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ARTICLE

One hundred and thirty-five years of avifaunal surveys around Santarém, central Brazilian Amazon

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ABSTRACT: We present an updated annotated avifaunal checklist for the Santarém region of central Pará state, Brazil, an area that has one of the oldest histories of ornithological exploration in South America. We combine data from a five-month quantitative survey of the birds of the municipalities of Santarém and Belterra (east of the Tapajós River) between 2010 and 2011 with an exhaustive search of material in museum collections worldwide and digital vouchers deposited online. Our own survey sampled habitats across a gradient of disturbance ranging from 'undisturbed' primary forest, through logged and burnt forest, patches of secondary forest, cattle pastures and intensive mechanized agriculture. Given the potential for species misidentifications in avian inventories, we paid special attention to obtaining voucher documentation. Here we present a collection of publicly accessible digital vouchers for all of the new species, in addition to providing museum catalogue numbers for all old records. We added 24 species to the regional list, principally species associated with anthropogenic land-uses, but also including seven species restricted to primary forest habitats which were missed from both recent published inventories and over the course of two centuries of intensive collecting efforts. The regional list now stands at 583 species for which voucher documentation is available, with an additional 26 undocumented species. Many of the species reported here are poorly known or represent notable range extensions, and we present new data on their status and distribution.

KEY-WORDS: bird survey, Amazonia, conservation, range extension, digital voucher.

INTRODUCTION

The compilation of accurate biodiversity inventories represents a critical first step for understanding natural patterns of environmental heterogeneity and species-specific responses to human-induced environmental change. Even for birds, perhaps the best studied of the Neotropical biota, such inventories remain a labor intensive and error prone task, particularly in extremely diverse tropical forest regions such as the Amazon basin (Remsen 1994, Cohn-Haft *et al.* 1997).

The Santarém region of central Pará (PA) state, south of the Amazon and east of the Tapajós Rivers, is one of the ornithologically best-studied landscapes in Amazonian Brazil, with a history of specimen collection starting from at least 1834 (Pelzeln 1871) and avian inventories spanning over 135 years (*e.g.* Allen 1876, Sclater & Salvin 1878, Riker 1891, Griscom & Greenway 1941, Henriques *et al.* 2003). Intensive sampling effort in the 19th and early 20th centuries saw many thousands of specimens collected in the region, but this data has never been synthesized in one place. The fruits of this labour during this period included the discovery of several new birds to science including Klage's Antwren *Myrmotherula klagesi*, Bare-eyed Antbird *Rhegmatorhina gymnops* and Point-tailed Palmcreeper *Berlepschia rikeri.*

The most exhaustive contemporary inventory undertaken in the region - Henriques *et al.* (2003) -

focused on the *terra firme* forest avifauna in the Floresta Nacional do Tapajós (Tapajós National Forest, hereafter FLONA), a 560,000-ha protected area managed by the Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio. Subsequent studies in the FLONA have investigated avian response to forest gaps (Wunderle *et al.* 2005) and reduced impact logging (Wunderle *et al.* 2006, Henriques *et al.* 2008). Elsewhere, the savannah enclave of Alter do Chão has been the subject of several quantitative avian studies (see *e.g.* Sanaiotti & Cintra 2001 and Cintra & Sanaiotti 2005). However, beyond the FLONA and Alter do Chão, the region has been relatively poorly inventoried, especially in non-forest landscapes.

We carried out a five month survey of the birds of the municipalities of Santarém and Belterra under the auspices of the 'Rede Amazônia Sustentável' (RAS: www.redeamazoniasustentavel.org), 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, Australia and US. Coordinating institutions are the Goeldi Museum and Embrapa Amazônia Oriental (Belém), and 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 (Gardner *et al. in press*). In this paper we present an updated and annotated species list derived from the avian component of RAS study region in the municipalities of Santarém/Belterra, our incidental observations from surrounding non-study landscapes *e.g.* Alter do Chão, and a critical review of old records, including a search of global museum holdings from the region.

METHODS

Study Landscape: climate and biophysical conditions

Santarém has a mean annual temperature of 25°C and a mean relative humidity of 86%, with annual rainfall averaging 1920 mm and a short dry season of 2–3 months, usually between August and October with severe droughts in El Niño years (Parrotta *et al.* 1995, Nepstad *et al.* 2002). Canopy heights of undisturbed *terra firme* forests are typically in the range of 30 to 40 m, with occasional emergent species up to 50 m tall. Most of the survey landscape is situated on a flat terrace of Tertiary sediments capped by the Belterra Clay Formation (Clapperton 1993), at least 90 m above the water level of the adjacent Tapajós and Amazon rivers. Regional soils are predominantly oxisols dominated by kaolinite clay minerals and free of hardpan or iron oxide concretions in the upper 12 m (Nepstad *et al.* 2002). Originally the survey region was entirely covered by lowland tropical forest. By 2008 approximately one third had been deforested with much of the forest outside the FLONA having been degraded from the impacts of logging and fire (RAS *unpubl. data*).

At the extreme north-western point of the region (Figure 1), there is an enclave of about 10,000 ha of savannah habitat on a peninsula beyond the town of Alter do Chão. The vegetation here is dominated by an herbaceous stratum composed principally of tuft-forming grasses (*e.g. Paspalum carinatum* and *Trachypogon plumosus*) and sedges (*e.g. Rhyncospora hirsute*) interspersed with patches of trees and shrubs (principally the families *Myrtaceae* and *Rubiaceae*) (Miranda 1993, Magnusson *et al.* 1999, Magnusson *et al.* 2008) and some larger forest fragments. The trees are short in stature, often with tortuous trunks, a thick cortex and leathery leaves, and do not form a continuous canopy. Regular semi-annual burning can significantly reduce the area covered by the common shrub species, which then become dominated by the grass *P. carinatum* (Sanaiotti & Magnusson 1995). Such savannah formations were formerly more widespread; Griscom & Greenway (1941) states of the environs of the city: '*the built-up part is surrounded by savannahs for a distance of about two kilometres, beyond which the dense vegetation, high and savage, begins*.'

The northern border of the region is delimited by the *várzea* forests and associated series of sedimentary islands and channels resulting from constant fluvial action. Behind these, on clay soils, lie savannahs and open lakes, both of which flood seasonally. The lakes swell and retract according to the flood cycle, sometimes covering tens of square kilometers. Large grasses found on the flooded savannah include *Echinochloa polystachya*, *E. spectabilis*, *Hymenachne amplexicaulis* and *Leersia hexandra*, in addition to sedges such as *Scirpus cubensis*, *Cyperus luzulae* and *Scleria geniculata*. At the ecotone between the savannah and forest habitats dominant shrubs and small vines include *Artemisia artemisiifolia*, *Ipomoea fistulosa*, *Polygonum punctatusm*, *Mimosa pigra*, *Montrichardia linifolia*, *Rhabdadenia macrostoma* and *Clitonia triquetum* (Pires & Prance 1985, Daly & Mitchell 2000).

2010-2011 survey experimental design

To develop our sampling approach the municipalities of Santarém-Belterra in the region between the Tapajós and Curuá-Una rivers, bordered to the north by the Amazon river and extending approximately 140 km south along the BR-163 highway (Figure 1), were divided up into catchments of 5,000 – 6,000 ha, which were delineated using a digital elevation model and SWAT (Soil and Water Assessment Tool) for ARCGIS 9.3

(ESRI 2008). We then selected a subset of 18 catchments (Table 1, Figure 1) to represent a gradient of accumulated forest loss from 78% (28% 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 was 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. All landowners in each catchment were visited prior to any fieldwork to introduce the RAS project and secure permissions for surveys in private properties (Gardner *et al in press*).

Within each catchment, we used a stratified-random sampling design that helped ensure that sample data provide a representative assessment of the overall environmental condition. In each catchment a standard density (1 per 400 ha) of 300 m study transects was distributed across the landscape in proportion to the percent cover of forest (including primary and secondary forests) and production areas (including agriculture,

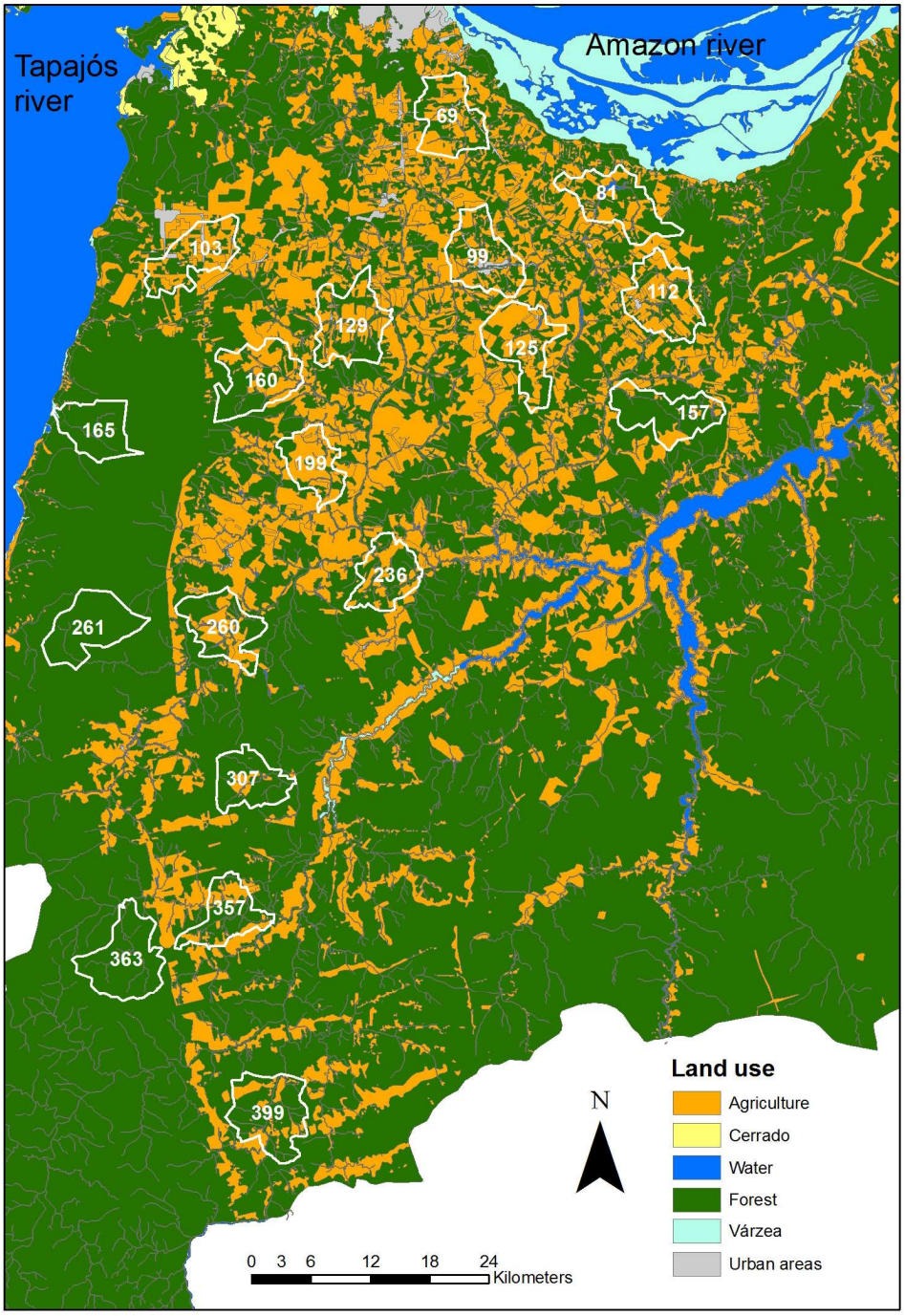

FIGURE 1. A map of the municipality of Santarém illustrating major land-use types and the locations (and numbers) of the 18 study catchments.

pasture, fruticulture and silviculture) – such that if half of the catchment is covered by forest then it 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 we captured important internal heterogeneities in forest and/or production systems. A minimum separation distance rule of 1,500 m between transects was employed to minimize dependence between points. Where forest cover fell below 1,200 ha, we maintained a minimum of three sample transects in forest (ensuring we captured a reasonable sample of the state of the forest in that catchment).

TABLE 1. Co-ordinates, total area and percentage forest cover (using using a 2008 Landsat-Palsar classified image courtesy of The Nature Conservancy) of the 18 catchments sampled during the study.

Catchment code	Latitude and Longitude of catchment centroid	Catchment size (ha)	% forest cover
69	2°32'53"S; 54°40'35"W	4299	46
81	2°37'45"S; 54°31'23"W	4659	57
99	2°40'28"S; 54°38'44"W	4546	47
103	2°40'30"S; 54°54'33"W	4105	39
112	2°42'37"S; 54°28'55"W	4795	38
125	2°45'21"S; 54°36'32"W	4852	39
129	2°44'17"S; 54°45'57"W	4963	52
157	2°49'8"S; 54°28'48"W	4321	81
160	2°47'0"S; 54°51'5"W	4841	60
165	2°49'44"S; 54°59'51"W	3447	99
199	2°51'52"S; 54°47'58"W	3228	28
236	2°57'50"S; 54°44'1"W	3681	63
260	3°1'7"S; 54°52'55"W	4219	59
261	3°1'7"S; 55°0'12"W	4654	100
307	3°9'14"S; 54°51'27"W	3451	87
357	3°16'50"S; 54°52'41"W	3518	67
363	3°19'1"S; 54°58'12"W	5166	100
399	3°27'40"S; 54°50'17"W	5215	77

Avian Sampling

Fieldwork by A. C. L., N. G. M., C. B. A., B. J. W. D. and E. V. L. was conducted from 16 October 2010 to 8 February 2011. We conducted two repetitions of three fixed width (75 m) 15-minute point counts per transect situated at 150 m intervals along a 300 m transect. All point counts (PCs) were conducted by principal observers A. C. L., N. G. M., C. B. A. and B. J. W. D. with the exception of two transects carried out independently by E. V. L. in Catchment 236 (see Figure 1 for numbering of study catchments). Surveys were not carried out on days with persistent rain and/or strong winds. 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.

