WATERBIRD OCCURRENCE AND ABUNDANCE IN THE STROBEL PLATEAU, PATAGONIA, ARGENTINA

JULIO L. LANCELOTTI [1,2,4], LUCIANA M. POZZI [1,2], FEDERICO MÁRQUEZ [1,2], PABLO YORIO [1,3] AND MIGUEL A. PASCUAL [1,2]

[1] *Centro Nacional Patagónico (CONICET). Blvd. Brown 2825, U9120ACF Puerto Madryn, Chubut, Argentina.*
[2] *Universidad Nacional de la Patagonia San Juan Bosco. Puerto Madryn, Chubut, Argentina.*
[3] *Wildlife Conservation Society. 2300 Southern Boulevard, 10460 Bronx, New York, USA.*
[4] *julio@cenpat.edu.ar*

ABSTRACT.— The Strobel Plateau is a conspicuous and representative basaltic plateau ("meseta") in the Patagonian steppe, Argentina. This plateau is dotted with more than 1500 shallow lakes, which are regularly used by waterbirds and support one of the main breeding populations of the near threatened Hooded Grebe (*Podiceps gallardoi*). We collected data on bird presence and abundance in 41 shallow lakes, covering a wide spectrum of the wetland environmental variability found in the area. We conducted six surveys from spring to fall between 2004 and 2006. We recorded a total of 18 waterbird species, which represent 5 different families. Anatidae was the family most represented with 12 species, accounting for 85% of the observed waterbirds. Waterbird distribution among lakes was variable, from 2.4% occupied lakes for Wilson's Phalarope (*Steganopus tricolor*) and Andean Ruddy-Duck (*Oxyura jamaicensis*) to 80% for Black-necked Swan (*Cygnus melanocorypha*), and abundance varied greatly both between species and seasons. The Hooded Grebe, in particular, was recorded in 14 lakes (1–81 individuals). Six species were detected breeding in the area: Hooded Grebe, Silvery Grebe (*Podiceps occipitalis*), Flying Steamer-Duck (*Tachyeres patachonicus*), Crested Duck (*Anas specularioides*), Upland Goose (*Chloephaga picta*), and White-winged Coot (*Fulica leucoptera*). The Hooded Grebe nested at four lakes, three of them not previously known to hold breeding birds. Results point to the need of further studies on the dynamic nature of waterbird lake use to adequately assess the importance of the Strobel Plateau as waterbird habitat.

KEY WORDS: *Patagonia argentina,* Podiceps gallardoi, *Strobel Plateau, waterbirds.*

RESUMEN. PRESENCIA Y ABUNDANCIA DE AVES ACUÁTICAS EN LA MESETA STROBEL, PATAGONIA, ARGENTINA.— La meseta Strobel, ubicada en la estepa patagónica, alberga más de 1500 lagunas que son utilizadas regularmente por aves acuáticas, incluyendo una de las principales poblaciones reproductivas del Macá Tobiano (*Podiceps gallardoi*), una especie endémica de la Patagonia austral. Se registró la presencia y abundancia de aves acuáticas en 41 lagunas, cubriendo el amplio espectro de la variabilidad ambiental de la región. Se llevaron a cabo seis campañas de campo desde fines de primavera a principios de otoño en el período 2004–2006. Se registraron un total de 18 especies de aves acuáticas correspondientes a cinco familias. La familia Anatidae fue la más representada con 12 especies, constituyendo el 85% de las aves acuáticas observadas. La distribución de las aves entre las lagunas fue variable, desde un 2.4% de lagunas ocupadas por el Falaropo Común (*Steganopus tricolor*) y el Pato Zambullidor Grande (*Oxyura jamaicensis*) hasta un 80% ocupadas por el Cisne Cuello Negro (*Cygnus melanocorypha*), y la abundancia varió mucho entre especies y estaciones. El Macá Tobiano, en particular, fue observado en 14 lagunas (1–81 individuos). Seis especies fueron detectadas reproduciéndose en la meseta: el Macá Tobiano, el Macá Plateado (*Podiceps occipitalis*), el Quetro Volador (*Tachyeres patachonicus*), el Pato Crestón (*Anas specularioides*), el Cauquén Común (*Chloephaga picta*) y la Gallareta Chica (*Fulica leucoptera*). El Macá Tobiano nidificó en cuatro lagunas, tres de las cuales no habían sido reportadas previamente como sitio de reproducción. Los resultados evidencian la necesidad de generar estudios futuros basados en la dinámica de uso de las lagunas para determinar adecuadamente la importancia de la meseta Strobel como hábitat para la avifauna acuática.

