Observations on migratory and resident shorebirds in lakes in the highlands of north-western Argentina

Claudio D. Laredo

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The highlands located in the extreme north-west of Argentina include several wetlands of significance to Nearctic migratory shorebirds during the southern spring and summer. In addition, resident shorebirds depend on the same habitats for breeding purposes. Since 1989, these birds have been observed at Pozuelos, Vilama, Pululos, Guayatayoc, Runtuyoc and other locations. Data are now available on the number of species in both groups, their relative abundances, a tentative model of phenology and resource use and the chief threats to the quality of these wetlands. The information obtained shows the importance of the study area to three species of migrants and the less frequent occurrence of a further six species in the same group. Observations of the resident species indicate a probable decline in populations, possibly as a result of human activities; these are primarily disturbances due to cattle and overgrazing, deliberate fires and the clearing of grassland and shrubs.

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Las zonas altas ubicadas en el extremo noroccidental de Argentina incluyen varios humedales de importancia significativa para las aves costeras migratorias néarticas durante la primavera y el verano en el sur. Ademas, las aves costeras residentes dependen de los mismos habitats para su reproducción. Desdes 1989, estas aves se han avistado en Pozuelos, Vilama, Pululos, Guayatayoc, Runtuyoc y otras localidades. Ya existen datos sobre el numero de especies en ambus grupos, su abundancia relativa, un modelo fenologico experimental y el uso de recursos, y las amenazas principales a la calidad de estos humedales. La informacion obtenida muestra la importancia del area de estudio para las tres especies migratorias y para otras seis especies del mismo grupo, avistadas con menos frecuencia. Las observaciones de especies residentes indican una diminucion probable de las problaciones, posiblemente como resultado de actividades humanas; se trata primariamente de perturbaciones debidas al ganado y el pastoreo excesivo, incendios deliberados y el corte de hierba y arbustos.

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Les hautes-terres de l'extrême Nord-ouest de l'Argentine abritent plusieurs milieux humides très utilisés par les oiseaux de rivage migrateurs des régions néarctiques durant le printemps et l'été de l'hémisphère austral. Les espèces résidentes dépendent aussi de ces habitats pour la reproduction. On observe depuis 1989 les oiseaux de rivage à Pozuelos, Vilama, Pululos, Guayatayoc, Runtuyoc et à d'autres endroits. On dispose maintenant de données sur le nombre d'espèces dans les deux groupes, leur abondance relative, un modèle phénologique et d'utilisation des ressources potentielles et les principales menaces à la qualité de ces milieux humides. Ces données montrent l'importance de la région étudiée pour trois espèces d'oiseaux migrateurs et la présence occasionnelle de six autres espèces du même groupe. L'observation des espèces résidentes révèle un déclin probable des populations, peut-être associé aux activités anthroppiques, surtout les perturbations causées par le bétail et le surpâturage, les incendies délibérés, le défrichage des prairies et la coupe d'arbustes.

Faculty of Natural Sciences and Miguel Lillo Institute, Universidad Nacional de Tucuman, c/o CC 75, Suc. 2, 4000 Tucuman, Argentina.

Introduction

The highlands located in the extreme north-west of Argentina include several wetlands of significance for Nearctic migratory shorebirds during the southern spring and summer. In addition, resident shorebirds depend on the same habitats for breeding purposes. Very little information is available on these birds in the region. There are partial lists, such as those of Correa Luna (1973), Canevari (1985) and others (*e.g.* Nores 1986, 1988; Jehl 1988; Laredo 1989), which contain estimates of the number of individuals observed of certain species. Accordingly, presented here are data and observations gathered recently on shorebirds in certain wetlands in north-western Argentina.

Study area

The sources of the information reported here include preliminary observations carried out since 1989 at Lake de los Pozuelos, a natural heritage site.

Table 1. Lakes in north-western Argentina visited in September 1991.

Wetland	Location	Altitude (m)	Area (ha)[a]	Type
Lake de los Pozuelos	22°20'S, 66°00'W	3,500	10,000	Permanent
Lake Larga–Lagunilla	22°21'S, 66°07'W	3,700	300	Permanent
Lake Vilama	22°10'S, 66°55'W	4,400	8,000	Permanent
Lake Pululos	22°40'S, 66°44'W	4,400	700	Permanent
Lake Runtuyoc	22°39'S, 65°41'W	3,400	600	Temporary
Lake sobre Rio Miraflores	23°02'S, 65°52'W	3,600	400	Temporary
Lake Leandro	23°00'S, 65°15'W	4,050	600	Temporary
Lake Blanca	22°58'S, 65°10'W	4,400	600	Temporary
Lake Guayatayoc	23°10'S, 65°33'W	3,660	20,000	Permanent

[a] From personal observations and maps.

