Revista Brasileira de Ornitologia 26(2): 123–140.
June 2018

ARTICLE

Bird assemblages from western Sierras Grandes and Traslasierra Valley in central Argentina: an important area for conservation of Chacoan and mountain birds

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Received on 22 June 2017. Accepted on 29 March 2018.

ABSTRACT: Between 1970 and 1980, many ornithological prospections were made in central Argentina. With this work we intend to fill some of the existing gaps regarding such knowledge. We conducted bird surveys in the central-western region of Córdoba province. We identified 240 bird species (63% of province's avifauna) belonging to 48 families: 10 of which are considered under some threat category, 37 are migrants, and two are endemic to the region. Throughout a qualitative analysis of ordination, we identified three clusters of environments that share similar bird composition. Among those, the most dissimilar group was composed of aquatic environments, whereas the two other groups included wooded and anthropized environments and high altitude environments, respectively. The high bird richness recorded in a relatively small region, encompassing a variety of environments, place upon this area a high bird conservation value. The inclusion of this area in the system of "Important Bird Areas" (IBAs) may prompt protection actions.

KEY-WORDS: altitudinal gradient, bird diversity, endemic birds, environmental heterogeneity, IBAs, threatened birds.

INTRODUCTION

Located in central Argentina, Córdoba province hosts a large and diverse number of avian species. Approximately 376 native bird species within 51 families have been recorded (Stempelmann & Schulz 1890, Frenzel 1891, Nores & Yzurieta 1975, Nores & Yzurieta 1979, Nores *et al.* 1980, Nores *et al.* 1983, Narosky & Yzurieta 1989, Nores *et al.* 1996). These species are distributed in Córdoba throughout a large variety of habitats, such as grassy highlands, xerophytic woodlands, wetlands and marshes. This is the result of the convergence of several ecological regions: the Great Chaco Ecoregion, the Pampas Ecoregion, and the Espinal Ecoregion (Luti *et al.* 1979, Zak & Cabido 2002, Nori *et al.* 2011). Despite the biodiversity found throughout this province, existing ornithological studies show a clear bias towards a few major areas: Mar Chiquita Lake in the northeast, and the grasslands on the top of Sierras Grandes in central Córdoba (*e.g.* Nores & Yzurieta 1983, Nores 1995, Giraudo *et al.* 2006).

Historically, the high bird abundance and the presence of endemic and threatened species has conferred the province high conservation value. Córdoba avifauna includes eight species endemic to Argentina and nine species globally endangered or threatened (López-Lanús *et al.* 2008). This has sustained the designation of nine Important Bird Areas (IBAs) in Córdoba province (Di Giacomo 2005). However, only fifty percent of those IBAs have effective protection. Furthermore, other regions with potential for avian conservation remain out of consideration due to the lack of information regarding avian species presence and distribution. Some of these regions are still relatively unaffected by anthropic disturbance, as is the case for western Sierras Grandes and Traslasierra Valley.

Sierras Grandes and the adjacent Sierras of Comechingones (Sierras Grandes-Comechingones hereafter) are the highest mountains within Córdoba province (maximum height 2780 m a.s.l.). The western

face presents short and steep slopes, where numerous streams run down, some of which shape the basin of Río de los Sauces and Allende Lake, commonly under the denomination "Traslasierra Valley" (Carignano *et al.* 2014, Fig. 1). Río de los Sauces alluvial valley has a plant community typical of Chaco lowland Forest, yet the mountain slopes also comprise a variety of contrasting vegetation units (*i.e.* woodland, shrubland, grassland; see description in study site section) in accordance with the altitudinal gradient (600 to 2700 m a.s.l.). This particular topography allows for the development of a highly heterogeneous landscape in a relatively small area, and the variety of environments hosts a great bird diversity. For example, the mountain tops include birds with an Andean origin, whereas lowland areas have Chacoans species (Nores & Yzurieta 1983, Nores & Cerana 1990). These characteristics confer western Sierras Grandes-Comechingones and Traslasierra Valley a high value for bird conservation.

The main goals of this study were to (1) study avian richness and composition while comparing bird assemblages among different habitats, and to (2) assess the feasibility of including this region into the system of IBAs. Specifically, we seek to know the avian richness and avian community composition at western Sierras Grandes-Comechingones and Traslasierra Valley, and to identify the similarities between bird assemblages among different habitat types. Our study aims to improve the understanding of the distribution of avian species across different habitats in this heterogeneous area, which historically has been understudied by ornithologists, in order to highlight the importance of this area for the conservation of birds in Lowland and Mountain Chaco region.

METHODS

Study area

Surveys were conducted in an area of Sierras Grandes delimited in the north by the rivers Río Chico de Nono and Río de los Sauces and the coast of Allende Lake. In the east, the area was limited by the Sierras Grandes-Comechingones summit. The west and south limits correspond to the meridian 65°03'W and the parallel 32°10'S, respectively, comprising an area of 464.75 km^2 (Fig. 1).

The physiognomy of plant communities and main plant species observed along Traslasierra Valley and western Sierras Grandes-Comechingones system from lowest to the highest altitude (*sensu* Luti *et al.* 1979, Fig. 2) included:

Lowland Chaco woodland (500–800 m a.s.l.): this area is dominated by several tree species such as *Aspidosperma quebracho-blanco*, *Prosopis flexuosa*, *Prosopis chilensis*, *Ziziphus mistol* and *Cercidium australe*. Shrubs commonly found in the area include *Larrea divaricata*, *Mimozyganthus carinatus*, *Maytenus spinosa*, and *Acacia furcatispina* (Cabido *et al.* 1992).

Mountain Chaco woodland (800–1350 m a.s.l.): characterized by the dominating presence of *Lithraea molleoides* and, to a lesser extent, *Celtis ehrenbergiana*, *Bouganvillea stipitata*, *Schinopsis haenkeana*, and *Xanthopylum coco.* Among the shrubs, dominant species include *Flourensia* sp. and *Condalia buxifolia* (Cabido *et al.* 1998).

Mountain shrubland (1350–1700 m a.s.l.): this community is characterized by the lack of trees, the dominant shrub being *Heterothalamus alienus*, and to

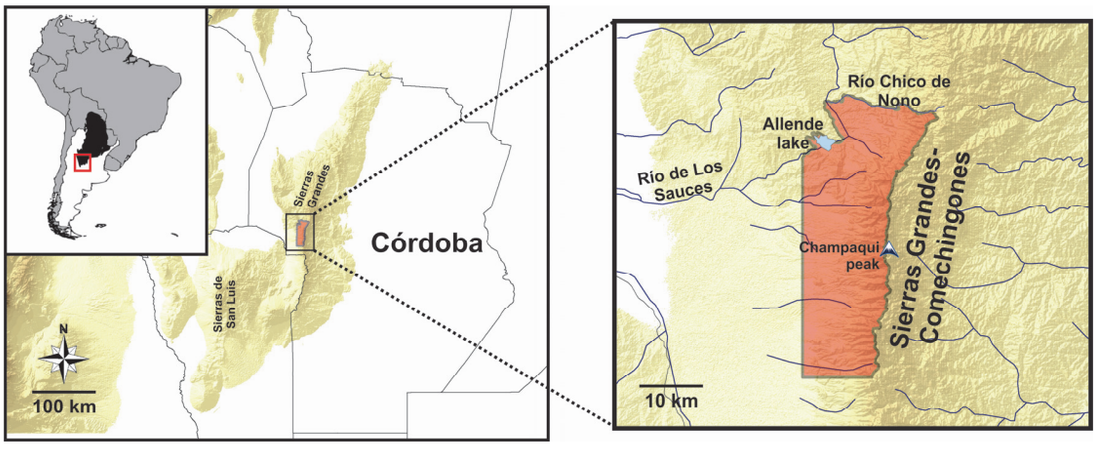

Figure 1. The map represents the location of our study site in Córdoba province, Argentina. The black shading area in the South American map represents the Great Chaco Forest. The red area in the right square indicates the study area, the north edge is delimitated by Río Chico de Nono, Río de los Sauces and the northern coast of Allende artificial lake, the east boundary is the maximal coat of Sierras Grandes-Comechingones, and the west and south limits correspond to the meridian 65°03'W and the parallel 32°10'S respectively. The delimited area goes from 700 m a.s.l. at the west limit to 2780 m a.s.l. (Champaquí peak, the highest altitude in Córdoba province) at the east limit. The area occupies 464.75 km^2.

a lesser extent *Acacia caven*, *Baccharis* sp., and many Poaceae species.