Digital Vouchers

We have archived digital vouchers (photo and sound-recording e-vouchers) on the internet to provide documentary evidence for all 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. Minimum criteria for inclusion on the list include multiple sight records by multiple observers, of species easy to identify and considered to be biogeographically likely in the region (i.e. there are documented records at other sites close to the study region). Our images have been archived on the Brazilian avian photo archive 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. Where we are unable to provide a voucher (4% of species) we moved the species to Appendix II and also provide observer(s) names and date and details of the sighting.

Historical Analysis

We provide accession numbers for voucher specimens of species previously collected in the region in Appendix 1. We compiled a list of specimens collected by previous fieldworkers from the Museu Paraense Emílio Goeldi, Belém, Brazil (MPEG) and were provided with digital data for the holdings of the Carnegie Museum of Natural History, Pittsburgh, USA (CM) and partial data (only non-passerines available) for the Museu de Zoologia Universidade de São Paulo, São Paulo, Brazil (MZUSP). We used the digital database *Ornis* http://www.ornisnet.org/ to search for historically-collected specimens and retrieved records from the American Museum of Natural History, New York, NY, USA (AMNH), the Academy of Natural Sciences, Philadelphia, PA, USA (ANSP), the Field Museum of Natural History, Chicago, IL, USA (FMNH), the Los Angeles County Museum of Natural History, Los Angeles, CA, USA (LACM), the Louisiana State University, Baton Rouge, LA, USA (LSU), the University of Michigan, Museum of Zoology, Ann Arbor, MI, USA (UMMZ) and the United States National Museum, Washington, D.C., USA (USNM). Collecting localities were located using Paynter & Traylor (1991).

We critically reviewed specimens and solicited photographic documentation of any specimens deemed by us and independent collaborators (Curtis Marantz & Bret Whitney) to be biogeographically unlikely. This search of museum holdings was accompanied by a review of previous published ornithological inventories from the region and we also include digital vouchers of images and sound-recordings archived on Wikiaves and Xeno-Canto by non-authors separately, coupled with voucher numbers for sound-recordings archived at the Macaulay Library http://macaulaylibrary.org/ (principally by Curtis Marantz) of species listed in Henriques *et al.* (2003).

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 427 species in 70 families (Appendix I), of these we provide our own digital vouchers for 375 species (88%, 250 species represented by images and 266 by sound-recordings). Historical collecting effort in Santarém was intense; we located records of over 10,000 specimens of 531 species in 10 collections. This in addition to a significant number of early skins deposited at the British Museum, Tring, UK which are as yet undigitalised. By totaling these historical records (and other contemporary records supported by digital vouchers) we can add a further 156 species to the total giving a total of 583 species in 70 families. Species recorded by us and missed by all previous inventories included the expected transient or scarce resident waterbirds (*e.g.* Snowy Egret *Egretta thula*), potentially colonizing non-forest species (*e.g.* Plain-breasted Ground-dove *Columbina minuta*), the poorly sampled nocturnal avifauna (*e.g.* Long-tailed Potoo *Nyctibius aethereus* but also that would be considered core members of the *terra firme* forest community such as Brown-banded Puffbird *Notharcus ordii* and Grey Elaenia *Myiopagis caniceps*. These latter species represent surprising omissions, but their canopy lifestyles probably put them 'beyond the shotgun reach' of many earlier collectors and may have been missed in contemporary surveys by a combination of local rarity and their unobtrusive habits. We retained one unvouchered species: Para Gnatcatcher *Polioptila paraensis* on the main list given multiple detections by our and past inventories; the presence of this species in the region is also supported by documented records from adjacent municipalities.

A number of species from recent inventories or unpublished observations (including our own) did not meet our minimum criteria for inclusion in the main list and these records (of 26 species) are summarized in Appendix II. In most cases we simply consider these records to be unproven and are not inferring necessarily that an identification is certainly in error. However, in the case of the report of Green-barred Woodpeckers *Colaptes melanochloros* from Alter do Chão listed in Sanaiotti & Cintra (2001) we consider it highly likely that these were misidentified Spot-breasted Woodpeckers *Colaptes punctigula* which are a common resident in that region and absent from the list of Sanaiotti & Cintra (2001). Likewise, the records of Rufous-capped Motmots *Baryphthengus ruficapillus* listed in Henriques *et al.* (2008) appeared in error and referred to Rufous Motmots *B. martii*.

We follow Silveira *et al.* (2005) in considering the presence of Sulphur-breasted Parakeet *Aratinga maculata* in the region as unproven. There are two specimen records from Santarém - one collected by E. Garbe in 1920 (MZUSP 10644) and the other by A. M. Olalla in 1935 (MZUSP 18451). The former is suspected as having come from Monte Alegre and the latter was apparently of captive origin (Silveira *et al.* 2005). In addition to these two specimen records, Silva & Willis (1986) reported a series of sight records of this species from Santarém – groups of

3, 5 and 6 in *várzea* forest at Maicá on 16 January 1984, 2 feeding on small melastomataceous fruits in seasonally flooded forest at Rodagém, Santarém on 18 October 1984 and groups of 3 and 5 in secondary forest at Urumari, in February 1985, all considered unproven by Silveira *et al.* (2005). Given that this species' distribution has recently been found to be far more extensive than previously thought, extending east to Amapá (da Costa *et al.* 2011) and north into Suriname (Mittermeier *et al.* 2010), then a confirmed record from the south bank of the Amazon river seems less far-fetched than was previously considered.

We paid particular attention to trying to validate historical records that were not supported by recent field observations and those which appeared to be biogeographically unlikely. At the top of this list was a record of Brown Tanager *Orchesticus abeillei* (UMMZ 22269) collected by Joseph Steere. We were unable to obtain images of the specimen but this record of an Atlantic Forest endemic is entirely unlikely and presumably either refers to a misidentified or mislabeled specimen. A number of skins collected by A. M. Olalla from the region were adjudged to be likely misidentified and this proved to be the case on examining images of the original skins. These included a specimen of Semipalmated Sandpiper *Calidris pusilla* which we re-identified as Least Sandpiper *Calidris minutilla* (MCZ 173283 see separate species account below); a specimen of Black-bellied Antwren *Formicivora melanogaster* (MCZ 174889) which we reidentified as a female Rusty-backed Antwren *F. rufa*; and a specimen of Black-necked Red-cotinga *Phoenicircus nigricollis* (MCZ 171158) which we reidentified as Guianan Red-cotinga *P. carnifex.* In addition we consider the identification of a female Thick-billed Euphonia *Euphonia laniirostris* (MCZ 176604) to be improbable by range and more likely to relate to a Violaceous Euphonia *E. violacea*, separation of females of these two replacement species is very difficult. Riker & Chapman (1891) list a record of an unidentified *Attila* sp. that they considered '*may be the as yet undescribed female of A. citriniventris*' [Citron-bellied Attila]. The specimen is deposited in the collection of the National Museum of Natural History (USNM 121134) and until recently was labeled as *A. citriniventris*. However, this would be biogeographically unlikely considering that this species is restricted in Brazil to the western Guianas. T. Chesser (*in litt*.) examined the specimen on our behalf and found the plumage to be in poor condition, stained by some unknown chemical, but noted that plumage coloration (to the extent that it can be discerned) and bill morphology and coloration match those of Dull-capped Attila *A. bolivianus*. Moreover, "yellow iris" is noted on the back of the original collector's label; a yellowish-white iris is found among species of *Attila* only in *bolivianus*. An old specimen record of Peruvian Recurvebill *Simoxenops ucayalae* (MPEG 32018), purportedly from Santarém has proven rather controversial. Novaes (1978) considered the specimen likely mislabeled, as at the time there were no records from the eastern Amazon, but the species has subsequently been found at various disjunct locations in eastern Amazonia, including as close as Altamira (230 km south-east), so although there have been no subsequent records from the region this species may occur in (or close to) the region (Aleixo *et al.* 2000). These exceptions aside we are confident that specimens labeled as 'Santarém' were taken from our study region south of the Amazon River and east of the Tapajós given the absence of specimens of common replacement *terra firme* forest species from adjacent areas of endemism (such as the west bank of the Tapajós, or north of the Amazon). However, an element of doubt remains over records of the following generalist and edge species which are typically widespread in anthropogenic habitat elsewhere in Amazonia: Rusty-fronted Tody-Flcatcher *Poecilotriccus latirostris*, Euler's Flycatcher *Lathrotriccus euleri* and Chalk-browed Mockingbird *Mimus saturninus* but which are only represented by historic specimens (and no contemporary observations). There remains the possibility that these species might have been collected from river-islands closer to the north than the south bank of the river Amazon or have simply failed to colonize *terra firme* habitats in the region.

Our own fieldwork produced several unconfirmed records (Appendix II). The most notable of these were the multiple detections of Spix's Guan *Penelope jacquacu*, which most contemporary distribution maps indicating that this species does not occur north of the Serra do Cachimbo (a significant faunal and floral barrier 600 km south of the region) in the Tapajós-Xingu interfluvium. However, this species was reported north of the Serra do Cachimbo, in Novo Progresso by Pacheco & Olmos (2005), has been collected 200 km SW of our region at Fazenda Jamanxim, Altamira, PA on 24 November 2005 by A. A., E. Portes and M. Silva (MPEG 59303) where the species was also recently recorded by C. B. A. and A. Whittaker, suggesting that our records may not be in error, despite the lack of previous reports of this large and generally conspicuous species.

Although not listed in Appendix II, a possible aural contact of Black-chested Tyrant *Taeniotriccus andrei* from secondary forest in catchment 112 is worthy of mention here given the lack of previous reports from the western half of the Tapajós-Xingu interfluvium. The distant and poorly heard single note contact call was only detected on revision of the point count recording, and therefore cannot be confirmed. Although Zimmer & Whittaker (2004) list a specimen (MPEG 49278) from 'Novo Fazenda, Jaburu, Santarém, PA' this actually refers to a bird collected at Fazenda Jaburu, Novo Santarém; confusion owing to a slightly ambiguous specimen label. Novo Santarém lies east of Belém, a region where *T. andrei* is reasonably common (*cf.* Lees & Moura 2011).

Selected species accounts for taxa of significant biogeographic or conservation interest recorded during RAS fieldwork

Brown Tinamou *Crypturellus obsoletus*

N. G. M. sound recorded several vocalising individuals in river-edge forest in catchment 165 on 14 December 2010 (Moura 2010a). This species was unrecorded by Henriques *et al.* (2003), but has previously been collected from the region by S. M. Klages who obtained three individuals at 'Colônia do Mojuy' (=Mojuí dos Campos) in November 1919 (Blake 1961). These birds pertain to the subspecies *griseiventris* which is significantly vocally and morphologically distinct from other Amazonian and Atlantic Forest populations and might be better considered a separate species.

Crested Eagle *Morphnus guianensis*

Although recorded from the first inventory, we include an account for this species given the collection of data on the species' breeding biology. João Batista Ferreira, a local landowner on whose property we had a transect (catchment 103), took us to see a nest of an 'eagle', which transpired to be the active nest of a pair of *Morphnus guianensis* with a dependent (circa 7 month old) juvenile (Andretti 2010a). The nest (Figure 2, Lees 2010a) was located within a patch of old secondary forest on the edge of the town of Belterra. The structure was quite small, 120 cm x 105 cm and 62 cm deep, positioned 30 m up in a 'morototó' tree, family Araliaceae (Programa de Conservação do Gavião-real *in litt.* 2011). This is the first report of a suburban pair of *Morphnus* from anywhere in the world and only the 7th nest of this species recorded from Brazil. This discovery parallels that of a suburban pair of Harpy Eagles *Harpia harpyja* in Alta Floresta, Mato Grosso (MT), which bred successfully for at least three consecutive years in a 270 ha forest fragment (Lees 2006). These two examples illustrate how large forest eagles may not be prey-limited in small forest fragments, but are probably extremely susceptible to being hunted should they become accustomed to prey upon small livestock (Trinca *et al.* 2008).

Aplomado Falcon *Falco femoralis*

We first recorded this falcon in catchment 260 where A. C. L. observed a single adult hunting over soy bean fields on 6 December 2010 (Lees 2010b). We subsequently recorded this species on a further five occasions including an additional two catchments (99 and 125), all hunting over open farmland. In addition, E. V. L. photographed a juvenile (Lopes 2011a) at Alter do Chão on 6 March 2011; a location where this species has previously been reported by Sanaiotti & Cintra (2001), who suspected on the basis of a single July record that this species may be a migrant in the region. Considering our records in the austral summer, we assume this species to be a rare resident in the region. There is one historical record from the region: one (MCZ 173143) collected by A. M. Olalla from 'Santarém, Tapajós river'. These records are apparently the only ones from central Amazonia, with the closest records coming from the southern savannahs of Guyana and Roraima (RO), 650 km NW (Robbins *et al.* 2004, Santos & Silva 2007), Vila Nova, AP, 520 km NE (Schunk *et al.* 2011), and Alta Floresta, MT, 815 km south (Mahood *et al.* 2012, Lees *et al.* 2013).

Plain-breasted Ground-dove *Columbina minuta*

We recorded this species on two occasions: single individuals photographed (Moura 2011a), and sound-recorded (Moura 2011b) by N. G. M. from cattle pasture in catchment 69 on 8 January 2011, and from a smallholder's fruit farm in catchment 112 on 31 January 2011. We are only aware of two previous reports from central Amazonia – an individual collected from the savannahs of Monte Alegre, PA (Vasconcelos *et al.* 2011) and sight records from the Juruti region, PA (Santos *et al.* 2011) but this species has been reported from several peri-Amazonian sites (*e.g.* Schunk *et al.* 2011, Somenzari *et al.* 2011). Our records probably relate to individuals colonizing anthropogenic habitats from these savannah enclaves rather than individuals spreading in from peri-Amazonian areas. We predict that this species will prove to be considerably more widespread in Amazonia than these scant records indicate.

Hyacinth Macaw *Anodorhynchus hyacinthinus*

We encountered this threatened macaw on two occasions from two different catchments; C. B. A. observed a single individual flying overhead on 17 October 2010 in catchment 261, and B. J. W. D. and A. C. L. independently heard and sound-recorded a single passing over the canopy in catchment 363 on 23 January 2011 (Davis 2011a). We assume that these pertain to wandering individuals from populations further south along the BR-163 (*e.g.* Pacheco & Olmos 2005) and highlight the current local rarity of the species. The species was formerly more widespread in the Santarém region; Riker (1891) obtained three specimens '*twenty-five miles back from Santarém*' on 10 June 1887.