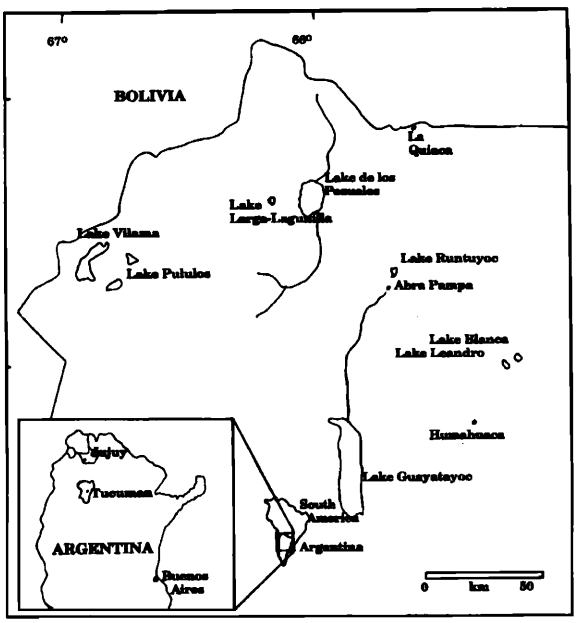

Figure 1. The locations of the wetlands in north-western Argentina considered in this study.

In September 1991, a survey of nine wetlands, including Lake de los Pozuelos, was carried out (Table 1). In addition, intermittent censuses carried out in Lake de los Pozuelos and Lake Larga–Lagunilla in November/December 1989, February 1990 and January 1991 have been used to supply comparative data (Figure 1).

Generally speaking, the lakes visited present similar features. They belong to the major Puna ecosystem (Morello 1983), which lies between 3,500 and 4,500 m above sea level, framed by mountains and attaining higher altitudes at their peaks. The water levels of the lakes vary each year, given the high seasonal variations in precipitation (rain in summer, between September and March) that characterize the region. Waters may be fresh, brackish or saline. The climate is continental, cold and dry (average annual precipitation is 280 mm), with high radiation. Temperatures fluctuate widely during the day, with differences of up to 40 °C. Cold, dry, blustery and intermittent high winds regularly sweep the western quadrant, which phytogeographically includes the Andean domain, a subregion of Punena Province (Cabrera 1968).

Three types of habitats were considered to be of interest in observing the shorebirds. These habitats occur frequently in the wetlands visited, so a brief description is in order:

(1) *Mudflats – shallow waters*: These consist of vast surfaces with very gentle slopes, devoid of vegetation, with patches of saltpetre and clumps of vegetation. Depending on wind direction and velocity, the water may be observed to advance and retreat each day, with frequent changes in humidity and resource availability for fauna. This situation is also apparent at the river-mouths, where the alluvial fans help create rapid habitat variations. Shallow waters are those portions of wetlands where water depths are between 5 and 40 mm and where aquatic plants such as *Potamogeton* and *Zannichellia*, among others, are frequently seen.

(2) *Grassland–shrubland*: These are located at the periphery of the wetlands behind the mudflats and generally extend throughout dry land in the entire region. Several plant species occupy this habitat, of which *Parastrephia* (shrubs) and *Stipa* (grass) are typical.

(3) *River-beds*: These include portions of rivers that invade the typical grassland–shrubland landscape and also include large areas of wetlands owing to their alluvial fans. The river-beds are generally of the ravine or canyon type, with depths up to 3 m from the grassland–shrubland levels. Depending on precipitation, the flow in these river-beds varies greatly. In association with rivers not of the canyon type and with springs and streams, swampy lowlands are commonly seen, consisting of communities of phanerogams covered by slowly but continuously flowing water.

