

NORTH WINTERING DISTRIBUTION, HABITAT USE AND REPRODUCTION OF THE TWO-BANDED PLOVER (*CHARADRIUS FALKLANDICUS*) IN BRAZIL

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The Two-banded Plover is a Neotropical shorebird that is endemic to South America with a breeding range extending from approximately 37°S to 55°S, and with migrant individuals reaching as far North as Rio de Janeiro on the East coast of Brazil and Peru on the West (Woods and Woods 1997). Knowledge of the ecology of the species is poorly studied and has been limited to field-guide descriptions, a few localized studies of distribution, and some detailed studies of the foraging behavior of wintering individuals (Piersma *et al.* 1997, D'Amico *et al.* 2004, Garcia-Peña *et al.* 2007, Alfaro *et al.* 2008). One population of Two-banded Plover winters in the Falkland Islands and reproduces in the Tierra del Fuego region, southern Argentina and Chile. Other members of the species also breed in the aforementioned areas, but remains on those reproductive areas during the non-breeding season. A third subset reproduces at the same site as the others, but migrates to northern wintering areas, in Uruguay and Brazil (Blanco *et al.* 2008, St Clair 2010). Reproductive activity was yet reported in the wintering areas in Argentina and Uruguay (Myers and Myers 1979, Alfaro *et al.* 2008), while in southern Brazil was reported in a single season three adult individuals in full breeding plumage and six chicks not yet able to fly between mid-October and mid to late November (Resende and Leeuwenberg 1989). In Rio Grande do Sul State, southern Brazil, this species winters in the Lagoa do Peixe (Ramsar site), and sightings have been made of adult individuals throughout the year (Resende and Leeuwenberg 1987, Belton 2000). Two-banded Plovers are found in greatest abundances during the winter period along the sandy beaches and mudflats of lakes used as foraging and roosting areas on the coasts of Argentina (Blanco *et al.* 2006), Uruguay (Alfaro *et al.* 2008) and Brazil (Resende and Leeuwenberg 1989, Vooren and Chiaradia 1990). The

four main objectives were: 1) evaluate the north wintering distribution of Two-banded Plovers in East coast of Brazil; 2) determine the preferred habitat use of the species in the Lagoa do Peixe; 3) document the reproductive status of this species in the Lagoa do Peixe; and 4) evaluate the human impact at Two-banded Plovers in the wintering areas.

The Two-banded Plover has been documented along the beaches since the border of Uruguay with Rio Grande do Sul until the Lagoa do Peixe National Park (LPNP) (Resende and Leeuwenberg 1987, Vooren and Chiaradia 1990, Alfaro *et al.* 2008). North of the LPNP, it does not occur on the beaches between Balneário Pinhal and Mostardas (present study), except for a few individuals on the beaches in Tramandaí (Belton 2000) and Rio de Janeiro (Woods and Woods 1997), between Imbé and Torres (Costa and Sander 2008), at the Saco da Fazenda estuary, Santa Catarina State coast (Branco 2007), and in Ilha Comprida, São Paulo (Barbieri and Mendonça 2005, WikiAves 2013) (Table 1). Data base records confirm the occasionally occurrence with only seven sightseers north of this lagoon (WikiAves 2013, Table 2). In this way, the LPNP is the principal northern wintering area for the Two-banded Plover in Brazil, and the species only occurs occasionally and sparsely on the beaches north of the Lagoa do Peixe.

In the LPNP, the preferred habitat use of the species was observed around the channel of lagoon (4.4 ind/ha) during April, and in September it was absent (Fig. 2). Similar densities were observed by Harrington *et al.* (1986) in early May on beaches near Lagoa do Peixe and by Resende and Leeuwenberg (1989) in the channel region, which confirms that this species prefers this habitat for foraging. The absence of Two-banded Plovers on the beaches may be related to censuses have been made North the channel where occurs occasionally (see above), while South the species is most abundant (Vooren and

Chiaradia 1990). On the beaches south of LPNP, this species occurs from March to September, with greatest abundances occurring in June and July (Vooren and Chiaradia 1990). The greatest concentrations of plovers have been documented in estuarine-saltmarshes and marine-sandy beaches on Cassino beach (Vooren and Chiaradia 1990), José Ignacio Lagoon (Maldonado) and Rocha Lagoon (Rocha) in Uruguay (Alfaro *et al.* 2008), and in the Samborombón Bay in Buenos Aires, Argentina (Blanco *et al.* 2006) (Table 1).