Long-tailed Potoo *Nyctibius aethereus*

We recorded this enigmatic potoo on two occasions, the first records from the Santarém region. C. B. A. sound-recorded one singing distantly (Andretti 2010b)

from catchment 261 on 20 October 2010 and B. J. W. D. sound-recorded one in catchment 363 on 24 January 2011. Despite regular night-time searches (and fairly regular aural contacts with White-winged Potoos *Nyctibius leucopterus*) we were unable to find Rufous Potoo *N. bracteatus* in the region. The closest records of this latter species are one sound-recorded 200 km south of the region from Trairão on 7 June 2008 by C. B. A. and on the west bank of the lower Tapajós at Juruti (Santos *et al.* 2011) and the Reserva Extrativista Tapajós-Arapiuns (MPEG 72300 and 72301).

Great Horned Owl *Bubo virginianus*

E. V. L. photographed a single individual day-roosting on the campus of the Universidade Federal do Oeste do Pará on 13 October 2011 (Lopes 2011b). There are few records of this species from the central Amazon, although this species is present on savannahs in Roraima (Naka *et al.* 2006) and Suriname (Mittermeier *et al.* 2010).

Streak-throated Hermit *Phaethornis rupurumii*

We recorded the *amazonicus* subspecies of this hermit on eight occasions from three different (although geographically adjacent) catchments (99, 125 and 129); most of these were secondary forest sites although we also encountered this species in logged and burnt primary forest. A. C. L. located two different leks – one each in 125 and 129 where the birds were photographed (Figure 3, Lees 2011a) and sound recorded (Lees 2011b). This taxon is typically considered to be restricted to the *várzeas* of the river Amazon and its major tributaries. However our observations, of leks in secondary forest over 25 km from a major river, mirror those of Schunck *et al.* (2011) from Vila Nova, Amapá, who found this species '*in woodlots and narrow riverine forest within the mosaic of savannistic formations of Vila Nova, distant from the widest rivers*'. This confirms that this species has a broader tolerance of forest habitats than previously suspected but we cannot rule out that this expansion into non-riparian habitats may be a recent phenomenon following land-use change. We may have overlooked this species if present at a low density elsewhere in the region owing to the sympatric presence of as many as six species of *Phaethornis* hermits (and *Glaucis hirsutus*), which made identification of fly-through individuals at times difficult or impossible.

Tapajós Hermit *Phaethornis aethopyga*

This species, recently re-elevated to species status (Piacentini *et al.* 2009) is endemic to the Tapajós-Xingu interfluvium, occurring between the river Teles Pires and the river Amazon and was listed as *Phaethornis*

FIGURE 2. Nest of Crested Eagle *Morphnus guianensis* at catchment 103 in Belterra (A. C. L.).

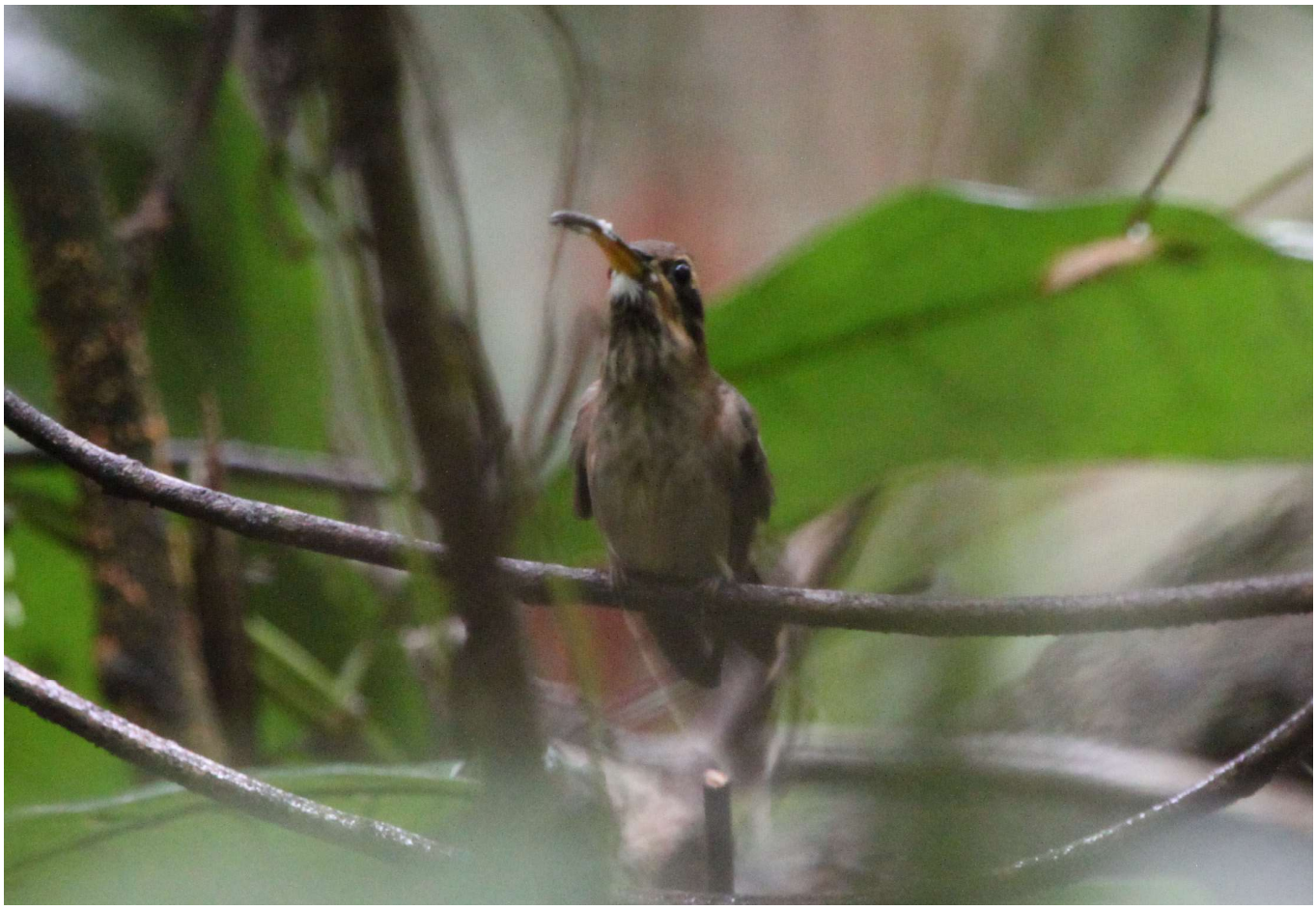

FIGURE 3. Streak-throated Hermit *Phaethornis rupurumii* at lek in a fragment of secondary forest (A. C. L.).

longuemareus in Henriques *et al.* (2003). We found it to be the most common *Phaethornis* hermit within the FLONA, but to be uncommon or absent from most of the catchments outside of the reserve where it was largely replaced by Reddish Hermit *Phaethornis ruber* and *P. rupurumii*, although S. M. Klages collected one individual at Colônia do Mojuy on 27 October 1919. Whether this current distribution is potentially related to topographically-determined micro-habitat preferences or direct replacement by these more ruderal hermit species remains unclear, but on current evidence this species appears to be quite disturbance intolerant *cf.* Henriques *et al.* (2008) although also see Piacentini *et al.* (2009).

Brown-banded Puffbird *Notharchus ordii*

We recorded this poorly known puffbird on two occasions: C. B. A. tape-recorded (Andretti 2010c) one in catchment 399 on 1 November 2010 and saw a second individual in catchment 261 on 19 October 2010. C. B. A. also recorded this species from the region of Trairão where the species was recorded on four dates in September 2009 on the Transamazônica 80 km NE of Itaituba and on the river Cupariri 92 km east of Itaituba (PA). This species is often reported as being associated with stunted forest on white sandy soils *e.g.* in Acre (Guilherme & Borges 2011), north-eastern Peru (Alonso & Whitney 2003), southwestern Venezuela, and the upper river Negro region of northern Brazil (Zimmer & Hilty 1997) and in dept Pando, Bolivia (Tobias & Seddon 2007). This record however, coupled with others from Alta Floresta (Zimmer *et al.* 1997), Novo Progresso (Aleixo *et al.* 2008), the Juruti region of Pará (Santos *et al.* 2011) and Tambopata, south-eastern Peru (A. C. L. & A. Whittaker) reinforces the notion that this species may be under-recorded in tall stature central Amazonian *terra firme* forests. Vasconcelos *et al.* (2011) lists a record from the opposite bank of the river Amazon at Monte Alegre, PA - a female (MPEG 4405) collected by A. Costa on 17 November which would be the first record of *N. ordii* east of the river Negro and north of the river Amazon. However, there is some uncertainty surrounding the locations of some Costa specimens from the region, which may have been taken on the south bank (F. Lima *in litt.*). Costa collected a second *N. ordii* specimen from Monte Cuçari on the south bank, seven days before collecting MPEG 4405 allegedly from Monte Alegre, this specimen is held in Berlin (ZMB 311582). Given these doubts and a lack of subsequent records, we consider the presence of *N. ordii* north of the Amazon and east of the Negro to be unproven.

Purple-throated Cotinga *Cotinga cotinga*

This spectacular cotinga was recorded on just two occasions: A. C. L. photographed (Lees 2010c) a single adult male from the LBA Tower at KM-67 on 5 December 2010; and observed a female in the canopy of old secondary forest in catchment 160 on 18 December 2010. The only other record for the region we managed to trace were two (USNM 120921 and USNM 120922) collected by C. Riker at Diamantina, one mentioned in Riker & Chapman (1891) as collected on 4 July 1887, the other listed as '1886'.

Pale-breasted Spinetail *Synallaxis albescens*

We recorded this non-forest spinetail from cattle pasture in just two transects (*e.g.* Lees 2011c) in two different catchments (129 and 157), this in sharp contrast to its abundance in our sister landscape in Paragominas where the species was a near-ubiquitous inhabitant of agropastoral landscapes (Lees *et al.* 2012). Both landscapes contain catchments with similar deforestation histories and abut areas where the species ancestrally occurred, so it remains unclear why the species has proliferated in Paragominas and not in Santarém. Aleixo *et al.* (2008) reported this species from disturbed habitats between Moraes de Almeida (50 km north of Novo Progresso) and Santarém on 11 December 2005. The only historical record we were able to find for the region concern a pair collected by S. M. Klages in April 1919, the male of which was later designated as the type of *S. a. griseonota* by Todd (1948). This proposed race was described as having a paler crown and wing-coverts and more greyish underparts than *inaequalis*, but has subsequently been synonymised with the latter (Remsen 2003).

Fiery-capped Manakin *Machaeropterus pyrocephalus*

We encountered this unobtrusive manakin twice: from catchment 157 on 2 February 2011 (A. C. L.), and from catchment 125 on 7 February 2011 (Davis 2011b). This species had been collected three times previously from the region: a male collected from the 'right bank of the Tapajós at Santarém' by A. M. Olalla on 19 June 1934; and two males collected by J. M. Cardoso da Silva at Urumari on 10 January and 2 February 1984. These scant records do not permit a confident appraisal of whether or not the lack of previous records from the FLONA (Henriques *et al.* 2003, our data) reflects a genuine absence from this site and other areas lacking sandy soils along the main Tapajós riverbank or difficulties in detecting the species on account of its relatively cryptic vocalisations and mist-net avoidance combined with its local rarity.

Yellow-crowned Elaenia *Myiopagis flavivertex*

We detected this flycatcher from three transects in two different catchments (69 and 81) between 12 and 17 January 2011 (*e.g.* Lees 2011d). *Myiopagis flavivertex* is widely considered to be a specialist of *várzea* forests, but all of our records come from logged and burnt *terra firme* forest sites on the plateau, although in all cases never more than 5 km from the river Amazon. These records might either represent wandering males which have been unable to secure 'high quality' territories in adjacent *várzea* forests or alternatively indicate a potentially new trend towards colonisation of moderately disturbed *terra firme* forests.

Gray Elaenia *Myiopagis caniceps*

This canopy flycatcher was found to be an apparently rare member of canopy mixed-species flocks and was detected just six times from five different catchments in addition to a pair regularly present at the LBA Tower at KM-67 (Figure 4). This species was missed by both historic and recent inventories owing to its unobtrusive canopy habits. The taxonomy of this species is under investigation by C. B. Andretti and collaborators, birds from Santarém are of the same vocal type as other eastern Amazonian and Atlantic Forest populations (although morphologically distinct from the latter) but are very different from populations in south-west Amazonia and northern Amazonia.

Bank Swallow *Riparia riparia*

A. C. L. photographed two individuals (Lees 2011e) within a migrating flock of c.1000 Barn Swallows *Hirundo rustica* hawking over cattle pasture in catchment 125 on 5 February 2011. This species is apparently rare in central-eastern and eastern Amazonia (Stotz *et al.* 1992), with no records from extensive surveys in the Belém centre of endemism (*e.g.* Novaes & Lima 1998, Portes *et al.* 2011) and only a single record from the Alta Floresta region (Lees *et al.* 2013), although the species was reported by Fávaro & Flores (2009) from the Estação Ecológica Terra do Meio, PA. This rarity should reinforce the notion that Neotropical migrant swallows are not uniformly distributed across the South American continent as illustrated in many published distribution maps and may be very spatiotemporally localised (*cf.* Remsen 2001).

Cocoa Thrush *Turdus fumigatus*

We include a species account for this taxon as it seems a rather odd omission from the Henriques *et al.* (2003) inventory, as it ought to be a 'core *terra firme*' species. However, we only recorded this species from three different transects in three different catchments in

FIGURE 4. Gray Elaenia *Myiopagis caniceps* photographed from the tower at KM-67 in the FLONA (A.C. L.).

addition to a relatively confiding pair that frequented the LBA Base at KM-83 (Figure 5, Lees 2010d). S. M. Klages collected four individuals in 1919, one from 'Colônia do Mojuy' and three from 'Santarém (Tapajós river; Right Bank) and Riker & Chapman (1890) collected three specimens and described the species as '*common in semi-palm growths*'.

