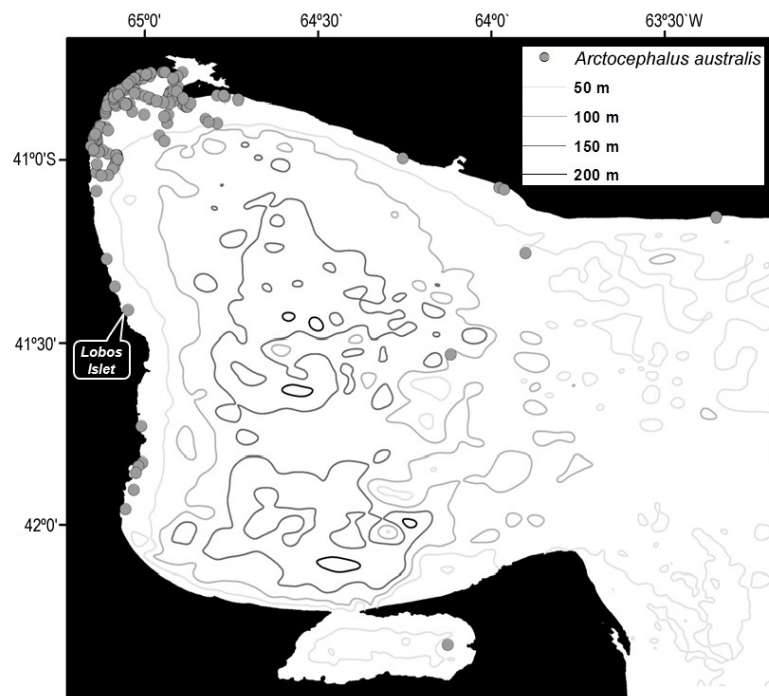
SAFS were observed at sea between May and October of each year of the sampling period (2006–2011), with the highest encounter rate in August. The

encounter rate of individuals began to decline in September, and by November there were no fur seals sightings at sea. Figure 4 also shows the observational effort made during the coastal nautical surveys in the northwest of SMG (the survey which had the highest number of groups sighted and the only one that had observational effort in all months of the year). The observational effort was different every month, however, in some months with few or no sightings, the effort was either similar to, or larger than those in which the encounter rate was high (Fig. 4). Then, the pattern observed may indicate the current pattern on the abundance of fur seals through the year in SMG. Moreover, the seasonal pattern of the individuals observed at sea is similar to that observed on land (*i.e.*, the number of individuals observed in winter and early spring is larger than that observed in summer (Figs. 3 and 4).

The seasonal pattern of the encounter rate of SAFS in SMG is similar to that reported in Punta Mogotes, on the Buenos Aires coast (Bastida & Rodríguez, 1994). In both places, fur seals begin to arrive in May

**Table 1.** Effort measures and number of SAFS (South American fur seals, *Arctocephalus australis*) sightings for each sector and survey type conducted in the study area between June 2006 and January 2011. SMG (San Matías Gulf), SJG (San José Gulf). Numbers in parentheses represent the relative effort (percentajes) of each survey on the total effort (sum of the efforts of all types of survey).

