Avifaunal inventory of the Amazonian savannas and adjacent habitats of the Monte Alegre region (Pará, Brazil), with comments on biogeography and conservation

Levantamento da avifauna das savanas amazônicas e de habitats adjacentes da região de Monte Alegre (Pará, Brasil), com comentários sobre biogeografia e conservação

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Abstract: Knowledge of the avifaunal composition of Amazonian savannas is important in facilitating a greater understanding of the patterns of evolution of the regional biota. Despite this, this vegetation type has been poorly sampled in comparison to adjacent rainforest habitats. The aim of this paper is to provide an avifaunal inventory of the savannas and other adjacent habitats of Monte Alegre, on the left bank of Amazon River, northwestern Pará, Brazil. Our survey is based both on our own fieldwork and on previously-collected specimens deposited in museums. A total of 300 bird species have been recorded in the region. Ninety-four species (31.3%) were restricted to a single habitat type, indicating that habitat heterogeneity is important to the overall species richness. Despite the fact that the Monte Alegre savannas present typical species restricted to this habitat, several open-country birds that occur in larger savanna areas located on the borders of Amazonia (along the Atlantic coast and close to the 'cerrado' boundaries) were not recorded in this area. Although Monte Alegre is species impoverished relative to other savanna regions in the Amazon basin, the Monte Alegre savannas shelter the Sulfur-breasted Parakeet (*Aratinga maculata*), a vulnerable species in Pará state that is only known from the Guianan area of endemism (Aleixo *et al*., 2011). We also comment on biogeography, taxonomy, noteworthy records, natural history and conservation of the regional avifauna.

Keywords: Avifaunal survey. Amazonian savannas. Biogeography. Natural history. Conservation. *Aratinga maculata*.

Resumo: O conhecimento sobre a composição da avifauna das savanas amazônicas é muito importante para o entendimento de padrões da evolução da biota regional. Entretanto, este tipo de vegetação foi pouco amostrado em comparação com áreas de florestas adjacentes. O objetivo deste trabalho é apresentar um levantamento da avifauna das savanas e de habitats adjacentes de Monte Alegre, na margem esquerda do rio Amazonas, noroeste do Pará, Brasil. Nossa pesquisa baseou-se em nossos trabalhos de campo e em exemplares coletados anteriormente e depositados em museus. Um total de 300 espécies de aves foi registrado na região. Noventa e quatro espécies (31,3%) estiveram restritas a um único tipo de habitat, indicando que a heterogeneidade de habitats é importante para a riqueza geral de espécies. Apesar de as savanas de Monte Alegre apresentarem espécies típicas deste habitat, faltam outras aves de ambientes abertos que ocorrem em áreas maiores de savana localizadas nas bordas da Amazônia, especialmente ao longo da costa Atlântica ou próximo aos limites do cerrado. Embora a avifauna de Monte Alegre seja relativamente pobre em comparação com outras áreas de savanas na bacia amazônica, as savanas de Monte Alegre abrigam o cacaué (*Aratinga maculata*), uma espécie vulnerável no estado do Pará, com distribuição restrita à área de endemismo Guiana (Aleixo *et al*., 2011). Também comentamos sobre biogeografia, taxonomia, registros notáveis, história natural e conservação da avifauna regional.

Palavras-chave: Levantamento de avifauna. Savanas amazônicas. Biogeografia. História natural. Conservação. *Aratinga maculata*.

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INTRODUCTION

Patches of savannas and other open vegetation biotypes are found nested in extensive areas of rainforest in Brazilian Amazonia (Prance, 1978; Pires & Prance, 1985; Sanaiotti *et al.*, 1997; Miranda & Absy, 2000; Vicentini, 2004; Gottsberger & Silberbauer-Gottsberger, 2006; Pennington *et al.*, 2006; Ratter *et al.*, 2006; Magnusson *et al.*, 2008). Amazonian savannas occur mainly on poor, sandy soils on both banks of the Amazon River (Gottsberger & Silberbauer-Gottsberger, 2006; Pennington *et al.*, 2006; Ratter *et al.*, 2006). Important sites include those in the states of Roraima, Amapá, Amazonas and Pará (Andrade-Lima, 1958; Miranda, 1993; Miranda & Absy, 2000; Gottsberger & Silberbauer-Gottsberger, 2006; Pennington *et al.*, 2006; Ratter *et al.*, 2006; Magnusson *et al.*, 2008).

