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Capa: Indivíduo de beija-flor-de-gravata-verde *Augastes scutatus* (Trochilidae), espécie de ave mais abundante nos campos rupestres da região da Serra do Cipó, MG (Foto: Lílian Mariana Costa). Nesta edição, Costa & Rodrigues apresentam o primeiro estudo de longo prazo sobre a estrutura e dinâmica das comunidades de aves dos campos rupestres da porção meridional da Serra do Espinhaço.
Cover: An individual Hyacinth Visorbearer *Augastes scutatus* (Trochilidae), the most abundant bird species on rocky grasslands of the "Serra do Cipó" region, state of Minas Gerais, Brazil (Photo: Lílian Mariana Costa). In this issue, Costa & Rodrigues present the first long-term study on the structure and dynamics of bird communities from the high elevation rocky grasslands of the southern portion of the "Espinhaço" Range, in southeastern Brazil.

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ARTICLE

Range extensions and breeding biology observations of the Sooty Swift (*Cypseloides fumigatus*) in the states of Bahia, Goiás, Minas Gerais and Tocantins

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ABSTRACT: Here we present the first records of the Sooty Swift (*Cypseloides fumigatus*) for three Brazilian states (Bahia, Goiás, and Tocantins), expanding the species' range into northeastern and central Brazil and the northern part of the Cerrado biome, in addition to three new records for the state of Minas Gerais. We also present data on the breeding biology of *C. fumigatus* in a Cerrado landscape in the municipality of Ponte Alta do Tocantins, state of Tocantins, where 13 active nests were located.

KEY-WORDS: Apodidae, Brazil, Cerrado, distribution, nesting.

INTRODUCTION

Field identification of any of the 10 swifts in the genus *Cypseloides,* distributed from Canada to Argentina, is one of the most challenging tasks for field ornithologists, and knowledge of even basic facets of the life history of many species is scanty (Chantler & Driessens 2000). The current Brazilian checklist (CBRO 2011) includes four species of *Cypseloides*: *C. cryptus*, *C. lemosi*, *C. fumigatus* and *C. senex*, with a fifth - *C. niger* recently having been proven to occur in Brazil (Beason *et al*. 2012) but not yet officially accepted. The Sooty Swift (*Cypseloides fumigatus*) has a wide distribution throughout South America occurring from eastern Bolivia to Paraguay, Argentina and southern Brazil (Figure 1, Sick 1997, Chantler & Driessens 2000). In Brazil it has been recorded from southern Rio Grande do Sul to Espírito Santo, Minas Gerais and in the northeast of Ceará (Chantler & Driessens 2000, Vasconcelos *et al*. 2006, Stopiglia & Raposo 2007, Albano & Girão 2008).

Previously it was thought that Brazilian populations of *C. fumigatus* were confined to the Atlantic Forest until the publication of Vasconcelos *et al*. (2006) who reported the species from the Cerrado biome, in the municipalities of Conceição do Mato Dentro and Unaí, both in the state of Minas Gerais, for the first time. Subsequently, Albano & Girão (2008) recorded the species from the Serra do Baturité, in northeast Ceará, from a lower mountain semideciduous forest, where the vegetation is more

FIGURE 1: Map adapted from Chantler & Driessens (2000) showing the known distribution of *C. fumigatus* in South America in light gray. Circles indicate previously documented records (Pichorim *et al*. 2001, Buzzetti 2002, Vasconcelos *et al*. 2006, Stopiglia & Raposo 2007, Albano & Girão 2008) and triangles indicate our new records in the states of Bahia, Goiás, Minas Gerais and Tocantins.

similar physionomically to the Atlantic rainforest than to the surrounding Caatinga (Tabarelli & Santos 2004).

In this study we report seven new sites for the species in the Cerrado biome, including the first records for the states of Bahia, Goiás and Tocantins (the northern Cerrado biome), in addition to presenting information on the species' breeding biology in Tocantins.

METHODS

Our initial records of *C. fumigatus* were made opportunistically in the municipalities of Lençóis, state of Bahia (BA); Brumadinho, Nova Ponte and Uberlândia, state of Minas Gerais (MG); Rio Verde and Alto Paraíso de Goiás, state of Goiás (GO); and Ponte Alta do Tocantins, state of Tocantins (TO), followed by a more detailed study at the latter site. We collected data on the species' reproductive biology at the Sussuapara Canyon, municipality of Ponte Alta do Tocantins, TO (10°44'S; 47°29'W). This latter site is located next to the TO-255 highway and is approximately 60 m long, 15 m high and 2 m wide (NATURATINS 2003). A partially dammed stream bisects the road and forms a small waterfall in the canyon, which is surrounded by riparian forests with an abundance of bryophytes on the rock walls.

Three visits were made to Sussuapara Canyon, in February 2009, February 2010 and November 2010. The site was first visited on 9 February 2009 when voucher field-photographs were obtained. From 18 – 21 February 2010 we undertook six hours of observations per day, totalling 24 hours. Watches began at dawn (around 06h00) and continued throughout the day until there was insufficient light to continue (around 18h00). We used a ladder to access the nests and measurements were taken with tape measures. We made sound-recordings of this colony using a Sony ICD – P620 recorder and took digital photographs with a Canon Rebel XSi camera and Sigma 150-500 mm lens. On 13 and 14 November 2010 nests were observed for two hours per day with the same protocols. We archived our digital field photographs and sound-recordings on the Brazilian ornithological database Wikiaves http://www.wikiaves.com.br, these digital vouchers are searchable by the catalogue numbers listed in the text.

RESULTS AND DISCUSSION

New distributional data

Minas Gerais

On 6 January 2012, W. N. and C. de Lima recorded at least seven individuals foraging over an area of *campo limpo* near the Parque Estadual do Rola Moça, in the district of Casa Branca, municipality of Brumadinho (20°05'S; 44°01'W). The birds were first located by their calls, which were recorded (Alves 2012). The landscape at this site includes rocky outcrops and is very close to a waterfall locally known as "Cachoeira da Ostra", which may prove be a breeding site for this species.

Goiás

On 9 January 2010 a mixed group of three *C. fumigatus* individuals and *S. zonaris* was observed by D. P. and R. B., hawking over "cerradão" in the municipality of Rio Verde (18°22'S; 50°93'W). They were identified by their calls and voucher photographs were obtained and archived (e.g. Bessa 2010).

On 22 January 2012 A. C. L. and N. Moura photographed (e.g. Figure 2; Lees 2012a, b) a group of circa 25 *Cypseloides* swifts hawking high over humid Cerrado 10 km west of Alto Paraíso de Goiás (14°09'S; 47°35'W) and encountered a second group of 10 individuals 3 km west of the city the following day over open Cerrado (14°09'S; 47°32'W). Although no sound recordings were obtained these birds were assigned to *C. fumigatus* based on structure and their uniform black colouration, with no sign of the contrasting pale head typical of *C. senex*.

Tocantins

On 9 February 2009, R. N. B. discovered a colony of unknown *Cypseloides* swifts nesting at the Sussuapara Canyon, in the municipality of Ponte Alta do Tocantins, (10º44'S; 47º29'W), identification was later confirmed as *C. fumigatus* by W. N. on 22 January 2010 helped by M. Vasconcelos and based on the species characteristic observed in pictures, such as its sooty brown coloration, and lack of a pale contrasting forehead. Given a high degree of philopatry in *Cypseloides* swifts (Fichberg *et al.* 1996a, b, Pichorim *et al.* 2001, Vasconcelos *et al.* 2006,

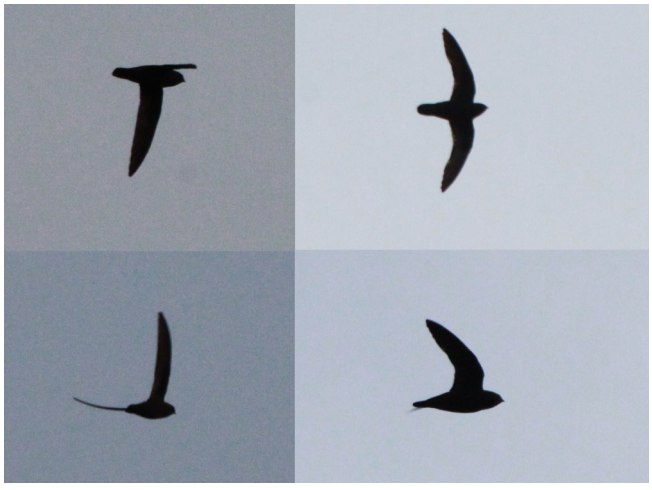

FIGURE 2: Composite image of *C. fumigatus* individuals observed in Alto Paraíso de Goiás, state of Goiás (photo: A. C. L.).

Stopiglia & Raposo 2007, Whittaker & Whittaker 2008), a second visit was made, on 18 to 21 February 2010, to gather information on the population's biology. During this visit photographs and voucher sound recordings were obtained (e.g. Biancalana 2010a, b, c, d, f).

Additional undocumented Records

Bahia

On 12 October 2011 C. A. observed and heard the calls of a group of six *C. fumigatus* individuals and many *Streptoprocne biscutata* hawking over an area of humid forest in the Chapada Diamantina region, municipality of Lençóis (12°33'S; 41°21'W). Subsequently on 14 November 2011 C. A. observed and heard the calls of a small group of six *C. fumigatus* individuals foraging with *S. biscutata*.

Minas Gerais

On 6 October 2001, D. P., G. Malacco and A. G. Franchin observed a group of *C. fumigatus* and *Streptoprocne zonaris* foraging above the Cerrado reserve and *veredas* (*Mauritia flexuosa* palm swamps) of the Clube Caça e Pesca in the municipality of Uberlândia, MG (19°00'S; 48°31'W).

On 6 September 2009, D. P., G. Malacco, C. S. Fontana and M. Repenning observed a group of *C. fumigatus* and *Streptoprocne zonaris* adjacent next to the MG-190 road in the municipality of Nova Ponte, MG (19°22'S; 47°74'W). These sites include a mosaic of land-uses including extensive agriculture and cattle pasture interspersed with typical Cerrado vegetation including cerrado *sensu stricto*, *veredas*, campos de murundus (earthmound fields) and gallery forests.

The identifications in both cases were helped by the fact that *C. fumigatus* was flying for a considerable amount of time next to *Streptoprocne zonaris*, allowing comparison of size, shapes (tail, wings, proportions) and color. All observers had extensive previous experience with *C. senex*.

C. fumigatus breeding biology in Tocantins

From 18 to 21 February 2010 the colony was found to be very active and thirteen nests were discovered in rock crevices. Measurements taken from three of them are listed in Table 1. These three nests were the only accessible ones, ranging from 1,49 m to 2,18 m above the ground. The remaining nests were 3 to 5 meters up and could not be checked safely, even with the aid of a ladder. All 13 nests were cup-shaped and composed of soil, roots and pebbles. The nests were sheltered from direct water spray but all were damp. All checked nests were occupied, one had an egg and two had chicks (Figure 3). The placement of the nests beyond the reach of direct waterfall spray and containing just a single egg or chick agrees with previously published reports for *Cypseloides fumigatus* (e.g. Pichorim *et al*. 2001, Vasconcelos *et al*. 2006). Nest metrics and architecture were also very similar to previous studies, including those of other *Cypseloides* species (e.g. Pichorim *et al*. 2001, Vasconcelos *et al*. 2006, Whittaker & Whittaker 2008).

Scratch marks observed on the rocks adjacent to the nests indicated frequent use. Adults observed at rest exhibited the typical plumage characteristics of *C.*

TABLE 1: Nest metrics for three *C. fumigatus* nests in Ponte Alta do Tocantins, state of Tocantins and previously published metrics.

P = Pichorim *et al*. (2001), V = Vasconcelos *et al*. (2006), B = Biancalana *et al*. (this paper, 2012), H = height from the ground to the nest, BW = nest width measured at the base, TW = nest width measured at the top, NH = nest hight measured on the exterior from bottom to top, ND = internal nest depth.

Nest Metrics	P (chick)	V (nest)	V (nest)	B 1 (adult and chick)	B 2 (adult and egg)	B 3 (chick)
H (m)	-	-	-	1,49	2,18	2
BW (cm)	-	-	-	11	10,6	9,1
TW (cm)	-	-	-	10,2	9,5	7,8
NH (cm)	3	3,54	8,1	7,3	4	5,3
ND (cm)	1,3	2,34	1,53	1,8	1,4	1,5

fumigatus notably the overall dark brown coloration with the mantle slightly darker than the head and the rump (Figures 4 and 5, Chantler & Driessens 2000, Stopiglia & Raposo 2007).

The chicks were covered in dark gray down with white edges to the feathers on the wing coverts and many feathers in pin on the chin, throat and forecrown, giving a white blaze effect (Figure 6). One of the focal chicks was left alone throughout the observation period and remained facing the inner part of the nest with its eyes closed, possibly in a state of torpor. One chick was accompanied by an adult and rested with its head under the adult's belly (Figure 5). The birds would orientate themselves to defecate over the rim of the nest, probably to avoid accumulation of faeces within the nest.

On 13 November 2010 at 16h50, 20 individuals were observed foraging in the air for 30 minutes and five adults were observed sitting on nests, presumably incubating. On 14 November at 09h00 a group of 8 *C. fumigatus* were observed foraging with *Tachornis squamata* for one hour and at 17h40 *C. fumigatus* were observed foraging with *S. zonaris* until sunset. During this visit voucher sound recordings also were obtained (e.g. Biancalana 2010e).

DISCUSSION

Our observations confirm the speculation of Vasconcelos *et al.* (2006) that *C. fumigatus* would later be found at other sites within the Cerrado biome. These new records in combination with older ones from the Serra da Canastra region (Silveira 1998, Buzzetti 2002) considerably expand the global range of *C. fumigatus* and indicate that recently discovered 'disjunct' populations in the Cerrado (e.g. Vasconcelos *et al.* 2006) may not in fact be isolated from Atlantic Forest populations and that the species may be sparsely distributed throughout the Cerrado biome. Even the supposedly disjunct populations

FIGURE 3: *Cypseloides fumigatus* nest with a single egg at Sussuapara Canyon (photo R. Biancalana).

FIGURE 4: Adult *Cypseloides fumigatus* in its nest, the same of the previous figure. The scratches on the rock and the accumulated feces suggest the frequent use of the site (photo R. Biancalana).

FIGURE 5: Adult *Cypseloides fumigatus* and offspring in the nest (photo R. Biancalana).

FIGURE 6: *Cypseloides fumigatus* offspring, note the feathers in pin (photo R. Biancalana).

in Bolivia (Chantler & Driessens 2000), may not in fact be that isolated given the record from Rio Verde, which suggest that there might be other reproductive sites somewhere in Mato Grosso and Mato Grosso do Sul. The new record for Bahia expands the species distribution in northeastern Brazil (Parrini *et al*. 1999).

The records from Ponte Alta do Tocantins, extend the species area of occurrence 615 km into the northern part of the Cerrado biome, although they do not represent the northernmost global reports since Albano & Girão (2008) observed *C. fumigatus* in the municipality of Pacoti, state of Ceará over 1,000 km NE of the Sussuapara canyon. Although Stopiglia & Raposo (2007) conducted some specific surveys in suitable sites in Mato Grosso do Sul, they did so in a season (July) that is outside of the known breeding season of this species in the Cerrado and Atlantic Forest. It is thought that *C. fumigatus* leaves the breeding colonies after the breeding season ends (around March) (Fichberg *et al*. 1996a, b, Pichorim *et al*. 2001, Vasconcelos *et al*. 2006, this paper), so we recommend that surveys of potential reproductive sites are conducted during this period. The non-breeding distribution of these northern populations is unknown but this species is occasionally reported from Amazônia, with published sight records by B. M. Whitney from the Serra dos Carajás 570 km NW of Ponte Alta do Tocantins (Pacheco *et al*. 2007).

Reproductive Data

The reproductive period in Tocantins appears to be similar from that previously described in the south and southeast of Brazil. The current literature suggests that the reproductive period extends from September to March (Fichberg *et al*. 1996a, b, Vasconcelos *et al*. 2006). Herein we reported observations of nests with eggs and young chicks in February, indicating that reproductive activity in Tocantins must extend at least until March. These similarities may be driven by favourable climatic conditions related to the onset and extent of the rainy season. Any sightings of out-of-range *Cypseloides* swifts in Brazil should be as fully documented as possible, preferably by both photographs and sound-recordings. The collection of voucher specimens from disjunct swift populations should be also encouraged to allow for a phylogeographic study whereby the level of natal philopatry and genetic variation within the species is evaluated. Field ornithologists should be alert to the possible occurrence of *C. fumigatus* anywhere in Brazil south of the Amazon and colonies of the species should be sought after anywhere with waterfalls. Any new colonies should be monitored carefully to quantify temporal variation in the species' breeding season throughout the species' range.

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ARTICLE

Paragominas: a quantitative baseline inventory of an eastern Amazonian avifauna

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ABSTRACT: We present the results of a five-month survey of the birds of Paragominas, Pará, a municipality in eastern Brazilian Amazonia that lies within the Belém center of endemism. We recorded 440 species, sampling habitats across a gradient of disturbance, ranging from 'undisturbed' primary forest, through logged and burnt forest, patches of varyingly aged secondary forest, cattle pastures and intensive mechanized agriculture. Given the potential for species miss-identifications in avian inventories, we paid special attention to obtaining voucher documentation (photographs and sound recordings) and here provide a unique collection of publically-accessible digital vouchers for 418 species recorded (95% of the total). Many of the species reported here are poorly-known or represent notable range-extensions, and we present data on their status and distribution, both within the municipality and elsewhere in the Belém center of endemism. Notable amongst these include the first records for Pará and Amazonia of Spotted Piculet (*Picumnus pygmaeus*), trans-Tocantins range-extensions for Large-headed Flatbill (*Ramphotrigon megacephalum*) and Yellow-shouldered Grosbeak (*Parkerthraustes humeralis*) and multiple observations of the threatened *paraensis* subspecies of Cinnamon-throated Woodcreeper (*Dendrexetastes rufigula*).

KEY-WORDS: Amazon; bird survey; conservation; digital voucher; range-extension.

INTRODUCTION

Accurate and comprehensive biodiversity inventories represent a fundamental baseline for understanding natural patterns of environmental heterogeneity and species responses to anthropogenic change. Such information is critically important for making evidence-based conservation-planning and management decisions (e.g. van Jaarsveld *et al.* 1998, Green *et al.* 2005, Wilson *et al.* 2009). Birds are among the best-studied of the Neotropical biota, yet even for this taxonomic group the compilation of comprehensive inventories remains a labor-intensive and error-prone task, particularly in very diverse regions of tropical forest such as the Amazon basin (Remsen 1994, Cohn-Haft *et al.* 2007). Here, we provide a uniquely comprehensive baseline assessment for birds in the Eastern Amazon, using archived digital vouchers to guarantee data integrity and maximize the value of these data for future research and application to conservation problems.

The subject of our study is the municipality of Paragominas, state of Pará, Brazil, a large 19,309 km^2 region on the eastern border of Amazonia. Paragominas lies within the 145,000 km^2 Belém center of endemism (hereafter Belém CE) which is delimited by the east bank of the Tocantins river and the eastern biogeographic limit of Amazonia *terra firme* forests in western Maranhão state (Haffer 1969). Just 1.4% of the Belém CE is covered by strictly protected areas (Categories I and II of the World Conservation Union - IUCN & WCPA 2005) while 9.8% is encompassed by sustainable use areas (Categories III to VI) and 6.5% by indigenous lands (Silva *et al.* 2005). Total forest loss in the Belém CE has reached at least 75% of the original extent and further extensive forest loss is forecast if effective forest conservation policies are not enforced (Silva *et al.* 2005, Soares-Filho *et al.* 2006).

There are no strictly protected area networks within the municipality, although some protection is afforded by the Alto Rio Guamá Indigenous Reserve that represents 14% of the eastern part of Paragominas (Monteiro *et al.* 2009), and a large FSC certified forest management area (Fazenda Rio Capim) in the west. The importance of the municipality for avian biodiversity is reflected in its inclusion within two Important Bird Areas (IBAs);

in the west the 'Rio Capim', a 21,416 km^2 region partly covering seven other municipalities and the 13,930 km^2 'Gurupi' which straddles the Pará/Maranhão border and includes part of nine other municipalities as well as the largest fragment of continuous forest left in the entire Belém CE (De Luca *et al.* 2009). These IBAs were recognized on the basis of the occurrence of populations of the following threatened or near-threatened IBA 'trigger species': White-crested Guan (*Penelope pileata*), Buff-browed Chachalaca (*Ortalis superciliaris*), Crested Eagle (*Morphnus guianensis*), Harpy Eagle (*Harpia harpyja*), Golden Parakeet (*Guaruba guarouba*), and Pearly Parakeet (*Pyrrhura lepida*). Other listed 'interest features' include a number of threatened subspecies, many of which are suboscine passerines likely to be subject to future taxonomic upgrades (A. A. *unpubl. data*).

Ornithological exploration of the region began in June 1849 when A. R. Wallace travelled up the Capim river (Sclater & Salvin 1867) and collected 28 species, followed by E. A. Goeldi who later recorded 137 species on a collecting trip in the same general region in June – July 1897 (Goeldi 1903). J. Hidasi sampled the municipality in 1962 and in 1968, accompanied by M. Moreira on the latter expedition (specimens housed at Museu de Zoologia da Universidade de São Paulo - MZUSP and Museu Paraense Emílio Goeldi - MPEG). Fazenda Vitória (02°57'21"S; 47°22'59"W) became an important site for the study of forest regeneration in fragmented landscapes (e.g., da Silva *et al.* 1996) and birds were collected here between 1985 and 1995 by M. S. Brígida, R. S. Pereira, J. M. Rosa, J. M. C. da Silva and D. C. P. Neto. Portes *et al.* (2011) detailed the latest round of ornithological surveys conducted in Paragominas, principally at Fazenda Rio Capim (3°40'10"S; 48°33'34"W) by C. E. B. Portes and M. S. Silva between 10-30 July 2005, by A. A. and F. Poletto between June 22-23 2007 and by A. Whittaker and K. J. Zimmer between 28 August – 3 September 2007. In addition, Portes *et al.* (2011) also presented an annotated list for a total of 439 species recorded in five other proximate municipalities for the Belém CE (Capitão Poço, Dom Eliseu, Santa Bárbara do Pará, Tailândia e Tomé-Açu) based on fieldwork between 1998 and 2009.

Our work in Paragominas was carried out under the auspices of the 'Rede Amazônia Sustentável' (RAS), a collaborative research initiative focused on the study of land-use sustainability in eastern Amazonia, involving more than 30 institutional partners from Brazil, the UK, the US and Australia. Coordinating institutions are the Museu Paraense Emílio Goeldi and Embrapa Amazônia Oriental (Belém), the Universities of Cambridge and Lancaster in the United Kingdom. The overall aim of RAS is to contribute towards an improved understanding of the long-term environmental and socio-economic consequences of current land-use and land-use change processes in the eastern Brazilian Amazon. This is one of the first research initiatives of its kind to assess responses of biodiversity to forest loss and habitat change at the landscape scale, with data being collected across 36 catchments arrayed along a gradient of deforestation and forest degradation. The project draws data from two study regions in the municipalities of Santarém-Belterra and Paragominas in Pará state (Brazilian Amazon), of which the latter is the subject of this paper.

The accuracy of biodiversity surveys in assessing responses to land-use change is dependent on accurate identification and taxonomy. Furthermore, tropical forest countries lack the standardized bird surveys that form the baseline for measuring change in some temperate countries (e.g. Gibbons *et al.* 1992, Price *et al.* 2005), and our large-scale quantitative survey provides an invaluable starting point for future work in the Eastern Amazon. In this paper we present an annotated species list (with links to a near complete set of digital vouchers) from the avian component of the Rede Amazônia Sustentável study in the municipality of Paragominas, together with a quantitative assessment of relative abundances of the regional avifauna.

MATERIAL AND METHODS

Experimental design

The municipality of Paragominas was divided up into micro catchments of 5000–6000 ha, which were delineated using a digital elevation model and SWAT (Soil and Water Assessment Tool) for ARCGIS 9.3 (ESRI, Redlands, CA, USA). We then selected a subset of 18 catchments to represent a gradient of accumulated forest loss from 89% (11% remaining forest cover) to 0% (100% remaining forest cover; Figure 1). Total deforestation extent is correlated with many other factors including age of occupation, types of historical land-use change, road access as well as biophysical variables (such as topography). Once a set of candidate catchments were identified to capture the full deforestation gradient, a final selection of 18 catchments was made to ensure satisfactory representation of current land-use practices, the spatial distribution of the rural population, and major soil types (e.g. Figure 2, Table 1). All landowners in each catchment were visited prior to any fieldwork to introduce the project and secure permissions for surveys in private properties.

Within each catchment, we used a stratified-random sampling design that helped to ensure that sample data provide a representative assessment of the overall environmental conditions. In each catchment 300 m transects were distributed across the landscape based on a standard density of one transect per 400 m and in

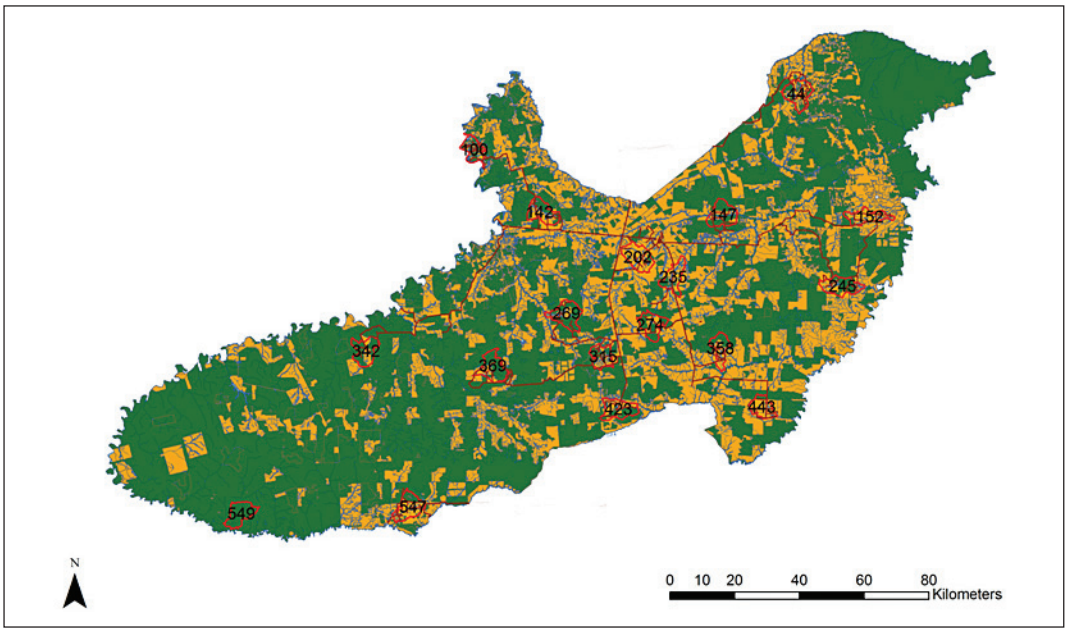

FIGURE 1. A map of the municipality of Paragominas illustrating major land-use types and the locations (and numbers) of the 18 study catchments.

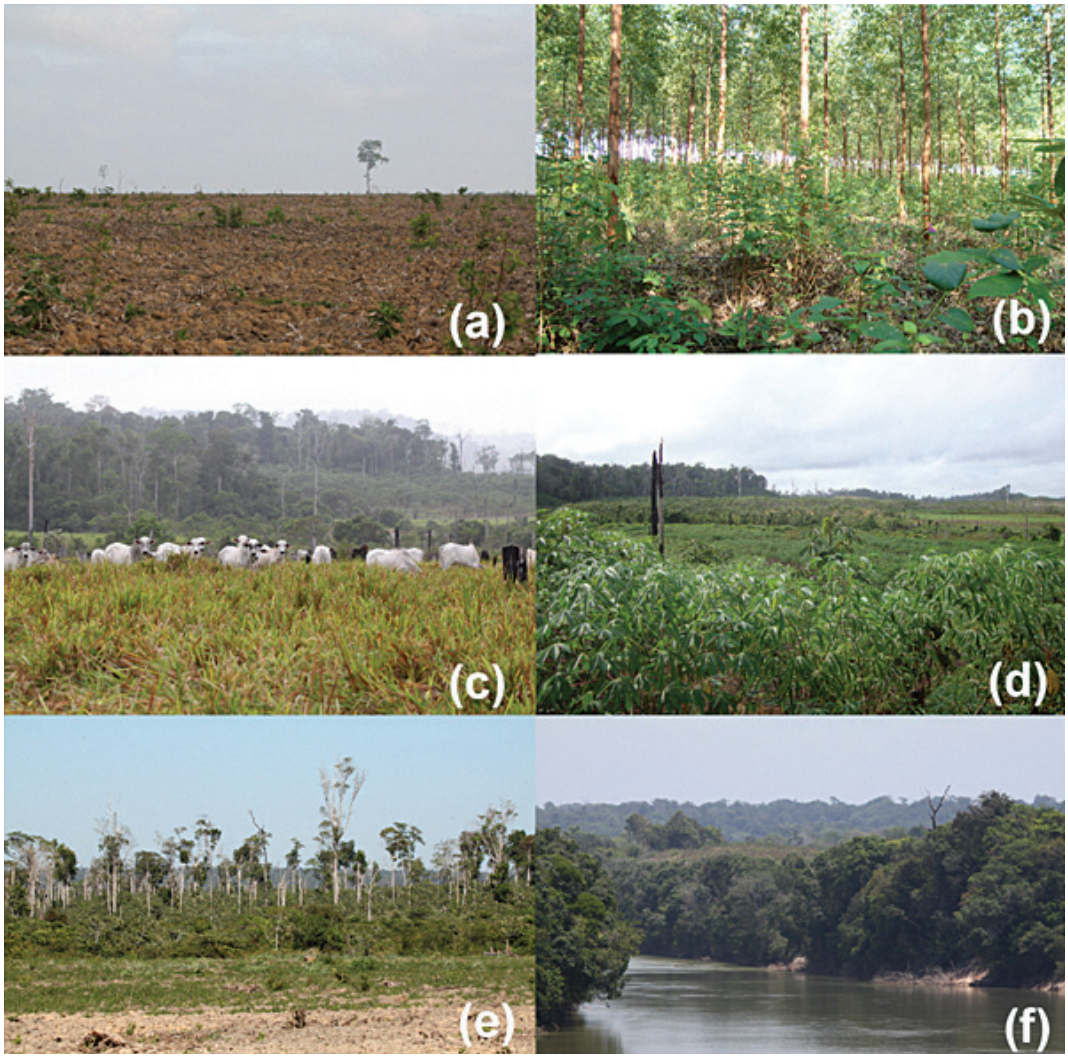

FIGURE 2. General aspects of vegetation types around Paragominas: (a) Catchment 423 - graded field after soy bean harvest; (b) Catchment 202 - Eucalyptus plantation; (c) Catchment 44 - foreground - cattle pasture, background primary and secondary forest; (d) Catchment 44 - smallholder's manioc plantation; (e) Catchment 423 - foreground graded field, background logged and burnt primary forest (f) Catchment 99 - primary forest alongside the Rio Capim. (A. C. L.).

TABLE 1. Co-ordinates (WGS 84 Lat/Lon hddd°mm'ss.s"), total area and percentage forest cover (using IMAZON 2010/RapidEye) of the 18 catchments sampled during the study.

