ORNITOLOGIA NEOTROPICAL 18: 421–432, 2007

ASSEMBLAGE OF SHOREBIRDS AND SEABIRDS ON ROCHA LAGOON SANDBAR, URUGUAY

Matilde Alfaro & Mario Clara

Sección Zoología de Vertebrados, Facultad de Ciencias, Universidad de la República. Iguá 4225, CP 11400, Montevideo, Uruguay.
E-mail: malfaro@fcien.edu.uy

Resumen. – Ensamble de aves marinas y costeras en la barra de la Laguna de Rocha, Uruguay. – La Laguna de Rocha es conocida por presentar gran cantidad de especies de aves marinas y costeras tanto residentes como migratorias. Con el fin de conocer mejor la comunidad de aves que utilizan esta área, se estudió la variación en la riqueza y abundancia del ensamble de aves marinas y costeras (Charadriidae, Scolopacidae y Laridae) durante un año (período 2000–2001), y se describieron algunas características del hábitat escogido por ellas. En un área de 60 ha, en la barra de la laguna, se obtuvieron datos de riqueza y abundancia. Se registraron en total 24 especies correspondientes a migratorias de verano, migratorias de invierno, y residentes. La riqueza fue menor en Julio (9) y Noviembre (11), momentos en los cuales se registraron las mayores abundancias de Gaviotines Golondrina (*Sterna hirundo*) y de Gaviotines Sudamericanos (*S. hirundinacea*), respectivamente. Los chorlos y playeros presentaron menor abundancia pero una alta riqueza, siendo las especies más comunes el Playerito Rabadilla Blanca (*Calidris fuscicollis*), el Chorlito Pecho Canela (*Charadrius modestus*) y el Chorlo Dorado (*Pluvialis dominica*). El Gaviotín Chico (*S. superciliaris*) fue registrado nidificando en el área de estudio durante dos temporadas reproductivas entre los meses de Octubre a Febrero. Se observó una marcada variación estacional, principalmente relacionada con la llegada de gran cantidad de aves migratorias en invierno (Julio) y a fines de la primavera (Noviembre). La barra de la laguna de Rocha ofrece una gran variedad de ambientes que fueron utilizados para descanso, alimentación y nidificación por las especies de aves migratorias y residentes. Las características particulares de este ambiente posiblemente también estén relacionadas con la alta riqueza de especies y con la variación temporal observada.

Abstract. – Rocha lagoon is known to present many migrant and resident seabird and shorebird species. In order to improve the knowledge of the birds community that inhabit this area, changes in richness and abundance of the shorebird and seabird assemblage (Charadriidae, Scolopacidae and Laridae) were studied during a year (period 2000–2001), and some of the habitat characteristics selected by the species were described. Data on richness and abundance of birds were obtained through seasonal censuses in an area of 60 ha in the lagoon's sandbar. Twenty four species of seabirds and shorebirds were registered in the study area corresponding to summer migrants, winter migrants, and residents. Richness was low in July (9) and November (11) when the highest peaks of abundances of Common Terns (*Sterna hirundo*) and South American Terns (*S. hirundinacea*), respectively, were registered. Shorebirds were in general, less abundant but showed high species richness, with the White-rumped Sandpiper (*Calidris fuscicollis*), the Rufous-chested Dotterel (*Charadrius modestus*), and the American Golden Plover (*Pluvialis dominica*) being the three most common species. Nesting of the Yellow-billed Tern (*S. superciliaris*) was registered in the study area during two consecutive reproductive seasons between October and February. Remarkable seasonal variation was observed, principally related with the arrival of migratory species in winter (July) and the end of spring (November). Rocha lagoon's sandbar offers a variety of habitats used for resting, feeding and breeding by

migratory and resident species. Particular characteristics of the study area are also possibly related to the high richness and the temporal variation observed. *Accepted 28 May 2007*.

Key words: Shorebirds, seabirds, temporal variation, estuarine environment, costal lagoon, Uruguay.

INTRODUCTION

Quantitative studies in species assemblages that involve migratory and resident species contribute to the knowledge of the basic ecological requirements in wintering and breeding grounds (Levey & Stiles 1992, Rappole *et al.* 1993). These kinds of studies also contribute to document the migratory routes and the evidence of population fluctuation (Levey & Stiles 1992, Rappole *et al.* 1993).

Bird assemblage composition and abundance vary among and within habitats, depending on the seasonal stability of the resources and climate conditions (Karr 1976). Irregularity in food resource availability could result in birds feeding on other resources or to move to another area (Karr 1976). Climate seasonality is another reason why many birds species migrate, avoiding the undesirable climate conditions and the scarcity of food resources (Karr 1976, Levey & Stiles 1992, Rappole & Tipton 1992).

Uruguay is located within the corridors used by many Nearctic and Neotropical migrant bird species which appear in the country during their non-breeding season (Escalante 1970, Gore & Gepp 1978, Azpiroz 2003). Shorebirds (plovers and sandpipers) are represented in Uruguay by 24 Nearctic (Charadriidae 3, Scolopacidae 21), three Neotropical (coming from southern South America), and two resident (Charadriidae) (Azpiroz 2003). Larids are represented by five Nearctic species, four Neotropical (also coming from the south) and nine resident (Azpiroz 2003).

Rocha lagoon, located in southeastern of Uruguay, is an important wintering area for migratory shorebirds and seabirds, as well as resident species during their whole life cycle (Clara & Maneyro 1999, Alfaro 2003). Although it is known as an important bird area, no published data based on periodical surveys in this area exist.