PALABRAS CLAVE: *aves acuáticas, meseta Strobel, Patagonia argentina,* Podiceps gallardoi.

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Wetlands have been widely recognized as primary resources for human activities, as well as irreplaceable habitat for a rich diversity of flora and fauna, particularly waterbird communities (Weller 1999). Despite the fact that wetlands remain among the world's most threatened habitats (Thorsell et al. 1997, Canevari et al. 1998, Williams 1999, Brinson and Malvárez 2002, Perotti et al. 2005), there is a considerable lack of basic information about their ecological characteristics and dynamics, as well as their importance at the regional level. Typically, this situation is more pronounced in remote areas where complete inventories of wildlife and water resources are still lacking.

In Patagonia, wetlands are prominent on the Andean region, which is characterized by its wealth of large lakes and rivers (Iglesias and Pérez 1998). In contrast, the Patagonian steppe receives less than 300 mm of rain per year, thus representing one of the most arid extensions in Argentina (Cabrera 1976). Whereas permanent water bodies are rare in this area, a system of several basaltic plateaus ("mesetas"), dotted with natural depressions that collect water from snow and ice melt, are prominent in the region (Iriondo 1989). The topography of such plateaus facilitates the development of complex shallow lake assemblages, which are characterized by a rich environmental diversity (Lancelotti et al. 2009). Despite the potential importance of the extra-Andean wetlands, little is known about the wildlife that depends on them. Waterbird surveys have been only conducted in isolated shallow lakes, but although they have provided general information on waterbird occurrence (Fjeldså 1985, 1986, Imberti 2005a, 2005b, 2005c), they were mainly focused on detecting the presence and describing basic ecological aspects of the threatened Hooded Grebe (*Podiceps gallardoi*) (Erize 1981, Lange 1981, Fjeldså 1986, Beltrán et al. 1992, Johnson 1997). Up to date, no quantitative studies have described the composition of waterbird assemblages inhabiting these ecosystems.

The goal of this study was to provide the first quantitative description of waterbirds inhabiting the Strobel Plateau, a conspicuous and representative basaltic plateau in the Patagonian steppe. Covering an area of over 2500 km^2, this plateau is dotted with more than 1500 shallow lakes, variable in size, shape, and limnological characteristics (Lange 1981, Lancelotti et al. 2009), which are regularly used by waterbirds and support one of the most important breeding populations of the Hooded Grebe (Johnson