Catchment	Lat	Long	Total area (ha)	% forest cover
44	W46 58 01.2	S2 35 42.9	5899	40
100	W47 52 05.6	S2 44 31.2	3985	43
142	W47 40 27.5	S2 54 44.3	5220	46
147	W47 10 37.8	S2 55 07.4	5596	65
152	W46 46 09.0	S2 55 47.9	4430	62
202	W47 24 41.5	S3 02 34.4	5836	12
235	W47 19 00.4	S3 05 51.6	4595	32
245	W46 50 44.5	S3 07 31.5	5546	54
269	W47 37 07.6	S3 12 26.4	6088	74
274	W47 22 17.1	S3 14 05.7	4777	64
315	W47 30 50.7	S3 19 17.7	4022	42
342	W48 10 08.7	S3 18 20.4	4963	72
358	W47 11 06.7	S3 18 30.4	3844	47
369	W47 49 07.6	S3 20 41.4	5608	73
423	W47 27 46.8	S3 28 04.8	5393	13
443	W47 03 53.8	S3 27 41.9	3967	18
547	W48 03 01.5	S3 44 10.1	5494	33
549	W48 30 57.6	S3 45 44.6	4867	100

proportion to the percentage cover of forest (including primary and secondary forests) and production areas (agriculture-pasture-silviculture) – such that if half of the catchment is covered by forest then this land use receives only half of the study transects. Within each of these major land-use categories sample transects were distributed randomly to increase the likelihood that they would capture important internal heterogeneities in forest and/or production systems. A minimum separation distance rule of 1500 m was employed to minimize dependence between points. Where forest cover fell below 1200 ha, we maintained a minimum of three sample transects in forests (ensuring we captured a reasonable sample of the state of the forests in that catchment). We were unable to sample the indigenous reserve which means that our overall results of species richness in the landscape should be viewed conservatively, as some disturbance-sensitive species unrecorded elsewhere in the region may persist within the reserve.

Study Landscape: climate and biophysical conditions

The average annual temperature of Paragominas is 26 degrees Celsius, with an average humidity of 81%. Average rainfall is 1.8 m, with a marked wet season between December and May, and peak dry season between July and October (Embrapa 1986). The majority of soils in the municipality are distrophic yellow latisols (Brazilian classification system), deep, acidic and rich in aluminium (Rodrigues *et al.* 2003). The municipality is divided almost evenly between two principal watersheds of the Capim and Gurupi rivers. The Capim basin is divided into six sub-basins, pertaining to the Surubiju, Camapi, Cauaxi, Jacamin, Paraquequera and Candiru-acu rivers. Similarly, the Gurupi river contains five tributaries in Paragominas, namely the Uraim, Maritaca, Piriá, Croatá and Poraci-Paraná. The terrain is hilly, with approximately 20% of the municipality between 150–200 m a.s.l., 35% between 100-150 m a.s.l., and 35% between 50 and 100 m a.s.l (Pinto *et al.* 2009).

Originally the municipality was entirely covered by lowland tropical forest. By 2008 approximately 45% had been deforested or severely degraded (Pinto *et al.* 2009, based on PRODES data from INPE). The remaining c. 55% of the municipality is still forested, and encompasses a range of different levels of degradation from historical and ongoing logging and wildfire. The majority of remaining forests (34% of the municipality) are dense lowland rainforest, with approximately 18% cover of dense submontane rainforest, and a small amount of flooded forest along river margins (approximately 3% of the territory) (IMAZON 2009). Primary forests are dominated by trees in the families Lecythidaceae, Sapotaceae, Fabaceae, Chrysobalanaceae, Arecaceae, and Violaceae, while secondary forests are dominated by species in the families Fabaceae, Annonaceae, Urticaceae, Salicaceae, Euphorbiaceae and Hypericaceae. Regenerating pastures tend to be dominated by the families Solanaceae, Urticaceae, and Hypericaceae with

the most abundant species being *Solanum crinitum*, *Vismia guianense*, and *Cecropia palmata*; all of which are absent from primary forests in the same region (E. Berenguer *unpubl. data*).

Avian Sampling. Fieldwork by A. C. L. and N. G. M. was conducted from 28 July to 20 November 2010 (A. S. accompanied the team from 3 August to 3 October 2010) and then again from 18 to 29 May 2011. We conducted two repetitions of three fixed width (75 m) 15-min. point counts per transect. All point counts (PCs) were conducted by principle observers A. C. L. and N. G. M. with the exception of three transects carried out independently by A. S. in Catchments 315 and 358 (see Figure 1 for numbering of study catchments). Surveys were not carried out on days with persistent rain and/or strong winds. If a species' identification was ever in doubt playbacks were used to lure the vocalizing bird for visual confirmation. Playbacks were not used systematically to increase the detectablity of any given species during the point count surveys. Any systematic effect of seasonality (presence/absence of austral/boreal migrants and peaks and troughs in vocalization activity) was minimized by systematically rotating surveys between catchments of varying total forest cover and between habitat types. We present landscape-wide relative abundance estimates (detection frequency) for all species recorded during the timed point-counts. For species that were not frequently recorded during the point count surveys (typically waterbirds, raptors, aerial insectivores and nocturnal species, and the naturally rare), we provide a rough estimate of their relative abundance by listing the number of days (out of 100 days in the field) during which these species were recorded. Some species from these groups were also recorded during the point count surveys, and for these species we also provide a second relative abundance metric as the point count surveys alone may convey a false sense of rarity.

The Amazonian avifauna is incredibly species rich, and like other taxa there are significant gaps in our knowledge regarding species distributions and the taxonomy of cryptically-similar taxa (Barlow *et al.* 2011). Given these constraints, we believe that species lists should be accompanied with as much supporting documentary evidence as possible (e.g. Cohn-haft *et al.* 1997). Such evidentiary standards are necessary to prevent false recordings of species presences becoming established in the literature (cf. McKelvey *et al.* 2008). To address this, we have archived digital vouchers (photos and sound-recordings) on the internet to provide documentary evidence for 95% of the species recorded (Appendix 1). Such vouchers are not intended to supplant traditional specimen vouchers (cf. Monk & Baker 2001), although even these can be wrongly identified; but instead are aimed at providing the opportunity for general peer-review, which is not possible if documentary vouchers such as archived museum skins, photographs or sound recordings are not also made electronically available. Our images have been archived on the Brazilian avian photo database Wikiaves (www.wikiaves.com.br) and our sound-recordings are archived on the global avian sound library Xeno-canto (www.xeno-canto.org). Recordings on both sites are searchable by the catalogue number provided in Appendix 1, in addition we also provide catalogue numbers for 'background species' on Xeno-canto recordings (researchers working on the taxonomy of Amazonian birds are welcome to solicit the original .wav files from us). Where we are unable to provide a voucher (5% of species) we list the observer(s) by name according to whether the bird(s) were seen, heard or both. We did not retain any undocumented species within the list that are not represented by voucher museum skins either from Paragominas or the adjacent municipalities (Novaes & Lima 2009, Portes *et al.* 2011 and the Museu Paraense Emílio Goeldi – hereafter MPEG -collection). We provide accession numbers for voucher specimens of species previously collected in the region in Appendix 1. In Appendix 2, we list species reported by Portes *et al.* (2011) from Paragominas which were not recorded during our survey.

We present an observed species-area accumulation curve (sample-based rarefaction curve), with 95% confidence intervals to indicate the degree of completeness of the total avifaunal community (based on the transect surveys). To estimate actual species richness of the entire sampled community we used nonparametric methods provided by the EstimateS program (Colwell 2009), using the incidence-based coverage estimators jacknife-2 and Chao-2 based on species presence/absence. We also present a figure showing relative abundance estimates of all 383 species detected during the transect-based surveys to give an impression of landscape-wide relative abundance of the entire community. Our taxonomy follows the checklist of Brazilian birds compiled by the Comitê Brasileiro de Registros Ornitológicos (CBRO 2011).

RESULTS

During our 100 days of fieldwork we recorded 440 species in 64 families (Appendix 1), of these we provide digital vouchers for 418 species (95%, 335 species represented by images and 292 by sound-recordings). Of this total, 120 species already have voucher specimens deposited at MPEG. We added 211 species not previously recorded from Paragominas and 61 species not registered region-wide by Portes *et al.* (2011). We missed 20 species previously recorded in Paragominas and 56 species previously recorded region-wide by Portes *et al.*

(2011). Three species we report here are reported for the first time from the Belém CE, one of which, the Spotted Piculet (*Picumnus pygmaeus*), is new to both the state of Pará and the Amazonian biome. Landscape-wide, the avifaunal assemblage is dominated by species tolerant of degraded and regenerating forest habitats and agricultural areas which typify this variegated landscape. Our species accumulation curve is near asymptotic (Figure 3) and the total species estimates (12 species of waterbirds excluded) produced by the chao-2 and jacknife-2 estimator were 429 and 427 respectively, indicating a total sampling efficiency of around 89%. The most abundant species at the landscape scale were a few habitat generalist species (e.g. Reddish Hermit *Phaethornis ruber*, Moustached Wren *Pheugopedius genibarbis* and Silver-beaked Tanager *Ramphocelus carbo*) and open-country species (e.g. Tropical Kingbird *Tyrannus melancholicus* and Red-breasted Blackbird *Sturnella militaris*) with the rest of the community made up by a long tail of rare species predominantly associated with primary forest habitats (Figure 4, Appendix 1).

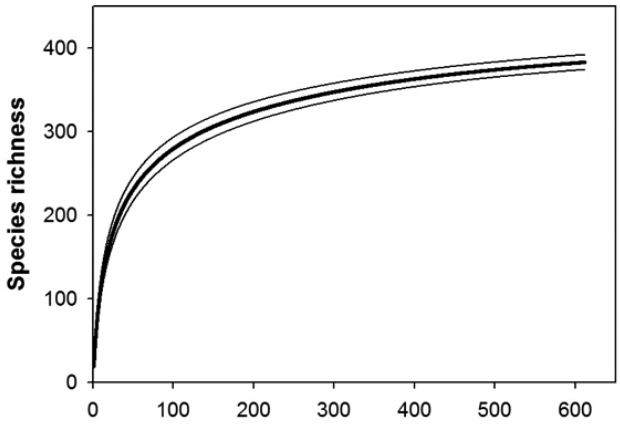

FIGURE 3. Sample-based rarefaction curve with 95% confidence intervals to indicate the degree of completeness of the transect-based surveys.

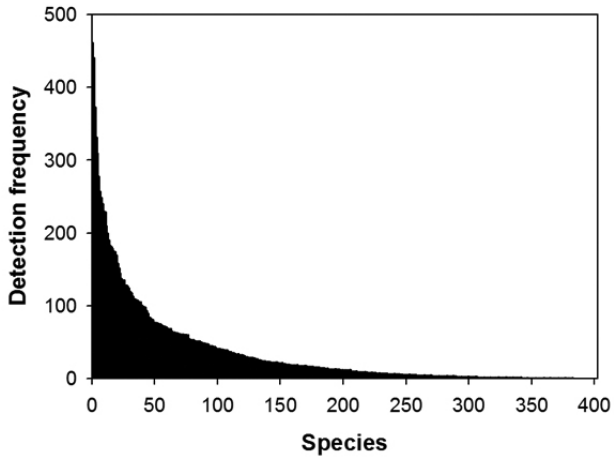

FIGURE 4. Landscape-wide relative abundance of the 383 species recorded during the transect-based surveys.

Selected species accounts for taxa of significant biogeographic or conservation interest

Zone-tailed Hawk (*Buteo albonotatus*). N. G. M. photographed (Moura 2010a) a single adult Zone-tailed Hawk flying over a cattle pasture in Catchment 369 on 6 November 2010. This species is considered to be absent from most of Amazonia, but it has been recorded along the Amazonia/Cerrado ecotones (e.g. Somenzari *et al.* 2011). Our lone record may reflect the first step towards colonization of anthropogenic habitats in the region from adjacent cerrado habitats, or a nominally vagrant individual (c.f. Veit 2000).

Orange-breasted Falcon (*Falco deiroleucus*). A. C. L. photographed (Figure 5, Lees 2010a) an adult male Orange-breasted Falcon plucking a medium-sized bird whilst perched on a relictual emergent tree in young second-growth in Catchment 423 on 4 November 2010. After finishing plucking the body it flew off east carrying the remains and was lost from view. Considering the recent discovery of an active Orange-breasted Falcon nest in a tree cavity in an agricultural landscape north of Manaus (A. Whittaker *in litt.*), the first such record in the lowland Amazon, this food carrying behaviour may also be indicative of local breeding.

FIGURE 5. Adult male Orange-breasted Falcon (*Falco deiroleucus*) Catchment 423, 4 November 2010 (A. C. L.).

Dark-winged Trumpeter (*Psophia obscura*). The only record obtained by the principal observers was a pair watched at close range and sound-recorded (Lees 2011a) by A. C. L. on 21 May 2011 in Catchment 549. However, the other biodiversity teams of RAS also reported this species on a number of occasions, with three sightings of groups of 2-5 individuals in Catchment 549 in May-June 2011 and a sighting of a pair in Catchment 342 in December 2010. All of these records came from catchments with extensive forest cover. This species was

most frequently documented in Catchment 549, where a ban on hunting is better enforced through ownership by a large certified logging company. Our trail-cutting team was shown the body of a freshly-killed trumpeter destined for human consumption near Catchment 342 on 12 November 2010. This taxon is currently listed as 'endangered' on the Brazilian national red list (Machado *et al.* 2008) and was recently afforded full species status by Oppenheimer & Silveira (2009) and Ribas *et al.* (2012), a judgment accepted by the CBRO creating a new species-level endemic for BCE. Should the South American Classification Committee (Remsen *et al.* 2012) follow this decision, then the species will qualify for red-list consideration by Birdlife International. We intend to publish separately a detailed quantitative evaluation of the conservation status of the threatened species in the region but here we suggest that this species should qualify as 'Critically Endangered' on the global red list. This on the basis of the species 'double jeopardy' traits of being restricted to the small patches of highly-fragmented primary forest in the region and its vulnerability to hunting, which appears to be prevalent in the region given the rarity of large mammals, *Tinamus* tinamous and large cracids (cf. Portes *et al.* 2011).

Paint-billed Crake (*Neocrex erythrops*). An adult was photographed at dusk accompanied by four chicks (e.g. Thompson 2011a,b) by I. Thompson on 26 June 2011 at Fazenda Juparanã (47°33'58"W; 02°53'6"S). The chicks of this species were only first described just over a decade ago (Watson & Benz 1998) and in this field photograph we can confirm their assertion that they are uniformly black with dark grey tarsi, and we additionally note that the eye is black and the beak dark grey. There is only one previous published breeding record from Brazil (although cf. Adeodato 2011) of this rarely-seen, patchily-distributed species - Kirwan (2009) observed a pair with three recently-fledged chicks on 24 October 2000 near Ubatuba in São Paulo state.

Semipalmated Plover (*Charadrius semipalmatus*). A. C. L., N. G. M. and A. S. encountered a single adult of this boreal migrant at a lake adjacent to Catchment 443 on 1 October 2010 (Figure 6, Lees 2010b). This individual was loosely associating with two Least Sandpipers (*Calidris minutilla*), another species which is also irregular as an interior migrant, and in addition to these three shorebirds, six Solitary Sandpipers (*Tringa solitaria*) and two Spotted Sandpipers (*Actitis macularius*) were also present at the same site on the same day. This species is extremely rare anywhere inland in Brazil, and known from only three previously published sight records from Amazonia: a single observed near Manaus, Amazonas on 29 September 1985 (Stotz *et al.* 1992), one seen by D. Buzzetti in January 2000 at the Parque Estadual do Cantão, Tocantins (Kirwan & Shirihai 2008) and one between between Taquaras (09º44'S; 65º13'W) and Araras, Rondônia, on 11 November 2006 (Kirwan & Shirihai 2008). Semipalmated Plovers are however regular visitors to the Guamá river in Belém (250 km NW, A. C. L. *pers. obs*. e.g. Lees 2011b) so occasional inland vagrants are not entirely unexpected.

FIGURE 6. Semipalmated Plover (*Charadrius semipalmatus*) Catchment 443, 1 October 2010 (A. C. L.).

Golden Parakeet (*Guarouba guarouba*). We recorded this emblematic species (Figure 7) on 57 occasions from 17 catchments totaling around 300 individuals; a detailed analysis intended to elucidate its habitat requirements and population size is in preparation.

FIGURE 7. Golden Parakeet (*Guarouba guarouba*) Catchment 142, 2 September 2010 (A. C. L.).

Blue-winged Parrotlet (*Forpus xanthopterygius*). We recorded several small groups of this species in Catchment 202, frequenting cattle pasture and young second-growth vegetation. Lees (2010c) depicts the diagnostic deep blue on the wing coverts and rump. These records represent the first records for the Belém region, presumably indicating a range expansion from nearby non-forest areas. We only

recorded Green-rumped Parakeet (*Forpus passerines*) from Catchment 549 so are unable to confirm micro-sympatry between these two closely related species.

Long-tailed Potoo (*Nyctibius aethereus*). Our only encounter with this poorly-known species concerns two individuals sound-recorded (Lees 2011c) counter-singing distantly by A. C. L. in Catchment 549 one hour before dawn on 20 May 2011. This species has been recorded at least twice previously from the Belém CE: one collected along the Rio Capim at 'Resacca' by Snethlage (1914), and one sound-recorded at the Reserva Florestal Agropalma, in the municipality of Tailândia (A. A. *pers. obs.*), listed erroneously as Tomé-Açu in Portes *et al.* (2011).

White-winged Potoo (*Nyctibius leucopterus*). We (A. C. L. and N. G. M.) first encountered this species (our only visual encounter) on 14 November 2010 when one started singing only 15 minutes after sunset (the moon had already risen) from tall *terra firme* forest alongside a logging camp on the northern edge of Catchment 342. This individual responded strongly to tape playback and was photographed (Figure 8, Lees 2010d) and sound-recorded (Lees 2010d). We had three subsequent encounters with this species: A. C. L. heard another individual singing from the canopy of tall *terra firme* forest in Catchment 342 pre dawn on the 16 November 2010 (5 km south of the first individual); N. G. M. sound-recorded one pre-dawn on 20 May 2011 in Catchment 549 (Moura 2011a) with a presumably different individual sound-recorded by A. C. L. on another transect 4.5 km from the first on 22 May 2011. Portes *et al.* (2011) lists three additional records from the Belém CE, from Fazenda Rio Capim (Paragominas) between 28 August and 2 September 2007 (K. Zimmer, A. Whittaker) and the adjacent municipality of Tomé Açú (9 August 1998: A. A.). This species appears to be restricted to areas of tall *terra firme* forest and is apparently absent from both secondary and degraded primary forest as has been found elsewhere (cf. Sberze *et al.* 2010)

FIGURE 8. White-winged Potoo (*Nyctibius leucopterus*) Catchment 342, 14 November 2010 (A. C. L.).

Fiery-tailed Awlbill (*Avocettula recurvirostris*). We encountered this charismatic hummingbird for the first time on 3 November 2010 when A. C. L. observed a single female/immature in young second growth in Catchment 423. Subsequently A. C. L. photographed two further females/immatures in Catchment 342 on 15 November 2010 (Lees 2010f,g) with both observed perched alongside access roads in selectively logged forest. This species was unrecorded by Portes *et al.* (2011) and from the adjacent metropolitan Belém study area by Novaes & Lima (2009). However, a male was collected on 7 March 1926 at 'Enquinhoca' on the Rio Guamá near Belém (Stone 1928) and A. C. L., N. G. M. and I. Thompson observed and photographed (Lees 2012) a female or immature plumaged bird in the canopy of degraded primary forest alongside the Rio Guamá in Marituba ($1^0$27'S; $48^0$18'W) 200 km NNE on 21 February 2012. Otherwise, the closest known localities to Paragominas are 250 km NE on the left bank of the Rio Tocantins at Cametá, ($2^0$15'S; $49^0$29'W MPEG), 260 km WSW on the left bank of the Rio Tocantins at Arumateua ($03^0$36'S; $49^0$42'W MPEG), the recently discovered Cerrado population in Tocantins state 310 km south (Pinheiro *et al.* 2008) and that located 450 km south-west on the Serra do Carajás, Pará state (Pacheco *et al.* 2007). The distribution of the Awlbill in Amazonia remains somewhat poorly known; probably both because of its cryptic similarity to Black-throated Mango (*Anthracothorax nigricollis*) and because of low population densities, in addition to as yet poorly understood habitat requirements. This species was for example missed in the first 16 years of intensive ornithological fieldwork around Alta Floresta, Mato Grosso (Lees *et al.* in prep.).

Spotted Piculet (*Picumnus pygmaeus*). We first encountered this unobtrusive woodpecker, considered to be endemic to the Caatinga (cf. Olmos *et al.* 2005) on 2 November 2010 when A. C. L. photographed (Figure 9, Lees 2010h) a family group consisting of two adults and three fledged juvenals in abandoned pasture in Catchment 443. Subsequently, we encountered this species in a further three Catchments – 358 (Lees 2010i,j), 152 and 423 always in overgrown pasture or young second-growth. Beyond Paragominas, we (A. C. L. and N. G. M.) also encountered Spotted Piculets in coastal mangrove forest 260 km N. of Paragominas at Salinópolis, Pará state, (Lees 2011d,e) on 6 and 7 May 2011. These records represent the first records of this species for the state of Pará and for the Amazonian biome at large. We assume that these records from Paragominas have resulted from a broad-front westerly range-expansion in the wake of deforestation, with this species being able

to adapt to deforested habitats with a similar structural composition to their 'native' Caatinga vegetation. The presence of this species in coastal mangrove is a little more difficult to explain however, but our record is not in isolation – with this species also recently photographed by G. Gonsioroski in coastal mangrove at Bacabeira in Maranhão on 1 January 2011 (Gonsioroski 2011). It is possible that this species was always present along the poorly-inventoried coastal strip and has subsequently spread inland following deforestation; further surveys in suitable habitats are required to ascertain the extent of this species' current distribution. Willis (1992) listed the species pair Spotted Piculet (*P. pygmaeus*)/Varzea Piculet (*P. varzeae*) as one of 20 cases of speciation between caatinga-cerrado and Amazonian semi-open zones, forest edges or the llanos. Given the use of flooded forest by Varzea Piculet then the occurrence of its sister species in another edge forest habitat (mangrove) is perhaps less extraordinary than it may at first appear.

FIGURE 9. Juvenal Spotted Piculet (*Picumnus pygmaeus*) 2 November 2010, Catchment 443 (A. C. L.).

Cinnamon-throated Woodcreeper (*Dendrexetastes rufigula*). Reported as potentially locally extinct in the study region by Portes *et al.* (2011), we here document (Lees 2010k,l) the rediscovery of this threatened taxon (ssp. *paraensis*) in Paragominas. We recorded Cinnamon-throated Woodcreepers in five different catchments (Catchments 147, 315, 358, 423 and 547) but only on a total of eight point counts (all A. C. L.) and always in primary forest. We did not record this species in the least degraded forests that were surveyed, which suggests that the species must be patchily distributed within the landscape; a life history characteristic likely to predispose this taxon to local or even global extinction. This subspecies was apparently unrecorded between 1959 and 2005 when found by S. M. Dantas on the west bank of the Rio Tocantins at Tucuruí (Silveira & Straube 2008, Portes *et al.* 2011). Based on plumage characters, this subspecies is closer to the nominate north bank subspecies, rather than the geographically more proximate *moniliger* subspecies occurring to the west of the Rio Tocantins (A. A. *unpubl. data*).

Black-chested Tyrant (*Taeniotriccus andrei*). We recorded this unobtrusive and spectacular flycatcher (Figure 10), regarded as being practically unknown in life prior to 2003 (Zimmer & Whittaker 2004, but see Aleixo *et al.* 2000) on 35 occasions from 20 transects in eight catchments (44, 100, 147, 152, 202, 315, 324 and 549). We found them occurring in a number of different habitats ranging from relatively undisturbed primary forest to *várzea* and young (7+ yr old) second growth, but in all localities however this species was restricted to areas with a dense understory, a habitat probably provided only naturally by vine-dominated and *várzea* forests, but now occurring plentifully in the region following recurrent burns and intensive timber extraction (Lees & Moura 2011). The species is extremely patchily distributed within the landscape, with many apparently suitable sites left unoccupied; a full analysis of potential topographic and floristic determinants of its distribution will be carried out separately. Of the two vocalizations described in Zimmer & Whittaker (2004) we relatively-rarely heard the two part vocalization 'CHEWP....K'DINK KDINK' (e.g. Lees 2010m), - except in response to playback, with the species normally only giving its unobtrusive single note call 'CHEWP' (e.g. Lees 2010n) that is easily passed off as an anuran by observers unfamiliar with the species. On 19 November 2010 A. C. L. briefly observed a Black-chested Tyrant in what appeared to be an undescribed plumage. The bird, which was associating with a singing male of this species, was striking grey on the mantle but otherwise resembled an adult female; we assume that this represents either the undescribed juvenal plumage of this species or a plumage aberration arising from a lack of green feather pigmentation.

FIGURE 10. Adult male Black-chested Tyrant *(Taeniotriccus andrei)* Catchment 547, 14 September 2010 (A. C. L.).

Stripe-necked Tody-tyrant (*Hemitriccus striaticollis*). We only recorded this species on one transect within the study region – in dense second growth forest bordering the Rio Piria in Catchment 423 where it was observed on 3 and 4 November 2010 (Lees 2010o,p). This species was previously unrecorded from the BCE and we assume that southern Paragominas represents the northernmost limit of the species' distribution in Eastern Amazonia. Given its preference for transitional forest habitats, this species may be a beneficiary of anthropogenic habitat changes in the region.

Olive-green Tyrannulet (*Phylloscartes viresecens*). Portes *et al.* (2011) reported this species (formerly considered to be restricted to the Guianan Area of Endemism) from the south bank of the river Amazonas for the first time, based on observations made by K. J. Zimmer and A. Whittaker in Paragominas (Fazenda Cikel) in September 2007. Our first field-contact with the species came on 30 October 2010 when A. C. L. photographed (Lees 2010q) a single individual with a mixed-species canopy flock in Catchment 245. Subsequent resampling of our point count recordings revealed we had overlooked this species from earlier the same day (e.g. Lees 2010r) and from the same catchment on 8 October. Our next contact with the species came in Catchment 549 (e.g. Lees 2010f) in May 2011, where we found them to be a nuclear inhabitant of mixed-species canopy flocks, often in company with Para Gnatcatchers (*Polioptila paraensis*). We found that individuals from this population responded strongly to a recording from French Guiana (Claessens 2009) suggesting a lack of strong genetic differentiation between populations on either side of the Amazon (to be expected in a canopy tyrannid, cf. Burney & Brumfield 2009), therefore obtaining a DNA sample to test this hypothesis is a priority for future work.

Amazonian Scrub-flycatcher (*Sublegatus obscurus*). We recorded a single Amazonian Scrub-flycatcher (Figure 11, Lees 2010s) in a narrow-band of second growth vegetation bordering selectively-logged primary forest in Catchment 342 on 15 November 2010. It is possible that we previously overlooked its presence in the municipality owing to a lack of experience with the species' vocalizations, but still consider it to be probably rare given a lack of prior (or subsequent) visual encounters.

Masked Water-tyrant (*Fluvicola nengeta*). After first recording a single individual foraging on emergent vegetation at a manmade lake in Catchment 443 on 30 September 2010 (Lees 2010t) we subsequently found a further four occupied sites – one territory in Catchments 274 (Moura 2010b) and three territories at sites close to (but outside of) Catchment 549 (e.g. Lees 2011g). Aguiar (2010) presented the first documented record

FIGURE 11. Amazonian Scrub-flycatcher (*Sublegatus obscurus*) Catchment 342, 15 November 2010 (A. C. L.).

of Masked Water-tyrant from Amazonia, an individual photographed at the mouth of the Peri river (52°09′W; 2°21′S), a left bank tributary of the Rio Xingu on 12 December 2008. This species had previously been reported from Paragominas in 2007/2008 by Dario (2008) albeit without supporting documentation or details. Masked Water-tyrants apparently began expanding their range in Brazil from the 1950s (Alvarenga 1990), outwards from their core distribution in the northeast, and these records suggest that the species may already be quite widespread in the Xingu and Tocantins interfluves.

Large-headed Flatbill (*Ramphotrigon megacephalum*). Of the 91 randomly allocated forest transects in Paragominas, just a single point in a single transect fell in an area with a *Guadua* bamboo dominated forest understory (in Catchment 245) - even away from designated point count stations we did not encounter any natural stands of *Guadua*. Whilst conducting a point count at P150 on this transect (no *Guadua*) on 30 October 2010, A. C. L. heard the distant song of a Large-headed Flatbill which subsequently responded strongly to playback and was sound-recorded and photographed (Figure 12, Lees 2010u,v). Examination of N. G. M.'s independent recordings from the following point count station (P300 the *Guadua* stand) from earlier the same day revealed at least two further singing individuals. These records represent the first for the interfluvium and the BCE and extend the species' range at least 700 km from the nearest known site at Gorotire (07°43′S; 51°11′W), on the banks of the Fresco river, an eastern tributary of the Xingu river (Aleixo *et al.* 2000). That Large-headed Flatbill is able to colonize such small pockets of bamboo forest within a vast matrix of 'unsuitable' habitat suggests that other nominally 'obligate' bamboo specialists such as Peruvian Recurvebill (*Simoxenops ucayalae*) and Dusky-tailed Flatbill (*Ramphotrigon fuscicauda*) may yet be found to

FIGURE 12. Large-headed Flatbill (*Ramphotrigon megacephalum*). Catchment 245, 30 October 2010 (A. C. L.).

be low-density residents in the BCE. The latter has been found as close as Marabá (Vasconcelos 2005) where it was found in vine-rich forest without bamboo, a habitat which provides a similarly dense understory structure.

Crimson Fruitcrow (*Haematoderus militaris*). We recorded this spectacular cotinga on just two occasions, both from the most extensive area of primary forest in Catchment 549. N. G. M. photographed (Figure 13, Moura 2011b) a single male perched in the canopy of logged primary forest on 19 May 2011. The following day N. G. M. sound-recorded a second individual (Moura 2011c) in tall *terra firme* forest 4 km distant from the first site, and observed this second individual eating *Cecropia* fruit. We consider this species, along with Guianan Red-cotinga (*Phoenicircus carnifex)* - which we also recorded only twice during fieldwork (from the same catchment), to be amongst the most fragmentation/perturbation sensitive species in the regional avifaunal pool.

Opal-crowned Manakin (*Lepidothrix iris*). We found this manakin to be remarkably rare in the study region, A. C. L. discovered a lek in tall *terra firme* forest in Catchment 142 on 3 September 2010 and found a further 3 leks in Catchment 549 on 22 and 23 May 2011 (e.g. Lees 2011h), but these are our only records despite extensive experience of the vocalizations of all the members of the *L. iris*/*villasboasi*/*natterei* superspecies. This is in stark contrast to the second study region of the RAS project in Santarém where we recorded *Lepidotrix iris eucephala* on 54 occasions from 13 catchments. This marked difference in response to habitat change might be related to intrinsic differences in sensitivity to disturbance between the nominate and *eucephala* or perhaps relate to more subtle differences in vegetative dynamics between the two landscapes.

Para Gnatcatcher (*Polioptila paraensis*). We encountered Para Gnatcatchers in four different catchments (245, 269, 358 and 549) all of which retain extensive and relatively undisturbed primary forest. This species was found exclusively following canopy mixed species flocks where its relatively quiet song (e.g. Lees 2011i) is easily missed. Our only visual contacts came from Catchment 549 where we were able to view a pair foraging in the canopy of an emergent tree, descending as low as 20 m following playback (e.g. Lees 2011j).

Yellow-shouldered Grosbeak (*Parkerthraustes humeralis*). A single individual was observed by A. C. L., A. S. and T. A. G., and photographed by A. C. L. (Figure 14, Lees 2010w) amidst a mixed-species tanager flock containing e.g. Spotted Tanager (*Tangara punctata*), Turquoise Tanager (*Tangara mexicana*) and Red-legged Honeycreeper (*Cyanerpes cyaneus*) in degraded primary forest atop a hill in Catchment 315 on 17 August 2010. A second individual was photographed by A. C. L. and

FIGURE 13. Crimson Fruitcrow (*Haematoderus militaris*) Catchment 549, 19 May 2011 (N. G. M.).