This coastal lagoon is a highly productive and dynamic estuarine ecosystem, changing both as a consequence of sedimentation and man-induced actions (removal of sediments to make discharge channels), which generate important changes in the extent of intertidal habitats (Pintos *et al.* 1988). Furthermore, birds enhance these coastal ecosystems with nutrients (guano), detritus, and food (as live or dead preys), increasing the biodiversity of the system (Polis *et al.* 1997). All these attributes affect the bird composition and abundance in temporal and spatial scales (Burger *et al.* 1977, Hill *et al.* 1993).

In order to improve the knowledge about the bird community at Rocha lagoon and to evaluate the importance of the area for migratory and resident species and their temporal variation, changes in richness and abundance of Charadriidae, Scolopacidae and Laridae families in the Rocha lagoon's sandbar were analyzed during the year, and some characteristics of their respective habitat were described.

STUDY AREA AND METHODS

Study area. Rocha lagoon, Rocha Department, is located on the Atlantic coast of Uruguay (34°33'S – 54°22'W), 10 km west from La Paloma city (Fig. 1). This lagoon is part of a coastal lagoon system ranging from Sauce lagoon in Maldonado, Uruguay, to Lagoa dos Patos in Rio Grande do Sul, Brazil (Clara & Maneyro 1999). It is included in a MAB-

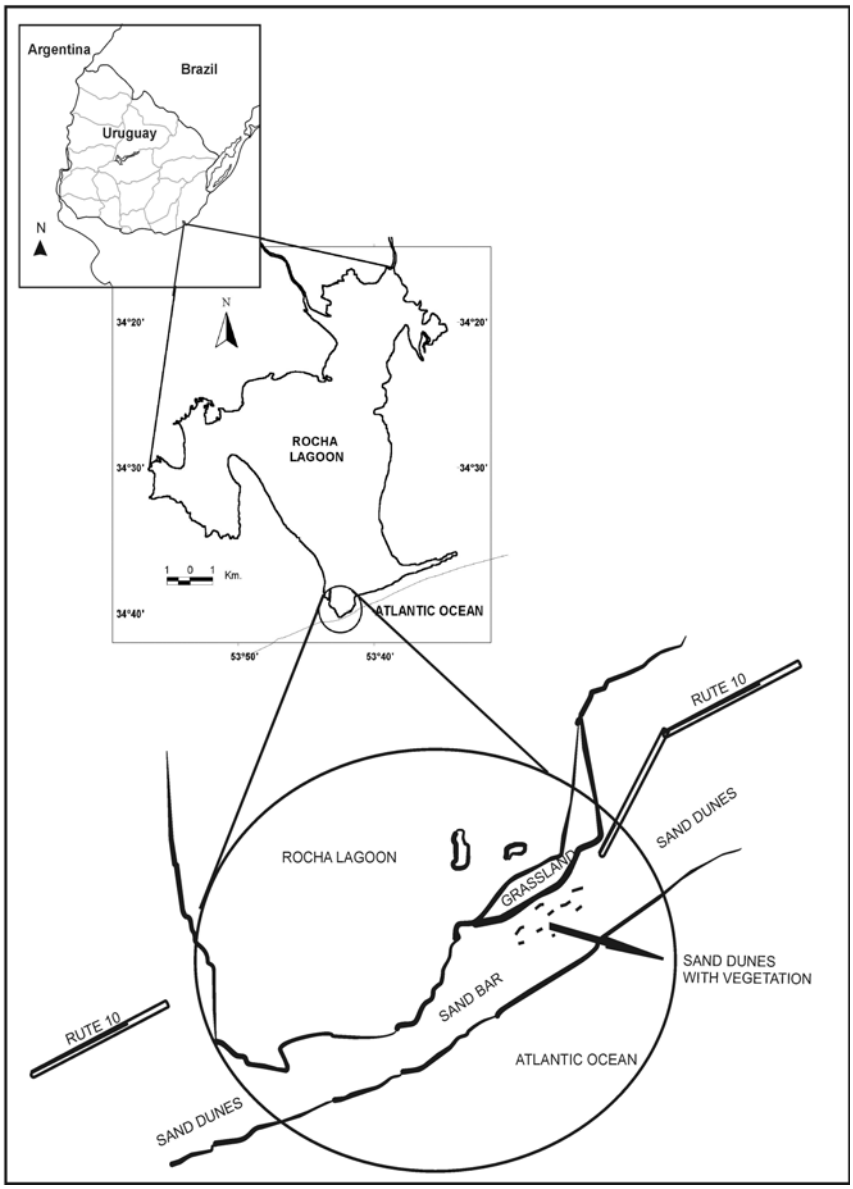

FIG. 1. Rocha lagoon, Rocha Department, Uruguay. The circle shows the study area.

UNESCO Reserve and was declared a National Park and Multiple Use Area (Law Nº 17234) in 2000.

The lagoon area covers about 7200 ha, with a maximum length of 13.85 km and a width of 11.5 km, with an average water depth of 0.6 m (Conde *et al.* 2000). The study area includes part of the sandbar that separates the lagoon from the sea (Fig. 1). This lagoon opens to the sea, naturally or artificially,

TABLE 1. Species of the Charadriidae, Scolopacidae and Laridae registered in Rocha lagoon sandbar, Uruguay, showing the status, and the abundance and species richness during the nine surveys. R = resident, SM = summer migrant, WM = winter migrant.