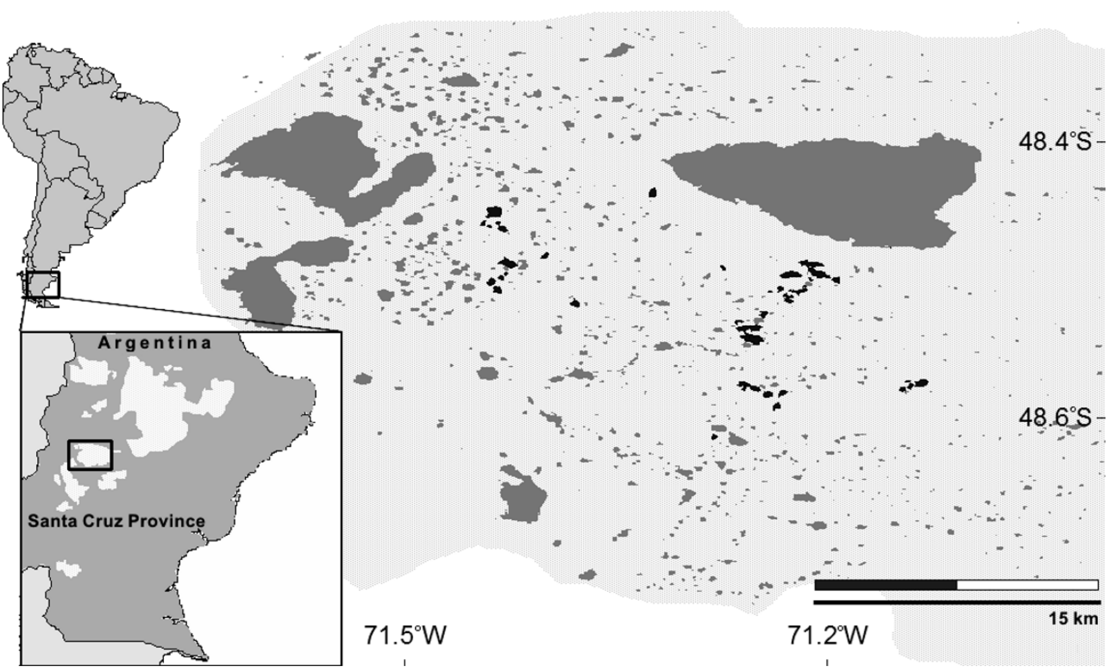

Figure 1. Map derived from a satellite image (Landsat 7) of the Strobel Plateau processed to mask land and highlight water bodies (grey polygons, with surveyed shallow lakes as black polygons). The insert showing Santa Cruz Province in Argentina indicates Strobel (black rectangle) and other plateaus (light gray polygons).

1997, Imberti 2005a). This area is also the focus of an insipient but growing rainbow trout (*Oncorhynchus mykiss*) aquaculture in this region. The beginning of this productive activity has generated concerns about the negative effects that fish introductions could have on waterbird communities (Pascual and Lancelotti 2006). Baseline information on the distribution and abundance of waterbirds is fundamental for the design of further research and the development of management and conservation strategies.

METHODS

The Strobel Plateau (48°50'S, 71°20'W; 900–1250 masl; 2500 km^2; Fig. 1) is a basaltic plateau generated during tectonic events occurred in the Tertiary period (Panza and Franchi 2002). The posterior sinking of mantle originated numerous hollows, which collect water from snow and ice melting, generating a complex lake system (Pereyra et al. 2002). Much of these lakes are smaller than 24 ha, and approximately 200 of them exceed 10 ha. This region is characterized by a significant inter-annual hydrological variability. Even some of the medium-size lakes (12 ha, 6 m deep) dry out during low precipitation years. Wetlands in this region present a high diversity of topographic and physical-chemical conditions (pH 8–12.3, conductivity 11.7–9090 us, suspended solids 0.00165–1.3 mg/l, depth 0.7–22 m). Macrophyte cover, mostly vinagrilla (*Myriophyllum elatinoides*), varies widely seasonally and between lakes, reaching in some water bodies a maximum of 95% of the total surface (Lancelotti et al. 2009). Aquatic communities present an important diversity of benthic and pelagic crustaceans, with a dominance of amphipods of the genus *Hyalella* (Lucchini 1975, Menu Marque et al. 2000, Lancelotti, unpublished data). Previous studies (Fjeldså 1986), observations by local people, and our own surveys failed to detect native fish in the shallow lakes of this area.

Table 1. Geographic location and area of shallow lakes surveyed in the Strobel Plateau during the 2004-2005 and 2005-2006 study periods.