FIGURE 14. Yellow-shouldered Grosbeak (*Parkerthraustes humeralis*) Catchment 315, 17 August 2010 (A. C. L.).

N. G. M. in Catchment 358 on 27 May 2011 (Lees 2011k) this time accompanying a 'typical' canopy flock containing e.g. Lineated Woodcreper (*Lepidocolaptes albolineatus*), Grey Elaenia (*Myiopagis caniceps*), Para Gnatcatcher (*Polioptila paraensis*), Red-billed Pied-tanager (*Lamprospiza melanoleuca*) and Guira Tanager (*Hemithraupis guira*). These records represent the first for the interfluvium and the Belém CE and a range-extension of circa 450km from the nearest known site in Carajás, PA on the west bank of the Tocantins river (Pacheco *et al.* 2007).

Wedge-tailed Grass-finch (*Emberizoides herbicola*). We recorded this species from three different pasture transects in three different catchments, single individuals in Catchment 202 on 22 August 2010 (Lees 2010x), Catchment 443 on 2 October 2010 (Lees 2010y) and Catchment 245 on 7 October 2010 (all A. C. L.). Portes *et al.* (2011) recorded this species in two municipalities in the CEB (Tailândia and Ulianópolis). We assume that this species has recently spread into the region from surrounding Cerrado landscapes, but this species may also have colonized jointly from the north where the species is present on natural grasslands on Marajó Island (Henriques & Oren 1997).

DISCUSSION

To fully sample an Amazonian avifauna a variety of techniques need to be employed (c.f. Terborgh *et al.* 1990, Somenzari *et al.* 2011). Our sampling protocol was based upon point counts and general field observations. It did not make use of mist-nets or canopy towers, and given our research priorities of understanding region-wide impacts of land-use change on biodiversity, was heavily biased towards degraded or regenerating *terra firme* forest sites and agricultural production landscapes. We missed a total of 20 species previously recorded from the region, typically those found close to rivers (e.g. Sunbittern (*Eurypyga helias*), Crimson Topaz (*Topaza pela*) and Golden-crowned Spadebill (*Platyrinchus coronatus*)), or rare and low-density species generally restricted to extensive areas of primary forest (e.g. Crested Eagle (*Morphnus guianensis*), Vulturine Parrot (*Pyrilia vulturina*) and Wing-banded Antbird (*Myrmornis torquata*)), neither of which were sampled extensively in our study. We were shown the remains of two nests reported to pertain to Harpy Eagles (*Harpia harpyja*) by foresters but do not list this species in Appendix 1 as we were unable to independently confirm the species identification from the relictual nest architecture alone (i.e. separate them from Crested Eagle nests). Some typically more common forest-dependent species recorded by Portes *et al.* (2011) were unrecorded by us (e.g. Gray-rumped Swift, (*Chaetura cinereiventris*), Plain-winged Antshrike (*Thamnophilus schistaceus*), Black-throated Antbird (*Myrmeciza atrothorax*), Zimmer's Tody-tyrant (*Hemitriccus minimus*) and Dusky-capped Greenlet (*Hylophilus hypoxanthus*)), although documentation for these species not previously recorded from the CEB has not been made publically available and no voucher skins were collected. We recommend caution before accepting these records for the CEB, and strongly encourage the publication of voucher material (specimens, photos, and recordings) obtained in the CEB in the future for those species and others which would also represent similarly significant range-extensions.

High-diversity tropical sites require many years, if not decades, of fieldwork to be completely inventoried (Remsen 1994), and colonizers, migrants and vagrants may be added at a slow rate, especially considering the colonization possibilities afforded for non-forest species from neighboring Cerrado and Caatinga landscapes in Maranhão. That naturally rare and/or unobtrusive species such as Olive-green Tyrannulet, Large-headed Flatbill and Yellow-shouldered Grosbeak could remain undetected in the interfluvium despite over two hundred years of ornithological fieldwork is a sage reminder of the danger of only conducting rapid biodiversity inventories (e.g. Gotelli & Colwell 2001). Moreover, if we are still identifying rare elements in the core *terra firme* forest avifauna in Paragominas, then it suggests there are many more undiscovered species in more remote areas of the Amazon basin.

Our inventory will hopefully serve as a baseline from which future avifaunal compositional changes in the Paragominas municipality can be monitored and assessed. Based on our data we anticipate a gradual turnover with the potential for local (or even global) extinction of some forest-dependent species and a replacement by more non-forest taxa as has been documented elsewhere along the Arc of Deforestation (e.g. Lees & Peres 2006). The baseline avifaunal community has already shifted considerably since A. R. Wallace and E. Goeldi first travelled up the Rio Capim to sample the regional avifauna in the 19th century. Goeldi (1903) described Rufous-vented Ground-cuckoo (*Neomorphus geoffroyi*) as being '*not very rare on the High Capim*', and there are several old specimens from the region (e.g. Figure 15). This species must now be very rare and dependent on the protection of the region's largest remaining forest blocks, which include western Paragominas, where a pair was recorded in September 2007 (Portes *et al.* 2011). The same hope, however, cannot be expressed for either the Hyacinth Macaw (*Anodorhynchus hyacinthinus*), or the Belém CE endemic subspecies of Bare-faced Currasow (*Crax fasciolata pinima*), the first of which is certainly locally extinct. We carried out many opportunistic semi-structured interviews with local people and hunters about the presence of the curassow but could find no-

one familiar with the species in Paragominas, despite widespread knowledge of Razor-billed Curassows (*Pauxi tuberosum*). This suggests that this taxon is already locally (if not globally) extinct and has evidently been 'lost from memory' by the local inhabitants, probably because it is among the most sought-after and easiest to capture game species (Brooks *et al.* 2007, L. F. Silveira *pers. com.*). The subspecies was last recorded with certainty in the wild in 1978 (Silveira & Straube 2008).

FIGURE 15. Rufous-vented Ground-cuckoos (*Neomorphus geoffroyi*), top collected by M. M. Moreira in the 'Municipality of Paragominas' on 4 August 1968, bottom (collector unknown) obtained on 30 June 1897 from the Rio Capim at 'Ressaca'. (A.C.L.)

Our total of 440 species probably represents at least 85% of the expected (non-vagrant) species pool in a peripheral Amazonian landscape, which is naturally less diverse than interfluves further west on account of the region's rather uniform topography, reduced precipitation, and restricted ecosystem diversity (cf. Rahbeck & Graves 2001, Hoorn *et al.* 2010). Nevertheless, what the region cannot muster in terms of total species richness (although this total still represents around 4% of the total global avian species richness) is compensated for by its importance as the last redoubt for a number of endemic and restricted-range (and poorly-known) taxa, the exact taxonomic position of which may be the subject of future systematic revisions (cf. Bird *et al.* 2011). With a recent municipality-wide ban on deforestation and efforts to restore some areas of forest, we hope that future surveys provide a more positive assessment of the conservation prospects of the regional avifauna. However, these positive environmental policies may take time to have an effect, and need to be balanced by the extinction debt associated with past forest loss, ongoing hunting pressure, and the impacts of future land uses, including agricultural intensification, agroforestry and the expansion of silviculture and biofuel production.

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APPENDIX I

List of 440 species recorded from the municipality of Paragominas (PA, Brazil). Photo reference and sound reference numbers are searchable in the online databases of www.wikiaves.com.br (WA) and www.xeno-canto.org (XC), respectively. Initials given in the place of voucher archives are those of the observers of undocumented species, this with the exception of HBW-IBC which indicates a record of *Panyptila cayennensis* photographed in-hand and archived elsewhere (http://tiny.cc/p5e33). Total number of detections of species during the quantitative surveys are listed in the abundance column, figures in brackets represent the number of days species were encountered during the survey (provided for species utilizing habitats or times of day poorly-represented by the quantitative surveys). Accession numbers are presented for species previously collected in the region and housed at the Museu Paraense Emilio Goeldi (MPEG). Taxonomy and nomenclature follow CBRO (2011).

Scientific name	English name	Photo Ref. WA:	Sound ref. XC:	Background	Abundance	MPEG specimens
TINAMIDAE						
Tinamus tao	Gray Tinamou	A. C. L.	A. C. L.		1	
Tinamus guttatus	White-throated Tinamou		84099		2	
Crypturellus cinereus	Cinereous Tinamou		84175		5	
Crypturellus soui	Little Tinamou		85576	84047	40	
Crypturellus strigulosus	Brazilian Tinamou		84083	84136	18	28438
Crypturellus variegatus	Variegated Tinamou		85515		19	28439
Crypturellus parvirostris	Small-billed Tinamou		86665	83992	44	
ANHIMIDAE						
Anhima cornuta	Horned Screamer	342957	84067		1 [<15]	
ANATIDAE						
Dendrocygna viduata	White-faced Whistling-Duck	341225			[7]	
Cairina moschata	Muscovy Duck	347052			4 [<15]	
Amazonetta brasiliensis	Brazilian Teal	341236			[<20]	
CRACIDAE						
Ortalis superciliaris	Buff-browed Chachalaca	341254		85520	13	
Penelope superciliaris	Rusty-margined Guan	347044	84162		10	
Penelope pileata	White-crested Guan	362959	85601	84131	2	
Aburria cujubi	Red-throated Piping Guan	357924			2	28442
Pauxi tuberosum	Red-billed Curassow	337794	85519		7	
ODONTOPHORIDAE						
Odontophorus gujanensis	Marbled Wood-Quail		86711	84028	5	58955
PODICIPEDIDAE						
Tachybaptus dominicus	Least Grebe	347038			[4]	
Podilymbus podiceps	Pied-billed Grebe	346367			[5]	
CICONIIDAE						
Mycteria americana	Wood Stork	340604			6 [<15]	
PHALACROCORACIDAE						
Phalacrocorax brasilianus	Neotropic Cormorant	342057			[<15]	
ANHINGIDAE						
Anhinga anhinga	Anhinga	342865			[8]	
ARDEIDAE						
Tigrisoma lineatum	Rufescent Tiger-Heron	341239			[<10]	
Zebrilus undulatus	Zigzag Heron		86169		[1]	
Butorides striata	Striated Heron	342889			2 [<20]	
Bubulcus ibis	Cattle Egret	345535			1 [7]	
Ardea cocoi	Cocoi Heron	341234			[3]	
Ardea alba	Great Egret	345537			2 [<20]	
Pilherodius pileatus	Capped Heron	340138			[2]	
Egretta thula	Snowy Egret	345521			[2]	19138

Scientific name	English name	Photo Ref. WA:	Sound ref. XC:	Background	Abundance	MPEG specimens
THRESKIORNITHIDAE						
Mesembrinibis cayennensis	Green Ibis	A. C. L., N. G. M.	A. C. L.		[2]	
Platalea ajaja	Roseate Spoonbill	N. G. M.			1	
CATHARTIDAE						
Cathartes aura	Turkey Vulture	347060			44	
Cathartes melambrotus	Greater Yellow-headed Vulture	341248			9	
Coragyps atratus	Black Vulture	340605			76	
Sarcoramphus papa	King Vulture	357986			2	
ACCIPITRIDAE						
Leptodon cayanensis	Gray-headed Kite	339319			[2]	
Elanoides forficatus	Swallow-tailed Kite	345206	85574		3 [10]	
Gampsonyx swainsonii	Pearl Kite	358651			4 [<15]	
Elanus leucurus	White-tailed Kite	362899			5 [7]	
Harpagus bidentatus	Double-toothed Kite	347765			[5]	
Harpagus diodon	Rufous-thighed Kite	348287			[1]	
Accipiter bicolor	Bicolored Hawk		79489		[1]	
Ictinia plumbea	Plumbeous Kite	337804			[<10]	
Busarellus nigricollis	Black-collared Hawk	339304	84159		1 [3]	
Geranospiza caerulescens	Crane Hawk	342077			[4]	
Heterospizias meridionalis	Savanna Hawk	345229			1 [<30]	
Urubitinga urubitinga	Great Black-Hawk	342891			1 [5]	
Rupornis magnirostris	Roadside Hawk	347776	85518		19 [<40]	
Geranoaetus albicaudatus	White-tailed Hawk	347761			3 [<40]	
Pseudastur albicollis	White Hawk	339335			[<20]	
Leucopternis kuhli	White-browed Hawk	339338	84042		5 [7]	
Buteo nitidus	Gray Hawk	342968	85516		12 [<30]	
Buteo brachyurus	Short-tailed Hawk	340140			2 [5]	
Buteo albonotatus	Zone-tailed Hawk	361599			1	
Spizaetus tyrannus	Black Hawk-Eagle	360993	84058		2 [4]	
Spizaetus melanoleucus	Black-and-white Hawk-Eagle	345211			1	
Spizaetus ornatus	Ornate Hawk-Eagle		85584		[2]	
FALCONIDAE						
Daptrius ater	Black Caracara	A. C. L.	A. C. L.		[1]	
Ibycter americanus	Red-throated Caracara	338588	85531	84042	23 [<30]	
Caracara plancus	Southern Caracara	362209	85557		16 [<40]	
Milvago chimachima	Yellow-headed Caracara	340590			1 [2]	
Herpetotheres cachinnans	Laughing Falcon	338597	85545		10 [<30]	
Micrastur ruficollis	Barred Forest-Falcon	345557	85586		26	
Micrastur mintoni	Cryptic Forest-Falcon		83974	83988	17	58956
Micrastur mirandollei	Slaty-backed Forest-Falcon		85828		[2]	
Micrastur semitorquatus	Collared Forest-Falcon	346341			2	
Falco sparverius	American Kestrel	362210			[2]	
Falco rufigularis	Bat Falcon	346356	85554		7 [<15]	
Falco deiroleucus	Orange-breasted Falcon	338596			[1]	
Falco peregrinus	Peregrine Falcon	341255			[1]	
PSOPHIIDAE						
Psophia obscura	Dark-winged Trumpeter		78755		1	
RALLIDAE						
Aramides cajanea	Gray-necked Wood-Rail	362207	87933	85602	[4]	
Laterallus viridis	Russet-crowned Crake		84044	87936	54 [<40]	46334
Laterallus melanophaius	Rufous-sided Crake	342971	84177	83991	2 [<15]	
Porzana albicollis	Ash-throated Crake		A. C. L.		[1]	
Neocrex erythrops	Paint-billed Crake	406481			n/a [1]	

Scientific name	English name	Photo Ref. WA:	Sound ref. XC:	Background	Abundance	MPEG specimens
Pardirallus maculatus	Spotted Rail	A. C. L., N. G. M.			[1]	
Gallinula galeata	Common Moorhen	347042			[7]	
Porphyrio martinica	Purple Gallinule	347047			[<15]	
CHARADRIIDAE						
Vanellus cayanus	Pied Lapwing	339315			[1]	
Vanellus chilensis	Southern Lapwing	337826	85577		16 [<40]	
Pluvialis dominica	American Golden-Plover	341256			[1]	
Charadrius semipalmatus	Semipalmated Plover	342893			[1]	
SCOLOPACIDAE						
Gallinago paraguaiae	South American Snipe	340593			[1]	
Actitis macularius	Spotted Sandpiper	342884			[6]	
Tringa solitaria	Solitary Sandpiper	345231			[<15]	
Tringa flavipes	Lesser Yellowlegs	342086			[2]	
Calidris minutilla	Least Sandpiper	342901			[1]	
Calidris fuscicollis	White-rumped Sandpiper	341253			[2]	
JACANIDAE						
Jacana jacana	Wattled Jacana	339313	85503		2 [<30]	
COLUMBIDAE						
Columbina passerina	Common Ground-Dove	342869	87914		81	18934
Columbina talpacoti	Ruddy Ground-Dove	358622			106	18916
Claravis pretiosa	Blue Ground-Dove	362924			2	
Columbina squammata	Scaled Dove	346359	85514		4	
Columba livia	Rock Dove	360746			[<30]	
Patagioenas speciosa	Scaled Pigeon	340125	87936	84175	40	
Patagioenas picazuro	Picazuro Pigeon	345191	85533		13	
Patagioenas cayennensis	Pale-vented Pigeon	A. C. L., N. G. M.			4	
Patagioenas subvinacea	Ruddy Pigeon		85549	85548	7	
Patagioenas plumbea	Plumbeous Pigeon	347735	84334	83988	71	
Zenaida auriculata	Eared Dove	362211			1	36992
Leptotila verreauxi	White-tipped Dove	341231		84156	48	18910
Leptotila rufaxilla	Gray-fronted Dove		87919	84046	36	18912
Geotrygon montana	Ruddy Quail-Dove		86161		10	39296
PSITTACIDAE						
Ara ararauna	Blue-and-yellow Macaw	N. G. M.	N. G. M.		1	
Ara macao	Scarlet Macaw	345526	85547		16	
Ara chloropterus	Red-and-green Macaw	342965		85588	21	
Guaruba guarouba	Golden Parakeet	345568	85575	85854	40	
Aratinga leucophthalma	White-eyed Parakeet	359782	86670	85599	14	
Aratinga jandaya	Jandaya Parakeet	342092	85513	84156	31	
Pyrrhura lepida	Pearly Parakeet	339318	85578	84167	28	
Pyrrhura amazonum	Santarem Parakeet		84336		[2]	
Forpus passerinus	Green-rumped Parakeet	357952	84102		[1]	19123
Forpus xanthopterygius	Blue-winged Parrotlet	346373			3	
Brotogeris chrysoptera	Golden-winged Parakeet	342064	85555	83989	54	19125
Pionites leucogaster	White-bellied Parrot	358021	87916	84106	23	19130
Pionus menstruus	Blue-headed Parrot	338589	84173	85534	158	
Pionus fuscus	Dusky Parrot	340622	84169	84115	66	
Amazona farinosa	Mealy Parrot	346362	85595	79487	85	28436
Amazona amazonica	Orange-winged Parrot	360995	84174	84029	145	
Amazona ochrocephala	Yellow-crowned Parrot	340610	84164	85854	23	
Deroptyus accipitrinus	Red-fan Parrot	357905	84082	84032	19	28437
OPISTHOCOMIDAE						
Opisthocomus hoazin	Hoatzin	347738			[1]	

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CUCULIDAE						
Coccycua minuta	Little Cuckoo	359781	86160	86668	3	
Piaya cayana	Squirrel Cuckoo	340173	85550	85549	77	19139
Coccyzus melacoryphus	Dark-billed Cuckoo	A. C. L., T. A. G.			[1]	19112
Crotophaga major	Greater Ani	340621			1 [4]	
Crotophaga ani	Smooth-billed Ani	358638	86673	83992	101	19096
Guira guira	Guira Cuckoo	362208	86697		3	
Tapera naevia	Striped Cuckoo	342914	86678	84156	18	
Dromococcyx pavoninus	Pavonine Cuckoo	337815	84066	86698	6	28455
Dromococcyx phasianellus	Pheasant Cuckoo	347078	83964	85586	15	
TYTONIDAE						
Tyto alba	Barn Owl	342087			[7]	
STRIGIDAE						
Megascops choliba	Tropical Screech-Owl	340639	86698		3 [10]	
Megascops usta	Austral Screech-Owl		84114		[3]	
Lophostrix cristata	Crested Owl		84110		3	28444
Pulsatrix perspicillata	Spectacled Owl	347079	85585		[7]	
Strix huhula	Black-banded Owl		84085		[1]	
Glaucidium hardyi	Amazonian Pygmy-Owl		85591	79499	2	
Glaucidium brasilianum	Ferruginous Pygmy-Owl	359783			[3]	
Athene cunicularia	Burrowing Owl	340614		86695	17	
Asio clamator	Striped Owl		85573		1	
NYCTIBIIDAE						
Nyctibius grandis	Great Potoo		A. C. L., N. G. M.		[3]	
Nyctibius aethereus	Long-tailed Potoo		79499		[4]	
Nyctibius griseus	Common Potoo		85909		1	
Nyctibius leucopterus	White-winged Potoo	335245	65638		2	
CAPRIMULGIDAE						
Nyctiphrynus ocellatus	Ocellated Poorwill	342973	86737		4	
Antrostomus rufus	Rufous Nightjar		A. C. L., N. G. M.		1	
Lurocalis semitorquatus	Short-tailed Nighthawk	339331			7	
Hydropsalis nigrescens	Blackish Nightjar	339337			6	
Hydropsalis albicollis	Pauraque	361598	84139	86665	12	39288
Hydropsalis parvula	Little Nightjar		A. C. L., N. G. M.		[2]	18856
Hydropsalis maculicaudus	Spot-tailed Nightjar	A. C. L., N. G. M.	A. C. L., N. G. M.		[10]	
Hydropsalis torquata	Scissor-tailed Nightjar	A. C. L., N. G. M.			[3]	
Chordeiles nacunda	Nacunda Nighthawk	A. C. L.			[1]	
APODIDAE						
Chaetura spinicaudus	Band-rumped Swift	348260			62	
Chaetura meridionalis	Ashy-tailed Swift	350895			3	
Chaetura brachyura	Short-tailed Swift	348259			63	
Tachornis squamata	Fork-tailed Palm-Swift	345525			1 [5]	18865
Panyptila cayennensis	Lesser Swallow-tailed Swift	HBW-IBC			[2]	
TROCHILIDAE						
Glaucis hirsutus	Rufous-breasted Hermit		86153		42	
Phaethornis ruber	Reddish Hermit	340192	87921	85888	461	39300
Phaethornis superciliosus	Long-tailed Hermit	345559	85916		69	
Campylopterus largipennis	Gray-breasted Sabrewing		85890		42	39299
Florisuga mellivora	White-necked Jacobin	358790			3	
Anthracothorax nigricollis	Black-throated Mango	338600	87915		23	
Avocettula recurvirostris	Fiery-tailed Awlbill	336809			1	

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Chrysolampis mosquitus	Ruby-topaz Hummingbird	361602	85534		13	
Thalurania furcata	Fork-tailed Woodnymph	413969	86162		11	39297
Hylocharis sapphirina	Rufous-throated Sapphire	A. C. L.			[2]	
Hylocharis cyanus	White-chinned Sapphire	336760	86166	84070	25	
Polytmus theresiae	Green-tailed Goldenthroat	338591	85913	83991	109	
Amazilia versicolor	Versicolored Emerald	342063			13	
Amazilia fimbriata	Glittering-throated Emerald	340611			6	
Heliothryx auritus	Black-eared Fairy	347736	84165		8	39298
Heliomaster longirostris	Long-billed Starthroat	340163	86159		5	
Calliphlox amethystina	Amethyst Woodstar	345204			5	
TROGONIDAE						
Trogon melanurus	Black-tailed Trogon		84331	84330	24	28440
Trogon viridis	White-tailed Trogon		86148	84329	53	
Trogon ramonianus	Violaceous Trogon	337832	84332		23	19136
Trogon curucui	Blue-crowned Trogon	A. C. L.	A. C. L.		12	
Trogon rufus	Black-throated Trogon	358078	84128	84036	13	
ALCEDINIDAE						
Megaceryle torquata	Ringed Kingfisher	345193	84326		6	
Chloroceryle amazona	Amazon Kingfisher	342881			[10]	
Chloroceryle aenea	American Pygmy Kingfisher		A. C. L., N. G. M.		[1]	
Chloroceryle americana	Green Kingfisher	342879			[7]	
Chloroceryle inda	Green-and-rufous Kingfisher		85852		2	
MOMOTIDAE						
Momotus momota	Blue-crowned Motmot	337790	85851	84136	63	
GALBULIDAE						
Brachygalba lugubris	Brown Jacamar	342972	85598	84069	4	28449
Galbula cyanicollis	Blue-cheeked Jacamar	345216	86206		64	
Galbula ruficauda	Rufous-tailed Jacamar	346416	85915		7	
Galbula dea	Paradise Jacamar	336772			11	18864
Jacamerops aureus	Great Jacamar	337783	86700	83988	16	
BUCCONIDAE						
Notharchus hyperrhynchus	White-necked Puffbird	359777	85510		11	18872
Notharchus tectus	Pied Puffbird	347065	87940	84330	26	
Bucco tamatia	Spotted Puffbird	337754	84068		13	
Bucco capensis	Collared Puffbird	345224	85829		12	
Nystalus striolatus	Striolated Puffbird	358652	84160		18	
Malacoptila rufa	Rufous-necked Puffbird	336847			17	
Monasa nigrifrons	Black-fronted Nunbird	339298	86732		5	
Monasa morphoeus	White-fronted Nunbird	347777	85556	84325	52	
Chelidoptera tenebrosa	Swallow-wing	347061			[<15]	18873
RAMPHASTIDAE						
Ramphastos tucanus	Red-billed Toucan	347752	84041	78755	72	
Ramphastos vitellinus	Channel-billed Toucan	339328	84051	84028	76	
Selenidera gouldii	Gould's Toucanet	337768	86658		27	
Pteroglossus inscriptus	Lettered Aracari	358027			15	
Pteroglossus bitorquatus	Red-necked Aracari	347064	84222	84330	22	
Pteroglossus aracari	Black-necked Aracari	336839	85512	79487	77	
PICIDAE						
Picumnus exilis	Golden-spangled Piculet	337840	84136		12	
Picumnus pygmaeus	Spotted Piculet	341252	87938	87937	4	
Melanerpes candidus	White Woodpecker	345197	86694	83976	12	
Melanerpes cruentatus	Yellow-tufted Woodpecker	346357	86727		12	
Veniliornis affinis	Red-stained Woodpecker	342055	86726	84165	34	18848

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Piculus flavigula	Yellow-throated Woodpecker	347073	86729	79487	24	
Colaptes melanochloros	Green-barred Woodpecker	337821			1	39301
Celeus undatus	Waved Woodpecker	338602	84063	79090	29	
Celeus flavus	Cream-colored Woodpecker		84029		3	
Dryocopus lineatus	Lineated Woodpecker	345530	86657		38	18843
Campephilus rubricollis	Red-necked Woodpecker	361600	86728	79090	23	
THAMNOPHILIDAE						
Myrmotherula multostriata	Amazonian Streaked-Antwren	336821	85600	79497	1	
Myrmotherula hauxwelli	Plain-throated Antwren		83979	85587	61	
Myrmotherula axillaris	White-flanked Antwren	357956	85854	79498	128	
Myrmotherula longipennis	Long-winged Antwren	345201	84329	84324	37	58977
Myrmotherula menetriesii	Gray Antwren	338584	83988	79090	69	39306
Formicivora grisea	White-fringed Antwren	347050	85499	83992	249	
Thamnomanes caesius	Cinereous Antshrike	338582	84040	84038	152	19038
Dysithamnus mentalis	Plain Antvireo	345198	84032	84324	50	39304
Herpsilochmus rufimarginatus	Rufous-winged Antwren		84043	84038	72	
Thamnophilus palliatus	Chestnut-backed Antshrike	358672	84134	84033	45	39303
Thamnophilus aethiops	White-shouldered Antshrike	335891	84130	84170	99	46335
Thamnophilus amazonicus	Amazonian Antshrike	336834	86664	84325	175	
Taraba major	Great Antshrike	338599	85544	84065	54	
Sclateria naevia	Silvered Antbird		84133	84174	2	
Pyriglena leuconota	White-backed Fire-eye	347753	84330	79487	200	58978
Cercomacra cinerascens	Gray Antbird	337837	85532	83970	310	
Cercomacra laeta	Willis' Antbird	347076	84135	84047	127	39305
Hypocnemoides maculicauda	Band-tailed Antbird		85583		3	
Pygiptila stellaris	Spot-winged Antshrike		84028	84116	12	
Willisornis poecilinotus	Scale-backed Antbird	345250	85553	78644	50	39311
Phlegopsis nigromaculata	Black-spotted Bare-eye		84086	84334	8	58980
CONIPOPHAGIDAE						
Conopophaga roberti	Hooded Gnateater	347767	64709	85885	60	39308
GRALLARIIDAE						
Grallaria varia	Variegated Antpitta		84118	84324	5	
Hylopezus macularius	Spotted Antpitta		86163		2	58982
FORMICARIIDAE						
Formicarius colma	Rufous-capped Antthrush	340641	84163	85554	9	58981
Formicarius analis	Black-faced Antthrush	336771	84101	83985	30	
SCLERURIDAE						
Sclerurus mexicanus	Tawny-throated Leaftosser	358062	84105		2	
Sclerurus rufigularis	Short-billed Leaftosser		79487		[2]	58974
Sclerurus caudacutus	Black-tailed Leaftosser	339307	83985	84107	13	
DENDROCOLAPTIDAE						
Dendrocincla fuliginosa	Plain-brown Woodcreeper	341250	85845	85846	64	
Dendrocincla merula	White-chinned Woodcreeper		85827		6	58961
Deconychura longicauda	Long-tailed Woodcreeper	340209	84108		4	
Certhiasomus stictolaemus	Spot-throated Woodcreeper		86699		2	58968
Glyphorynchus spirurus	Wedge-billed Woodcreeper	358680	84171	84036	136	18855
Xiphorhynchus spixii	Spix's Woodcreeper		86157		48	18851
Xiphorhynchus obsoletus	Striped Woodcreeper		86680		8	
Xiphorhynchus guttatus	Buff-throated Woodcreeper		84081	84070	107	18852
Dendroplex picus	Straight-billed Woodcreeper	341249	86675		43	
Lepidocolaptes albolineatus	Lineated Woodcreeper	358655	84090	85510	69	
Dendrexetastes rufigula	Cinnamon-throated Woodcreeper		84062	79487	8	
Dendrocolaptes certhia	Amazonian Barred-Woodcreeper		85837	84338	24	39302

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FURNARIIDAE						
Xenops minutus	Plain Xenops	360754	84324	84118	108	18854
Automolus paraensis	Para Foliage-gleaner	335885	84100	84038	29	61490
Automolus rufipileatus	Chestnut-crowned Foliage-gleaner	335889	84049	64709	17	
Philydor ruficaudatum	Rufous-tailed Foliage-gleaner		79498		9	
Philydor erythrocercum	Rufous-rumped Foliage-gleaner	357967	84104	84118	24	58973
Philydor erythropterum	Chestnut-winged Foliage-gleaner	340634	84111		13	
Philydor pyrrhodes	Cinnamon-rumped Foliage-gleaner		79492		1	
Synallaxis albescens	Pale-breasted Spinetail	342089	86674	86665	183	
Synallaxis rutilans	Ruddy Spinetail	340197	85587		19	
Synallaxis gujanensis	Plain-crowned Spinetail	338606	85501	85500	33	
PIPRIDAE						
Tyranneutes stolzmanni	Dwarf Tyrant-Manakin		86667	84128	90	
Pipra rubrocapilla	Red-headed Manakin		84333	84030	84	18866
Lepidothrix iris	Opal-crowned Manakin	358036	84109		2	
Manacus manacus	White-bearded Manakin	339329	86681		52	
Dixiphia pipra	White-crowned Manakin	345234	84328	84084	22	
Chiroxiphia pareola	Blue-backed Manakin		83989	85499	12	
TITYRIDAE						
Onychorynchus coronatus	Royal Flycatcher	347075	85599		22	39312
Terenotriccus erythrurus	Ruddy-tailed Flycatcher		85594		55	39318
Myiobius atricaudus/barbatus [2]	Black-tailed/Whiskered Flycatcher		84096		5	61495
Schiffornis turdina	Thrush-like Schiffornis		85848	84032	30	58986
Laniocera hypopyrra	Cinereous Mourner		85551	85515	6	
Iodopleura isabellae	White-browed Purpletuft	341218			2	
Tityra inquisitor	Black-crowned Tityra	336813			5	
Tityra cayana	Black-tailed Tityra	340184	85908	84169	42	18942
Pachyramphus viridis	Green-backed Becard		85529		1	
Pachyramphus rufus	Cinereous Becard	340602	86682	84174	9	18936
Pachyramphus castaneus	Chestnut-crowned Becard		85888		2	
Pachyramphus polychopterus	White-winged Becard	345178	86691		6	39290
Pachyramphus marginatus	Black-capped Becard	340176	84038	84029	22	
Pachyramphus minor	Pink-throated Becard	347762			14	
Pachyramphus validus	Crested Becard	359778			4	
COTINGIDAE						
Lipaugus vociferans	Screaming Piha	336778	84112	84028	106	
Xipholena lamellipennis	White-tailed Cotinga	340637	84161		19	18946
Cotinga cotinga	Purple-breasted Cotinga	360991			1	
Cotinga cayana	Spangled Cotinga	347773			1	18939
Haematoderus militaris	Crimson Fruitcrow	358087	78644		1	
Querula purpurata	Purple-throated Fruitcrow	347764	85588	84157	52	18940
Phoenicircus carnifex	Guianan Red Cotinga		84116		1	28457
INCERTAE SEDIS						
Platyrinchus saturatus	Cinnamon-crested Spadebill		79485		4	
Platyrinchus platyrhynchos	White-crested Spadebill		85552	84048	13	58985
Piprites chloris	Wing-barred Piprites		84131	84047	34	
RHYNCHOCYCLIDAE						
Taeniotriccus andrei	Black-chested Tyrant	342976	59238	84159	34	
Mionectes oleagineus	Ochre-bellied Flycatcher	338583	85910		3	19089
Mionectes macconnelli	MacConnell's Flycatcher		84176	84031	16	
Corythopis torquatus	Ringed Antpipit	335870	84084		8	
Phylloscartes virescens	Olive-green Tyrannulet	339321	79090	84169	7	
Rhynchocyclus olivaceus	Olivaceous Flatbill	345200	84087	84032	4	
Tolmomyias sulphurescens	Yellow-olive Flycatcher		83967	84175	8	