Methods

On the mudflat – shallow water habitats, the birds were observed and counted with 8× binoculars and a 40× telescope; in the grassland–shrubland habitat, transects were used; and in river-beds, the birds seen along the shore were counted. In all cases, distances and widths covered were monitored with the use of a Spectrum 500 telemeter (scope 18–457 m and accuracy ±3 m up to 300 m). Directions were taken and corrected by compass. The counts were made between 7:00 a.m. and 5:00 p.m. when atmospheric conditions were sufficiently stable and favourable to achieve reliable observations.

Results

The shorebird species censused were divided into two groups: migrants, having their breeding grounds in the Northern Hemisphere, and residents, breeding in the study area. In the wetlands visited, the occurrence of nine migratory species and ten resident species was recorded (Table 2).

Tables 3, 4 & 5 show the numbers of birds obtained from censuses undertaken on nine wetlands in September 1991 as well as their densities per hectare of habitat and percentage of species that were migrants or residents. As well, these tables contain data collected from Lake de los Pozuelos in November/December 1989, February 1990 and January 1991 and from Lake Larga–Lagunilla in January 1991 for comparative purposes. Table 6 presents values of relative importance (RI) (Bucher & Herrera 1981) for all species counted during the September 1991 censuses in the nine wetland types considered here. These values were calculated using the following formula:

$$RI = \frac{Ni \times Mi}{Nt \times Mt} \times 100$$

where Ni is the number of individuals observed from species i in all samples, Nt is the total individuals for all species, Mi is the number of samples in which species i was present and Mt is the total number of samples.

Below are additional data on the species censused.

Lesser Golden-Plover *Pluvialis dominica*

In the past three years (1989–1991), solitary individuals of this species have been observed beginning in mid-August. The September, November/December and January censuses show compact groups of 15–20 individuals appearing frequently in mudflat – shallow water habitats and infrequently in other habitats. In February, the groups are more numerous, in loose groupings of up to 150 individuals in grassland–shrubland habitats over 5,000 m from the main wetland. During this period, greater flock mobility was observed as well.

Hudsonian Godwit *Limosa haemastica*

This species is commonly observed in groups of not more than 150 individuals frequenting mudflats – shallow waters, with a few isolated individuals occasionally entering deeper waters. No records earlier than September are available. Beginning in mid-February, some compact flocks of up to 350 individuals were observed in the area adjacent to the mouth of the Cincel River at Lake de los Pozuelos. In late February, some individuals in an advanced state of moult to breeding plumage were observed.

Yellowlegs (*Tringa* spp.)

Both Greater Yellowlegs *Tringa melanoleuca* and Lesser Yellowlegs *Tringa flavipes* are common, although apparently differing in number and disposition. *Tringa flavipes* frequently occurs in compact groups of 15–20 individuals, whereas *T. melanoleuca* appears in loose groupings of 2–5 individuals. Records for both species show little variation between September and February, and occurrences of solitary and scattered individuals also exist for the months of June and July. *Tringa flavipes* has been observed only on mudflats – shallow waters and in temporary ponds, but *T. melanoleuca* is frequently seen in river-mouths and swampy lowlands as well.

Wilson's Phalarope *Phalaropus tricolor*

Very numerous and compact flocks are recorded for this species. Not only does this species frequent mudflats – shallow waters, but high numbers, over 2,500 individuals, have been seen swimming on the waters of Pozuelos, Vilama and Guayatayoc lakes, more than 1,500 m from the shore. Smaller groups of 80–100 individuals are also seen in small temporary ponds. Numerous groups are recorded beginning in late August. Aplomada Falcon *Falco femoralis* hunts large flocks of this species. Beginning in the first half of March, some individuals are moulting to breeding plumage. Isolated and very scattered groups are frequently seen in the months of June and July in Laguna de los Pozuelos.

Baird's Sandpiper *Calidris bairdii*

Large concentrations of birds of this species are recorded beginning in August in Lake de los Pozuelos. In September, flocks of over 1,500 birds are seen massing on mudflats – shallow waters, and groups of up to 400 individuals are regularly scattered over grassland–shrubland habitats. In September, high RI values are recorded for this species, together with *Phalaropus tricolor*, in censuses

Table 2. List of shorebird families and species recorded in the wetlands of the highlands of north-western Argentina.