Scientific names	Status	Oct. 00	Feb. 01	March-4-01	May-4-01	May-30-01	July 01	Sept. 01	Nov.-6-01	Nov.-25-01	Total
CHARADRIIDAE											
Vanellus chilensis	R	6	2	3	1	13	3	6	6	6	46
Pluvialis dominica	SM	7	4	1				38	35	32	117
Charadrius falklandicus	WM		3	2	15	2					22
Charadrius collaris	R	2	10	8	2	1	3	5	2	3	36
Charadrius modestus	WM					50	16				66
SCOLOPACIDAE											
Tringa melanoleuca	SM							8	3		11
Tringa flavipes	SM	4	4						2		10
Tringa solitaria	SM		1								1
Tryngites subruficollis	SM		22		3				22	2	49
Arenaria interpres	SM	2									2
Calidris melanotos	SM				2						2
Calidris alba	SM				5					11	16
Calidris fuscicollis	SM	87	113	36	26	13		33	128	150	586
Limosa haemastica	SM		1					1			2
Gallinago paraguaiae	R			1		2	1				4
LARIDAE											
Larus dominicanus	R	28	31	40	39	105	83	37	64	163	590
Larus maculipennis	R	4	9	148	174	127	8	5			475
Sterna trudeaui	R			9	71	14	35	34			163
Sterna hirundo	SM	22	348	3		2		9	700	1300	2384
Sterna hirundinacea	WM			19	223	5	2105				2352
Sterna superciliaris	R	5	14	5	2			26	9	15	76
Thalasseus eurygnathus	R	3		30				9	3	23	68
Thalasseus maximus	R	4				1		6	1	1	13
Rynchops niger	R	97		3	220		30				350
Abundance		271	562	308	783	335	2284	217	975	1706	7441
Species richness		13	13	14	13	12	9	14	12	11	

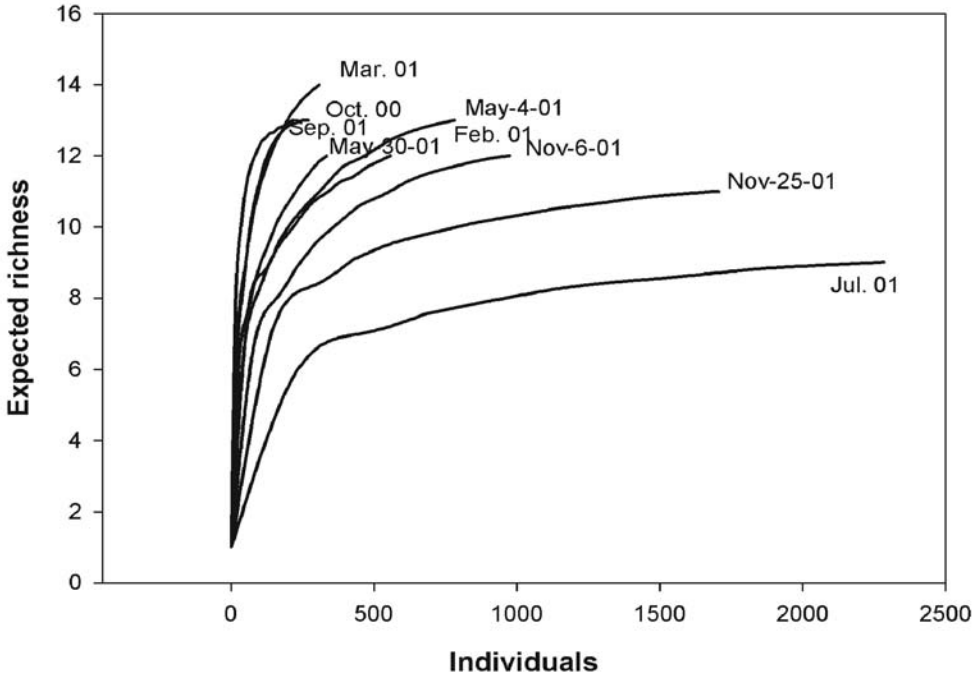

FIG. 2. Monthly individual rarefaction curves of expected richness. The graph shows that September, October and March were the most diverse survey periods, and November and July the lower.

several times in a year, leading to a strong salinity gradient in the lagoon (Pintos *et al.* 1988, Conde *et al.* 2000).

Part of the study area (5 ha) is dominated by psammophyle vegetation (*Panicum racemousm*, *Hydrocotyle bonaerensis*, *Senecio crassiflorus*, *Calystegia soldanella*, *Androtrichum triginum* and *Croton capensis*) on the sand dunes. We also found halophyte (*Juncus acutus*) and hydrophilic vegetation (*Erythrina cristagalli*, *Hibiscus cisplantinus*, *Canna glauca*, *Typha latifolia*, *Iris pseudacorus*) in estuarine marshes along part of lagoon shore areas (0.9 ha) (Alonso 1997, Lahitte & Hurrell 1997). There is a small portion (7 ha) of coastal grassland between the dunes and the lagoon dominated by *Schoenoplectus americanus* and *Paspalum vaginatum* (Fagúndez & Lezama 2005). However, the major part of the area (47 ha) consists of a mudflat with sand dunes, and both the marine coast and shallow lagoon areas without vegetation (Fig. 1).

