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Seasonal Abundance and Distribution of Larids at Ilha Comprida (São Paulo State, Brazil)

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ABSTRACT

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We recorded eight species of birds in the Laridae family on the Ilha Comprida beach (southern São Paulo State, Brazil), during weekly censuses over 3 years (1999, 2000, and 2001). These species were grouped into three clusters by their abundance, permanence, and time of beach-flat use. The first cluster was formed by *Larus dominicanus, Sterna eurygnatha,* and *Sterna maxima,* which were in high abundance and present on the flat in all years. The second cluster included *Sterna hirundo* and *Sterna hirundinacea. Sterna hirundo* were seasonally abundant, and all individuals migrated to North America during the reproductive season. *Sterna hirundinacea* were always present for short periods. The third group included species of low abundance: *Sterna superciliaris, Sterna trudeaui,* and *Larus maculipennis.* The number of species and the number of individuals probably fluctuated because of migration or movement between neighboring beaches.

ADDITIONAL INDEX WORDS: *Laridae, Ilha Comprida, distribution, abundance, gull, tern, Brazil.*

INTRODUCTION

Birds from the Laridae family are common species on the Brazilian coast, and they can be divided in two groups: seagulls and terns (BRANCO, 2004; SICK, 1997). They are frequently found foraging and congregating on the island of Ilha Comprida, using the beach as a feeding and recovery ranch during their migration (BARBIERI, MENDONÇA, and XAVIER, 2000).

The beaches offer several resting and foraging areas for many bird species. On the beaches of the southern and southeastern coasts of Brazil, many migratory bird species forage to supply themselves with the necessary energy to migrate (BARBIERI and MENDONÇA, 2005; BARBIERI and SATO, 2000; VOOREN and CHIARADIA, 1990). The migrant species in the Laridae family that come from the Northern Hemisphere, such as the common tern (*Sterna hirundo*), start to arrive by the end of the austral spring and at the beginning of summer; the species that come from the southern part of South America, such as the brown-hooded gull (*Larus maculipennis*) and Trudeau's tern (*Sterna trudeaui*), arrive during the austral winter. The species of *Sterna* (*S. maxima, S. hirundinacea,* and *S. eurygnatha*) fish in coastal waters and rest on the beach (QUINTANA and YORIO, 1997, 1998, 1999; SICK, 1997). Kelp gulls (*Larus dominicanus*) feed on the beach in adjacent waters and may be found in many places along the southern Brazilian coasts; they are distributed throughout the entire coastal extension, without a regulated pattern of fixed landing ranches (BRANCO, 2003; VOOREN and CHIARADIA, 1990).

Research on marine and coastal birds in the state of São Paulo is rare, especially along the south coast. Although the Ilha Comprida beach extends more than 70 km, few studies have documented the presence of particular species or the oscillation in numbers of individuals throughout the year (BARBIERI, MENDONÇA, and XAVIER, 2003). The region has an intense fishing industry, using both homemade and commercial boats. Such activity is quite attractive to birds because of the many rejected fish that are thrown into the ocean.

We wanted to examine the temporal pattern of beach use by several larid species to better understand those patterns. Our objective in this research was to determine the abundance and pattern of seasonal and monthly occurrence of birds in the Laridae family within the Ilha Comprida beach study area.

STUDY AREA

Ilha Comprida is located on the southern coast of São Paulo State and is part of the Ribeira de Iguape hydrographic basin, whose mouth marks the northern limit of the Iguape–Cananéia–Paranaguá estuarine complex. The island is, on average, about 70 km long and 3 km wide (Figure 1). Ilha Comprida was formed by the accumulation of sandy sediments and is a prominent landscape on the southern coast of São Paulo State (24°52′ S, 47°50′ W). However, the area is fragile because of intensive anthropogenic occupation (TESSLER, 1988). The vegetation is primarily swamps, dunes, scrub for-

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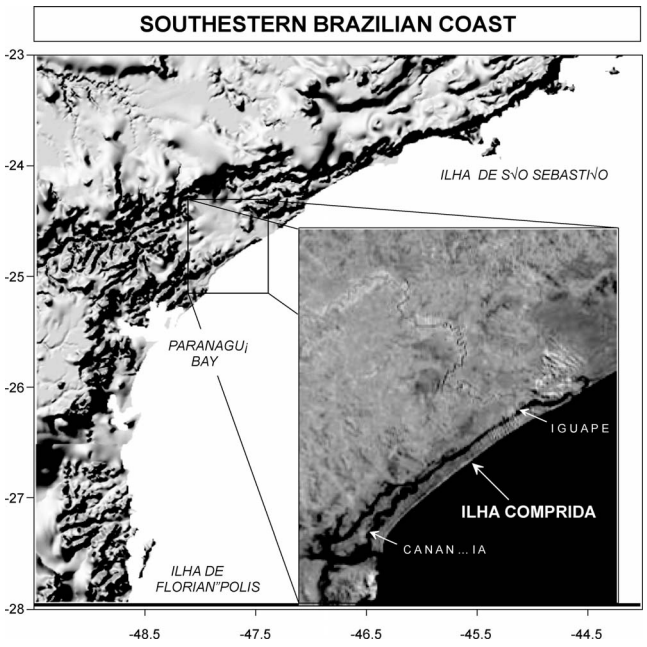

Figure 1. Southestern Brasilian coast with Ilha Comprida indicated.

ests, and mangroves with resident fauna and visitor birds from the Northern and the Southern Hemispheres. The island is a recent quaternary barrier of marine origin (SUGUIU and MARTINS, 1987).

