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The avifauna of Ypetí Nature Reserve, and its implication for the consolidation of the Atlantic Forest Corridor in Paraguay

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ABSTRACT—We provide information on all birds known to date at Ypetí Private Nature Reserve and Estancia Golondrina. We reviewed all ornithological records from 1997 to 2017, totaling 348 bird species for the area. Habitat preferences and relative abundance for each species are detailed. The avifauna of Ypetí is composed of 58 Atlantic Forest endemics. At least 4 species are threatened and 9 are near-threatened, including *Celeus galeatus*, *Amazona vinacea*, and *Pteroglossus bailloni*. Brief comments are provided on the records of each of these species. The avifauna of the reserve is fourth in terms of species richness in the Atlantic Forest domain of Paraguay, and sixth in presence of endemics to this threatened biome. Received 27 December 2017. Accepted 25 September 2018.

Key words: Atlantic Forest, avifauna, biological corridor, conservation, Paraguay.

La avifauna de la Reserva Natural Ypetí, y su implicancia para la consolidación del Corredor de Bosque Atlántico en Paraguay

RESUMEN (Spanish)—Proveemos información sobre las aves conocidas hasta la fecha en la Reserva Natural Privada Ypetí y Estancia Golondrina. Hemos revisado todos los registros ornitológicos desde 1997 a 2017, totalizando 348 especies de aves para el área. Se detallan preferencias de hábitat y abundancia relativa para cada especie. La avifauna de Ypetí está compuesta de 58 endémicas del Bosque Atlántico. Al menos 4 especies están amenazadas y 9 casi-amenazadas, incluyendo *Celeus galeatus*, *Amazona vinacea* y *Pteroglossus bailloni*. Proveemos breves comentarios sobre los registros de cada una de estas especies. La avifauna de la reserva se encuentra en cuarto lugar en términos de riqueza de especies en el dominio del Bosque Atlántico del Paraguay, y sexto en cuanto a presencia de endémicas de este bioma amenazado.

Palabras claves: avifauna, Bosque Atlántico, conservación, corredor biológico, Paraguay.

The Atlantic Forest in South America has been ranked as the fourth most important ecoregion for global biodiversity conservation due to its habitat loss and by virtue of it having some of the highest numbers of endemic plants and vertebrates in the world (Myers et al. 2000). Originally, the forest extended from Río Grande do Norte and Ceará to Río Grande do Sul in Brazil, northeast of Argentina and east of Paraguay, and the coast of Uruguay, covering a total of 1,233,875 km², of which only 99,996 km² (8.1%) remains in pristine condition (da Fonseca et al. 2004).

In Paraguay, the Atlantic Forest remained almost “intact” until 1940, with the main form of deforestation being selective logging (Cartes 2003). In the early 1970s, over 70% of the forest

remained. During the following 30 yr, the forest cover was reduced to 40.7% by 1989 and to less than 25% by 2000 (Huang et al. 2007). From 2003 to 2013, more than 6,000 km² of forest cover was lost, with an annual deforestation rate of 1.8% of the remaining Atlantic Forest (da Ponte et al. 2017).

The avifauna of Paraguay has been historically one of the least studied in the Neotropics (Winker 1998) with one of the lowest publication rates of South American countries (Freile et al. 2014). Between 2007 and 2016, only 23 publications have included data about birds of the Paraguayan Atlantic Forest: 5 of the articles documented occurrence and distribution of species (Cockle et al. 2007, Bodrati and Velázquez 2008, Areta et al. 2013, Hostettler and Smith 2014, Smith et al. 2014); 4 contributed information on natural history (Bodrati and del Castillo 2008, Kirwan et al. 2010, Areta et al. 2013, Foster and Johnson 2017); 4 supplied information on population ecology (Cockle et al. 2007, Areta and Bodrati 2008, Areta and Bodrati 2010, Esquivel M. and Peris 2012); 6 provided information on community and/or landscape ecology (Esquivel and Peris 2008, Filloy et al. 2010; Zurita and Bellocq 2010, 2012; Esquivel M. and Peris 2012, Zurita et al. 2012); 4 provided information on bird or site conservation (Cockle et