Survey design. Between October 2000 and November 2001, 18 censuses were realized in the study area following a 1500 m long and 400 m wide (60 ha) line transect parallel to the sea coast and the lagoon shorelines. The study area was visited on nine opportunities: 6 October 2000, 10 February, 9 March, 4 and 30 May, 2 July, 30 September, 6 and 25 November 2001. During each visit, two censuses, one in the morning between 07:30 to 11:30 h and one in the afternoon between 16:00 to 18:30 h, were realized in order to register the species richness and relative abundance of birds during the day. Each census lasted 2 h and the determination of the species was done using 10 x 50 binoculars and a 30 x 80 scope. Because of biases associ-

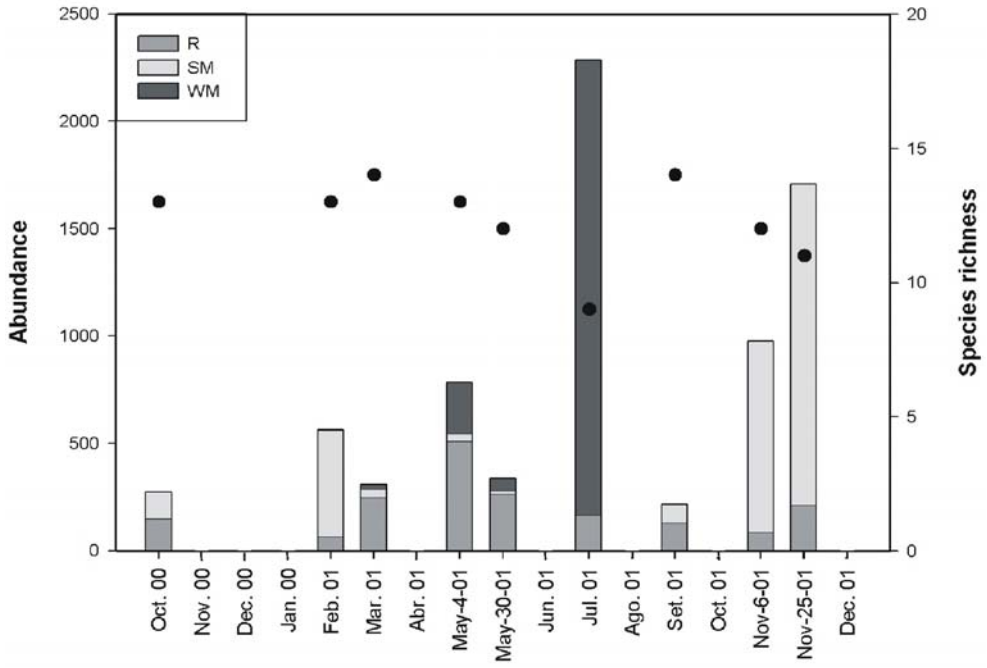

FIG. 3. Total species richness and abundance of birds during the study period. Bars represent the abundance of residents (R), summer migrants (SM) and winter migrants (WR), and dots represent the species richness.

ated with the observer's detection and count of birds, we considered relative abundances as the minimum estimates. Aggregations of more than 500 birds were counted by two observers, using the estimation method of counting a small bird group and then estimating the entire flock (Gregory *et al.* 2004).

Data analysis. The two censuses done in each visit (one in the morning and one in the afternoon) were lumped together using the highest abundance of each species for that day. Temporal variation was assessed by a correspondence analysis that can be used to link species space and sample units space (McCune & Grace 2002). Rarefaction curves were performed to compare species diversity between samples (Krebs 1989).

RESULTS

During the study period, 24 species of shorebirds and seabirds (Charadriidae, Scolopacidae and Laridae) were recorded (Table 1). The assemblage was composed by 11 Nearctic migrant (summer migrants = SM), three Neotropical migrants (winter migrants = WM) and 10 residents (Table 1). Variation on species richness was low, except in July and end of November 2001, when diversity clearly decreased, as shown in the rarefaction curves (Fig. 2). June and November censuses showed the highest abundance registered during the study period (Fig. 3).

Common Terns (*Sterna hirundo*) were the most abundant Nearctic species, and were the responsible for the pick detected in November (Fig. 3, Table 1). White-Rumped Sandpip-