	Latitud	Longitud	Area (ha)
Álvarez 10	48°27'29"S	71°27'32"W	17.32
Álvarez 101	48°27'29"S	71°25'59"W	5.03
Álvarez 103	48°27'40"S	71°26'17"W	4.46
Álvarez 7	48°27'04"S	71°26'06"W	59.95
Álvarez 9	48°27'43"S	71°25'48"W	18.34
Campamento	48°32'06"S	71°15'25"W	42.83
Cardielito	48°34'30"S	71°08'06"W	26.99
Casco	48°26'13"S	71°19'26"W	21.23
Chanchos	48°32'31"S	71°15'18"W	60.38
Compuerta	48°30'04"S	71°12'43"W	4.72
Dat log	48°31'59"S	71°15'58"W	3.48
Gallaretas	48°30'32"S	71°14'31"W	3.59
Grup	48°34'48"S	71°08'53"W	7.01
Herradura	48°30'54"S	71°13'41"W	16.81
Martínez 2	48°34'55"S	71°13'55"W	13.98
Martínez 29	48°34'37"S	71°12'50"W	9.15
Martínez 3	48°34'59"S	71°14'35"W	15.78
Martínez 39	48°34'37"S	71°15'25"W	44.45
Martínez 4	48°35'31"S	71°14'10"W	16.85
Nidos	48°36'36"S	71°16'48"W	8.76
Nueve	48°30'14"S	71°12'54"W	12.07
Ocho	48°30'35"S	71°13'21"W	23.04
Oliva	48°30'31"S	71°14'08"W	8.86
Patos	48°29'31"S	71°25'37"W	7.38
Pichón	48°30'03"S	71°19'14"W	4.34
Potrerito	48°29'59"S	71°12'02"W	6.25
Potrero	48°29'37"S	71°12'45"W	78.56
Puesto	48°34'29"S	71°08'40"W	4.33
Rodríguez 16	48°29'16"S	71°25'32"W	47.23
Rodríguez 18	48°29'55"S	71°25'53"W	7.61
Rodríguez 19	48°30'06"S	71°26'19"W	18.37
Rodríguez 2	48°27'46"S	71°18'52"W	23.62
Rodríguez 20	48°30'28"S	71°26'01"W	18.30
Rodríguez 3	48°27'39"S	71°21'38"W	12.29
Rodríguez 51	48°31'15"S	71°22'50"W	17.04
Rodríguez 8	48°28'29"S	71°24'20"W	7.42
Sat lag 2	48°33'10"S	71°15'27"W	1.95
Sat lag 7	48°30'21"S	71°13'03"W	2.07
Seis	48°31'33"S	71°14'47"W	15.28
Temp	48°30'06"S	71°11'47"W	12.50
Vega	48°29'53"S	71°17'06"W	9.21

Based on a general inspection of the environments in the Strobel Plateau and on the analysis of satellite images (Landsat 7; Fig. 1) we selected 41 lakes for this study (Table 1), covering a wide spectrum of variability of wetlands found in the area. All 41 lakes were surveyed during the first study year, while due to logistical reasons we only surveyed a representative subset (20) of those 41 lakes during the second year. Lakes of the subset were selected considering their limnological characteristics (e.g., size, macrophyte cover, water color) in order to capture the environmental diversity observed on the plateau.

From early fall to early spring, lakes are covered by ice and snow, being the large lakes Strobel, Quiroga Grande and occasionally Quiroga Chico, the only water bodies that hold birds during this period (A Rodríguez, pers. com.).

Table 2. Relative frequency (RF), occupied lakes (O, in percentage), and relative importance index (*RII*) of each waterbird species observed in shallow lakes surveyed in the Strobel Plateau during the 2004-2005 and 2005-2006 study periods.