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Tolmomyias assimilis	Yellow-margined Flycatcher	360752	84125	84032	41	
Tolmomyias poliocephalus	Gray-crowned Flycatcher	337771	84338	84138	18	
Tolmomyias flaviventris	Yellow-breasted Flycatcher	360756	86679	83991	179	39319
Todirostrum cinereum	Common Tody-Flycatcher	340629	86677		109	
Todirostrum chrysocrotaphum	Yellow-browed Tody-Flycatcher		85907		7	
Poecilotriccus fumifrons	Smoky-fronted Tody-Flycatcher	341242	86669	84175	100	48026
Poecilotriccus sylvia	Slate-headed Tody-Flycatcher	358689	84168	84066	98	39291
Myiornis ecaudatus	Short-tailed Pygmy-Tyrant		84166	86692	49	
Hemitriccus striaticollis	Stripe-necked Tody-tyrant	338608	84064		4	
Lophotriccus galeatus	Helmeted Pygmy-Tyrant	345238	84047	84048	230	
TYRANNIDAE						
Zimmerius acer	Guianan Tyrannulet		86666	84032	74	19084
Ornithion inerme	White-lored Tyrannulet		84170	84031	75	
Camptostoma obsoletum	Southern Beardless-Tyrannulet	347737	86676	85503	113	
Elaenia flavogaster	Yellow-bellied Elaenia		83992	83991	240	19080
Myiopagis gaimardii	Forest Elaenia	336837	86202	84136	136	19087
Myiopagis caniceps	Grey Eleania		84088		11	
Myiopagis viridicata	Greenish Eleania	347070			2	
Tyrannulus elatus	Yellow-crowned Tyrannulet		86692	84167	41	19085
Phaeomyias murina	Mouse-colored Tyrannulet		85603	84156	229	19086
Attila cinnamomeus	Cinnamon Attila		86154		4	
Attila spadiceus	Bright-rumped Attila	338585	83990	83989	45	
Legatus leucophaius	Piratic Flycatcher	337757	86683	84033	40	19044
Ramphotrigon megacephalum	Large-headed Flatbill	339327	79497	86711	2	
Ramphotrigon ruficauda	Rufous-tailed Flatbill		84048		8	
Myiarchus tuberculifer	Dusky-capped Flycatcher	335892	86656	84047	49	
Myiarchus ferox	Short-crested Flycatcher	358028	86170	85575	61	
Rhytipterna simplex	Grayish Mourner	337779	85602	83974	60	
Casiornis fuscus	Ash-throated Casiornis	347074			5	
Pitangus sulphuratus	Great Kiskadee	358647	85517	83991	118	19074
Philohydor lictor	Lesser Kiskadee	342887			1 [5]	
Myiodynastes maculatus	Streaked Flycatcher	346354	83991		15	
Megarynchus pitangua	Boat-billed Flycatcher	340152	86712		27	
Myiozetetes cayanensis	Rusty-margined Flycatcher	360747	86748	83992, 84033	124	
Myiozetetes similis	Social Flycatcher	357914	84184		[5]	
Tyrannus melancholicus	Tropical Kingbird	340608	86672	83992	257	19046
Tyrannus savana	Fork-tailed Flycatcher	346361			[1]	
Griseotyrannus aurantioatrocristatus	Crowned Slaty-flycatcher	347755			2	
Empidonomus varius	Variegated Flycatcher	347745	87937		26	19083
Colonia colonus	Long-tailed Tyrant	345212	84167	86726	10	
Myiophobus fasciatus	Bran-colored Flycatcher	360747	84156	84044	120	36996
Sublegatus obscurus	Amazonian Scrub-flycatcher	336844			[1]	
Fluvicola albiventer	Black-backed Water-Tyrant	342873			[3]	
Fluvicola nengeta	Masked Water-Tyrant	357976			[6]	
Cnemotriccus fuscatus	Fuscous Flycatcher	360994	85593		20	
Arundinicola leucocephala	White-headed Marsh-Tyrant	342068			[6]	
Lathrotriccus euleri	Euler's Flycatcher	340145			14	
VIREONIDAE						
Cyclarhis gujanensis	Rufous-browed Peppershrike		85911	84047	61	39293
Vireo olivaceus	Red-eyed Vireo	347746			10	18988
Hylophilus semicinereus	Gray-chested Greenlet		84052	84051	75	
Hylophilus pectoralis	Ashy-headed Greenlet	340607	86747	86682	35	46340
Hylophilus ochraceiceps	Tawny-crowned Greenlet		84115	79090	5	28448

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HIRUNDINIDAE						
Atticora fasciata	White-banded Swallow	336776			[4]	
Atticora tibialis	White-thighed Swallow	358030			1	
Stelgidopteryx ruficollis	Southern Rough-winged Swallow	336833		84058	128	19131
Progne tapera	Brown-chested Martin	345550			[4]	
Progne chalybea	Grey-breasted Martin	345554	86693	84177	278	
Tachycineta albiventer	White-winged Swallow	345545			7	19132
Hirundo rustica	Barn Swallow	345542			20	
TROGLODYTIDAE						
Microcerculus marginatus	Scaly-breasted Wren	336842	84070		13	
Troglodytes musculus	Southern House-Wren	336825	85502	84044	181	19005
Campylorhynchus turdinus	Thrush-like Wren		83976		[2]	
Pheugopedius genibarbis	Moustached Wren	346414	85511	84135	373	
DONACOBIIDAE						
Donacobius atricapilla	Black-capped Donacobius	340122	84033		4	
POLIOPTILIDAE						
Ramphocaenus melanurus	Long-billed Gnatwren	358657	84046	79485, 84028	170	19032
Polioptila plumbea	Tropical Gnatcatcher	345524	84045	84044	25	
Polioptila paraensis	Para Gnatcatcher	358053	84113	79090	5	
TURDIDAE						
Turdus nudigenis	Bare-eyed Thrush	340632			[2]	18859
Turdus leucomelas	Pale-breasted Thrush	358791	86668	84033	61	
Turdus fumigatus	Cocoa Thrush		85914	79497	4	18857
Turdus albicollis	White-necked Thrush		84036		2	6496
MOTACILIDAE						
Anthus lutescens	Yellowish Pipit	346366	87920		73	19004
COEREBIDAE						
Coereba flaveola	Bananaquit	345529	85542	84044	331	
THRAUPIDAE						
Saltator grossus	Slate-colored Grosbeak	337811	84137	85512	52	
Saltator maximus	Buff-throated Saltator	358789	85543	84043	174	19006
Saltator coerulescens	Grayish Saltator	338598	86671		32	
Parkerthruastes humeralis	Yellow-shouldered Grosbeak	346418			2	
Lamprospiza melanoleuca	Red-billed Pied Tanager	337835	85548	84090	37	
Nemosia pileata	Hooded Tanager	338590			2	
Tachyphonus rufus	White-lined Tanager	340219		83992	93	18875
Ramphocelus carbo	Silver-beaked Tanager	341246	85500	83976	441	18877
Lanio luctuosus	White-shouldered Tanager	338581			17	
Lanio cristatus	Flame-crested Tanager	337828		84169	29	19042
Lanio cucullatus	Red-crested Finch	342071	84065		3	39321
Lanio surinamus	Fulvous-crested Tanager	336816	84069		10	
Tangara gyrola	Bay-headed Tanager	336828	84335		21	
Tangara mexicana	Turquoise Tanager	340221			10	
Tangara velia	Opal-rumped Tanager	357960			9	
Tangara punctata	Spotted Tanager	346412			20	
Tangara episcopus	Blue-gray Tanager	340220	85530	85854	210	18896
Tangara sayaca	Sayaca Tanager	345205			10	
Tangara palmarum	Palm Tanager	340586	87939	84069	60	18888
Cissopis leverianus	Magpie Tanager	358632			3	
Schistochlamys melanopis	Black-faced Tanager	347058	87918		36	
Paroaria dominicana	Red-cowled Cardinal	N. G. M.			[1]	
Tersina viridis	Swallow Tanager		A. C. L.		6	
Dacnis cayana	Blue Dacnis	337838			12	18991

Scientific name	English name	Photo Ref. WA:	Sound ref. XC:	Background	Abundance	MPEG specimens
Cyanerpes caeruleus	Purple Honeycreeper	339310			2	18957
Cyanerpes cyaneus	Red-legged Honeycreeper	338603			4	18962
Chlorophanes spiza	Green Honeycreeper	339323		84043	3	
Hemithraupis guira	Guira Tanager	338580	87917	83988	45	
EMBERIZIDAE						
Ammodramus humeralis	Grassland Sparrow	342079			18	
Ammodramus aurifrons	Yellow-browed Sparrow	340168	85520	86665	13	
Emberizoides herbicola	Wedge-tailed Grass-Finch	342091			3	
Volatinia jacarina	Blue-black Grassquit	340131	86696	83976	138	18994
Sporophila americana	Wing-barred Seedeater	347739			33	36997
Sporophila nigricollis	Yellow-bellied Seedeater	346348			8	
Sporophila caerulescens	Double-collared Seedeater	363693			[1]	
Sporophila leucoptera	White-bellied Seedeater	340200			[1]	
Sporophila minuta	Ruddy-breasted Seedeater	345556			19	39324
Sporophila angolensis	Chestnut-bellied Seed-Finch	358649	87291	85603	18	39323
Arremon taciturnus	Pectoral Sparrow	358670	84132	85885	29	58988
CARDINALIDAE						
Granatellus pelzelni	Rose-breasted Chat		83970	85885	41	
Caryothraustes canadensis	Yellow-green Grosbeak	360744	84138	84082	60	
Periporphyrus erythromelas	Red-and-black Grosbeak	358042	84031	84030	10	46341
Cyanoloxia cyanoides	Blue-black Grosbeak		84107	85604	18	58989
PARULIDAE						
Geothlypis aequinoctialis	Masked Yellowthroat	347744	86695	83992	82	36998
Phaeothlypis rivularis	Neotropical River Warbler		84155		2	39292
ICTERIDAE						
Psarocolius viridis	Green Oropendola	347734	87934	84101	23	
Psarocolius bifasciatus	Olive Oropendola		85912		6	
Cacicus haemorrhous	Red-rumped Cacique	339294	84103	84106	15	19028
Cacicus cela	Yellow-rumped Cacique	339301	86731	86732	23	19027
Icterus cayanensis	Epaulet Oriole	342060	84157		7	
Icterus jamacaii	Campo Troupial	342074			2	
Molothrus oryzivorus	Giant Cowbird	360723			1	
Molothrus bonariensis	Shiny Cowbird	340159	86733		11	
Sturnella militaris	Red-breasted Blackbird	340159	85521	85520	190	
FRINGILLIDAE						
Euphonia violacea	Violaceous Euphonia	341241			2	
Euphonia chrysopasta	Golden-bellied Euponia	374914	84106		1	
Euphonia minuta	White-vented Euphonia		A. C. L.		[1]	18979
Euphonia cayennensis	Golden-sided Euphonia		84030	84031	10	
PASSERIDAE						
Passer domesticus	House Sparrow	358619			1 [<50]	

[1] Not applicable.
[2] Indicates that one of the two species was recorded.

APPENDIX II

List of 20 species recorded from the municipality of Paragominas (PA, Brazil) by Portes *et al.* (2011) but unrecorded during this survey. Accession numbers are presented for species previously collected in the region and housed at the Museu Paraense Emilio Goeldi (MPEG).

		MPEG
Chondrohierax uncinatus	Hook-billed Kite	
Harpia harpyja	Harpy Eagle	
Eurypyga helias	Sunbittern	
Touit purpuratus	Sapphire-rumped Parrotlet	
Neomorphus geoffroyi	Rufous-vented Ground-cuckoo	28441
Pyrilia vulturina	Vulturine Parrot	
Lophornis gouldi	Dot-Eared Coquette	
Discosura longicaudus	Racket-tailed Coquette	
Ramphastos toco	Toco Toucan	
Myrmornis torquata	Wing-banded Antbird	61494
Cranioleuca gutturata	Speckled Spinetail	
Oxyruncus cristatus	Sharpbill	
Platyrinchus coronatus	Golden-crowned Spadebill	
Hemitriccus minimus	Zimmer's Tody-tyrant	
Elaenia spectabilis	Large Elaenia	
Elaenia chiriquensis	Lesser Elaenia	
Conopias parvus	Yellow-throated Flycatcher	
Hylophilus hypoxanthus	Dusky-capped Greenlet	
Dacnis lineata	Black-faced Dacnis	
Cyanerpes nitidus	Short-billed Honeycreeper	
Zonotrichia capensis	Rufous-collared Sparrow	

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ARTIGO/ARTICLE

Importantes e inéditos registros de aves para o ecótono Amazônia/Cerrado no centro norte do Estado do Tocantins: implicações biogeográficas e extensão de distribuição geográfica de aves amazônicas.

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ABSTRACT: We present records of 13 species of birds for the ecotonal region of the Amazon and Cerrado biomes in the central-northern part of the state of Tocantins, Brazil. This area represents a major gap on the knowledge of bird distributions in both Amazon and Cerrado biomes. Our records of *Odonthophorus gujanensis*, *Hydropsalis nigrescens*, *Nystalus striolatus*, *Selenidera gouldii, Cercomacra manu, Synallaxis cherriei, Attila spadiceus*, *Cotinga cotinga*, and *Rhytipterna immunda* represent important eastward range extensions for these species into southeastern Amazonia. New localities are given for the threatened species *Celeus obrieni*, *Cercomacra ferdinandi* and *Procnias averano*. Records of *Hydropsalis nigrescens*, *Synallaxis hypospodia*, and *S. cherriei* are the first for the state of Tocantins, while records of *O. gujanensis* and *N. striolatus* represent the rediscovery of these species in the state of Tocantins after nearly 40 years without records. Overall, these records demonstrate the potential of new ornithological discoveries in this eastern portion of the Amazon and in the Tocantins state.

KEY-WORDS: Amazonia, birds, Cerrado, ecotone, range extension, Tocantins.

INTRODUÇÃO

O Estado do Tocantins reúne em seu território uma importante zona ecotonal entre os biomas Amazônia e Cerrado (Ab'Sáber 2003, MMA 2007), onde é possível observar um mosaico de fisionomias vegetais savânicas concomitantes às formações florestais ombrófilas (IBGE 2004, SEPLAN 2008). Do ponto de vista ornitológico, esta zona de transição possibilita um compartilhamento de espécies de aves típicas tanto dos ambientes do Cerrado quanto dos ambientes da Amazônia, como verificado na região do Cantão (Pinheiro & Dornas 2009) e no Bico do Papagaio (Olmos *et al.* 2004), oeste e norte do Tocantins, respectivamente.

Apesar de se saber que a condição ecotonal possa promover uma elevada riqueza de espécies de aves, ainda é marcante a falta de informação ornitológica nesta porção do Tocantins. Inicialmente, era listado um total de 524 espécies de aves para o Estado (Hidasi 1998); concomitantemente, Oren & Albuquerque (1991), Silva (1995) e Oren (2001) destacavam o Estado como uma das grandes lacunas de conhecimento ornitológico no país.

Dornas (2009a) em uma sistematizada síntese deste conhecimento ornitológico do Tocantins lista um total de 628 espécies de aves e aponta que 10 % da área do território tocantinense tiveram sua avifauna minimamente amostrada, ou seja, localidades onde houveram a elaboração de listas com pelo menos 100 espécies de aves ou pelo menos 50 espécies documentadas entre coleta, fotografia e/ou gravação sonora. Segundo o autor, o incremento destes números comparado a Hidasi (1998) é resultante da intensificação de estudos de inventário no Estado, principalmente após o ano de 2000 e, seguramente, estes valores devem aumentar ao longo dos anos subsequentes.

Com o propósito de incrementar o conhecimento ornitológico do Estado, este manuscrito tem por objetivo apresentar uma série de registros importantes e inéditos de aves realizados pelos autores para zona ecotonal entre o

Cerrado e a Amazônia no centro norte do Tocantins. Estes registros são importantes porque fornecem informações adicionais à distribuição geográfica e biogeografia de algumas das espécies mencionadas a nível nacional, e inéditas, pois alguns dos registros apresentados são os primeiros das respectivas espécies em território tocantinense.

MÉTODOS

Os registros efetuados por meio de gravação de vocalizações foram depositados no acervo de vocalizações do portal Xeno-canto - XC - (www.xenocanto.org). Os registros fotográficos foram depositados no acervo de fotos do portal Wikiaves - WA - (www.wikiaves.com.br) e espécimes coletados foram depositados na Coleção Ornitológica da Universidade Federal do Tocantins (COUFT). Os registros apresentados são provenientes de trabalhos de campo distintos realizados entre os anos 2008 e 2011 na região de transição entre os biomas Cerrado e Amazônia no centro-norte do estado do Tocantins (Figura 1).

RESULTADOS E DISCUSSÃO

As espécies cujos registros são importantes e inéditos para a zona ecotonal entre o Cerrado e a Amazônia, no centro norte do Tocantins, são listadas e comentadas abaixo.

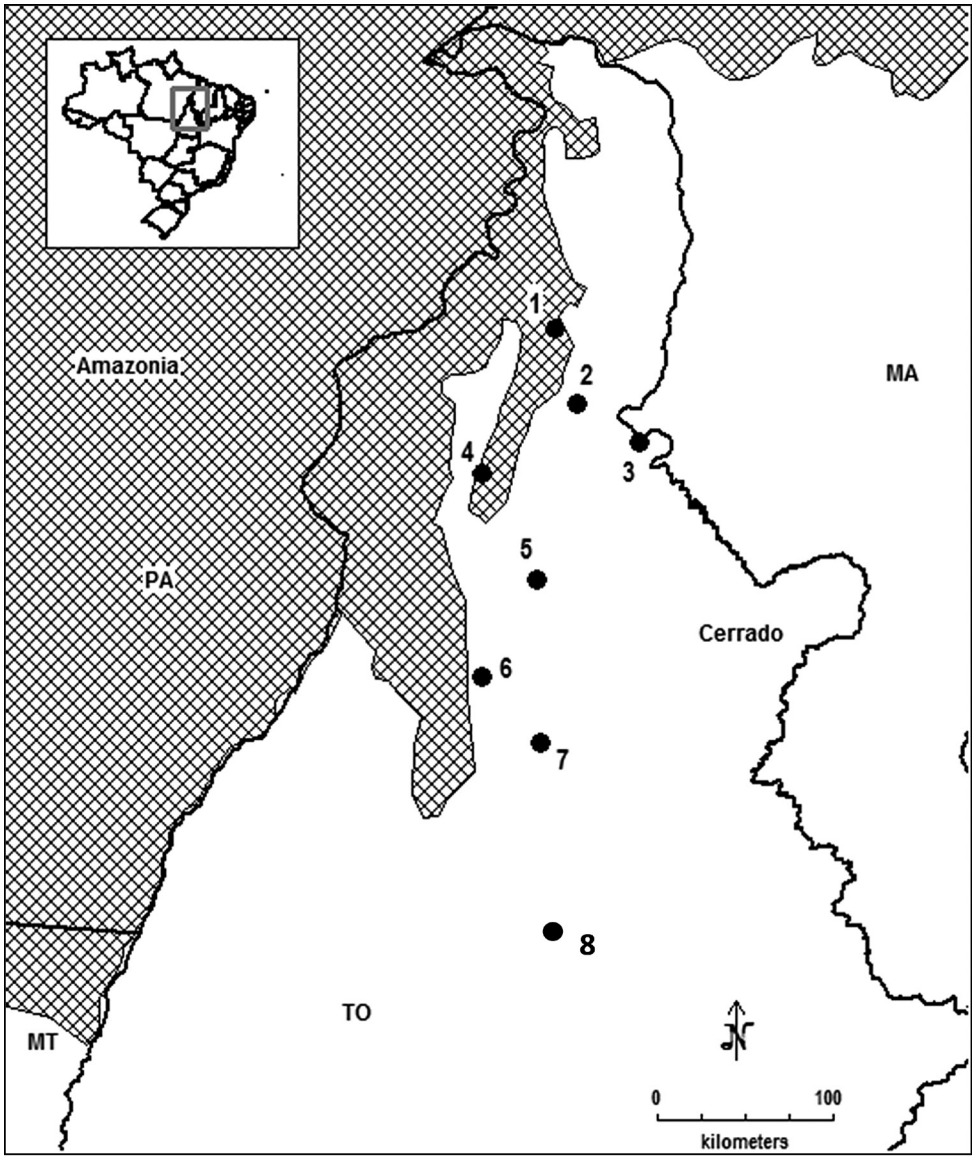

FIGURA 1. Localidades onde ocorreram os registros das espécies discutidas neste estudo. 1. Fazenda Sapucaia; 2. Córrego Sangue; 3. Córrego Cana-Brava; 4. Mata TO-266; 5. Afluente TO-335; 6. Mata do córrego Água Fria; 7. Córrego Porteira e 8. Campina, reservatório UHE LEM. Estados: PA – Pará, MA – Maranhão, TO – Tocantins e MT – Mato Grosso. Em branco o bioma Cerrado, em quadrículas o bioma Amazônico.

FIGURE 1. Sites where records were obtained with the species discussed in this study. 1. Fazenda Sapucaia; 2. Córrego Sangue; 3. Córrego Cana-Brava; 4. Mata TO-266; 5. Afluente TO-335; 6. Mata córrego Água Fria; 7. Córrego Porteira and 8. Campina, reservatório UHE LEM. States: PA – Pará, MA – Maranhão, TO – Tocantins e MT – Mato Grosso. The Amazonian biome is denoted in dashes while the Cerrado biome is shown in white.

Odonthophorus gujanensis (uru-corcovado)*:* ave típica da serrapilheira de terra firme, ocorre em toda Amazônia (Sick 1997, Sigrist 2006). No Tocantins, sua ocorrência foi assinalada pela primeira vez para município de Araguatins, extremo norte do Estado, devido às coletas realizada por J. Hidasi em 1964 (Dornas & Pinheiro 2011). Desde então, somente mais dois novos registros da espécie foram realizados para o Tocantins. Olmos *et al.* (2004) registraram a espécie nas florestas ombrófilas da Fazenda Sapucaia, enquanto os autores verificaram no dia 6 de outubro de 2009, um novo registro da espécie em remanescentes florestais nas divisas da Fazenda Sapucaia e Assentamento Costa Rica (6°44'14.07"S; 48°4'50.17"O) em Wanderlândia. Foram ouvidas e gravadas as vocalizações de pelo menos quatros indivíduos ao entardecer (Dornas 2009b). A exclusividade de registros recentes nas matas ombrófilas da Fazenda Sapucaia e a condição cinegética da espécie preocupam quanto à manutenção e conservação de *O. gujanensis* no Tocantins. Demais estudos de inventário realizados em outros remanescentes ombrófilos da região do Bico do Papagaio não conseguiram flagrar nenhum outro indivíduo (Olmos *et al.* 2004, T. D. *obs. pess.*).

Hydropsalis nigrescens (bacurau-de-lajeado): caprimulgídeo amazônico intensamente negro, é associado geralmente à ambientes rochosos como lajedos de granito (Ingels *et al.* 1984, Sick 1997) bem como bordas de florestas e ambientes ribeirinhos (Sigrist 2006, Erize *et al.* 2006). Registros da espécie no Tocantins eram desconhecidos (Dornas 2009a) até a coleta de um macho (COUFT 258), no dia 20 de outubro de 2009 nas matas ombrófilas da Fazenda Sapucaia, em Wanderlândia (6°44'11.63"S; 48° 5'54.55"O). Anteriormente à coleta, um casal pousado, em galhada seca de uma árvore caída, praticamente ao nível do solo, foi visualizado junto à trilha selecionada para prospecção. Inexistem lajedos ou rochas na região do registro e cursos d'água de volume expressivos se encontram há quase 1 km do local, contrariando assim a descrição típica de habitat apresentada para esta espécie anteriormente (Ingels *et al.* 1984, Sick 1997). Trata-se do primeiro registro *H. nigrescens* no Tocantins, cujo achado representa a adição de mais um táxon a lista de aves do Estado (Dornas 2009a) e ainda um aumento na distribuição geográfica da espécie (Sick 1997, Sigrist 2006, NatureServe 2007a). Outros dois novos recentes registros da espécie foram assinalados para a região do Centro de Pesquisa Canguçu, local com floresta ombrófilas inundáveis adjacente ao Parque Estadual do Cantão, no extremo oeste do estado, às margens do rio Javaés (Albano 2011, Barbosa 2011a). Muito provavelmente, a presença da espécie será confirmada em outros remanescentes ombrófilos do norte do Estado à medida que mais estudos forem realizados.

Nystalus striolatus (rapazinho-estriado): buconídeo endêmico da Amazônia, aparentemente dividido em duas populações, uma para região do baixo rio Tocantins e baixo rio Amazonas e outra na região da Amazônia ocidental, nas adjacências do rio Guaporé (Sick 1997, Sigrist 2006). No Tocantins sua ocorrência é assinalada para a região do rio Araguaia, em Santa Fé do Araguaia, por um único exemplar (MPEG 34649) coletado por Manoel Santa-Brígida em 1983 (Dornas & Pinheiro 2011). A ocorrência da espécie por meio de registros fotográficos e gravações sonoras também foi verificada na região de Ananás (R. T. P. *et al.* dados não publicados). O novo registro da espécie no Tocantins foi efetuado no dia 19 de janeiro de 2010, em remanescente de floresta ombrófila, no município de Presidente Kennedy próximo ao ribeirão Água Fria (8°31'46.75"S; 48°27'45.82"O). A gravação da vocalização da espécie (Dornas 2009c) consiste no quarto registro de *N. striolatus* em território tocantinense (Dornas 2009a), aumentando significativamente a distribuição geográfica da espécie no extremo sudeste amazônico (Sick 1997, Sigrist 2006, NatureServe 2007b). A presença da espécie nas matas ombrófilas próximas ao rio Araguaia, no sudeste do Pará (Somenzari *et al.* 2011), podem dar indícios da presença deste buconídeo em formações florestais ombrófilas do oeste do Tocantins.

Selenidera gouldii (saripoca-de-gould): Tucano quase-exclusivamente amazônico com ocorrência entre a porção oriental da Amazônia, Mato Grosso e margem sul do rio Amazonas até o Maranhão (Oren 1990, Sick 1997, Sigrist 2006). Possui um registro pontual no Ceará (Novaes & Cunha-Lima 1991, Sigrist 2006). No Tocantins, a espécie foi primeiramente registrada em Araguatins, em 1963, através da coleta de J. Hidasi (Dornas & Pinheiro 2011). Mais recentemente, a ocorrência de *S. gouldii* foi verificada em remanescentes de matas ombrófilas no norte do Tocantins (Olmos *et al.* 2004) e em Araguacema, região oeste do Estado (Oikos 2006), este último reforçado pelo registro da espécie no extremo sudeste do Pará através de espécime depositado no MPEG (Somenzari *et al*. 2011). Um novo registro foi obtido no dia 7 de outubro de 2009, com a visualização de quatro indivíduos em Wanderlândia (6°44'11.63"S; 48° 5'54.55"O), no mesmo remanescente de floresta ombrófila da Fazenda Sapucaia onde Olmos *et al.* (2004) detectaram este ranfastídeo. Um casal de *S. gouldii* também foi detectado, em 19 de janeiro de 2010, no remanescente de floresta ombrófila próximo ao ribeirão Água Fria, em Presidente Kennedy (8°31'46.75"S; 48°27'45.82"O). Ambos os registros tiveram as vocalizações da espécie gravada (Dornas 2009d, e, respectivamente), sendo que, o segundo registro estende a ocorrência da espécie para porção centro-norte do Tocantins e consequentemente a distribuição geográfica de *S. gouldii* para extremo sudeste amazônico.

Celeus obrieni (pica-pau-do-parnaíba): pica-pau em perigo de extinção em nível global (IUCN 2012), redescoberto após 80 anos de anonimato, era conhecido até em 2006 de apenas duas localidades: Goiatins e Uruçui (Prado 2006). Nos últimos anos, sucessivos registros aumentaram consideravelmente a área de distribuição geográfica da espécie, tanto em nível estadual quanto nacional (Santos & Vasconcelos 2007, Pinheiro & Dornas 2008, Dornas *et al.* 2009, Pacheco & Maciel 2009, Pinheiro *et al.* 2012). Os novos registros da espécie para o Tocantins ocorreram em matas de galeria associadas à cerradões e florestas ombrófilas mistas mesclados a densos e extensos tabocais (*Guadua paniculata*). No dia 16 de outubro de 2009 uma fêmea da espécie foi fotografada (Dornas 2009f) e teve sua vocalização gravada (Dornas 2009g) às margens da TO-226 em Araguaína (7°28'49.48"S; 48°27'27.46"O). Ainda no mesmo dia, nas margens de um pequeno afluente do ribeirão Água Fria, em Presidente Kennedy (8°33'18.14"S; 48°28'39.66"O) uma fêmea de *C. obrieni* foi novamente fotografada (Dornas 2009h) e teve seu chamado (Dornas 2009i) e tamborilar do casal gravados. Em ambos os pontos os indivíduos foram registrados após a reprodução de suas vozes através de playback.