Mountain grassland and *Polylepis* forest (1700–2800 m a.s.l.): consists of a mosaic of *Polylepis australis* woodland (mainly in humid and pronounced ravines), tussock grasslands (dominated by *Poa stuckertii*, *Deyeuxia hieronymi*), grazing lawn (dominated by *Alchemilla-Carex* lawn), granite outcrops, and eroded areas with exposed rock surface (Cingolani *et al*. 2004, 2008).

We assigned surveyed birds to different habitat types considering the following environment classification based on previous descriptions (see Fig. 2): 1 - artificial lake; 2 - river; 3 - stream; 4 - lowland forest; 5 - mountain forest; 6 - mountain shrubland; 7 - mountain grassland; 8 - *Polylepis* forest; 9 - agricola field; and 10 - urban area.

Data collection

Three different survey techniques were used to prevent biases that may be caused by one single technique (Bibby *et al*. 2000): (a) detection of species presence through direct observations with binoculars and aural identification of songs, (b) recording of species presence by means of capture with mist nets and (c) recording of species presence via interviews with local residents. Scientific nomenclature is in accordance with South American Classification Committee (SACC–American Ornithologists' Union, Remsen-Jr. *et al*. 2015). The conservation status of each bird species follows López-Lanús *et al*. (2008).

(a) Between January 2011 and December 2015,

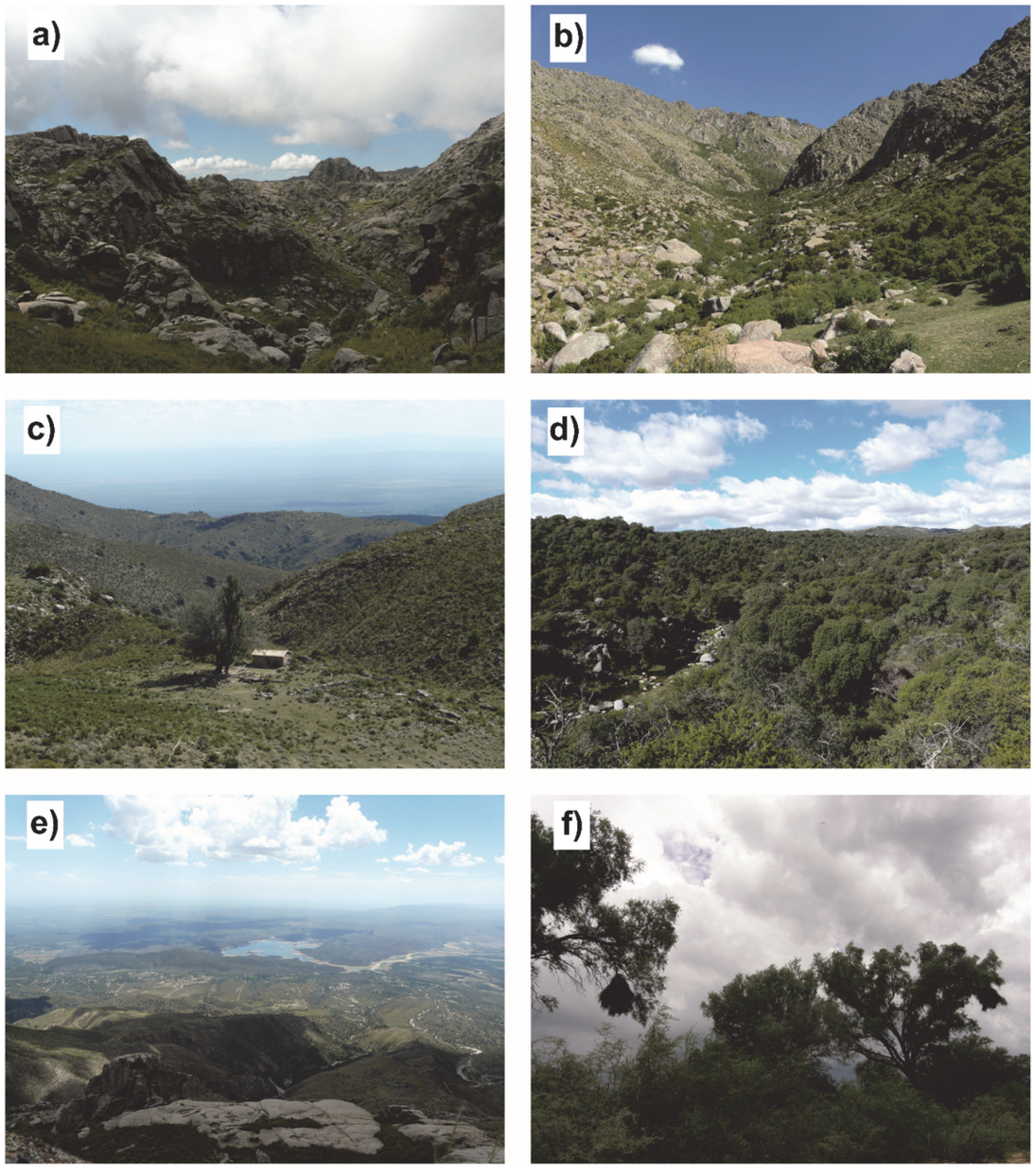

Figure 2. Different environments included in the study area. (**A**) Mountain grassland, (**B**) ravine with a *Polylepis* forest, (**C**) mountain shrubland, (**D**) mountain forest, (**E**) panoramic view of Traslasierra Valley showing Allende artificial lake, and (**F**) lowland forest.

we conducted approximately 80 surveys in the study area and registered bird species visually and aurally. Each survey consisted in walks during time-periods of high bird activity, from sunrise to midday and from 5:00 to sunset. In addition, we conducted nocturnal walks using playback to detect nocturnal species of Caprimulgidae and Strigiformes. Sixty percent of those surveys were conducted in areas corresponding to lowland and mountain Chaco woodland (data from a collateral specific study, Vergara-Tabares 2017), and areas of Allende artificial Lake and Río de los Sauces.

(b) During the autumn-winter 2014, we used mist nets in three sectors of mountain woodland. We also used mist nets during 20–29 April, 10–19 July, and 20–29 September at three sites [Los Hornillos (31°54'5.10''S; 64°58'28.92''W), San Javier (32°1'42.77''S; 65°0'13.34''W) and Luyaba (32°10'4.44''S; 65°0'29.35''W)]. Nets were mounted in sites with intense bird activity and were separated by at least 50 m (*i.e*. near the streams and/or between patches of arboreal vegetation). We opened four 12-m nets from sunrise to 12:00 h and from 16:00 h to sunset during three successive days (approximately 108 h/net per site).

(c) Interviews: some local residents, mostly rural inhabitants, were interviewed and questioned about the bird species they had identified to be in the region. In order to minimize the confusion generated by common bird names (which vary from one region to another), we used photo books of Chacoan birds with their scientific and common names to avoid misleading recognitions. This methodology allowed us to check *in loco* whether the species mentioned in the interviews were expected to occur in this region of study, focusing on those species that may have suffered local extinctions in many sites of their ranges (*e.g*. *Gubernatrix cristata*, *Strix chacoensis* and *Pheucticus aureoventris*).

Data analysis

We graphically explored the relationship among the different habitats and bird assemblage composition using UPGMA based on Jaccard's qualitative index of similarity. Qualitative indexes were estimated on a presence-absence matrix of birds registered in the different habitats. We used the Vegan package (Oksanen *et al*. 2007) in the free user analysis platform R (R Core Team 2012).