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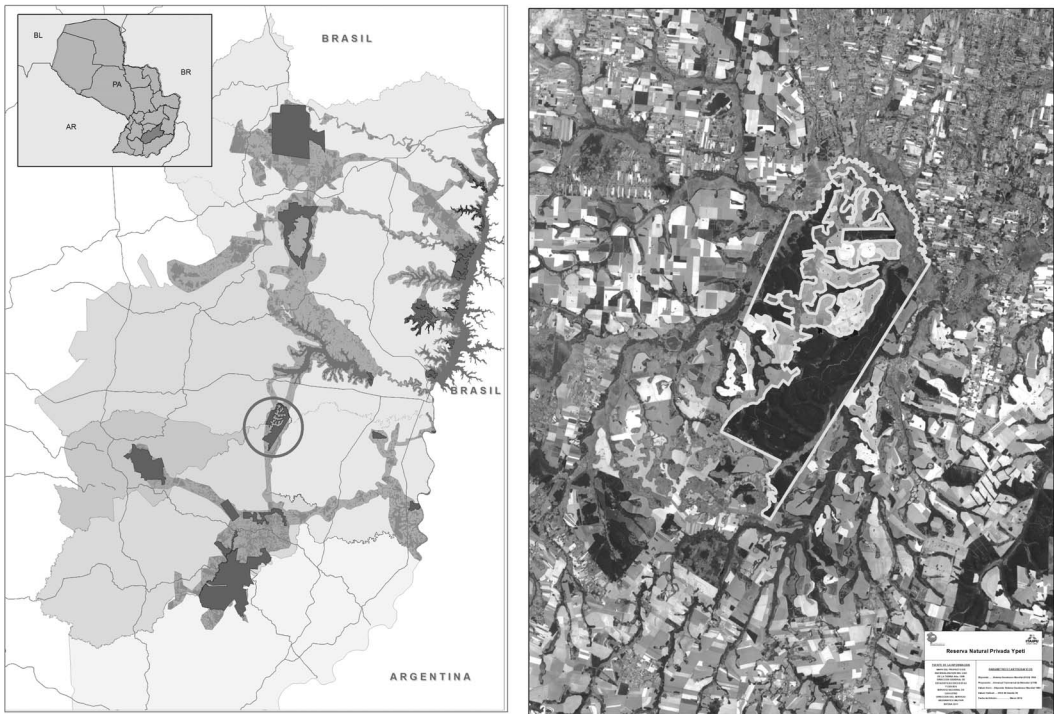


Figure 1. Location of Ypetí Private Nature Reserve in the Atlantic Forest Corridor of Paraguay. LandSat image of 2 January 2015 (Darío Pérez: Proyecto Paraguay Biodiversidad).

al. 2007, Esquivel M. et al. 2007, Areta et al. 2013, Smith et al. 2016); 1 study provided information on morphology (Smith 2016b) and 3 on taxonomy or phylogeny (Areta and Bodrati 2008, Areta and Bodrati 2010, Vilaça and Santos 2010); and 2 informed about behavior aspects (Smith 2016a, 2017). Only 4 articles provided information on the avifauna of Atlantic Forest remnants during the last 10 yr (Esquivel M. et al. 2007, Esquivel M. and Peris 2011, Foster and Johnson 2017, Smith et al. 2016).

The avifauna of Ypetí Private Nature Reserve was previously studied during the CANOPY'92 project, and 274 bird species were reported. It was identified as an "Important Bird and Biodiversity Area" (IBA) in 2007, meeting criteria A1, A2, and A3 (BirdLife International 2017b). The site is of high importance for the conservation of Atlantic Forest birds; nevertheless all data remained unpublished, with only a few remarkable records mentioned in the literature (Brooks et al. 1995, Lowen et al. 1997). A main part of the forest of Ypetí is subject to selective logging, and different

bird studies have been developed during the last 20 yr to monitor its avifauna. We here provide updated information on the status and abundance of the birds of Ypetí, with emphasis on globally threatened species and habitat preferences.

Methods

Location, vegetation, and climate

Ypetí Private Nature Reserve (25°39'S, 55°29'W) is located in the Caazapá Department (Fig. 1), with an area of 13,592 ha. The reserve is part of the Estancia Golondrina, a property of 23,911 ha. The property encompasses Atlantic Forest, a portion of natural grasslands/wetlands, agricultural land, forest, and cattle lands. It is delimited by the Monda'y River to the north, the Ypetí River in the east, and Capiibary River in the west.

Ypetí's vegetation includes (1) tall and medium semi-deciduous forest with globally threatened tree species, such as *Aspidosperma polyneuron*, *Cedrela fissilis*, *Pterogyne nitens*, and others with

Table 1. Fieldwork and methods of bird surveys at Ypetí Private Nature Reserve, Paraguay, with total number of species recorded.