Ilha Comprida is a favorite tourist spot, and has both tourist facilities and residences, with a few traditional fishing communities. With sandy beaches, interrupted by small streams, the scenery is beautiful. It is disorderly occupied by secondary residents, but a few traditional fishing communities still survive.

Lunar tides have an amplitude of about 1.50 m on average. The sea level is lowered by the prevailing northeasterly wind and raised by the southerly winds. The beach has a gentle slope (an incline of 4° to 6°), and as a result, the swash zone is wide, generally about 15 m. In this zone, invertebrates are found in high densities (MISHIMA *et al.*, 1985).

MATERIALS AND METHODS

Bird counts were carried out weekly between January 1999 and December 2001. The weekly censuses provided a total 144 samplings. The counts began in the morning (8:30 AM) and lasted for a minimum of 2.5 hours and a maximum of 4 hours, for a total of 540 hours. The Ilha Comprida beach was traversed by car at a medium speed (40 km/h) and proceeding through the transect for the 70 km. We followed the methodology proposed by BIBBY, BURGUES, and HILL (1992) for these types of ambient conditions and described by BARBIERI and MENDONÇA (2005) in their study of Charadriidae at Ilha Comprida. During the counts, the number of boats that were fishing was also registered. The direction of travel was from south to north (from Canal de Cananéia to Canal de Icapara), transiting to the north (Canal de Icapara), then, identifying

Table 1. *Total number of Laridae species found at the beach of Ilha Comprida in 1999, 2000, and 2001. RA = relative abundance.*

	1999		2000		2001	
Species of Laridae	Total	RA (%)	Total	RA (%)	Total	RA (%)
Larus dominicanus	21,230	36.26	15,593	31.67	14,532	38.20
Sterna eurygnatha	32,354	55.11	28,004	56.88	18,682	49.11
Sterna maxima	1364	2.32	5147	10.45	4043	10.62
Sterna hirundinacea	3436	5.85	406	0.82	656	1.72
Sterna hirundo	324	0.55	79	0.16	118	0.21

and counting the birds (Figure 1). Binoculars (7 × 50 mm and 20 × 60 mm) were used to aid in the observations.

The average number of individuals was tested using an analysis of variance (ANOVA), ($p < 0.05$) to assess differences between years, species, and month. Pearson's lineal correlation (r) with $p = 0.05$) was used to verify the relationship between the average number of birds in the Laridae family and the number of fishing ships along the Ilha Comprida beach in 2000. To assess the relative abundance of each species, the following scale was used: birds present in >50% of the counts = Dominant; 30%–50% = Abundant; 10%–30% = Uncommon; and <10% = Rare (individuals within a taxon as a percentage of the total number of individuals).

A constancy index was calculated using the following formula: $C = (p \times 100)/P$ (DAJOZ, 1978), in which p corresponds to the number of visits in which a species was sighted, and P refers to the total number of visits. Species were classified as follows: taxa present in more than 50% of the visits = Constant; those present during 25% to 50% of the visits = Accessories; and those represented in less than 25% of the visits = Accidental.

RESULTS

Eight species of gulls and terns were found, and the most abundant species were kelp gulls (*Larus dominicanus*), cayenne terns (*Sterna eurygnatha*), royal terns (*Sterna maxima*), and South American terns (*Sterna hirundinacea*). The num-

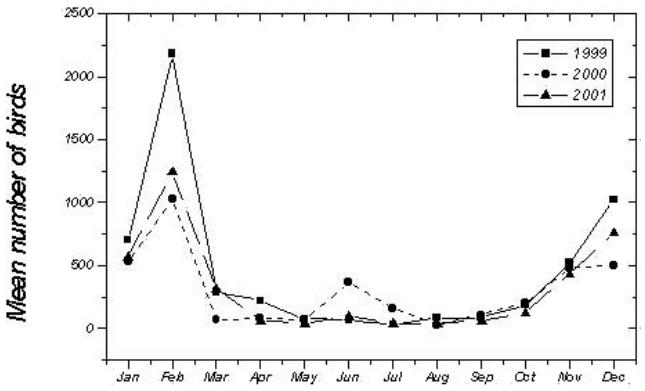

Figure 2. Monthly average of birds from the Laridae family from 1999 to 2001 along Ilha Comprida coast.

Table 2. *Total number of* Larus dominicanus, Sterna eurygnatha, S. maxima, S. hirundinacea, *and* S. hirundo *sighted in 1999, 2000, and 2001, at Ilha Comprida, with the respective total numbers of individuals (T), occurrence frequency (OF), density (D birds/km), average (A), standard deviation (SD), and constancy (C).*