RESULTS

A total of 240 species of birds belonging to 48 families were recorded (Appendix I). The most represented families were Tyrannidae, Furnariidae, and Thraupidae with 35, 24, and 24 species, respectively. For the non-passerines, the most represented families were Accipitridae, Ardeidae, Picidae, and Rallidae with 12, 8, 8, and 8 species respectively. Forty-five species occurred exclusively within one type of environment (Fig. 3A, Appendix I) and two species occurred in seven non-aquatic environments (*i.e*. *Turdus chiguanco* and *Zonotrichia capensis*). According to López-Lanús *et al*. (2008), we recorded two "Endangered" species (*Gubernatrix cristata* only through interviews and *Buteogallus coronatus*), two threatened species, and six "Vulnerable" species (although *S. chacoensis* only through interviews, Appendix I).

Graphical exploration with UPGMA showed three groups of habitats based on bird assemblage composition (Table 1, Fig. 4). Two similar groups included: 1) mountain shrubland, mountain grassland, and *Polylepis* forest ("highland habitats" hereafter), and 2) lowland forest, mountain forest, agricola field, and urban areas ("lowland habitats" hereafter). The third, less similar, group included the following aquatic habitats: artificial lake, stream, and river ("aquatic habitats" hereafter). We

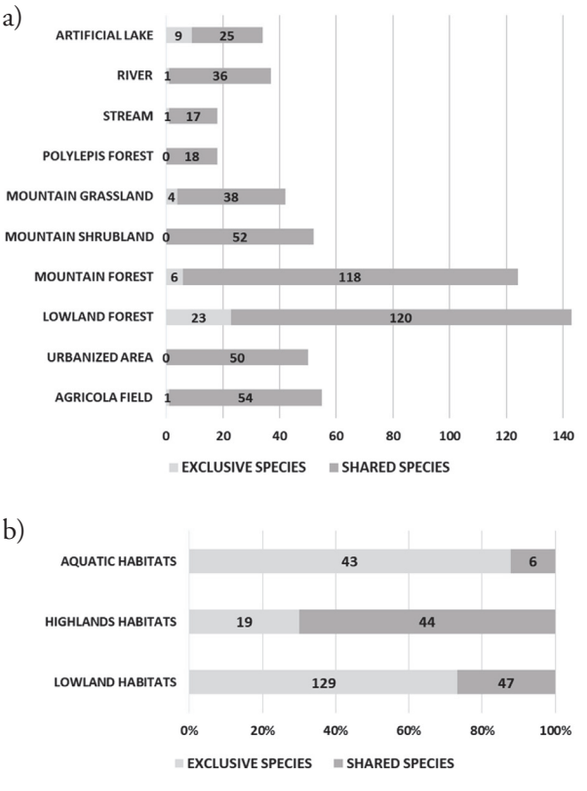

Figure 3. (**A**) Number of bird species recorded at each environment of our study site. The light gray section of the bar indicates the number of species that inhabits exclusively that particular environment and the dark gray section shows the number of species that are found in more than one environment. (**B**) Proportion of exclusive (light gray bars) and shared (dark gray bars) species per group of habitats (number of species in bold numbers). Group of habitats are illustrated in Fig. 4.

Table 1. Similarity matrix of Jaccard index among habitats surveyed in western slopes of Sierras Grandes-Comechingones and Traslasierra Valley, Argentina.

	Lowland forest	Mountain forest	Mountain shrubland	Mountain grassland	*Polylepis* forest	Agricola field	Urban area	Stream	River	Artificial lake
Lowland forest	1.00									
Mountain forest	0.59	1.00								
Mountain shrubland	0.14	0.22	1.00							
Mountain grassland	0.05	0.11	0.50	1.00						
Polylepis forest	0.01	0.07	0.29	0.29	1.00					
Agricola field	0.30	0.21	0.17	0.11	0.04	1.00				
Urban area	0.28	0.32	0.24	0.12	0.07	0.47	1.00			
Stream	0.00	0.00	0.00	0.00	0.00	0.04	0.00	1.00		
River	0.00	0.00	0.00	0.02	0.00	0.03	0.01	0.36	1.00	
Artificial lake	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.11	0.60	1.00

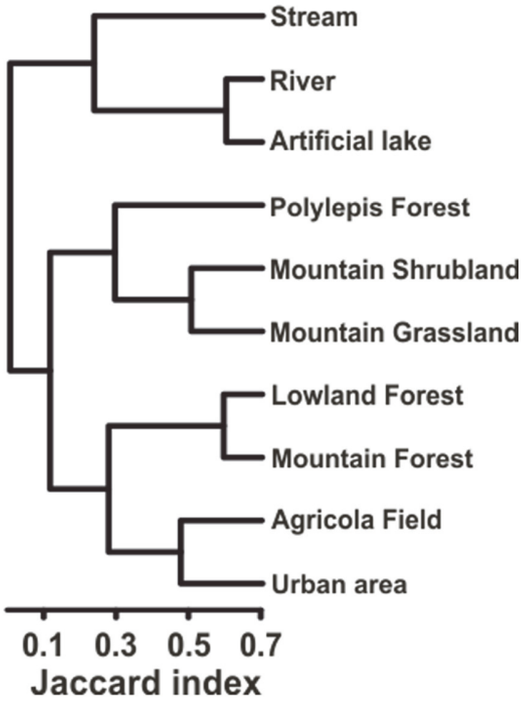

Figure 4. Hierarchical clustering analysis (UPGMA) for avian assemblages in different habitats in western slopes of Sierras Grandes-Comechingones and Traslasierra Valley using Jaccard similarity distances.

regrouped species *a posteriori* to count species exclusively present in each group of habitats. Aquatic habitats showed the highest proportion of exclusive species (but the lowest bird richness) and highland habitats was the group with lowest proportion of exclusive species. Lowland habitats showed intermediate proportions of exclusive species but the highest richness (129 species, see Fig. 3B).

A total of 17 species expected to ocurr in the area were not found (Appendix II).

DISCUSSION

Noteworthy species

Below we present some information and comments about noteworthy birds species registered in the study area, including species threatened by local activities, species included in threat categories, and endemic species. Some of this information may be relevant for conservation purposes (Di Giacomo 2005).

Andean Condor (*Vultur gryphus*): its range formerly stretched along the total length of the Andes mountains, from Venezuela to Tierra del Fuego, including Sierras Centrales of Córdoba and San Luis (Houston *et al*. 2016). We frequently observed this nearly-threatened species in our study site (Fig. 5A, B). In a few opportunities, we observed groups of 40–50 individuals feeding on dead horses or cows in areas above 1400 m a.s.l. Although a population decline has been reported for this species in Ecuador, Peru and Bolivia, the species appears to be common and the population seems to be stable in Argentina (Houston *et al*. 2016). However, in Argentina, lead poisoning (from ammunition used to hunt game) is potentially a new and increasing threat for the species (Saggese *et al*. 2009, Lambertucci *et al*. 2011).

Chaco Eagle (*Buteogallus coronatus*): We recorded two individuals of this eagle during 2011 in the central area of our study region (Fig. 5D) and we found the first active nest for Córdoba province (previous to this study there were only hints but no confirmation that the species would potentially nest in the region, Torres *et al*. 2006). On 03 February 2014, we found one nest in the southern portion of the prospected area with one nestling in advanced state of development (Fig. 5C). We were able to record many feeding events by both parents (see Capdevielle *et al*. 2015). The nest consisted of a platform built on a Molle de Beber (*Lithraea molleoides*) located in

the mountain forest (at ~950 m a.s.l.). During the two following years, a pair of *B. coronatus* produced a new nestling in the same nest. Distribution of *B. coronatus* in western and north central Argentina extends south to Río Negro, La Pampa, and southern Buenos Aires (Collar *et al*. 1992, Gonnnet & Blendinger 1998). This eagle occurs in open and semi open habitats consisting of mixed open grassland, bushland, savannah, marsh and open woodland in lowland areas (Maceda 2007). In view of its low population density and the number of threats faced by this species, the IUCN Red List conservation status of the Chaco Eagle is "Endangered" (BirdLife International 2016).

