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Seasonal Variability of South American Fur Seals (*Arctocephalus australis*) and Sea Lions (*Otaria flavescens*) in Two Haulouts and Interactions with Small-Scale Fisheries Off the Coast of Montevideo, Uruguay

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Abstract

Conflicts between marine mammals and fisheries occur worldwide. Uruguay is an important breeding area of two pinniped species: the South American fur seal (*Arctocephalus australis*) and the South American sea lion (*Otaria flavescens*). Sea lions frequently interact with small-scale fisheries as their coastal feeding area coincides with the fishing zone used by coastal fisheries. In recent years, fishers have reported the presence of pinnipeds in small rookeries, Las Pipas and Isla de Flores, off the coast of Montevideo. The aim of this study was to assess the seasonal variability of both species at these two haulouts and to monitor their interactions with the small-scale fishery. We considered interactions to be when the presence of pinnipeds or predation or damages on catches were recorded during fishing operations. Between February 2013 and April 2014, six pinniped counts were made at each haulout; and between November 2013 and May 2014, 19 fishing events were monitored aboard fishing boats. Most animals in the colonies were adult males. The maximum number was recorded at Las Pipas in winter (160 animals). Sea lions were recorded throughout the year, while fur seals were only recorded in winter. In contrast, at Isla de Flores, only between 10 and 20 sea lions were recorded. Additionally, fishery catches were low (between 3 and 92 kg per fishing event). The catches per unit of effort were significantly higher in summer and autumn than in spring. However, catches did not differ significantly in the presence or absence of interactions. Sea lion predation varied from 0 to 1.72 kg per fishing event, averaging 2.37% of the potential catches. Interactions between sea lions and fishing operations were low in spring and summer, and the animals involved were mostly subadult and adult males. The fishing events with interactions and the abundance of pinnipeds were minimal in summer and maximal in autumn. In conclusion, the abundance of pinnipeds at the two haulouts can be explained by the reproductive cycles of these species, but also as a response of some animals to an increase in local food associated with the small-scale fisheries.

Key Words: abundance, haulout, interaction with fisheries, South American fur seals, *Arctocephalus australis*, South American sea lions, *Otaria flavescens*

Introduction

Conflicts between fisheries and marine mammal species are common in much of the world, and these are an example of some of the problems between humans and wildlife (Northridge, 1985; Read, 2005; Reeves et al., 2013). These conflicts occur and increase as marine mammal distributions coincide with fishing areas (Wickens, 1995; Szteren & Páez, 2002). Fish caught in fishing gear represent an accessible and abundant food source for the pinnipeds, requiring lower energy expenditure towards its search and capture (Northridge, 1985; Read, 2005, 2008). Two types of interactions can be distinguished: (1) operational interactions, which include damage to fishing gear or catches, disturbance of the fishing activity, and incidental marine mammal catches; and (2) biological interactions, which include predation or competition for resources between pinnipeds and fisheries (Wickens, 1995). Operational interactions are readily detectable by fishers as they inflict economic damage.

In Uruguay, two pinniped species breed and reproduce sympatrically: the South American fur seal (*Arctocephalus australis*; Zimmermann, 1783) and the South American sea lion (*Otaria* *flavescens*; Shaw, 1800) (southern sea lion), with 300,000 and 10 to 12,000 individuals, respectively (Páez, 2006). The breeding population of both pinnipeds is located in four main groups of islands along the coast (Vaz-Ferreira, 1956): (1) Lobos group: Lobos Island and Islet; (2) Torres group: Rasa and Encantada Islands and Islet; (3) Marco Island; and (4) La Coronilla group: Verde Island and La Coronilla Islet (only sea lions). The fur seal population is increasing around 1.02% annually, while the sea lion population is declining by 2% annually (Páez, 2006). Sea lions usually follow small-scale fishing boats, feeding on their catches and damaging their fishing gear (Szteren & Páez, 2002). Their diet is mainly composed of stripped weakfish (*Cynoscion guatucupa*), whitemouth croaker (*Micropogonias furnieri*), sablefish (*Trichiurus lepturus*), and Marini's anchovy (*Anchoa marinii*) (Naya et al., 2000). Fur seals do not usually follow fishing boats, and their diet is composed mainly of stripped weakfish, Marini's anchovy, sablefish, Argentine anchovy (*Engraulis anchoita*), Argentine hake (*Merluccius hubbsi*), and cephalopods (Naya et al., 2002; Franco-Trecu et al., 2013). Although both species share some feeding species, they do not compete for food. Fur seals feed offshore, while sea lions forage in coastal waters (Ponce de León & Pin, 2006; Franco-Trecu et al., 2012, 2014).

The interactions between sea lions and small-scale fisheries have been studied throughout their distribution area—for example, in Chile (Oporto et al., 1991; Sepúlveda et al., 2006; Goetz et al., 2008), in Brazil (Carvalho et al., 1996; Ott et al., 1996), and in Argentina (Fazio et al., 2000; Suárez et al., 2000). In Uruguay, small-scale fishers along the coast claim that interactions have increased, and they believe the problem has expanded to the western part of Uruguay (Fishers, informal conversations, 2008-2015). However, previous studies have shown that the variability of catches did not respond solely to interactions with pinnipeds as catches with or without interactions were not significantly different (Szteren & Páez, 2002; De María et al., 2014). Artisanal or small-scale fisheries in Uruguay involve simple equipment and utilize mainly manual effort carried out in fleets with less than 10 Gross Register Tonnage (GRT) (Dirección Nacional de Recursos Acuáticos [DINARA], 2009). Catches are extremely variable because they depend on the availability of resources and climatic conditions (Altez et al., 1988). The main fishing gear used on the Uruguayan coast is passive—bottom set gillnets and longlines (Crossa et al., 1991). This study focused on gillnets, which are usually set in the bottom of the water column and vary in mesh size, according to the species of interest, for the capture of whitemouth croaker, stripped weakfish, King weakfish (*Macrodon ancylodon*), and so on (Crossa et al., 1991).