Knowledge of the avifauna composition of Amazonian open habitats is crucial to understanding patterns of distribution and evolution of birds in South America (E. Snethlage, 1909; Haffer, 1967, 1969, 1974, 1985, 1987; Silva, 1995; Silva *et al*., 1997; Silva & Bates, 2002; Bates *et al*., 2003; Robbins *et al.*, 2004; Mittermeier *et al*., 2010). Amazonian savannas are considered present-day 'refugia' of a widespread open vegetation type that probably expanded across the Amazonian belt of low precipitation during dry phases of the Cenozoic (Haffer, 1967, 1969, 1974; Prance, 1978, 1987; Haffer & Prance, 2001; Ab'Saber, 2002). Despite their importance for the Amazonian biogeography, these areas have been poorly sampled in comparison to rainforest sites throughout the Amazonian region, and published avifaunal inventories have focused on savannas in the Sipaliwini region (Suriname) and in the Brazilian states of Roraima, Amazonas, Pará, Amapá and Rondônia (Henriques & Oren, 1997; Silva *et al.*, 1997; Sanaiotti & Cintra, 2001; Naka *et al.*, 2006; Aleixo & Poletto, 2007; Santos & Silva, 2007; Mittermeier *et al*., 2010; Aleixo *et al*., 2011).

Monte Alegre is located on the left (northern) bank of the Amazon River, northwestern Pará, Brazil. The region is located on the southern border of the Guianan area of endemism, a well known area of avian endemism (see Cracraft, 1985). Monte Alegre savannas are isolated from other large savanna areas (e. g., 'cerrado', Amapá, Llanos, Roraima-Rupununi, Sipaliwini) by hundreds of kilometers of Amazonian rainforest, but are only separated by the Amazon River from other savanna enclaves on the southern bank (Alter do Chão) (Figure 1).

Ornithological surveys of Monte Alegre started in the 19th century, when F. W. Sieber collected some specimens in this region, between 1801 and 1812 (Pinto, 1979). These specimens were deposited in the Museum für Naturkunde (ZMB), Berlin (Pinto, 1979). The famous British naturalist A. R. Wallace also explored the area in 1849 and collected a few specimens that have been deposited in the British Museum of Natural History (BMNH), Tring (Sclater & Salvin, 1867; Pinto, 1979). Later, more detailed ornithological collections were made by E. Snethlage, O. Martins, A. Costa, J. de Sá, J. Anthero and F. J. José during the first two decades of the 20th century (E. Snethlage, 1906, 1907, 1914; H. Snethlage, 1930; Miranda-Ribeiro, 1938). During these expeditions, over 720 specimens were collected and deposited in the Museu Paraense Emílio Goeldi (MPEG), Belém. Between 1917 and 1920, F. Q. Lima and E. Garbe, working for the Museu Paulista (currently Museu de Zoologia da Universidade de São Paulo, MZUSP), also collected specimens in Monte Alegre (Pinto, 1944, 1945). Shortly after these expeditions, C. Lako collected birds in the Monte Alegre region (Maicuru River) in 1928 and 1929 (Paynter & Traylor, 1991; Silveira *et al*., 2005). These specimens were deposited in the Field Museum of Natural History (FMNH) and in the American Museum of Natural History (AMNH) (Paynter & Traylor, 1991; Silveira *et al*., 2005). A. M. Olalla also visited the region in 1936, when he collected specimens that were sent to the FMNH (Paynter & Traylor, 1991). Recently, a new species of parakeet (Psittacidae), *Aratinga maculata* (Sulfur-breasted Parakeet), was described from Monte Alegre (Silveira *et al*., 2005) (the species was described as *Aratinga pintoi* but this is now considered a junior synonym of *Aratinga maculata*, see Nemésio & Rasmussen, 2009), and the region became better known among ornithologists and