Cercomacra manu (chororó-de-manu)*:* considerado endêmico da Amazônia este thamnofílideo foi descrito a partir de registros efetuados no Peru (Fitzpatrick & Willard 1990) tendo ocorrência confirmada no noroeste da Bolívia e Brasil (Fitzpatrick & Willard 1990, Zimmer *et al.* 1997) . Caracterizada por uma apresentar uma distribuição disjunta no Brasil, a ocorrência da espécie é assinalada para o estado do Acre, região de Alta Floresta no Mato Grosso (Sick 1997, Zimmer *et al.*1997, Sigrist 2006), região da Serra do Cachimbo (Sick 1997, Sigrist 2006) e recentemente na Serra dos Carajás (Dantas 2008) no sul e leste do Pará, respectivamente. Mais recentemente sua presença foi confirmada para o Estado do Tocantins, na região de Guaraí (Beadle *et al.* 2003) e também em Araguacema (Oikos 2006). Esses registros somados a outras gravações e fotografias da espécie depositadas nos portais Xeno-Canto e Wikiaves representam os únicos apontamentos conhecidos da espécie no Brasil. Todavia, apresentamos dois novos registros de *C. manu* no estado do Tocantins. O primeiro trata-se da coleta de um macho (COUFT 271) acompanhada da gravação de sua vocalização (Dornas 2010a), em 12 de janeiro de 2010, às margens da TO-226, em Araguaína (7°28'49.48"S; 48°27'27.46"O). O segundo refere-se à visualização de um casal e gravação sonora (Dornas 2011a) de um macho, em 1 de abril de 2011, nas margens do córrego Porteira, cerca de 200 m de sua foz com o rio Tocantins, no município de Tupirama (8°52'9.17"S; 48°9'42.06"O). Ambos representam os mais recentes registros de *C. manu* para o Brasil Central e delimitam uma nova distribuição geográfica desta espécie, ainda embasada em um padrão disjunto de suas populações. O primeiro registro ocorreu no mesmo cerradão com floresta ombrófila mista mesclado a um denso tabocal (*Guadua cf. paniculata*), onde foi registrado também *Celeus obrieni.* Durante algumas horas de prospecção neste local foi possível visualizar e ouvir pelo menos mais outros seis indivíduos de *C. manu*. O segundo registro foi efetuado na vegetação ripária do córrego Porteira, cuja abundância de tabocais (*Guadua sp*., identificação específica ainda não confirmada) é muito expressiva. Outra característica importante deste segundo local é a presença de uma mata de várzea com forte alagamento durante estação chuvosa e uma fitofisionomia característica das matas ciliares do rio Tocantins, onde o dossel é relativamente alto com árvores alcançando algo em torno de 20 m e alguns casos até 30 m, como constado em campo. Esta característica de alagamento com formação de várzea inundável não se perpetua nas porções mais à montante deste córrego onde inclusive a espécie também não foi detectada, sugerindo a presença de *C. manu* somente na sua porção mais próxima à foz com rio Tocantins. Ao longo dos 300 m prospectados entre o ponto exato do contato com o indivíduo gravado até a foz do referido córrego, foi possível detectar mais três indivíduos sem distinção do sexo, sugerindo a presença de dois casais. Entretanto, manifestações de vocalização durante esta prospecção foram escassas, ainda que incitadas por playback. Embora possa refletir baixa população, presume-se que nesta localidade exista uma população maior do que apenas os dois casais assinalados. Inclusive, é importante frisar que os padrões de plumagem da fêmea avistada diferem, a princípio, das fêmeas das populações da Amazônia ocidental onde predomina uma plumagem cinza-esverdeada. A fêmea visualizada no córrego Porteira apresentou uma plumagem cinza-amarronzada, diferença morfológica que do ponto de vista taxonômico pode reforçar as suspeitas de determinação das populações do centro-leste amazônico como uma nova espécie (Zimmer *et al.* 1997, Beadle *et al.* 2003).

Cercomacra ferdinandi (chororó-de-goiás)*:* espécie endêmica do bioma Cerrado (Silva & Santos 2005) e considerada vulnerável de extinção em nível nacional (MMA 2003, Machado *et al.* 2005), este thamnophílideo era há pouco tempo atrás considerado um endemismo tocantinense, devido sua conhecida ocorrência restrita a planície da Ilha do Bananal (Silva 1989, Silva 1997). A amostragem ornitológica em outras localidades ao longo da calha do rio Araguaia e rio Tocantins demonstraram a presença da espécie nas vegetações ripárias dos respectivos rios e afluentes nos Estados do Pará e Maranhão (Olmos *et al.* 2005, Vasconcelos & Werneck 2008). Um novo registro da espécie foi efetuado em pequeno afluente do rio Tocantins em Filadélfia, nordeste do Tocantins. Um casal da espécie teve suas vocalizações gravadas (Dornas

2009j) em 12 de outubro de 2009, nas matas de galeria do córrego Cana-Brava (7°19'20.77"S; 47°38'46.95"O). A região do registro localiza-se próxima ao município de Palmeirante, limite de ocorrência conhecido da espécie na calha do rio Tocantins (Olmos *et al.* 2005). Os diversos barramentos previstos no rio Tocantins para empreendimentos hidrelétricos, onde se destaca a UHE de Estreito, representam uma grande ameaça a população da espécie estabelecida na calha do rio Tocantins cujo tamanho populacional deverá ser fortemente reduzido (Olmos *et al.* 2005).

Synallaxis hypospodia (joão-grilo): Embora tenha ampla distribuição geográfica, assinalada desde o nordeste, passando pelo Brasil Central e alcançando regiões amazônicas, este furnarídeo tem como particularidade uma ocorrência pontual (Sick 1997, Ridgely & Tudor 1994, C. Albano *com. pess.* 2010). A distribuição da espécie é mencionada para todo o território tocantinense (Sigrist 2006), no entanto, a única menção de ocorrência deste furnarídeo no Tocantins refere-se à Ilha do Bananal, porém sem qualquer citação quanto à possível documentação da espécie (MMA *et al.* 2001). A confirmação de ocorrência de *S. hypospodia* para o Tocantins é resultante da gravação da vocalização de um casal (Dornas 2009k) e posterior coleta dos mesmos (COUFT 0259, 0260) em 10 de outubro de 2009. O registro foi realizado em volumoso capinzal exótico e típico de pastagens, entremeado a arbustos secos, às margens da rodovia TO-226, no município de Araguaína (7°30'20.56"S; 48°24'15.35"O). Tratam-se dos primeiros registros documentados da espécie no Estado, possibilitando assim, a adição de mais um táxon na lista de aves do Tocantins segundos critérios adotados por Dornas (2009a).

Synallaxis cherriei (puruchém): considerado um endemismo amazônico (Stotz *et al.* 1996) e globalmente quase-ameaçado de extinção (IUCN 2012), este outro furnarídeo é considerado uma espécie rara, sendo conhecida no Brasil em pouquíssimas localidades (Sick 1997, Zimmer *et al.* 1997, Aleixo *et al.* 2000, Pacheco *et al.* 2007). Alguns de seus registros mostram uma adaptabilidade a ambientes florestais mesclados a tabocais, porém sua presença em habitats florestais ausentes de bambus também procede (Aleixo *et al.* 2000). No Tocantins, essa espécie não apresentava nenhum registro (Dornas 2009a), sendo o primeiro para o Estado, resultante da gravação da vocalização (Dornas 2010b) e avistamento de um único indivíduo no dia 9 de janeiro de 2010, em remanescente de floresta ombrófila na Fazenda Sapucaia, em Wanderlândia (6°44'11.63"S; 48° 5'54.55"O). No local do registro não foi verificado nenhum sinal correspondente à presença de tabocais e anteriormente à gravação da sua vocalização e posterior reprodução da mesma, o indivíduo vocalizou intensa e insistentemente. Este registro possui dupla consequência: amplia em quase 300 km a distribuição geográfica da espécie para leste, já que seu limite anterior considerava a Serra dos Carajás (Pacheco *et al.* 2006) e a Fazenda Fartura (Somenzari *et al.* 2011), respectivamente no leste e sudeste do Pará, e ainda, representa a adição de mais um táxon a lista de aves do Tocantins (Dornas 2009a).

Attila spadiceus (capitão-de-saíra-amarelo): espécie polimórfica com ampla distribuição amazônica tem registros no Tocantins associados à porção norte e oeste do Estado (Olmos *et al.* 2004, Oikos e MRS 2005, Oikos 2006). Na porção central do Tocantins, *A. spadiceus* não apresentava, *a priori*, a mesma capacidade de estabelecimento de seu congênere *A. cinnamomeus*, várias vezes detectado nessa região do Estado (Bagno & Abreu 2001, Pinheiro 2004). Porém, em 18 de março de 2010, foi gravada a vocalização da espécie (Dornas 2010c) nas matas de galeria do córrego Porteira, afluente do rio Tocantins, em Tupirama (8°52'28.92"S; 48°12'6.92"O), região central do Estado. O indivíduo não visualizado vocalizava continuadamente. Este registro representa uma expressiva ampliação na distribuição geográfica da espécie, alcançando faixa transitória entre o Cerrado e Amazônia. *A. spadiceus* demonstra ser mais uma espécie associada às matas ciliares e de galeria dos rios Tocantins e afluentes nas porções mais centrais do Cerrado (Silva 1996).

Cotinga cotinga (anambé-de-peito-roxo): o macho desta espécie possui coloração notável, com uma combinação de azul e rosa púrpuro reluzente, ao contrário da fêmea pardacenta e sem brilho. Distribuída pela Amazônia oriental-setentrional (Ridgely & Tudor 1994, Sick 1997) com algumas ocorrências pontuais no extremo oriente amazônico, necessita de mais esclarecimentos sobre sua distribuição geográfica (Sigrist 2006). Inicialmente documentada para o Tocantins através de coleta em Araguatins, realizada por J. Hidasi entre 1962 e 1968, a presença de *C. cotinga* também é mencionada em matas próximas ao rio Araguaia em Araguacema, extremo oeste do Tocantins (Oikos 2006) e na porção norte do Tocantins, como em Wanderlândia (Olmos *et al.* 2004) e em Palmeiras do TO e Babaçulândia (Oikos 2002). Dois novos registros da espécie são apresentados. O primeiro, efetuado em 10 de maio de 2009, em fragmento de floresta ombrófila mista no município de Angico (6°29'10.70"S; 47°48'43.77"O), uma fêmea foi visualizada pousada em copa de árvore; o segundo, realizado em 18 de maio de 2009, consistiu no avistamento de um macho, pousado no topo de árvores na mata de galeria de um pequeno córrego, afluente do rio Tocantins, na rodovia TO-335, município de Palmeirante (8°1'15.64"S; 48°10'35.79"O). A fotografia deste macho, embora permita uma correta diagnose, não adquiriu consistente nitidez e boa qualidade fotográfica (Dornas 2009l). Este registro dista

aproximadamente 250 km e 650 km das localidades de Babaçulândia e Araguacema, respectivamente, os quais em conjunto a este segundo registro, representam um expressivo aumento na distribuição geográfica atual deste cotingídeo (Ridgely & Tudor 1994, Sick 1997, Sigrist 2006). Por fim, este registro em Palmeirante, mostra que *C. cotinga*, bem como *A. spadiceus,* são espécies amazônicas que utilizam as matas ciliares e de galeria dos rios Tocantins e afluentes para adentrar aos limites do Cerrado (Silva 1996).

Procnias averano (araponga-do-nordeste): espécie de cotingídeo considerada vulnerável de extinção no país (MMA 2003, Machado *et al.* 2005), possui plumagem inusitada, além de vocalização característica, cujo som lembra "marteladas em uma bigorna", atributos que fazem da espécie uma ave perseguida pelo tráfico de animais (Sick 1997, Sigrist 2006). Com uma ocorrência disjunta, a espécie está distribuída em populações nas Guianas, Trinidad e Tobago e Estado de Roraima e ainda em populações ao longo do nordeste do Brasil alcançando o Tocantins e o sudeste do Pará (Ridgely & Tudor 1994, Sick 1997, Sigrist 2006, Somenzari *et al.* 2011). No Tocantins, há registros no Jalapão entre os municípios de Mateiros e Dianópolis (Rego *et al.* 2010; R. T. P. & T. D. *obs. pess.*) e em Babaçulândia, leste do Estado (Oikos 2002). A presença da espécie também foi constatada na região do rio Piranhas, em Araguacema, oeste do Tocantins (Oikos 2006). Os novos registros da espécie foram efetuados em duas localidades. A primeira em remanescente de floresta ombrófila na Fazenda Sapucaia, em Wanderlândia (6°44'11.63"S; 48°5'54.55"O), onde no dia 07 de outubro de 2009 foi ouvida a vocalização da espécie e efetuada a gravação da mesma (Dornas 2009m). A segunda, um remanescente de floresta ombrófila adjacente ao córrego Sangue e tributários em Araguaína (7°7'5.80"S; 47°58'30.22"O), *P. averano* foi detectada, em 14 de janeiro de 2010, somente por meio de registro auditivo resultante de duas repentinas e rápidas "marteladas" que não mais se repetiram enquanto encontrávamos presentes naquela localidade, ainda que estimulada por playback. A forte e intensa fragmentação e supressão das formações florestais do norte do Tocantins (SEPLAN 2008) podem representar um elevado risco para a manutenção das populações de *P. averano* no Cerrado Norte. Mais agravado pode ser este iminente risco se estudos taxonômicos atuais comprovarem que as populações encontradas no Cerrado Norte tratam-se de uma nova espécie ainda não descrita (L. F. Silveira *com. pess.,* C. Albano *com. pess.*).

Rhytipterna immunda (vissiá-cantador): tiranídeo pouco conhecido, tem como habitat principal as formações vegetacionais abertas, como campinas e campinaranas, onde o solo é predominantemente formado por areia (Lanyon 1973, Sick 1997, Borges 2004). Embora tenha distribuição geográfica ampla, ocorre de forma pontual em toda Amazônia (Sigrist 2006, Ridgely & Tudor 2009). Nos últimos anos a espécie foi descoberta em novas regiões do Mato Grosso (Lees *et al.* 2008), Amazonas (Whittaker 2009) e Pará (Pacheco & Olmos 2005, Pacheco *et al.* 2007, Somenzari *et al.* 2011), preenchendo uma grande lacuna de sua ocorrência geográfica. No estado do Tocantins é exclusivamente conhecida a partir do registro de Olmos *et al.* (2004) para região de Ananás, no extremo norte do estado. Segundo os autores, a espécie estava associada às áreas de campinas, vegetação de porte médio com solo arenoso, localmente chamado de carrasco. Contudo um novo registro de *R. immunda* foi efetuado em remanescente de vegetação arbóreo-arbustiva, no município de Porto Nacional as margens do reservatório da UHE Luís Eduardo Magalhães (10°6'S; 48°26'O). Em 14 de agosto de 2011, por volta de 8:00h, após detecção auditiva, a espécie foi atraída por playback sendo fotografada (Barbosa 2011b) e gravada sua vocalização (Dornas 2011b). O local de registro apresenta uma vegetação visualmente semelhante às campinas do norte do estado, denominada de carrasco (Olmos *et al.* 2004). Embora nenhum esforço florístico tenha sido realizado, a vegetação do local se distinguia das formações de cerrado *sensu strictu* e cerradão da região, sendo o solo predominante arenoso. Assim como observado por Lees *et al.* (2008), *R. immunda* estava acompanhada de *Formicivora grisea*, *Hemitriccus margaritaceiventer* e *Neopelma pallescens*. Diferentemente das campinas do norte do Tocantins (Olmos *et al.* 2004), na região do atual registro não foram encontrado indivíduos de *H. minimus*. Por outro lado, a descoberta desta população de *R. immunda* associada a uma área de campina, com solo arenoso na porção central do Tocantins, gera grandes expectativas de registros inéditos de outras espécies típicas destes habitats conhecidos para porções tipicamente amazônicas.

Considerações finais

Os respectivos registros incrementam a listagem das aves elaborada por Dornas (2009a) em mais três espécies cujo aumento tem se dado constante com a indicação de outros novos primeiros registros para o Estado (Barbosa & Braz 2010, Crozariol & Leite 2010, Dornas *et al.* 2010, Pacheco & Olmos 2010). As várias espécies redescobertas para o Estado, dentre elas *Nystalus striolatus*, há quase 40 anos sem registros, bem como *Cercomacra manu, Odontophorus gujanensis*, *P. averano* e *Rhytipterna immunda* demonstram o quanto essa região ecotonal entre a Amazônia e o Cerrado, no centro-norte do Tocantins, é importante do ponto de vista biogeográfico.

Os achados de *C. manu* demonstram que a espécie,

embora tenha uma ocorrência pontual e disjunta, parece estar presente no estado do Tocantins numa faixa leste-oeste ao longo da porção centro-norte do estado rumo à Amazônia centro-ocidental, onde há outras populações de *C. manu* sabidamente estabelecidas. Considerando tal presunção, é muito possível que em algum local nas matas de várzea inundáveis no rio Tocantins ou no rio Araguaia *C. manu* possa ser simpátrica à *C. ferdinandi*, já que esta possui sua ocorrência relacionada a este ambiente em ambos os rios (Olmos *et al.* 2005, Vasconcelos & Werneck 2008). Caso tal condição fosse confirmada seriam os primeiros relatos de simpatria entre *C. manu* e alguma das espécies do gênero.

Outro aspecto com implicações biogeográficas interessante é a forte associação de *C. manu* a ambientes com tabocas (*Guadua paniculata* e *Guadua sp*.) e mata de várzea inundável conforme verificado nas localidades de registro apresentados e também pelos relatos já enunciados na literatura (Fitzpatrick & Willard 1990, Sick 1997, Zimmer *et al.* 1997, Beadle *et al.* 2003, Sigrist 2006). No entanto, um questionamento pertinente é se há populações de *C. manu* na margem direita do rio Tocantins ou se o mesmo atuaria como eficiente barreira biogeográfica.

Esta forte associação da espécie a este tipo de habitat, aliada a condição ecotonal de toda porção norte do bioma Cerrado sustenta a suspeita de que a espécie possa ter mais populações disjuntas ao longo da margem direita do rio Tocantins e consequentemente em seus afluentes em território do estado do Maranhão. As matas de galeria, ciliares e outras formações florestais no Maranhão apresentam condições ecológicas e florística semelhantes às encontradas no centro-norte do Tocantins, permitindo abrigar elementos da avifauna amazônica (Santos *et al*. 2010), bem como a presença de tabocais (*Guadua sp*.), que asseguram a ocorrência confirmada de *Celeus obrieni* (Santos & Vasconcelos 2007, Santos *et al.* 2010), espécie sintópica a *C. manu* no Tocantins, conforme registro apresentado para Araguaína. Porém, os projetos de construção de usinas hidrelétricas ao longo da calha do rio Tocantins são uma ameaça muito forte a possíveis respostas, pois os reservatórios instalados e ainda previstos inundam as várzeas sucumbindo possíveis populações não descobertas como parece ter ocorrido com *C. laeta*, que teve uma população recém descoberta na margem direita do rio Tocantins nas proximidades da UHE de Estreito, no Maranhão (Buzzetti 2004).

A presença de *R. immunda* nesta porção central do Tocantins associada a uma vegetação arbórea-arbustiva sobre um solo tipicamente arenoso, remetendo as campinas de diferentes partes da Amazônia, demonstra que esse singular habitat está localizado muito além dos limites amazônicos. Em consequência disto, uma particular avifauna pode ainda estar por ser descoberta, já que espécies tipicamente associadas a campinas como *Hemitriccus minimus* e *Xenopipo atronitens* foram registradas nos limites setentrionais do Tocantins (Olmos *et al.* 2004, T. D. & R. T. P. *obs. pess.*). Contudo, estas campinas da porção central do estado já foram parcialmente eliminadas, pois expressiva parcela foi submersa durante o enchimento do reservatório da UHE de Luís Eduardo Magalhães, principalmente aquelas partes conectadas as matas ciliares do rio Tocantins. Portanto, além de inventários ornitológicos mais sistematizados e recorrentes, esses ambientes merecem atenção especial dos poderes públicos estaduais e municipais, já que a região vem sofrendo grande especulação imobiliária para estabelecimento de áreas residenciais e recreação.

Por outro lado, é notório o quanto os registros apresentados refletem um potencial enorme a outros achados inéditos e/ou de extrema relevância para o Tocantins, indicando a presença de uma diversidade de aves ainda maior nessa porção leste da Amazônia, sendo muito bem ilustrados pelos os primeiros registros de *Hydropsalis nigrescens, Synallaxis cherriei e S. hyposposdia.* Entretanto, cabe salientar que esta região norte do Tocantins apresenta um elevado grau de modificação e antropização, sendo estimada a existência de 15% a 30% de cobertura vegetal nativa (FUNCATE 2007, SEPLAN 2008), com possibilidades de maiores reduções ao longo dos próximos anos.

Este cenário reflete em uma situação drástica e delicada para conservação e manutenção das espécies de aves amazônicas em território tocantinense, pois deve culminar em curto e médio prazo, em uma inevitável categorização das espécies de aves amazônicas a algum grau de ameaça de extinção em nível estadual. Concomitante, outras espécies de aves amazônicas devem estar inseridas nessa região, demonstrando portanto, o quanto essa porção ecotonal entre Cerrado e Amazônia no estado do Tocantins é relevante para o avanço do conhecimento ornitológico brasileiro.

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ARTICLE

Description of the nest, nestling and broken-wing behavior of *Conopophaga aurita* (Passeriformes: Conopophagidae)

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ABSTRACT: The Chestnut-belted Gnateater is an Amazonian species with a wide distribution, but few studies exist on its reproductive biology and behavior. In this paper we describe the nest and aspects of the behavioral repertoire employed in nest defense. Observations were made on the Dimona farm, in the municipality of Presidente Figueiredo, state of Amazonas. On December 8, 2010, we observed a female Chestnut-belted Gnateater doing a "broken wing" display, suggesting that the parent was trying to distract us away from an active nest nearby. On December 10, we found the nest on a fern at a height of 56 cm, containing a feathered chick; two days later, the chick was no longer in the nest. The height, shape and material of the nest, were similar to those of other *Conopophaga* species in which the clutch size is two, but commonly producing only one surviving nestling.

KEY-WORDS: Breeding, chick, egg, nesting, reproduction.

INTRODUCTION

The family Conopophagidae comprises eight insectivorous Neotropical species (Whitney 2003). Little is known about their habits, and their natural history and biology are poorly known (Hillman & Hogan 2002, Whitney 2003). They are small birds, some with flashy colors, even including red tones. They often perch on twigs close to the ground, standing upright, and can stand still for long periods (Sick 1997).

The Chestnut-belted Gnateater (*Conopophaga aurita*) is an Amazonian endemic species with the widest distribution in the genus; despite the wide distribution, few studies exist of its reproductive biology and behavior. In French Guiana, the breeding period is between March and April, and a fledged offspring was observed in Manaus in July (Whitney 2003). Here, we describe the nest of this species and aspects of its behavioral repertoire in defending the nest.

METHODS

The observations were carried out in a 100 ha forest fragment on the Dimona farm (2°24'43.36"S; 60° 5'26.61"W), in the municipality of Presidente Figueiredo, about 80 km north of Manaus, state of Amazonas. Dimona is part of a set of upland forest fragments overseen by the "Biological Dynamics of Forest Fragments" - PDBFF in partnership with the Instituto Nacional de Pesquisas da Amazônia - INPA. Within the fragment there are five east-west trails at 200 meters intervals, connected by a central north-south trail 1 km long.

The observations of the defensive behavior and parental care totaled approximately 15 hours. For measurements of the nest and chick, we used a tape measure with an accuracy of 1 cm, calipers with an accuracy of 1 mm, and scales accurate within 1 gram.

RESULTS

During the field study, the trails of the fragment were visited for five days, and on the morning of 8 December 2010, D. B. M. saw a female Chestnut-belted Gnateater displaying broken-wing behavior, suggesting the presence of an active nest nearby.

We returned on consecutive days to locate the nest and to conduct further observations. We returned to where the distraction display (broken-wing) occurred on the

afternoon of 8 December, and again saw the broken-wing display (Figure 1) by the female. The male was observed near the site, but did not engage in distraction display. On 9 December, in the morning, we observed both female and male performing broken-wing displays. The male displayed a short distance from its partner, but in a spot that would be less conspicuous to potential predators. Both vocalized and repeatedly dragged their wings along the ground, flying into the vegetation if we approached more closely. We observed the female with a small insect in its beak, presumably intended as food for the nestling or fledgling. The female began broken-wing distraction displays while we conducted an active search for the nest. The male was seen 5 m away, perched on a twig.

On the morning of 10 December, we returned and immediately observed the female. It was continuously foraging on the ground. It held a small insect in its beak, and was attentive to our movement. On at least two occasions, the female disappeared for a few seconds, doing broken-wing displays until it was out of sight, then reappearing without food in its beak. During this period, we did not search for the nest, instead focusing on the movements of the adults. Later that day, we returned to the place where the pair met and found the nest with a fledgling at an advanced stage of development, feathered and almost the size of the adults (Figure 2).

The fledgling weighed 16 g, with a total length of 80 mm and a wing length of 45 mm. It had no tail, the tarsus was 27 mm, and bill length was 89 mm. Its plumage was white on the belly, brown slightly streaked with yellow on the back, and brown on the breast. During the nearly 20 minutes we measured the nest and fledgling, the female continued broken-wing displays within 1 m of us, but when the nestling began calling, it approached even closer, with more acute and repetitive vocalizations, bristling and exposing conspicuous white eyebrows. Occasionally,

FIGURE 1. Female Chestnut-belted Gnateater *Conopophaga aurita* showing broken-wing behavior, observed at the Dimona farm, Municipality of Presidente Figueiredo, Amazonas, Brazil (9 December 2010).

it stopped moving and intently observed our activity with the fledgling.

The nest was 56 cm above the ground, built on an epiphytic fern affixed to the trunk of a small tree. It was lined with 11 broad dark green leaves. The exterior of the nest consisted of dried leaves of dicotyledons and palms (Poaceae), both whole and fragmented, and thin dry sticks. The exterior color was various shades of beige, 123 mm in diameter and 96 mm in height; the nest was lined with dark fine roots, with a diameter of 58 mm and a depth of 32 mm (Figure 3).

On the morning of 11 December we inspected the nest from a distance, and the fledgling was alive inside. On the morning of 12 December, the nest was empty and intact, showing no signs of predation.

During the search for the nest, we moved in various directions, assuming that the female was trying to draw us the opposite direction from the nest. We made reference points, with small branches, to where the female did broken-wing behaviors before flying. After we had found the nest we were able to determine a radius of approximately four meters around the nest within which it conducted its distraction displays. It moved in at least four different directions, "protecting" an area of approximately 48m^2.

Whenever we were more than 6 meters from the nest, the female returned to somewhere within the 48 m^2 vicinity of the nest.

FIGURE 2. Nestling of Chestnut-belted Gnateater *Conopophaga aurita* photographed at the nest at Dimona farm, Municipality of Presidente Figueiredo, Amazonas, Brazil on 9 December 2010.

FIGURE 3. Nest of the Chestnut-belted Gnateater *Conopophaga aurita* in an epiphytic fern at Dimona farm, Municipality of Presidente Figueiredo, Amazonas (picture taken on 10 December 2010).

DISCUSSION

Broken-wing can be considered a secondary defense, which is used when a potential predator is very close to the nest (Edmunds 1974). Broken-wing is part of the behavioral repertoire of many avian species, in many families such as Charadriidae and Caprimulgidae, as well as in other species of the genus *Conopophaga* (Deane 1944, Hilmar & Hogan 2002, Vasconcelos *et al.* 2003). In the case of Gnateaters, this behavior tends to be more intense during the final stage of reproduction, when the chicks are almost ready to leave the nest (Whitney 2003). It appears to serve to distract the predator away from the nest or nestling (Deane 1944, Hilty 1975).

The Chestnut-belted Gnateater, particularly the female, exhibited this behavior when we approached within about 4 m of the nest. Similar behavior, stimulated by observer approach to within about 4 m of the nest, has been observed for Ash-throated Gnateater *C. peruviana* (Hillman & Hogan 2002).

Our observation of just one fledgling differs from the clutch of two eggs in Manaus described by Whitney (2003), though he, too, found only one fledgling out of the nest. The previous nest was found in July, not December, as in this study. Other studies described one egg and one nestling for Ash-throated Gnateater (Hilman & Hogan 2002) and two eggs but only one fledgling for Chestnut-crowned Gnateater (Hilty 1975). For the Rufous Gnateater, Sick (1997) noted the presence and survival of two nestlings.

The nests of both the Chestnut-crowned Gnateater and Ash-throated Gnateater were at heights (65 cm and 70 cm, respectively) similar to those for our Chestnut-belted Gnateater nest. The shape, material and measurements of those nests were also similar to ours (Hilty 1975, Hilman & Hogan 2002). The Chestnut-belted Gnateater nest found by Whitney (2003) was 80 cm above the ground, and he stated that most nests for this genus of birds are less than 1 m above, but never on, the ground.

Sick (1997) and Whitney (2003) also noted similar forms and materials for their nests, such as dried leaves and twigs, suggesting that fairly similar nest construction and distraction displays occur across the genus *Conopophaga*.

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ARTICLE

Bird community structure and dynamics in the campos rupestres of southern Espinhaço Range, Brazil: diversity, phenology and conservation

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ABSTRACT: "Campos rupestres" comprises the open vegetation growing above 900 m altitude mainly along the Espinhaço Range, eastern Brazil. We presents the first thorough assessment concerning the bird community structure and dynamics in campos rupestres of southern Espinhaço, in the western slope of Serra do Cipó. We investigated the species richness, composition, abundance, seasonality, and conservation. From 2005 to 2007 we performed visual and acoustic detections and mist-netting. Every species was categorized according to two types of classification schemes that reflect its pattern of occurrence and seasonality: Frequency of Occurrence (FO) and Phenological Category of presence (PC). We recorded 81 species, including endemics, endangered, and new records. The 287 mist-netted individuals showed a multi-modal abundance distribution among species, suggesting that the community has few common and many rare species. The most abundant species was a campos rupestres endemic hummingbird, the Hyacinth Visorbearer *Augastes scutatus*. The same pattern was verified for the FO, with few "Common" (5%) and many "Occasional" (27%) species. Regarding the PC, almost half of the species were categorized as "Residents" (47%), 14% as "Migratory", and 31% as "Occasional visitors". The annual occurrence pattern of the seasonal species differ by "Occasional visitors" being more narrowly concentrated than "Migratory" species. We discuss the occurrence and phenology patterns of species and some threats to the campos rupestres. Although relatively poor in species richness, the Cipó campos rupestres avifauna has a distinct composition, and we suggest that the patterns found here reflect a general dynamic for the campos rupestres habitat as a whole. Our results may be useful in further investigations concerning the existence of distinct ecosystems within "campos rupestres" complex, and may also provide a baseline for future assessments of the conservation status of those threatened ecosystems.

KEY-WORDS: Avian assemblage, highlands, mountaintops, seasonality, Serra do Cipó, Minas Gerais, *Augastes scutatus.*

INTRODUCTION

"Campos rupestres" (rocky fields or rocky grasslands) harbor a wide variety of physiognomies, but is recognized by its typical open vegetation of grasses, herbs and scattered small bushes growing on rocky outcrops and shallow quartzite soils above 900 m (Ribeiro & Walter 1998, Benites *et al*. 2003). This ecosystem occurs mainly along the Espinhaço Range ("Cadeia do Espinhaço"), a mountain range in eastern Brazil that is an important centre of plant diversity (Giulietti *et al*. 1997, Jacobi *et al*. 2007) and animal endemism (Stattersfield *et al*. 1998, Silva & Bates 2002, BirdLife International 2003, Vasconcelos *et al*. 2008a, and references therein). Because of its distinctive flora, degree of endemism and significant anthropic pressures, the Espinhaço Range was recently declared an area of extreme importance for biodiversity conservation (Drummond *et al*. 2005).

Compared to the numerous taxonomic and ecological studies on its flora (Giulietti *et al*. 1997), very little is known about the avifauna assemblages of the campos rupestres of Espinhaço Range. Most of our current knowledge about the bird community is restricted to standard species checklists (*e.g.*, Willis & Oniki 1991, Parrini *et al.* 1999, Melo-Júnior *et al*. 2001, Machado 2005, see detailed revision in Vasconcelos *et al*. 2008a). A recent work shows 205 bird species recorded in the campos rupestres of Espinhaço, predominating wide-ranging species (85.9%), but also Atlantic Forest (7.3%), Caatinga (0.5%), Cerrado (2.9%,) and seven endemic to the open-habitats of southeastern Brazilian mountaintops (3.4%) (Vasconcelos & Rodrigues 2010).

Although the species composition can be the most relevant property on community studies, other parameters like bird species abundance, temporal and spacial distribution remains unknown for this ecosystem. Those parameters provide more substantial data about the local ecological dynamics (Wiens 1989).