Red-crested Finch *Lanio cucullatus*

We recorded this species on two occasions from catchment 369, two different singing males (3 km apart) located on 3 December 2010 by A. C. L (*e.g.* Lees 2010e). The first was singing from the edge of primary forest, bordered by a ploughed field and the second from scrubby second growth bordering primary forest. Further afield, C. B. A. photographed and sound-recorded two individuals of this species from the town of Trairão 220 km south-west of the region on 8 and 15 June 2008. These records represent substantial range extensions from the nearest sites in Alta Floresta (Lees *et al.* 2013) and Paragominas (Portes *et al.* 2011, Lees *et al.* 2012), we cannot eliminate the possibility that such records might relate to local introductions, but considering the speed at which open country species have colonized much of the Amazon, natural colonization seems more likely (*cf.* Mahood *et al.* 2012).

Historical Records

Sharp-shinned Hawk *Accipiter striatus*

Whilst searching through the catalogue of birds collected by S. M. Klages from the region, we came across a record of a female *Accipiter striatus* (CM 72339) collected at Santarém (Tapajós river; Right Bank) on 2 May 1919 and assigned to the subspecies *erythronemius*. *Accipiter striatus* is unrecorded from the Brazilian Amazon, or indeed anywhere in lowland Amazonia, so given the importance of the record we solicited images of the original skin from S. Rogers at the Carnegie Museum. The images (Figure 6) confirm that the specimen pertains to *A. striatus* and can be further aged as a subadult female by the retained (streaked) juvenile feathers on the throat. This record represents the first confirmed record from the Brazilian Amazon. Subsequently M. Cohn-Haft (*in litt.*) collected an immature plumaged bird in savannah woodland on 7 May 2007 in Amazonas (AM) in the Madeira-Purus interfluvium on the Ramal do Mucuim, 50 km west of Porto Velho at 8° 40' S; 64° 25' W. Other

FIGURE 5. Cocoa Thrush *Turdus fumigatus* at the LBA Base KM-83, FLONA forest (A. C. L.).

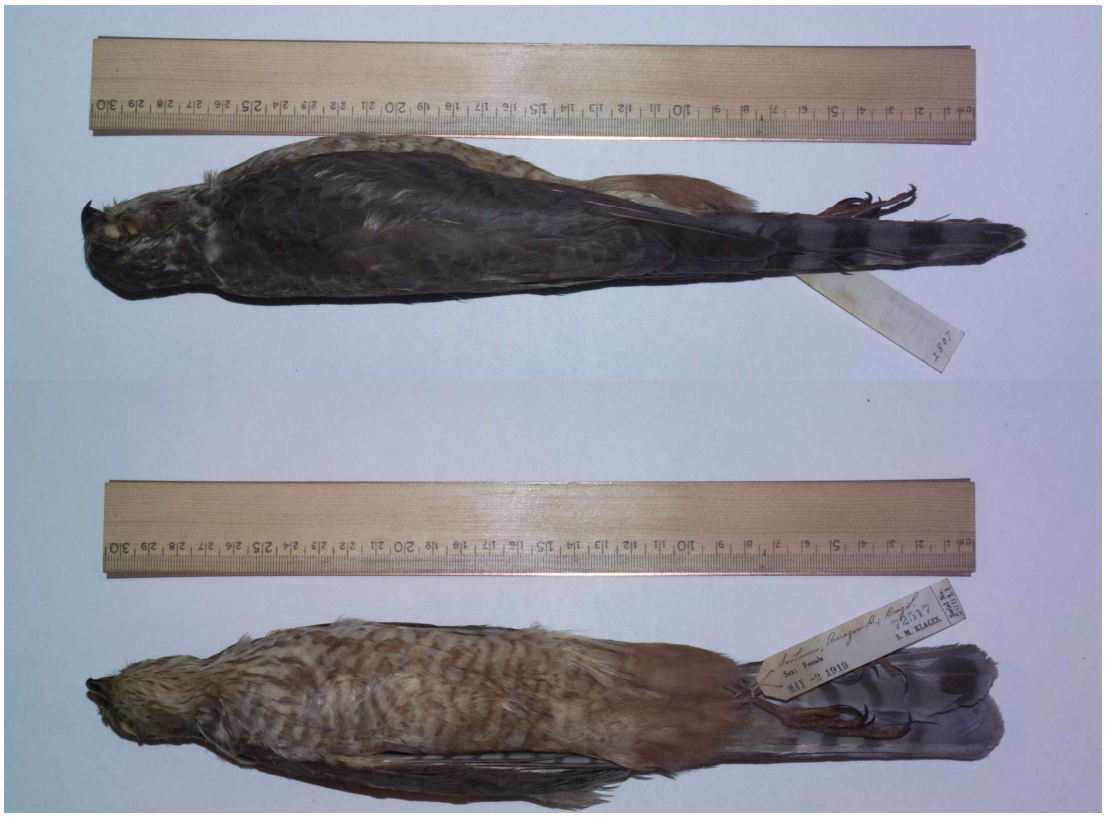

FIGURE 6. Composite image of the first Brazilian Amazonian record of Sharp-shinned Hawk *Accipiter striatus* (S. Rogers copyright Carnegie Museum).

sight records include two undocumented sight records from Manaus, AM in Cohn-Haft *et al.* (1997) and two sight records from Alter do Chão on 11 and 29 November 2000 (R. Cintra *in litt.*).

Least Sandpiper *(Calidris minutilla)*

A record of a 'Semipalmated Sandpiper *Calidris pusilla*' collected by A. M. Olalla on 18 November 1932 (MCZ 173283) from 'Santarém' (Griscom & Greenway 1941, Stotz *et al.* 1992) was to our knowledge the only documented record of this species in the interior of the Brazilian Amazon. We examined digital images (Figure 7) of the original specimen and reidentified the individual as a Least Sandpiper *C. minutilla* based on the thin, slightly decurved beak, extensive dark-centers to the mantle feathers and yellowish legs. Least Sandpiper is an uncommon vagrant/scarce passage migrant to the interior of Amazonia with documented records from MT, PA, RO and AM (Stotz *et al.* 1992). We consider Semipalmated Sandpiper to be an unproven vagrant to Amazonia and any future reports should preferably be documented with high quality digital images.

Gull-billed Tern *Gelochelidon nilotica*

The only record that we can trace for the region concerns a single breeding-plumaged adult photographed by Kurazo Okada (Aguiar 2010) at the Lago do Maicá on 31 July 2010. The status of this species in the interior of the Amazon basin is unclear, but circumstantial evidence suggests that this species maybe a regular seasonal visitor (breeder?) along the river Amazon. For instance, Kirwan *et al.* (2012) recorded four individuals of *Gelochelidon nilotica* associating with a mixed colony of Large-billed Terns *Phaetusa simplex* and Black Skimmers *Rhynchops niger* and exhibiting indications of breeding on the Ilha da Benta, Itacoatiara, Amazonas state (c.400 km WSW of Santarém) on 21–22 November 2011. Closer to the study region, G. M. Kirwan and C. F. Collins observed one midstream in the river Amazon c.20 km west of Monte Alegre, Pará, on 8 December 2005 (Kirwan *et al.* 2012). Further afield, this species has been collected from Marajó Island (Henriques & Oren 1997) and we (A. C. L. and N. G. M.) have recorded flocks of this species on the Pará coast at Salinópolis, Bragança and Augusto Corrêa (*e.g.* Lees 2011f).

FIGURE 7. Composite image of Least Sandpiper *Calidris minutilla* originally identified as Semipalmated Sandpiper *Calidris pusilla* (J. Trimble, copyright Museum of Comparative Zoology, Harvard University).

Scaled Ground-cuckoo *Neomorphus squamiger*

The type series of the micro-endemic *Neomorphus squamiger* comes from Colônia do Mojuy by S. M. Klages – four individuals (two males and two females) collected on three dates in October and November 1919. Klages, in Todd (1926) remarked of the habitat preferences of this taxon: "*It lives on or near the ground in the dense forest, where it accompanies the hunting ants, and is rare so far as my experience goes. It was never met with in the littoral area, nor yet in the contiguous forested mesa, but only upon penetrating back into the more elevated Mojuy district. We sought for it in vain along the Tapajós*." Subsequently A. M. Olalla collected two (MCZ 173562 and MCZ 173563) at Tauary, 39 km south-west of Santarém and alongside the Tapajós. We know of no subsequent reports for the region. Although we have no evidence for its continued persistence within the FLONA, we assume that the species is likely still extant there in more isolated regions and likely also persists in extensive areas of unsurveyed upland forest in the east of the region. Elsewhere, C. B. A. briefly observed one at Trairão (PA) on 14 September 2009 following a large understorey mixed species bird flock in selectively-logged forest. The absence of a breast band was noted and the bird was observed removing loose bark from a decomposing fallen tree.

Pavonine Quetzal *Pharomachrus pavoninus*

One (MCZ 173835) was collected by A. M. Olalla at Tauary and has apparently been overlooked in subsequent publications. The nearest records from the Tapajós-Xingu interfluvium were made by Pacheco & Olmos (2005) at Vicinal Progresso (07°10'S; 55°06'W), 30 km SSE from Novo Progresso, PA (440 km south of Santarém) on 16 May 2002 and Aleixo *et al.* (2008) recorded this species from the Floresta Nacional de Altamira, near Moraes Almeida (PA) in December 2005 (370 km south of Santarém). The south-central FLONA probably represents the northern limit of the range for a species which generally occurs at low density throughout its range.

Red-billed Scythebill *Campylorhamphus trochilirostris*

Two specimens collected by S. M. Klages from Santarém (Tapajós river; Right Bank) in "swamp forest" on 26 March (CM 71504) and 13 June (73210) 1919 were originally identified as *C. procurvoides multostriatus* by Todd (1948), but later re-identified as *C. trochilirostris snethlageae* by A. A. upon direct examination of the specimens involved and comparison with dozens of *Campylorhamphus* specimens from several collections. Both specimens from Santarém possess the typical brick-reddish hue on the underparts distinguishing the *várzea* specialist *C. t. snethlageae* (Zimmer 1934), rather than the distinct brownish olivaceous, which characterizes the underparts of *C. procurvoides* populations of Santarém found exclusively in upland *terra firme* forest. Despite Todd's misidentification, Klages himself had noticed that those two Santarém specimens collected in *várzea* belonged to a different taxon than the *Campylorhamphus* found in nearby upland *terra firme* forest as shown by his field notes, transcribed as follows: "*The birds with the serial number 2436 were collected in the upland forest. I consider this series to be different from series 2401*". Both Santarém specimens mentioned above belong to Klages' series 2401, whereas all 2436 series birds included only specimens of two *C. procurvoides* taxa associated with *terra firme*: *multostriatus* and *notabilis* (A. A. *pers. obs*). Klages could distinguish those two sympatric (but not syntopic) species of *Campylorhamphus* from Santarém mainly by their bill color, still well preserved shortly after collection, as indicated by his field notes: "*This form with the redder h. (unreadable) and less deeply curved bill seems to be restricted to the swampy-forest*".

Zimmer's Woodcreeper *Dendroplex kienerii*

S. M. Klages collected four individuals of this seasonally-flooded forest (*várzea* and *igapó*) specialist between 24 March and 8 April 1919 from Santarém (Tapajós river; Right Bank) and A. A. and J. D. Weckstein collected two females and one male on 22 July 2000 11 km south east of Santarém, in tall forest at Lago do Maicá (MPEG 55159, 55160, 55290). The distribution of this woodcreeper seems confined mostly to western Amazonia and the Negro river basin, with the easternmost records coming from the vicinity of Santarém.

White-eyed Tody-tyrant *Hemitriccus griseipectus*

S. M. Klages collected one male (Figure 8, CM 74717) as '*Hemitriccus zosterops*' at Colônia do Mojuy on 1 November 1919. At the suggestion of B. M. Whitney we solicited images of the skin to check the identification and on comparison with skins of all Amazonian *Hemitriccus* and *Lophotriccus* species can confirm that the identification is correct (identification also independently checked by M. Cohn-Haft) and we have no reason to doubt the provenance of the skin. We do not believe we missed *H. griseipectus* during our own surveys, the voice of which all observers are familiar, and suggest that this species may be restricted to tall *terra firme* only in the east of the region and its distribution may be associated with as yet undiagnosed topographical factors. The nearest records of this species come from the FLONA do Trairão 90 km east of Itaituba (C. B. A. *unpubl. data*). There are no confirmed records of Snethlage's Tody-tyrant *Hemitriccus minor* from any sites in the Tapajós-Xingu interfluvium north of the Teles Pires river (Cohn-Haft 2000).

FIGURE 8. Composite image of the only regional record of White-belied Tody-tyrant *Hemmitriccus grisepectis* (S. Rogers copyright Carnegie Museum).

'Trail's Flycatcher' *Empidonax traillii/alnorum*

An *Empidonax* flycatcher (Figure 9) was collected by G. P. Silva at Vila Mojuí dos Campos, Estrada do Palhal km 5 on 24 February 1978. This individual (MPEG 32320), was identified as Willow Flycatcher *Empidonax trailli* by E. Eisenmann and A. R. Phillips (Sick 1985), the first and only Brazilian record of this species. However, without comment the same record is listed as Alder Flycatcher *Empidonax alnorum* in Stotz *et al.* (1992) and again in Vasconcelos *et al.* (2008). This has created some confusion in the subsequent literature – for instance Silva (2011) lists February records for both species for Santarém based on different sources. We re-examined the specimen (aged as a first winter based on prominent growth-bars on the tail) but unfortunately its biometrics fell within the range of overlap in the discriminant formulas of Pyle (1997) so robust identification will have to await molecular testing (A. C. L., A. A, G. Thom *in prep*.). Vasconcelos *et al.* (2008) list just three records of *Empidonax alnorum,* the aforementioned Santarém record, a singing bird at Manaus, AM on 15 December 1984 (Stotz *et al.* 1992) and an unsexed individual (DZUFMG 4580) collected by M. F. Vasconcelos on 19 November 2005 in the Pantanal at Fazenda Figueirinha (Corumbá municipality) MS. Additional records include an individual seen and sound-recorded (ML 117234) by Curtis Marantz at Igarape Crajari, AM on 5 April 1997, a female sound-recorded and collected by M. Cohn-Haft at Igrapé Craiata, 9 km ESE of Benjamin Constant AM on 5 April 1991, a male collected at Feijó, Envira river, Locality Novo Porto, Fóz do Igarapé Paraná do Ouro, AC by E. Guilherme and N. S. Brígida on 20 November 2011 and one collected by E. Guilherme and P. Maurício at Manoel Urbano, BR 364, Seringal "Sardinha", AC on 10 November 2004.