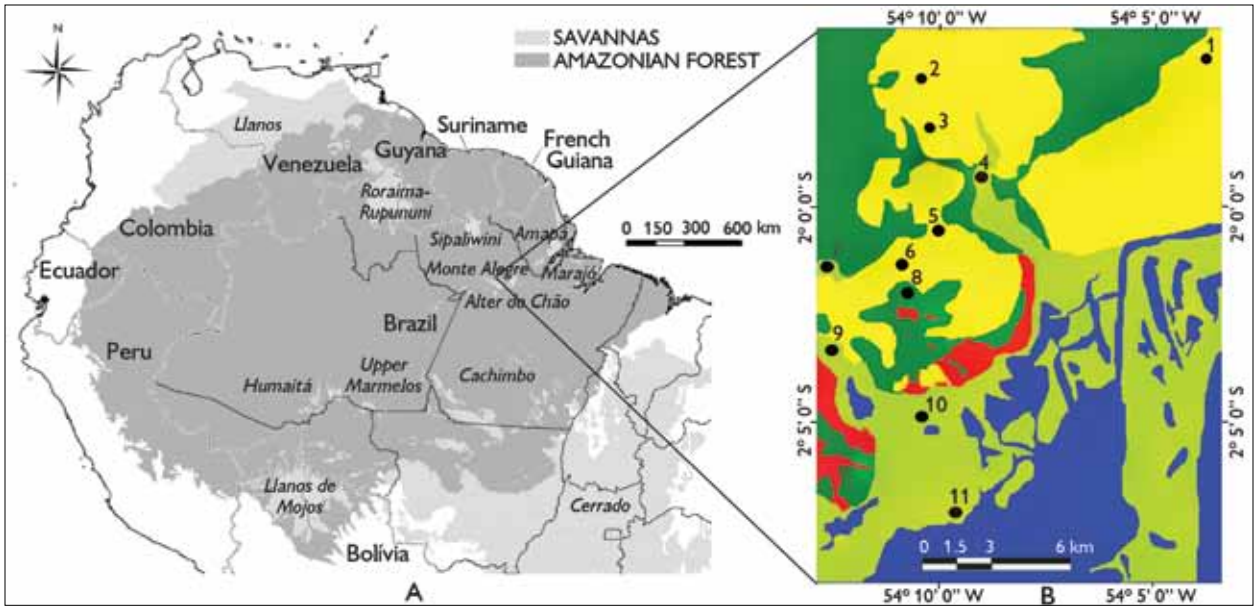

Figure 1. Study area. A: Map of northern South America showing the main savanna areas referenced in the text. Adapted from Aleixo & Poletto (2007). B: Main habitat types and surveyed sites in the Monte Alegre region. Habitats: savanna (white); flooded forest and 'campo de várzea' (light gray); 'terra firme' forest and 'campinarana' (gray); disturbed areas (dark gray); lakes and rivers (black). Sites: 1 = km 4 of road PA-423; 2 = Campo do Desterro; 3 = Colônia do Ererê; 4 = Igarapé do Ererê; 5 = Santana; 6 = Serra do Ererê; 7 = Aruchi; 8 = Ilha Grande; 9 = Mutuacá; 10 = Lago da Conceição; 11 = Margin of the Amazon River. Adapted from Pereira *et al*. (2003).

birdwatchers (Silveira, 2005; Balchin, 2006). Although this region has been inventoried by generations of ornithologists, old collections from Monte Alegre have never been studied in detail and the area lacks an ornithological checklist. Thus, the aim of this paper is to provide an avifaunal inventory of the Monte Alegre region, based on our own fieldwork and on specimens held in museums. We also comment on biogeography, taxonomy, noteworthy records, natural history and conservation of the avifauna.

MATERIAL AND METHODS

STUDY AREA

Our study was located in the Monte Alegre region (between 01° 56' and 02° 07' S, and 54° 03'and 54° 13' W), state of Pará, northern Brazil (Figure 1). The elevation ranges from 3 m to 400 m (Pastana, 1999) and the climate is hot and humid (type Awi of the Köppen classification) (Ayoade, 1998). Temperatures vary between monthly averages of 25.7° and 27° C (Oliveira-Júnior *et al.*, 1999) and mean annual precipitation is 1,678 mm (Moraes *et al.*, 2005). Rainfall peaks in April and the rainy season is concentrated between February and May, when monthly precipitation surpasses 200 mm. The dry season is between September and October, when monthly rainfall averages are lower than 50 mm (Oliveira-Júnior *et al.*, 1999).

Savanna vegetation (locally named 'coberto') occurs generally on sandy or rocky soils, with the presence of a few species of grasses and herbs and a very inconspicuous litter layer (Figure 2A and Figure 2B). Shrubby-arboreal vegetation is primarily represented by sparse individuals of the following species: *Curatella americana*, *Qualea grandiflora*, *Salvertia convallariodora*, *Sclerolobium paniculatum*, *Anacardium occidentale*, *Palicourea rigida* and *Tocoyena formosa*, generally varying from 1 to 4 m in height. At Serra do Ererê (02° 01' 16" S 54° 10' 55" W), a mountainous locality in this region (elevation: 220 m), savanna occurs mainly over and between rock