Authors ^a	Field surveys	Methods ^b	Number of species recorded	Total species
CANOPY'92	Jul 1992	REA	274	274
Clay (FMB)	Sep 1997	PC	186	293
Bartrina (FMB)	Oct 2011	REA	111	298
Centrón (RPC)	May 2013	REA	104	306
Del Castillo (GP)	Jan 2015	REA	102	312
Esquivel (PyBio)	Feb 2016	PC and McKlists	108	320
Esquivel (FMB, PyBio, and GP)	Sep and Oct 2016; Jan, Feb, Mar, and May 2017	PC and McKlists	271	348

^a Author's affiliation: FMB, Fundación Moisés Bertoni; PyBio, Paraguay Biodiversidad (ITAIU Binacional - Banco Mundial); GP (Guyra Paraguay); Red, Red Paraguaya de Conservación en Tierras Privadas.

^b Methods: PC, point counts; REA, rapid ecological assessments; McKlists, 10-species McKinnon lists.

high commercial value including *Handroanthus heptaphyllus*, *Enterolobium contortisiliquum*, *Myrcocarpus frondosus*, and *Holocalyx balansae*; (2) forest on flooded soils, which usually includes tree ferns such as *Alsophila setosa* and *Cyathea atrovirens*, and other trees such as *Inga affinis*, *Luehea divaricata*, *Trichillia catigua*, and *T. elegans*; and (3) gallery forest, with bamboo (*Chusquea ramosissima*) and trees including *Campomanesia xanthocarpa* and *Eugenia* spp.

The climate is sub-tropical, with an annual average of 21 °C, mean high temperature of 32 °C during summer, and mean low temperature of 4 °C during winter. Annual precipitation average is 1,600–1,700 mm.

Systematic list and species accounts

Bird surveys were conducted by the authors at different times and using different methods (Table 1). Taxonomy and nomenclature follow the South America Checklist Committee (Remsen et al. 2017). Global conservation status of the species follows BirdLife International (2017a). Endemic species status follows Brooks et al. (1999) and Guyra Paraguay (2004), with the addition of Buff-bellied Puffbird (*Notharchus swainsoni*) and the exclusion of Red-ruffed Fruitcrow (*Pyroderus scutatus*).

Results

Species richness, seasonal patterns, and habitat preferences

A total of 348 bird species have been recorded at Ypetí (Supplemental Table S1). Fifty-eight

species are Atlantic Forest endemics. At least 299 (86%) are resident species in Paraguay, and 49 (14%) are migrants. Fourteen species are Nearctic migrants (breed in North America, found in the area Oct–Apr), most of which are sandpipers and swallows. Another 26 species are northern austral migrants, mainly kites, tyrant-flycatchers, martins, and seedeaters, found from October to April. Five are breeding southern austral migrants, breeding in Paraguay and increasing in numbers during our winter due to the arrival of migrants from the south. Four are southern austral migrants, present during the austral winter but not known to breed locally.

Habitats for each species are summarized (Supplemental Table S1). A total of 218 species were recorded in forest habitats, of which 170 appear to be restricted to this habitat (55 are Atlantic Forest endemics) and 101 were only recorded inside the forest; grasslands/wetlands have the second greatest species richness, with 105 bird species, 52 only found in this type of habitat; 36 species have been recorded in aquatic habitats, and 88 in anthropogenic habitats (Fig. 2).

Threatened and near-threatened species accounts

Four species are “Globally threatened”: 2 endangered (EN) and 2 vulnerable (VU). Nine species are near threatened (NT; BirdLife International 2017a).

Solitary Tinamou (*Tinamus solitarius*; NT)—This Atlantic Forest endemic was recorded occasionally during the studies in September 1997 and October 2011. No records were obtained in the last bird studies in the area, but local