Gray-cheeked Thrush *Catharus minimus*

G. P. Silva collected one specimen (MPEG 47943, Figure 10) at KM-84 of the BR-163 on 15 December 1972 and LMPH captured one individual in the FLONA on 20 March 2000. Stotz *et al.* (1992) considered this species to be '*almost completely unknown from south of the Amazon*'. The 1972 record is the first from the southern Brazilian Amazon. Outside of our region, subsequent southern Amazonian records include one collected by G. P. Silva from the Sena Madureira (AC) on 4 November 1976 (Novaes 1978), and a sight record from Alta Floresta (MT) by A. Lang on 12 December 2002 (Lees *et al.* 2013).

DISCUSSION

This updated checklist provides a solid baseline for future quantitative studies and we believe that the list covers all core members of the regional avifauna. However, we anticipate that the list will continue to increase in size as new open-habitat colonizers, migrants and vagrants are added, especially considering the colonization possibilities

FIGURE 9. Composite image of 'Trail's Flycatcher' *Empidonxa traillii/alnorum* (A. C. L. copyright Museu Paraense Emilio Goeldi).

FIGURE 10. Gray-cheeked Thrush *Catharus miniimus* collected on 15 December 1972 (A. C. L. copyright Museu Paraense Emilio Goeldi)

afforded for non-forest species following extensive habitat conversion (Lees & Peres 2006, Mahood *et al.* 2012) and even the periodic incursion of pelagic vagrants into Amazonia (*cf.* Teixeira *et al.* 1986). The region is particularly rich in boreal migrant and vagrant passerines for a central Amazonian site with 12 species recorded, perhaps indicating that the Tapajós may function as a migration corridor for boreal migrants. However, species richness for shorebirds is quite low, with notable omissions including Greater Yellowlegs *Tringa melanoleuca* and White-rumped Sandpiper *Calidris fuscicollis*, more intense surveys of suitable habitats at peak migration times will no doubt plug these gaps in the pool of expected species. Our own fieldwork did not focus on river island and *várzea* habitats which are regionally of high conservation importance, recognized in the Important Bird Area PA04 'Várzeas de Monte Alegre' which includes parts of the municipalities of both Santarém and Belterra (De Luca *et al.* 2009), although historical collecting effort in these areas was quite intense.

A quantitative analysis of regional beta diversity is beyond the scope of this paper, but it is evident that even among least disturbed *terra firme* forests of the region there is considerable heterogeneity, probably driven by topographic and edaphic factors and resulting in a patchy distribution for many species (*cf.* Alonso & Whitney 2003). Nearly two hundred years of fieldwork have failed to find within the study region many *terra firme* forest bird species known from the Tapajós-Xingu interfluvium as close as Trairão 200 km SW of the region. These apparently absent species include Collared Trogon *Trogon collaris*, White-browed Antbird *Myrmoborus leucophrys*, Black-throated Antbird *Myrmeciza atrothorax* and Striped Woodhaunter *Hyloctistes subulatus*, which probably reflects different forest physiognomies between these adjacent regions. This turnover is also reflected in the absence of records of Golden Parakeet *Guaruba guarouba* (Laranjeiras & Cohn-Haft 2009) and documented records of both Band-tailed Antbird *Hypocnemoides maculicauda* and Speckled Spinetail *Cranioleuca gutturata* (B. Whitney *in litt.*) from the southern boundary of the FLONA, but outside of our study region. These absences also illustrate that published distribution maps for many Amazonian bird species are very liberal, as they are frequently based on the extent of occurrence, while the actual area of occupancy for many species is far smaller as they are extremely patchily distributed even with the same interfluvium (*cf.* Gaston & Fuller 2009).

Santarém has one of the longest histories of ornithological fieldwork in the Brazilian Amazon; that our own fieldwork added core *terra firme* birds to the regional list is testament to the low population density and patchy distribution of many rarer taxa, and the importance of thorough familiarity with vocalizations of such species which may be easily missed in rapid inventories or by inexperienced observers Modern avian surveys (*sensu* Aleixo 2009) are an invaluable tool for uncovering true biogeographic patterns, and forming robust baselines for conservation policies, and should include as much accessible documentary evidence as possible to allow for general peer review (Lees *et al.* 2012).

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APPENDIX 1

List of 583 species recorded from the Santarém-Belterra region, south of the Amazon and east of the Tapajós (PA, Brazil). Inventories are as follows: 1= this study (* denotes if recorded during quantitative fieldwork), 2 = Henriques *et al.* 2003, 3 = Sanaiotti and Cintra (2001). Photo reference and sound reference numbers are searchable in the online databases of www.wikiaves.com.br (WA), www.xeno-canto.org (XC) and the Macaulay Library http://macaulaylibrary.org/ (ML). Initials given after online voucher numbers are those of non-author contributors, photographers: DO = D. Oliveira, DLF = Diogo Lagroteria Faria, FG = Felipe Gomes, FS = Francisco Sérgio, FP = Frederico Pereira, GL = Gilmar Leal, HGS = Helena G. Salgado, IT = Ian Thompson, IM = Ingrid Macedo, IG = Ivo Ghizoni-Jr, JAA = J Augusto Alves, KO = Kurazo Okada, LATB = Luiz Álvaro Toledo Barros, RC = Robson Czaban, TD = Tulio Dornas, VH = Valdir Hobus and sound-recordists: CM = Curtis Marantz, JM = Jeremy Minns, PI = Phyllis Isler, Sidnei Dantas. Accession numbers are presented for species previously collected in the region and housed at the American Museum of Natural History, New York City, USA (AMNH), the Academy of Natural Sciences, Philadelphia, USA (ANSP), the Carnegie Museum of Natural History, Pittsburgh, USA (CM), the Field Museum of Natural History, Chicago, USA (FMNH), the Los Angeles County Museum of Natural History, Los Angeles, USA (LACM), the Louisiana State University Museum of Natural Science, Baton Rouge, USA (LSUMZ), the Museu Paraense Emilio Goeldi, Belém, Brazil (MPEG), the Museu de Zoologia Universidade de São Paulo, São Paulo, Brazil (MZUSP), the University of Michigan Museum of Zoology, Ann Arbor, USA (UMMZ) and the United States National Museum, Washington, USA (USNM). Taxonomy and nomenclature follows CBRO (2011).

Family / species	Inventories	This study			Previous fieldwork				
		XC foreground	XC background	Wikiaves	Specimen	Wikiaves	Photographer	Sound	Recordist
TINAMIDAE									
Tinamus tao	1*,2	XC91214			MZUSP 10583			ML114917	CM
Tinamus guttatus	1*,2	XC94649			CM 74874			ML115028	CM
Crypturellus cinereus	1*,2	XC90693	XC91205						
Crypturellus soui	1*,2	XC90703	XC90764		CM 72221			ML117119	CM
Crypturellus obsoletus	1	XC94679			CM 74876				
Crypturellus undulatus	1,3		XC94878		CM 78240				
Crypturellus strigulosus	1*,2	XC91207	XC91203		CM 78199				
Crypturellus variegatus	1*,2	XC90705	XC94871		MPEG 56038				
Crypturellus parvirostris	1*,2	XC94650	XC94670		MPEG 47652				
ANHIMIDAE									
Anhima cornuta					CM 73737				
ANANTIDAE									
Sarkidiornis sylvicola					CM 73268				
Cairina moschata	1			WA580720	UMMZ 27966	WA189071	KO		
Amazoneta brasiliensis	1*			WA426586	MZUSP 20920	WA559786	VH		
Dendrocygna autumnalis	1,3			WA429940	CM 73634	WA576641	IT		

Family / species	Inventories	This study			Previous fieldwork				
CRACIDAE									
Ortalis motmot	1*,2,3	XC94608		WA340078	MZUSP 46267				
Penelope superciliaris	1*,2,3				CM 75036				
Penelope pileata	1*	XC91206			MZUSP 21058				
Aburria cujubi	1*,2			WA500190	MZUSP 20832				
Pauxi tuberosum	1*,2		XC91214	WA675633	MZUSP 20467				
ODONTOPHORIDAE									
Odontophorus gujanensis	1*,2	XC94805			MZUSP 10602				
PODICIPEDIDAE									
Tachybaptus dominicus	1			WA500150	MCZ 173025				
CICONIIDAE									
Ciconia maguari					MCZ 23047				
PHALACROCORACIDAE									
Phalacrocorax brasilianus	1				MZUSP 21925	WA185783	KO		
ANHINGIDAE									
Anhinga anhinga	1			WA580721	MCZ 173021	WA98813	JAA		
ARDEIDAE									
Tigrisoma lineatum	1				CM 72000	WA100655	JAA		
Agamia agami					MZUSP 35885				
Cochlearius cochlearius	1			WA359482	MZUSP 35886				
Zebrilus undulatus	1				CM 75076				
Botaurus pinnatus					MCZ 173069				
Ixobrychus exilis					CM 72388				
Nycticorax nycticorax					CM 78113	WA183342	KO		
Butorides striata	1,2			WA580731	MZUSP 61789	WA77559	LATB		
Bulbucus ibis	1,3			WA372477	MPEG 36473	WA185772	KO		
Ardea cocoi	1				MCZ 23190	WA74313	LATB		
Ardea alba	1*			WA329322	LACM 34344	WA557916	VH		
Pilherodius pileatus	1,2				MZUSP 46199				
Egretta thula	1			WA329325					
Egretta caerulea				WA675594		WA183310	KO		

Family / species	Inventories	This study			Previous fieldwork				
THRESKIORNITHIDAE									
Mesembrinibis cayennensis	1*			WA588367	MCZ 173072				
Theristicus caudatus	1*			WA366370		WA205442	KO		
CATHARTIDAE									
Cathartes aura	1*2,3			WA505835	CM 78110	WA242292	IT		
Cathartes burrovianus	1*,3			WA359441		WA189075	KO		
Cathartes melambrotus	1*2,3			WA333384					
Coragyps atratus	1*2,3			WA333385	CM 78109	WA242294	IT		
Sarcoramphus papa	1,2				AMNH 285739				
PANDIONIDAE									
Pandion haileautus	1,3			WA357402	MCZ 173117	WA549592	VH		
ACCIPITRIDAE									
Leptodon cayanensis	1,2				MCZ 173091	WA918207	RC	ML115074	CM
Chondrohierax uncinatus	1*,2			WA435547	MCZ 173092				
Elanoides forficatus	1*2,3			WA429985	CM 73057				
Gampsonyx swainsonii	1			WA629547	MPEG 34430				
Harpagus bidentatus	1*,2				MPEG 15342	WA320216	FG		
Harpagus didon					MPEG 35598				
Accipter superciliosus	1*2			WA361613	CM 72934				
Accipter striatus	3				CM 72517				
Accipter bicolor					CM 72339				
Ictinia plumbea	1,2,3			WA936127					
Busarellus nigricollis	1				FMNH 257783	WA185781	KO		
Rostrhamus sociabilis				WA435213	FMNH 257787				
Geranospiza caerulescens				WA645500	FMNH 257800				
Buteogallus schistaceus					FMNH 101510				
Heterospizias meridionalis	1*,3			WA431330		WA180997	KO		
Urubutinga urubitinga	1*,2,3			WA514779	FMNH 257765				
Rupornis magnirostris	1*,2,3	XC94809		WA329171	MZUSP 10134	WA206722	KO	ML117158	CM
Geranoaetus albicaudatus	1*,3			WA443906	MCZ 173102				
Pseudastur albicollis	1*,2			WA432803	MPEG 13772				
Leucopternis melanops					MZUSP 46240				

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Leucopternis kuhli	1*,2	XC92080	XC94851	WA514724	FMNH 101120	WA320489	FG		
Buteo nitidus	1*,2,3	XC95086	XC94874	WA491528	MPEG 35598				
Buteo brachyurus	1*,3			WA499991					
Buteo swainsoni					USNM 121073				
Morphnus guianensis	1			WA356485					
Harpia harpyja	1			WA616225	MPEG 1855				
Spizaetus tyrannus	1*,2	XC96328	XC96343	WA329317	FMNH 101130	WA320256	FG	XC85417	JM
Spizastur melanoleucus	1*,2			WA467097	MCZ 173114				
Spizaetus ornatus	1*,2		XC96376		MCZ 173115			XC85417	JM
FALCONIDAE									
Daptrius ater	1*,2			WA347314	CM 74791				
Ibycter americanus	1*,2	XC95591		WA356727	CM 72788			ML115015	CM
Caracara plancus	1*,2			WA580755	ANSP 76478				
Milvago chimachima	1*,2,3			WA500112	MZUSP 35888	WA552031	VH		
Herpetotheres cachinnans	1*,2,3			WA516301					
Micrastur ruficollis	1*,2	XC90680	XC90687						
Micrastur mintoni	1*,2	XC95106	XC90680		MZUSP 18030				
Micrastur mirandollei	1*	XC94623			MZUSP 10862				
Micrastur semitorquatus	1*,2			WA346345	CM 74614			ML114997	CM
Falco rufigularis	1*,2,3			WA447466	CM 75002				
Falco deiroleucus					CM 73801	WA632317	IG		
Falco femoralis	1*,3			WA500144	MCZ173143				
Falco peregrinus						WA325212	FP		
EURYPYGIDAE									
Eurypyga helias				WA517296	CM 72364				
ARAMIDAE									
Aramus guarauna				WA583437	CM 73676	WA185149	KO		
PSOPHIDAE									
Psophia dextralis		XC96488		WA359490	CM 75034				
RALLIDAE									
Aramides cajanea	1*,2	XC94871			CM 72145				
Amaurolimnas concolor					CM 71647				