Spot-winged Falconet (*Spiziapteryx circumcincta*): this monotypic species is considered endemic to the Chaco region, but is also present in monte shrubs of Río

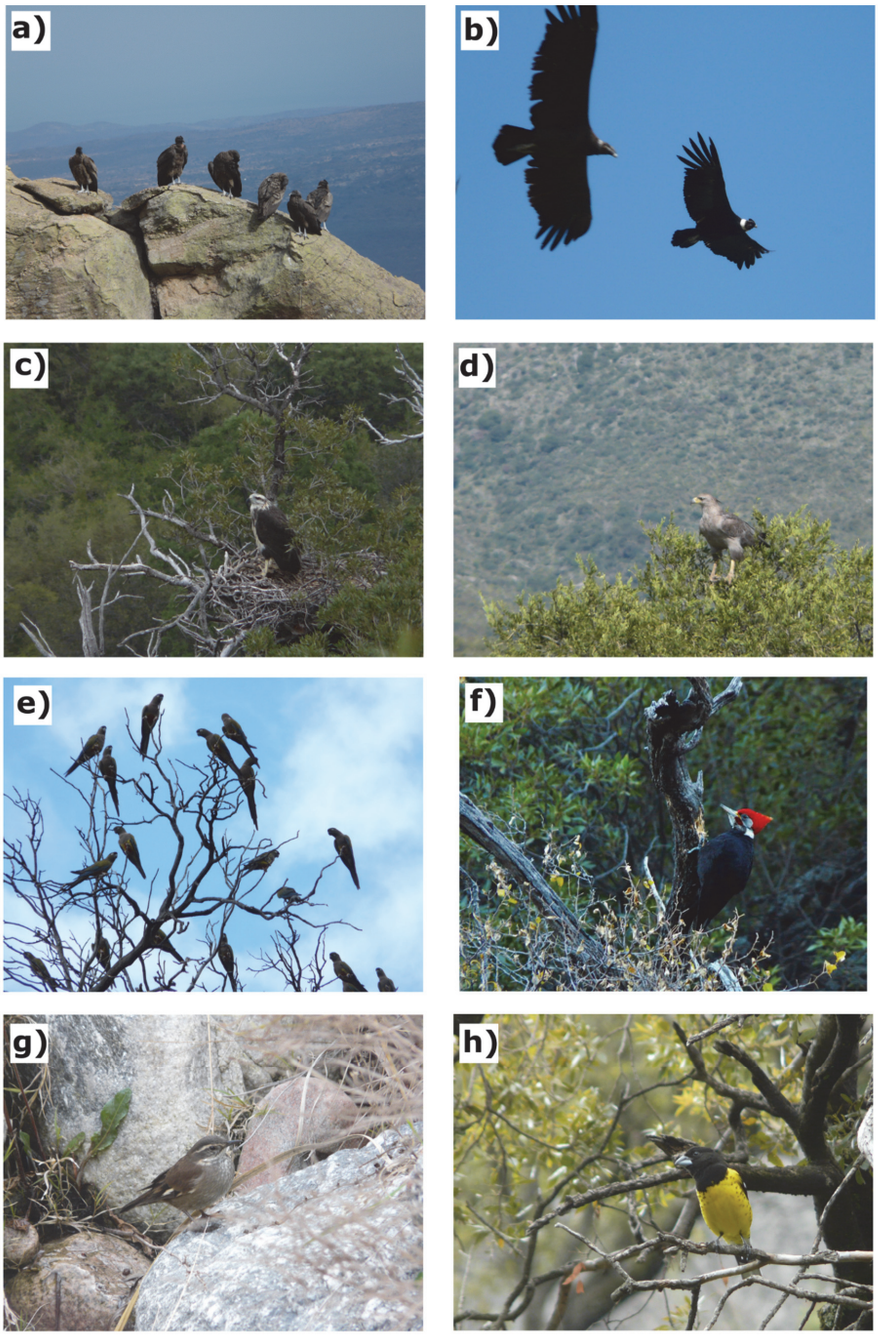

Figure 5. Noteworthy bird species registered at our sturdy area: (**A**) group of juvenile individuals of Andean Condors; (**B**) adults Andean Condors, a female on the left and a male on the right; (**C**) Crowned Eagle fledglings in their nest. First records of a Crowned Eagle nest for Córdoba province; (**D**) one of the Crowned Eagle pair that produced fledglings; (**E**) group of Burrowing Parrots that conform a colony in Los Barrancos Wildlife Refuge; (**F**) male of Black-bodied Woodpecker, the second woodpecker most abundant in mountain forests (Vergara-Tabares, unpub. data); (**G**) Olrog's Cinclodes, one of two endemic species in central mountains of Cordoba province; (**H**) male of Black-backed Grosbeak, a species threatened by illegal captures and traffic for cage birds. Photo author: D.L. Vergara-Tabares.

Negro, Argentina (Bierregaard *et al*. 2016). This species is not globally threatened (Bierregaard-Jr. *et al*. 2016), but López-Lanús *et al*. (2008) categorized this falconet as "Vulnerable" in Argentina. Its status is virtually unknown, although it is considered locally common in Córdoba, where its habitat has been seriously devastated in the region (Zak & Cabido 2002). We recorded this species in lowland forests and, in lower frequencies, in mountain forests mainly during winter.

Burrowing Parrot (*Cyanoliseus patagonus*): this species includes 4 subspecies, where *C. p. conlara* (Nores & Yzurieta 1983) occurs in San Luis and Córdoba provinces. Masello *et al*. (2011) evidenced that this subspecies represents a hybrid population of *C. p. patagonus* and *C. p. andinus*, and this is the most genetically diverse of the four *C. patagonus* taxonomic groups. This population was identified as one of four management units for conservation, being important for their genetic characteristics and low population size (1700 individuals; Masello *et al*. 2015). Due to behavioral attributes, we were able to register four noteworthy colonies of Burrowing Parrots in our study area. The largest colony occurs within the limits of Los Barrancos Wildlife Refuge, and the others (similar in size), occur in burrows at Río de Los Sauces and in ravines at mountain area between 900 and 1000 m a.s.l. However, smaller groups were recorded feeding along all the woody areas in our study region (except in *Polylepis* forests, Fig. 5E).

Chaco Owl (*Strix chacoensis*): the geographic distribution of the Chaco Owl overlaps approximately 90% of the overall Chaco region (Trejo *et al*. 2012). This owl inhabits both dense and semi-open vegetation on hilly and flat areas (Cracraft 1985). Despite its wide distribution, it is listed as "Vulnerable" in Argentina (*e.g*. López-Lanús *et al*. 2008, Trejo *et al*. 2012). López-Lanús *et al*. (2008) consider *S. chacoensis* moderately sensitive to anthropogenic habitat changes. Habitat conversion and fragmentation is probably the main threat to this species (Holt *et al*. 2016). In Córdoba province, the species has been recorded in Chancani Provincial Park and we documented its presence in lowland forest via local interviews. Although we conducted night searches of *S. chacoensis* using playbacks, we were unable to detect this species.

Black-bodied Woodpecker (*Dryocopus schulzi*): this woodpecker (Fig. 5F) is endemic to the Chaco region, and it is considered "Nearly Threatened" (López-Lanúz *et al*. 2008, Lammertink 2014, Winkler & Christie 2016). Despite its wide distribution across the Chaco region, this species is generally rare on a local scale (Madroño & Pearman 1992). However, on a regional scale in the western face of Sierras Grandes-Comechingones, we commonly recorded this woodpecker in mountain forests habitats from Las Chacras to Luyaba − close to their southern limit − (Vergara-Tabares, unpub. data). Madroño & Pearman (1992) suggest the existence of two main populations, one in central Paraguay and the other one in Córdoba province. However, Yzurieta (1995) has stated that this woodpecker is rare in Córdoba, contrary to our observations in the study area. Big woodpeckers, such as *D. schulzi*, are sensitive to logging and deforestation, as trees are required to build their nests (Lammertink 2014). Therefore, urbanization of pristine mountain forests may present a new threat for these locally abundant populations of *D. schulzi*. Human activity may not only threaten the survival of *D. schulzi* populations, but also the presence or persistence of other woodpecker species, including the southernmost populations of *Campephilus leucopogon* (Mikusiński 2006), an uncommon species in Córdoba (Yzurieta 1995).