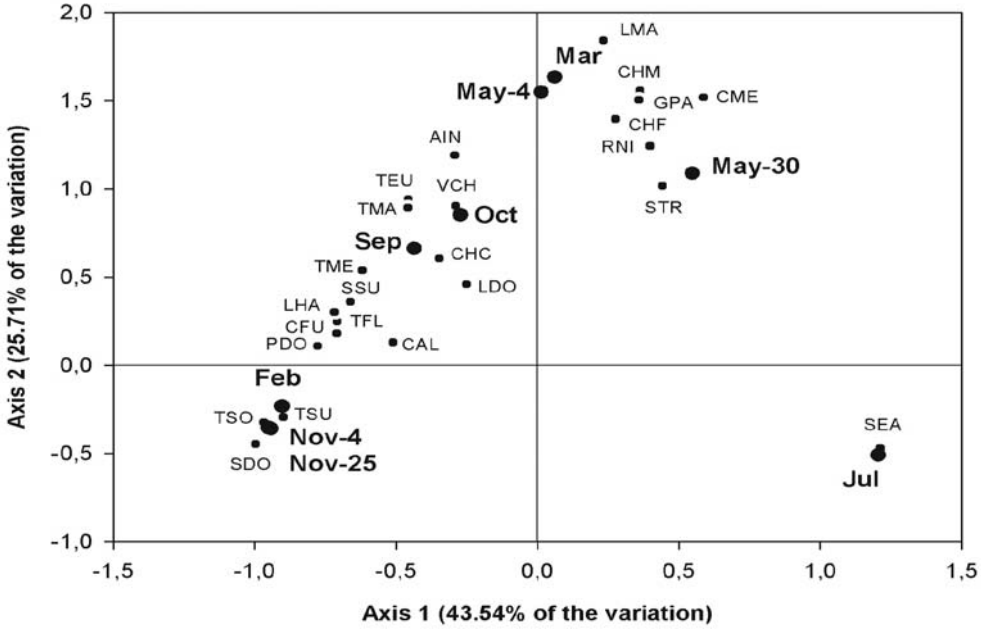

FIG. 4. Result of the correspondence analysis showing the distribution of the species between surveys. Large dots represent the months and small dots correspond to the species. AIN = *Arenaria interpres*; CAL = *Calidris alba*, CHC = *Charadrius collaris*; CHF = *C. falklandicus*, CFU = *C. fuscicollis*, CME = *C. melanotos*; CHM = *C. modestus*; GPA = *Gallinago. paraguaiae*; LDO = *Larus dominicanus*, LHA = *Limosa haemastica*; LMA = *L. maculipennis*, PDO = *Pluvialis dominica*; RNI = *Rynchops niger*; SDO = *Sterna hirundo*, SEA = *S. hirundinacea*; SSU = *S. superciliaris*, STR = *S. trudeaui*; TEU = *Thalasseus eurygnathus*, TFL = *Tringa flavipes*, TMA = *T. maximus*; TME = *T. melanoleuca*; TSO = *T. solitaria*; TSU = *Tryngites subruficollis*; VCH = *Vanellus chilensis.*

ers (*Calidris fuscicollis*) were the most abundant shorebirds, and were present in all the surveys except in July. However, most individuals of this species appeared during spring–summer surveys (September–March). Other frequently observed Nearctic shorebirds were the American Golden Plover (*Pluvialis dominica*) and the Buff-breasted Sandpipers (*Tryngites subruficollis*), manly in spring–summer surveys (September–March) (Table 1).

Neotropical migrants were best represented by the South American Tern (*Sterna hirundinacea*), which was the most abundant species of the whole assemblage (Table 1). It had its highest abundance in July, which determined the pick detected (Fig. 3). The Rufous-chested Dotterel (*Charadrius modestus*) appeared at the end of March and in July but with considerably lower abundances, as well as the Two-banded Plover (*Charadrius falklandicus*) which appeared during February to the end of May (Table 1).

Resident species were best represented by larids, being the Kelp Gull (*Larus dominicanus*), the Brown Hooded Gull (*Larus maculipennis*) and the Black Skimmer (*Rinchops niger*) the most abundant (Table 1). Kelp Gulls, Collared Plovers (*Charadrius collaris*) and Southern Lapwings (*Vanellus chilensis*) appeared in all surveys (Table 1). The Snowy-crowned Tern (*Sterna trudeaui*), the Brown Hooded Gull and the Black Skimmer were more abundant during autumn (March–May), except that Black Skimmers were also abundant in October

(Table 1). Yellow-billed Terns (*S. superciliaris*) were breeding on the sand dunes with psammophyle vegetation. Reproductive activity was observed on four occasions corresponding to the 2000–2001 and 2001– 2002 breeding seasons. In February 2001, chicks were observed on the nests and juveniles were observed in March. By the end of September 2001, adults with breeding plumage were observed displaying courtship activity. Finally, on 6 November 2001, we counted three nests with eggs and, on 25 November, eight nests with eggs.

In general, shorebirds used lagoon shore areas, shallow water and grasslands where they were observed foraging. They also used the sand dunes and grasslands for resting. Seabirds were observed roosting on the sand dunes and shore areas of the lagoon, and used the lagoon and sea waters for foraging.

Correspondence analysis showed two major important axes that explained the 69.25% of the total variation in richness and abundance of the system (Axis 1: 43.54% of variation, eigenvalue = 0.869; Axis 2: 25.71% of the variation, eigenvalue = 0.513; Fig. 4). Axis 1 separates spring–summer months (September–October–November–February) from the autumn–winter ones (March–May–July). This separation was strongly associated with the two most abundant migrant species: the Common Tern (36.6% of the variation) in November (23.4% of the variation) and the South American Tern (56.5% of the variation) in July (51.3% of the variation) (Fig. 4). This separation also clearly divides Nearctic migrants from those migrating from the south, except for one species, the Pectoral Sandpiper (*Calidris melanotos*), a summer migrant that appeared joining the autumn–winter group. This species was registered only in one occasion, in early May, thus the analysis considered this species only associated with the May survey. Residents species appeared dispersed between the two groups.

Axis 2 separates fall and spring months (September, October, May, March) from February, November, and July (Fig. 4). The Brown Hooded Gull represented 42.2% of the total variation in the samples and was strongly associated with March and May censuses, while Common Terns again were associated with November and February (12.4% of the variation), and South American Terns with July (13.6% of the variation) (Fig. 4).

DISCUSSION

The assemblage of shorebirds and seabirds showed a strong temporal variation related to the arrival and departure of migratory species during the study period. Many studies of seasonal variation in bird communities showed important variations in richness and abundance during the year, principally associated with the availability of food resources, the passage of migrant birds, and the changing characteristics of the habitat (Karr 1976, Burger *et al.* 1977, Howe 1984, Avery & Riper 1989, Marone 1992, Hill *et al.* 1993, Ferreira Rodriguez 2000, Isacch *et al.* 2003a).

Nearctic species were well represented in the study area, principally by five species which were the most abundant. Common Terns arrive to the Uruguayan coast during the southern spring and summer for overwintering and feeding (Escalante 1970). High numbers of this species were observed in Lagoa dos Patos, Brazil (up to 14,000) and in Punta Rasa, Argentina (20,000–30,000); both sites are classified as non-reproductive resting areas of major importance (Hays *et al.* 1997, Saponznikow *et al.* 2002, Bugoni & Vooren 2005). In Rocha lagoon, abundances were considerably lower and, although we could not cover the whole spring–summer season (September–March), recent studies in the area have shown that Common Terns are present during the whole season with about the same numbers (unpubl. data). Common Tern

flocks were observed roosting over the sand dunes and using both the lagoon and sea for foraging activities.