Family / species	Inventories	This study			Previous fieldwork				
Laterallus viridis	1*,2	XC94670			MZUSP 35891			ML117040	CM
Laterallus exilis	1*				MCZ 173214				
Neocrex erythrops	1*	XC91474			MPEG 74208				
Gallinula galeata					MZUSP 22636				
Porphyrio martinica	1*,2			WA500120	CM 71555	WA104023	GL		
Porphyrio flavirostris					CM 71615				
HELIORNITHIDAE									
Heliornis fulica				WA362963	MZUSP 35892				
CHARADRIIDAE									
Vanellus cayanus	1			WA333899	CM 73189	WA99261	JAA		
Vanellus chilensis	1*			WA583439	CM 73677	WA182115	KO		
Pluvialis dominica					LACM 34401	WA757451	HGS		
Charadrius collaris	1			WA467107	MZUSP 35894	WA546923	VH		
RECURVIROSTRIDAE									
Himantopus mexicanus				WA431336		WA183311	KO		
SCOLOPACIDAE									
Gallinago paraguaiae					MPEG 36472	WA205424	KO		
Bartramia longicauda					MZUSP 35895				
Actitis macularius				WA357318	CM 74312				
Tringa solitaria	1			WA357320	MZUSP 35896	WA242305	IT		
Tringa flavipes				WA508864	CM 73689	WA182114	KO		
Calidris melanotos					MCZ 173293	WA189072	KO		
Calidris minutilla					MCZ 173283				
JACANIDAE									
Jacana jacana				WA511911	MZUSP 3376	WA205425	KO		
STERNIDAE									
Sternula superciliaris				WA435379	CM 78510				
Phaetusa simplex				WA432695	CM 73739	WA549214	VH	ML47954	PI
Gelochelidon nilotica						WA176659	KO		
RYNCHOPIDAE									
Rynchops niger				WA357316	MCZ 23042	WA559241	VH		

Family / species	Inventories	This study			Previous fieldwork				
COLUMBIDAE									
Columbina passerina	1*,2,3		XC94650	WA500208	MPEG 17611	WA550785	VH		
Columbina minuta	1*	XC94621	XC94956	WA441603					
Columbina talpacoti	1*,2			WA333907	CM 73312	WA319722	FG		
Claravis pretiosa	3				MPEG 47665			ML117176	CM
Columba livia	1*			WA333902					
Patagioenas speciosa	1*,3				MZUSP 10607				
Patagioenas cayennensis	1*,3			WA372475	MZUSP 35897	WA205427	KO		
Patagioenas plumbea	1*,2	XC94779	XC94851		AMNH 285541			ML115068	CM
Patagioenas subvinacea	1*,2	XC95107			CM 74472			XC87137	JM
Zenaida auriculata	1*,3			WA359445	MPEG 17612	WA547583	VH		
Leptotila verreauxi	1*,2		XC94620	WA505858	CM 72540				
Leptotila rufaxilla	1*,2,3	XC95111	XC92089		CM 73078				
Geotrygon montana	1*,2,3	XC95572			MZUSP 10606	WA320511	FG		
PSITTACIDAE									
Anodorhynchus hyacinthinus	1*	XC91202			MCZ 173413				
Ara ararauna					CM 72105				
Ara macao	1*,2			WA522295				ML115115	CM
Ara chloropterus	1*,2,3	XC95108			MCZ 173415				
Ara severus	1*,2	XC90773	XC90776	WA444684	MZUSP 11834	WA185148	KO		
Orthopsittaca manilata	1*	XC94856			CM 72174				
Aratinga leucophthalma	1*,2	XC95676	XC96344	WA426594	CM 74387	WA319711	FG		
Aratinga aurea	1*,3	XC94618		WA357380	MPEG 28147	WA180979	KO	ML117043	CM
Pyrrhura amazonum	1*,2	XC94954		WA356522	MZUSP 3416			XC85381	JM
Forpus passerinus	1*			WA467169	MPEG 2330	WA205438	KO		
Brotogeris versicolurus	1*,3	XC94874	XC96344	WA351745	MZUSP 3410				
Brototeris chrysoptera	1*,2	XC94955	XC87290	WA351744	MPEG 8890				
Brotogeris sanctithomae				WA872402	MZUSP 35909	WA183291	KO	XC84943	JM
Touit huetii	1*							ML115198	CM
Pionites leucogaster	1*,2	XC95118			CM 74836				
Pyrilia vulturina	1*,2	XC95120			MZUSP 10630			ML114929	CM
Graydidascalus brachyurus					CM 72417				

Family / species	Inventories	This study			Previous fieldwork				
Pionus menstruus	1*,2,3	XC95117	XC94832	WA352463	MZUSP 10624				
Pionus fuscus	1*,2	XC95125		WA500133	CM 74545			ML115035	CM
Amazona festiva					CM 72900				
Amazona farinosa	1*,2	XC95112	XC90706	WA356731	CM 74734			ML115064	CM
Amazona amazonica	1*,2	XC95122	XC90773		LACM 34501				
Amazona ochrocephala	1*,2	XC94682			CM 73608				
Deroptyus accipitrinus	1*,2	XC95123		WA500189	MZUSP 10618			ML114902	CM
OPISTTHOCOMIDAE									
Opisthocomus hoazin				WA432121	MZUSP 35889	WA183343	KO		
CUCULIDAE									
Coccycua minuta	1*	XC94622		WA567160	CM 72868				
Piaya cayana	1*,2,3	XC96333		WA500202	MZUSP 61865	WA247315	IT		
Piaya melanogaster	1*,2	XC96382		WA432789	MPEG 56039				
Coccyzus melacoryphus					CM 73549	WA182095	KO		
Coccyzus euleri					CM 72739	WA552668	VH		
Crotophaga major	1*,3			WA337955	MZUSP 35904	WA189087	KO		
Crothophaga ani	1*,2,3	XC94607	XC94648	WA500149	MPEG 17617	WA189086	KO		
Tapera naevia	1,2				MPEG 47671				
Dromococcyx phasianellus	1*	XC87287	XC95171		LACM 34519				
Neomorphus squamiger					CM 74616				
TYTONIDAE									
Tyto alba				WA436255	MCZ 173144				
STRIGIDAE									
Megascops choliba	1*,2,3		XC94800	WA432016	CM 73578				
Megascops usta	1*,2		XC94645		MPEG 53840				
Lophostrix cristata	1*,2				CM 72585			ML114946	CM
Pulsatrix perspicillata	1*,2	XC90764			CM 72854				
Bubo virginianus				WA481116					
Strix virgata	1*	XC94713			MCZ 173158				
Strix huhula	1*	XC94712							
Glaucidium hardyi	1*,2	XC94683	XC94710					ML114944	CM
Athene cunicularia	1*			WA509541					

Family / species	Inventories	This study			Previous fieldwork				
Asio clamator				WA357321					
Asio stygius				WA583443	MCZ 173148				
NYCTIBIIDAE									
Nyctibius grandis	1,2,3				MZUSP 35913				
Nyctibius aethereus	1*	XC94710							
Nyctibius griseus	1*,2,3			WA567100	CM 72237	WA49272	IM		
Nyctibius leucopterus	1*,2	XC94711						ML114943	CM
CAPRIMULGIDAE									
Nyctiphrynus ocellatus	1*,2	XC95113			MPEG 54302			ML115108	CM
Antrostomus rufus	1*,3				MZUSP 10894	WA631559	IG		
Antrostomus sericocaudatus	1*	XC86600			MPEG 56042			ML114945	CM
Lurocalis semitorquatus	1*,2	XC90702							
Hydropsalis leucopyga					MZUSP 35916	WA756417	HGS		
Hydropsalis nigrescens	1*,2			WA576637	CM 71585			ML115079	CM
Hydropsalis albicollis	1*,2		XC94800		CM 73263			ML115038	CM
Hydropsalis parvula					CM 73674				
Hydropsalis maculicauda					CM 73816				
Hydropsalis climacocerca				WA431349	CM 71658	WA98817	JAA		
Hydropsalis torquata					MPEG 27368	WA25992	IM		
Chordeiles nacunda					CM 73153	WA178884	KO		
Chordeiles rupestris					MCZ 173600				
Chordeiles acutipennis	1,3				MPEG 37761	WA316733	DLF		
APODIDAE									
Chaetura spinicauda	1*,2				CM 74412			ML115092	CM
Chaetura chapmanii	1*			WA360041					
Chaetura brachyura	1*,2		XC94831			WA320213	FG		
Tachornis squamata	1*,2			WA573688	CM 73577				
Panyptila cayennensis	1,2				MPEG 37764				
THROCHILIDAE									
Glaucis hirsutus	1*,2,3			WA360047	MPEG 53832				
Phaethornis rupurumii	1*	XC84327		WA360065	MPEG 8869				
Phaethornis aethopyga	1*,2,3	XC90519		WA358701	CM 74518				

Family / species	Inventories	This study			Previous fieldwork				
Phaethornis ruber	1*		XC94882		AMNH 148269	WA206708	KO		
Phaethornis bourcieri	1*,2				MPEG 56041				
Phaethornis superciliosus	1*,2,3	XC91212			CM 74606				
Campylopterus largipennis	1,2							ML114922	CM
Eupetonema macroura					CM 78361	WA634736	IT		
Florisuga mellivora	1*,2				MPEG 53839				
Anthracothorax viridigula					CM 73471				
Anthracothorax nigricollis	1*,2,3				CM 73265				
Avocettula recurvirostris	2				MZUSP 3409			ML115199	CM
Topaza pella	1,2							XC5725	SD
Chlorostilbon notatus	3				MPEG 8881				
Thalurania furcata	1*,2,3			WA567110	MPEG 53837				
Hylocharis sapphirina	1,2,3			WA645522	CM 72123				
Polytmus theresiae	1,3				MCZ 173823	WA185793	KO		
Amazilia versicolor					MCZ 173755				
Amazilia fimbriata	1*			WA584520,	MPEG 35617	WA185769	KO		
Heliothryx auritus	1*,2				CM 78631				
Heliomaster longirostris	1,2			WA624861	MZUSP 3404	WA319712	FG		
Caliphlox amethystina				WA625025		WA183292	KO		
TROGONIDAE									
Trogon melanurus	1*,2	XC94717		WA583441	CM 72885			ML115062	CM
Trogon viridis	1*,2,3	XC95314	XC94623	WA500148	MZUSP 35920	WA78768	LATB	ML115159	CM
Trogon ramonianus	1*,2			WA522329	CM 74432				
Trogon rufus	1*,2	XC95308	XC91207	WA676347	MPEG 53841			ML114920	CM
Pharomachrus pavoninus					MCZ 173835				
ALCEDINIDAE									
Megaceryle torquata	1*,2			WA583444	MPEG 27312	WA325211	FP		
Chloroceryle amazona	1,2,3			WA366364	MZUSP 35922	WA98818	JAA		
Chloroceryle aenea	2,3				MZUSP 15947				
Chloroceryle americana	1*,2,3			WA583449	MZUSP 46551	WA185167	KO		
MOMOTIDAE									
Baryphthengus martii	1*,2		XC90680	WA356477	CM 75042				

Family / species	Inventories	This study			Previous fieldwork				
Momotus momota	1*,2		XC94679	WA442693	CM 74832				
GALBULIDAE									
Galbula cyanicollis	1*,2	XC95109	XC95110		CM 74550			XC4883	SD
Galbula ruficauda				WA936123	CM 71853				
Galbula dea	1*,2			WA573667	CM 75062			ML115189	CM
Jacamerops aureus	1*,2	XC94777	XC87290	WA676330	CM 75073			ML115013	CM
BUCONNIDAE									
Notharchus hyperrhynchus	1*,2		XC91203	WA500142	MZUSP 10683	WA320253	FG	ML117113	CM
Notharus ordii	1*	XC94707							
Notharchus tectus	1*,2,3	XC91203		WA363562	MZUSP 10688	WA101535	JAA	ML117107	CM
Bucco tamatia	1*,2			WA544924	CM 71967	WA553066	VH		
Bucco capensis	1*,2	XC94709	XC94871		CM 72995			ML114990	CM
Nystalus maculatus	1*,2,3		XC94618	WA500146	MPEG 17614	WA551718	VH	ML117140	CM
Malacoptila rufa	1*,2		XC90772	WA567157	MPEG 56044				
Monasa nigrifrons	1			WA583455	MZUSP 35926				
Monasa morphoeus	1*,2	XC95269	XC94679	WA500134	MPEG 40577			ML115175	CM
Chelidoptera tenebrosa	1*,2,3			WA428002	MZUSP 35928				
RAMPHASTIDAE									
Ramphastos toco	1,3			WA435202	CM 74281				
Ramphatos tucanus	1*,2		XC90703	WA472581	MZUSP 82495				
Ramphastos vitellinus	1*,2,3		XC90774	WA352476	MPEG 14851			ML114981	CM
Selenidera gouldii	1*,2		XC94803	WA871417	MZUSP 10671				
Pteroglossus inscriptus	1*,2,3			WA352331	MZUSP 3424	WA320254	FG		
Pteroglossus bitorquatus	1*,2	XC95110		WA500203	MZUSP 10659	WA49283	IM	ML117120	CM
Pteroglossus aracari	1*,2,3	XC90777		WA467112	MZUSP 10665	WA319710	FG	ML114949	CM
PICIDAE									
Picumnus aurifrons	1*,2,3		XC90709	WA349052	MPEG 53843				
Picumnus cirratus				WA351754	CM 78190				
Melanerpes candidus					CM 73144			ML47952	PI
Melanerpes cruentatus	1*,2		XC95086	WA573656	CM 73063				
Veniliornis affinis	1*,2	XC95304			MPEG 36697	WA320545	FG	ML114951	CM
Veniliornis passerinus					CM 72952				