Date	*Larus dominicanus*						*Sterna eurygnatha*						*Sterna maxima*		
Month	T	OF %	D	A	SD	C %	T	OF %	D	A	SD	C %	T	OF %	D
1999															
Jan	2111	79.78	30.15	703.66	190.39	100	391	14.78	5.58	130.33	91.33	100	6	0.22	0.08
Feb	8731	48.42	125.4	2182.7	730.10	100	8753	48.54	125.0	1438.2	763.17	100	248	1.37	3.54
Mar	974	44.59	13.91	288.5	92.26	100	974	44.59	13.91	326.33	210.82	100	41	1.87	0.58
Apr	874	27.40	12.48	219.5	141.25	100	2286	71.68	32.65	571.5	481.79	100	3	0.09	0.04
May	305	8.71	4.35	76.25	30.60	100	3070	87.68	43.85	767.5	579.67	100	54	1.54	0.77
Jun	276	9.99	3.94	69	15.28	100	1882	68.16	26.88	470.5	378.35	100	505	18.29	7.21
Jul	118	20.81	1.68	29.5	15.30	100	440	77.60	6.28	146.66	100.09	100	5	0.88	0.07
Aug	332	26.75	4.74	83	37.14	100	729	58.74	10.41	182.25	126.39	100	135	10.87	1.92
Sep	418	9.55	5.97	83.6	24.46	100	3168	72.42	45.25	633.6	261.99	100	286	6.53	4.08
Oct	913	28.55	13.04	182.6	54.05	100	2113	66.09	30.18	422.6	230.73	100	57	1.78	0.81
Nov	2093	29.86	29.9	523.25	202.13	100	2664	38.01	38.05	666	434.59	75	5	0.07	0.07
Dec	4085	40.81	58.35	1021.2	69.95	100	5884	58.78	84.05	1470.7	620.85	100	19	0.18	0.27
2000															
Jan	2650	59.60	37.85	530	91.54	100	1633	36.72	23.32	326.6	176.49	100	141	3.17	2.01
Feb	5116	38.77	73.08	1023.2	388.90	100	7279	55.17	103.9	1455.8	610.81	100	762	5.77	10.88
Mar	287	13.81	4.10	71.75	18.69	100	1473	70.91	21.04	368.25	76.27	100	312	15.02	4.45
Apr	317	22.56	4.52	79.25	24.74	100	775	55.16	11.07	193.75	169.21	100	309	21.94	4.38
May	328	11.29	4.68	65.6	14.04	100	2107	72.53	30.1	421.4	195.87	100	468	16.11	6.68
Jun	1425	32.38	20.35	366.25	267.08	100	2553	58.02	36.47	638.25	379.60	100	422	9.59	6.02
Jul	629	12.74	8.98	157.25	61.45	100	3253	65.93	46.47	813.25	267.96	100	1052	21.32	15.02
Aug	147	2.22	2.10	29.4	12.39	100	5414	81.85	77.34	1082.8	617.43	100	995	15.04	14.21
Sep	321	42.46	4.58	107	59.47	100	346	45.76	4.94	115.33	52.67	100	135	17.85	1.92
Oct	594	29.53	8.48	198	35.72	100	1081	53.75	15.44	360.33	133.45	100	84	4.17	1.2
Nov	1766	45.44	25.22	479.4	124.25	100	1799	46.29	25.7	359.8	127.82	100	304	7.82	4.34
Dec	2013	80.45	28.75	503.25	205.57	100	291	11.63	4.15	97	91.55	66.67	163	6.51	2.32
2001															
Jan	2258	91.01	32.25	564.5	80.48	100	52	2.09	0.74	13	4.636	75	151	6.08	2.15
Feb	4963	76.77	70.90	1240.7	493.12	100	1046	16.18	14.94	348.66	174.65	100	412	6.37	5.88
Mar	890	61.54	12.70	314.4	106.61	100	413	28.56	5.9	103.25	98.94	60	138	9.54	1.97
Apr	238	20.74	3.40	59.5	18.50	100	850	74.10	12.14	212.5	69.63	100	42	3.66	0.6
May	204	17.58	2.91	40.8	6.35	100	650	56.03	9.28	130	36.36	100	256	22.06	3.65
Jun	374	8.51	5.34	93.5	25.64	100	2609	57.10	37.27	652.25	180.58	100	1135	25.83	16.21
Jul	159	5.91	2.27	39.75	10.97	100	1198	44.52	17.11	299.5	52.79	100	1112	41.38	15.88
Aug	162	8.79	2.31	40.5	14.25	100	1299	70.52	18.55	324.75	39.38	100	381	20.68	5.44
Sep	252	11.50	3.60	63	20.41	100	1741	79.49	24.87	435.25	122.024	100	149	6.80	2.12
Oct	251	6.53	3.58	125.5	72.5	100	3588	92.04	51.25	1794	1562	100	20	0.51	0.28
Nov	1754	24.93	25.05	436.25	87.55	100	5202	73.94	74.31	1734	868.88	50	22	0.31	0.31
Dec	3027	91.92	43.24	756.75	305.92	100	34	1.03	0.48	11.33	8.51143	50	225	6.83	3.21

ber of individuals from these species was variable and differed during the 3 years they were studied. The other species, the common tern (*Sterna hirundo*), the snowy-crowned tern (*Sterna trudeaui*), the yellow-billed tern (*Sterna superciliaris*), and the brown-hooded gull (*Larus maculipennis*), occurred in smaller numbers. *Sterna hirundo* were seasonally distributed during the years, but the presence of the other species was rare.

The most abundant species were *S. eurygnatha,* totaling 55.11%, 56.88%, and 49.11%; *L. dominicanus,* representing 36.26%, 31.67%, and 38.20%; and *S. maxima* at 2.32%, 10.45%, and 10.62% of the sightings in 1999, 2000, and 2001, respectively (Table 1). The average number of birds in 1999 was statistically different from the number in 2000 and 2001. In 1999, November and February were the months with the greatest number of birds. The total number of larids was higher in 1999 in November and February than any other month. In 2000, the highest numbers were in summer and winter (June to August) (Figure 2, Table 2). These differences were caused by an increase in the number of *S. eurygnatha* during the winter (Figure 3).