The magnitude or frequency of interactions and the number of animals involved may be larger near sea lion colonies. For example, a previous study in Uruguay reported an exponential inverse relationship between the number of interacting sea lions and the distance to the nearest colony (Szteren, 1999). However, the temporal variability of interactions in relation with the abundance of animals at haulouts has not been assessed to our knowledge.

In the middle of the southern Uruguayan coast, east of Montevideo, the capital city, small rocky islets called *Las Pipas* (LP) comprise a small pinniped haulout. Fur seals have never been reported, while the presence of small groups of sea lions was mentioned in Vaz-Ferreira (1956). This is a nonreproductive colony to the west of Isla de Lobos, the largest pinniped colony in Uruguay. The only counts were conducted from June 2008 to June 2009, indicating the presence of 10 to 212 individuals among both species (Szteren, 2015). In that study, the presence of pinnipeds showed a seasonal pattern: both species were maximum in winter; however, while sea lions were recorded in low numbers in other seasons, fur seals were only observed from June to October. This haulout is located in a fishing area frequently used by small-scale fishermen who have affirmed that an increase of sea lions has occurred in this haulout, and they also mention that animals are present in another coastal island in front of Montevideo—*Isla de Flores* (IF). Until now, the number of pinnipeds has never been counted there.

Sea lion and fur seal abundance fluctuates throughout the seasons in breeding colonies (Ponce de León & Pin, 2006) and nonbreeding haulouts (Szteren, 2015) due to the alternation between breeding, lactation assistance, and feeding trips. In this sense, it was hypothesized that if operational interactions have become common far from the breeding areas (De María et al., 2014), sea lions may be increasingly relying on these haulouts to rest during their feeding trips. If this is true, sea lion numbers should be higher when interactions are higher and decline when there are fewer animals in these islands. In this sense, it was predicted that there would be a seasonal coupling among the frequency of interactions and pinniped abundance.

The objective of this study was to assess the operational interactions between pinnipeds and the small-scale fishery near the LP and IF haulouts off the southeastern coast of Montevideo, and to explore their temporal fluctuations. For the first time, the pinniped populations in both haulouts were monitored together with their interactions with the small-scale fisheries. This allowed us to simultaneously assess the relationship between the number of pinnipeds and the extent and frequency of the interactions. This type of study is important because it provides scientific data about the local extent of the negative interaction between pinnipeds and small-scale fisheries and its seasonal variability. This information is valuable for the management of the problem that affects a commercial activity, which sustains the livelihood of many coastal communities.

Methods

Study Area

The Rio de la Plata estuary is a wide dynamic estuarine system located between the southwestern coast of Uruguay and the northeastern coast of Argentina. It is influenced by tides and has a salinity gradient produced by the mixture of water masses from the Uruguay and Paraná Rivers with the Atlantic Ocean. This generates a saline front and an increase in turbidity produced by suspended particles and nutrients (Defeo et al., 2009).

The area where the two pinniped haulouts are located is inside the internal estuarine zone and is characterized by its low salinity levels (Defeo et al., 2009). Las Pipas (34° 56' 50" S, 55° 56' 14" W) are a group of rocky islets located on the border between the Montevideo and Canelones departments, ~2.8 km from the coast (Figure 1). They are in the fishing area used by small-scale fishermen from the eastern coast of Montevideo. Isla de Flores (34° 56' 00.7" S, 55° 55' 02.8" W) is located 10 km from the coast (Figure 1). It comprises three islets.

Pinniped Census

From February 2013 to April 2014, a total of 12 censuses of fur seals and sea lions were conducted at LP and IF, six at each haulout. Seven counts were performed aboard small-scale fishing boats, and another five were performed aboard a tourist boat. Their seasonal distribution was summer 2013 (N = 2), autumn 2013 (N = 2), winter 2013 (N = 2), spring 2013 (N = 3), summer 2014 (N = 1), and autumn 2014 (N = 1). At LP, the boat surrounded all the islets at a distance of about 10 to 15 m from the coast, and observations were made from around 30 m in IF. Animals on the rocks were counted and identified, and we also counted animals that were already in the water. Since some animals went to the water after the boat passed, we did not count back or travel backwards with the boat. Counts were made early in the morning to ensure the presence of the maximum number of animals resting at the colony. Counts were performed by naked eye, using binoculars when necessary. Fur seals and sea lions were classified according to their defined sex and age classes—adult males, subadult males, females, juveniles, and pups—according to their