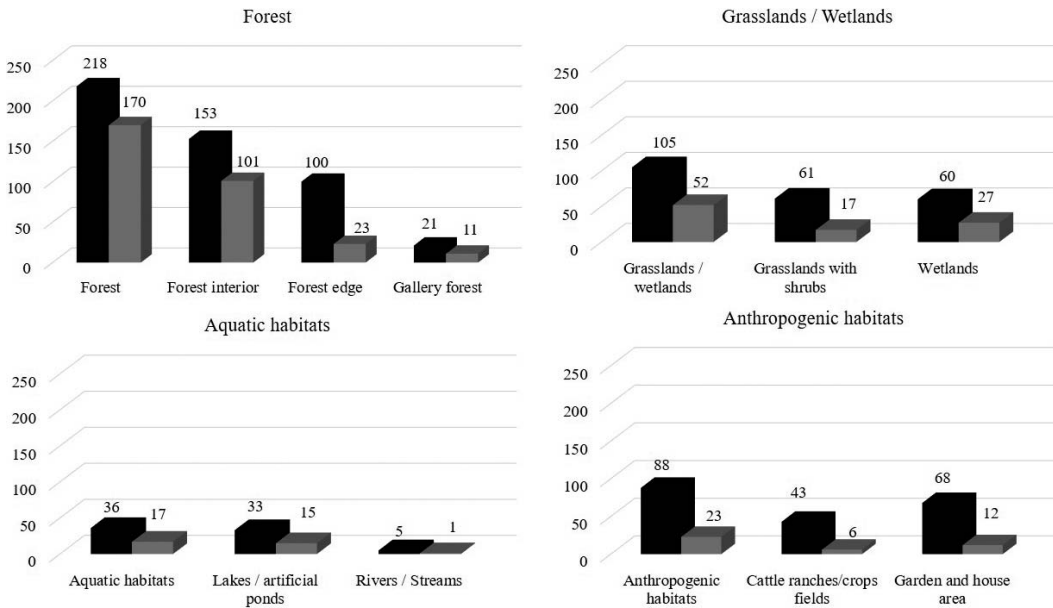


Figure 2. Bird habitat distribution at Estancia Golondrina and Ypetí Private Nature Reserve, Caazapá, Paraguay. Black bars represent total number of species recorded; gray bars represent species restricted to the habitat.

indigenous people reported that they still found nests of the species in recent years. There is a strong possibility that populations are declining due to hunting pressure in the area.

Crowned Eagle (*Buteogallus coronatus*; EN)—The only record of Crowned Eagle at Ypetí Private Nature Reserve is from 1992, during the CANOPY'92 project. It is a scarce species in the Central Paraguay ornithogeographic region (Guyra Paraguay 2004).

Saffron Toucanet (*Pteroglossus bailloni*; NT)—An Atlantic Forest endemic recorded rarely during the studies. In the most recent studies, one individual was recorded in September 2016 in the unlogged forest.

Helmeted Woodpecker (*Celeus galeatus*; VU)—This Atlantic Forest endemic was recently added to the bird list of Ypetí Private Nature Reserve. An individual was aurally recorded on 18 January 2017 by AEM, and later, on 10 May 2017, a female was observed and photographed by AEM (ML 73006951). Photo is available at eBird checklist with reference S36723517 (Esquivel M. and Ruiz 2017). Both records were obtained in the same unlogged forest of the reserve.

Vinaceous-breasted Parrot (*Amazona vinacea*; EN)—The only record of this Atlantic Forest

endemic for Ypetí was reported in CANOPY'92. The species was also recorded at Estancia Itabó Private Nature Reserve during CANOPY'92, and reported to be often observed eating palmito fruits during August, and less common in December, suggesting that seasonal movements may be related to palmito fruit availability (Lowen et al. 1995). At Ypetí, no stands of palmitos were observed in the forest, and presumably the Vinaceous-breasted Parrot has never been common in the area.

White-browed Foliage-gleaner (*Anabacerthia amaurotis*; NT)—A single bird of this Atlantic Forest endemic was reported at Ypetí during the studies of CANOPY'92 (Brooks et al. 1995). The species also has been reported at Estancia San Antonio, Alto Paraná Department, where 7 records were obtained during July 1992 (Brooks et al. 1995). At Caazapá National Park, Caazapa Department, another 7 records of the species were obtained during July 1995 (Lowen et al. 1997). At San Rafael National Park, Itapúa and Caazapa Department, 2 records of the species were obtained during July 1995, with no recent records in later studies (Lowen et al. 1997, Esquivel M. et al. 2007).

Table 2. Atlantic Forest endemics and/or globally threatened or near-threatened species with historical records (1992–1997) at Ypetí Private Nature Reserve, Caazapá, Paraguay.