Cordoba Cinclodes (*Cinclodes comechingonus*): this species breeds only in the isolated Sierras Grandes, occupying mainly streams in mountain grasslands and *Polylepis* forests (Remsen-Jr. 2016a). We recorded this species in all mountain grasslands and *Polylepis* forests. During autumn-winter, we observed individuals at lower altitudes (~900 m a.s.l.). Although this species inhabits a restricted range, it is not considered globally threatened because the habitat occupied by this species is relatively free from human disturbances other than cattle grazing (Cingolani *et al*. 2004).

Olrog's Cinclodes (*Cinclodes olrogi*): this species (Fig. 5G) is restricted to the Sierras Grandes, mirroring the distribution of the Cordoba Cinclodes (Remsen-Jr. 2016b). In winter, we recorded *C. olrogi* in streams at lower elevations. This species is less common than *C. comechingonus*, and it is more strictly associated with streams.

Cinnamon Warbling-finch (*Poospiza ornata*): this is a species endemic to Argentina (Mazar-Barnett & Pearman 2001). In summer, *P. ornata* occur in a strip that extends from northwestern to southeastern Argentina, moving to sites located further north and east of its summer distribution during the winter (Cueto *et al*. 2011). We have obtained scarce records, only in lowland forests, during our surveys. Although this species is a common inhabitant of arid lowland woodlands and shrubs in the Monte Desert, and taller shrubs in xeric Andean foothill ravines, some individuals may arrive at lowland Chaco Forest (Traslasierra Valley) in winter (Jaramillo 2016b). *Poopiza ornata* was classified as "Least Concern" by IUCN (2011). However, López-Lanús *et al*. (2008) have listed this species as "Vulnerable", due to its restricted distribution, the imposing risk by illegal wildlife trade, and the lack of accurate information about its population size and dynamics.

Yellow Cardinal (*Gubernatrix cristata*): this species historically occurred in north and central Argentina,

extreme southeastern Brazil and Uruguay. Currently, this species is one of the few Neotropical birds that has suffered a massive and negative effect from the caged bird trade. Consequently, remaining populations of this cardinal are small and fragmented (Jaramillo 2016a). During the 1980's, Miatello *et al*. (1994) registered some individuals in several areas inside and adjacent to our study site. Based on this observation, Nores (1996) considered this species under recovery in Córdoba province. We performed specific searches for this species using playback without success. Contrasting with our negative results, the interviews with rural inhabitants reveal the presence of *G. cristata* until five years ago.

Black-backed Grosbeak (*Pheucticus aureoventris*): this species (Fig. 5H) is distributed in south Peru, south and east Bolivia and northwestern Argentina (Brewer & de Juana 2014). Although most of the populations are sedentary, there is some evidence that suggests a pattern of local movements at the geographical end of its range of distribution that includes our study site (Chebez 2009). In accordance with this evidence, our observational records for this species were obtained only during the breeding season in spring-summer, only in ravines from 900 to 2000 m a.s.l. (*i.e*. mountain woodlands and *Polylepis* forests). In addition, we found two nests during December 2012 near Los Hornillos stream. Although López-Lanús *et al*. (2008) considered *P. aureoventris* a non-threatened species in Argentina, at a local scale its presence is rare, making this species especially valuable to be trapped and caged as a pet. We also directly observed extraction of nestlings for bird trade, activity that would reduce the reproductive success of its wild populations (López-Lanús *et al*. 2008).

Ultramarine Grosbeak (*Cyanocompsa brissonii*): this species has a large range of distribution (Brewer 2016) and is considered a quite common species. In Argentina, it is also considered a quite common and non-threatened species (López-Lanús *et al*. 2008). Although this species is not included in any threat category, the loss and fragmentation of its habitat and the illegal capture and trade of individuals as cage birds represent a conservation problem. In fact, this species is one of the most common illegally traded species (Ferreira & Glock 2004, Alves *et al*. 2010, Richard *et al*. 2010). We observed captive individuals in numerous houses throughout our study area.

Bird assemblages and human threats

In this study, we recorded 240 bird species in several bird assemblages from western Sierras Grandes and Traslasierra Valley in central Argentina. Considering that in Córdoba province there are 376 cited species (Nores *et al*. 1996), it is noteworthy that the study area (0.28% of the provincial territory) hosts 63.6% of the overall avifauna of Córdoba province. Moreover, not only is it remarkable for the rich composition of its avifauna, but also for the presence of some threatened species, such as *B. coronatus* at both regional and global scales. Another important observation is the common presence of the "Near Threatened" *D. schulzi* in mountain forests and endemic and restricted-range species such as *C. comechingonus* and *C. olrogi* that highlight the conservation value of the area for birds.

The great bird richness found in the area is likely due to two main factors. First, the evident altitudinal gradient in the study area (from 600 m a.s.l to 2800 m a.s.l) allows for the existence of several contrasting vegetation units. This heterogeneous landscape is able to host different bird assemblages, such as grassland birds, woody birds, and aquatic birds. Secondly, although in Córdoba province the expansion of the agricultural frontier for the past 30 years is alarming, especially in the north, east and south of the province (Silvetti 2012, Hoyos *et al*. 2013, Cáceres 2015), this process in the west of the province is less evident, leaving large forest areas which still host a rich diversity of birds. Nevertheless, agricultural and urban encroachments are recent threats to this area, particularly the replacement of natural cover by soybean crops under artificial irrigation (Fehlenberg *et al.* 2017).

We identified three groups of habitats based on similarity of bird assemblages. The most dissimilar group corresponded to aquatic habitats (*i.e*. stream, river, and artificial lake). The other two groups were composed of terrestrial habitats: one included wooded and anthropized habitats at low altitude between 600 and 1300 m a.s.l. (*i.e*. lowland forest, mountain forest, agricola field, and urban area) and the other group included highland habitats above 1300 m a.s.l. (*i.e*. mountain shrubland, mountain grassland, and *Polylepis* forest). Aquatic habitats had the greatest proportion of exclusive species, a pattern explained by the presence of aquatic specialized species (see Fig. 3B). Though, notably, this group also presents the lowest richness. Despite the fact that lowland habitats do not show a high proportion of exclusive species, these habitats present the highest richness (see Fig. 3A, B). Given the pattern of habitat aggregation and great number of exclusive species in each group, we considered that these entities might represent discrete units of conservation that would be susceptible to different human threats and worthy of protection.

Each group of habitats and their associated avifauna seem to suffer from different threats. For instance, in the lowland habitats, forests are replaced by agricultural habitats (lowland forest) and urban habitats (lowland and mountain forests). Furthermore, highland habitats experience anthropogenic fires and over-grazing of grasslands that contribute to the increasing erosion rates (Argañaraz *et al*. 2015). Finally, the capture of some

species for caged bird trade is a widely distributed and common activity in cities such as Villa Dolores and Mina Clavero (pers. obs.). Because of the high avifauna richness of the region, as well as its numerous threats, it is necessary to conduct educational and awareness campaigns focused on the local community to highlight the importance of the area for forest and bird conservation. The study area represents an important remnant of lowland and mountain Chaco Forest in a province with only 3% of the original forest remaining (Hoyos *et al*. 2013). This area has been identified as one with priority for endemic conservation for the Great Chaco region (Nori *et al*. 2016). The inclusion of the area in the system of Important Bird Areas (IBAs) is imperative to preserve this particular and threatened ecosystem in Córdoba province and its rich and unique bird community. We believe this inclusion would contribute to the development of bird and environment conservation and education programs.

ACKNOWLEDGEMENTS

We thank Miguel Santillan and an anonymous reviewer of this manuscript for constructive comments. We also want to thank Miguel Saggese for his valuable comments on this work. We especially thank R. Schmidt for help with English aspects of the manuscript. Partial funding was provided by Rufford Small Grants from The Rufford Foundation and by the Association of Field Ornithologists (AFO; Bergstrom Memorial Award to D.L.V.-T.). S.I.P. is a researcher at CONICET. D.L.V.-T., A.A.S., E.G.V., A.Q., T.N.R., and A.D. are CONICET fellowship holders.