Family	Migrants	Residents
Recurvirostridae	None	*Himantopus himantopus* *Recurvirostra andina*
Charadriidae	*Pluvialis dominica*	*Vanellus resplendens* *Charadrius alticola* *Phegornis mitchellii* *Oreopholus ruficollis*
Scolopacidae	*Limosa haemastica* *Tringa melanoleuca* *Tringa flavipes* *Phalaropus tricolor* *Calidris bairdii* *Calidris melanotos* *Calidris himantopus* *Tryngites subruficollis*	*Gallinago andina*
Thinocoridae	None	*Attagis gayi* *Thinocorus orbignyianus* *Thinocorus rumicivorus*

taken in seven of the nine wetlands visited. Flocks of this species are frequently pursued by *Falco femoralis*.

Pectoral Sandpiper *Calidris melanotos*

Birds of this species were observed in small groups of between five and seven individuals beginning in early August. In mid-September, regular flocks of 30–50 individuals are observed, both in mudflats – shallow waters and in grassland–shrubland. Also, single individuals were frequently seen among large concentrations of *Calidris bairdii*.

Stilt Sandpiper *Calidris himantopus*

No sightings earlier than September were recorded for this species. These birds frequent principally mudflats – shallow waters. Smaller groups also enter deeper areas, where they feed by completely submerging their heads and the lower front portion of their bodies. Because of the gentle slopes of the wetlands visited, several birds of this species remained outside the area covered by the censuses (approximately 100 m from the water's edge), given the habitat mentioned earlier. In February, groups gradually grow more numerous, and flocks of over 300 individuals can be seen in early March.

Buff-breasted Sandpiper *Tryngites subruficollis*

A few birds of this species were observed in mudflats – shallow waters; they were always in low numbers and very dispersed. They have also been seen in very loose and small groups feeding in grassland–shrubland with small temporary ponds. Some birds were seen along the roadside adjacent to the wetlands. These groups occasionally amounted to more than 20 individuals. No records are available earlier than September for this species.

Black-winged Stilt *Himantopus himantopus*

This is undoubtedly the most numerous resident species found in the wetlands visited. It frequents almost exclusively waters near the shore with depths of up to 100 mm. Spindle-shaped groups are very common, comprising more than 2,500 individuals. Also very frequently seen are small loose flocks of 30–50 birds. The larger groups are first seen in late August, and numbers decline substantially by early February. No data are available on nesting in the study area.

Andean Avocet *Recurvirostra andina*

Groups of 15–20 individuals are generally observed in somewhat compact groups, although 2 or 3 birds can often be found feeding at a short distance from one another but isolated from larger groups. Dispersed groups totalling 20 birds almost constantly use the mudflats – shallow waters near the mouth of the Cincel River in Lake de los Pozuelos. Some loose flocks frequent waters up to 80 mm in depth. In February, a nest of this species was found on the narrow beaches of the terraces to the east of Lake de los Pozuelos, located on very irregular ground with vestiges of old swamps. The nest was attacked and destroyed by an Andean Gull *Larus serranus*, despite aggressive attacks by three *R. andina* to repell the gull; one egg, of three in the clutch, was rescued.

Andean Lapwing *Vanellus resplendens*

This species was recorded in every month of the year. Very loose groupings of 15–20 individuals

Table 3. Results of shorebird censuses in Lake de los Pozuelos: (a) mudflats – shallow waters, (b) grassland–shrubland and (c) river-beds and valleys.

