



Daily activities of *Larus dominicanus* (Lichtenstein 1823) at Saco da Fazenda, Itajaí-Açu river estuary, Itajaí, SC

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Abstract. The gull *Larus dominicanus* is one of the most common coastal seabirds of the Brazilian coast, being capable of using several habitats and types of preys. In that context the estuary of Saco da Fazenda is an important feeding area, bathing, cleaning of the feathers and resting. The objective of this work was evaluating the population structure and daily activity of *L. dominicanus* in the estuary. From February/2004 to January/2005, the gulls were monitored in monthly census in the Saco da Fazenda, with intervals of two hours among the census from the 6:00 am to 8:00 pm. The oscillations observed in the population of *L. dominicanus* along the year were considered significant, being higher in autumn. The occupation of the estuary started from the first hours of the day, culminating at the 2:00 pm. In the morning, the gulls were observed in feeding activity, following by the bathing, cleaning of the feathers and resting. In the afternoon the abundance reduced significantly, with the dispersion of the gulls to close areas to the Saco da Fazenda. The oscillations found in the abundance of *L. dominicanus* during this study can be attributed to events of the cycle of life of the gulls and the differences observed in the number of gulls along the day to the period of activity of the fishing fleet.

Keywords: *Larus dominicanus*, daily activity, Saco da Fazenda.

Resumo. Atividades Diárias de *Larus dominicanus* no Estuário do Saco da Fazenda no Rio Itajaí-Açu, Itajaí, SC. A gaivota *Larus dominicanus* é uma das aves marinhas mais comuns da costa brasileira, sendo capaz de utilizar vários habitats e tipos de presas. Dentro deste contexto o estuário Saco da Fazenda é considerada uma importante área para alimentação, banho, limpeza das penas e descanso. O objetivo deste trabalho foi o de avaliar a estrutura da população e as atividades diárias de *L. dominicanus* no estuário. De Fevereiro/2004 a Janeiro/2005, as gaivotas foram monitoradas através de censos mensais compreendidos entre 6:00 e 20:00 horas. As oscilações observadas na população de *L. dominicanus* ao longo do ano foram consideradas significantes, com os maiores valores registrados no outono. A ocupação do estuário foi gradativa, iniciando nas primeiras horas do dia, culminando as 14:00 horas. Pela manhã, as gaivotas eram observadas em atividade de alimentação, seguido de banho, limpeza de penas e descanso. No período vespertino, a abundância reduzia significativamente, com a dispersão das gaivotas para áreas próximas ao Saco da Fazenda. As oscilações encontradas na abundância de *L. dominicanus* durante este estudo podem ser atribuídas a eventos do ciclo de vida da espécie, enquanto que as diferenças observadas no número de gaivotas ao longo do dia, ao período de atividades dos barcos de pesca.

Palavras chave: *Larus dominicanus*, atividades diárias, Saco da Fazenda.

Introduction

In recent decades, populations of kelp gulls have dramatically increased along the coastal areas of North America, Europe, Canada, the USA, South Africa, Australia and Argentina (Crawford *et al.* 1982, Belant 1997, Yorio *et al.* 1998, Temby 2000). This increase is mainly attributed to the ability to use food resource out of anthropogenic sources (Yorio *et al.* 1998), reproductive plasticity (Burger & Gochfeld 1980, Crawford *et al.* 1982) and a potential conflict with human activities (Schiavini & Yorio 1995).

The kelp gull *Larus dominicanus* (Lichtenstein 1823) is widely distributed through the Southern Hemisphere, where it can be observed on the shoreline, as well as on the coastal islands of both the Pacific and the Atlantic Oceans; on the Falkland Islands and on the Antarctic Peninsula; and from Tierra del Fuego to Northern Peru. On the Brazilian coast, it is found from Rio Grande do Sul to Espírito Santo (Sick 1997, Novelli 1997, Higgins & Davies 1996). It is also found in New Zealand, Australia, and in Southwestern Africa (Watson 1975, McLachlan & Liversidge 1978, Brooke & Cooper 1979).