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Associate Editor: Gustavo S. Cabanne.

APPENDIX I

List of bird species recorded at western Sierras Grandes-Comechingones and Traslasierra Valley. We also included the environment type that each species inhabits and the category of conservation. The number of environment represents: 1 - lowland Chaco woodland; 2 - mountain Chaco woodland; 3 - Romerillo shrubland; 4 - mountain grassland; 5 - *Polilepys* forest; 6 - agricola field; 7 - urbanized area; 8 - stream; 9 - river; and 10 - artificial lake. Status abbreviations: LC - "Least Concern"; EN - "Endangered"; VU - "Vulnerable", AM - Threatened. Abundance classification: C - Common; U - Uncommon; R - Rare; and A - Accidental. Seasonal presence: Y - Year-round; S - Summer presence; W - Winter presence; and A - Altitudinal movements.

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Tinamidae					
Nothura darwinii	Darwin's Nothura	1, 6	LC	C	Y
Nothoprocta cinerascens	Brushland Tinamou	1, 2	LC	C	Y
Nothoprocta pentlandii	Andean Tinamou	2, 3, 4	LC	C	Y
Nothura maculosa	Spotted Nothura	1	LC	C	Y
Crypturellus tataupa	Tataupa Tinamou	1, 2	LC	U	Y
Eudromia elegans	Elegant-crested Tinamou	1	VU	R	Y
Podicipedidae					
Tachybaptus dominicus	Least Grebe	10	LC	A	Y
Podiceps major	Great Grebe	10	LC	C	Y
Podilymbus podiceps	Pied-billed Grebe	9, 10	LC	C	Y
Rollandia rolland	White-tufted Grebe	9, 10	LC	C	Y
Phalacrocoracidae					
Phalacrocorax brasilianus	Neotropic Cormorant	9, 10	LC	C	Y
Ardeidae					
Ardea cocoi	White-necked Heron	9, 10	LC	U	Y
Ardea alba	Great Egret	9, 10	LC	C	Y
Egretta thula	Snowy Egret	8, 9	LC	C	Y
Bubulcus ibis	Cattle Egret	6, 8, 9	LC	C	Y
Syrigma sibilatrix	Whistling Heron	6, 8	LC	C	Y
Butorides striata	Striated Heron	8, 9	LC	U	Y
Nycticorax nycticorax	Black-crowned Night-heron	8, 9	LC	C	Y
Ixobrychus involucris	Stripe-backed Bittern	9, 10	LC	R	Y
Threskiornithidae					
Phimosus infuscatus	Bare-faced Ibis	9, 10	LC	U	Y

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Plegadis chihi	White-faced Ibis	9, 10	LC	C	Y
Theristicus caudatus	Buff-necked Ibis	4, 9	LC	U	S
Cathartidae					
Vultur gryphus	Andean Condor	4	VU	C	Y
Cathartes aura	Turkey Vultur	1, 2	LC	C	Y
Coragyps atratus	Black Vultur	1, 2, 3, 4, 6, 7	LC	C	Y
Anatidae					
Anas bahamensis	White-cheeked Pintail	10	LC	C	Y
Anas georgica	Yellow-billed Pintail	8, 9, 10	LC	C	Y
Anas flavirostris	Speckled Teal	8, 9, 10	LC	C	Y
Anas platalea	Red Shoveler	10	LC	C	Y
Oxyura vittata	Lake Duck	9, 10	LC	U	Y
Heteronetta atricapilla	Black-headed Duck	10	LC	R	Y
Netta peposaca	Rosy-billed Pochard	10	LC	C	Y
Accipitridae					
Geranoaetus melanoleucus	Black-chested Buzzard-eagle	2, 3, 4	LC	C	Y
Geranoaetus polyosoma	Red-backed Hawk	2, 3, 4	LC	C	Y
Geranoaetus albicaudatus	White-tailed Hawk	4	LC	U	Y
Elanus leucurus	White-tailed Kite	1	LC	U	S
Buteo magnirostris	Roadside Hawk	1, 2	LC	C	Y
Circus buffoni	Long-winged Harrier	3, 4	LC	C	Y
Circus cinereus	Cinereous Harrier	1, 4	LC	C	Y
Parabuteo unicinctus	Bay-winged Hawk	1	LC	R	Y
Rostrhamus sociabilis	Snail Kite	9, 10	LC	C	Y
Accipiter striatus	Sharp-shinned Hawk	2	LC	C	Y
Accipiter bicolor	Bicolored Hawk	1, 2	LC	U	Y
Buteogallus coronatus	Crowned Eagle	1, 2	EN	R	Y
Falconidae					
Caracara plancus	Southern Crested-caracara	1, 2, 3, 4, 6, 7	LC	C	Y
Milvago chimango	Chimango Caracara	1, 2, 3, 4, 6, 7	LC	C	Y
Spiziapterix circumcinctus	Spot-winged Falconet	1, 2	VU	C	Y
Falco peregrinus	Peregrine Falcon	1, 2, 7	LC	C	Y
Falco femolaris	Aplomado Falcon	1, 6	LC	C	Y
Falco sparverius	American Kestrel	1, 2, 6	LC	C	Y
Rallidae					
Aramides cajaneus	Gray-necked Wood-rail	2, 8	LC	C	Y
Pardirallus sanguinolentus	Plumbeous Rail	8	LC	C	Y
Gallinula galeata	Common Gallinule	8, 9	LC	C	Y
Gallinula melanops	Spot-flanked Gallinule	10	LC	U	Y
Fulica armillata	Red-gartered Coot	9, 10	LC	C	Y
Fulica leucoptera	White-winged Coot	9, 10	LC	C	Y
Fulica rufifrons	Red-fronted Coot	9, 10	LC	C	Y
Fulica ardesiaca		10	LC	A	

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Aramidae					
Aramus guarauna	Limpkin	9, 10	LC	U	Y
Cariamidae					
Chugna burmeisteri	Black-legged Seriema	1, 2	LC	U	Y
Jacanidae					
Jacana jacana	Wattled Jacana	10	LC	C	Y
Recurvirostridae					
Himantopus mexicanus	American Stilt	9, 10	LC	C	Y
Charadriidae					
Vanellus chilensis	Southern Lapwing	4, 6, 7, 9, 10	LC	C	Y
Charadrius collaris	Collared Plover	9	LC	U	Y
Scolopacidae					
Tringa melanoleuca	Greater Yellowlegs	9, 10	LC	U	Y
Tringa flaviceps	Lesser Yellowlegs	9, 10	LC	U	Y
Calidris bairdii	Baird's Sandpiper	10	LC	U	S
Gallinago gallinago	Common Snipe	3, 4	LC	U	Y
Columbidae					
Columba livia	Rock Pigeon	6, 7	LC	C	Y
Patagioenas picazuro	Picazuro Pigeon	1, 2, 6	LC	C	Y
Patagioenas maculosa	Spot-winged Pigeon	1, 2, 6, 7	LC	C	Y
Zenaida auriculata	Eared Dove	1, 2, 3, 6, 7	LC	C	Y
Columbina picui	Picui Ground-dove	1, 2, 6, 7	LC	C	Y
Leptotila verreauxi	White-tipped Dove	2, 6, 7	LC	C	Y
Psittacidae					
Thectocercus acuticaudata	Blue-crowned Parakeet	1, 2, 7	LC	C	Y
Cyanoliseus patagonus	Burrowing Parrot	1, 2	LC	U	Y
Myiopsitta monachus	Monk Parakeet	1, 2, 6, 7	LC	C	Y
Psilopsiagon aymara	Gray-hooded Parakeet	2, 3, 4, 5, 7	LC	C	A
Amazona aestiva	Turquoise-fronted Parrot	1, 2	LC	R	Y
Cuculidae					
Coccyzus melacoryphus	Dark-billed Cuckoo	1, 2	LC	U	S
Guira guira	Guira Cuckoo	1, 2, 6, 7	LC	C	Y
Tapera naevia	Striped Cuckoo	1, 2, 6	LC	C	S
Tytonidae					
Tyto alba	Barn Owl	1, 2, 6, 7	LC	U	Y
Strigidae					
Bubo virginianus	Great Horned Owl	2, 3, 4	LC	U	Y
Megascops choliba	Tropical Screech-owl	1, 2	LC	C	Y
Glaucidium brasilianum	Ferruginous Pygmy-owl	1, 2	LC	C	Y
Pseudoscops clamator	Striped Owl	1	LC	R	Y
Athene cunicularia	Burrowing Owl	1, 2, 6, 7	LC	C	Y
Strix chacoensis	Chaco Owl	1	AM	R	Y
Asio flammeus	Short-eared Owl	4, 6	LC	U	Y