We present the first thorough assessment of the bird community structure and dynamics in campos rupestres

of the southern Espinhaço Range, in southeastern Brazil. Here, we focus on species richness, taxonomic composition, relative abundance, frequency of occurrence, seasonality, and conservation status of the species at this highly threatened ecosystem.

MATERIAL AND METHODS

Study Area

The bird community was studied in a campos rupestres area called 'Alto da Boa Vista', hereafter ABV (19°17'- 19°18'S; 43°34'- 43°35'W). This area is the type locality of the Cipó Canastero *Asthenes luizae,* one of the most recently described furnariid (Vielliard 1990). ABV is located on the western slope of the Serra do Cipó mountains, nearby the Parque Nacional da Serra do Cipó, southern portion of Espinhaço Range, in the municipality of Santana do Riacho, state of Minas Gerais, southeastern Brazil (Figure 1). Serra do Cipó region shows little variation in annual and monthly averages temperatures (Madeira & Fernandes 1999, Rodrigues *et al.* 2011) but a high daily amplitude in temperature, a general pattern observed for most campos rupestres (Ribeiro & Walter 1998). Mist is relatively common within the first few hours of the day, but mainly during the rainy season (*pers. obs.*). There is extreme variation in rainfall, with very wet summers (mainly from November to January) and very dry winters (mainly from May to September) (Madeira & Fernandes 1999, Rodrigues *et al.* 2011).

For study site, we selected a 200 ha area with an altitudinal range from 1,180 to 1,360 m a.s.l., largely covered by rock outcrops with typical campos rupestres plants (Giulietti *et al*. 1997). Additionally, there is a portion of open grassland surrounding the rock outcrops, patches of temporary small marshes with a dense cover of scrub along a seasonal stream, and a narrow strip of riparian forest with small trees along of a perennial stream.

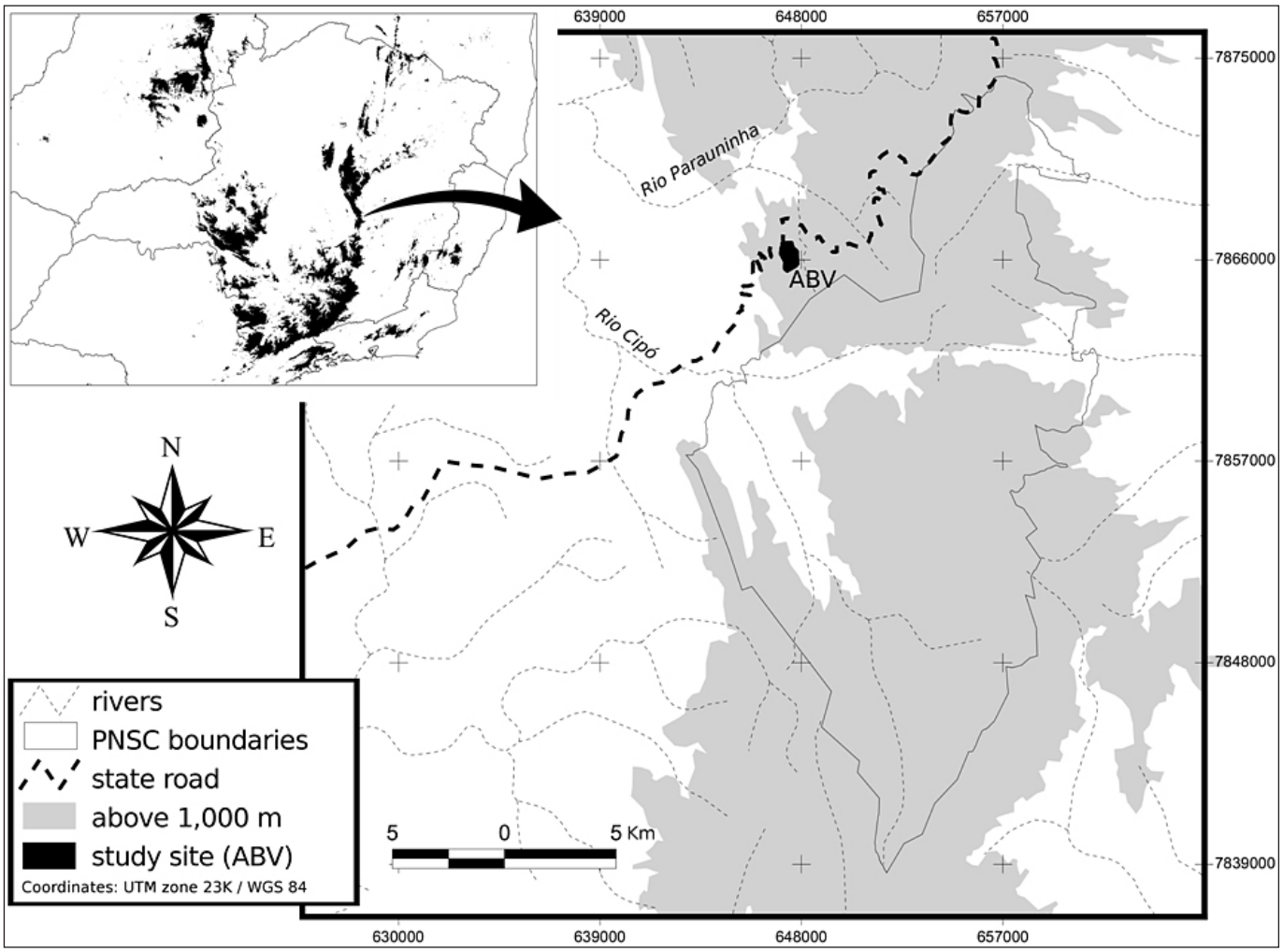

FIGURE 1. Location of 'Alto da Boa Vista' (ABV), nearby the Parque Nacional da Serra do Cipó (PNSC), on the western slope of Espinhaço Range. On the upper left, the location of ABV in Minas Gerais state, southeastern Brazil (dark areas above 1,000 m).

Sampling Methods

Field work period, from July 2005 to August 2007, included 104 days in 22 months. To access the community species richness, composition, relative abundance and seasonality we employed two basic sampling methods: visual and acoustic detections, and mist-netting.

Visual and acoustic detections were performed along slow walking with frequent stops throughout the study site. This method was employed over all 104 field work days in a total sampling effort of *c.* 620 hours. All birds seen or heard were identified using 8x40 binoculars and sound recordings (Sony TCM-5000EV with microphones Sennheiser ME-66).

Mist-netting was carried out in a 25 ha core area of the study site that lies within rocky outcrops cut by a seasonal stream. In that area, we placed 2 to 17 nets per day (12 x 2.5 m, 36 mm mesh) during 45 days along 14 months spread over the field work period, producing a total effort of 72,551 h.m² (computed according to Straube & Bianconi 2003). In each of the 12 months of the year (January - December) the average effort was (mean ± SD) 14.8 ± 10.9 nets or 6,046.6 ± 5,584.6 h.m². Each captured bird was identified and banded with a unique combination of colored plastic leg bands and a metal alphanumeric band (provided by the *Centro Nacional de Pesquisa para Conservação de Aves Silvestres* - CEMAVE/IBAMA), allowing individual recognition.

Analysis

The community species richness and composition were the sum of all species recorded by both methods (visual and acoustic detections and mist-netting; Rodrigues *et al.* 2005). To analyze species richness, we plotted a species discovery curve with sampling days as the unit of effort (Robertson & Liley 2000) and estimated the predicted species richness with extrapolation using a first-order jackknife estimator. Calculations were made using 'EstimateS' software with 95% confidence intervals (Colwell 2005).

Species abundances were estimated based on the number of individuals captured on mist-nets, excluding recaptures. We recognize that sampling with nets can be biased because only some species can be captured. Nonetheless, those data provide a rough estimate of the relative proportion of individuals, bringing information about the most abundant species and about the equitability from this subset of the community. To analyze the relative abundances of species we constructed a rank-abundance diagram, ordering the species from the most to the least captured. We divided the total number of captured individuals by the total of captured species, finding a hypothetical number of individual birds per species that represents the maximal value of equitability or diversity (evenness). We then analyze the proportion of species above and below this number.

Every recorded species during all field work period (104 days) was assigned to two types of classification schemes designed to reflect its pattern of occurrence and seasonality: Frequency of Occurrence (FO) and Phenological Category of presence (PC). Those analyses were based mostly on visual and acoustic detections, but we also addressed a category to two species that were recorded exclusively by mist-netting only a single time (see results).

FO was based on the proportion of effort units (days) in which a given species was detected. Six categories of FO were used, being five adapted from Naka *et al.* (2002) and Rodrigues *et al.* (2005): 'Common', recorded 75-100% of the visits; 'Fairly common', 50-74 %; 'Uncommon', 25-49%; 'Rare', 6-24%; 'Occasional', less than 5% of the visits. An additional category, 'Single record', was used for species only recorded on a single day.

For the PC classification we first calculate the monthly Pattern of Frequency of species (adapted from Figueira *et al.* 2006). Every species records were clustered throughout a hypothetical year in order to estimate the number of months (1-12) a particular species was present in the area. Based on the results, we assigned to species one of the following phenological categories (according to suggestions of Donatelli *et al.* 2004): 'Residents', species with at least one record during each period of four consecutive months; 'Migratory', species having at least four consecutive months without records in the area, but with at least three months of recorded occurrence overall; 'Occasional visitors', species recorded in only one or two months throughout the year; and 'Undefined', those that do not match any of those categories.

The taxonomy used here follows CBRO (2011). Endemic status for Cerrado, eastern Brazilian mountaintops, and campos rupestres follow Silva & Bates (2002) and Vasconcelos (2008). Regional and global conservation status follow Machado *et al.* (1998) and BirdLife International (2012).

RESULTS

Species richness

Eighty-one species of 30 families and 13 orders were recorded (Appendix). Most species belong to the families Tyrannidae (14 species), Trochilidae, and Emberizidae (eight species each). Passeriformes was the richest order (46 species, 57% of the total richness) followed by Apodiformes (nine species, 11%) and Accipitriformes (five species, 6%). A Jackknife first-order estimate predicted that 93.88 ± 3.64 bird species are likely to appear in the sampling area (Figure 2).

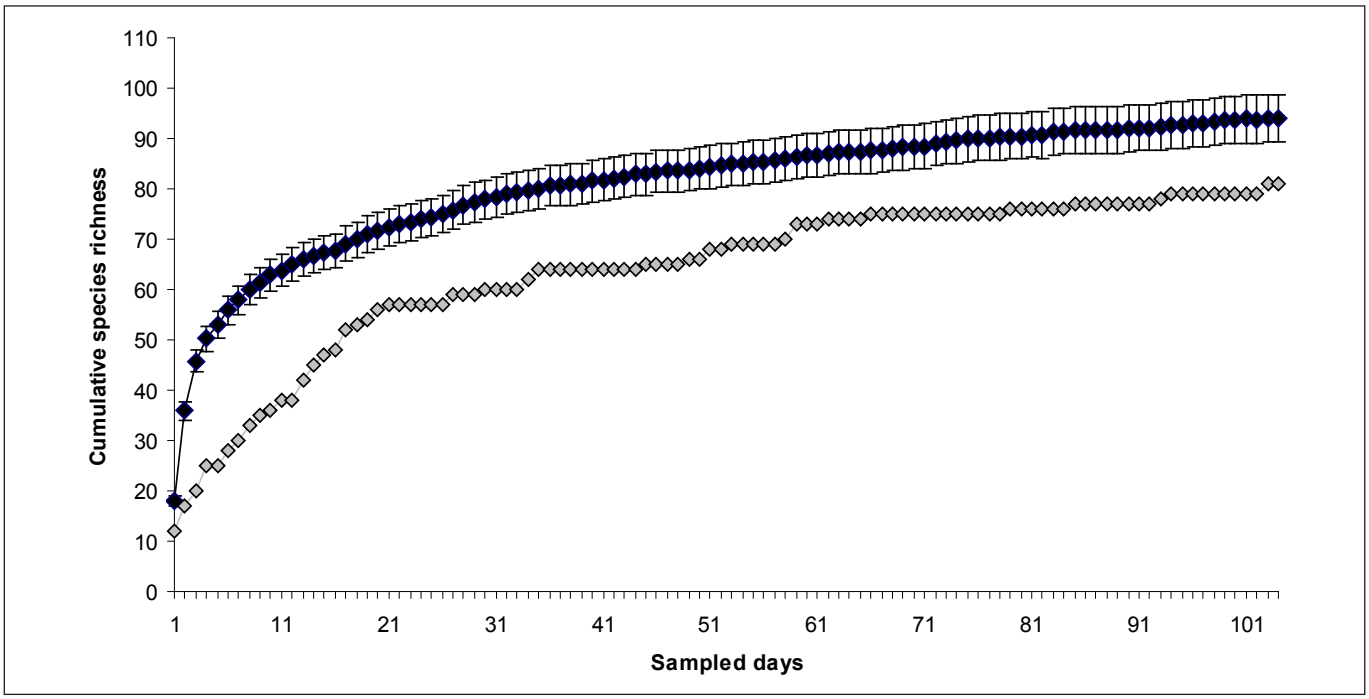

FIGURE 2. Species discovery curve of observed (gray) and estimated (black) bird species during 104 sampled days from July 2005 to August 2007 at 'Alto da Boa Vista', a campos rupestres area of the Serra do Cipó mountains, Brazil. Vertical lines represent 95% confidence intervals around the mean.

Species composition

Ten percent of the species recorded in ABV are endemic to some restricted area (Appendix). Four species are considered endemic to the Cerrado (*Cyanocorax cristatellus, Saltatricula atricollis, Porphyrospiza caerulescens,* and *Poospiza cinerea*), four are endemic to the eastern Brazilian mountaintops (*Augastes scutatus, Asthenes luizae, Polystictus superciliaris* and *Embernagra longicauda*). *Augastes scutatus* and *A. luizae* are restricted to campos rupestres of the southern portion of Espinhaço Range.

Six percent of all recorded birds are of conservation concern, recognized as threatened (*P. cinerea* – Vulnerable) or near-threatened species (see Appendix). *Asthenes luizae* and *P. cinerea* are also regionally threatened in Minas Gerais.

Seven of the species observed in this work were recorded for the first time in campos rupestres of the Serra do Cipó (Willis & Oniki 1991, Melo-Júnior *et al.* 2001, Vasconcelos & Rodrigues 2010, Rodrigues *et al.* 2011). *Chrysolampis mosquitus* and *Turdus flavipes* were not recorded even in other habitats of Serra do Cipó (Rodrigues *et al.* 2005, Mesquita *et al.* 2008). *Hydropsalis parvula* and *Veniliornis mixtus* were not recorded in any other locality of campos rupestres of Espinhaço Range (Vasconcelos & Rodrigues 2010) (Appendix).

Abundance

We mist-netted 287 individuals of 40 species, belonging to 16 families and five orders. These species represents 49% of the total richness that we recorded at ABV. In this subset of species, the richest families were the same of the whole community: Tyrannidae (eight species, 20% of total captures), Trochilidae and Emberizidae (seven species each, 18%). Belonging to those families, are also the most abundant species in ABV: *A. scutatus*, with 68 mist-netted individuals (24% of the captured birds), *Elaenia cristata* (34 individuals, 12%), and *Zonotrichia capensis* (28 individuals, 10%).

With the total numbers of individuals and species captured, we would find 7.2 individual birds per species if the number of captured individuals was evenly distributed amongst the species (maximum equitability). Considering this estimate, nine species (22.5%) are more abundant than predicted (> 7.2 birds) and 31 (77.5%) are less abundant (< 7.2 birds). Sixteen (40%) species were mist-netted only once (Figure 3), including the only two species that were not recorded by visual or acoustic detections: *Amazilia lactea* and *Turdus flavipes* (Appendix).

Frequency of Occurrence and Phenology

The number of species by FO category tends to increase from "Common" (four species, 5%) to

"Occasional" (22 species, 27%; Figure 4). Additionally, thirteen species (16%) were recorded only once in ABV (FO "Single record"), such as *Heterospizias meridionalis*, *Zenaida auriculata*, and *Pitangus sulphuratus.* The only few Common species were the same of the most captured (*A. scutatus*, *Elaenia cristata*, and *Z. capensis*) plus *Schistochlamys ruficapillus* (Appendix)

The analysis of the monthly Pattern of Frequency revealed that most species appeared in ABV either throughout the year (11 to 12 months, 30%) or during just a small part of the year (1 to 2 months, 30%). However, 13 (87%) of the 15 species only found in one month are those recorded only once (FO of "Single record"). When these are excluded from the analysis,

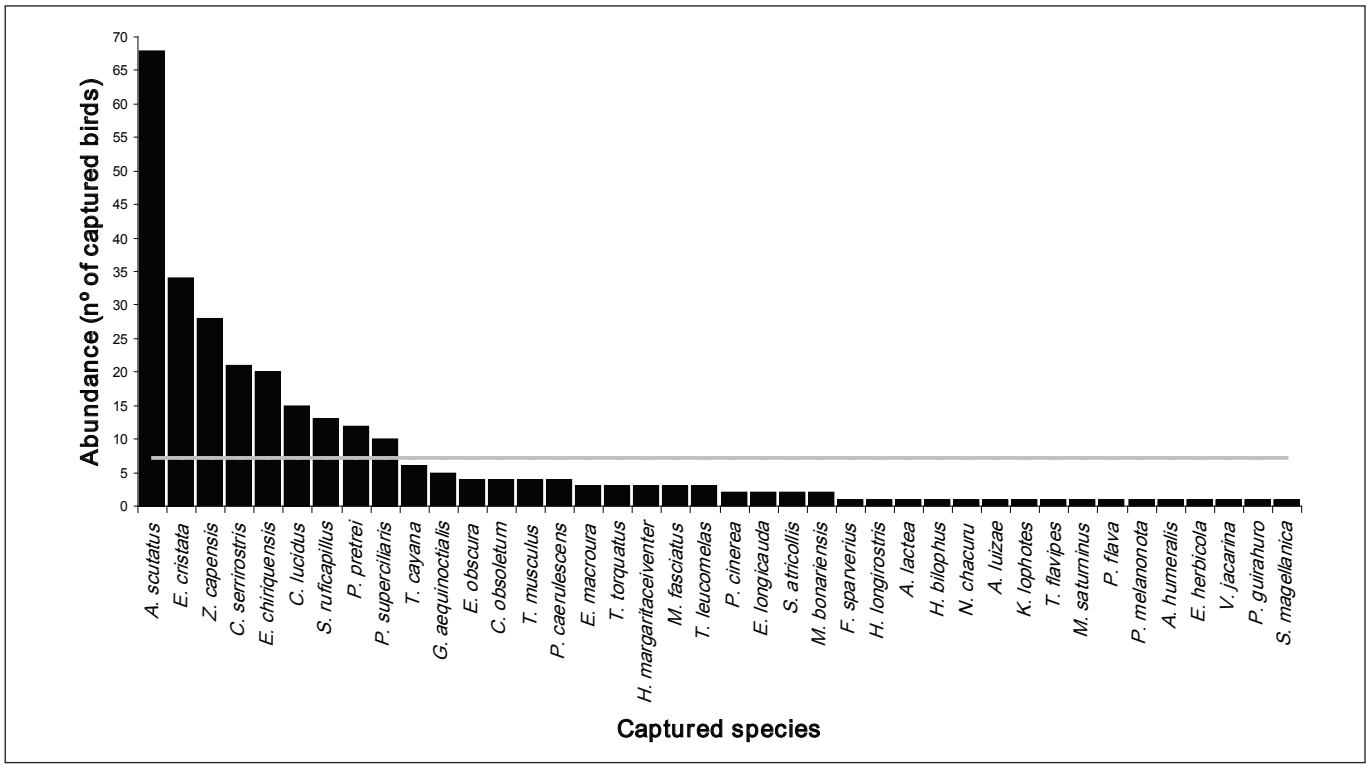

FIGURE 3. Rank-abundance diagram of mist-netted bird species during 45 sampling days from July 2005 to August 2007 at 'Alto da Boa Vista', a campos rupestres area of the Serra do Cipó mountains, Brazil. The gray line indicates the most homogeneous abundance (7.2 individuals per species; see text for details).

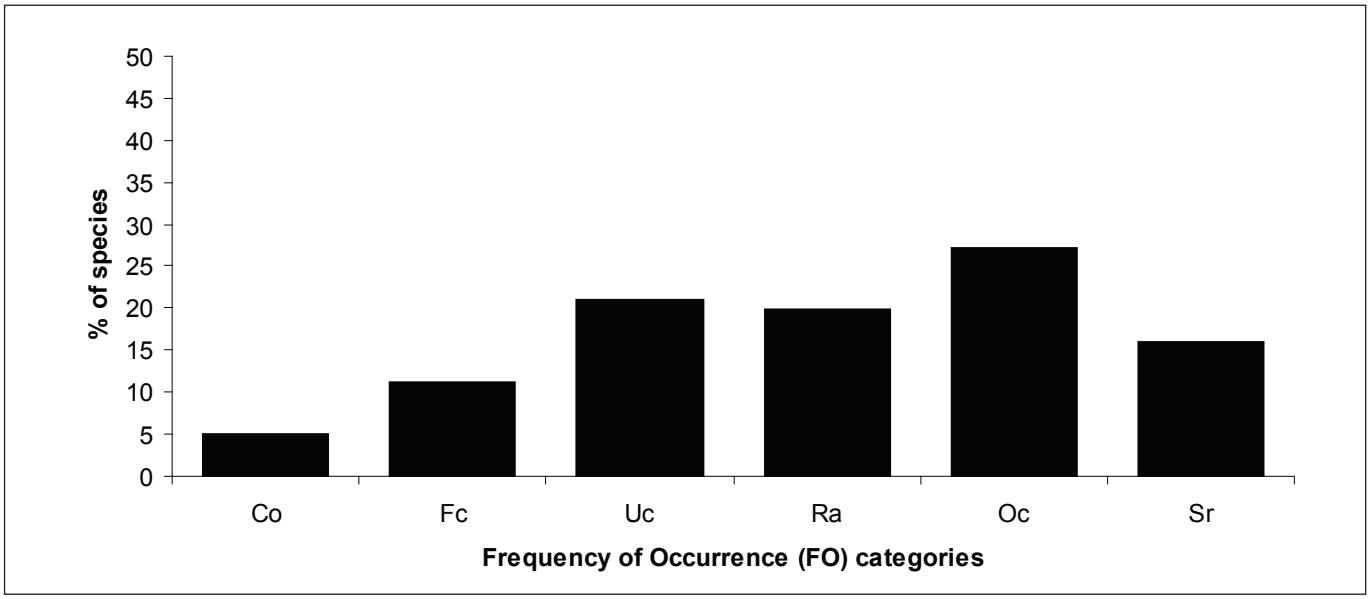

FIGURE 4. Distribution of the Frequency of Occurrence (FO) categories of bird species recorded from July 2005 to August 2007 at 'Alto da Boa Vista', a campos rupestres area of the Serra do Cipó mountains, Brazil. Percentage of species by categories: Co, "Common"; Fc, "Fairly common"; Uc, "Uncommon"; Ra, "Rare"; Oc, "Occasional"; Sr, "Single record". See text for details.

more than one third of the remaining species appear in ABV throughout the year (35%) and only a few occur during just a few months (18%; Figure 5).

Almost half (38 species, 47%) of the species recorded were categorized according to the PC as "Residents' at ABV (Figure 6). Eleven species were "Migratory" (14%) and 25 "Occasional visitors" (31%); but 13 of "Occasional visitors" species (52%) were those categorized as "Single record". However, even after excluding these species from the analysis, "Occasional visitors" remains the second richest PC of the community (Figure 6).

Most of the species considered as "Migratory" and "Occasional visitors" show a very similar monthly pattern throughout the year, occurring from mid-winter until the end of summer, with a peak of record in August (Table 1). Analysis of these PC categories separately indicates a slight difference in the monthly pattern of "Migratory" and "Occasional visitors" species, with the presence of the later falling sharply during the summer months (Figure 7).

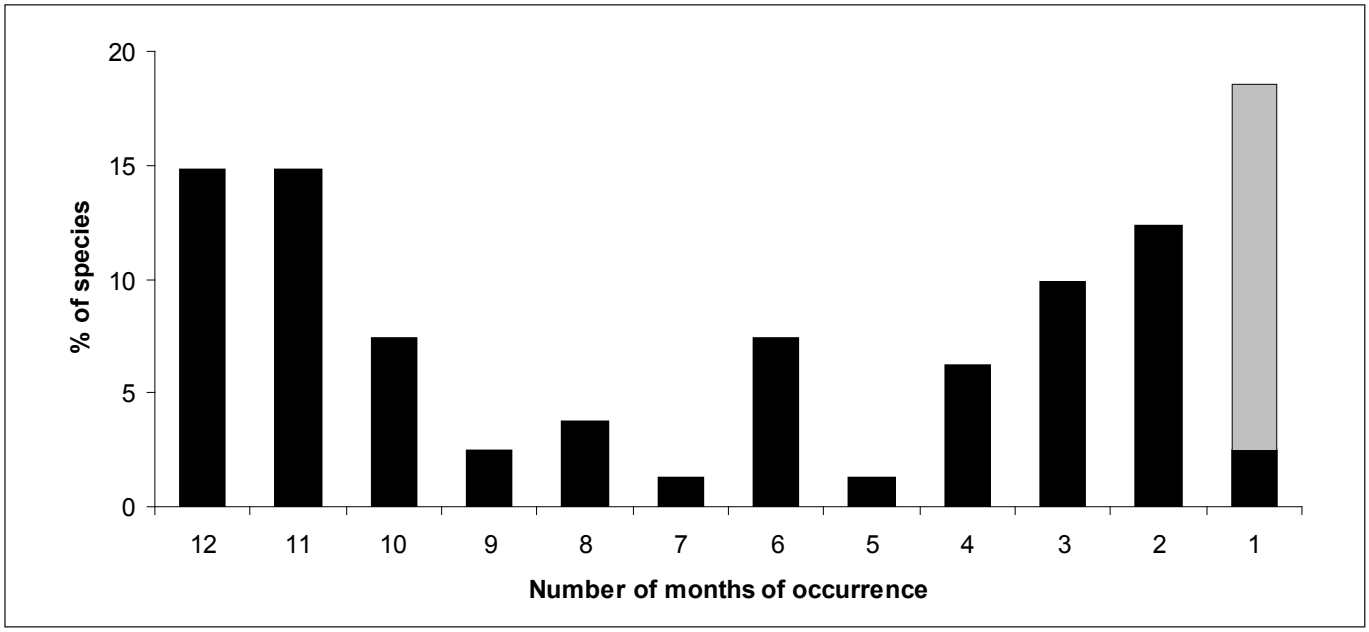

FIGURE 5. Monthly Pattern of Frequency of bird species recorded from July 2005 to August 2007 at 'Alto da Boa Vista', a campos rupestres area of the Serra do Cipó mountains, Brazil. Percentage of species according to the number of months of occurrence within a hypothetical year. This analysis was used for calculate the Phenological Category of presence (PC). The grey area represents species with FO 'Single record'. See text for details.

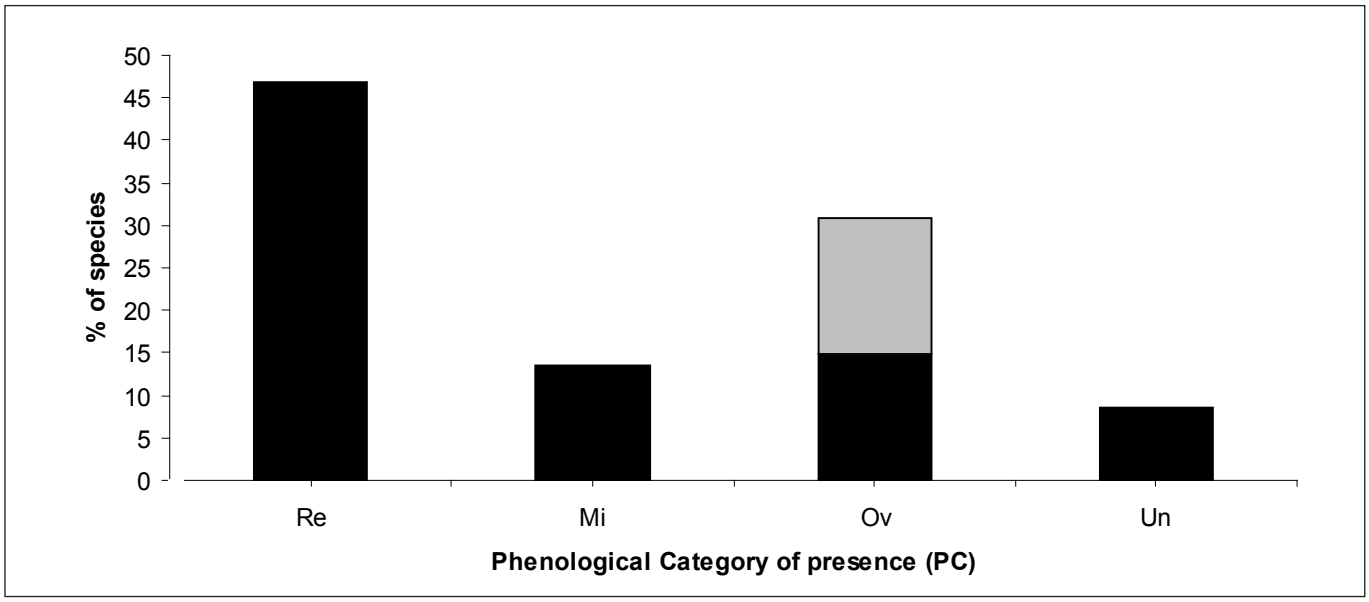

FIGURE 6. Distribution of the Phenological Category of presence (PC) of bird species recorded from July 2005 to August 2007 at 'Alto da Boa Vista', a campos rupestres area of the Serra do Cipó mountains, Brazil. Percentage of species by categories: Re, "Residents"; Mi, "Migratory"; Ov, "Occasional visitors"; Un, "Undefined". The grey area represents species with FO 'Single record'. See text for details.

TABLE 1. List of the seasonal bird species - Phenological Category (PC) of "Migratory" and "Occasional visitors" - recorded from July 2005 to August 2007 at 'Alto da Boa Vista', a campos rupestres area of the Serra do Cipó mountains, Minas Gerais state, Brazil, indicating months of occurrence in the monthly Pattern of Frequency analysis (see text for details).

	Seasonal species	Months of occurrence											
		J	F	M	A	M	J	J	A	S	O	N	D
Migratory	*Nothura maculosa*		X						X	X	X	X	
	Herpetotheres cachinnans							X	X		X		
	Elaenia chiriquensis	X	X					X		X	X	X	X
	Tyrannus melancholicus									X	X	X	
	Knipolegus nigerrimus					X		X	X				
	Stelgidopteryx ruficollis							X	X	X			
	Turdus leucomelas							X	X	X	X	X	X
	Ammodramus humeralis							X	X	X	X	X	X
	Sicalis citrina		X		X								X
	Molothrus bonariensis						X		X	X	X	X	X
	Sporagra magellanica										X	X	X
Occasional visitors	*Sarcoramphus papa*							X	X				
	Heterospizias meridionalis [1]			X									
	Rupornis magnirostris [1]								X				
	Buteo albonotatus								X	X			
	Patagioenas cayennensis								X				
	Zenaida auriculata [1]								X				
	Piaya cayana [1]		X										
	Hydropsalis parvula [1]										X		
	Chrysolampis mosquitus [1]		X										
	Amazilia lactea [1]	X											
	Veniliornis mixtus											X	X
	Synallaxis albescens [1]								X				
	Elaenia flavogaster [1]												X
	Pitangus sulphuratus [1]										X		
	Tyrannus savana								X	X			
	Knipolegus lophotes [1]									X			
	Xolmis velatus							X	X				
	Cyclarhis gujanensis							X					
	Cyanocorax cristatellus [1]								X				
	Turdus flavipes [1]					X							
	Cypsnagra hirundinacea					X		X					
	Pipraeidea melanonota						X			X			
	Emberizoides herbicola					X		X					
	Volatinia jacarina									X	X		
	Gnorimopsar chopi	X							X				

[1] Indicates that the species has a Frequency of Occurrence (FO) "Single record".