On October 2011, a Two-banded Plover nest was found in pasturelands near the muddy border, opposite of channel of the Lagoa do Peixe (31°19'52,1"S, 051°04'0,1"W). The nest constructed in the soil was sparsely lined with grass and contained three dark grey eggs with black speckles. An individual with breeding plumage was incubating the eggs. This is the first documentation of a nest with eggs of this species in the Lagoa do Peixe during the reproductive season, however

chicks of 7-14 days were documented in October and November 1986 in the Lagoa do Peixe by Resende and Leeuwenberg (1989). In Rocha Lagoon, Uruguay, Alfaro *et al.* (2008) reported reproductive activity in December 1998, and occasional reproduction was verified on the coast of Buenos Aires, Argentina (Myers and Myers 1979).

ANOVAs analysis showed significant lower bird abundances in high human impacted sites ($F_{2,15} = 14.48$; $P < 0.0001$). In the same way, the birds numbers were negatively correlated with the higher human impacted areas, but not significantly ($R^2 = -0.17$; $P = 0.09$). The Falkland Islands are breeding areas in which the Two-banded Plovers are habituated to human activity, but the flushing distances increased with the presence of mammalian predators (St Clair 2010). Therefore, in the wintering areas the species can select high quality areas along the urbanized shoreline, avoiding areas with the presence of dogs and cats in abundance (Burger *et al.* 2004, Yasué 2005).

Table 1. Number of Two-banded Plover observed in localities in different studies of Brazil, Uruguay and Argentina. Studies: (1) Barbieri & Mendonça 2005, (2) Branco 2007, (3) Costa & Sander 2008, (4) Belton 1994, (5) Present study, (6) Resende & Leeuwenberg 1989, (7) Vooren & Chiaradia 1990, (8) Alfaro *et al.* 2008, (9) Blanco *et al.* 2006.

ACCOUNT NUMBER	HUMAN IMPACT	COASTAL LANDSCAPE*	LOCALITY	STUDY
0	Moderate	Manine-sandy beaches	Ilha Comprida / SP	1
1	High	Estuarine-freshwater marshes	Saco da Fazenda - Itajaí / SC	2
1	High	Manine-sandy beaches	Imbé to Torres / RS	3
< 10	High	Manine-sandy beaches	Tramandaí / RS	4
0	Moderate	Manine-sandy beaches	Mostardas to Balneário Pinhal / RS	5
4.3 b/ha	Low	Estuarine Saltmarshes	Lagoa do Peixe - Tavares / RS	5
3.3 b/ha	Low	Estuarine Saltmarshes	Lagoa do Peixe - Tavares / RS	6
0.6 b/Km	Low	Manine-sandy beach	Cassino - Rio Grande / RS	7
109	Low	Estuarine Saltmarshes	Rocha Lagoon - Rocha / Ur	8
472	Low	Estuarine Saltmarshes	José Ignacio Lagoon - Maldonado / Ur	8
65	Moderate	Manine-sandy beaches	San José beaches - San José / Ur	8
0 - 9 counts	Moderate	Several landscapes	Other 16 localities of Uruguay	8
4.1 b/Km	Low	Estuarine saltmarshes	Ea. La Monita / Ar	9
7.3 b/Km	Low	Estuarine saltmarshes	Punta Rasa- Buenos Aires / Ar	9
11.1 b/Km	Low	Estuarine saltmarshes	Tapera de López - Buenos Aires / Ar	9
8.8 b/Km	Low	Manine-sandy beach	Dunamar - Buenos Aires / Ar	9
20.5 b/Km	Low	Estuarine saltmarshes	Cabeza de Buey - Buenos Aires / Ar	9
0 - 3.0 b/Km	Low	Several landscapes	Other 49 localities of Buenos Aires	9

* Coastal Landscape classified according Blanco *et al.* 2006.

Table 2. Number of Two-banded Plover records in WikiAves data base in Brazil.

LOCALITY	RECORDS
Ilha Comprida / SP	2
São Francisco do Sul / SC	1
Laguna / SC	1
Cidreira / RS	3
Mostardas - RS	6
Tavares / RS	31
São José do Norte / RS	2
Rio Grande / RS	7
Santa Vitória do Palmar / RS	1

The Two-banded Plover is most abundant along the beaches and lagoons in the wintering areas during the austral winter (Vooren and Chiaradia

1990, Belton 2000, Blanco *et al.* 2006, Alfaro *et al.* 2008). The species select high quality stopover and wintering areas (low human impact in estuarine-saltmarshes habitats and/or sandy beaches with restinga patches) during the annual migrations between the Brazil and Tierra del Fuego. A small portion of the population remains and reproduces in the wintering areas during the austral summer (Myers and Myers 1979, Resende and Leeuwenberg 1989, Alfaro *et al.* 2008). In virtue of the few studies conducted around the Lagoa do Peixe, it is likely that this species reproduces annually near dunes and grasslands. A threat to the reproduction of this and other shorebird species is the risk of trampling and vehicular traffic in the nesting areas. Therefore, regulations against habitat loss due to raising livestock and planting exotic tree species such as Pines are of utmost importance to the reproduction of this species.

