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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

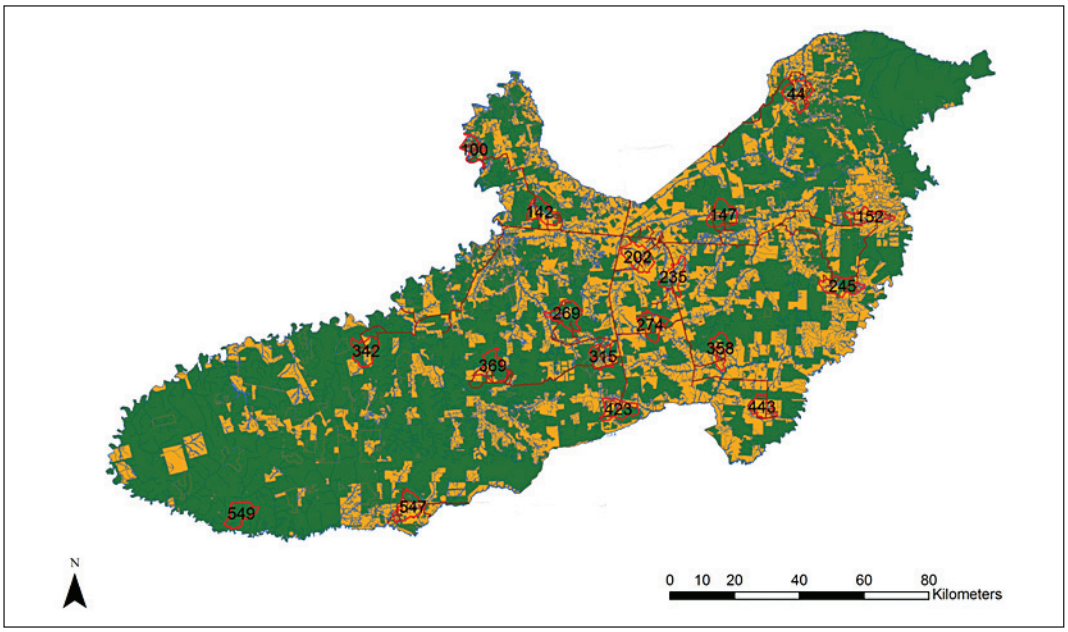

FIGURE 1. A map of the municipality of Paragominas illustrating major land-use types and the locations (and numbers) of the 18 study catchments.