The reproductive biology of this species was recently studied on coastal islands of São Paulo (Dantas *et al.* 2010), Paraná (Carniel & Krul 2010) and Santa Catarina (Branco *et al.* 2009, Prellvitz *et al.* 2009). Despite frequent ornithological surveys in those regions, there is little information on the occurrence and abundance of *L. dominicanus* in estuarine regions (Barbieri 2008). It is consensus among researchers that monitoring an animal group requires prior knowledge of their activity patterns and abundance. Thus, determining the daily activity of the kelp gull can contribute to the understanding of habitat use (Branco *et al.* 2009) and possible impacts on aquatic communities of these ecosystems (Moraes & Krul 1995, Rodrigues & Michelin 2005).

The study area, which is part of the Itajaí-Açu river estuary, presents a high dynamism and high heterogeneity of environmental conditions. Thus, it can be understood as an important feeding site for the kelp gull. Furthermore, it is considered a sheltered area, favoring activities related to foraging, such as plumage maintenance and rest (Branco 2007).

Based on birds feeding behavior evolutionary theories, especially in understanding the optimal foraging theory, this study aimed to characterize the daily activities of *Larus dominicanus* in the region, as well as understanding the role of the species local

grouping of individuals, and thus contribute to the understanding of the kelp gull ecological role at Saco da Fazenda.

Methods

The ecosystem Saco da Fazenda is located in the Itajaí-Açu River (26°53'33" - 26°55'06" S, 48°38'30" - 48°39'14" W), Itajaí, SC. It is a semi-enclosed body of water with an area of approximately 0.7 square kilometers, a result of anthropic action that modified the original river mouth due to the building of containment jetties. It presents silt-clayey substrate, a maximum depth of 2.0 meters (except in the canal that connects to the river, which reaches up to 9.0 meters) and tidal range of less than 1.4 meters (Branco & Ebert 2002, Branco 2007) (Figure 1).

Samples were collected from February 2004 to January 2005, with a total of 96 hours of field observation. Daily activity of *L. dominicanus* was monitored monthly through eight direct population counts on a single day (06:00 to 20:00 hours). Throughout such period, four activities were monitored (focal and scan methods), with the aid of 10x50 binoculars, 1 - **feeding**: searching for food and foraging were observed throughout the Saco da Fazenda, which usually occurred in the early hours in the morning and late afternoon, 2 - **bathing**: semi-submerged body with neck and head tilted slightly forward due to thrust generated by the flapping of wings in the water on a continuous, repetitive motion; 3 - **plumage maintenance**: aligned legs and rectrices generally parallel to the substrate following the movement of the body, where the beak touches from the base to the tip of the feathers, wings attached to the body, depending on where the activity is taking place; 4 - **rest**: birds with their wings close to their bodies, rectrices opened at various angles, head and neck either near or far from the body, with small horizontal and vertical beak movements.

In field spreadsheets, the number of individuals, date, observation time (in hours) and duration of activity for the population were registered, regardless of age. The moving around the estuary was done aboard a rowboat, which allowed good approach to the kelp gulls.

The "one-way" analysis of variance, ANOVA, (Sokal & Rohlf 1969) was applied to the average number of individuals per activity and census period and logarithmized (natural logarithm), being tested for homogeneity of variance (Bartlett test) and normality of distribution (Kolmogorov -