White-rumped Sandpipers are common in the Uruguayan coast during their non-breeding season from September to April (Tauge 1955, Gerzenstein 1965). Their reported biggest congregations along the coast of Argentina took place mainly at the beginning (October–December) and the end (March–April) of their non-breeding season (Bala *et al.* 2001, Hernández *et al.* 2004, Gatto *et al.* 2005). Our data show that the highest numbers were observed in October, November and February, but recent studies at the same site indicate that they remain during December and January with higher abundances (unpubl.). They used the sand shorelines and shallow waters for feeding, like in other non-breeding areas in the region (Vooren & Chiaradia 1990, D'Amico *et al.* 2004, Hernández & Bala 2007). Other important Nearctic shorebirds in the area were the American Golden Plover and the Buff-breasted Sandpiper. These species are principally associated with grassland habitats in winter areas (Lanctot *et al.* 2002, Isacch *et al.* 2003b, Isacch *et al.* 2003c, Blanco *et al.* 2004). Buff-breasted Sandpipers were always observed using the grassland portion of the study area. Otherwise, American Golden Plovers also used the sand shores of the lagoon for feeding, as observed in the coast of Buenos Aires Province and southern Brazil (Vooren & Chiaradia 1990, Blanco *et al.* 2004, Blanco *et al.* 2006). Buff-breasted Sandpipers appeared sporadically during the spring–summer censuses. Rocha lagoon has many grassland areas along the inland coast used by many of them during the non-breeding season (Lanctot *et al.* 2002). It is probably that they moved from one site to another, searching for suitable food or roosting areas, and that could be a reason for the infrequent observations in the study area.

The South American Tern, the most abundant of the three recorded Neotropical species, breeds in Patagonia, Argentina from November to January and migrates northward to the wintering areas in Argentina, Uruguay and Southern Brazil (Gerzenstein 1965, Escalante 1970, Scolaro *et al.* 1996, Favero *et al.* 2000, Bugoni & Vooren 2005, Yorio 2005). Other populations breed in Santa Catarina, Brazil during the southern winter (Sick 1997, Branco 2003). Given the high registered numbers and the period of time they were in the study area, the individuals that overwintered in Uruguay should have come from Patagonian populations. Like Common Terns, they used the sand dunes and sandbanks for resting but mainly the sea for foraging.

The Rufous-chested Dotterel and the Two-banded Plover occur in Uruguay mainly during fall–winter seasons (April–August) (Gore & Gepp 1978). Rufous-chested Dotterels are principally observed in grassland habitats during the non-breeding season (Isacch *et al.* 2003b, Isacch *et al.* 2003c, Blanco *et al.* 2004), but in the study area they also used the lagoon shorelines. The Two-banded Plover was always observed using sand dunes and the lagoon shore for feeding as it was in southern Brazil and the Buenos Aires Province (Vooren & Chiaradia 1990, Blanco *et al.* 2006).

During spring (September) and autumn (March), we registered the highest species richness due to the presence of both the northern and the southern migrants, and many resident species. These two seasons represented the moments when the migratory species interchanges took place, and their abundances were fairly distributed. In autumn surveys (March, May), the Brown-hooded Gull was the most abundant species. It is a resident species common on the Uruguayan coast during autumn and winter, disappearing from the coast during spring and summer, possibly due to the movements to breeding areas (Escalante 1970). Other resident species common in the study area, the Black Skim-

mer, the Kelp Gull, and the Snowy-crowned Tern, had a similar behavior, breeding in other areas and using the Rocha lagoon during their non-breeding season. In contrast, Yellow-billed Terns were breeding in the area and dispersed during the non-breeding season. Data available on the breeding biology of the Yellow-billed Tern in South America show that the species prefers sandbars with scarce vegetation for nesting (Escalante 1970, Krannitz 1989, Maugeri 2005). Yellow-billed Terns breeding in the area had low reproductive success, possibly due to human disturbances (egg predation and vehicle traffic over the dunes).

Because of their diverse behavior, breeding and resting in different sites at different moments, resident species were not represented in the analysis as an independent group from the migrants; they were mixed with them and showed a difference in number between summer and winter migrants.

Sand shorelines of Rocha lagoon offer a great variety of invertebrates that could be used by shorebirds as food resources (Kloetzer 2003). The estuary of Rocha lagoon offers other food resources like fish, and also resting and breeding areas for seabirds and shorebirds. Further studies are necessary to explore the relationship between the bird assemblage and the dynamics of Rocha lagoon sandbar and food availability in a temporal scale.

This study shows the importance of the area for many species of shorebirds and seabirds as a breeding, roosting and foraging site. Only a few places in Uruguay support migratory species like in the Rocha lagoon. Migratory species are the object of conservation concerns because of their behavior, high aggregation in colonies and roosting areas, and their habitat degradation (Rappole *et al.* 1993, Yorio *et al.* 2001, Yorio 2005). Rocha lagoon is a National Park but lacks a management plan for a correct use of the area by visitors. This study contributes to the knowledge of the basic requirements for the conservation of bird species in this area.