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Piculus flavigula	1*,2,3	XC94957		WA675088	CM 75072			ML114956	CM
Piculus chrysochloros	1*			WA356507	CM 72647				
Colaptes punctigula	1,3			WA366369	MZUSP 3420	WA183309	KO		
Celeus grammicus	1*,2,3	XC91204		WA674439	MZUSP 3419				
Celeus elegans	1*,2,3			WA356077	MPEG 56045				
Celeus flavescens					CM 73169				
Celeus flavus	1*,2	XC95305		WA359486	MZUSP 10708			ML115217	CM
Celeus torquatus	1*,2	XC96148	XC96151		CM 74743	WA919233	RC	ML114909	CM
Dryocopus lineatus	1*,2,3	XC94959		WA349050	MZUSP 10716			XC87455	JM
Campephilus rubricollis	1*2	XC95102	XC95109	WA675642	CM 72866	WA319721	FG	ML114957	CM
Campephilus melanoleucos	1*,3	XC95103		WA442184	MZUSP 35932	WA629817	IT		
THAMNOPHILIDAE									
Myrmornis torquata	2				MPEG 53917				
Pygiptila stellaris	1*2	XC95310	XC90772		CM 74493				
Microrhopias quixensis	1*2	XC94851			MPEG 53900			XC88940	JM
Myrmeciza hemimelaena	1*2	XC95315	XC90760	WA352334	MPEG 56086			ML115203	CM
Epinecrophylla leucophthalma	1*2	XC96451		WA356470	MPEG 56078			ML114994	CM
Epinecrophylla ornata	1*2				MPEG 53893				
Myrmotherula brachyura	1*2	XC94887	XC90774	WA359432	MPEG 56084				
Myrmotherula sclateri	1*2	XC95307	XC90760		CM 74937			ML114962	CM
Myrmotherula klagesi					CM 78427				
Myrmotherula hauxwelli	1*2	XC90707			MPEG 56072				
Myrmotherula axillaris	1*2	XC95311	XC90704	WA621984	MPEG 53897	WA320531	FG		
Myrmotherula longipennis	1*2	XC95317	XC96303		MPEG 56071			ML115032	CM
Myrmotherula menetriesii	1*2	XC95316	XC96455		MPEG 56074			XC88775	JM
Myrmotherula assimilis					CM 73136			ML47950	PI
Formicivora grisea	1*,3	XC94648	XC94670	WA583458	MPEG 35616			ML117125	CM
Formicivora rufa	3				MPEG 37766	WA639485	IT		
Thamnomanes caesius	1*2	XC94719	XC94851		MPEG 56068			ML115122	CM
Dichrozona cincta	2				MPEG 53904			XC88789	JM
Herpsilochmus rufimarginatus	1*2	XC95402	XC90760	WA357413	CM 74645			ML114913	CM
Sakesphorus luctuosos				WA583465	CM 72794	WA185174	KO	XC87606	JM

Family / species	Inventories	This study			Previous fieldwork				
Thamnophilus doliatus	1,3				MPEG 26699	WA634314	FS		
Thamnophilus schistaceus	1*2	XC90697	XC87290		MPEG 56062				
Thamnophilus nigrocinereus					CM 72219				
Thamnophilus stictocephalus	1*,3	XC94611		WA619262	MPEG 26710			ML117126	CM
Thamnophilus aethiops	1*2	XC95318	XC95466		MPEG 53872				
Thamnophilus amazonicus	1*				CM 74955				
Cymbilaimus lineatus	1*2	XC94888	XC91205	WA356488	MPEG 56060			ML115024	CM
Taraba major	1*2		XC94620		CM 72511				
Sclateria naevia	1*2				CM 74856	WA206694	KO		
Schistocichla rufifacies	2				CM 72556			ML115023	CM
Hypocnemoides melanopogon	1				CM 72350				
Hylophylax naevius	1*2	XC90776	XC91214		MPEG 56093			ML115186	CM
Hylophylax punctulatus	1*2	XC94780	XC95401		CM 74463				
Pyriglena leuconota	1*2		XC96494		MPEG 40590			ML115047	CM
Myrmoborus lugubris					CM 72226			ML47948	PI
Myrmoborus myotherinus	1*2	XC90747	XC90773	WA675602	MPEG 56244				
Cercomacra cinerascens	1*2	XC91216	XC91204		MPEG 56064	WA185151	KO		
Cercomacra nigrescens	1*2	XC95465		WA447471	CM 74773			ML114996	CM
Hypocnemis striata	1*2	XC96355	XC90709	WA356468	MPEG 56096	WA320252	FG	ML114911	CM
Hypocnemis hypoxantha	1*2	XC87289	XC94623	WA356117	CM 74732			ML115172	CM
Willisornis poecilinotus	1*2	XC91222			CM 75079				
Phlegopsis nigromaculata	1*2	XC90744	XC91206		MPEG 56104			ML114942	CM
Rhegmatorhina gymnops	1*2	XC96150	XC94872		MPEG 56102			XC90272	JM
CONOPOPHAGIDAE									
Conopophaga aurita	1*2	XC94952		WA357416	MPEG 56105			ML114979	CM
GRALLARIDAE									
Grallaria varia	1*2	XC94645			CM 72858				
Hylopezus macularius	1*2	XC86599	XC90705	WA357411	MPEG 56099			ML115081	CM
Hylopezus berlepschi	1*2	XC94723	XC96341		CM 78386			XC6519	SD
Myrmothera campanisona	1*2	XC94889	XC91202		CM 74656			ML114910	CM
FORMICARIIDAE									
Chameaza nobilis					CM 75049				

Family / species	Inventories	This study			Previous fieldwork				
Formicarius colma	1*2	XC95312			MPEG 53920				
Formicarius analis	1*2	XC95313		WA500201	MPEG 53921				
SCLERURIDAE									
Sclerurus mexicanus	1*2	XC96534			MPEG 53866				
Sclerurus rufigularis	1*2	XC96380	XC90707		MPEG 53869				
Sclerurus caudacutus	1*2	XC94774			MPEG 36465				
DENDROCOLAPTIDAE									
Dendrocincla fuliginosa	1*,2	XC94830	XC95269		MPEG 56046			ML114930	CM
Dendrocincla merula	1*,2,3	XC94829	XC94831		MPEG 53850			ML115052	CM
Deconychura longicauda	1*,2	XC95571			MPEG 53852			ML115073	CM
Certhiasomus stictolaemus	1*,2				MPEG 53851				
Sittasomus griseicapillus	1*,2	XC96151		WA356030	MPEG 47735				
Glyphorynchus spirurus	1*,2	XC95678	XC90709		MPEG 56054	WA320215	FG		
Xiphorhynchus spixii	1*,2	XC94876	XC96376		MPEG 56051			ML115123	CM
Xiphorhynchus obsoletus	1				MPEG 55293				
Xiphorhynchus guttatus	1*,2,3	XC95467	XC90740	WA676332	MPEG 56049			ML114900	CM
Campylorhamphus procurvoides	1*,2	XC90761			MPEG 56093				
Campylorhamphus trochilirostris					CM 71504				
Dendroplex picus	1*,2,3	XC94885	XC90697	WA337960	MPEG 55291	WA189088	KO		
Dendroplex kienerii					MPEG 55160				
Lepidocolaptes angustirostris	1,3			WA337961	MPEG 19701	WA550043	VH		
Lepidocolaptes albolineatus	1*,2	XC96153	XC96154	WA675589	MPEG 56055			ML117115	CM
Nasica longirostris	1				CM 73175				
Dendrexetastes rufigula	1*	XC87286	XC96496						
Dendrocolaptes certhia	1*,2	XC90769	XC94679		MPEG 53855			ML114916	CM
Dendrocolaptes picumnus	1*,2	XC90767	XC90703	WA500147	MPEG 53859			ML115181	CM
Xiphocolaptes promeropirhynchus	1*,2	XC94715	XC95467		MPEG 47698			ML114924	CM
Hylexetastes uniformis	1*,2	XC90740	XC90705	WA360070	MPEG 53857			ML117106	CM
FURNARIIDAE									
Xenops minutus	1*,2		XC96457		MPEG 56057	WA320530	FG	ML115050	CM
Berlepschia rikeri					USNM 109221				
Furnarius figulus	1*			WA359474	CM 72394				

Family / species	Inventories	This study			Previous fieldwork				
Furnarius minor					CM 72014	WA180980	KO		
Ancistrops strigilatus	1*	XC95119			CM 74882				
Automolus ochrolaemus	1*,2	XC94886	XC90693	WA360092	CM 74600				
Automolus paraensis	1*,2	XC95303			MPEG 53864			ML115019	CM
Automolus rufipileatus	1*,2	XC95468	XC96457		MPEG 53863				
Philydor ruficaudatum	1*,2	XC95121			CM 74983				
Philydor erythrocercum	1*,2	XC96455		WA500204	MPEG 56056				
Philydor pyrrhodes	1*,2	XC95124			MPEG 47737				
Certhiaxis cinnamomeus					MPEG 36471	WA98816	JAA		
Certhiaxis mustelinus					CM 72392				
Synallaxis albescens	1*	XC87288	XC94798		CM 72311				
Synallaxis rutilans	1*,2	XC94606			CM 74663			ML114952	CM
Synallaxis gujanensis	1*,2		XC94806		CM 72131			XC6583	SD
Cranioleuca vulpina					CM 72181			XC91265	JM
Cranioleuca muelleri					CM 71831				
PIPRIDAE									
Neopelma pallescens	1,3			WA432109	CM 78332			ML117165	CM
Tyranneutes stolzmanni	1*,2	XC94831	XC94951	WA357339	CM 74778			ML115137	CM
Pipra aureola					CM 73444				
Pipra rubrocapilla	1*,2	XC95466	XC90774	WA360056	CM 72985				
Lepidothrix iris	1*,2	XC95469	XC94872	WA350948	CM 74351			ML115232	CM
Manacus manacus	1*,2,3	XC95470	XC94611		CM 71803	WA552475	VH	ML117132	CM
Heterocercus linteatus	1				CM 74422				
Machaeropterus pyrocephalus	1*	XC91205			MPEG 35610				
Chiroxiphia pareola	1*,2,3	XC90695	XC95100	WA621992	MPEG 27125			ML117138	CM
TITYRIDAE									
Onychorhynchus coronatus	1*,2	XC94724			MPEG 56122			ML114935	CM
Terenotriccus erythrurus	1*,2	XC96314			MPEG 53924	WA320528	FG		
Myiobius barbatus	1*,2				MPEG 53929				
Myiobius atricaudus					MCZ 175749				
Schiffornis major					CM 78261				
Schiffornis turdina	1*,2	XC90687	XC96303		MPEG 56123				

Family / species	Inventories	This study			Previous fieldwork				
Laniocera hypopyrra	1*,2		XC94719		CM 74551				
Iodopleura isabellae	1*,2			WA500136					
Tityra inquisitor	1*,2,3				CM 74683				
Tityra cayana	1*,2				CM 72152				
Tityra semifasciata	1*,2			WA356510	CM 73293			ML115041	CM
Pachyramphus rufus	1*,2	XC96341		WA363556	CM 73309	WA634740	IT	ML115089	CM
Pachyramphus castaneus					CM 73462				
Pachyramphus polychopterus	1*,3				CM 72347				
Pachyramphus marginatus	1*,2		XC90680	WA500164	CM 74892				
Pachyramphus minor	1*,2		XC94849	WA674422	CM 74712			ML115056	CM
Pachyramphus validus					MPEG 56120				
COTINGIDAE									
Lipaugus vociferans	1*,2	XC95589	XC90679		CM 74728			ML114921	CM
Gymnoderus foetidus	1,3				CM 74417				
Xipholena lamellipennis	1*,2	XC96154		WA467154	CM 78385	WA320546	FG		
Cotinga cotinga	1*			WA356517	USNM 120922				
Cotinga cayana	1*,2			WA467112	CM 74452	WA320488	FG		
Querula purpurata	1*,2		XC91212	WA585264	CM 72789	WA320527	FG	ML115077	CM
Phoenicircus carnifex	1*,2		XC90519	WA358706	MZUSP 10781			ML115046	CM
RHYNCHOCYCLIDAE									
Platyrinchus saturatus	1*,2				MPEG 56112			ML114961	CM
Platyrinchus coronatus	2				MPEG 47907			ML114912	CM
Platyrinchus platyrhynchos	1*,2	XC96149			MPEG 56114			ML114975	CM
Piprites chloris	1*,2	XC94949	XC95466		MPEG 53943				
Mionectes oleagineus	1*,2	XC95577			CM 74861				
Mionectes macconnelli	1*,2	XC95582	XC95589	WA358691	MPEG 56109			ML115011	CM
Corythopis torquata	1*,2	XC94832			CM 74611				
Rhynchocyclus olivaceus	1*,2	XC90704	XC90703		MPEG 56119				
Tolmomyias assimilis	1*,2	XC90760	XC94647		CM 75085			ML115022	CM
Tolmomyias poliocephalus	1*,2	XC94953		WA573666	CM 73047			ML115009	CM
Tolmomyias flaviventris	1*,3	XC94813	XC87286	WA584504	MPEG 47911				
Todirostrum maculatum	1,3			WA357387	MPEG 15446	WA181010	KO		

Family / species	Inventories	This study			Previous fieldwork				
Todirostrum cinereum	1,3			WA363019	CM 78277				
Todirostrum chrysocrotaphum	1*	XC95679		WA359478	CM 73630				
Poecilotriccus latirostris					CM 73669				
Myiornis ecaudatus	1*,2		XC94889	WA360064	CM 73468			ML115043	CM
Hemitriccus griseipectus					CM 74717				
Hemitriccus striaticollis	1*,2,3	XC94612		WA361101	MPEG 50976			ML115017	CM
Hemitriccus minimus	1*,2	XC86601	XC95119	WA357409	CM 78150			ML114970	CM
Lophotriccus galeatus	1*,2	XC95590	XC94953		MPEG 56106			ML117099	CM
TYRANNIDAE									
Zimmerius acer	1*,2	XC95352	XC90774	WA357348	CM 78409			ML114932	CM
Inezia subflava					MCZ 175873				
Ornithion inerme	1*,2	XC95592		WA357363	CM 78584			ML117101	CM
Camptostoma obsoletum	1*,2,3		XC94885		MPEG 25716				
Elaenia flavogaster	1*,2,3		XC94776	WA359465	MPEG 35603			ML117175	CM
Elaenia parvirostris	3				CM 73503				
Elaenia cristata	1*,3			WA357381	MPEG 17659	WA206691	KO		
Elaenia pelzelni					CM 73687				
Elaenia chiriquensis	1,3			WA361082	MPEG 32449			ML117144	CM
Suiriri suiriri	3				MPEG 26415				
Myiopagis gaimardii	1*,2,3	XC90775	XC90697	WA444713	CM 74859			ML115069	CM
Myiopagis caniceps	1*	XC104022		WA357356					
Myiopagis flavivertex	1*	XC87285			CM 71927				
Myiopagis viridicata	1*				CM 74642				
Tyrannulus elatus	1*,2,3	XC94803		WA363020	MPEG 47920				
Capsiempis flaveola	1*	XC94620			CM 78368				
Phaeomyias murina	1*,3		XC94648	WA361751	MPEG 40568			ML117159	CM
Serpophaga hypoleuca					CM 72406				
Attila cinnamomeus	1*,2		XC94611	WA352332	MPEG 35605				
Attila spadiceus	1*,2		XC90702	WA676334	MPEG 53931			ML114928	CM
Attila bolivianus					CM 72909				
Legatus leucophaius	1*,2,3		XC94953	WA515389	CM 73516				
Ramphotrigon ruficauda	1*,2	XC94680		WA357403	MPEG 8627				