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Caprimulgidae					
Systellura longirostris	Band-winged Nightjar	1, 2	LC	U	Y
Hydropsalis torquata	Scissor-tailed Nightjar	1, 2	LC	C	Y
Setopagis parvula	Little Nightjar	1	LC	C	Y
Apodidae					
Streptoprogne zonaris	White-collared Swift	2, 3, 4, 5,	LC	U	Y
Aeronautes andecolus	Andean Swift	2, 3, 4, 5	LC	C	Y
Trochilidae					
Heliomaster furcifer	Blue-tufted Starthroat	1, 2	LC	C	Y
Sephanoides sephaniodes	Green-backed Firecrown	2	LC	A	
Chlorostilbon lucidus	Glittering-bellied Emerald	1, 2, 6, 7	LC	C	Y
Sappho sparganurus	Red-tailed Comet	2, 3, 4, 5, 7	LC	C	A
Alcedinidae					
Chloroceryle amazona	Amazon Kingfisher	8, 9, 10	LC	U	Y
Chloroceryle americana	Green Kingfisher	8, 9, 10	LC	U	Y
Megaceryle torquata	Ringed Kingfisher	8, 9, 10	LC	C	Y
Bucconidae					
Nystalus maculatus	Spot-backed Puffbird	1, 2	LC	C	Y
Picidae					
Colaptes campestris	Campo Flicker	1, 2, 3, 6, 7	LC	C	Y
Colaptes melanochloros	Green-barred Woodpecker	1, 2, 3, 7	LC	C	Y
Melanerpes cactorum	White-fronted Woodpecker	1	LC	C	Y
Melanerpes candidus	White Woodpecker	1, 2	LC	U	Y
Veniliornis mixtus	Checkered Woodpecker	1, 2, 7	LC	C	Y
Picumnus cirratus	White-barred Piculet	1, 2	LC	U	Y
Campephilus leucopogon	Cream-backed Woodpecker	1, 2, 7	LC	U	Y
Dryocopus schulzi	Black-bodied Woodpecker	2, 7	AM	C	Y
Furnariidae					
Geositta rufipennis	Rufous-banded Miner	3, 4, 5	LC	U	Y
Upucerthia dumetaria	Scale-throated Earthcreeper	1, 2	LC	U	Y
Tarphonomus certhioides	Chaco Earthcreeper	1, 2	LC	C	Y
Cinclodes atacamensis	White-winged Cinclodes	8, 9	LC	C	A
Cinclodes comechingonus	Cordoba Cinclodes	8, 9	VU	C	A
Cinclodes fuscus	Buff-winged Cinclodes	6, 8, 9	LC	C	W
Cinclodes olrogi	Olrog's Cinclodes	8, 9	VU	C	A
Furnarius rufus	RufousHornero	1, 2, 3, 6, 7	LC	C	Y
Furnarius cristatus	Crested Hornero	1, 6	LC	C	Y
Coryphistera alaudina	Lark-like Brushrunner	1, 2, 6, 7	LC	C	Y
Phleocryptes melanops	Wren-like Rushbird	9, 10	LC	U	Y
Cranioleuca pyrrophia	Stripe-crowned Spinetail	1, 2	LC	C	Y
Asthenes baeri	Short-billed Canastero	1, 2	LC	C	Y
Asthenes pyrrholeuca	Sharp-billed Canastero	1, 2	LC	U	Y
Asthenes modesta	Cordilleran Canastero	3, 4	LC	C	Y

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Asthenes sclateri	Puna Canastero	3, 4	LC	C	Y
Anumbius annumbi	Firewood-gathered	1, 6	LC	C	Y
Synallaxis frontalis	Sooty-fronted Spinetail	1, 2	LC	C	Y
Synallaxis albescens	Pale-breasted Spinetail	1, 2	LC	C	Y
Leptasthenura platensis	Tufted Tit-spinetail	1, 2	LC	C	Y
Leptasthenura fuliginiceps	Brown-capped Tit-spinetail	2, 4, 5	LC	U	Y
Pseudoseisura lophotes	Brown Cacholote	1, 2, 3, 6, 7	LC	C	Y
Lepidocolaptes angustirostris	Narrow-billed Woodcreeper	1, 2	LC	C	Y
Drymornis bridgesii	Scimitar-billed Woodcreeper	1, 2, 3, 7	LC	C	Y
Thamnophilidae					
Thamnophilus caerulescens	Variable Antshrike	1, 2	LC	C	Y
Taraba major	Great Antshrike	1, 2	LC	R	Y
Rhinocryptidae					
Rhinocrypta lanceolata	Crested Gallito	1, 2	LC	U	Y
Melanopareiidae					
Melanopareia maximiliani	Olive-crowned Crescentchest	3, 4, 5	LC	C	Y
Tyrannidae					
Campostoma obsoletum	Southern Beardless-tyrannulent	1, 2, 7	LC	C	Y
Myiophobus fasciatus	Bran-colored Flycatcher	1, 2	LC	C	S
Hemitriccus margaritaceiventer	Pearly-vented Tody-tyrant	1, 2	LC	C	Y
Elaenia albiceps	White-crested Elaenia	1, 2	LC	U	S
Elaenia parvirostris	Small-billed Elaenia	1, 2	LC	C	S
Sublegatus modestus	Southern Scrub-flycatcher	1, 2	LC	U	Y
Suiriri suiriri	Suiriri Flycatcher	1, 2	LC	C	Y
Lessonia rufa	Rufous-backed Negrito	8, 9	LC	U	W
Serpophaga nigricans	Sooty Tyrannulet	9, 10	LC	U	Y
Serpophaga subcristata	White-crested Tyrannulet	1, 2	LC	C	Y
Serpophaga munda	White-bellied Tyranulet	1, 2	LC	C	Y
Pyrocephalus rubinus	Vermilion Flycatcher	1, 6	LC	C	S
Euscarthmus meloryphus	Tawny-crowned Pygmy-tyrant	1, 2	LC	C	Y
Anairetes flavirostris	Yellow-billed Tit-tyrant	2	LC	C	Y
Anairetes parulus	Tufted Tit-tyrant	2, 5	LC	U	A
Stigmatura budytoides	Greater Wagtail-tyrant	1, 2	LC	C	Y
Myiodynastes maculatus	Streaked Flycatcher	2	LC	C	S
Pitangus sulphuratus	Great Kiskadee	1, 6, 7	LC	C	Y
Tyrannus melancholicus	Tropical Kingbird	1, 2, 6, 7	LC	C	S
Machetornis rixosa	Cattle Tyrant	1, 6, 7	LC	C	Y
Myiarchus tyrannulus	Brown-crested Flycatcher	1, 2	LC	R	S
Myiarchus swainsoni	Swainson's Flycatcher		LC	C	S
Hirundinea ferruginea	Cliff Flycatcher	2, 3, 7	LC	C	Y
Knipolegus aterrinus	White-winged Black-tyrant	1	LC	U	S
Knipolegus striaticeps	Cinereous Tyrant	1	LC	U	S