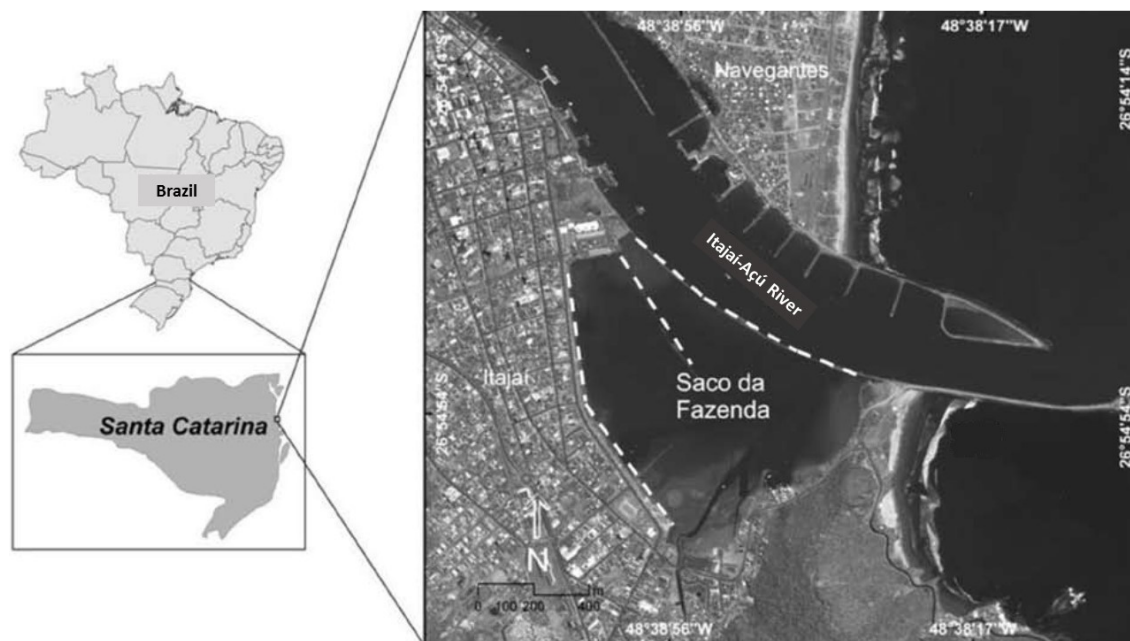


Figure 1. Satellite photograph of the study area. The Saco da Fazenda bay, Itajaí, SC, Brazil. (Source: Google Earth).

Smirnov test). For the existence of significant differences, the contrast of means (Tukey-Kramer test) was used to indicate which means were significantly different. Due to the sporadic records or absence of kelp gulls at 20:00 hours, this was removed from the analysis of variance.

Results

During the period of February 2004 to January 2005, the occurrence of the 6290 specimens of *L. dominicanus* were registered at the Saco da Fazenda estuary. The analysis of Figure 2a indicates that there were oscillations of the monthly average abundance, with the largest contributions in March (181.6 $\pm$ 35.1), followed by a sharp drop in April,

oscillating from May to September, reaching the lowest abundance average in October (21.0 $\pm$ 4.9). These oscillations were significant ($F_{11-84} = 9.115$; $p < 0.001$) and were influenced (Tukey-Kramer test) by the highest abundances in March.

The variation of the abundance average by sampling period shows that there were no significant differences in the daily pattern of the ecosystem occupation throughout the year ($F_{6-77} = 0.5592$; $p > 0.05$), but there was a gradual increase of kelp gulls between 06:00 and 16:00 hours (72.4 $\pm$ 14.2), followed by the gradual departure from the estuary until the beginning of the night (3.8 $\pm$ 3.0) (Figure 2b).

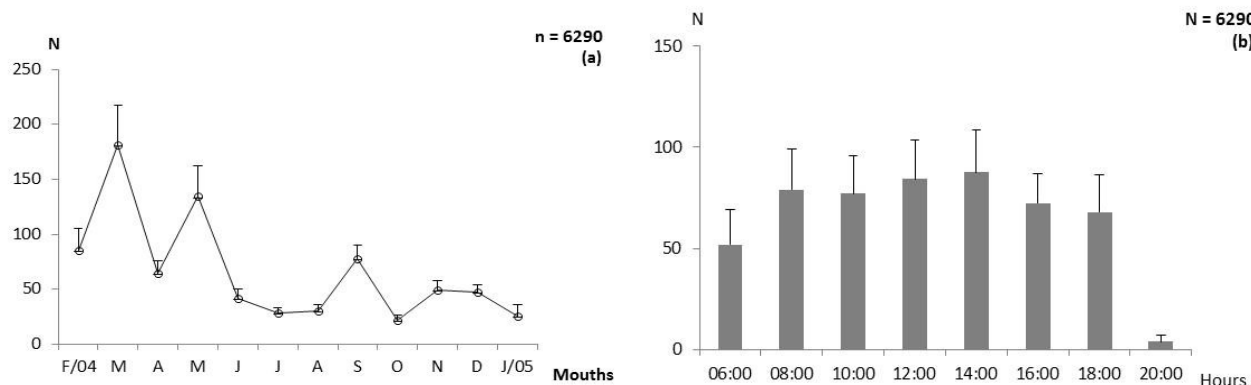


Figure 2. Population occurrence of *Larus dominicanus* during the year (a), and along the day (b) in the period of February/2004 and January/2005.