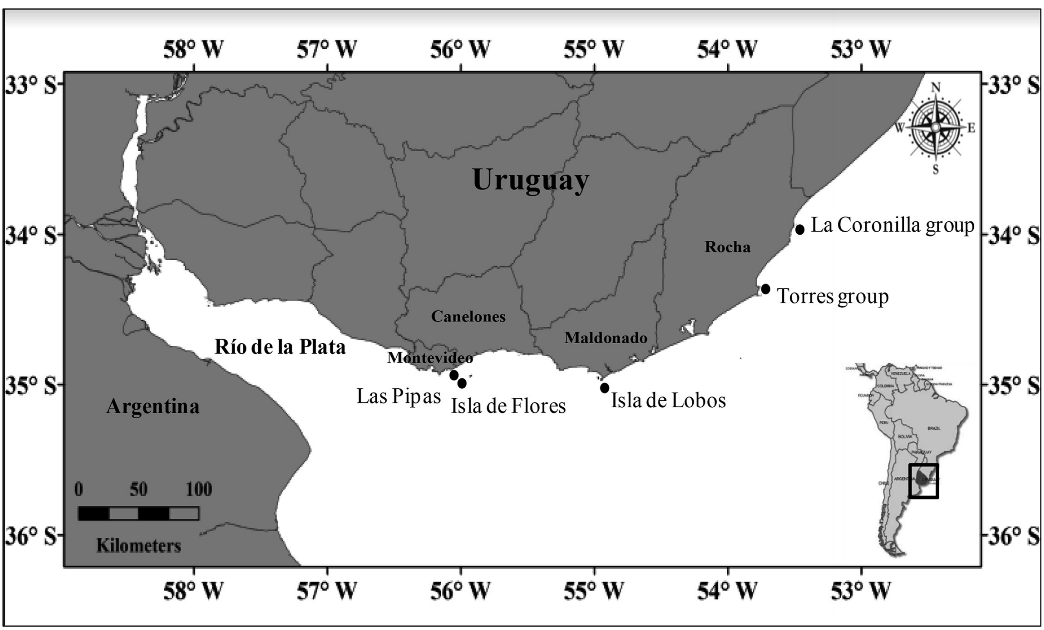

Figure 1. Location of Las Pipas (LP) and Isla de Flores (IF) haulouts, and the breeding colonies Isla de Lobos, Torres group, and La Coronilla group along the Uruguayan coast

morphologic external characters, size, shape, and coloration (Vaz Ferreira, 1982a, 1982b). Animals whose sex and age could not be determined because they were not clearly sighted (e.g., in water) were counted and classified as "non-identified" (NI).

Interactions Between Pinnipeds and the Small-Scale Fishery

To evaluate the interactions, we conducted 13 samplings (~50 h of observation) aboard small-scale fishing boats during routine journeys from Buceo Port (Montevideo) from November 2013 to May 2014. This included a total of 19 fishing events: spring 2013 (N = 3), summer 2014 (N = 9), and autumn 2014 (N = 7).

The location of each set gillnet was georeferenced with a GPS (Figure 2). Additionally, we recorded the time (h) when gillnets were set and retrieved as well as their length and width. Using those data, we calculated the fishing effort. A fishing event was defined as a fishing activity performed the same day with a specific effort in a specific area. If part or all of the fishing gear was retrieved and set again, that would be considered another fishing event. Additionally, if the fishing gear were set sufficiently far away (in practice we considered a distance of 15-min navigation), the data were separated as two different events (De María et al., 2014).

In addition, the species, number, and age class of the pinnipeds interacting in each event during the fishing operations were recorded using morphological characters as mentioned before. We considered that a sea lion was interacting whenever it was sighted consuming or damaging fish during the fishing operations, or traveling throughout the set fishing gear. The fish species and number of consumed and damaged fish were also recorded. If the pinnipeds were consuming fish, the number and species of fish consumed were also recorded, as well as the bitten and damaged fish (Szteren, 1999).

Data Analysis

We calculated the frequency of interactions between pinnipeds and the small-scale fishery for each fishing event. We also estimated catch per unit of effort (CPUE) of each fishing event as

$$CPUE = C/A/t$$

where C is the total catch of the fishing event (kg), A is the gillnet area (1,000 m^2), and t is the soak time (h).

The CPUE was compared among the seasons and between the presence/absence of interactions using one-way ANOVA. We used a Kolmogorov-Smirnov test to test the normality of the data, and

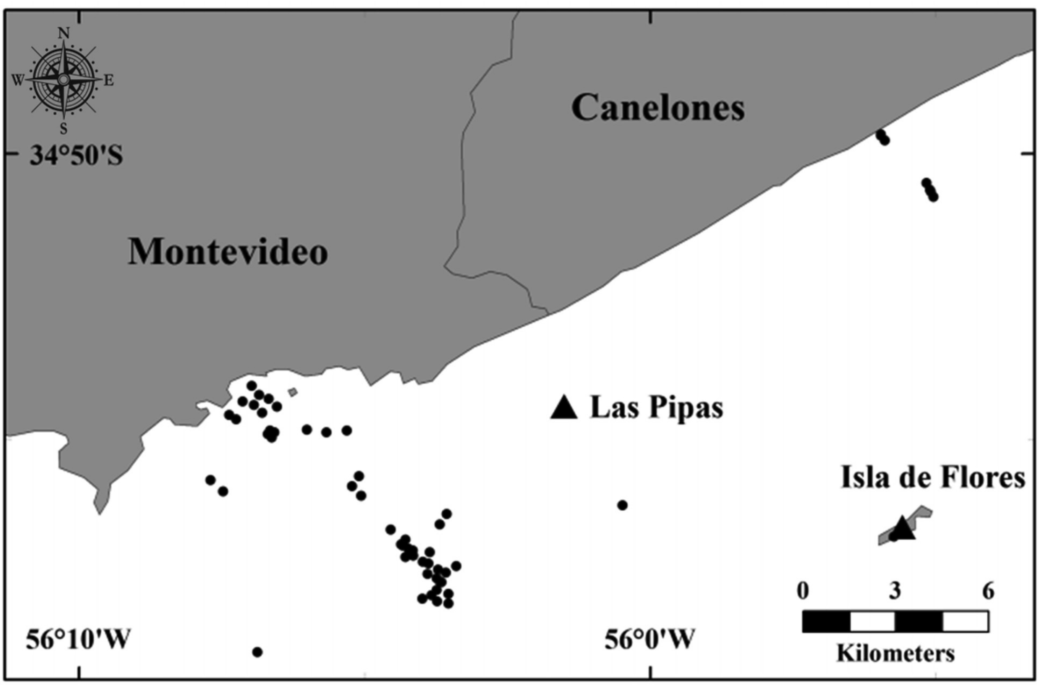

Figure 2. Location of the sampled gillnets during onboard monitorings aboard small-scale fishing boats off the eastern coast of Montevideo, and LP and IF haulouts (▲)