Species	Status ^a	End ^b	IUCN ^c
<i>Buteogallus coronatus</i> (Crowned Eagle)	Res		EN
<i>Notharchus swainsoni</i> (Buff-bellied Puffbird)	Res	ATL	
<i>Amazona vinacea</i> (Vinaceous-breasted Parrot)	Res	ATL	EN
<i>Mackenziaena leachii</i> (Large-tailed Antshrike)	Res	ATL	
<i>Xiphorhynchus fuscus</i> (Lesser Woodcreeper)	Res	ATL	
<i>Anabacerthia amaurotis</i> (White-browed Foliage-gleaner)	Res	ATL	NT
<i>Clibanornis dendrocolaptoides</i> (Canebrake Groundcreeper)	Res	ATL	NT
<i>Heliobletus contaminatus</i> (Sharp-billed Treeshunter)	Res	ATL	
<i>Mionectes rufiventris</i> (Gray-hooded Flycatcher)	Res	ATL	
<i>Procnias nudicollis</i> (Bare-throated Bellbird)	Res	ATL	VU
<i>Pyrrhocoma ruficeps</i> (Chestnut-headed Tanager)	Res	ATL	
<i>Haplospiza unicolor</i> (Uniform Finch)	Res	ATL	
<i>Sporophila ruficollis</i> (Dark-throated Seedeater)	NAM		NT

^a Status: Res, resident species in Paraguay; NAM, northern austral migrant (breeds in Paraguay but is less abundant or absent from May to September).

^b End (Endemism): ATL, Atlantic Forest endemics (Brooks et al. 1999, Guyra Paraguay 2004).

^c IUCN, Globally threatened and near-threatened species: NT, near-threatened; VU, vulnerable; EN, endangered (BirdLife International 2017a).

Canebrake Groundcreeper (*Clibanornis dendrocolaptoides*; NT)—A single bird was mist-netted in moist primary forest adjacent to a bamboo thicket on 11 July 1992 at Ypetí (Brooks et al. 1995). The latest record of the species in the country is a single bird recorded at Caazapa National Park in July 1995 (Lowen et al. 1997). During 2016 and 2017, AEM has done voice playback in different areas of Ypetí, but with no results.

Southern Bristle-Tyrant (*Phylloscartes eximius*; NT)—A scarce Atlantic Forest species at Ypetí, found usually in pairs in the mid-story of mature or degraded forest.

São Paulo Tyrannulet (*Phylloscartes paulista*; NT)—An Atlantic Forest endemic rarely found at the mid-story of mature forest of Ypetí.

Bay-ringed Tyrannulet (*Phylloscartes sylviolus*; NT)—Rarely recorded at primary forest of Ypetí. AEM recorded a pair in a gallery forest of the Ypetí River, in January 2017, only 100 m from one of the recently logged forest plots.

Bare-throated Bellbird (*Procnias nudicollis*; VU)—The only record of this species at Ypetí is from 1992, during the CANOPY'92 project, but there are reports from local people of singing individuals in the forest in 2017.

Creamy-bellied Gnatcatcher (*Polioptila lactea*; NT)—The species was first recorded in 1992, during the CANOPY'92 project. No other record of this Atlantic Forest endemic existed until

October 2016 when AEM recorded a pair in a mixed-species flock in the canopy of a recently logged forest. Other species in the mixed flock were Guira Tanager (*Hemithraupis guira*), Tropical Parula (*Setophaga pitiayumi*), Sibilant Sirystes (*Sirystes sibilator*), and Chestnut-vented Conebill (*Conirostrum speciosum*).

Dark-throated Seedeater (*Sporophila ruficollis*; NT)—The only record of this species at Ypetí is from 1992, during the CANOPY'92 project.

Historical vs. actual records at Ypetí

Fifty-three bird species recorded during studies of 1992 to 1997 were not recorded in later studies (Supplemental Table S1). Of these 53 birds, only 13 are of either conservation concern or Atlantic Forest endemics (Table 2). On the other hand, studies since 2011 have added 55 bird species to the list of Ypetí, including 4 Atlantic Forest endemics, one that is vulnerable to extinction (Table 3).

Discussion

Avian diversity

A total of 348 bird species have now been reliably recorded in Ypetí Nature Reserve and Estancia Golondrina. This total represents almost 50% of all species documented for Paraguay (Guyra Paraguay 2005). Only 3 other locations in the Atlantic Forest Biome of eastern Paraguay

Table 3. Atlantic Forest endemics added to Ypetí Private Nature Reserve, Paraguay, in studies from 2011 to 2017.

Species	Status ^a	End ^b	IUCN ^c
<i>Megascops atricapilla</i> (Black-capped Screech-Owl)	Res	ATL	
<i>Celeus galeatus</i> (Helmeted Woodpecker)	Res	ATL	VU
<i>Turdus nigriceps</i> (Slaty-thrush)	AM	ATL	
<i>Amaurospiza moesta</i> (Blackish-blue Seedeater)	Res	ATL	

^a Status: Res, resident species in Paraguay; AM, southern austral migrant (present Apr–Sep and not known to breed in the country).