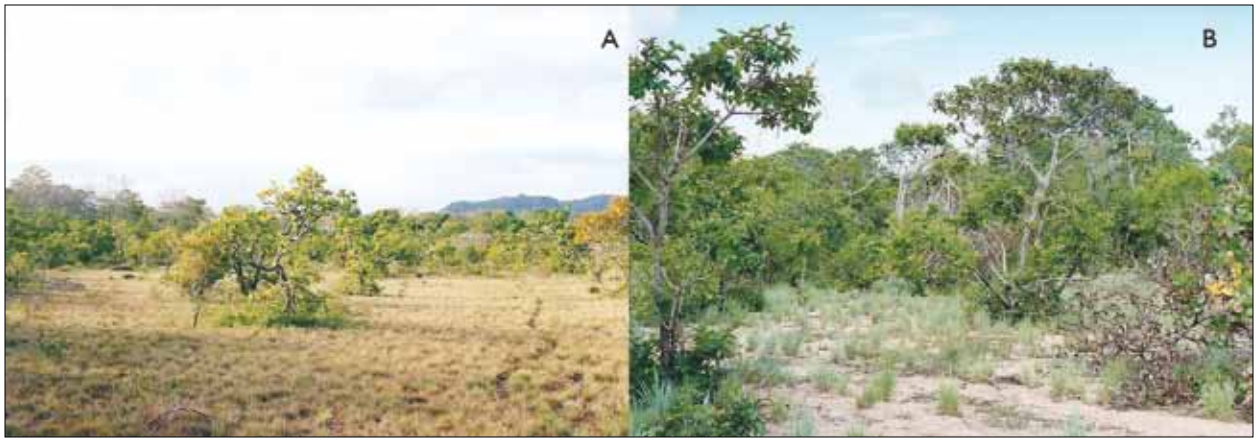

Figure 2. Typical savanna sites in Monte Alegre. A: Savannas on gravel substrate with tortuous trees and dense grass layer, showing Serra do Ererê on the background. B: Savannas on sandy soil with a sparse grass layer. Photos: M. F. Vasconcelos, 1999.

outcrops, with shrubs of *Cereus* sp., *Phyllodendron* sp. and *Norantea guianensis*. In this area there are also sparse shrubby-arboreal individuals of *Aspidosperma* sp., *Byrsonima crassifolia*, *Q. grandiflora* and *S. convallariodora* growing on sandy or rocky soils. Some of these trees are parasitized by a mistletoe (*Psittachanthus* sp.) with hummingbird-pollinated flowers (Vasconcelos & Silva, 2005). For a detailed botanical inventory of the Monte Alegre savannas, see Andrade-Lima (1958).

These savannas are intermixed with patches of 'campinarana', a low-canopy forest growing on sandy soil with trees reaching up to 10 m in height. These 'campinaranas' are very dense, with a developed understory with tangles of vines and shrubs (mainly *Miconia* sp.). At some places within the savannas, there are clumps of trees that resemble small patches of 'campinarana', with a denser layer of litter and shrubs of *Eugenia* sp., *Miconia* sp. and *Cereus* sp.

Original 'terra firme' forests ('floresta ombrófila') were extensively cleared and fragmented (Pereira *et al*., 2003). Several areas originally covered by this vegetation type are now occupied by clumps of an abundant pioneer species of palm tree (*Attalea* sp.), and the remnant fragments are subject to illegal logging (see below). Typical tree species of those forests are: *Aspidosperma desmanthum*, *Bellucia* sp., *Geissospermum sericeum*, *Hymenaea parviflora*, *Inga micradenia*, *Licania* spp., *Myrcia paivae*, *Nectandra mollis* and *Protium paniculatum* (Garcia *et al*., unpublished data 2008).

Flooded forests occur along watercourses, usually associated with flooded open habitats ('campos de várzea'), with 'buriti' (*Mauritia flexuosa*) and 'açaí' (*Euterpe oleracea*) palm groves. Rivers and lakes also represent important habitats for water birds in the Monte Alegre region.

METHODS

We made three expeditions to Monte Alegre aiming principally to collect specimens in the savannas. The first expedition was performed by JMCS, MFV and D. C. Pimentel Neto between 2 and 20 January 1999. Specimens were collected with shotguns and mist-nets and have been deposited in MPEG and in the ornithological collection of the Department of Zoology, Universidade Federal de Pernambuco (UFPE). Localities sampled during this expedition were: savannas and 'campinaranas' at km 4 of road PA-423 (01º 56' 38" S 54º 03' 45" W); savannas of Campo do Desterro (01º 57' 04" S 54º 10' 20" W); savannas and 'terra firme' forest fragments at Colônia do Ererê (01º 58' 14" S 54º 10' 01" W); and savannas and 'campinaranas' at Serra

do Ererê (02º 01' 16" S 54º 10' 55" W). The second expedition was made by SMD and J. N. Santa Brígida, between 21 and 28 September 2006, during a study for the management plan of the Monte Alegre State Park. Fieldwork was conducted in the following localities: a 'terra firme' forest fragment at Ilha Grande (02º 01' 55" S 54º 10' 39" W); flooded forest at Aruchi (02º 01' 28" S 54º 12' 33" W); flooded forest at Igarapé do Ererê (01º 59' 20" S 54º 08' 57" W); 'terra firme' forest and savannas at Colônia do Ererê (02º 00' 06" S 54º 10' 48" W); savannas at Santana (02º 00' 30" S 54º 09' 58" W); and savannas at Serra do Ererê (02º 01' 32" S 54º 11' 07" W). Specimens were collected with mist-nets and deposited in MPEG. The third expedition was made by SMD, between 19 and 23 March 2009, in the following localities: lake at Lago da Conceição (02º 04' 54" S 54º 10' 21" W); 'buriti' palm grove at Mutuacá (02º 03' 18" S 54º 12' 21" W); and flooded forests along the Amazon River (02º 07' 08" S 54º 09' 36" W). In all expeditions, birds were also photographed and tape-recorded. Recordings will be deposited at the Arquivo Sonoro Prof. Elias Coelho (ASEC), Departamento de Zoologia, Universidade Federal do Rio de Janeiro (UFRJ), Rio de Janeiro, Brazil. Some of these recordings have been archived on the online resource Xeno-Canto (2009).