	2004-2005			2005-2006		
	RF	O	*RII*	RF	O	*RII*
Podicipedidae						
White-tufted Grebe (*Rollandia rolland*)	0.01	11.9	< 0.01	0.14	15.0	0.03
Silvery Grebe (*Podiceps occipitalis*) [a]	4.45	50.0	2.97	7.69	50.0	4.34
Hooded Grebe (*Podiceps gallardoi*) [a]	1.58	26.2	0.49	2.74	50.0	1.54
Phoenicopteridae						
Chilean Flamingo (*Phoenicopterus chilensis*)	1.21	35.7	0.59	1.51	35.0	0.65
Anatidae						
Andean Ruddy-Duck (*Oxyura jamaicensis*)	0.01	2.4	< 0.01	-	-	-
Argentine Ruddy-Duck (*Oxyura vittata*)	0.10	9.5	0.02	0.01	5.0	< 0.01
Flying Steamer-Duck (*Tachyeres patachonicus*) [a]	2.02	61.9	1.48	2.16	65.0	1.50
Rosy-billed Pochard (*Netta peposaca*)	0.21	11.9	0.04	0.18	15.0	0.04
Chiloé Wigeon (*Anas sibilatrix*)	16.50	59.5	10.20	17.81	70.0	13.16
Yellow-billed Pintail (*Anas georgica*)	7.19	57.1	4.27	1.10	55.0	0.66
Red Shoveler (*Anas platalea*)	17.51	54.7	10.05	32.05	75.0	25.08
Crested Duck (*Anas specularioides*) [a]	2.38	69.0	1.81	1.94	65.0	1.34
Speckled Teal (*Anas flavirostris*)	0.42	21.4	0.11	4.91	70.0	3.63
Coscoroba Swan (*Coscoroba coscoroba*)	3.43	23.8	0.38	0.76	35.0	0.33
Black-necked Swan (*Cygnus melanocorypha*)	33.27	61.9	21.60	21.34	80.0	17.62
Upland Goose (*Chloephaga picta*) [a]	3.43	47.6	1.76	3.06	65.0	1.99
Rallidae						
White-winged Coot (*Fulica leucoptera*) [a]	5.69	35.7	2.46	2.59	45.0	1.35
Scolopacidae						
Wilson's Phalarope (*Steganopus tricolor*)	0.59	2.4	0.02	-	-	-

[a] Species that reproduce in the Strobel Plateau.

Six surveys were conducted covering three different seasons in two consecutive years: two in late spring (7–17 December 2004 and 24 November–2 December 2005), two in mid-summer (26 February–8 March 2005 and 17–27 January 2006), and two in early fall (7–16 April 2005 and 29 March–9 April 2006).

To evaluate presence and abundance of waterbirds, we made direct counts from one or more vantage points, depending on the size and shape of the lakes. We counted all birds present in each lake and identified them to the species level, using 10×50 binoculars and a 25× spotting scope. Only one observer made counts in each field trip. In total, we made 126 censuses in 41 different lakes, surveying 2143 ha during 210 hours of observation.

We calculated the median of total abundance of every species in each single season, taking into account only counts with positive observations. We calculated the frequency of occupied lakes using $p_i = N_i/N_t$, where N_i is the sum of the abundance of species *i* in all lakes and N_t is the sum of the total abundance of all species involved. We estimated the Relative Importance Index (*RII*), defined by Bucher and Herrera (1981) and modified by Gatto et al. (2005), as $RII = 100\, p_i (S_i + L_i)/(S_t + L_t)$, where S_i and L_i are the number of seasons and the number of lakes in which the species *i* was observed, respectively, and S_t and L_t are the total number of seasons and lakes, respectively. The index evaluates the relative importance of each species in proportion to its abundance, taking into account temporal and spatial variability. For each species, we calculated the absolute frequency as the sum of all of its individuals recorded, and the relative frequency as the absolute frequency divided by the sum of all individuals recorded for all species.

RESULTS

We recorded a total of 18 waterbird species throughout the study period (Table 2), which

Table 3. Median and maximum observed abundance of each waterbird species in spring, summer and fall during the 2004-2005 and 2005-2006 study periods in shallow lakes surveyed in the Strobel Plateau. Median abundance was calculated considering only lakes with positive observations for each species (number of lakes between parentheses).