^b End (Endemism): ATL, Atlantic Forest endemics (Brooks et al. 1999, Guyra Paraguay 2004).

^c IUCN, globally threatened species: VU, vulnerable (BirdLife International 2017a).

surpass Ypetí in terms of species richness: San Rafael National Park, an area of 748 km² that encompasses Atlantic Forest and Mesopotamian Grasslands ecosystems, with a total of 426 bird species recorded (Esquivel M. and Peris 2011, Smith and Clay 2015); the Reserva Natural del Bosque Mbaracayú in Canindeyú Department, with an area of 644 km², which includes both Atlantic Forest and Cerrado habitats and contains at least 409 species (del Castillo et al. 2003); and Reserva Natural Privada Tapyta, an area of 46 km² that includes Atlantic Forest and Mesopotamian Grasslands and a total of 375 bird species (FMB 2014).

Ypetí is also one of the areas that holds the highest number of endemic birds of Atlantic Forest in Paraguay: 74% of the 78 Atlantic Forest bird species of the country have been reliably recorded in its forests. This percentage is surpassed only by San Rafael National Park with 70 endemic bird species (Esquivel M. and Peris 2011), Reserva Natural Privada Tapyta with 65 endemics (FMB 2014), Caazapá National Park with 62 endemics (Madroño N. et al. 1997), and Reserva Natural del Bosque Mbaracayú with 61 (del Castillo et al. 2003).

Implications of Ypetí Natural Reserve for consolidation of the Atlantic Forest Corridor of Paraguay

Ypetí Natural Reserve is one of the 17 protected areas that comprise the main remnants of Atlantic Forest that are being focused on to create a biodiversity corridor in the country, which extends for about 1.2 million hectares in 6 departments. This conservation goal is a major challenge in a scenario where agriculture and cattle ranches account for almost 30% of the economy of the country (Unión de Gremios de la Producción 2015) and, undoubtedly, its development means

the conversion of forested areas for land use. These originally forested lands now form an agricultural landscape with scattered and fragmented forest remnants. It is not surprising that even with a general moratorium for the original area of Atlantic Forest range (the “Zero Deforestation” Law, in place since 2004 in the Eastern Region of Paraguay), Atlantic Forest is still being lost at a rate of 1.8% per year (da Ponte et al. 2017).

About half of the forest of Ypetí is currently used for sustainable forest management, certified under FSC C117138. A cycle of 13 yr has been recently approached, and during 2017 a new cycle has started. The impact of these forest activities on the avifauna of the reserve is being studied (Esquivel et al. in prep.). Still, some of the near-threatened endemic species such as Creamy-bellied Gnatcatcher, Bay-ringed Tyrannulet, and Southern Bristle-Tyrant are still present in managed forest. During the last studies (2011–2017), we did not obtain records of 11 Atlantic Forest endemics, some of them threatened and near-threatened, such as Vinaceous-breasted Parrot, White-browed Foliage-gleaner, Canebrake Groundcreeper, and Bare-throated Bellbird. One of the main reasons for the absence of these species may be the fragmentation of the Atlantic Forest, as Ypetí is almost isolated from other areas that hold important populations of Vinaceous-breasted Parrot and Bare-throated Bellbird; in the case of Canebrake Groundcreeper, Ypetí is one of 2 areas where the species is known in the country, and there have been no reports since 1995 (Lowen et al. 1997); the apparent absence of the species may be due to a mix of its special habitat requirements and its very rare occurrence in Paraguay. White-browed Foliage-gleaner has been also historically rare in the Paraná basin (Lowen et al. 1997), which could be the reason

for its apparent absence during the last studies at Ypetí. However, we recognize the need to develop more rigorous studies to reliably determine if these species have been extirpated from the area.

Given the presence of key bird species (47 Atlantic Forest endemics, 1 vulnerable, and 7 near-threatened have been reported during fieldwork of this study), Ypetí is a key “stepping stone” in the biological corridor of the Atlantic Forest. This unites the southern conservation areas of Caazapa National Park, San Rafael Reserved Area for National Park, and Tapyta Private Nature Reserve, with the most important block of conservation areas in the north, Reserva Natural del Bosque Mbaracayú and Reserva Natural Privada Morombi. The area also plays an important role as a source of biodiversity for future initiatives for the recreation of the connectivity, now lost due to the advance of agriculture.

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