We also studied old specimens collected in the Monte Alegre region deposited in MPEG and checked the literature (Pinto, 1944; Ruschi, 1951; Silveira *et al.*, 2005) for additional specimens deposited in the following institutions: AMNH, FMNH, MZUSP and Museu Nacional do Rio de Janeiro (MNRJ).

We took notes in the field in which habitat each species was observed. For those recorded exclusively in museums, we classified them by habitat type based on our own field experience and following Ridgely & Tudor (1989, 1994), Stotz *et al.* (1996), Cohn-Haft *et al*. (1997), Borges *et al*. (2001) and Naka *et al*. (2006). Systematic order and nomenclature follow those of the Comitê Brasileiro de Registros Ornitológicos (CBRO, 2009).

RESULTS AND DISCUSSION

AVIFAUNAL SURVEY

A total of 300 bird species was recorded in the Monte Alegre region (Appendix). Flooded forests and 'terra firme' forests held the highest species richness (146 and 143 species, respectively), followed by 'campinarana' (122 species), savannas (109 species) and 'campos de várzea' (99 species) (Table 1). Disturbed areas and open waterbodies (lakes and rivers) had the lowest species richness (respectively 57 and 54 species, Table 1).

Ninety-four species (31.3%) were restricted to a single habitat type (Table 1). This shows that habitat heterogeneity is important for the overall species richness (see Cohn-Haft *et al*., 1997). Similar results were obtained in other surveys of Amazonian savannas intermixed with other vegetation types (Silva *et al*., 1997; Aleixo & Poletto, 2007; Santos & Silva, 2007; Aleixo *et al*., 2011). Open waterbodies (lakes and rivers) hold the highest percentage of exclusive species (48.1%), followed by savannas, which presented 18.3% exclusive species (Table 1). On the other hand, 'campinaranas' showed the lowest percentage of exclusive species (3.3%), probably because this habitat shelters several birds that also live in other forest types, such as 'terra firme' and flooded forests (Borges, 2004).

Aratinga maculata (Sulfur-breasted Parakeet) was the only species considered to be restricted to the Monte Alegre region (Silveira *et al*., 2005), although some specimens listed by these authors were taken from Suriname and considered mislabeled. Recently, Mittermeier *et al*. (2010) collected an additional specimen in the Sipaliwini savanna, confirming its presence in Suriname. More recent records were presented by Aleixo *et al*. (2011) from Trombetas State Forest, southern part of the Grão Pará Ecological Station and Paru State Forest. *Lophornis ornatus* (Tufted Coquette) was previously considered by Cracraft (1985) as a Guianan area of endemism endemic, but it also occurs in Cracraft's Parian Montane area of endemism (see map in

Züchner, 1999) and on the right bank of the Amazon River, in the savannas of Alter do Chão (Sanaiotti & Cintra, 2001).

Three threatened species were recorded in the region (following Machado *et al*., 2005; SECTAM, 2006; BirdLife International, 2009): *Anodorhynchus hyacinthinus* (Hyacinth Macaw) - globally endangered, vulnerable in Brazil and in Pará state; *Primolius maracana* (Blue-winged Macaw) - near threatened globally and in Brazil, vulnerable in Pará state; and *Aratinga maculata* (Sulfur-breasted Parakeet) - vulnerable in Pará state, but not yet evaluated by BirdLife International (2009) and by the Brazilian red list.