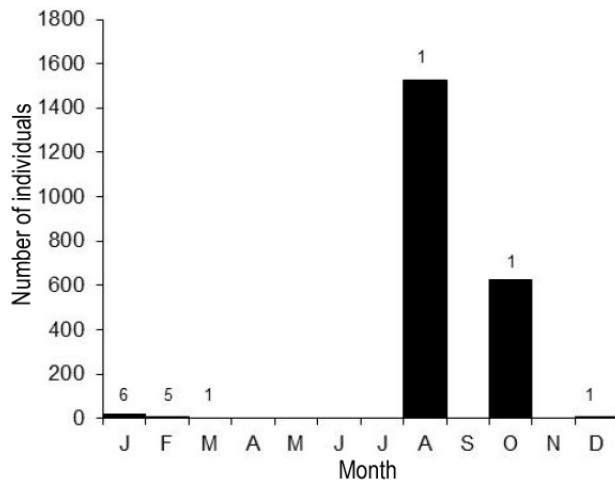
| Survey               | Sector                                  | Observational effort |               |                  |   |   |   |   |   |   |   |   |   |    |   |     | N° sightings |
|----------------------|---|----------------------|---------------|------------------|---|---|---|---|---|---|---|---|---|----|---|-----|--------------|
|                      |   | km                   | h             | N° daily surveys |   |   |   |   |   |   |   |   |   |    |   |     |              |
|                      |   |                      |               | J                | F | M | A | M | J | J | A | S | O | N  | D |     |              |
| Coastal (nautical)   | Northwest of SMG                        | 2234 (15.6)          | 174:48 (46.1) | 1                | 1 | 5 | 1 | 3 | 1 | 5 | 5 | 9 | 2 | 3  | 1 | 154 |              |
|                      | SJG                                     | 411 (2.9)            | 26:48 (7.1)   |                  | 1 |   | 1 |   |   |   | 1 | 1 |   | 1  |   | 0   |              |
| Off shore (nautical) | SMG, SJG and adjacent continental shelf | 2725 (19.0)          | 125:40 (33.1) |                  | 4 | 1 |   |   | 6 |   |   |   | 5 | 7  | 4 | 4   |              |
| Coastal (aerial)     | Coastal strip south of 42°S             | 6474 (45.2)          | 38:46 (10.2)  | 1                | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 5 | 3 | 2  |   | 0   |              |
|                      | Coastal strip north of 42°S             | 1049 (7.3)           | 6:33 (1.7)    |                  |   |   |   |   |   |   |   | 1 |   | 2  |   | 18  |              |
| Off shore (aerial)   | SMG, SJG and adjacent continental shelf | 1442 (10.1)          | 6:37 (1.7)    | 1                |   |   |   |   |   |   |   |   | 1 |    |   | 0   |              |
| Total                |   | 14335                | 379:14        | 3                | 7 | 8 | 4 | 5 | 9 | 7 | 9 | 1 | 1 | 13 | 5 | 176 |              |



**Figure 2.** Distribution of SAFS groups sighted at sea during the study period 2006-2011. Isobaths are shown every 50 m.

(austral autumn); then, their number reaches a peak in winter (July to August), followed by a gradual decrease during spring, until they disappear during summer. The fluctuation observed in Punta Mogotes

was related to the fluctuation in the number of individuals from breeding colonies in Uruguay: the greatest dispersion of individuals from the rookeries of Uruguay takes place during autumn, whereas their