Sectors	Variables	Nov.–Dec. 1989	Feb. 1990	Jan. 1991	Sept. 1991
(a)	Total no. birds	2,899	1,680	nc[a]	6,216
Peninsula N	Mean no./ha	58.0	33.6		124.3
(50 ha)	% migrants (no. spp.)	46.4 (9)	70.0 (8)		76.8 (9)
	% residents (no. spp.)	53.6 (5)	30.0 (5)		23.2 (5)
NW	Total no. birds	1,713	nc	nc	3,669
(20 ha)	Mean no./ha	85.6			183.4
	% migrants (no. spp.)	52.2 (8)			80.2 (9)
	% residents (no. spp.)	47.8 (4)			19.8 (5)
NE	Total no. birds	nc	nc	nc	8,709
(60 ha)	Mean no./ha				145.1
	% migrants (no. spp.)				78.4 (7)
	% residents (no. spp.)				21.6 (4)
S	Total no. birds	2,166	1,820	883	6,189
(60 ha)	Mean no./ha	36.1	30.3	14.7	103.1
	% migrants (no. spp.)	49.9 (8)	88.2 (7)	57.7 (6)	94.7 (7)
	% residents (no. spp.)	50.1 (6)	11.8 (5)	42.3 (4)	5.3 (4)
River-mouth	Total no. birds	2,981	2,349	2,333	7,880
Cincel River	Mean no./ha	49.7	39.1	38.8	131.3
(60 ha)	% migrants (no. spp.)	50.2 (9)	41.3 (9)	74.4 (7)	81.1 (9)
	% residents (no. spp.)	49.8 (4)	58.7 (4)	25.6 (5)	18.9 (4)
(b)	Total no. birds	521	754	nc	nc
Terrazan del	Mean no./ha	20.8	30.1		
E (25 ha)	% migrants (no. spp.)	72.5 (5)	70.1 (8)		
	% residents (no. spp.)	27.5 (5)	29.9 (4)		
NW	Total no. birds	540	nc	nc	2,617
(20 ha)	Mean no./ha	27.0			130.8
	% migrants (no. spp.)	71.1 (3)			95.8 (4)
	% residents (no. spp.)	28.9 (4)			4.2 (4)
S	Total no. birds	256	nc	nc	675
(15 ha)	Mean no./ha	17.0			45.0
	% migrants (no. spp.)	62.1 (3)			93.2 (1)
	% residents (no. spp.)	37.9 (3)			6.8 (4)
(c)	Total no. birds	294	321	nc	nc
River-bed	Mean no./ha	39.2	42.8		
Cincel River	% migrants (no. spp.)	40.8 (3)	26.2 (4)		
(7.5 ha)	% residents (no. spp.)	59.2 (5)	73.8 (5)		

nc = not censused.

were very frequent in grassland–shrubland and less common in mudflats – shallow waters. Nests were found only in the months of November and January, but chicks, fledglings and juveniles were frequently seen between November and February.

Puna Plover *Charadrius alticola*

From early August to February, some birds of this species occur in the study area in breeding plumage. During this period, only small, widely dispersed flocks are seen, never exceeding 30 birds. Only very few groups frequent grassland–shrubland, as mudflats are the most important of this species' habitats. There, these birds feed on brine flies (Ephydridae). Fledglings and juveniles without flight feathers have been seen during the last half of January.

Diademed Sandpiper-Plover *Phegornis mitchellii*

The vernacular name of this species refers to the distinctive crown pattern; it is probably the rarest of the region's shorebirds. These birds were observed only in temporary drainage ditches and swampy lowlands adjacent to Lake Blanca (three birds) in the month of September. However, they were also observed in ditches very close to mudflats south of Lake de los Pozuelos (also three birds) in

Table 4. Results of shorebird censuses in 1991 in Lake Larga–Lagunilla: (a) mudflats – shallow waters and (b) grassland–shrubland.

Sectors	Variables	Jan. 1991	Sept. 1991
(a)	Total no. birds	1,021	1,443
SW	Mean no./ha	31.9	45.1
(32 ha)	% migrants (no. spp.)	64.6 (4)	80.4 (4)
	% residents (no. spp.)	35.4 (5)	19.6 (5)
(b)	Total no. birds	75	41
SW	Mean no./ha	3.7	2.0
(20 ha)	% migrants (no. spp.)	0	0
	% residents (no. spp.)	100.0 (3)	100.0 (4)
E	Total no. birds	52	0
(25 ha)	Mean no./ha	2.0	0
	% migrants (no. spp.)	0	0
	% residents (no. spp.)	100.0 (3)	0
Total no. birds seen		1,148	1,484
Total area censused (ha)		77.0	77.0

Table 5. Results of shorebird censuses conducted in seven wetlands in 1991: (a) mudflats – shallow waters and (c) river-beds and valleys.