COMMENTS ON THE BIOGEOGRAPHY OF THE MONTE ALEGRE SAVANNA AVIFAUNA

It is possible to make some biogeographical comments on the avifauna of the Monte Alegre savannas. For example, *Colinus cristatus* (Crested Bobwhite) is the only species restricted to the savannas north of the Amazon River found in Monte Alegre (Sick, 1997). On the other hand, 13 savanna species whose ranges in South America are mainly centered on regions located south of Amazonia ('caatinga', 'cerrado' and 'chaco'; following Silva *et al*., 1997) were recorded at Monte Alegre: *Buteo albicaudatus* (White-tailed Hawk), *Aratinga aurea* (Peach-fronted Parakeet), *Chordeiles pusillus* (Least Nighthawk), *Colaptes campestris* (Campo Flicker), *Formicivora rufa* (Rusty-backed Antwren), *Lepidocolaptes angustirostris* (Narrow-billed Woodcreeper), *Elaenia cristata* (Plain-crested Elaenia), *Suiriri suiriri* (Suiriri Flycatcher), *Xolmis velatus* (White-rumped Monjita), *Tyrannus albogularis* (White-throated Kingbird), *Tyrannus savana* (Fork-tailed Flycatcher), *Mimus saturninus* (Chalk-browed Mockingbird) and *Ammodramus humeralis* (Grassland Sparrow). These species exhibit the Peri-Atlantic distribution pattern (following Silva, 1995). This pattern suggests connections between the 'cerrado' region and the northern South American savannas through an Atlantic coast savanna corridor (Silva, 1995; Silva & Bates, 2002). However, other important species sharing this pattern of distribution occur in coastal savannas (e. g., Marajó Island and Amapá state; see Silva, 1995; Henriques & Oren, 1997; Silva *et al*., 1997), but are absent in the Monte Alegre savannas. Examples are: *Uropelia campestris* (Long-tailed Ground-Dove), *Guira guira* (Guira Cuckoo), *Neothraupis fasciata* (White-banded Tanager) and *Coryphaspiza melanotis* (Black-masked Finch). Thus, it seems that the avifauna of the Monte Alegre savannas have been isolated from other large South American savannas ('cerrado' and Llanos) for a longer period in comparison to coastal savannas, which seem to have had more recent connections to the 'cerrado' (Silva, 1995; Silva *et al*., 1997; Silva & Bates, 2002; Bates *et al*., 2003; Mittermeier *et al*., 2010). This pattern does not support the presence of a broad savanna corridor across the Amazonian belt of low precipitation, one of the assumptions of the refuge theory (Haffer, 1969, 1974). However, in a recent paper, Haffer & Prance (2001) stressed that not just savannas were believed to expand and isolate the wet forest 'refugia'. They suggested that other vegetation types of seasonally dry climates (e.g., dry forest, liana forest and bamboo forest) could have been effective barriers to the dispersal of rainforest 'refugia' organisms (see also Pennington *et al*., 2000). Bonaccorso *et al*. (2006) modeled potential distributions of 17 species of plants and birds during the Last Glacial Maximum and suggested that past climate changes fragmented rainforest species' ranges but there

Table 1. Bird species richness in habitats of Monte Alegre region.

Habitats	Total species	Exclusive species	(%) Exclusive species
Flooded forest	146	17	11.6
'Terra firme' forest	143	14	9.8
'Campinarana'	122	4	3.3
Savanna	109	20	18.3
'Campo de várzea'	99	11	11.1
Man-made, disturbed areas	57	2	3.5
Open waterbodies (lakes and rivers)	54	26	48.1
Total	300	94	31.3

was not a clear pattern for savanna species. These results also do not support the broad expansion of savannas into areas currently covered by Amazonian rainforests. Various other studies show a similar pattern; most notably those based on the pollen record (see Bush & de Oliveira, 2006 for a recent review).

Furthermore, the relatively small area of Monte Alegre savannas, coupled with their isolated location in central Amazonia relative to other larger savanna areas within the borders of the Amazon region, such as Amapá (Silva *et al*., 1997), Roraima-Rupununi (Robbins *et al*., 2004; Santos & Silva, 2007) and the upper Marmelos River (Aleixo & Poletto, 2007), can also explain the absence of several other typical South American savanna species recorded in those regions. Examples are: *Heliactin bilophus* (Horned Sungem), *Melanopareia torquata* (Collared Crescentchest), *Polystictus pectoralis* (Bearded Tachuri), *Euscarthmus rufomarginatus* (Rufous-sided Pygmy-Tyrant), *Xolmis cinereus* (Gray Monjita), *Anthus lutescens* (Yellowish Pipit), *Cypsnagra hirundinacea* (White-rumped Tanager), *Emberizoides herbicola* (Wedge-tailed Grass-Finch) and *Sporophila bouvreuil* (Capped Seedeater). Alter do Chão, another central Amazonian savanna site, also presents an impoverished savanna avifauna (Sanaiotti & Cintra, 2001). Thus, local extinction is another potential explanation for the lack of some species in Monte Alegre and other small and isolated central Amazonian savannas. These species may have colonized the region during past expansions of non-forest vegetation types into the Amazonian region (Haffer & Prance, 2001), but may have subsequently become extinct as either the habitat became unsuitable or habitat patches too small to support effective metapopulations.

Finally, among the species considered above, it is important to stress that *Tyrannus albogularis* and *T. savanna* are represented by resident and austral migrant populations in Amazonia (Sick, 1997; Infonatura, 2009), while *Guira guira*, *Anthus lutescens* and *Ammodramus humeralis* can be invasive species in several deforested areas, especially pastures and farmlands (Sick, 1997; Vasconcelos *et al.*, 2007b). Thus, these species should be treated with some caution in biogeographical analyses of savanna birds.

SPECIES ACCOUNTS

Below, we present comments on distribution, taxonomy and natural history of selected species:

Colinus cristatus (Crested Bobwhite)

The only regional record for this northern South American savanna game bird is based on two specimens (a couple) collected by O. Martins in October 1916 (MPEG 13006-13007). This record was probably overlooked, since it represents a range extension for this species to the mid-lower left bank of the Amazon River (see maps in Carrol, 1994 and Infonatura, 2009). We failed to find the Crested Bobwhite during our fieldwork and it is possible that the species could have been extirpated from the region due to hunting pressure (see below).