the homoscedasticity was tested using the Levene analysis. To estimate the biomass predated by pinnipeds, we first estimated the mean weight of the catch for each fish species, assuming the predated fish weight distribution coincides with the distribution of the caught fish (see Szteren & Páez, 2002). Then, we estimated the predation per unit of effort (PPUE) as

$$PPUE = \frac{P}{t.A}$$

where P is the part of the catch predated by pinnipeds (kg), t is the soak time (in h), and A is the gillnet area (1,000 m^2).

The PPUE was compared among seasons using a Kruskal-Wallis test because the data were not normally distributed. To determine the proportion of predated biomass present in catches, we calculated the percentage of depredation for each fishing event as the depredation in relation to the potential catch. The potential catch is calculated as the catch plus depredation and represents the amount that fishers would have caught if no fish had been consumed by pinnipeds (Szteren, 1999; Szteren & Páez, 2002).

Finally, to analyze the seasonal variability between pinniped abundance and the frequency interactions, the total number of sea lions at each season was compared with the frequency of interactions for the three seasons for which the data coincided (spring 2013, summer and autumn 2014) using a product-moment Pearson correlation.

Results

Pinniped Census

At LP, both pinniped species were recorded. A total of 160 individuals were recorded between the two species in winter 2013, and a minimum of 23 were recorded in summer 2013 (Figure 3). Sea lions were present during all seasons and had a maximum abundance of 69 individuals during the winter, with a minimum abundance in the summers of both 2013 and 2014 (Figure 3). Moreover, the presence of fur seals was only recorded in August 2013 during winter, having a greater abundance than sea lions (91 individuals; Figure 3). At IF, the abundance of pinnipeds did not exhibit great variation, with a maximum of 21 sea lions in summer 2013 and 0 in summer 2014 (Figure 3).

Concerning sex-age classes, at LP, sea lions were represented by all categories (except pups). Adult and subadult males were the most abundant, being maximal during the winter with 37 (54%) and 20 (29%) individuals, respectively. Females remained between two and ten individuals, and juveniles were very scarce (Figure 4a). Adult males were the most abundant along the different seasons—except in spring 2013 when females were the most abundant. Subadult males were

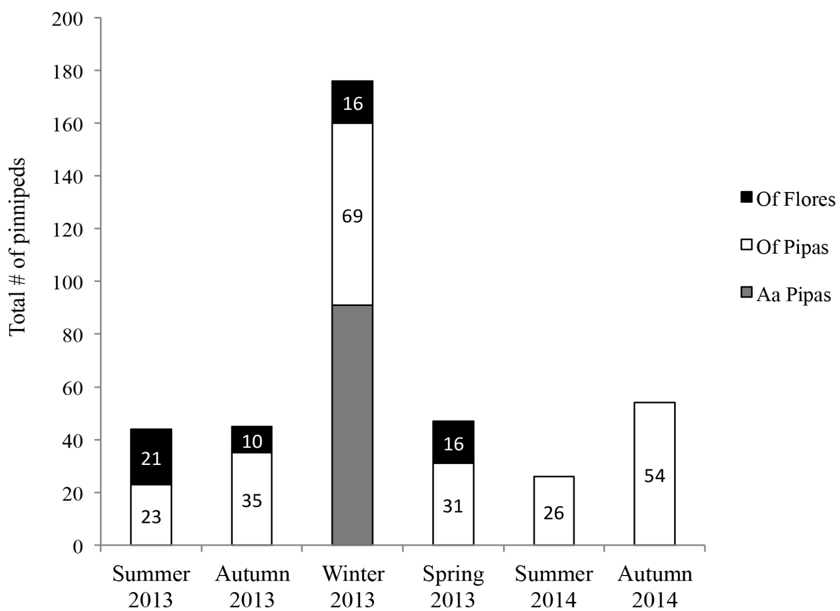

Figure 3. Total pinniped abundance at each season at LP and IF; Of Flores = *Otaria flavescens* at Isla de Flores, Of Pipas = *Otaria flavescens* at Las Pipas, and Aa Pipas = *Arctocephalus australis* at Las Pipas.