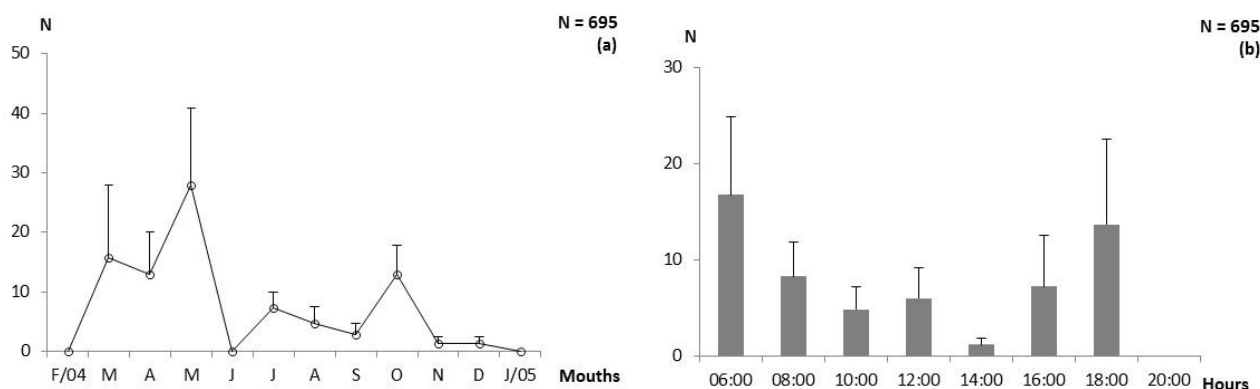


Figure 3. Population occurrence of *Larus dominicanus* during the year (a), and along the day (b), in feeding activity, in the period of February/2004 and January/2005.

Regardless of the age group, during the study period, 695 gulls were observed at feed activity, with a monthly average of 57.9 birds, except in February, June and January when there was no such activity. Three periods of greater feeding activity were registered, being the most intense in May (28.0 ± 12.7), followed by absence and oscillations with gradual decrease until December (Figure 3a).

Throughout the year, the highest abundance average of kelp gulls at feeding activity were recorded early in the day (16.7 ± 8.1) and late afternoon (13.6 ± 8.8) (Figure 3b), being that from 06:00 hours, there was a gradual decrease until the lowest abundance average at 14:00 hours, followed by new increase at 18:00 hours. These oscillations were significant ($F_{6,77} = 3.7737$; $p < 0.05$) and influenced by the kelp gulls lower abundance at

14:00 hours.

We registered 716 kelp gulls at bathing activity in the Saco da Fazenda estuary, such activity being generally performed after the feeding period. An average of 59.6 birds per month were observed, with the greatest abundance occurring in March (33.7 ± 18.2), followed by sharp decline and oscillations in the following months until it reaches the lowest abundances in January; in June and August, kelp gulls were not observed at this activity (Figure 4a). By analyzing the behavior of kelp gulls throughout the day, one can realize that the average of individuals at bathing activity increased gradually from 06:00 hours, peaking at 14:00 hours (19.5 ± 11.9), followed by significant reduction ($F_{6,77} = 2.598$, $P > 0.05$) in the number of individuals until 18:00 hours (Figure 4b).

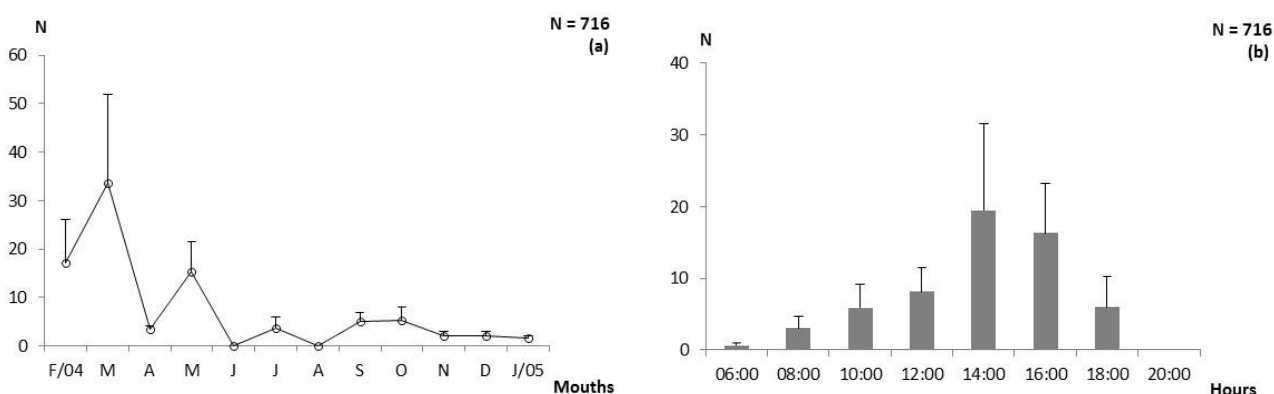


Figure 4. Population occurrence of *Larus dominicanus* during the year (a), and along the day (b), in bath activity in the period of February/2004 and January/2005.