Buteo albicaudatus (White-tailed Hawk)

This is an uncommon species in Amazonia, with sparse records for other savanna areas, such as Marajó Island (Henriques & Oren, 1997), Amapá (Silva *et al*., 1997), Alter do Chão (Sanaiotti & Cintra, 2001), Roraima-Rupununi (Robbins *et al*., 2004; Santos & Silva, 2007), upper Marmelos River (Aleixo & Poletto, 2007) and Sipaliwini (Mittermeier *et al*., 2010). In Amazonia, the species was also recorded around 'terra firme' forests in the Alta Floresta region (Zimmer *et al*., 1997) and on the Serra dos Caiabis, in transitional forest (Lees *et al*., 2008). The first record for Monte Alegre is an adult bird photographed by MFV on 16 January 1999. The bird was perched on a rock outcrop atop Serra do Ererê and took flight some minutes later. On 19 January 1999, three individuals (one in dark phase) were seen flying over the same locality.

Aratinga maculata (Sulfur-breasted Parakeet)

This species is endemic to the Guianan area of endemism (Silveira *et al*., 2005; Mittermeier *et al*., 2010; Aleixo *et al*.,

2011); records from Santarém, on the south bank of the Amazon River, are probably from captive birds or mislabeled old specimens (Silveira *et al*., 2005). We observed flocks of 3-8 individuals in five localities: Monte Alegre city, Campo do Desterro, Colônia do Ererê, Santana and Aruchi. Birds were observed principally in savannas but were also recorded close to forest fragments or flying over forested or urban areas. Two males that were used in the original description of *A. pintoi* (Silveira *et al*., 2005) were collected by JMCS, MFV and D. C. Pimentel Neto, at Colônia do Ererê on 9 January 1999 (MPEG 54330, UFPE 1792).

Chordeiles pusillus (Least Nighthawk)

In Amazonia, this species is restricted to open vegetation enclaves (savannas and 'campinas'), such as Amapá (Silva *et al*., 1997), Roraima-Rupununi (Robbins *et al*., 2004; Santos & Silva, 2007), Jaú National Park (Borges *et al*., 2001; Borges, 2004), upper Marmelos River (Aleixo & Poletto, 2007) and Sipaliwini (O'Shea, 2005; Mittermeier *et al*., 2010). In the early morning (05:30 h) of 11 January 1999, several individuals of *C. pusillus* were detected at Campo do Desterro by their typical song (see Cleere & Nurney, 1998). At 07:30 h, four specimens (three males and one female) were collected by JMCS, MFV and D. C. Pimentel Neto (MPEG 54339-54341, UFPE 1780). These birds were shot when roosting on a gravel patch of c. 40 m^2 amidst the savanna vegetation. Another three birds (not collected) were roosting in the same area. At dawn on 14 January 1999, five individuals were observed and heard at Colônia do Ererê. Based on plumage, these specimens were identified as *C. p. septentrionalis*. However, *C. p. esmeraldae* is the subspecies that probably moves to central and eastern Amazonia during migratory movements (Cleere & Nurney, 1998; Cleere, 1999). Recently, Mittermeier *et al*. (2010) found intermixed characters of plumage and measurements of four subspecies (*C. p. septentrionalis*, *C. p. esmeraldae*, *C. p. novaesi* and *C. p. pusillus*) when analyzing 12 specimens from Sipaliwini. Thus, as pointed out by others (Robbins *et al*., 2004; Aleixo & Poletto, 2007; Mittermeier *et al*., 2010), more studies are needed to understand the taxonomy, geographical variation and migratory patterns of this species in Amazonia. It is possible that some populations are resident and that one or more subspecies are invalid due to the great individual variation that occurs in several nightjar species (Cleere & Nurney, 1998; Cleere, 1999, 2010).

Lophornis ornatus (Tufted Coquette)

This species is known from Monte Alegre from a single male specimen (MPEG 4759) collected by E. Snethlage on 15 February 1906. This appears to be the only specimen from the mid-lower reaches of the north bank of the Amazon River (see maps in Züchner, 1999 and Infonatura, 2009).

Notharchus ordii (Brown-banded Puffbird)

This poorly known puffbird is known from scattered records in the basins of the Amazon and Orinoco (Zimmer & Hilty, 1997; Zimmer *et al*., 1997; Borges *et al.*, 2001; Rasmussen & Collar, 2002; Infonatura, 2009). The only record for the left bank of the mid-lower Amazon River appears to be a female (MPEG 4405) collected by A. Costa on 17 November 1905.