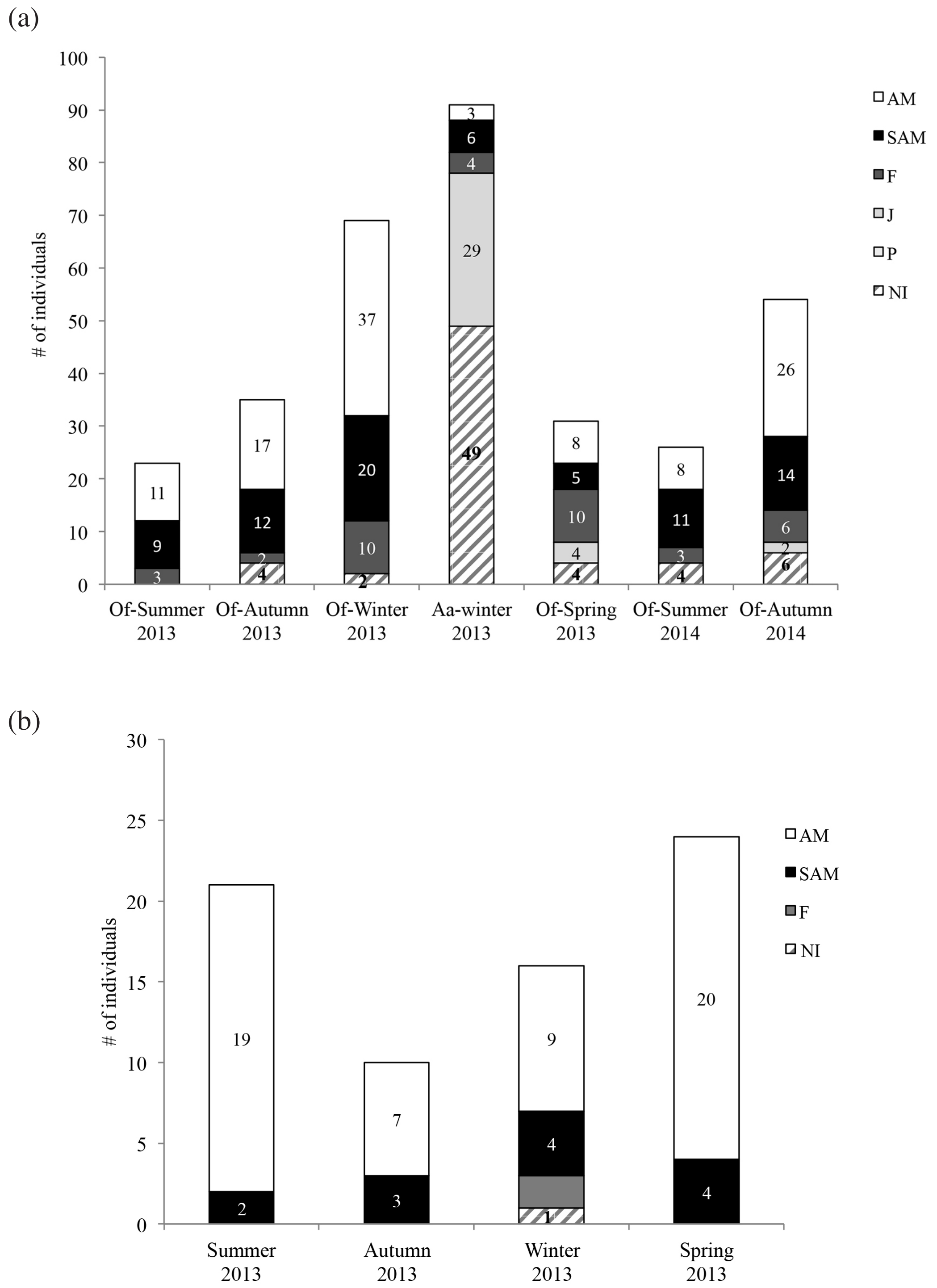

Figure 4. Number of animals of each species by sex-age category: (a) at LP from summer 2013 to autumn 2014; Of = *Otaria flavescens* and Aa = *Arctocephalus australis*. (b) *O. flavescens* at IF from summer 2013 to summer 2014; AM = adult males, SAM = subadult males, F = females, J = juveniles, P = pups, and NI = non-identified.

Table 1. Mean seasonal fishing catches (kg), predation by South American sea lions (*O. flavescens*) (in kg), CPUE (kg/1,000 m^2/h), PPUE (kg/1,000 m^2/h), and percentage of predation in sampled fishing events off the coast of Montevideo

Season	Catch (kg)	Predation (kg)	CPUE (kg/m^2h)	PPUE (kg/m^2h)	% predation
Spring	23.0	0.23	1.34	0.01	0.98
Summer	49.8	0.15	6.10	0.02	0.61
Autumn	47.0	0.35	4.04	0.03	0.49

abundant in summer and autumn. In contrast, we found a majority of unidentified fur seal individuals, and those identified were mainly juveniles (32%) (Figure 4a).

At IF, adult males was the most abundant age class in all seasons, followed by subadult males. Two females were counted in winter 2013, while juveniles and pups were never recorded, nor the presence of fur seals (Figure 4b).

Interaction Between Pinnipeds and the Small-Scale Fishery

Catches obtained during the study period varied between 3 and 92 kg, being maximum in summer (49.8 kg) and minimum in spring (23.0 kg). (Table 1). The main species caught were King weakfish and whitemouth croaker. The species observed during fisheries interactions events was always *O. flavescens*. A total of five animals were recorded: one in a fishing event in summer and two each in two fishing events in autumn. The proportion of fishing events with interactions was the highest (i.e., 43%) in autumn (three of seven total events in which two animals were observed near the boat, and the other had the presence of bitten fish). This proportion was minimal (i.e., 11%) in summer (one out of nine total events).