Wetland	Area (ha)	Total no. birds	Mean no./ha	% migrants (no. spp.)	% residents (no. spp.)
Lake Vilama					
(a) River-mouth	80	5,932	74.1	94.2 (8)[a]	5.8 (4)
Eastern shore	100	5,250	52.5	89.8 (7)	10.2 (3)
Lake Pululos					
(a) River-mouth	30	3,512	117.0	91.0 (4)	9.0 (4)
Lake Runtuyoc					
(a) NE	60	776	12.9	65.2 (4)	34.8 (4)
Lake Guatatayoc					
(a) N-NW	80	4,175	52.2	89.3 (5)	10.7 (4)
Lake sobre Rio Miraflores					
(a) River-mouth	40	542	13.5	62.3 (7)	37.7 (5)
Lake Leandro					
(a) River-mouth	30	1,497	49.9	81.6 (5)	18.4 (4)
(c) River-bed/valley	15	20	1.3	0	100.0 (5)
Lake Blanca					
(a) River-mouth	30	1,986	66.2	82.3 (4)	17.7 (4)
(c) River-bed/valley	20	72	3.6	0	100.0 (6)

[a] Number of species in parentheses.

November. One bird with juvenile plumage was observed in February along the Cincel River.

Tawny-throated Dotterel *Oreopholus ruficollis*

Groups of 10–15 birds were frequently seen in grassland–shrubland near small temporary ponds. In mudflats – shallow waters, only solitary birds were observed very sporadically, although groups of 5–10 birds made short incursions into the beach from shrubbery close to the water's edge, as observed on the mudflats of the northern peninsula of Lake de los Pozuelos. An important factor in the decline of this species' populations is considered to be the clearing of thickets of *Parastrephia*. Nesting records are available only for the month of September. Juveniles were seen in the second half of December.

Table 6. Values of relative importance (RI) for each shorebird species seen during the 1991 censuses in nine wetlands.

(i)	Wetland			
Species	Lake de los Pozuelos	Lake Larga–Lagunilla	Lake Vilama	Lake Pululos
H. himantopus	8.85	3.75	3.67	5.92
R. andina	0.76	0.78	1.28	0.76
V. resplendens	1.61	1.61	1.76	0.79
P. dominica	1.35	0.08	0.11	–
C. alticola	1.08	1.07	0.32	1.50
P. mitchellii	–	0.02	–	–
O. ruficollis	0.12	0.42	–	–
L. haemastica	0.19	–	0.68	1.48
T. melanoleuca	0.50	0.51	0.67	0.31
T. flavipes	0.76	–	0.38	–
P. tricolor	25.76	18.89	45.71	30.18
C. bairdii	39.54	6.62	35.73	52.67
C. melanotos	2.81	–	3.44	5.21
C. himantopus	0.10	–	0.27	1.13
T. subruficollis	0.21	–	0.07	–
G. andina	0.00	0.65	–	–
A. gayi	0.03	0.04	0.16	–
Thinocorus spp.	0.00	0.04	–	–

(ii)	Wetland				
Species	Lake Runtuyoc	Lake sobre Rio Miraflores	Lake Leandro	Lake Blanca	Lake Guayatayoc
H. himantopus	11.85	12.23	10.01	22.06	4.86
R. andina	6.18	3.32	1.38	7.09	0.88
V. resplendens	6.31	5.16	10.28	7.09	2.68
P. dominica	–	1.29	0.52	1.11	–
C. alticola	10.43	9.59	1.91	1.79	2.13
P. mitchellii	–	–	0.19	0.04	–
O. ruficollis	–	2.95	0.32	–	–
L. haemastica	1.54	0.92	0.19	0.77	0.69
T. melanoleuca	2.19	2.21	0.65	–	1.22
T. flavipes	–	–	–	–	0.04
P. tricolor	39.30	–	47.46	65.35	63.95
C. bairdii	22.16	41.88	31.64	12.14	23.42
C. melanotos	–	15.68	–	–	–
C. himantopus	–	0.18	–	–	–
T. subruficollis	–	0.18	–	–	–
G. andina	–	–	0.13	0.63	–
A. gayi	–	0.36	–	–	0.09
Thinocorus spp.	–	–	0.19	0.04	–

Andean Snipe *Gallinago andina*

This species was very frequently seen in grassland–shrubland habitat. Solitary individuals were sighted in Lake de los Pozuelos and Lake Larga–Lagunilla and valleys close to Lake Blanca. A nest was seen in a gully close to Lake de los Pozuelos in mid-September.

Rufous-bellied Seedsnipe *Attagis gayi*

Birds of this species have been observed in swampy lowlands at river-mouths and along the shores of lagoons with tufted vegetation, which is a common habitat along the eastern shore of Lake Vilama. Loose flocks of 8–10 birds are frequently sighted feeding in pairs or groups of 3 birds very close to each other. Records are available for almost all months of the year, with the greatest concentrations between the second half of August and the end of April. No data are available on nesting for this species.