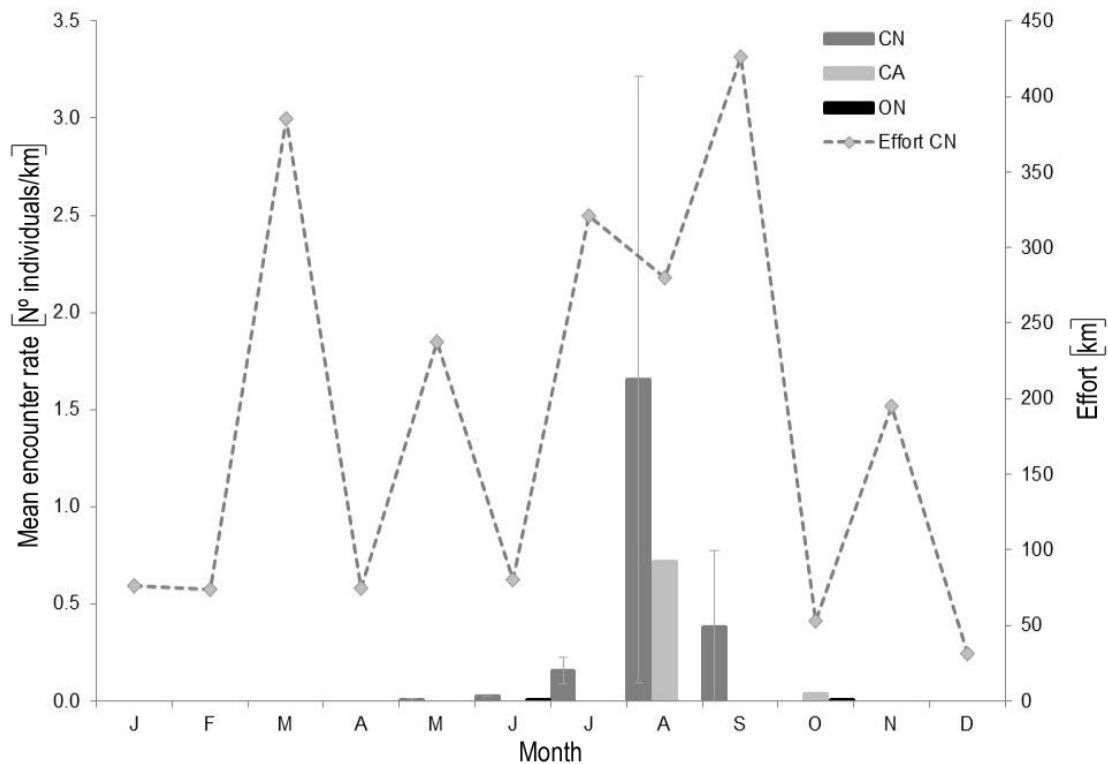


**Figure 3.** Mean number of SAFS per month counted on Islote Lobos. Numbers over bars represent the number of years sampled.

return to the rookeries starts in October (Bastida & Rodríguez, 1994; Ponce de León & Pin, 2006). Based on this observation, Bastida & Rodríguez (1994)

suggested that the individuals observed in Buenos Aires originate from the colonies in Uruguay. Since a similar seasonal pattern was observed in SMG, we could speculate that the fur seals observed in SMG might also come from the breeding colonies in Uruguay. Also, the occurrence of SAFS individuals in Brazilian coast during winter and spring also demonstrated the large distances that animals of Uruguayan colonies may perform during the post-reproductive season (Pinedo, 1990; Sanfelice *et al.*, 1999). However, the movements of South American fur seals of central and southern rookeries of Patagonia are unknown, and fur seals of SMG might also come from these rookeries.

Considering fur seals on land and at sea at the same time, the maximum number of individuals was estimated at 1,681 by August (08/23/2007). This number represents a minimum of the total individuals that may be using the study area in a given year because it is assumed that not all individuals are counted in a single survey.



**Figure 4.** Mean encounter rate per month of SAFS sighted at sea during coastal nautical surveys north of 42°S (CN), off shore nautical surveys (ON) and coastal aerial surveys north of 42°S (CA). Bars over columns show the standard error of the encounter rate calculated for each month. The figure also shows the monthly effort made during coastal nautical surveys (north of 42°S) between 2006 and 2011 (Effort CN).

The presence of SAFS in the SMG may be a consequence of the population expansion that has been suggested for the Atlantic. Although it is unknown when the current occupation of SMG by the SAFS started, it is likely that it is recent, not beyond the last 10 to 20 years. The first records of this species available in the study area are from a census conducted on Islote Lobos in February 1995. Despite of the censuses of the rookeries, prior to 2006 there were no systematic sighting surveys of marine mammals in the area and the season where and when fur seals are actually observed. Then, it is difficult to perform a historical reconstruction of the occupation. However, it is interesting to note that although occasional sightings at sea (during fisheries research surveys) and strandings of different marine mammals were recorded and reported during the 1980's and early 1990's (González, 1990; González *et al.*, 1992), these reports did not include SAFS. Moreover, from the mid-twentieth century several researchers have reported South American fur seal settlements at various locations along the coast of Argentina (south of the SMG), but never on the shores of SMG, although these were also examined (Carrara, 1952; Vaz-Ferreira, 1982; Crespo *et al.*, 1999; Tunez *et al.*, 2008). This observation leads to the assumption that the species was absent in SMG at least during the mid to late twentieth century, and reinforces the hypothesis of a recent occupation. On the other hand, recent archeological studies conducted on the shores of SMG revealed that the SAFS was one of the main food sources of human groups (hunter-gatherers) who lived in such coasts between 4,000 and 700 years ago (Borella, 2007). This finding suggests that the current presence in the gulf corresponds to a reoccupation of this area.