The CPUE was significantly different among the seasons (F = 4.81, df = 2, p = 0.023), with higher catches in summer and lower catches in autumn (Tukey post hoc analysis: p = 0.022) (Figure 5). However, the CPUE did not differ

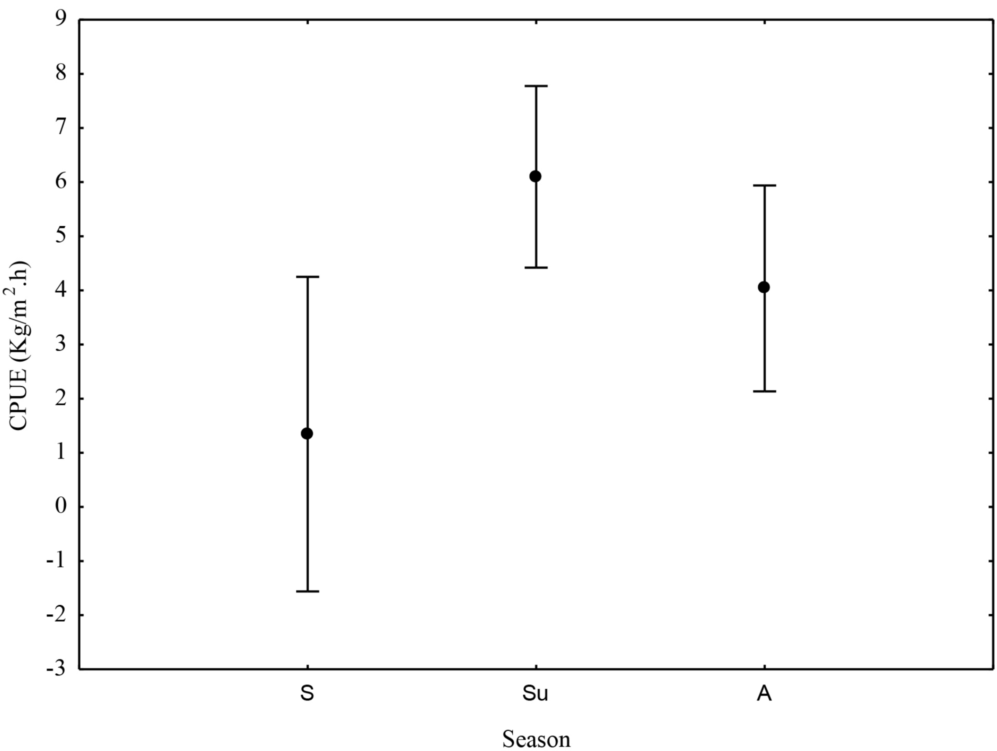

Figure 5. Means and standard deviations (SDs) of the CPUE among the seasons; Sp = spring, S = summer, and A = autumn.

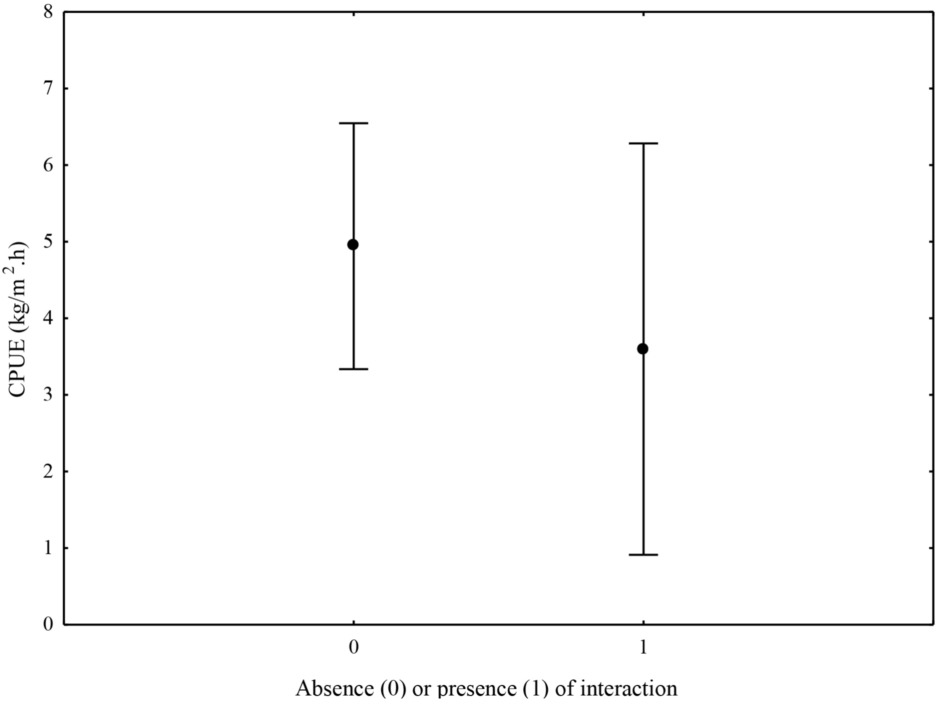

Figure 6. Means and SDs of the CPUE in the presence (1) or absence (0) of interaction in Montevideo