Among the predominant species, *S. eurygnatha* had the highest counts in November and February, and *S. maxima* were most common in winter, often forming heterospecific decree flocks along the beach (Figures 3 and 4). *Sterna eurygnatha* were present in nearly constant numbers in almost every month studied, except November and December of 2001 (Table 2), during which its appearance declined to the Accessory category. However, there were statistical differences in February compared with other months. In 1999, the relative abundance of *S. eurygnatha* was Dominant or Abundant in almost every month studied, except January, in which it was Uncommon. In 2000, the tendency was the same; however, the month in which they were Uncommon was December (Table 2). In 2001, the species was Rare in December and January, Uncommon in February and March, and Dominant or

Table 2. *Extended.*

Sterna maxima			*Sterna hirundinacea*						*Sterna hirundo*					
A	SD	C %	T	OF %	D	A	SD	C %	T	OF %	D	A	SD	C %
2	1.15	66.67	138	5.20	1.97	46	46	33.33	0	0	0.0	2.66	1.45	0
62	14.79	100	83	0.46	1.18	20.75	13.09	100	216	1.19	3.08	54	27.73	100
13.66	3.48	100	163	7.46	2.32	54.33	31.99	100	32	1.46	0.45	10.66	10.17	66.66
0.75	0.25	75	19	0.59	0.27	4.75	3.47	75	7	0.21	0	1.4	0.87	50
13.5	9.18	100	72	2.05	1.02	18	11.56	100	0	0	0	0	0	0
126.25	124.58	75	98	3.54	1.4	24.5	11.02	75	0	0	0	0	0	0
41.33	39.35	66.66	4	0.70	0.057	1.33	0.88	33.33	0	0	0	0	0	0
33.75	32.08	100	45	3.62	0.64	11.25	10.91	50	0	0	0	0	0	0
57.2	40.57	80	502	11.47	7.17	125.2	124.91	60	0	0	0	0	0	0
11.4	5.81	80	103	3.22	1.47	20.6	19.85	60	11	0.34	0.15	2.75	1.88	40
1.25	1.25	25	2201	31.40	31.44	440.2	440.2	25	45	0.64	0.64	11.25	4.71	75
4.75	2.86	75	8	0.07	0.11	2.66	0.66	75	13	0.12	0.18	3.25	1.97	50
28.2	13.87	100	16	0.35	0.22	3.2	2.33	40	6	0.13	0.08	1.2	1.2	20
150.4	29.21	100	28	0.21	0.4	5.6	1.96	80	8	0.06	0.11	1.6	0.97	40
78	32.67	100	4	0.19	0.057	1	1	25	1	0.04	0.01	0.25	0.25	25
77.25	45.09	75	2	0.14	0.028	0.5	0.5	25	2	0.14	0.02	0.4	0.4	25
93.6	47.16	80	1	0.03	0.014	0.2	0.2	20	1	0.03	0.01	0.2	0.2	20
105.5	66.43	75	0	0	0	0	0	0	0	0	0	0	0	0
263	64.04	100	0	0	0	0	0	0	0	0	0	0	0	0
199	77.85	100	58	0.87	0.82	13.6	4.52	75	0	0	0	0	0	0
45	35.76	100	54	7.14	0.77	18	11.71	33.33	0	0	0	0	0	0
28	13.57	100	239	11.88	3.41	79.66	56.95	33.33	13	0.64	0.18	4.33	2.33	66.66
60.8	17.92	100	4	0.10	0.057	0.8	0.8	20	13	0.33	0.18	2.6	1.77	40
54.33	24.84	100	0	0	0.0	0	0	0	35	1.39	0.50	11.66	6.64	33.33
37.75	9.84	100	20	0.80	0.28	5	5	25	0	0	0	0	0	0
137.33	52.10	100	43	0.66	0.61	14.33	14.33	33.33	0	0	0	0	0	0
27.6	19.02	75	0	0	0	0	0	0	5	0.34	0.07	1	1	20
10.5	5.5	75	17	1.48	0.24	4.25	4.25	25	0	0	0	0	0	0
51.2	12.92	100	50	4.31	0.71	10	8.30	60	0	0	0	0	0	0
283.75	54.15	100	276	6.28	3.94	69	56.45	50	0	0	0	0	0	0
278	109.52	100	218	8.11	3.11	54.5	32.91	75	0	0	0	0	0	0
97.75	26.01	100	0	0	0	0	0	0	0	0	0	0	0	0
37.25	17.10	100	7	0.31	0.10	1.75	1.03	50	41	1.87	0.58	10.25	4.76	75
10	10	50	25	0.64	0.35	12.5	12.5	50	14	0.35	0.20	7	3	100
5.5	4.51	75	0	0	0.0	0	0	0	57	0.81	0.81	14.25	8.52	50
56.25	41.475	75	0	0	0.0	0	0	0	7	0.21	0.1	1.75	1.18	50

Abundant in all other months studied (Table 2). The average number of individuals in 1999 was significantly different ($p < 0.05$) than those in 2000 and 2001 (Table 1).

Larus dominicanus had larger concentrations during the hottest months, decreasing in number during the winter (Figure 5) but were Constant in every month of the studied years. There were statistical differences during January, February, November, and December in comparison with other months. However, in relation to their relative abundance, the species was Rare or Uncommon in the winter months and Dominant or Abundant in the summer months. The results shown in Figure 5 clearly reveal that the number of individuals decreased in winter. Again, there was a significant difference ($p < 0.05$) between the averages obtained in 1999 and those obtained in 2000 and 2001.