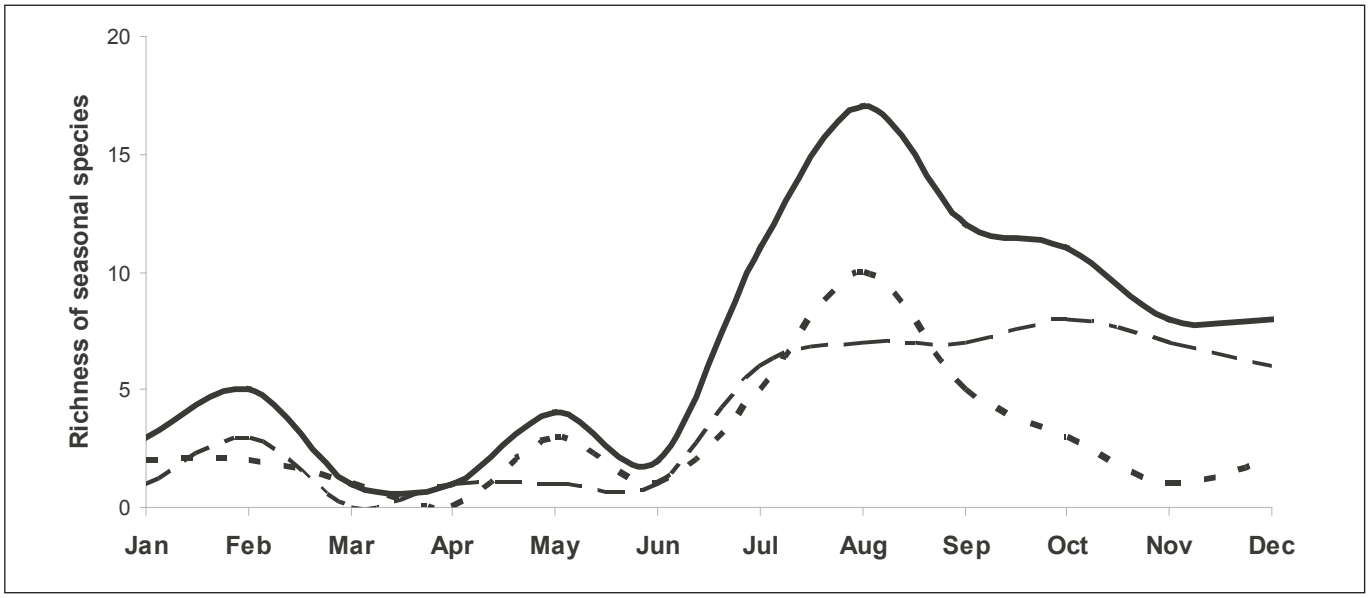

FIGURE 7. Distribution of "Migratory" and "Occasional visitors" bird species within a hypothetic year at 'Alto da Boa Vista', a campos rupestres area of the Serra do Cipó mountains, Brazil. The solid line shows the general pattern of occurrence for these species, whereas the traced line shows "Migratory" species and the dotted line the "Occasional visitors".

DISCUSSION

Species richness

The species richness estimated by us suggests that no more than 98 bird species coexist in the 200 ha area sampled in ABV. The species discovery curve shows a plateau, suggesting that most species occurring in ABV were recorded. The plateau was reached after approximately 60 days of sampling, which was completed after almost one year of field work, probably due the phenology of some species.

There are few previous studies of the avifauna of Serra do Cipó mountains that include sampling at higher altitudes. Willis & Oniki (1991) found 165 bird species in the Serra do Cipó region, most (131 species, 79%) found at higher altitudes, with less than half (63 species, 38%) appearing in campos rupestres. Melo-Júnior *et al*. (2001) recorded 269 bird species in the region (although they exhibit a number of 273 species in the paper, their table contains only 269 species), with nearly the same proportion (99 species, 37%) found in campos rupestres. A recent survey conducted at 'Alto do Palácio', an area located in the highlands at the eastern slope of Serra do Cipó, found 151 bird species (Rodrigues *et al.* 2011), with only 39 species (26%) recorded on rock outcrops habitat. Accordingly, ABV holds *c.* 36-59% of the bird richness recorded on previous surveys at Serra do Cipó, and at least 99% of the total bird richness found in campos rupestres of this region. Also, ABV represents *c.* 48% of the total bird richness found in the campos rupestres for the whole Espinhaço Range (Vasconcelos & Rodrigues 2010).

When one considers campos rupestres as part of the Cerrado domain, ABV includes no more than 11% of the 856 species recorded for this domain (Silva & Santos 2005). A survey carried out in the Cerrado lowlands of Serra do Cipó recorded 226 bird species (Rodrigues *et al*. 2005). Thus, ABV includes only *c.* 43% of the species richness of this nearby lower altitude locality. These comparisons indicate that the avian assemblages in campos rupestres are depauperate in terms of species richness when compared to other Cerrado physiognomies (*e.g.,* Bagno 1998, Marini 2001, Tubelis & Cavalcanti 2001, Lopes & Braz 2007). This contrasts sharply with patterns of plant communities (Giulietti & Pirani 1988), maybe due several micro-habitats that harbor high concentration of narrow endemic plant species (Rapini *et al*. 2008).

Species composition

Some species recorded at ABV are new records for Serra do Cipó, or for the campos rupestres of this region, or even for the whole Espinhaço Range. Most of these new records at ABV were categorized by their FO as "Single record" (43%) and included into the PC "Occasional visitors" (71%). Only *Hemitriccus margaritaceiventer* and *Poospiza cinerea* were more constant in the study area, with an FO "Uncommon" and a PC "Resident". Despite Serra do Cipó being a comparatively well-studied site, new bird species additions have been recently made at nearby highland localities, including some noteworthy records (Costa *et al*. 2008, Freitas *et al*. 2008, Vasconcelos *et al*. 2008b).

Although relatively poor in species richness, the campos rupestres avifauna has a composition distinct, but influenced by adjacent habitats (Vasconcelos & Rodrigues 2010). In particular, ABV includes 21% of the bird species considered endemic to the Cerrado domain, 57% of the endemics to the eastern Brazilian mountaintops, 50% of the endemics to the campos rupestres of Espinhaço, and all of endemics to the Espinhaço's south-central sub-area of endemism (Silva & Bates 2002, Vasconcelos 2008, Vasconcelos *et al*. 2008a). It is noteworthy that the highlands on the eastern slope of Serra do Cipó, otherwise, present also many species endemic to Atlantic Forest or typically related to forested habitats (Rodrigues *et al*. 2011).

Most species of global conservation concern in ABV are near-threatened. Recently, *Asthenes luizae* was downlisted from Vulnerable to Near-threatened, while *Polystictus superciliaris* was downlisted from Near-threatened to Least Concern (BirdLife International 2012). The number of species of conservation concern in ABV corresponds to 10% of the total number of threatened birds in the Cerrado region (Marini & Garcia 2005). All the threatened or near-threatened species of the ABV assemblage are also endemic to a biome domain (40%) or restricted to a particular habitat (60%). Habitat loss is the main threat to all of these species (BirdLife International 2012). Two species, *A. luizae* and *P. cinerea*, are also thought to be threatened by invasive species, by brood-parasitism of the Shiny Cowbird *Molothrus bonariensis*, and by further habitat shifting and alteration due climate change (BirdLife International 2012). All of the endemic or threatened bird species recorded at ABV - except for *Cyanocorax cristatellus* - are residents and were regularly observed, breeding in the area (*e.g.*, Costa & Rodrigues 2007, Gomes & Rodrigues 2010, Costa 2011).

Abundance

The large number of rare species and few very abundant species captured at ABV fits the general pattern found elsewhere in the tropics (Putman 1994, Macedo 2002, Donatelli *et al*. 2004). However the high abundance of *A. scutatus* was surprising. It has been

previously suggested that hummingbirds can be the most abundant non-passerine species in particular areas of the Amazon (Sick 1997). But we do not know of any area studied so far in the Neotropics where a hummingbird is the most abundant bird species, as we found in ABV. Trochilinae species have high flight capacity and frequency, low site fidelity and generalist feeding habit, factors that can increase the capture rate (Remsen & Good 1996). Another explanation lies in known seasonal movements of hummingbirds for seasonal floral resources (Terborgh *et al*. 1990, Sick 1997, Macedo 2002). Most plant species in the Espinhaço range are animal-pollinated, especially by birds (Machado *et al*. 2007, Rapini *et al*. 2008). Hummingbird broader dispersal to riparian forests during the dry season has been suggested for Cerrado (Macedo 2002), but there is no data supporting this hypothesis in ABV. It would be valuable, then, to explore if this species is so abundant in other campos rupestres areas, as also if the congeneric species *A. lumachella* is also so well represented in the bird communities of northern Espinhaço, in Bahia state.

The second and third most abundant species, *E. cristata* and *Z. capensis*, on the other hand, are also common in the nearby lowlands (Rodrigues *et al*. 2005) as well as in other areas within the Cerrado domain (Donatelli *et al*. 2004). *Zonotrichia capensis* is also very common at higher altitudes in all of southeastern Brazil (Sick 1997). There is evidence that part of *E. cristata* populations migrate locally within the Cerrado region (Alves 2007). It is possible that ABV receives some of these migratory individuals from the adjacent lowlands.

We recognized that estimate relative abundances by mist-netting can be biased, but we provided data that can be used to develop some testable hypotheses for future work. The three most captured species were also the most frequently observed (FO "Common"), so we expect some partial correlation between both methods. Observation of color-banded individuals helped us to determine that, for most cases, our estimates of abundance fit well or approximates to our observed abundances. For example, we captured and observed only a few more individuals of *Schistochlamys ruficapillus* that might be predicted by a previous study at the same locality (more than 13, against nine birds; Domingues & Rodrigues 2007). The abundance of captured *Poospiza cinerea* (two birds) is the very same of that observed at the study site (Costa & Rodrigues 2006), corroborating with its supposed rarity (Machado *et al*. 1998). However, we captured only two individuals of *Embernagra longicauda* recognizing that its abundance in ABV is underestimated, but only a few additional non-banded birds were observed. As it seems to be very abundant and may select wetter habitats on the eastern slope of Serra do Cipó (Freitas & Rodrigues 2012), its density can be distinct among the slopes, since those habitats are less common on the drier western slope.

Frequency of Occurrence and Phenology

The FO analysis showed that few species occur frequently and many are rare or occasional, *i.e.*, the same pattern found in the analysis of absolute abundance. The distribution of the species on FO categories at ABV differ of that found at Cerrado lowlands of Serra do Cipó where most species have high FO (Rodrigues *et al*. 2005), but is similar to other bird communities elsewhere on Cerrado and Atlantic Forest (Donatelli *et al*. 2004, Curcino *et al*. 2007). It is desirable to further investigate if the FO pattern found at ABV also occurs in other campos rupestres areas.

The PC analysis showed that many species are found in ABV throughout the year (approximately half of species were "Residents"), but also that many only occur over the course of a few months (approximately one third of species were "Occasional visitors"). Excluding those recorded only once, "Occasional visitors" species appear to be using the area regularly, since most were recorded more than once on the same month(s) of consecutive years (*e.g. Veniliornis mixtus, Tyrannus savana,* and *Volatinia jacarina*).

Four of the species categorized as "Migratory" in this study, *Nothura maculosa, Herpetotheres cachinnans*, *Turdus leucomelas,* and *Ammodramus humeralis*, are not recognized as such in literature (Silva 1995, Stotz *et al*. 1996, Sick 1997, Alves 2007). *Nothura maculosa* and *A. humeralis* are typically terrestrial species that are recorded when they explosively take flight as the observer approaches (Sick 1997). As we did not record these species in such a situation during other seasons of the year, we are confident with the seasonal status assigned to them, at least into sampled area in ABV. *Turdus leucomelas* is certainly 'migratory' in ABV, since it is an easily observed species and its winter call is frequently heard throughout the year in other localities. It is known that other *Turdus* species are at least partially migratory and most make short scale altitudinal movements in other regions of Brazil (Sick 1997, Macedo 2002, Alves 2007).

It appears that there is a distinct seasonal effect in the ABV area that is relatively well marked by the emergence of "Migratory" and "Occasional visitors". This should reflect the seasonal nature of some resources present in study site, as well as in surrounding habitats (*e.g.*, food and water availability). Observation of these species starts in July and August just before the beginning of the breeding season for most birds in Brazil (September to January; Sick 1997), which can be considered as a time of transition between wintering and breeding areas (Alves 2007). The ABV seems to be a breeding area at least for some of the "Migratory" species, such as *Elaenia chiriquensis*, *T. leucomelas*, *Sicalis citrina,* and *Molothrus bonariensis*. Breeding records for all of which were made in the area (Vasconcelos & Endrigo 2008, Gomes

& Rodrigues 2010, L. M. C. & M. R. *unpubl. data*). Species classified as "Occasional visitors", which have a narrower occurrence period, are considered to be passing through ABV during altitudinal or latitudinal migrations, maybe using the area as a stopover site. In fact, of these species in particular, *V. mixtus*, *Xolmis velatus, Tyrannus savana,* and *Volatinia jacarina* have known migratory habits (Sick 1997, Macedo 2002, Alves 2007).

Assemblage of bird species

The species composition of any biotic community is the result of a balance between species addition (colonization and speciation) and loss (emigration and local extinction). Species that can be potentially added to the community are the "pool of species" and are 'selected' for inclusion at various barrier levels, mainly by factors such as (1) dispersal and (2) environmental constraints, and (3) internal dynamics of the assemblage (Diamond 1975, Wiens 1989, Begon *et al*. 2006).

The potential "pool of species" for ABV community includes those that occur in other habitats closest to campos rupestres, adjacent areas of Cerrado and Atlantic forest habitats of lower altitudes. Since ABV is located on the western slope of Serra do Cipó, it is likely that the pool of species is mainly influenced by Cerrado species (*e.g.*, Rodrigues *et al*. 2005). All of the species able to overcome the dispersal barrier (1st factor) could potentially be recorded at ABV. Even those species unable to overcome environmental restrictions (2nd) between these areas might be recorded as 'Single records', soon leaving the area or dying. Species which might overcome the second barrier and that are not restricted by the first, could potentially co-occur naturally with the previously resident species of ABV, even if they are temporarily present and do not participate considerably in the established network of ecological interactions (3rd). This type of species could be recorded as 'Occasional visitors'.

We suggest that all species having a PC of 'Residents' form the core species of campos rupestres assemblage, and can be considered the typical bird community of this ecosystem. Certainly, seasonal fluctuations in resources and even fire can affect the local assemblage in terms of richness, composition and abundance. We anticipate that the pattern at ABV, which has been described here, may be effectively used in future comparison with other bird communities structures elsewhere in Espinhaço Range.

Conservation

Biodiversity conservation of campos rupestres is favored by the low fertility of their shallow soils, which are poorly suited for agriculture. On the other hand, there are many threats that affect this ecosystem, such as mining, cattle ranching, arson, and biological invasion (Vielliard 1990, Giullieti *et al*. 1997, Viana *et al*. 2005, Rodrigues & Costa 2006, Jacobi *et al*. 2007, Medina & Fernandes 2007). Unfortunately, all of these negative impacts occurs in ABV, and can even be found within the officially protected Conservation Unit of the region, the Parque Nacional da Serra do Cipó.

If the density of bird species in campos rupestres is as reduced as the present study suggests, we must assume that even small-scale disturbances can significantly and adversely affect the diversity of this ecosystem. Aside from what we are learning from bird research, additional studies suggest that other biotic elements of campos rupestres must be poorest in species richness and less dense, and highly distinct from those of other habitat types (Giullieti *et al*. 1997, Ribeiro & Fernandes 2000, Rodrigues 2005, Medina & Fernandes 2007).

The Espinhaço Range is an outstanding biogeographical barrier separating two hydrological basins and important biome domains at its southern portion: the dry Cerrado on the western slope (rio São Francisco basin), and the wet Atlantic forest on the eastern slope (rio Doce basin; Giulietti *et al*. 1997). Although campos rupestres occurs on mountaintops along the Espinhaço Range, it is officially included within Cerrado domain (Ribeiro & Walter 1998, Ribeiro *et al*. 2009). However, there are notable differences in soil types, rock arrangement, phytophysiognomy, and humidity between the campos rupestres of both slopes in some regions, the last one primarily because the eastern slope receives moister air from the Atlantic Ocean (Ribeiro *et al*. 2009). Preliminary biodiversity surveys have shown substantial differences also in bird and plant assemblages (see Melo-Júnior *et al*. 2001, Vasconcelos & D'Angelo Neto 2007, Ribeiro *et al*. 2009, Rodrigues *et al*. 2011), and we suggest here that at least two distinct biotic communities may occur on either slope of some regions of the Espinhaço Range, inhabiting different campos rupestres types. At Serra do Cipó, those differences are due mostly to the stationary cloudiness line that lies on eastern slope, coinciding with the hydrological basins limits in some points (Ribeiro *et al*. 2009), where we could found "wet campos rupestres"; contrasted to "dry campos rupestres" on the west. Efforts to refine the delimitation of the frontier Cerrado/Atlantic forest domains has recently started in Serra do Cipó (Ribeiro *et al*. 2009). By containing a distinct fauna and flora and, simultaneously, typical elements from Atlantic forest, Cerrado (at its southern portion) and Caatinga (at its northern portion), we agree with previous authors that it is urgent the recognition of campos rupestres as a biological unit apart those biome domains (Vasconcelos 2008, Ribeiro *et al*. 2009, Vasconcelos & Rodrigues 2010, Rodrigues *et al.* 2011).

We believe that we took the first step to understanding the community structure of campos rupestres birds beyond its species richness and composition. Herein, we presented by means of the categories of abundance, occurrence and phenology, an indication of the probability of finding each species throughout the year within the study area. We also show the core species of this bird community (*i.e.*, 'Resident' species), and two different occurrence patterns of regular visitors (Migratory and Occasional visitors). We hope that our analyses of a bird community structure and dynamics inhabiting campos rupestres on the western slope of the Serra do Cipó can be useful in further comparative investigations elsewhere on Espinhaço Range. We propose two hypotheses that can be further tested with our data: that the communities of campos rupestres differs from those of surrounding biome domains, and that there are distinct ecosystems within what is generally known as "campos rupestres". Further biological inventories that contain community structure and dynamic analyses of both slopes at other Espinhaço regions are urgently needed to better understand those questions, allowing suitable managements dealing with the conservation of the entire campos rupestres.

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APPENDIX

Frequency of occurrence, phenological category of presence, endemic and conservation status of bird species recorded from July 2005 to August 2007 at 'Alto da Boa Vista', a campos rupestres area of Serra do Cipó mountains, Minas Gerais state, Brazil. Endemic status follows Silva & Bates (2002) and Vasconcelos (2008). Conservation status follows Machado *et al*. (1998) and BirdLife International (2012). FO - Frequency of Occurrence*:* Co, "Common"; Fc, "Fairly common"; Uc, "Uncommon"; Ra, "Rare"; Oc, "Occasional"; Sr,"Single record". PC - Phenological Category of presence*:* Re, "Residents"; Mi, "Migratory"; Ov, "Occasional visitors"; Un, "Undefined". END. - Endemism: Ce, endemic to Cerrado domain; Cr, endemic to campos rupestres; Ms, endemic to the eastern Brazilian mountaintops. CON. - Conservation status*:* Re, regionally threatened; Gl, globally threatened (NT, Near-Threatened; VU, Vulnerable).

Orders, Families, and species	FO	PC	END.	CON.
TINAMIFORMES				
Tinamidae				
Rhynchotus rufescens (Temminck, 1815)	Ra	Re		
Nothura maculosa (Temminck, 1815)	Ra	Mi		
CATHARTIFORMES				
Cathartidae				
Cathartes aura (Linnaeus, 1758)	Fc	Re		
Coragyps atratus (Bechstein, 1793)	Oc	Un		
Sarcoramphus papa (Linnaeus, 1758)	Oc	Ov		
ACCIPITRIFORMES				
Accipitridae				
Heterospizias meridionalis (Latham, 1790)	Sr	Ov		
Rupornis magnirostris (Gmelin, 1788)	Sr	Ov		
Geranoaetus albicaudatus (Vieillot, 1816)	Ra	Re		
Geranoaetus melanoleucus (Vieillot, 1819)	Oc	Un		
Buteo albonotatus Kaup, 1847	Oc	Ov		
FALCONIFORMES				
Falconidae				
Caracara plancus (Miller, 1777)	Ra	Re		
Milvago chimachima (Vieillot, 1816)	Uc	Re		
Herpetotheres cachinnans (Linnaeus, 1758)	Oc	Mi		
Falco sparverius Linnaeus, 1758	Uc	Re		
CARIAMIFORMES				
Cariamidae				
Cariama cristata (Linnaeus, 1766)	Ra	Re		
COLUMBIFORMES				
Columbidae				
Patagioenas picazuro (Temminck, 1813)	Uc	Re		
Patagioenas cayennensis (Bonnaterre, 1792)	Oc	Ov		
Zenaida auriculata (Des Murs, 1847)	Sr	Ov		
PSITTACIFORMES				
Psittacidae				
Aratinga aurea (Gmelin, 1788)	Fc	Re		
CUCULIFORMES				
Cuculidae				
Piaya cayana (Linnaeus, 1766)	Sr	Ov		
Guira guira (Gmelin, 1788)	Ra	Re		

Orders, Families, and species	FO	PC	END.	CON.
CAPRIMULGIFORMES				
Caprimulgidae				
Hydropsalis parvula (Gould, 1837) [1]	Sr	Ov		
Hydropsalis longirostris (Bonaparte, 1825)	Uc	Re		
APODIFORMES				
Apodidae				
Streptoprocne zonaris (Shaw, 1796)	Oc	Re		
Trochilidae				
Phaethornis pretrei (Lesson & Delattre, 1839)	Fc	Re		
Eupetomena macroura (Gmelin, 1788)	Uc	Re		
Colibri serrirostris (Vieillot, 1816)	Fc	Re		
Chrysolampis mosquitus (Linnaeus, 1758) [2]	Sr	Ov		
Chlorostilbon lucidus (Shaw, 1812)	Uc	Re		
Amazilia lactea (Lesson, 1832) [3]	Sr	Ov		
Augastes scutatus (Temminck, 1824)	Co	Re	Ms, Cr	Gl (NT)
Heliactin bilophus (Temminck, 1820)	Oc	Un		
GALBULIFORMES				
Bucconidae				
Nystalus chacuru (Vieilloy, 1816)	Ra	Re		
PICIFORMES				
Picidae				
Veniliornis mixtus (Boddaert, 1783) [1]	Oc	Ov		
Colaptes campestris (Vieillot, 1818)	Ra	Re		
PASSERIFORMES				
Thamnophilidae				
Thamnophilus torquatus Swainson, 1825	Uc	Re		
Furnariidae				
Synallaxis albescens Temminck, 1823	Sr	Ov		
Asthenes luizae Vielliard, 1990	Fc	Re	Ms, Cr	Re, Gl (NT)
Rhynchocyclidae				
Hemitriccus margaritaceiventer (d'Orbigny & Lafresnaye, 1837) [4]	Uc	Re		
Tyrannidae				
Camptostoma obsoletum (Temminck, 1824)	Uc	Re		
Elaenia flavogaster (Thunberg, 1822)	Sr	Ov		
Elaenia cristata Pelzeln, 1868	Co	Re		
Elaenia chiriquensis Lawrence, 1865	Uc	Mi		
Elaenia obscura (d'Orbigny & Lafresnaye, 1837)	Uc	Re		
Polystictus superciliaris (Wied, 1831)	Fc	Re	Ms	
Pitangus sulphuratus (Linnaeus, 1766)	Sr	Ov		
Tyrannus melancholicus Vieillot, 1819	Oc	Mi		
Tyrannus savana Vieillot, 1808 [4]	Oc	Ov		
Myiophobus fasciatus (Statius Muller, 1776)	Ra	Re		
Knipolegus lophotes Boie, 1828	Sr	Ov		
Knipolegus nigerrimus (Vieillot, 1818)	Oc	Mi		
Xolmis cinereus (Vieillot, 1816)	Ra	Un		
Xolmis velatus (Lichtenstein, 1823)	Oc	Ov		
Vireonidae				
Cyclarhis gujanensis (Gmelin, 1789)	Oc	Ov		
Corvidae				
Cyanocorax cristatellus (Temminck, 1823)	Sr	Ov	Ce	

Orders, Families, and species	FO	PC	END.	CON.
Hirundinidae				
Pygochelidon cyanoleuca (Vieillot, 1817)	Oc	Un		
Stelgidopteryx ruficollis (Vieillot, 1817)	Oc	Mi		
Troglodytidae				
Troglodytes musculus Naumann, 1823	Fc	Re		
Turdidae				
Turdus flavipes Vieillot, 1818 [2,3]	Sr	Ov		
Turdus leucomelas Vieillot, 1818	Ra	Mi		
Mimidae				
Mimus saturninus (Lichtenstein, 1823)	Uc	Re		
Motacillidae				
Anthus hellmayri Hartert, 1909	Oc	Un		
Thraupidae				
Saltatricula atricollis (Vieillot, 1817)	Uc	Re	Ce	
Cypsnagra hirundinacea (Lesson, 1831)	Oc	Ov		
Tangara cayana (Linnaeus, 1766)	Uc	Re		
Schistochlamys ruficapillus (Vieillot, 1817)	Co	Re		
Pipraeidea melanonota (Vieillot, 1819)	Oc	Ov		
Emberizidae				
Zonotrichia capensis (Statius Muller, 1776)	Co	Re		
Ammodramus humeralis (Bosc, 1792)	Ra	Mi		
Porphyrospiza caerulescens (Wied, 1830)	Uc	Re	Ce	Gl (NT)
Poospiza cinerea Bonaparte, 1850 [4]	Uc	Re	Ce	Re, Gl (VU)
Sicalis citrina Pelzeln, 1870	Ra	Mi		
Emberizoides herbicola (Vieillot, 1817)	Oc	Ov		
Embernagra longicauda Strickland, 1844	Uc	Re	Ms	Gl (NT)
Volatinia jacarina (Linnaeus, 1766)	Oc	Ov		
Cardinalidae				
Piranga flava (Vieillot, 1822)	Oc	Un		
Parulidae				
Geothlypis aequinoctialis (Gmelin, 1789)	Fc	Re		
Icteridae				
Gnorimopsar chopi (Vieillot, 1819)	Oc	Ov		
Pseudoleistes guirahuro (Vieillot, 1819)	Fc	Re		
Molothrus bonariensis (Gmelin, 1789)	Ra	Mi		
Fringillidae				
Sporagra magellanica (Vieillot, 1805)	Ra	Mi		

[1] new records for all campos rupestres of the Espinhaço Range.
[2] new records for the entire Serra do Cipó region.
[3] species recorded only by mist-netting.
[4] new records for the campos rupestres habitats of the Serra do Cipó region.

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ARTICLE

Harpy Eagle sightings, traces and nesting records at the "Reserva Natural Vale", a Brazilian Atlantic Forest remnant in Espírito Santo, Brazil.

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ABSTRACT: We present 25 records of sightings, feathers and nests of the Harpy Eagle *Harpia harpyja* in the last 27 years and also the first detailed description of a nest of a Harpy Eagle in the Brazilian Atlantic Forest, found at the "Reserva Natural Vale" (RNV), Linhares, Espírito Santo, Brazil. Most Harpy Eagle records were obtained along the RNV roads by researchers and the RNV staff. Two nests have been mapped at the RNV until now. An especially relevant record occurred in 1997 when a juvenile Harpy Eagle was found dead, 4 km distant from the nest mapped and measured in 2010. The nest was 1.8 m X 1.6 m in diameter, and was built 28 m above ground, on the main fork of an *Astronium concinnum* tree measuring 37 m height and 1 m in diameter at breast height (DBH). This nest was the second of the species to be reported at RNV, being 5 km away from the first one, found in 1992, and built 30 m above the ground on the main fork of a *Cariniana legalis* tree 36 m high and 1.1 m in DBH. All Harpy Eagle records at RNV indicate that this protected area offers enough resources and has carrying capacity to maintain at least two Harpy Eagle pairs. However, because of the fragmentation around RNV, the local Harpy Eagle population cannot expand due to reduced habitat availability. The data gathered in this study confirm the importance of the RNV for the conservation of the critically endangered Harpy Eagle population of the Brazilian Atlantic Forest. We recommend the establishment of a reforestation program to increase the size and the connections of fragments around the RNV. We suggest that the creation and effective implementation of protected areas may contribute to Harpy Eagle protection in the Brazilian Atlantic Forest, but the long-term conservation of remaining populations is an essential step to allow for the occupation and re-colonization of other areas.

KEY-WORDS: Birds of prey, conservation, Harpy Eagle nest, Neotropics, Brazilian Atlantic Forest.

INTRODUCTION

The Harpy Eagle *Harpia harpyja* (Accipitridae) is the largest flying predator of Central and South America (Sick 1997), and occurs in dense forest areas in Brazil (Pinto 1964). Several nests of this species have been studied in British Guiana (Rettig 1978, 1995), Venezuela (Kung & Alvarez 1997) and Brazil (Ruschi 1979, Galetti & Carvalho Jr. 2000, Luz 2005, Sanaiotti *et al.* 2007, Aguiar-Silva 2007, Piana 2007, Banhos *et al.* 2008, Luz *et al.* 2010). The Harpy Eagle was included in the Brazilian Official List of Threatened Species under the category of Threatened until 2003 (Bernardes *et al.* 1990); currently, it is considered nationally a Near-Threatened species (Machado *et al.* 2008). According to regional state lists in Brazil, it is regarded as probably Extinct in the Wild (EW) in Rio Grande do Sul (Bencke *et al.* 2003); in Rio de Janeiro it is listed as Endangered (EN) (Alves *et al.* 2000), whereas in the states of Paraná (Mikich & Bérnils 2004, Instituto Ambiental do Paraná 2011), Santa Catarina (IGNIS 2008), Minas Gerais (Fundação Biodiversitas 2007) and Espírito Santo (Simon *et al.* 2007) it is considered Critically Endangered (CR). The decline of Harpy Eagle populations in Brazil is attributed mainly to forest destruction and hunting pressure (Vargas *et al.* 2006).

Harpy Eagles are rare in remnants of the Brazilian Atlantic Forest (Albuquerque 1995, Galetti *et al.* 1997,

Pacheco *et al*. 2003), where in some regions there have been no records of this species for almost 90 years (Scherer-Neto & Straube 1995), although the species apparently is still abundant in the Brazilian Amazon, as highlighted by several nesting records in the region (Vargas *et al*. 2006, Banhos *et al*. 2008, Luz *et al*. 2010, Aguiar-Silva *et al*. 2011; Aguiar-Silva *et al*. in press). The forests in the Amazon have been threatened for only about four decades, whereas the Brazilian Atlantic Forest has suffered severe fragmentation throughout the last five centuries, resulting in remnant areas covering 16% of the original area, including secondary forests and fragments smaller than 50 ha (Ribeiro *et al*. 2009). Nevertheless, some Brazilian Atlantic Forest remnants still host Harpy Eagles, with recent reports for the states of Bahia (Silveira *et al*. 2005, Sánchez-Lalinde *et al*. 2011) and Espírito Santo (Srbek-Araujo & Chiarello 2006).