AKNOWLEDGMENTS

We thank Guillermo Kloetzer, Gastón Azzis, Leonardo Lorenzo, Victoria Calvo and Javier Llopart for their help during field surveys. We also thank Graciela Fabiano and Orlando Santana (DINARA – La Paloma) for logistic support, and Facultad de Ciencias for lodging in their Biological Station in La Riviera, Rocha. We are also indebted to Andres Canavero, Daniel Naya, Laura Mauco, Luis Lavarello and Julián Torres Dowdall for helpful comments and suggestions on this manuscript, and Marcel Achkar for help with the design of the Rocha lagoon map. We thank Richard Lanctot, María de los Angeles Hernández, Raymond McNeil and two anonymous reviewers for their suggestions and comments that greatly improved this manuscript. We are grateful to Mercedes Gutierrez for her help with the English. This study was part of the undergraduate honor thesis of Matilde Alfaro and was partially financed by Sección Zoología de Vertebrados, Facultad de Ciencias, Universidad de la República.

REFERENCES

Alfaro, M. 2003. Variación estacional en la composición de especies de las familias Charadiidae, Scolopacidae y Sternidae de la barra de la Laguna de Rocha, Uruguay. Tesis de Licenciatura. Univ. de la República, Montevideo, Uruguay.

Alonso, E. 1997. Plantas acuáticas de los humedales del Este. PROBIDES, Montevideo.

Avery, M. L., & C. van Riper III. 1989. Seasonal changes in bird communities of the chaparral and blue-oak woodlands in central California. Condor 91: 288–295.

Bala, L. O., M. A. Hernández, & V. L. D'Amico. 2001. Shorebirds present on Fracasso Beach (San Jorge Gulf, Valdés Peninsula, Argentina):

Report of the 1999 migrating season. Wader Study Group Bull. 94: 27–30.

Blanco, D. E., R. B. Lanctot, J. P. Isacch, & V. A. Gill. 2004. Pastizales templados del sur de América del Sur como hábitat de aves playeras migratorias. Ornitol. Neotrop. 15 (Suppl.): 159–167.

Blanco, D. E., P. Yorio, P. F. Petracci, & G. Pugnali. 2006. Distribution and abundance of non-breeding shorebirds along the coast of the Buenos Aires Province, Argentina. Waterbirds 29: 381–390.

Branco, J. O. 2003. Reprodução de *Sterna hirundinacea* Lesson e *S. eurygnatha* Saunders (Aves, Laridae), no litoral de Santa Catarina, Brasil. Rev. Bras. Zool. 20: 655–659.

Bugoni, L., & C. M. Vooren. 2005. Distribution and abundance of six tern species in southern Brazil. Waterbirds 28: 110–119.

Burger, J., M. A. Howe, D. C. Hahn, & J. Chase. 1977. Effects of tide cycles on habitat selection and habitat partitioning by migrating shorebirds. Auk 94: 743–758.

Clara, M., & R. Maneyro. 1999. Humedales del Uruguay. El ejemplo de los Humedales del Este. Pp. 71–83 *in* Malvarez, A. I. (ed.). Tópicos sobre humedales subtropicales y templados de Sudamérica. UNESCO, Montevideo, Uruguay.

Conde, D., L. Aubriot, & R. Sommaruga. 2000. Changes in UV penetration associated with marine intrusions and freshwater discharge in a shallow coastal lagoon of the Southern Atlantic Ocean. Mar. Ecol. Prog. Ser. 207: 19–31.

D'Amico, V. L., M. A. Hernández, & L. O. Bala. 2004. Selección de presas en relación con las estrategias de forrajeo de aves migratorias en Península Valdés, Argentina. Onitol. Neotrop. 15: 357–364.

Escalante, R. 1970. Aves marinas del Río de la Plata y aguas vecinas del Océano Atlántico. Barreiro y Ramos, Montevideo, Uruguay.

Fagúndez, C., & F. Lezama. 2005. Distribución especial de la vegetación costera del litoral Platense y Atlántico uruguayo. Proyecto Protección Ambiental del Río de la Plata y su Frente Marítimo, Montevideo, Uruguay.

Favero, M., M. S. Bó, M. P. Silva R. & C. García-Mata. 2000. Food and feeding biology of the South American Tern during non-breeding season. Waterbirds 23: 125–129.

Ferreira Rodriguez, A. A. 2000. Seasonal abundance of Nearctic shorebirds in the Gulf of Maranhão, Brazil. J. Field Ornithol. 71: 665–675.

Gatto, A., F. Quintana, P. Yorio, & N. Lisnizer. 2005. Abundancia y diversidad de aves acuáticas en un humedal marino del Golfo San Jorge, Argentina. Hornero 20: 141–152.

Gerzenstein, E. 1965. Aves de la costa marítima y orilla fluvial del Uruguay. Hornero 10: 235–246.

Gregory R. D., D. W. Gibbons, & P. F. Donald. 2004. Bird census and survey techniques. Pp. 17–55 *in* Sutherland, W. J., I. Newton, & R. E. Green (eds.). Bird ecology and conservation. A handbook of techniques. Oxford Univ. Press, New York, New York.

Gore M. E. J., & A. M. R. Gepp. 1978. Las aves del Uruguay. Mosca Hermanos S. A., Montevideo, Uruguay.

Hays, H., J. DiCostanzo, G. Cormons, P. de Tarzo Zuquim Antas, J. L. X. do Nacimento, I. de Lima Serrano do Nacimento, & R. E. Bremen. Recoveries of Roseate and Common terns in South America. J. Field Ornithol. 68: 79–90.

Hernández, M. A., & L. O. Bala. 2007. Prey selection and foraging patterns of the White-rumped Sandpiper (*Calidris fuscicollis*) at Península Valdés, Patagonia, Argentina. Ornitol. Neotrop. 18: 37–46.