Sterna maxima were also Constant in almost every month studied, except for November of 1999 and October of 2001, when it was categorized as Accessory (Table 1). In relative abundance, *S. maxima* were only Abundant in July 2001, being Rare or Uncommon in the other months. Significant differences were verified (by ANOVA) between the data for June, July, August, and February when they were compared with the other months in all the corresponding periods. The average number of *S. maxima* individuals was significantly different ($p < 0.05$) in 1999 when compared with 2000 and 2001 (Table 1), increasing in the latter 2 years over the 1999 counts.

In November 1999, there were a remarkable number of *S. hirundinacea*; a decree of 2001 individuals was counted, with *S. maxima* and *L. dominicanus* present as well (Figure 6). The difference in the particular months was not statistically significant, but the difference among years was significant. In relation to perseverance, *S. hirundinacea* was Constant during the months of 1999 and categorized as Accessory or

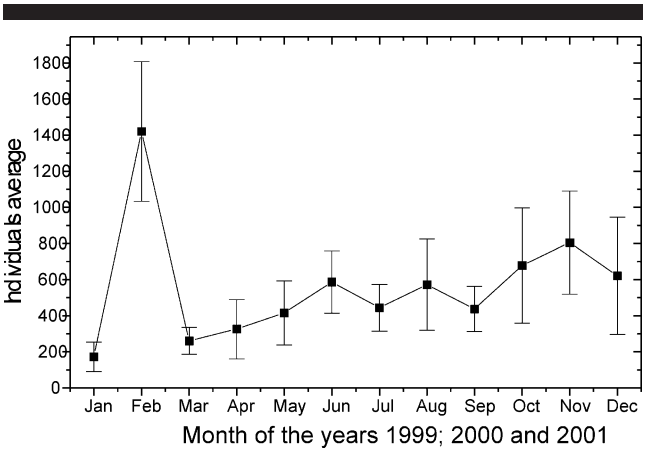

Figure 3. Average number of individuals of *Sterna eurygnatha* in 1999, 2000, and 2001 on Ilha Comprida beach. The values correspond to an average of 12 samplings. The bars are the respective standard deviations.

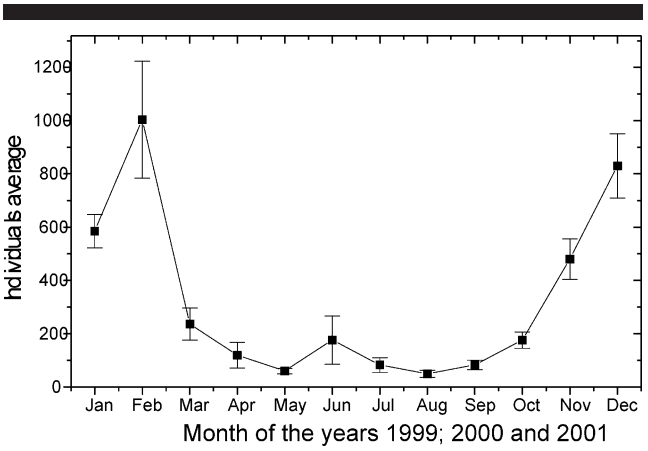

Figure 5. Average number of individuals of *Larus dominicanus* in 1999, 2000, and 2001 on Ilha Comprida beach. The values correspond to an average of 12 samplings. The bars are the respective standard deviations.

Accidental during the months of 2000 and 2001 (Table 2). The relative abundance of *S. hirundinacea* was Rare in every month studied. The average number of individual *S. hirundinacea* was significantly different ($p < 0.05$) in 1999 when compared with 2000 and 2001 (Table 1).

Sterna hirundo only appeared in spring and in summer, *i.e.,* during the hot months, with the largest decree counted in February of 1999 (140 individuals in one sampling) (Figure 7). The average number of individuals was significantly different ($p < 0.05$) in 1999 when compared with 2000 and 2001 (Table 1). Also, there were statistical differences among the months of January, February, September, October, November, and December in comparison with the other months studied. *Sterna hirundo* was always observed in heterospecific decrees with flocks of other species of terns, and was categorized as Constant and Accessory in spring and summer, respectively, and as Absent in winter (Table 2).

Sterna superciliaris were only observed in the winter and spring months, and their occurrence were Rare. Five individuals of *S. trudeaui* were sighted in August 2000. Five individuals of *L. maculipennis* were counted, three in April and two in October of 1999. It was difficult to sight these two species on the Ilha Comprida beach.

The gathering places of the Laridae birds found on the Ilha Comprida beach were in the extreme south and north, which constitute the punctual areas between the beaches and the canals of Cananéia and Icapara, respectively (Figure 8). In these two areas, more than 4000 birds of *L. dominicanus, S. eurygnatha, S. maxima,* and *S. hirundinacea* species were counted.

Along the beach, the Laridae family was distributed in decreasing numbers traveling north, probably due to the presence of boats, cars, people, and food. In 2000, there was a strong correlation between the distribution of *L. dominicanus* along the beach and the distribution of fishing boats ($r =$

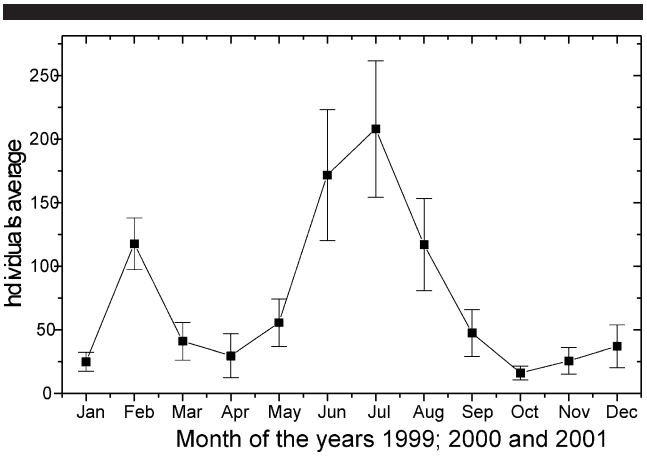

Figure 4. Average number of individuals of *Sterna maxima* in 1999, 2000, and 2001 on Ilha Comprida beach. The values correspond to an average of 12 samplings. The bars are the respective standard deviations.