	Median abundance						Maximum abundance					
	2004-2005			2005-2006			2004-2005			2005-2006		
	Spr	Sum	Fall	Spr	Sum	Fall	Spr	Sum	Fall	Spr	Sum	Fall
White-tufted Grebe	2 (1)	1 (3)	-	-	3 (2)	2.5 (2)	2	4	-	-	4	4
Silvery Grebe	11 (10)	25 (6)	22 (12)	14.5(4)	16 (9)	20.5 (8)	135	56	167	32	190	48
Hooded Grebe	15 (4)	4.5 (6)	9 (6)	4 (5)	16 (6)	4 (7)	90	45	31	22	37	26
Chilean Flamingo	10.5 (10)	8 (6)	12 (5)	16 (4)	4.5 (6)	4 (3)	25	21	25	20	21	6
Andean Ruddy-Duck	1 (1)	-	-	-	-	-	2	-	-	-	-	-
Argentine Ruddy-Duck	4 (1)	4.5 (2)	3 (1)	-	-	1 (1)	4	6	3	-	-	1
Flying Steamer-Duck	2 (19)	6 (13)	6 (10)	3 (7)	6 (8)	2 (9)	55	86	39	17	25	18
Rosy-billed Pochard	2 (3)	3 (2)	8 (3)	4 (2)	1 (1)	2.5 (2)	3	4	13	5	1	3
Chiloé Wigeon	111 (13)	29 (15)	22 (15)	16 (3)	90 (9)	9 (11)	400	130	175	476	188	40
Yellow-billed Pintail	30 (12)	17 (13)	4 (13)	1 (1)	2.5 (6)	2 (7)	123	173	25	1	28	11
Red Shoveler	44 (13)	21 (15)	22 (13)	114 (7)	48 (11)	82 (9)	920	135	114	543	135	145
Crested Duck	2.5 (16)	5 (15)	2 (13)	2 (9)	6 (8)	3 (7)	150	24	33	22	18	10
Speckled Teal	1 (1)	4 (7)	2.5 (4)	5 (5)	7.5 (8)	7 (7)	1	30	3	22	131	89
Coscoroba Swan	6 (3)	4.5 (6)	2 (5)	4 (4)	2 (3)	2 (5)	81	17	8	12	3	25
Black-necked Swan	26.5 (14)	67 (16)	43 (19)	25 (8)	41 (9)	32 (10)	2500	303	291	78	208	421
Upland Goose	6 (9)	3 (11)	7 (5)	1.5 (8)	12.5 (10)	-	121	108	48	10	81	-
White-winged Coot	13 (9)	20.5 (6)	4 (10)	4 (7)	24 (2)	6 (4)	82	284	100	88	41	17
Wilson's Phalarope	96 (1)	5 (1)	-	-	-	-	96	5	-	-	-	-

represent 5 bird families. Anatidae was the family most widely represented in the study area, with 12 species, followed by Podicipedidae, with 3 species (Table 2). The family Anatidae accounted for 86.5% (20614 individuals) of the observed waterbirds and Podicipedidae was the second in abundance, comprising 8% of the observed birds. From those in the family Podicipedidae, 73.7% corresponded to the Silvery Grebe (*Podiceps occipitalis*) and 26.6% to the Hooded Grebe (467 individuals observed; Table 2). We recorded another four species related with water bodies, but we did not include them in the data set of waterbirds analyzed because the census methodology did not allow an adequate estimation of their numbers. These included the shorebirds Two-banded Plover (*Charadrius falklandicus*), White-rumped Sandpiper (*Calidris fuscicollis*) and Magellanic Plover (*Pluvianellus socialis*), and the Kelp Gull (*Larus dominicanus*).

Waterbird distribution among lakes was variable, from 2.4% occupied lakes for the Wilson's Phalarope (*Steganopus tricolor*) and Andean Ruddy-Duck (*Oxyura jamaicensis*) to 80% for the Black-necked Swan (*Cygnus melanocorypha*) (Table 2). Many of the waterbird species showed a widespread distribution among lakes, as we observed them in over half of the surveyed water bodies in at least one of the study years.

Bird abundance varied between species and seasons, from a median of 1 to 111 individuals (Table 3). Maximum counts varied between 1 for the Speckled Teal (*Anas flavirostris*), Yellow-billed Pintail (*Anas georgica*), Rosy-billed Pochard (*Netta peposaca*) and Argentine Ruddy-Duck (*Oxyura vittata*), and 2500 for the Black-necked Swan (Table 3).