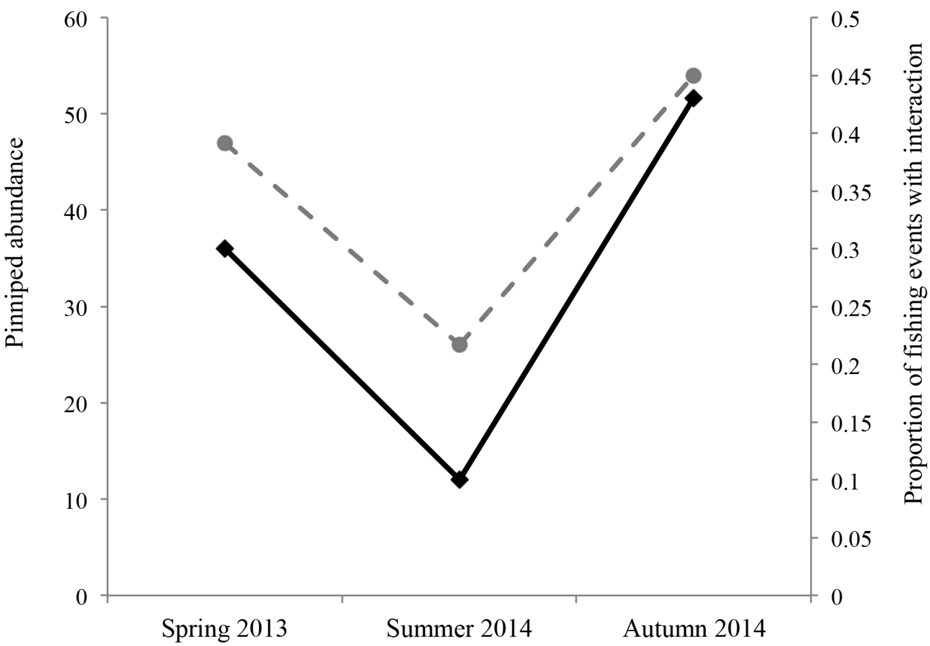

Figure 7. Seasonal variability of pinniped abundance (black solid line) and the proportion of fishing events with interactions (grey dashed line)

significantly in the presence or absence of interaction (F = 0.82, df = 1, $p = 0.28$) (Figure 6). We found great variability in the data, especially in the presence of interaction. Moreover, predation varied between 0 and 1.72 kg, representing an average of 2.37% of the total catches and a maximum of 5.5%. Predation was higher in spring (0.98%) and lower in autumn (0.49%) (Table 1). The PPUE showed no significant differences between the seasons (U = 11,000, $p = 0.64$).

Finally, the seasonal pattern between the number of pinnipeds at the LP haulout and the frequency of interactions was very similar ($r = 0.987$, $p < 0.05$): both were lower in summer and higher in autumn (Figures 7 & 8).

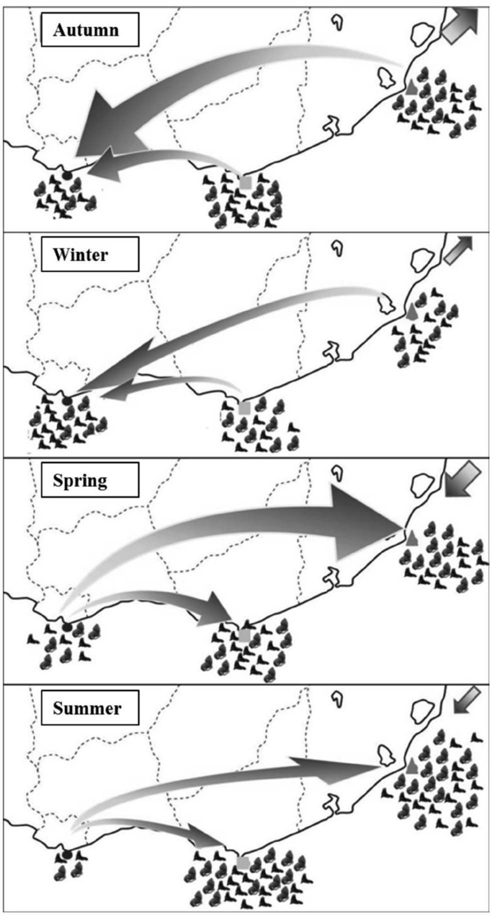

Figure 8. Proposed scheme of the pinniped movements from the breeding areas in Isla de Lobos and Cabo Polonio (■), to LP-IF (●), and to southern Brazil (▲); the arrows represent the movements of pinnipeds between colonies and to/from Brazil in the different seasons.

Discussion

This study confirms the presence of pinnipeds at Las Pipas and Isla de Flores. Both sites are nonbreeding haulouts located off the eastern coast of Montevideo. Sea lions were present at both haulouts in all seasons, while fur seals were recorded only at LP in winter. Our results agree with a previous study at LP (Szteren, 2015), with an increase of animals in autumn and winter compared with summer. This seasonal pattern was also observed at IF to a lesser degree and can be related to the reproductive cycle of both species that travel to the breeding areas (Isla de Lobos and Torres Islands; Figure 1) in spring and summer where they invest their energy towards reproduction (de la Torriente et al., 2009). In contrast, in autumn and winter, pinnipeds allocate their energy towards foraging activities and recovering their body condition (Rodríguez et al., 2013) after the period of lower feeding. This agrees with what was reported for the haulouts on the coast of Río Grande do Sul, where the population increases during autumn and winter (Rosas et al., 1994). In the same way, a winter population increase was reported for haulouts at Mar del Plata and Quequén, Argentina (Giardino et al., 2013) and at Patagonia (Grandi et al., 2008). The lower variability in pinniped abundance at IF may be due to the movement of animals away from LP during high tides as the available surface on the rocks is decreased, and some animals may find a better place at IF.

The population increase at LP, and their presence at IF, could be due to a greater movement or redistribution of animals coming from the breeding areas and not to a global population increase as the sea lion population is declining in Uruguay (Páez, 2006). The same would occur to the east of the breeding colonies, increasing the sea lion abundance at Isla Verde-Islote La Coronilla mainly during winter as previously reported (Szteren, 2015).