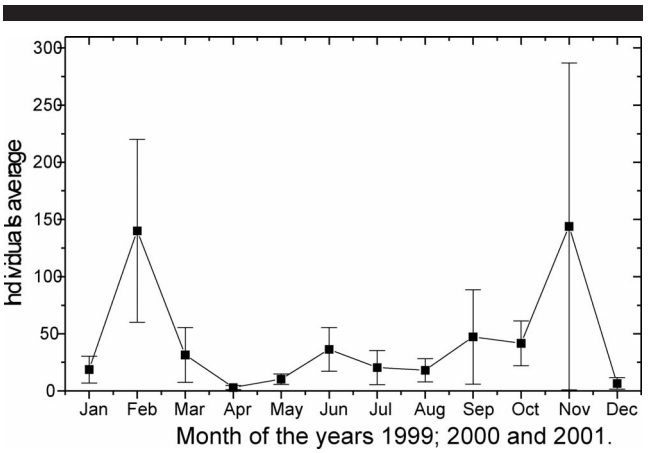

Figure 6. Average number of individuals of *Sterna hirundinacea* in 1999, 2000, and 2001 on Ilha Comprida beach. The values correspond to an average of 12 samplings. The bars are the respective standard deviations.

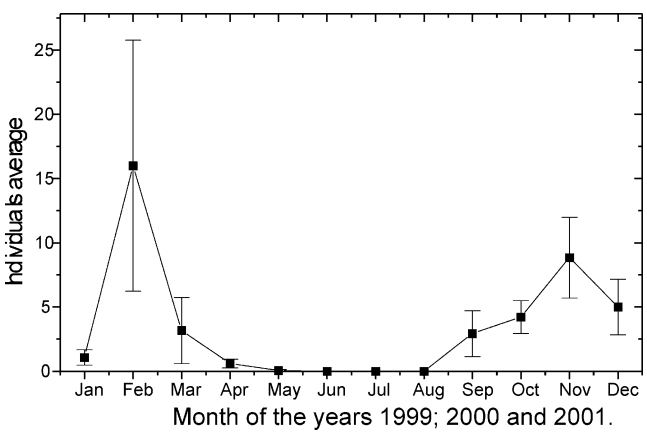

Figure 7. Average number of individuals of *Sterna hirundo* in 1999, 2000, and 2001 on Ilha Comprida beach. The values correspond to an average of 12 samplings. The bars are the respective standard deviations.

0.88) (Figure 9). The largest anthropic influence on the birds was the presence of fishing boats because *L. dominicanus* fed on the waste fish thrown overboard. The place with the largest concentration of birds, Boqueirão Sul, was also the place with the largest concentration of boats (Figure 8). *L. dominicanus* was also observed eating remains left on the beach by tourists.

DISCUSSION

Larus dominicanus inhabits the coast and coastal islands of the Pacific Ocean and the South American Atlantic Ocean, from Tierra del Fuego to northern Peru, along the coast of Brazil up to the state of Espirito Santo (NOVELLI, 1997; SICK, 1997). *Larus dominicanus* is also found in southern Africa, Australia, New Zealand, and in the Antarctic continent on sub-Antarctic islands (BURGER and GOCHFELD, 1996). *Larus dominicanus* is described as predator, necrophagic, and an intra- and interspecific kleptoparasite (HOCKEY, RYAN, and BOSMAN, 1989; SICK, 1997), with a marked tendency toward opportunistic behavior (FAVERO, SILVA, and FERREYRA, 1997), a description that accurately reflects the behavior observed in this study. Most research indicates that the alimentary feeding behavior of *L. dominicanus* is strictly linked to the presence of small fish close to its nesting areas (BUR-