In northern Espírito Santo, the "Reserva Natural Vale" (RNV) covers approximately 23,000 ha, and the "Reserva Biológica de Sooretama" (Rebio Sooretama) covers 24,250 ha; together, these continuous areas of native vegetation correspond to about 10% of the Atlantic Forest remaining in the state (Fundação SOS Mata Atlântica & INPE 2009). The RNV is the second largest reserve of lowland rainforest or Lowland Coastal Zone ("Hiléia Baiana") in Espírito Santo (Srbek-Araujo & Chiarello 2006), where an active Harpy Eagle nest was found in 1992 (Galetti *et al*. 1997).

Since 1999, the Brazilian Harpy Eagle Conservation Program (PCGR) has been mapping Harpy Eagle nests in the Amazon, Atlantic Forest, and forest enclaves of the Cerrado. Interviews with researchers, riverside dwellers, fishermen, hunters, farm workers and staffs from the protected areas, are sources of information about Harpy Eagles nests (Sanaiotti *et al*. 2007).

The PCGR carried out a protocol for mapping Harpy Eagle records in the Atlantic Forest, sampling in 2004 a Harpy Eagle nest located on the Macanaíba-pele-de-sapo Road at the RNV, based on literature and information from local collaborators and researchers (Peixoto & Peixoto 1986, Galetti *et al*. 1997, Pacheco *et al*. 2003). The aim was to evaluate the physical characteristics of the tree where the nest was discovered in 1992, and to determine potential locations where the pair could have built an alternative nest, given that nesting had not been reported in the original tree since 1995.

Here, we summarize the Harpy Eagle records at RNV since 1985 to evaluate the conservation status of the species in the area. We also report on the results of a new PCGR survey conducted in September 2010 at RNV with the aim of revisiting locations where both old (Peixoto & Peixoto 1986, Galetti *et al*. 1997, Pacheco *et al*. 2003) and recent records of Harpy Eagle were obtained (Srbek-Araujo & Chiarello 2006).

METHODS

Harpy Eagle records were obtained through interviews with current RNV staff, photos, sightings and feathers found on the forest floor, scientific publications (Ruschi 1979, Peixoto & Peixoto 1986, Galetti *et al.* 1997, Pacheco *et al*. 2003, Srbek-Araujo & Chiarello 2006, Banhos & Sanaiotti 2011), and from specimens deposited in museums collected in the region of the Espírito Santo.

Given the rarity of sightings and the few records of Harpy Eagle nests in the Brazilian Atlantic Forest, a protocol for the location of nests in fragmented forests has been used by the PCGR since 2005. The technique consists of accessing the forest canopy at specific points, defined by the locations where direct and indirect records (sightings, photos, traces and/or vocalizations) of the Harpy Eagle have been made. From these points, the top of a nearby emergent tree (or the tree of the past sighting event itself, when possible) is accessed with the use of a static rope, which can be released in an emergency and which is anchored to the base of a nearby tree or the climbed tree itself. Ventral and manual ascenders with automatic locking are used to climb the rope. The climber uses binoculars to look for emergent trees of the climbed tree within an area of about 300 m. When nest sightings are not reported for the nearby trees, the climber in the canopy plays begging calls of the species (11 sequences) with the use of speakers, for around 30 min, to attract individuals or stimulate them to call.

RESULTS

Sightings and feathers

In the last 27 years there have been 25 different Harpy Eagle records including sightings (n = 23) and feathers (n = 2) at the RNV (Table 1). The records include a juvenile Harpy Eagle founded dead in 1997 about 500 m from the northern edge of the RNV (Figure 1). This specimen is deposited at the Elias Lorenzutti Museum in Linhares, Espírito Santo state (MEL120). Harpy Eagles reuse the same tree for breeding in successive reproductions (Rettig 1978), but there heve been no other records of any juvenile at RNV since. Three records of successful predation on two mammal species: Sloth and Capuchin Monkey (Table 1).

Nests

Two Harpy Eagle breeding areas were identified at the RNV (Table 1). In September 2010, the PCGR protocol was conducted at the RNV at five points (Boleira, Oiticica, Gávea, Flamengo and Macanaíba-pele-de-sapo Roads), corresponding to the locations where Harpy

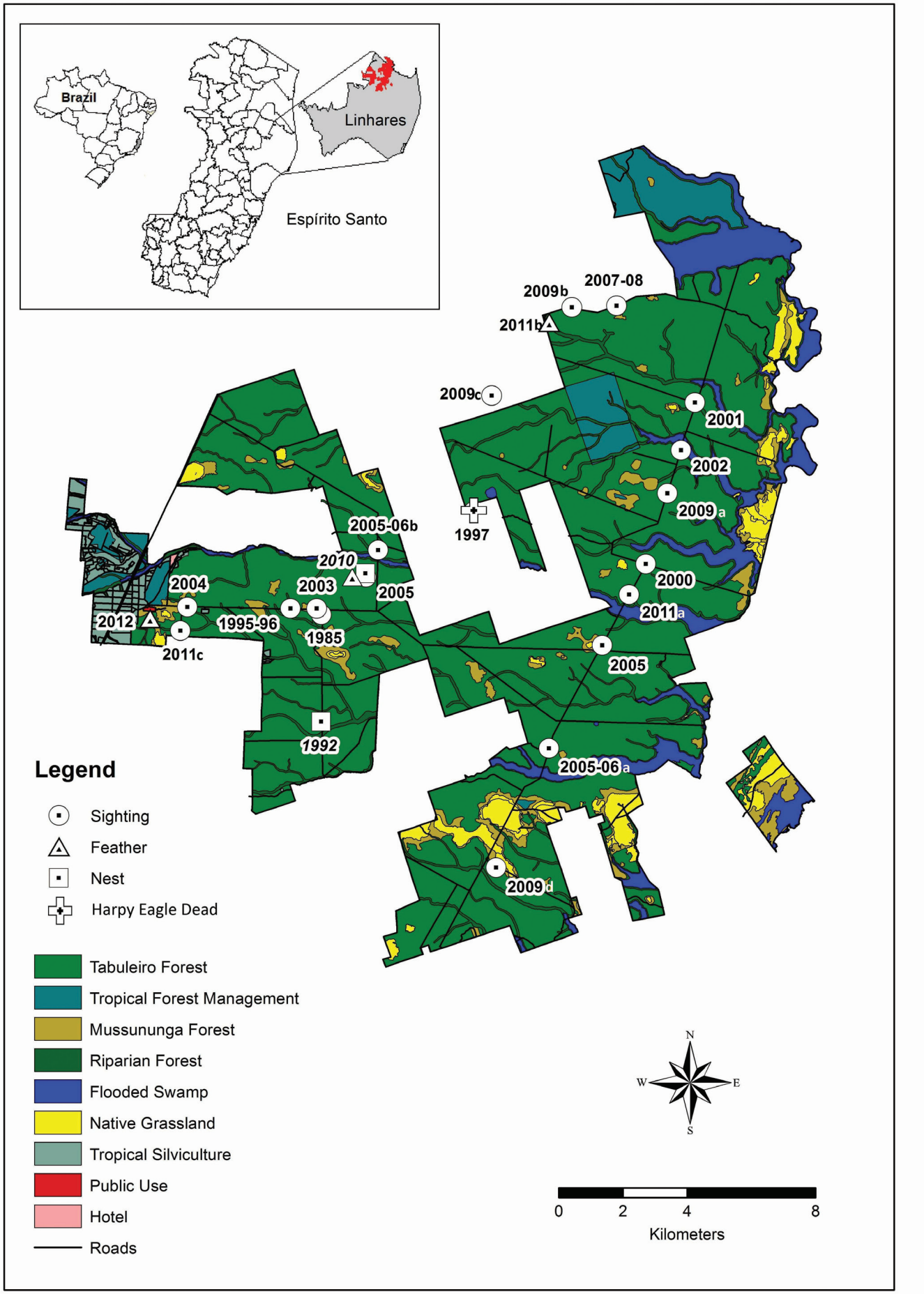

FIGURE 1. Vegetation map of the RNV, Espírito Santo state, Brazil, showing the locations of Harpy Eagle records obtained in the last 27 years, including Nest 1 (1992 at Macanaíba-pele-de-sapo Road) and the new nest record - Nest 2 (2010 at Oiticica Road).

Eagle records were obtained over the last 27 years (Figure 1, Table 1). Success was obtained by the find of the new Harpy Eagle nest (Nest 2) at Oiticica Road where, in 2005, A. C. S. sighted and photographed an adult male Harpy Eagle (Table 1) perched on a "farinha-seca" tree (*Pterygota brasiliensis* (Fr. All.) K. Schum. (Sterculiaceae), which was over 30 m high (Srbek-Araujo & Chiarello 2006). This tree was climbed by O. J. in September 2010 and, from the main fork, a nest was sighted about 130 m away. Feathers of the Harpy Eagle were collected below the tree where the tree climber saw the nest (Nest 2) in 2010, and probably may be from the adults of that nest (Nest 2). This record suggests that this nest existed since 2005.

The first Harpy Eagle nest was observed at RNV (Nest 1) in 1992 (Pacheco *et al*. 2003). It was found on the Macanaíba-pele-de-sapo Road, being built on the main fork, 30 m above ground, in a "jequitibá-rosa" (*Cariniana legalis* (Mart.) Kuntze 1898; Lecythidaceae) 36 m high and measuring 1.1 m in DBH (Table 2). Since its structure was lost and the same fork had not been reused since 1994 (Table 1), it was not possible to measure the nest dimensions, only the fork that held it.

The second nest (Nest 2), found in 2010, was positioned on the main fork, 28 m above the forest floor, on an emergent "gonçalo-alves" tree (*Astronium concinnum* Schott ex Spreng., 1827; Anacardiaceae) 37 m high and measuring 1 m in DBH (Table 2). The nest measured 1.80 m X 1.60 m in diameter and 1.60 m in external height. It was built with thick sticks (the largest measuring 5 cm in circumference), and lined with dry leaves. Adult white downy feathers and recently dried leaves in the nest indicate that it was being used by adults.

Breast band feathers feathers from Harpy Eagle adults were collected on the ground below the nest tree, as well as two fragmented vertebrae, a femur from a medium-sized mammal, and a pellet containing sloth nails and fur. The nest dimensions (Table 2), the feather, and prey remains confirm that it was a Harpy Eagle nest.

All trees mentioned above were identified in 2005 by G. S. based on comparisons with material at the RNV Herbarium.

TABLE 1. Description of Harpy Eagle records, feathers, nests and evidence of prey taken over the past 27 years at the RNV, Espírito Santo, Brazil.

Author(s)	Record description	Month / Year	Source
Harpy Eagle sighting/photo/feather			
A. L. Peixoto & O. L. Peixoto	Photo of Harpy Eagle adult female found on Flamengo Road at Macanaíba-pele-de-sapo Road.	1/1985	Peixoto & Peixoto 1986
	Harpy Eagle preying on a sloth, perched 5 m above ground.	8/1992	Galetti *et al*. 1997
	Harpy Eagle perched 20 m above ground.	12/1992	Galetti *et al*. 1997
E. Costa	Sighted large bird flying and leaving a dead sloth with a hole on the back over a bunch of twigs on the Flamengo Road, nearby tower, old path.	1995-96	This study
Museu Elias Lorenzutti (MEL120)	João A. Rocha found on the forest floor a fledgling Harpy Eagle dead. Fazenda Santa Terezinha, at the edge of the RNV.	1997	This study
P. R. Paz	Sighted near intersection of the Gávea Road and Jequitibá Rosa Road.	2000	This study
J. C. Silva – RNV	Sighted adult perching on a tree. Gávea Road with Caingá Road intersection.	2001	This study
A. C. Santos – RNV	Sighted a Harpy Eagle on the Gávea Road near the Alberico stream.	2002	Pacheco *et al*. 2003
J. C. Silva – RNV	Sighted adult on the forest floor. Flamengo Road at the tower patio.	2003	This study
J. C. Silva, A. Hartuique & E. Silva – RNV	Sighted adult Harpy Eagle eating an individual Capuchin Monkey (*Sapajus robustus*) on the ground, where Flamengo Road meets the Roxinho Road.	2004	This study
D. Folli & M. Cruz – RNV	Sighted Harpy Eagle flying from the ground at the intersection of Gávea and Flamengo roads.	2005a	This study
A. C. S. – RNV	Photo of adult male Harpy Eagle on a "farinhaseca" tree (*Pterygota brasiliensis)* about 250 m inside the forest on Oiticica Road.	8/2005b	Srbek-Araujo & Chiarello 2006
E. Costa	Sighted Harpy Eagle adult perched on dead tall tree, on Gávea Road with Ipê Amarelo Road.	2005-06a	This study

E. Costa	Reported adult Harpy Eagle perched in a tree ca.40 m inside the forest at the intersection of Oiticica Road with Rancho Alto stream.		2005-06b	This study
J. C. Gonçalves & P. P. Reis - RNV	Reported young Harpy Eagle on the ground, on the road at the border between RNV and Rebio Sooretama.		2007-08	This study
A. Hartuique, J. S. Santos, A. S. Coutinho, Alan & Ectori - RNV	Adult Harpy Eagle photographed on a dry tree on the intersection of Gávea Road and the road that continues to the Tropical Forest Management plot.		3/2009a	This study
A. C. S. - RNV	Adult Harpy Eagle adult vocalizing in the canopy, above a birdwatching group, on the border with the Rebio Sooretama.		7/2009b	This study
J. Negrelli – Rebio Sooretama	Sighted a Harpy Eagle pair on the imbuia tree (*Ocotea porosa*) near Fazenda Santa Terezinha 500 m from border of the RNV.		2009c	This study
G. S. - RNV	Sighted Harpy Eagle while accompanying Harri Lorenzi during botanical collections at the Boleira Road.		2009d	This study
D. Folli, C. C. Silva & A. A. Cruz	Sighted Harpy Eagle eating a Capuchin Monkey (*Sapajus robustus*) on the floor of Gávea Road 1º T. A Harpy Eagle feather was collected.		2/2011a	This study
Equipe Brigadistas Rebio Sooretama	Found a feather of the Harpy Eagle on the forest floor at Caingá Road on the border with the Rebio Sooretama.		6/2011b	This study
G. S. - RNV	Reported adult between the Roxinho Road and Acero Ceolin.		8/2011c	This study
K. T. Biancardi – RNV	Harpy Eagle feather found on the RNV environmental education trail.		6/2012	This study
Harpy Eagle nests				
A. J. Batista - RNV	Nest branches on jequitibá-rosa (*Cariniana legalis*) of the Macanaíba-pele-de-sapo Road nest.	Nest 1	1992	This study
R. M. Jesus – RNV	Nest on the Macanaíba-pele-de-sapo Road.	Nest 1	1992-95	Galetti *et al*. 1997, Pacheco *et al*. 2003
J. C. Silva - RNV	Adult on the left side of the nest on the Macanaíba-pele-de-sapo Road, photographed by Bret M. Whitney.	Nest 1	Before 1994	This study
E. Costa - RNV	Adult in the nest on a jequitibá-rosa at the Macanaíba-pele-de-sapo Road.	Nest 1	Before 1994	This study
E. O. Willis (*pers. comm*.)	Nest branches on the nest tree at the Macanaíba-pele-de-sapo Road.	Nest 1	1995	-
E. Setz (*pers. comm*.)	Photo of the empty Harpy Eagle nest, partly undone on the jequitibá-rosa. Field notes include the Domingos Folli report "it was occupied until August of 1994".	Nest 1	1/1995	-
B. M. Whitney (*pers. comm*.)	Absence of branches that used to form the nest on the main fork of the jequitibá-rosa (*Cariniana legalis*).	Nest 1	2001	-
T. M. S. (*pers. obs.*)	Absence of branches forming a nest on the main fork of the jequitibá-rosa (*Cariniana legalis*).	Nest 1	2004	-
F. H. A.-S., O. J. & A. Hartuique	Absence of branches forming a nest on the main fork of the jequitibá-rosa (*Cariniana legalis*).	Nest 1	2010	This study
F. H. A.-S., O. J., A. C. S & G. S.	New nest mapped on Oiticica Road. Harpy Eagle feather found 130 m away from the new nest.	Nest 2	9/2010	This study
L. Avelar & G. S. – RNV	Adult vocalizing near the nest tree, arriving and staying for few minutes on the nest. Oiticica Road.	Nest 2	3/2011	This study
A. B., J. N. Silva & R. C. Silva - PCGR	Adult on the nest.	Nest 2	2/2012	This study

TABLE 2. Dimensions of the trees with Harpy Eagle nest at the Reserva Natural Vale, Linhares, ES, Brazil. SH = shaft height, TTH = total tree height, DBH = diameter at breast height, NMB = number of main branches, D = diameter of the fork branches, B = branch (B1, B2 and B3 represent the number of each branch supporting the nest), DFB = distance between the fork branches. Dimension of the nests: LDN = largest diameter of the nest, SDN = smallest diameter of the nest, HNS = height of the nest structure, IDN = inner depth of nest, CTB = circumference of the thickest branch of the nest, nn = no nest.

Dimensions		Nest 1 (*Cariniana legalis*) Macanaíba-pele-de-sapo Road (m)	Nest 2 (*Astronium concinnum*) Oiticica Road (m)
SH		30	28
TTH		36	37
DBH		1.1	1
NMB		1	1
	B1	0.4	0.6
D	B2	0.5	0.4
	B3	0.4	0.5
	B1-B2	1.6	0.8
DFB	B2-B3	1.3	0.9
	B1-B3	1.6	0.9
LDN		No nest	1.8
SDN		No nest	1.6
HNS		No nest	1.6
IDN		No nest	0.15
CTB		No nest	0.05

DISCUSSION

Harpy Eagles use large emergent trees to nest, which, in the Amazon, are on average 43.7 m high and 1.4 m in DBH; there, nests are positioned on average 32 m above ground (Luz 2005). The nests at RNV were built on slightly shorter emergent trees. The trees used by the eagles were 36 - 37 m high and 1 m in DBH, and nests were on average 29 m above ground. According to Peixoto *et al.* (1995), the dense lowland forest at RNV can be divided into arboreal, bush and herbaceous strata, with the canopy reaching an average of 24 m (19 - 31 m) height and being discontinuous, with emergent trees up to 40 m.

The last Harpy Eagle nests recorded in Espírito Santo were described by Ruschi (1979), who reported on three nests: one in Linhares, 1944, on a jequitibá-rosa tree (*Cariniana estrellensis*), one in Santa Teresa, in 1945, also on a jequitibá-rosa tree (*Cariniana legalis*) and one in São Gabriel da Palha, before 1946, on a sapucaia tree (*Lecythis urnigera*). Ruschi (1979) further reported that a Harpy Eagle nestling was collected in the Santa Teresa nest and deposited in the Museu de Biologia Professor Mello Leitão (MBML 2098), Santa Teresa, Espírito Santo. However, this specimen was later re-identified as a Crowned Solitary Eagle *Urubitinga coronata* (Banhos & Sanaiotti 2011). Ruschi (1979) did not report on any other nestlings collected from the other remaining nests, so there is no way to confirm that they were really Harpy Eagle nests (Banhos & Sanaiotti 2011).

We believe that the Harpy Eagle nest (Nest 1) on the Macanaíba-pele-de-sapo Road has not been reused since the 1992-1995, and that the pair may have remained at the RNV, based on sightings and other records obtained by local collaborators at the RNV (Figure 1, Table 1).

Since 1985, there have been about 25 sight reports of Harpy Eagle at the RNV (Table 1). Most records took place along the Gávea Road, probably because it corresponds to the largest forest corridor for the species at the RNV, and also because it is an often used road during activities such as seed collection and forest management research (Figure 1). The new nest (Nest 2, at Oiticica Road) is about 5 km away from Nest 1 (at Macanaíba-pele-de-sapo Road), and at least 6 km away from the

region with the most sightings (Figure 1). We believe that the sightings on the Gávea Road are of another pair, based on the distance from the new active nest. We expect to confirm this hypothesis by searching for the nest from these records.

Inter-nests distances between active pairs were on average 3 to 5 km as reported in Venezuela and Panama by Álvarez (1994) and Álvarez-Cordero (1996) (n = 9 nests, 45 - 79 km² per pair; n = 6 nests, 10 - 20 km² per pair, respectively) and Vargas-González & Vargas (2011) (n = 25 nests, 16 km² per pair). Piana (2007) reported three active nests in the Peruvian Amazon that were 7.4 km from each other (43 km² per pair). In a protected area in the Brazilian Amazon, the average distance between active nests was 8 km (n = 6, range 5 km - 12 km) (Aguiar-Silva *et al*. 2011). Here, we provide for the first time the distance between two nearby breeding Harpy Eagle nests in the Atlantic Forest and, in conjunction with the total area of the RNV, estimate that this conservation unit harbors at least two Harpy Eagle pairs.

It is not possible to confirm whether nests 1 and 2 at RNV were used by the same pair, since no biological material was collected from the first nest (Nest 1). However, genetic material from feathers found in 2011 and 2012 are available to allow the analysis of individuals associated with Nest 2 (Table 1, Figure 1) and those sighted at Gávea Road, which may confirm the existence of a second pair at the study site. Also, with genetic analysis, we can clarify whether the Harpy Eagle juvenile found dead in 1997 came from Nest 2 or elsewhere.

Harpy Eagle records at RNV in Espírito Santo indicate that this reserve offers enough resources and has carrying capacity to maintain a Harpy Eagle population of reduced size. Evidenced by the records of sightings of the Harpy Eagle preying successfully sloths and monkeys, and prey remain found on the forest floor below new nest (Nest 2) (Table 1). Sloths are the main Harpy Eagle prey at the Brazilian Amazon forest (Aguiar-Silva 2007, Aguiar-Silva *et al.* in press).

Recently, Harpy Eagles have also been recorded at "Reserva Biológica Augusto Ruschi" (Rebio Augusto Ruschi; Novaes *et al*. 2010) a 3,598.41 ha protected area in the Brazilian Atlantic Forest in Espírito Santo. Together with the data reported here, both the RNV and the state of Espírito Santo as a whole constitute very important conservation areas for Harpy Eagle populations in the Brazilian Atlantic Forest.

We recommend the establishment of a reforestation program to increase the size and the connections of fragments around the RNV. We suggest that the creation and effective implementation of protected areas may contribute to the Harpy Eagle protection in the Brazilian Atlantic Forest, but the long-term conservation of remaining populations is an essential step to allow for the occupation and re-colonization of other areas.

Finally, the RNV and the Rebio Sooretama, together, protect species of great ecological importance that have become rare or extinct in other Atlantic Forest regions. Such groups of species include the Brazilian Harpy Eagle, and a range of large forest eagles, such as the Crested Eagle (*Morphnus guianensis*) and the Ornate Hawk-Eagle (*Spizaetus ornatus*), as well as their prey species.

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NOTA/SHORT-COMMUNICATION

Rattus rattus (Mammalia: Rodentia) predation by *Ramphastos vitellinus* (Aves: Ramphastidae) in Santa Teresa Municipality, Espírito Santo, Brazil.

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ABSTRACT: The Channel-billed Toucan (*Ramphastos vitellinus*) is a frugivorous bird that eventually predates small vertebrates. This note reports a predatory event of one Channel-billed Toucan upon a black rat (*Rattus rattus*). The bird captured the rat on the ground with its beak, then, it returned to the canopy where it killed the rat beating it against a tree branch. After the rats death, the toucan ingested muscular and visceral tissues. Although the predation upon small vertebrates has been described for this species, the consume of black rats had never been reported; the role of the Channel-billed Toucan in rat population control in urban centres must be evaluated in future studies.

KEY-WORDS: black rat, predation, Piciformes.

Toucans, aracaris and toucanets are members of the Ramphastidae family (Sick 1997, Sigrist 2007). Species of this family are mainly frugivorous and considered good seed dispersers; their long-distance flights facilitate seed establishment in places far away from the mother tree (Galetti *et al.* 2000, Holbrook 2011). The Channel-billed Toucan (*Ramphastos vitellinus* Lichtenstein, 1823) is widely distributed in Brazil, occuring in forests, *Cerrado* (savannah-like vegetation), pastures, plantations and swamps (Sick 1997, Sigrist 2007). Although their diet are consisted predominantly by fruits, they can also ingest arthropods and small vertebrates (bats, rats, bird chicks, lizards and frogs; Remsem *et al.* 1993, Leite *et al.* 2010), capturing them directly from the ground, nests or tree hollows (Alvarenga 2004).

Here we report on a predation event by a Channel-billed Toucan upon a black rat (*Rattus rattus* Linnaeus, 1758) at the Mello Leitão Biology Museum park, located at the Santa Teresa Municipality (19°55'S; 40°35'W), Espírito Santo State, southeastern Brazil, on February 23th, 2011. The Channel-billed Toucan was perched on a tree branch, staring at the ground. After locating the rat, the bird flew down to the ground and captured it, returning to the canopy soon after, with the rat on its beak. The toucan, then, started to beat the rat against the tree branch, killing it. After the rat's death, the bird started to cut it into pieces using its feet to handle the prey, ingesting pieces of meat thereafter (Figure 1).

Small vertebrate consumption by Ramphastidae members is described by some authors (Sick 1997, Sigrist 2007). According to Remsem *et al.* (1993), Channel-billed Toucan is one of the *Ramphastos* species recorded eating such food items (3.9% of 26 stomachs evaluated showed vertebrate remains, mainly bird nestlings). The consume of black rats had never been reported, and the possible role of the Channel-billed Toucan in rat population control in urban centres must be evaluated in future studies.

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FIGURE 1: Channel-billed toucan (*Ramphastos vitellinus*) ingesting a black rat (*Rattus rattus*). Photos: J. N. S..

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NOTA/SHORT-COMMUNICATION

Primeiro registro do tio-tio-pequeno, *Phacellodomus sibilatrix* (Passeriformes: Furnariidae) no Brasil

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ABSTRACT: First record of the Little Thornbird *Phacellodomus sibilatrix* (Passeriformes: Furnariidae) in Brazil. On 26 January 2012, we obtained the first record of the Little Thornbird, *Phacellodomus sibilatrix* (Passeriformes: Funariidae) for Brazil at Barra do Quaraí, state of Rio Grande do Sul, on the border with Uruguay and Argentina. Two individuals of this resident species in these neighboring countries were photographed and their vocalizations recorded for the first time in Brazil.

KEY-WORDS: *Phacellodomus sibilatrix*, Little Thornbird, Rio Grande do Sul, Tiotío Chico

A família Furnariidae se distingue por possuir espécies com habilidades arquitetônicas na construção de ninhos (Belton 2004), e também por ser a segunda família com o maior número de espécies no Rio Grande do Sul (Bencke *et al.* 2010).

A fronteira oeste do Rio Grande do Sul está inserida no bioma Pampa, caracterizado pelos campos, onde ocorre o predomínio das famílias botânicas Poaceae, Asteraceae e Fabaceae no estrato herbáceo. No município de Barra do Quaraí, dia 26 de janeiro de 2012 às 16h52min (horário local), as autoras observaram, fotografaram e gravaram a vocalização de dois indivíduos de *Phacellodomus sibilatrix* em uma propriedade pertencente ao Parque Estadual do Espinilho (Rio Grande do Sul, Brasil; 30°11'56"S; 57°29'56"W; Figura 1). A identificação através da vocalização e imagens fotográficas (Oliveira 2012) contou com o auxílio dos usuários do site WikiAves e consultas à referências bibliográficas, sendo observados os seguintes caracteres morfológicos que distinguem *P. sibilatrix* das demais espécies do gênero: 1) presença de uma coloração ferrugem amarronzada na fronte, nas laterais da cauda, no dorso e nas asas e 2) lista superciliar branca riscada.

Os dois indivíduos de *Phacellodomus sibilatrix* observados (Figura 2) foram encontrados em um ninho localizado em um espinilho (*Acacia caven*; Figura 3), que chama atenção pelo tamanho de aproximadamente 80 centímetros de formato globular, com duas entradas, uma na parte superior e outra na parte inferior. Ambos agiram naturalmente ao notar a presença das observadoras, continuando o trabalho no ninho, onde um indivíduo coletava gravetos grandes de um tamanho médio de 20 a 30 centímetros de comprimento, entregando-os ao outro indivíduo, que os colocava no ninho, parecendo dar os toques finais da construção. Enquanto um arrumava os gravetos, o outro foi até os galhos do arbusto que abrigava o ninho e ficou bicando a procura de alimento, até que ambos voaram para longe, voltando e vocalizando fortemente enquanto carregavam plumas para o ninho. Posteriormente, o mesmo indivíduo que ficou trabalhando na finalização do ninho permaneceu no seu interior por aproximadamente 15 minutos, enquanto o outro indivíduo procurava novamente por alimento, desta vez, no chão.

O Parque Estadual do Espinilho está situado no extremo sudoeste do Rio Grande do Sul, estando inserido na microbacia do Arroio Quaraí-Chico e às margens do rio Uruguai, distantes, respectivamente um e cinco quilômetros do local do registro aqui reportado. A vegetação da área apresenta uma composição arbórea-arbustiva, representada pelas espécies *Acacia caven* (espinilho), *Parkinsonia aculeata* (cina-cina), *Prosopis affinis* (inhanduvá) e *Prosopis nigra* (algaborro) que, aliada às condições edafoclimáticas, constitui o Parque Estadual do Espinilho em um ecossistema diversificado e peculiar no território brasileiro. É uma área de extrema importância por oferecer abrigo e proteção para as espécies tanto da flora como da fauna, especialmente aquelas endêmicas da região e que se encontram em estado vulnerável por causa da intensificação das atividades agropecuárias sem enfoque sustentável.

Phacellodomus sibilatrix possui tamanho de aproximadamente 12 centímetros de comprimento

FIGURA 1: Um indivíduo de *Phacellodomus sibilatrix* fotografado no ninho no dia 26 de janeiro de 2012 na Barra do Quaraí - RS, Brasil.
FIGURE 1: Individual of *Phacellodomus sibilatrix* photographed on January 26, 2012 at Barra do Quaraí - RS, Brazil.

FIGURA 2: Dois indivíduos de *Phacellodomus sibilatrix* fotografados no ninho no dia 26 de janeiro de 2012 na Barra do Quaraí - RS, Brasil.
FIGURE 2: Two individuals of *Phacellodomus sibilatrix* photographed on January 26, 2012 at Barra do Quaraí - RS, Brazil.

FIGURA 3: Ninho de *Phacellodomus sibilatrix* fotografado no ninho no dia 26 de janeiro de 2012 na Barra do Quaraí - RS, Brasil.
FIGURE 3: Nest of *Phacellodomus sibilatrix* photographed on January 26, 2012 at Barra do Quaraí - RS, Brazil.

(Narosky & Yzurieta 2003), menor que as demais espécies do gênero, justificando o nome tio-tio-pequeno, que encontra análogos também nas línguas inglesa (Little Thornbird) e espanhola (Tiotío Chico; Aves Uruguay 2012). Esta espécie possui uma dieta a base de insetos e outros artrópodes e não apresenta comportamento migratório (Dardanelli *et al.* 2006). Sua distribuição engloba os seguintes países: Argentina, Paraguai, Bolívia e Uruguai (Birdlife International 2012). No Uruguai, a espécie é relatada no oeste do Departamento de Colonia e no sudoeste do Departamento de Soriano, enquanto no Paraguai há registros para o Departamento de Boquerón, na Bolívia para a região do Chaco de Santa Cruz e na Argentina para as províncias de Córdoba e Entre Ríos (Gerzenstein 1965, Neris & Colman 1991, Ayuso & Sánchez 2002, Goijman & Zaccagnini 2008, Salvador 2012).

O ineditismo da ocorrência de *P. sibilatrix* no estado do Rio Grande do Sul e Brasil pode estar associado a mais de um fator, como, por exemplo, a relativa escassez de inventários da avifauna nos pampas gaúchos, bem como uma possível recente expansão da distribuição da espécie em função da degradação de hábitat nativo nos países vizinhos, como o Uruguai.

Descarta-se a hipótese de que os dois indivíduos observados estivessem de passagem, pois demonstraram comportamento reprodutivo ao construir um ninho, comprovando a ausência de um comportamento migratório, conforme relatado por Gerzenstein (1965).

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