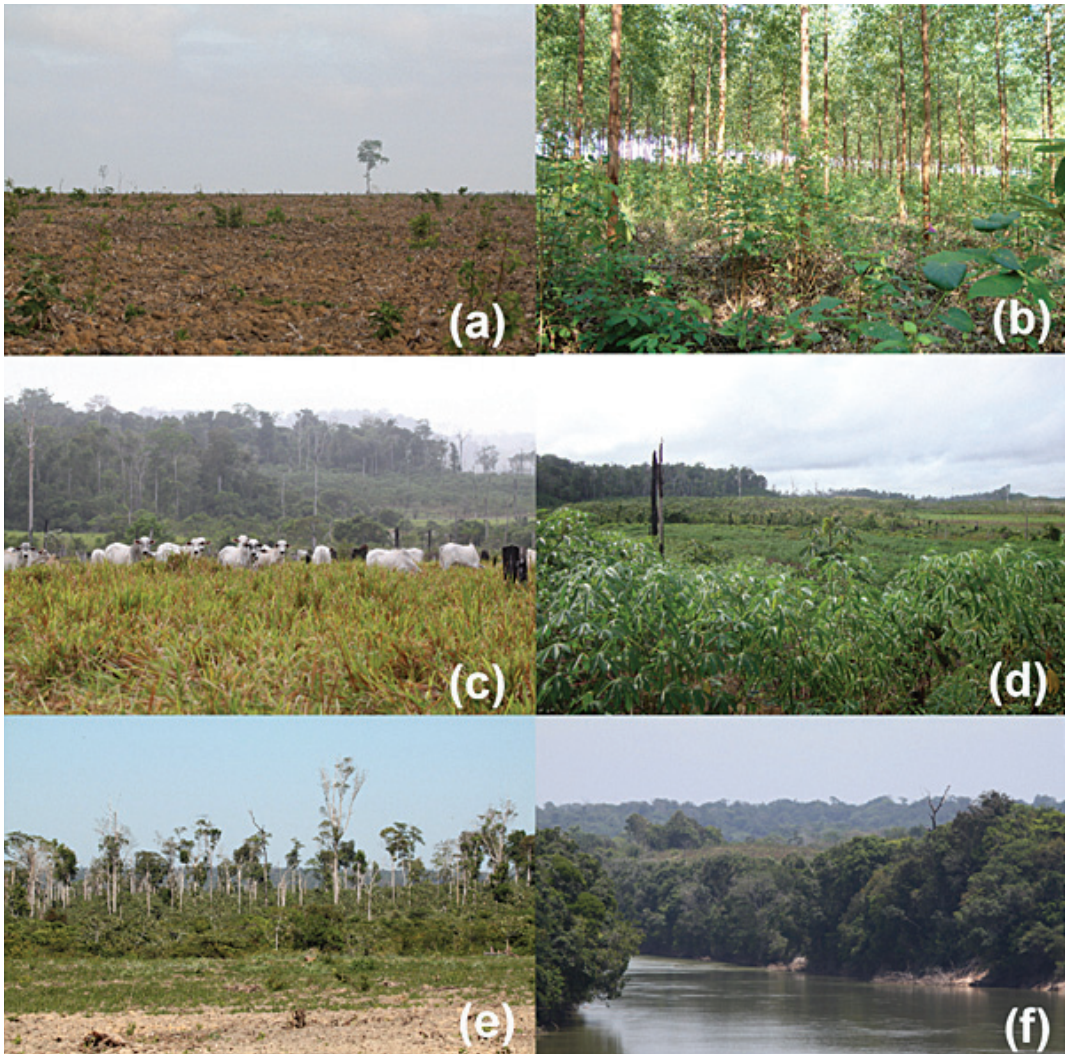

FIGURE 2. General aspects of vegetation types around Paragominas: (a) Catchment 423 - graded field after soy bean harvest; (b) Catchment 202 - Eucalyptus plantation; (c) Catchment 44 - foreground - cattle pasture, background primary and secondary forest; (d) Catchment 44 - smallholder's manioc plantation; (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).

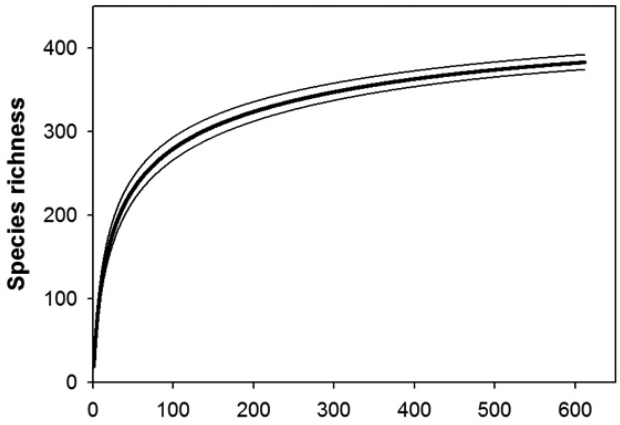

FIGURE 3. Sample-based rarefaction curve with 95% confidence intervals to indicate the degree of completeness of the transect-based surveys.

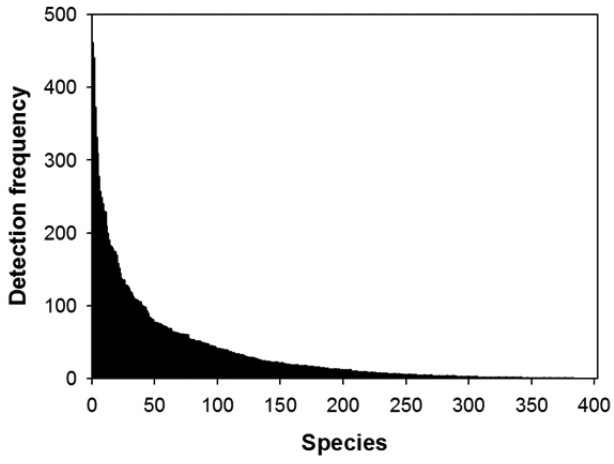

FIGURE 4. Landscape-wide relative abundance of the 383 species recorded during the transect-based surveys.

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]	

Scientific name	English name	Photo Ref. WA:	Sound ref. XC:	Background	Abundance	MPEG specimens
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	