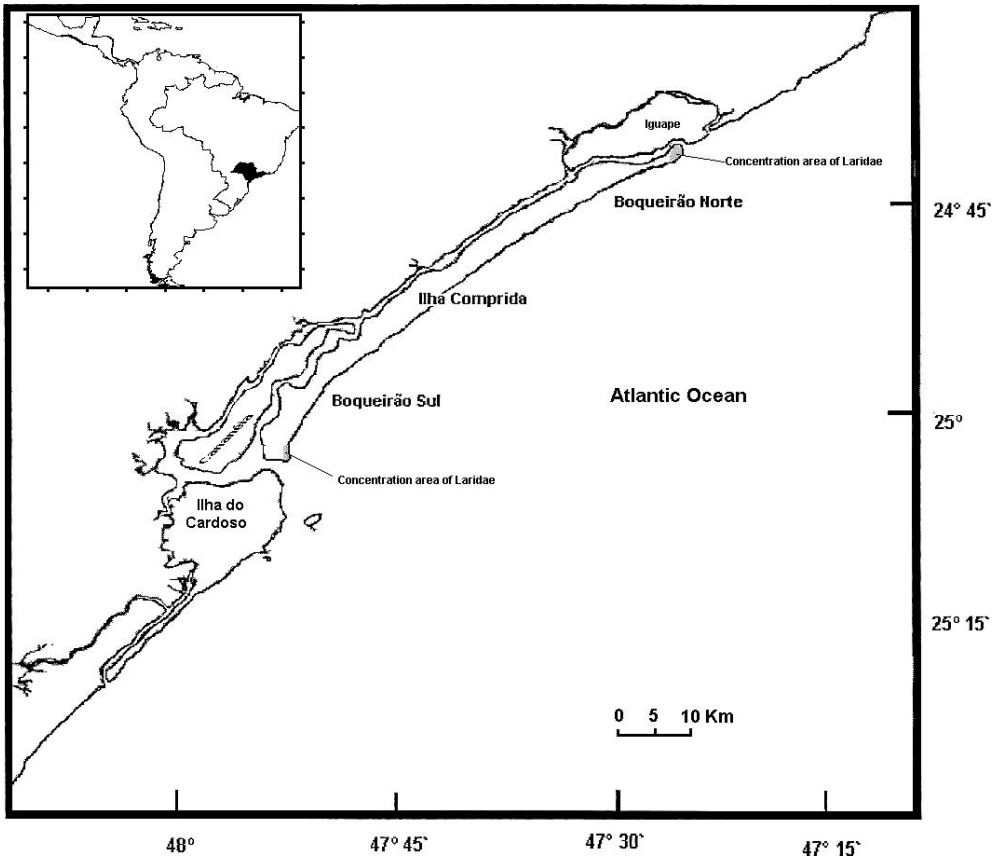

Figure 8. Ilha Compridas on the Brazilian coast, with the area with the largest Laridae concentration, the Canal de Cananéia and the Canal de Icapara (images not available), marked.

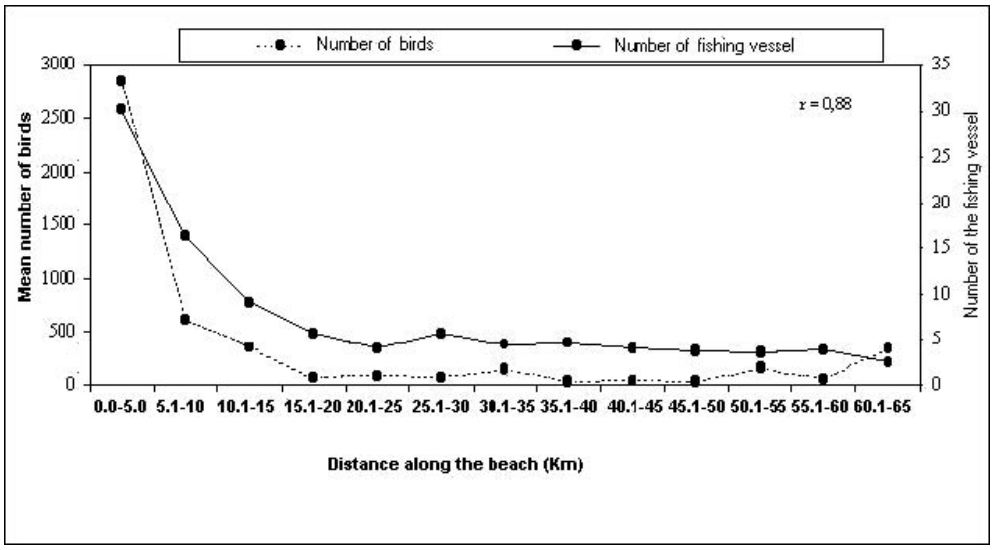

Figure 9. Relationship between the average number of birds in the Laridae family and the number of fishing ships along the beach of Ilha Comprida in the year of 2000.

GER and GOCHFELD, 1966; NOVELLI, 1997; SICK, 1997). The current literature provides evidence that *L. dominicanus* obtains its alimentary food resources in the surf zone and on the beach (NOVELI, 1997; SICK, 1997; VOOREN and CHIARADIA, 1990) but are also commonly seen on land, feeding on the carrion remains of animals and garbage left by people (SICK, 1997). The *L. dominicanus* population increase, in some cases, was attributed to readily available food found in garbage of human origin (CRAWFORD, COOPER, and SHULDON, 1982), as well as the dead marine mammals thrown onto the beach, which are also known to be a food source for those birds (NOVELLI, 1997). The increase of the *L. dominicanus* individuals during the hot months in our surveys can possibly be linked to waste from shrimp fishing, which leaves many rejects that are used as food by the bird.

There are 149 coastal islands, flagstones, and rocks listed for the state of São Paulo (ANGELO, 1989), but published information concerning the birds that live on these islands is rare, especially for the south coast. Bird species usually reproduce in the summer on the coast of America and Patagonia (PERREIRA, PUTZE, and SANDER, 1990; QUINTANA and YORIO, 1998; YORIO *et al.,* 1994). In Brazil, reproduction registrations have also been recorded in winter (BEGE and PAULI 1998; SOARES and SCHIEFLER, 1995a, 1995b). The abundance of birds on the Ilha Comprida beach increased in the summer (the nonreproductive period) as a hibernating area for birds that originally belonged to other colonies, possibly located in the Santa Catarina State or elsewhere (BEGE and PAULI, 1989; SOARES and SCHIEFLER, 1995a, 1995b; PEREIRA *et al.*, 1990; YORIO, *et al.,* 1994; QUINTANA and YORIO, 1998, 1999).