Throughout the study, 503 kelp gulls were recorded at cleaning feathers activity, with a monthly average of 41.9 individuals. In May occurred the greatest abundance (23.5 ± 13.4), followed by sharp decline between June and July, fluctuating moderately over the remaining months (Figure 5a). Throughout the day, the major abundance averages were registered at 08:00 hours (15.5 ± 9.5), followed by decline and significant oscillations ($F_{6,77}=3.164$, $p> 0.001$) until 18:00 hours (Figure 5b).

Among the daily activities performed by the

population of kelp gulls at the Saco da Fazenda, rest was the most frequent with a significant difference among study months ($F_{11,84}=4.215$; $p<0.05$), where the major occurrences were recorded in March (116.6 ± 27.6) and the minor in October (10.1 ± 4.5) (Figure 6a). Throughout the day, the abundance of individuals at rest gradually increased from 06:00 hours until 14:00 hours (56.2 ± 9.2) and then decreased moderately to the smallest records at 20:00 hours (3.0 ± 3.0) (Figure 6b). Disregarding the average at that time, oscillations throughout the day were not significant ($F_{6,77}=1.766$, $p> 0.05$).

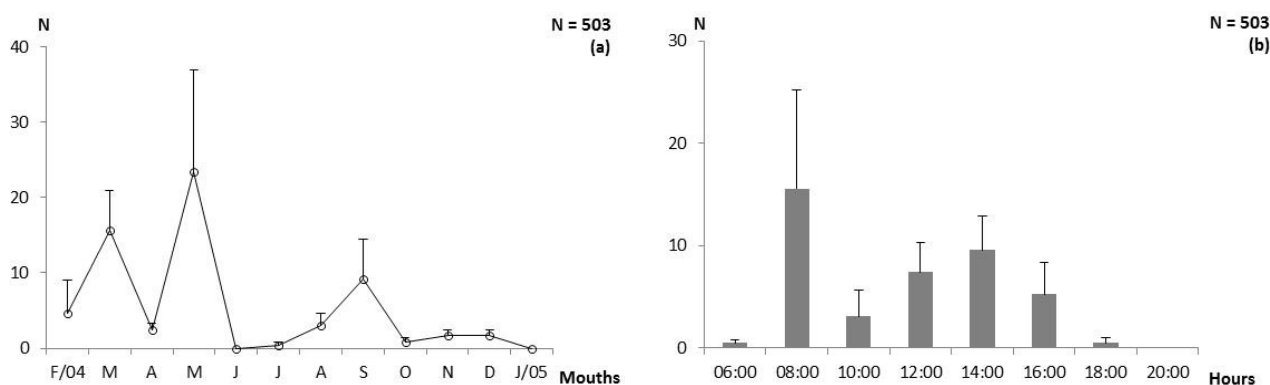


Figure 5. Population occurrence of *Larus dominicanus* during the year (a), and along the day (b), in cleaning feathers in the period of February/2004 and January/2005.