Hernández, M. A., V. L. D'Amico, & L. O. Bala. 2004. Shorebirds surveys at Península Valdés, Patagonia, Argentina: Report for the years 2001 and 2002. Wader Study Group Bull. 105: 101–105.

Hill, D., S. P. Rushton, N. Clark, P. Green, & R. Prys-Jones. 1993. Shorebird communities on British estuarines: Factors affecting community composition. J. Appl. Ecol. 30: 220–234.

Howe, R. W. 1984. Local dynamics of bird assemblages in small forest habitat islands in Australia and North America. Ecology 65: 1585–1601.

Isacch, J. P., M. S. Bo, N. O. Maceira, M. R. Demaría, & S. Peluc. 2003a. Composition and seasonal changes of the bird community in the west Pampa grasslands of Argentina. J. Field Ornithol. 74: 59–65.

Isacch, J. P., & M. M. Martínez. 2003b. Temporal

variation in abundance and the population status of non-breeding Nearctic and Patagonian shorebirds in the flooding pampa grasslands of Argentina. J. Field Ornithol. 74: 233–242.

Isacch, J. P., & M. M. Marínez. 2003c. Habitat use by non-breeding shorebirds in flooding pampas grasslands of Argentina. Waterbirds 26:494–500.

Karr, J. R. 1976. Seasonality, resource availability, and community diversity in tropical bird communities. Am. Nat. 110: 973–994.

Kloetzer, G. 2003. Variación estacional de la disponibilidad de presas para las aves playeras en el sur de la laguna de Rocha (Uruguay). Tesis de Licenciatura, Univ. de la República, Montevideo, Uruguay.

Krannitz, P. G.1989. Nesting biolgoy of Black Skimmers, Large-billed Terns, and Yellow-billed Terns in Amazonian Brazil. J. Field Ornithol. 60: 216–223.

Krebs, C. J. 1989. Ecological methodology. Harper & Row Publishers, New York, New York.

Lahitte, H. B., & J. A. Hurrell. 1997. Plantas de la costa. Literature of Latin America (L.O.L.A.), Buenos Aires, Argentina.

Lanctot, R. B., D. E. Blanco, R. A. Dias, J. P. Isacch, V. A. Gill, J. B. Almeida, K. Delhey, P. F. Petracci, G. A. Bencke, & R. A. Balbueno. 2002. Conservation status of the Buff-breasted Sandpiper: Historic and contemporary distribution and abundance in South America. Wilson Bull. 114: 44–72.

Levey, D. J., & F. G. Stiles. 1992. Evolutionary precursors of long-distance migration: resource availability and movement patterns in Neotropical landbirds. Am. Nat. 140: 447–476.

Marone, L.1992. Seasonal and year-to-year fluctuations of bird populations and guilds in the Monte Desert, Argentina. J. Field Ornithol. 63: 294–308.

Maugeri, F. G. 2005. Primer registro de nidificación en ambiente fluvial del Gaviotín Chico Común (*Sterna superciliaris*) para la Provincia de Buenos Aires y nueva evidencia de su nidificación asociada con el Chorlito de Collar (*Charadrius collaris*). Ornitol. Neotrop. 16: 117–121.

McCune, B., & J. B. Grace. 2002. Analysis of ecological communities. MjM Sofware Design, Gleneden Beach, Oregon.

Pintos, W., R. Sommaruga, D. Conde, R. de León, & G. Chalar. 1988. Antecedentes y nuevos aportes al conocimiento de la Laguna de Rocha. Univ. de la República, Montevideo, Uruguay.

Polis, G. A., W. B. Anderson, & R. D. Holt. 1997. Toward an integration of landscape and food web ecology: The dynamics of spatially subsidized food webs. Annu. Rev. Ecol. Syst. 28: 289–316.

Rappole, J. H., E. S. Morton, T. E. Lovejoy III, & J. L. Ruos. 1993. Aves migratorias Neárticas en los Neotrópicos. Conservation and Research Center, National Zoological Park, Front Royal, Virginia.

Rappole, J. H., & A. R. Tipton. 1992. The evolution of avian migration in the Neotropics. Ornitol. Neotrop. 3: 45–55.

Sapoznikow, A., A. Vila, J. Lopez de Casenave, & P. Vuillermoz. 2002. Abundance of Common Terns at Punta Rasa, Argentina; a major wintering area. Waterbirds 25: 378–381.

Scolaro, J. A., S. Laurenti, & H. Gallelli. 1996. The nesting and breeding biology of the South American Tern in northern Patagonia. J. Field Ornithol. 67: 17–24.

Sick, H. 2001. Ornitología brasileña. Editorial Nova Fronteira, Rio de Janeiro, Brasil.

Tauge, G. W. 1955. Aves del litoral uruguayo. Observaciones sobre aves indígenas y migratorias del orden Charadriiformes (Chorlos, gaviotas y sus congéneres) que frecuentan las costas y esteros del litoral del Uruguay. Com. Zool. Mus. Montevideo 4(72): 1–55.

Vooren C. M., & A. Chiaradia. 1990. Seasonal abundance and behavior of coastal birds on Cassino Beach, Brazil. Ornitol. Neotrop. 1: 9–24.

Yorio, P. 2005. Estado poblacional y de conservacion de gaviotines y escúas que se reproducen en el litoral marítimo Argentino. Hornero 20: 75–93.

Yorio, P., E. Frere, P. Gandini, & A.Schiavini. 2001. Tourism and recreation in seabird breeding sites in Patagonia, Argentina: Current concerns and future prospects. Bird Conserv. Int. 11: 231–245.