The Black-necked Swan, the Chiloé Wigeon (*Anas sibilatrix*) and the Red Shoveler (*Anas platalea*) were the most abundant and widespread species, occupying over 50 and 70% of the surveyed lakes in the first and second study years, respectively (Table 2). This predominance was reflected in the relative importance index, with clearly higher values when compared to the other species. Almost 60% of the recorded species showed relative importance index values larger than 0.5 in at least one year. Although several species changed their relative importance between years, the general pattern remained similar (Table 2).

We recorded the Hooded Grebe in 14 of the lakes surveyed in the two years, in numbers that varied between 1–81 individuals (Table 4). We also recorded breeding activity in four of the lakes: Ocho, Herradura, Martínez 4 and Potrerito (Table 4). Nest numbers ranged from 2 to 40. Observation of eggs was difficult, but adult grebes were sitting on their nests suggesting incubating behaviour. We were able to confirm the presence of eggs in 1 of the 40 nests in Ocho Lake during the late spring of 2004 and in 4 of the 13 recorded nests in Herradura Lake during late spring of 2005. We recorded Hooded Grebe chicks only during the summer of 2006 at Martinez 4 Lake, although our observations underestimate chick presence given the difficulty in discriminating chicks from Hooded Grebe and Silvery Grebe (we recorded Hooded Grebe chicks only in cases of unambiguous identification based on behaviour; e.g., when being fed by their parents or carried on their parents' backs). In addition to the Hooded Grebe, five other species were recorded breeding in the study area: Silvery Grebe, Flying Steamer-Duck (*Tachyeres patachonicus*), Crested Duck (*Anas specularioides*), Upland Goose (*Chloephaga picta*) and White-winged Coot (*Fulica leucoptera*) (Table 2).

Table 4. Hooded Grebe (*Podiceps gallardoi*) abundance (number of individuals) in spring, summer and fall during the 2004-2005 and 2005-2006 study periods in shallow lakes surveyed in the Strobel Plateau. The number of nests is shown between parentheses. The code following lake's name corresponds to that used by Johnson (1997); lakes without code were not surveyed by this author.

	2004-2005			2005-2006		
	Spr	Sum	Fall	Spr	Sum	Fall
Cardielito (S86)					6	
Herradura		10	15		41 (13)	1
Martínez 4 (S94)	24		6	9 (2)	31	10
Nidos		2				
Ocho	81 (40)	45	31	22	22	26
Oliva		7	1	4		
Potrerito	6 (2)				2	
Potrero (M8)			6	2		4
Rodríguez 16		2				
Rodríguez 18						3
Rodríguez 51		1				
Sat lag 7					9	4
Temp			12	3	2	8
Vega (S121)	3					

At the individual lake level, total bird abundance showed considerable variation both within and between years (Fig. 2). Cardielito Lake, for example, held over 1300 birds in late spring 2004 while in the summer and early fall 2005 numbers were less than 400 birds. The number of waterbirds in each lake also varied between years, particularly during late spring and summer, remaining fairly constant during the fall (Fig. 2).

Discussion

The Strobel Plateau represents an important reservoir of water in the arid Patagonian steppe, characterized for a high environmental variability (Lancelotti et al. 2009). This plateau has previously been reported to represent primary