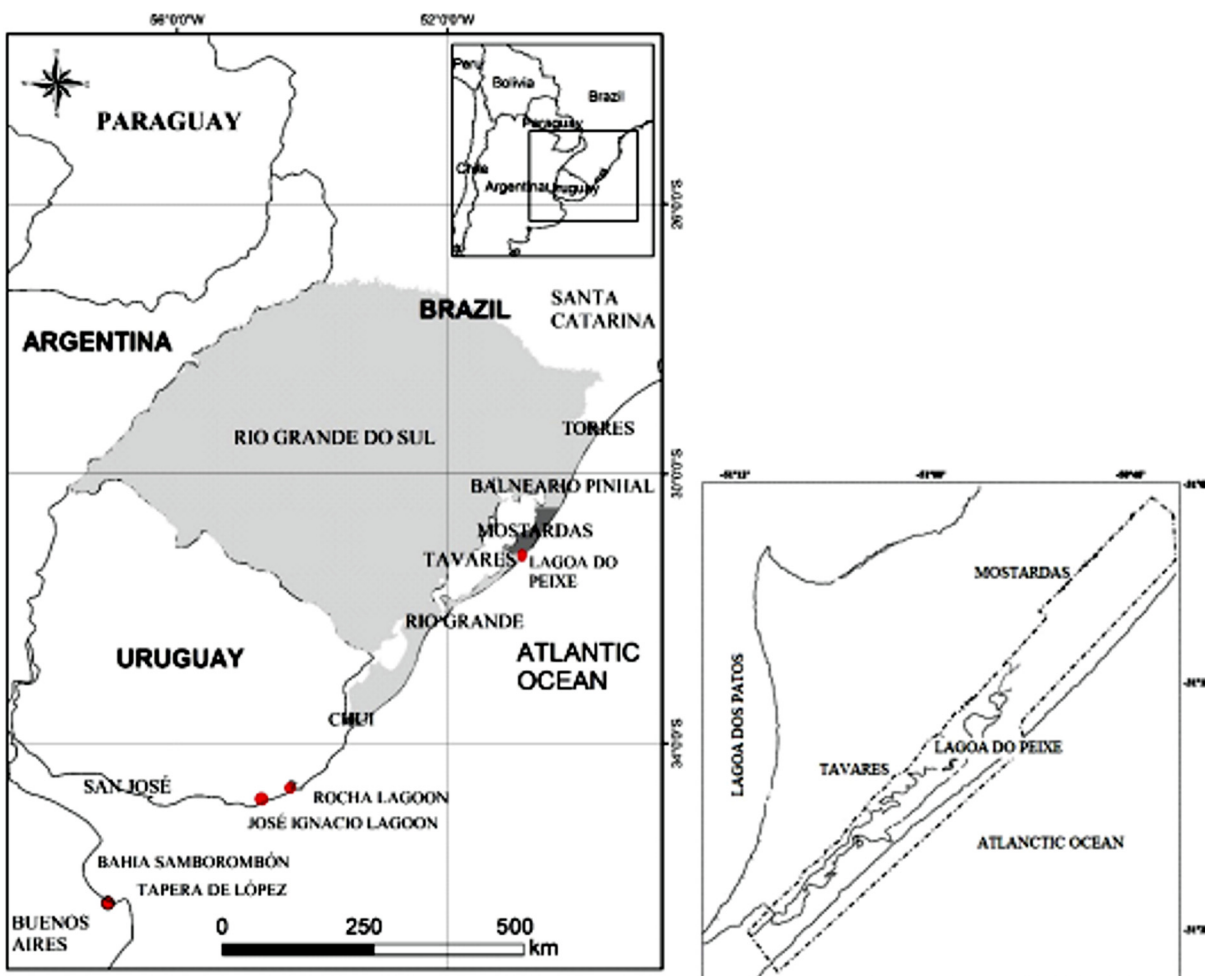


Figure 1. Study area showing the main wintering sites (Red Points) of the Two-banded Plover. In the right side in detail the Lagoa do Peixe National Park in southern Brazil.