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Hymenops perspicillatus	Spectacled Tyrant	1, 3, 4	LC	C	Y
Empidonomus aurantioatrocristatus	Crowned Slaty-flycatcher	1, 2, 7	LC	C	S
Tyrannus savana	Fork-tailed Flycatcher	1, 7	LC	C	S
Xolmis coronatus	Black-crowned Monjita	1	LC	U	W
Xolmis irupero	White Monjita	1, 6	LC	C	Y
Agriornis micropterus	Gray-bellied Shrike-tyrant	1, 2, 3,	LC	U	W
Agriornis murinus	Lesser Shrike-tyrant	1, 6	LC	U	W
Agriornis montanus	Black-billed Shrike-tyrant	3, 4, 5	LC	C	Y
Muscisaxicola rufivertex	Rufous-naped Ground-tyrant	3, 4	LC	C	Y
Muscisaxicola maclovianus	Dark-faced Ground-tyrant	6	LC	U	W
Tityridae					
Pachyramphus validus	Crested Becard	2	LC	U	S
Pachyramphus polychopterus	White-winged Becard	2	LC	U	S
Cotingidae					
Phytotoma rutila	White-tipped Plantcutter	1, 3, 6	LC	C	Y
Vireonidae					
Vireo olivaceus	Red-eye Vireo	1, 2	LC	C	S
Cyclarhis gujanensis	Rufous-browed Peppershrike	1, 2	LC	C	Y
Hirundinidae					
Progne elegans	Southern Martin	2, 3, 6	LC	C	S
Progne tapera	Brown-chested Martin	2, 3	LC	C	S
Tachycineta leucorrhoa	White-rumped Swallow	1, 2, 7	LC	C	S
Tachycineta leucopyga	Chilean Swallow	1	LC	C	W
Pygochelidon cyanoleuca	Blue-and-White Swallow	1, 2	LC	C	Y
Troglodytidae					
Troglodytes aedon	House Wren	1, 2, 3, 4, 6, 7	LC	C	Y
Cistothorus platensis	Grass Wren	3, 4, 5	LC	C	Y
Polioptilidae					
Polioptila dumicola	Masked Gnatcatcher	1, 2, 3	LC	C	Y
Turdidae					
Catharus ustulatus	Swainson's Thrush	1, 2	LC	R	S
Turdus amaurochalinus	Creamy-bellied Thrush	1, 2, 6, 7	LC	C	Y
Turdus rufiventris	Rufous-bellied Thrush	1, 2, 3, 5, 6, 7	LC	C	Y
Turdus nigriceps	Slaty Thrush	2	LC	U	Y
Turdus chiguanco	Chiguanco Thrush	1, 2, 3, 4, 5, 6, 7	LC	C	Y
Mimidae					
Mimus triurus	White-banded Mockingbird	1, 6	LC	C	W
Mimus patagonicus	Patagonian Mockingbird	1	LC	U	W
Mimus saturninus	Chalk-browed Mockingbird	1, 2, 3, 6, 7	LC	C	Y
Motacillidae					

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Anthus furcatus	Short-billed Pipit	3, 5	LC	U	Y
Anthus lutescens	Yellowwish Pipit	3	LC	U	Y
Anthus hellmayri	Hellmayr's Pipit	3	LC	C	Y
Parulidae					
Parula pitiayumi	Tropical Parula	1	LC	U	Y
Geothlypis aequinoctialis	Masked Yellothroat	1, 2	LC	C	Y
Myioborus brunniceps	Brown-capped Redstart	3, 4, 5	LC	C	A
Thraupidae					
Pipraeidea bonariensis	Blue-and-yellow Tanager	1, 2, 3, 7	LC	C	Y
Thraupis sayaca	Sayaca Tanager	1	LC	C	Y
Phrygilus alaudinus	Band-tailed Sierra-finch	3, 4	LC	C	Y
Phrygilus unicolor	Plumbeous Sierra-finch	3, 4, 5	LC	C	Y
Phrygilus carbonarius	Carbonated Sierra-finch	1, 2	LC	R	W
Phrygilus plebejus	Ash-breasted Sierra-finch	3, 4, 5	LC	C	Y
Sicalis flaveola	Saffron Yellow-finch	1, 6, 7	LC	C	Y
Sicalis luteola	Grassland Yellow-finch	1, 6	LC	C	Y
Saltraticula multicolor	Many-colored Chaco-finch	1	LC	C	Y
Poospiza ornata	Cinnamon Warbling-finch	1	VU	C	W
Poospiza hypochondria	Rufous-sided Warbling-finch	3, 5	LC	U	Y
Poospiza nigrorufa	Black-and-rufous Warbling-finch	1, 2	LC	C	Y
Poospiza torquata	Ringed Warbling-finch	1	LC	C	Y
Poospiza melanoleuca	Black-capped Warbling-finch	1, 2	LC	C	Y
Lophospingus pusillus	Black-crested Finch	1	LC	U	Y
Gubernatrix cristata	Yellow Cardinal	1, 2	EN	R	
Paroaria coronata	Red-crested Cardinal	1	LC	U	Y
Coryphospingus cucullatus	Red-crested Finch	1	LC	U	Y
Sporophila caerulescens	Double-collared Seedeater	1, 2	LC	C	S
Catamenia analis	Band-tailed Seedeater	2, 3, 4	LC	C	Y
Catamenia inornata	Plain-colored Seedeater	3, 4, 5	LC	C	Y
Diuca diuca	Common Diuca-finch	1	LC	C	S
Embernagra platensis	Great Pampa-finch	1, 3	LC	C	Y
Saltator aurantiirostris	Golden-billed Saltator	1, 2, 3, 6, 7	LC	C	Y
Emberizidae					
Zonotrichia capensis	Rufous-collared Sparrow	1, 2, 3, 4, 5, 6, 7	LC	C	Y
Rhynchospiza strigiceps	Stripe-capped Sparrow	1	LC	C	Y
Ammodramus humeralis	Grassland Sparrow	1, 3	LC	C	Y
Cardinalidae					
Pheucticus aureoventris	Black-backed Grosbeak	2, 3, 5	LC	U	S
Piranga flava	Hepatic Tanager	1, 2	LC	C	Y
Cyanocompsa brissonii	Ultramarine Grosbeak	1, 2	LC	U	Y

Taxon	English Name	Environment	Status	Abundance	Seasonal Presence
Icteridae					
Icterus cayanensis	Epaulet Oriole	1, 2, 7	LC	C	Y
Molothrus rufoaxillaris	Screaming Cowbird	1, 2, 6, 7	LC	C	Y
Molothrus bonariensis	Shiny Cowbird	1, 2, 6, 7	LC	C	Y
Agelaioides badius	Bay-winged Cowbird	1, 2, 6, 7	LC	C	Y
Sturnella loyca	Long-tailed Meadowlark	3, 4	LC	C	Y
Sturnella superciliaris	White-browed Blackbird	1, 6	LC	C	Y
Fringillidae					
Euphonia chlorotica	Purple-throated Euphonia	1, 2	LC	U	Y
Sporagra magellanica	Hooded Siskin	1, 3, 4, 6, 7	LC	C	Y
Passeridae					
Passer domesticus	House Sparrow	6, 7	LC	C	Y

APPENDIX II

Bird species predicted to occur at our study area and including probable habitat (see references in Appendix I). It includes species known from nearby areas, based on Nores (1996) and unpublished data.

Species	English name	Environment
Annas cyanoptera	Cinnamon Teal	10
Buteo swainsoni	Swainson's Hawk	1, 6
Pandion haliaetus	Osprey	10
Cariama cristata	Red-legged Seriema	1
Nyctibius griseus	Common Potoo	1
Chordeiles minor	Common Nighthawk	1
Chaetura meridionalis	Sick's Swift	1
Upucerthia validirostris	Buff-breasted Earthcreeper	4
Leptasthenura aegithaloides	Tufted Tit-Spinetail	1
Phacellodomus sibilatrix	Little Thornbird	1
Lathrotriccus euleri	Euler's Flycatcher	1
Pseudocolopteryx acutipennis	Subtropical Doradito	3, 4
Pseudocolopteryx flaviventris	Warbling Doradito	9, 10
Tachuris rubrigastra	Many-colored Rush-tyrant	9, 10
Knipolegus hudsoni	Hudson's Black-tyrant	1, 6
Muscisaxicola capistratus	Cinnamon-bellied Ground-tyrant	4, 6
Phrygilus gayi	Gray-hooded Sierra-Finch	1, 3, 4