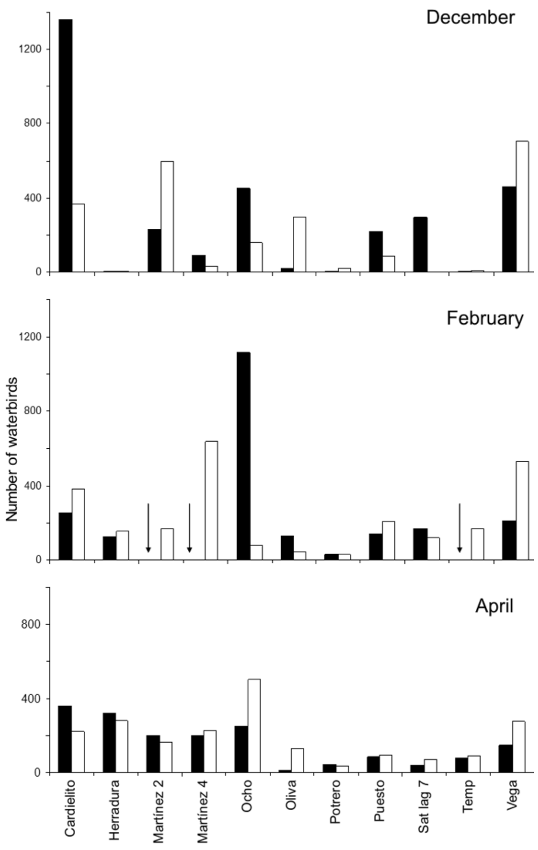

Figure 2. Waterbird abundance in eleven shallow lakes surveyed in the Strobel Plateau during spring (December), summer (February) and fall (April) of 2004-2005 (black bars) and 2005-2006 (white bars) study periods. Arrows indicate non available data.

habitat for a diversity of birdlife (Fjeldså 1986, Beltrán et al. 1992, Johnson 1997, Imberti 2005a). The importance of this plateau for birds has been widely recognized and due to the presence of the near threatened Hooded Grebe, Chilean Flamingo (*Phoenicopterus chilensis*), Magellanic Plover and other waterbird concentrations, it has been designated as an Important Bird Area (Di Giacomo 2005, Imberti 2005a). However, very little is known about bird populations, and except for the Hooded Grebe, information on bird distribution and abundance is scarce. Fjeldså (1986), for example, reports that a survey of 118 lakes indicated the presence of an estimated 13000 waterfowl and almost 1000 grebes in 1984, but he does not present data by species or location. Our results show that at least 18 waterbird species use the aquatic environments of the Strobel Plateau, with numbers at some lakes that may reach hundreds of individuals.

The family Anatidae was clearly the most widely represented, both in number of individuals and number of lakes occupied. Among these, Black-necked Swan, Chiloé Wigeon and Red Shoveler dominated waterbird assemblages. In addition, at least five species bred in the plateau, including endemic species of Patagonia such as Hooded Grebe and Flying Steamer-Duck. The Strobel Plateau had been previously recognized as one of the most important breeding grounds for the Hooded Grebe (Beltrán et al. 1992, Johnson 1997). Three of the Hooded Grebe colonies recorded in this study were found in lakes not previously surveyed (see Table 4; Johnson 1997). The identification of new breeding sites constitutes an important step for the spatial planning of the area and the conservation of this near threatened species. This information, for example, could be used in planning rainbow trout culture activity in order to preserve lakes used by the Hooded Grebe (Lancelotti et al. 2009).

In all surveys, we observed contrasting differences in bird abundances, even between neighbouring lakes. Substantial variation exists between lakes regarding their general limnological and topographic characteristics, such as the percentage of emerged macrophytes, salinity, water depth and lake size (Lancelotti et al. 2009). These characteristics are well known to affect the distribution and abundance of waterbirds, and could explain specific waterbird preferences in several wetlands (e.g., Skagen and Knopf 1994, Weller 1999, Boyle et al. 2004, Connor and Gabor 2006, Guadagnin and Maltchik 2007), including the Strobel Plateau (Lancelotti et al. 2009).

Repeated surveys of individual lakes showed that waterbird numbers can vary substantially among seasons. In addition, we frequently observed bird movements between neighbouring lakes which could result in considerable variation in bird abundance even between days. The relatively short distance between shallow lakes facilitates these movements. For example, only 60 km separates the two most distant shallow lakes in this plateau, and the area between them is dotted with a continuous spread of several hundred lakes. In this scenario, birds can cover their ecological requirements from an ample environmental spectrum and migrate with low energetic costs between individual shallow lakes in response to changing environmental conditions (e.g., water levels, food availability, disturbance). Many waterbird species have been shown to exploit mosaics of wetland habitat for feeding and breeding, and their survival is likely to depend on a wetland-network rather than on individual water bodies (Skagen and Knopf 1994, Williams 1999, Guadagnin and Maltchik 2007). Future studies should focus on the dynamic nature of waterbird lake use and extend the analysis to include other lakes to adequately assess the importance of the Strobel Plateau as waterbird habitat from a more integral perspective.

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