The *S. eurygnatha* decrease in numbers during the autumn and winter of 1999 in Ilha Comprida could be expected because this species is a winter breeder, with nesting beginning in May and extending to July (EFE, 2004; EFE *et al.,* 2000). Even so, in 2000 and 2001, there was an increase in the abundance of *S. eurygnatha* in autumn and winter along the island. During the same period, there was a decrease in the number of individuals at Espirito Santo, leading us to conclude that the events were related. It is possible that some of the individuals of *S. eurygnatha* observed at Ilha Comprida came from Santa Catarina because this bird predominantly breeds on the islands of Santa Catarina from May to December (BRANCO, 2003).

Sterna maxima are the more vulnerable coastal bird species in Brazil (IBAMA, 2003) because their reproductive colonies suffered from extensive egg collecting by people fishing. Some *Sterna maxima* populations nidificate in the Northern Hemisphere, migrating to the Caribbean and northern South America; another population nidificates in Chubut and Patagonia, Argentina (NOVELLI, 1997; QUINTANA and YORIO, 1997, 1998, 1999; YORIO *et al.*, 1994), and another breeds in Africa. The species was present at Ilha Comprida throughout the year, with the locally nesting birds and those from the southern reaches of South America co-occurring. Although NEVES (1994) registered the nesting of *Sterna maxima* in Laje de Santos (São Paulo State), that was probably not the source of the individuals at Ilha Comprida because the individuals in our study did not display breeding plumage.

The great variation among the censuses made within 1 month are common in this type of research, showing that some species move rapidly and frequently between close places, which causes great fluctuations in survey counts of their abundance. This situation was also reported by BARRAMES and PEREIRA (1992) in their survey of Laridae and Scolopacidae families.

Sterna hirundo only occurred during the hottest months at Ilha Comprida, as well as at Praia do Cassino in Rio Grande do Sul State (HARRINGTON, ANTAS, and SILVA, 1984; HAYS *et al.,* 1997, 1999; VOOREN and CHIARADIA, 1990). The ab-

sence of *S. hirundo* during winter can be explained because, at that time, these birds were at their reproduction ranches and were breeding in the Northern Hemisphere. According to SICK (1997), these birds are regular visitors to the Brazilian coast, and they are among the marine birds that make the longest migrations, traveling along the Atlantic or Pacific ocean coast from Canada to Patagonia (HARRISON, 1987; NOVELLI, 1997). The presence of *S. hirundo* at the Ilha Comprida beach in small decree numbers makes us believe that they use the island as stopover point for recovery during the migration.

Sterna hirundinacea appeared in all years studied, although in reduced number, and its occurrence can probably be related to the use of the area for rest, feeding, and, possibly, reproduction. Reproduction by this species along Brazilian coast was previously mentioned by EFE *et al.* (2000), BEGE and PAULI (1989), NEVES (1994), ESCALANTE, AZEVEDO, and FREYESLEBEN (1988), ANTAS (1990), and NOVELLI (1997).

The two areas of the island where the Laridae concentrated (Figure 8) are located in the Canal de Cananéia and Canal de Icapara, which drain to the seawaters of the Cananéia–Iguape Estuary–Lake complex. This very localized concentration is probably due to the large number of fishing boats, from which people discard rejected fish in the vicinity of the sandbars. Also, during low tides, the sandbanks in this area are exposed and are used by the birds for resting. These influences can explain the high correlation between the number of Laridae and the presence of fishing boats ($r = 0.88$).

The distribution of other bird species on the Ilha Comprida beach depends primarily on available food (BARBIERI and MENDONÇA, 2005). The negative correlation between the number of people and the number of birds was anticipated because of the disturbances caused by anthropogenic action (BARBIERI and PINNA, 2005). Crowds can cause the birds to leave their resting places, which is what we found in the southern portion of the island during the summer, when the birds left the areas of heavy tourist use.

The sighting of the Laridae family forming heterospecific decree flocks can be explained as a defense strategy of the species. The habit of forming decree flocks with other species seems to be a normal behavior for *S. eurygnatha, S. maxima, S. hirundinacea,* and *L. dominicanus* (ESCALANTE, 1970; NOVELLI, 1997). The group we sighted was composed of a single gull and three terns, and it used the whole extension of the beaches from the Estuary–Lake area of Cananéia–Iguape as a landing area throughout the entire year, providing access to the alimentary resources of the whole area. For the populations of coastal birds that live in this way, with the space division among decree flocks, extensions of beach of about a dozen kilometers should be preserved and maintained free from human disturbance. This conclusion should guide the environmental preservation strategy of the Ilha Comprida beach as a whole. According to ESCOFET *et al.* (1993), the pressures of human development, along with the absence of plans for handling urban expansion, cause the disordered use of the planet region by birds, especially and primarily in the coastal zones. This process, in particular, causes the loss of natural areas, with the consequent loss of species.

The place with the largest concentration of birds was the Boqueirao do Sul, which also had the largest number of boats (Figure 1). There was a high correlation between the numbers of birds and boats in our study because of the proximity of the Porto de Cananéia, with its reduced number of tourists on the beach, being inaccessible by automobile.

CONCLUSION

Ilha Comprida needs to be protected, and environmental planning is required to minimize the effects of tourism on the shorebird population. The number of visitors could be limited, or a bird refuge could be delimited. Results of changed management practices could be documented by defining goals for Laridae use and measuring them with the methods used in this study. The Ilha Comprida beach is particularly important to *L. dominicanus, S. eurygnatha,* and *S. maxima* because of their great abundance there. The presence of these species in great numbers indicates that this beach has ideal conditions for feeding and resting.

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