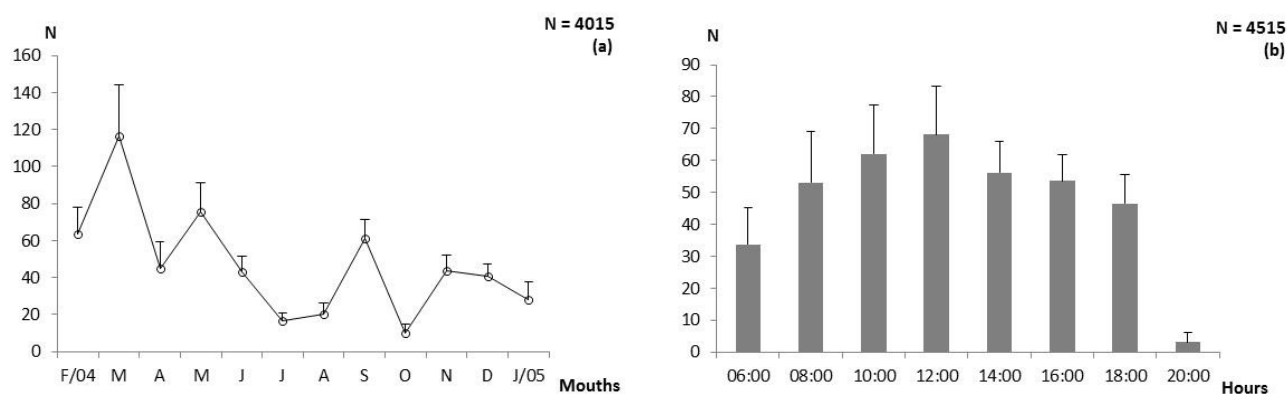


Figure 5. Population occurrence of *Larus dominicanus* during the year (a), and along the day (b), in resting activity in the period of February/2004 and January/2005.

Discussion

In general, seasonal oscillations of the population of kelp gulls in the estuary may be associated with the species reproductive pattern, and the lowest abundances between June to December, attributed to relocation and occupation of nesting sites, where as the increase from January on

indicates the return of adult individuals and entering of recruit individuals into the population (Branco & Ebert 2002, Ebert & Branco 2009).

Behavioral patterns of the *L. dominicanus* throughout the day indicate a gradual occupation of the estuary from the early morning hours, culminating with the highest

frequencies around 14:00 hours and the lowest at the end of the day. Probably, this increase in the morning is associated with the consumption of by catch from sea bob artisan fishing boats near the estuary (Branco 2001), whereas the oscillations throughout the afternoon reflected the action on fish scraps from processing industries and consumption of organic waste deposited in sand banks exposed during the low tide. This characteristic seems to be constant, since the high mobility of the kelp gull entails oscillations of both the abundance and composition of the population in response to the spatiotemporal dynamics of the estuary (Branco 2007). Similar behavior was reported on seabird communities in coastal and estuarine areas (Schiefler & Soares 1994, Schiavini & Yorio 1995, Krul 1999).

Other studies also reported on mariculture areas of the Penha-SC beach where, after the using of the ichthyofauna discarded, kelp gulls, terns and cormorants started using mollusks floating strings as substrate for rest, plumage maintenance, and abandoning the place at the end of the day (Branco *et al.* 2006). Thus, the daily activity pattern of a species can contribute to the understanding the use of habitat (Branco *et al.* 2009), where feeding may be the essential factor in understanding the activities of *Larus dominicanus* at the Saco da Fazenda, assisting in the evaluation of potential changes in the ecosystem and consequential damages to bird communities. According to Orgeira (1996), the abundance of seabirds on the South Georgia Island are subject to the availability of krill in the water column. Changes in foraging behavior could also be associated to the availability of such food resource. Similar to other seabird species, kelp gulls rest and feed in flocks (Viet & Hunt 1991). However, such grouping only occurs after the birds find the food (Hoffman *et al.* 1981), suggesting that the formation of bands is a consequence of the finding of food by ungrouped individuals.

Heterospecific bird groups in maritime-influenced environments are usually formed as a result of food sharing, adequate place for rest and group protection (Branco 2007). Kelp gulls were observed performing similar activities during feeding, bathing and plumage maintenance. Barbieri (2008) also highlights that species grouping in the *Laridae* family may be related to defense strategies, since several options of landing sites could be found in the estuary. Similar behavior has also been observed by other researchers (Olmos & Silva 2003, Brusque & Vooren 1999).

Thus, one can say that the kelp gull *Larus dominicanus* plays an important role in maritime-influenced ecosystems. However, as it obtains competitive advantages in relation to other species at, for example, food searching, the increase in the number of individuals in some regions could be related to inter-specific competition, harming less able species (Schiavini & Yorio 1995, Yorio *et al.* 1998, Yorio & Quintana 1997, Giaccardi *et al.* 1997, Barbieri 2008, Ebert & Branco 2009).

The knowledge of the daily activities of a certain bird species, associated to hetero specific interactions, facilitate the understanding of habitat using and ecological role that the kelp gull perform at the Saco da Fazenda and surrounding areas. Studies on the dynamics of these activities in the estuary, as well as on sources of food are of great importance (Rijn & Eerden 2003). Therefore, changes in the behavior of the kelp gull, observed through continuous monitoring, could indicate possible changes in the ecosystem Saco da Fazenda, with consequent loss of environmental quality.

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