Seedsnipes (*Thinocorus* spp.)

Records of both species (Grey-breasted Seedsnipe *Thinocorus orbignyianus* and Least Seedsnipe *Thinocorus rumicivorus*) are very scarce here. These

birds have been observed only in grassland–shrubland with gentle slopes and crossed by vast swampy lowlands. *Thinocorus rumicivorus* has been observed in groups of three or four birds in the underbrush (*Parastrephia*) close to the eastern shore of Lake Larga–Lagunilla. In November, underbrush in this area is completely cleared for agriculture. Records available for *T. orbignyianus* include only a very few solitary birds. During the second half of January, in the grassland–shrubland to the south-east of Lake Larga–Lagunilla, a nest located in a hollow in the ground contained four eggs partially covered with bits of straw. This clutch was attributed to *T. orbignyianus* because of the presence of two birds of this species near the nest.

Discussion

Human activities carried out in the region tend to alter natural conditions within these habitats to a varying degree. The activity with the most impact is cattle raising. The grassland–shrubland and swampy lowlands are used intensively to maintain large herds of sheep, goats, cattle and donkeys. The swampy lowlands are the only areas that are green all year round and contribute greatly to the hydraulic balance of certain important wetlands (*e.g.* Vilama, Blanca and Leandro lakes). The underbrush is cleared to make up for shortfalls in energy and is used by Puna settlers almost exclusively for fuel. New areas, such as those adjacent to Lake de los Pozuelos and Lake Larga–Lagunilla, are cleared to grow forage grasses. This means more livestock entering natural areas shortly, given the rapid impoverishment of crop areas. These practices eventually favour the introduction of pockets of sand and, consequently, sand dunes, which are already common in Puna. In addition, there are the effects of major earth moving, done for incomplete mining projects. Mining is now done on a small scale only, and the bigger mines are not in operation. Some of them, such as the Pan de Azucar Mine, are flooded, and the waters of the Cincel River continue to leach toxic materials into Lake de los Pozuelos.

Not all human activities in Puna have adverse effects. In 1990, a group of technicians was able to have named as a MAB-UNESCO (Man and the Biosphere Programme of the United Nations Educational, Scientific and Cultural Organization) World Biosphere Reserve the watershed where Lake de los Pozuelos is located (Arabella 1991). Others continue to work from public sector institutions to create the Vilama Binational Andean Wildlife Reserve (the exact area yet to be determined), which will include large portions of the Rinconada department in Argentina and the Sub-Lipez department in Bolivia.

Although the data referred to here are discontinuous and rather dispersed, certain preliminary conclusions can be drawn. In view of logistic and methodological constraints, particularly regarding the censuses, the data reported here are considered to illustrate certain aspects of interest in connection with the shorebirds in this part of the Argentine Puna.

(1) The species of migrant shorebirds that occur in the wetlands visited can be divided into three groups according to numeric importance, permanence and use of available resources. A tentative decreasing model of the three aspects indicated could coincide with the following model: *Pluvialis tricolor* and *Calidris bairdii* (abundant); *Calidris melanotos, Pluvialis dominica, Tringa melanoleuca* and *Tringa flavipes* (fairly common); *Limosa haemastica, Calidris himantopus* and *Tryngites subruficollis* (scarce).

(2) Three wetlands can be highlighted as significant for migratory species as staging sites and wintering grounds. In view of the foregoing point, they could be (i) Lake de los Pozuelos, (ii) the complex made up of Lake Vilama, Lake Pululos and the extensive adjacent system of temporary ponds and (iii) Lake Guayatayoc.

(3) The censuses of September 1991 appear to indicate a significant migratory peak, at least for three species: *Phalaropus tricolor, Calidris bairdii* and *Calidris melanotos.*

(4) With respect to the resident species, the wetlands studied offer favourable conditions for populations of *Vanellus resplendens, Charadrius alticola, Himantopus himantopus* and *Recurvirostra andina.* Meanwhile, populations of the scarcer species, *Oreopholus ruficollis, Phegornis mitchellii, Gallinago andina, Thinocorus orbignyianus, Thinocorus rumicivorus* and *Attagis gayi,* could be threatened by increasing losses of their breeding grounds and activity sites.

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