The importance of SMG in the ecology of SAFS seems to depend on different factors and/or its combination. SMG constitutes an intermediate geographic zone between the colonies of Uruguay and those of central and southern Patagonia. This system is located more than 1,000 km away from the colonies of Uruguay and more than 400 km away from the colonies of the central coast of Patagonia. If fur seals move between these two areas, SMG would be a strategic location and would be used by some individuals for different purposes, as resting and/or feeding.

Regarding the last, exploiting food resources in SMG may allow fur seals to replenish the energy reserves expended whilst moving between Uruguay and Patagonia or accumulate energy reserves necessary for the breeding season. These hypothesis are supported by the fact that two of the main prey items

of the South American fur seal, the anchovy *Engraulis anchoita* and the juvenile hake *Merluccius hubbsi* (Naya *et al.*, 2002; Szteren *et al.*, 2004; Ponce de León & Pin, 2006), are found in abundance in the gulf during the same seasons in which fur seals are present (Madirolas & Castro-Machado, 1997; Hansen *et al.*, 2001; Buratti *et al.*, 2006; Romero *et al.*, 2010; Ocampo-Reinaldo *et al.*, 2011).

Lastly, SMG has availability of physical environment suitable for coastal settlements. The new settlement reported in this work, the Islote Lobos, presents the typical physiognomic characteristics that have been described for most of the SAFS colonies: rocky, steep, isolated from the continent and with tide pools (Vaz-Ferreira, 1960; Schiavini, 1987; Bastida & Rodríguez, 1994; Crespo *et al.* 1999; Sanfelice *et al.*, 1999; Stevens & Boness, 2003). These features would be selected by fur seals because they provide a suitable environment to carry out thermo-regulatory behaviors (tide pools and piles of rocks that give them shade) and to avoid predators or human disturbance (steep terrain and/or isolated from the mainland; Stevens & Boness, 2003). Specifically, the Islote Lobos is a granitic outcrop separated from the mainland by a distance of 2 km, with an approximate surface of 23,500 m<sup>2</sup>, and with tidal pools, large rocks and cracks in the substrate (Gelos *et al.*, 1992). In the study area, there are other sites that have some of the physiognomic characteristics mentioned above and that could potentially be used as rookeries by fur seals, but so far no fur seals have been detected there.

The Islote Lobos is located within a Marine Protected Area (MPA) known as "Complejo Islote Lobos", created in 1977 (Decree N°1402, Río Negro Province Government), to protect a breeding colony of South American sea lions and nesting areas of several seabirds species (Tagliorette & Manzur, 2008). This MPA holds a management category type IV (Habitat/Species Management Area) of the IUCN standard. This conservation status coupled with the access restrictions imposed by natural terrain features determine very low levels of disturbance on this complex of islands throughout the year. It is hoped that the maintenance over time of these conditions favor the presence of SAFS individuals in the area, so the monitoring of the abundance of the species along the year jointly with other studies designed to assess ecological aspects, will be essential to understand the causes and perspectives of the re-colonization process.

The whole studied area may serve as a corridor connecting northern and southern rookeries, possibly allowing the interchange of individuals. Although reproductive activities were not observed, the availability of a feeding or resting area may allow

individuals to interchange the places where they mate. If such an area was not available, isolation among colonies could be more accentuated, with important consequences on population dynamics.

To conclude, this paper reports the presence of a significant number of SAFS (both on land and at sea) in SMG during the post-reproductive season. The presence of this species in this ecosystem is recent and probably is a consequence of the population expansion that has been suggested for the Atlantic region. The importance of SMG in the ecology of SAFS seems to lie on three factors a) the strategic location of potential movements of individuals between distant colonies, b) the availability of food resources, and c) the physical environment suitable for coastal settlements.

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