Family / species	Inventories	This study			Previous fieldwork				
Myiarchus tuberculifer	1*,2			WA472584	MPEG 40565				
Myiarchus swainsonii	3				CM 72386				
Myiarchus ferox	1*,2,3		XC94723	WA361742	MPEG 47899			ML115096	CM
Myiarchus tyrannulus	1*,3			WA357382	MPEG 25539			ML117042	CM
Rhytipterna simplex	1*,2	XC95588	XC95590		MPEG 56121				
Rhytipterna immunda					CM 78626				
Casiornis fuscus					CM 73783				
Pitangus sulphuratus	1*,2,3		XC94775	WA363015	CM 72043				
Philohydor lictor	1*,2			WA584507	CM 73735	WA100649	JAA		
Myiodinastes maculatus	1*,2,3		XC94723		MPEG 47896	WA446708	TD	ML117079	CM
Tyrannopsis sulphurea	1*,3			WA359435	CM 73243				
Megarhynchus pitangua	1*,2,3	XC94956		WA361104	CM 73775			ML47949	PI
Myiozetetes similis	1			WA361748	CM 78404				
Myiozetetes cayanensis	1*,2,3		XC94650	WA361745	MPEG 40564	WA205426	KO		
Myiozetetes luteiventris	1*,2	XC96496		WA515439	CM 74488			ML114934	CM
Tyrannus albogularis	1,3			WA590808	MPEG 26016	WA421557	DO		
Tyrannus melancholicus	1*,2,3		XC94812	WA143667	MPEG 47892	WA446713	TD		
Tyrannus savana	1*,3			WA436252	CM 72317	WA446706	TD		
Griseotyrannus aurantioatrocristatus	1			WA361093	MPEG 26478				
Empidonomus varius	1*,2,3		XC94874	WA361089	MPEG 47895			ML115083	CM
Conopias trivirgata	1*,2	XC87290	XC94680	WA357332	CM 72771				
Colonia colonus	1*	XC95681							
Myiophobus fasciatus	1*	XC94776							
Sublegatus obscurior					MPEG 56107				
Sublegatus modestus					MCZ 175958				
Pyrocephalus rubinus					CM 72875				
Fluvicola albiventer	1				CM 71619	WA185168	KO		
Arundinicola leucocephala	1				MPEG 36694				
Cnemotriccus fuscatus	1*	XC94878			CM 78450				
Lathrotriccus euleri					CM 78471				
Empidonax traillii					MPEG 32320				
Contopus nigrescens								ML114941	CM

Family / species	Inventories	This study			Previous fieldwork				
Knipolegus poecilocercus					CM 78169				
VIREONIDAE									
Cyclarhis gujanensis	1*,2,3		XC94878	WA363554	MPEG 40572				
Vireolanius leucotis	1*,2	XC90679	XC87290	WA357364	CM 74926			ML114963	CM
Vireo olivaceus	1*,2,3	XC90697	XC94648	WA363560	MPEG 54788	WA552752	VH		
Vireo altiloquus	1				MCZ 176304				
Hylophilus semicinereus	1*,2	XC92089	XC94620		MCZ 176308				
Hylophilus pectoralis	1*,2,3		XC94620	WA363555	MPEG 47949			ML117123	CM
Hylophilus hypoxanthus	1*,2	XC94847	XC94680	WA360087	MPEG 47950			XC6510	SD
Hylophilus ochraceiceps	1*,2	XC96312			MPEG 36470			ML115235	CM
HIRUNDINIDAE									
Atticora fasciata	1,2			WA584510					
Stelgidopteryx ruficollis	1*,2,3			WA472579	CM 72747	WA100657	JAA		
Progne tapera	1,3			WA462582	MPEG 54787				
Progne subis	1			WA573665	LACM 38905				
Progne chalybea	1*,2	XC96378	XC95572	WA348548	CM 74309	WA205428	KO		
Tachycineta albiventer	1*,2,3			WA348554	CM 72712	WA206709	KO		
Hirundo rustica	1*,3			WA360057	MPEG 47927				
Riparia riparia	1*			WA360063					
TROGLODYTIDAE									
Microcerculus marginatus	1*,2	XC94706			MPEG 56138			XC6568	SD
Odontorchilus cinereus	1*,2	XC90774	XC94623	WA335247	CM 74980			ML114936	CM
Troglodytes musculus	1*,2,3	XC94798		WA358650	MPEG 47936				
Campylorhynchus turdinus	1*,2	XC96294			CM 75082				
Pheugopedius coraya	1*,2	XC90737	XC86601	WA360049	MPEG 53947			ML115045	CM
Canthorchilus leucotis	1*,2,3	XC94806	XC94620	WA142405	MPEG 47935			ML117127	CM
Cyphorhinus arada	1*,2		XC96732		MPEG 56136			ML117074	CM
DONACOBIIDAE									
Donacobius atricapilla	1*	XC94812			CM 71507				
POLIOPTILIDAE									
Ramphocaenus melanurus	1*,2		XC94882		CM 74871			ML114958	CM
Polioptila plumbea	1			WA352469	CM 78424				

Family / species	Inventories	This study			Previous fieldwork				
Polioptila paraensis	1*,2								
TURDIDAE									
Catharus fuscescens					MPEG 54844				
Catharus mimus					MPEG 47943				
Turdus nudigenis					CM 72988				
Turdus leucomelas	1*,3	XC90695	XC94670	WA443928	MPEG 35602	WA446714	TD		
Turdus fumigatus	1*			WA358714	CM 74475				
Turdus albicollis	1*,2	XC96492			MPEG 56139				
MIMIDAE									
Mimus saturninus					MPEG 08546				
MOTACILIDAE									
Anthus lutescens	1*	XC96368			CM 73185				
COEREBIDAE									
Coereba flaveola	1*,2,3			WA333900	MPEG 53952			ML115037	CM
THRAUPIDAE									
Saltator grossus	1*,2	XC90772	XC92089	WA515530	MPEG 56142			ML114919	CM
Saltator maximus	1*,2	XC96344			MPEG 23662				
Saltator coerulescens	1*			WA610324	CM 72178				
Parkerthraustes humeralis	1*,2	XC104858		WA357371					
Lamprospiza melanoleuca	1*,2	XC94951	XC94949	WA500186	CM 74850				
Nemosia pileata	1,3			WA357328	CM 72632			ML117145	CM
Tachyphonus rufus	1*,2,3	XC96330		WA358064	FMNH 258333	WA509899	IT		
Ramphocelus carbo	1*,2,3		XC94611	WA358061	MPEG 22794	WA100650	JAA	ML115208	CM
Ramphocelus nigrogularis					CM 72702				
Lanio luctuosus	1*,2				CM 75084				
Lanio cristatus	1*,2			WA467147	CM 74707				
Lanio cuculatus	1	XC94890		WA435508					
Lanio versicolor	1*,2	XC96152			MPEG 53955			XC91264	JM
Lanio surinamus	1*,2				CM 75078			ML115051	CM
Lanio penicillatus					CM 73592				
Tangara mexicana	1*,2,3	XC96313			CM 72207			XC5981	SD
Tangara velia	1*,2			WA357353					

Family / species	Inventories	This study			Previous fieldwork				
Tangara varia	1*	XC96295							
Tangara punctata	1*,2			WA467140					
Tangara episcopus	1*,2,3		XC94878	WA358065	MPEG 17778	WA182124	KO		
Tangara palmarum	1*,2,3		XC94648	WA500207	CM 72052	WA182125	KO		
Tangara cayana	1,3			WA444716	CM 78198	WA509900	IT		
Schistoclamis melanops				WA551855	MPEG 37767				
Paroaria gularis	1,2,3			WA340077	CM 73727	WA559505	VH		
Dacnis lineata	1*,2			WA356513					
Dacnis flaviventer					CM 72799				
Dacnis cayana	1*,2,3			WA467126	MPEG 23826				
Cyanerpes caeruleus	1*,2			WA487618	CM 74612				
Cyanerpes cyaneus	1*,2,3			WA356513	CM 72808			ML117142	CM
Chlorophanes spiza	1*			WA443043	MCZ 22928			ML115025	CM
Hemithraupis guira	1*,2			WA500180	CM 74941				
Conirostrum bicolor					CM 73679				
EMBEREZIDAE									
Amnodramus humeralis	1,3			WA544922	MPEG 23449			ML117039	CM
Ammodramus aurifrons	1			WA583468	CM 73732	WA183290	KO		
Sicalis colombiana	1			WA144015	MPEG 36695	WA446718	TD	ML47953	PI
Sicalis luteola					CM 73513				
Volatinia jacarina	1*,2,3		XC94618	WA467122	CM 71954			ML117171	CM
Sporophila schistacea					MPEG 47983				
Sporophila americana	1*		XC94776	WA444715	CM 71800				
Sporophila lineola	1*			WA500123	CM 72651				
Sporophila nigricollis	1*			WA347325		WA576640	IT		
Sporophila caerulescens	2				MCZ 176848				
Sporophila minuta	1*			WA467116	CM 72072				
Sporophila castaneiventris				WA340079	CM 71617				
Sporophila angolensis	1*,2,3		XC94874	WA514803	CM 72521				
Arremon taciturnus	1*,2	XC94778			MPEG 53961			ML115061	CM
CARDINALIDAE									
Piranga flava	3				USNM 276980				

Family / species	Inventories	This study			Previous fieldwork				
Piranga rubra				WA924652	MZUSP 47382				
Habia rubica	1*,2		XC96312		MPEG 35338			ML88362	CM
Granatellus pelzelni	1*	XC92090			CM 74460				
Periporphyrus erythromelas	1*,2	XC104023							
Cyanoloxia cyanoides	1*,2	XC94734			MPEG 35608			ML115042	CM
PARULIDAE									
Phaeothlypis rivularis					MPEG 53957			ML114985	CM
Dendroica striata	3				MPEG 50977			ML117141	CM
Geothlypis aequinoctialis					CM 78459				
ICTERIDAE									
Psarocolius viridis	1*,2		XC91202		CM 75037			ML115067	CM
Psarocolius decumanus	1*,2,3				CM 71975			ML115059	CM
Psarocolius bifasciatus	1*,2		XC94714		CM 73313				
Procacicus solitarius					CM 71999				
Cacicus haemorrhous	1*,2				CM 74580				
Cacicus cela	1*,2,3	XC94775		WA441607	MPEG 23351			ML115210	CM
Icterus cayanensis	1,2			WA675100	CM 72081				
Icterus croconotus					CM 72609			XC91267	JM
Gymnomystax mexicanus	1			WA348555	CM 71607	WA550297	VH		
Chrysomus icterocephalus					CM 71939				
Molothrus oryzivorus	1*,2,3			WA348559	MPEG 15252	WA240665	IT		
Molothrus bonariensis	1*,2			WA348556	MPEG 36693	WA550669	VH		
Sturnella militaris	1*,3			WA467176	MPEG 35614				
FRINGILIDAE									
Euphonia chlorotica	1,3			WA357326	CM 72623	WA370312	IT		
Euphonia violacea	1*,2			WA584513	CM 72853			ML115106	CM
Euphonia minuta	1*,2				CM 73799				
Euphonia xanthogaster					CM 74535				
Euphonia rufiventris	1*,2	XC94738		WA514793				ML115140	CM
PASSERIDAE									
Passer domesticus	1			WA349047					

APPENDIX 2

List of 26 species reported from the Santarém-Belterra region, south of the Amazon and east of the Tapajós (PA, Brazil) but without any permanent vouchering material.

Species	**Details of sighting**
Penelope jacquacu	Sight records, C. B. A., A. C. L., B. J. W. D., Catchments: 69, 81, 99, 103, 157, 165, 236, 260, 261, 307, 399
Egretta tricolor	Sight record, A. Whittaker 14/11/1988, Alter do Chão
Ictinia mississippiensis	Sight record, G. M. Kirwan & C. F. Collins, 19 Alter do Chão 4/12/2005, listed in Whittaker *et al.* (2008)
Helicolestes hamatus	Sight record listed in Henriques *et al.* (2003)
Buteo albonotatus	Sight record listed in Sanaiotti & Cintra (2001)
Falco columbarius	Sight record, E. L., 30/11/2011, campus of the Universidade Federal do Oeste do Pará
Aratinga maculata	Sight records by E. Willis: Maicá 16/011984, Rodagém, 18/10/1984, Urumari, in Feb,1985, listed in Willis & Silva (1986)
Pyrrhura lepida	Aural records, E. L, 15/02/2012, Rio Curuauna
Cypseloides sp.	Sight record, A. C. L., 27/01/2011, Catchment 129
Threnetes leucurus	Mist net captures listed by Henriques *et al.* (2003)
Phaethornis hispidus	Sight record, B. J. W. D. 31/01/2011, Catchment 112
Lophornis ornatus	Sight record Henriques *et al.* (2003)
Chrysolampis mosquituus	Sight record B. Whitney Km 21 on road to Alter do Chão, 19 June and again 7 July 1995)
Trogon curucui	Aural records C. B. A., A. C. L., B. J. W. D., Catchments: 81, 112
Brachygalba lugubris	Sight records in Henriques *et al.* (2003)
Xenops rutilans	Sight records C. B. A., Catchment: 157
Microxenops milleri	Sight records C. Marantz, 23/8/1999, 18/09/1999, 09/10/1999, Base de Sucupira, FLONA
Dixiphia pipra	Mist-net capture, Henriques *et al.* (2003)
Tolmomyias sulphurescens	Mist-net capture, reported in Henriques *et al.* (2003)
Sirystes sibilator	Sight record listed in Sanaiotti & Cintra (2001)
Contopus cooperi	Sight record, C. Marantz, 26/09/1999, Base de Sucupira, FLONA
Petrochelidon pyrrhonota	Sight record, A. Whittaker, 14/111988, Alter do Chão (in Stotz *et al.* 1992)
Atticora tibialis	Sight record, C. B. A.,18/11/2010, Catchment 307
Cyanocorax chrysops	Sight record, B. Whitney, 06/071995, Maicá
Tersina viridis	Sight record in Sanaiotti & Cintra (2001)
Cissopis leverianus	Sight record, C. B. A. 03/11/2010, Catchment 399