The presence of southern fur seals only in the winter at LP may be due to the reproductive cycle and the foraging areas used by this species. Although both pinnipeds share some dietary items (Ponce de León & Pin, 2006), fur seals feed far from the coast in deeper waters in contrast to sea lions (Franco-Trecu et al., 2014). Furthermore, the foraging trips of both species are different: sea lion females travel between 38 and 136 km from the breeding site (Riet-Sapriza et al., 2013), while fur seal females use feeding areas far from the coast (~500 km) and make deeper dives (Franco-Trecu, 2015). Most identified fur seals were juveniles, so it may be possible that they are using the area to rest while traveling as juveniles may be less capable of performing longer trips (Fowler et al., 2007). In addition, De María et al. (2012) reported the interaction of a fur seal with the small-scale fishery in Montevideo and an incidental catch of another fur seal in Piriápolis, both in winter 2010. Further, in the south of Chile, the incidental catch of fur seals was reported (Oporto et al., 1991). Although fur seals do not typically behave as boat followers and do not predate on their catches, they may be acquiring this behavior as a consequence of decreasing fish stocks (Defeo et al., 2009). Another possible explanation may be that they are expanding their feeding area in search of food (De María et al., 2012).

But why are there fur seals in LP but not in IF? Three non-excluding explanations are possible: (1) maybe the higher density of sea lions at LP causes some of them to move to IF; (2) perhaps as there are more sea lions in the area they have begun to use IF to rest—in the future, maybe fur seals would colonize, too; and (3) IF may offer less available or suitable habitat for that species. We cannot discard the possibility that some individual fur seals rest on the island but have not been reported due to our low sampling number.

Sea lion sex and age categories also allow us to deduce that both LP and IF are used as resting areas due to the presence of mainly adult and subadult males. This is similar to what was found on the coast of Rio Grande do Sul (Rosas et al., 1994) and at the Isla de Lobos haulout in Brazil (Pavanato et al., 2013). Because of the age structure and the absence of newborns and pups, we can classify these haulouts as nonreproductive sites (Grandi et al., 2008; Sepúlveda et al., 2011).

Interactions with the Small-Scale Fishery

The interaction between pinnipeds and the small-scale fishery at the coast of Montevideo was very low because the number of fishing events with interactions, the number of pinnipeds sighted during interactions, and the predation levels were low compared with other locations along the coast (Szteren & Páez, 2002; Szteren & Lezama, 2006a, 2006b; De María et al., 2014) and with other countries (Sepúlveda et al., 2006; de la Torriente et al., 2009). Catches were also scarce and highly variable. These factors support the hypothesis that pinnipeds are not the only agent responsible for fishers' low and variable catches as previously suggested (Szteren & Páez, 2002; Szteren & Lezama, 2006a, 2006b; De María et al., 2014). Furthermore, since the catches did not differ in the presence or absence of interactions, we can support the notion that pinnipeds would not be responsible for low catches. Other factors, such as environmental or oceanographic conditions (e.g., ocean warming), the incidence of other predators (South American fur seals, cetaceans, or other fish species) in the system, and the extension and selectivity of fishing operations, among others, also may have affected catches despite the predation caused by sea lions. Low catches may be related to the industrial fishery because of its large-scale landings and non-selective gear, which decrease the abundance of fish stocks and cause alterations in the sea bottom (Bertola et al., 1996).

Regarding the pinniped species involved in these interactions, our observations are in agreement with previous studies confirming that the sea lion is the species implicated with such events (Szteren & Páez, 2002; Szteren & Lezama, 2006a, 2006b; De María et al., 2014). This may be because this species feeds mainly in coastal areas compared to fur seals (Franco-Trecu et al., 2014). The number of interacting animals was low compared to what was reported previously in Uruguay and in Chile in small-scale fisheries, and they were mainly subadult males (Szteren & Páez, 2002; Sepúlveda et al., 2006; De María et al., 2014). Low interactions were found in spring and summer because the animals are restricted to the breeding areas in those seasons (De María et al., 2014). Once the breeding season ends, the animals need to recover their body condition so they perform longer feeding trips and go to different areas to feed. This, in turn, causes an increase in their interactions with coastal fisheries in autumn and winter in the west as observed in this study.

Predation per unit of effort was similar among the seasons. This does not allow us to define a season which is mostly or poorly affected by interactions as in other studies (Szteren & Páez, 2002). The maximum level of predation was 5.5% of the potential catches in summer. This may be because summer is not the main fishing season, and, thus, catches are low, causing interactions to have a greater impact on catches. Nevertheless, this number is similar to those reported in Chile (1.6 to 6.5%) (Sepúlveda et al., 2006; de la Torriente et al., 2009) and to those reported previously in Montevideo, Uruguay (Puerto del Buceo and La Mulata beach) (1.37 to 38.01%) (De María et al., 2014).

Finally, the abundance of sea lions and the proportion of fishing events with interactions coincided among the different seasons of the year, supporting the hypothesis that the higher frequency of interactions would coincide with the higher abundance of sea lions at LP and IF. De María et al. (2014) also reported that the higher interaction frequency at the port of La Mulata in Montevideo was in winter, which coincidentally is the season with the higher pinniped abundance at LP (Szteren, 2015, this study). This links the population variability with the animal movements from the breeding area (eastern coast) to the western coast (LP and IF) and with the possible learning behavior with respect to obtaining food, thus supporting the idea of a redistribution of the pinnipeds to the western coast (Figure 8). Moreover, there are no islands or islets used by pinnipeds between Isla de Lobos and LP-IF.

In conclusion, the patterns of abundance and the sex-age categories observed in the haulouts can be explained by the reproductive cycles of these species but also as a response of some animals to an increase in local food associated with the small-scale fishery. We recommend the continued monitoring of both haulouts, ideally making counts the same day to minimize the possibility of animal movements between both islands. It would also be valuable to record daily tides to assess if they can be related to the movement of animals from Las Pipas to Isla de Flores.

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