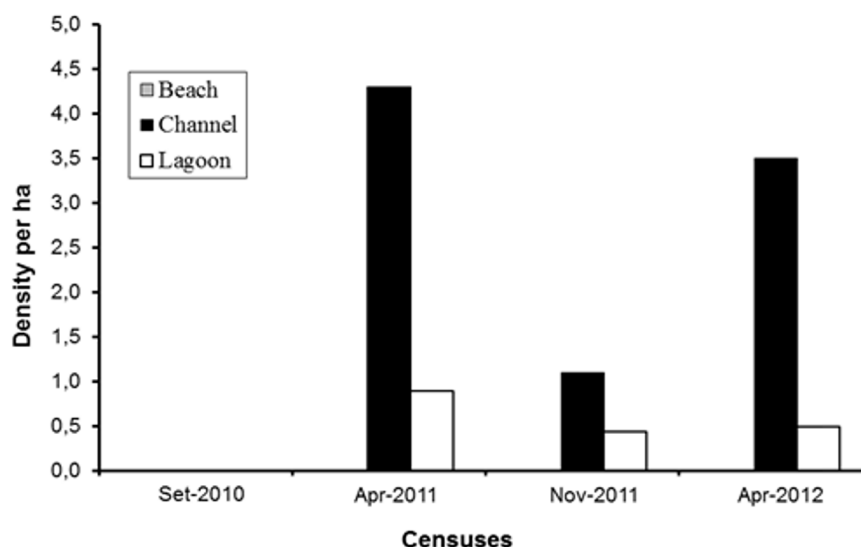


Figure 2. Mean density per hectare of the Two-banded Plover in three different transects and periods in Lagoa do Peixe National Park (PNLP).

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METHODS

The study was conducted in the Lagoa do Peixe National Park (LPNP) (between 31°26'S, 051°10'W and 31°14'S, 050°54'W) in the municipality of Tavares, Rio Grande do Sul State, Brazil. Lagoa do Peixe is a brackish to saltwater lagoon that is used by many shorebirds as a stopover and wintering site (Resende and Leeuwenberg 1987, Belton 2000). To evaluate the preferred habitat use of Two-banded Plovers in the Lagoa do Peixe, censuses were conducted in three different transects (100 m each) along the beach above the channel of the lagoon, three different transects (100 m each) in the channel region of the Lagoa do Peixe; and three different transects (100 m each) in the central mudflat region of Lagoa do Peixe. Each transect was separated from each other by a minimal distance of 200 m (Bibby *et al.* 1992). Censuses were repeated three times at each season in four distinct periods, totaling 12 repetitions: 19-21 September 2010, 1-7 April 2011, 2-5 November 2011, and 24-26 April 2012. One census a day was alternately performed at morning (09:00-12:00) and

afternoon (15:30-18:30), and randomly in each transect. Twenty active shorebird nest searches were conducted along the beach and grasslands around the lagoon during the months of the censuses above. Additionally, surveys were employed north of the LPNP to determine the abundance of Two-banded Plovers between the beaches of Balneário Pinhal (30°14'57"S, 050°13'48"W) and Mostardas (31°10'52"S, 050°50'03"W) (Fig. 1). These beaches are an important stopover and wintering area for North America migratory shorebirds in southern Brazil (Belton 2000, Scherer and Petry 2012) and should to be used by Two-banded Plovers. Monthly surveys on the beaches of Balneário Pinhal to Mostardas (n=50) were conducted between July 1997 and July 1998 and between October 2007 and January 2012 along 120 km of beach in an automobile traveling north to south (maximal speed 20 Km/h). Direct counts were made of the individual of each Two-banded Plover (Bibby *et al.* 1992). Historical data from studies on the beaches and lakes of Brazil, Uruguay and Argentina were also utilized to evaluate the number of Two-banded Plover in each the wintering area (Table 1). Human impact at each wintering site of Two-banded Plover was classified using LandSat imagery (Google Earth®) at low (impact value=1), moderate (impact value=5), and high (impact value=10). Factorial ANOVA test was used to evaluate the effect of human impact on Two-banded Plover abundances in the wintering areas. Each site impact value was used in the Pearson's correlation with the number of birds of each area. All analyses were implemented in R Program (R Core Development Team 2012). Records of WikiAves® data base were used to support the Two-banded Plover distributions in Brazil. This study was carried out according to permits No. 20084-1 and 23159-1, granted by the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio).

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