Formicivora rufa (Rusty-backed Antwren)

Silva *et al*. (1997) suspected that the subspecies of the Rusty-backed Antwren occurring in Monte Alegre would be *F. r. chapmani*, a taxon restricted to the Amazonian savannas other than Humaitá and the upper Marmelos River (both in Amazonas state and close to the border of the 'cerrado'), where the nominate race has been collected (Silva *et al*., 1997; A. Aleixo & F. Lima, personal communication). This species is known in Monte Alegre from a female (MPEG 4744) and a male (MPEG 6004), collected by E. Snethlage and O. Martins, on 14 February 1906 and on 21 July 1908, respectively. Between 10 and 19 January 1999, four specimens (one male and three females) were obtained in the Monte Alegre savannas

by JMCS, MFV and D. C. Pimentel Neto (MPEG 54367-54370). The female specimens present heavy streaking on underparts (especially on throat) and blackish tails, typical features of *F. r. chapmani*, following Zimmer & Isler (2003) (but see Pinto, 1940, 1947 for a critical point of view, suggesting that some of these characters may be related to individual variation).

Suiriri suiriri (Suiriri Flycatcher)

Suiriri Flycatcher is known from few sites in Amazonia (Silva *et al*., 1997; Sanaiotti & Cintra, 2001; Robbins, 2004; Infonatura, 2009; Mittermeier *et al*., 2010). However, *S. s. affinis* is fairly common in the Monte Alegre savannas, where five specimens were collected by E. Snethlage (MPEG 5934) and by JMCS, MFV and D. C. Pimentel Neto (MPEG 54390-54391, UFPE 1770-1771).

Conopias trivirgatus (Three-striped Flycatcher)

The only nesting record for this species is based on observations of a pair of the nominate form (in Argentina) taking leaves to an old woodpecker hole in a broken branch (Narosky & Salvador, 1998; Mobley, 2004c). The Amazonian subspecies (*C. t. berlepschi*) possibly represents a full species (Pinto, 1936; Ridgely & Tudor, 1994; Mobley, 2004c), and virtually nothing is known about its breeding ecology. On 20 January 1999, JMCS and MFV observed one individual taking material to a nest located in the top of a broken branch of a dead savanna tree, c. 3 m above the ground (Figure 3A). The cup-shaped nest was c. 25 cm inside a hollow in this branch without any upper protection (Figure 3B). It was composed of leaves of grass, tree bark and some feathers, lined with rachis and central veins of dry dicotyledon leaves. Nest measurements (in cm) were: external diameter 4.7, internal diameter 3.3 and depth 3.0. This nest was collected and deposited in the MPEG nest collection. Nesting in holes or tree cavities was also reported for other species of *Conopias* (Ridgely & Tudor, 1994; Mobley, 2004a, 2004b). It has also been reported that *Conopias* flycatchers usurp hanging nests of caciques (*Cacicus* spp.) and oropendolas (*Psarocolius* spp.) (Ridgely & Tudor, 1994; Sick, 1997; Mobley, 2004a, 2004b, 2004d). Close to the nest (c. 100 m), there was an active colony (seven nests) of *Psarocolius decumanus* (Crested Oropendola), but we did not observe any Three-striped Flycatchers engaged in nesting activities there.

Sicalis citrina (Stripe-tailed Yellow-Finch)

The Stripe-tailed Yellow-Finch is a species with two main populations in South America: one north of Amazonia and the other south of this region (the North-South disjunction pattern of distribution proposed by Silva, 1995). This species has only been previously found on the borders of Amazonia (Ridgely & Tudor, 1989; Infonatura, 2009). The first record of this species in a central Amazonian savanna is of a male (MPEG 54434), collected by JMCS, MFV and D. C. Pimentel Neto, at Serra do Ererê on 16 January 1999. This bird was associated with a flock of several other individuals that were vocalizing and performing aerial displays, similar to those described from populations south of the Amazon (Vasconcelos *et al.*, 2007a). Small flocks of 2-5 birds were observed foraging on the ground, among clumps of grasses. Silva (1995) suggested that populations of this species might be able to disperse across Amazonia, since it has a tendency toward long-distance movements (Ridgely & Tudor, 1989; Sick, 1997).

CONSERVATION

Vegetation types in Monte Alegre have been severely degraded by human activities since the first colonizers arrived in the region, during the 17th century (Pastana, 1999). Savannas provided a good opportunity for cattle ranching (Pastana, 1999), probably because this open physiognomy (with native grasses) facilitated this activity, and it is possible that non-natural fires have occurred in this open vegetation type at least since the 18th century. To what extent fires caused faunal and floral impoverishment is unknown and it is possible that even the earliest naturalists that explored the region already found degraded savanna

Figure 3. Nest of the Three-striped Flycatcher (*Conopias trivirgatus berlepschi*). A: nest entrance in the top of a broken branch, c. 3 m above the ground (indicated by an arrow). B: cup-shaped nest inside the branch (external diameter: 4.7 cm). Photos: M. F. Vasconcelos, 1999.

vegetation in Monte Alegre. Fires continue to be set in the savannas, and the herb layer is extremely depauperate and sparsely vegetated in recently burnt areas.

Intensive logging in Monte Alegre started toward the end of the 18th century when the Royal Sawmill ("Serraria Real") exploited the timber for commercial purposes (Pastana, 1999). This logging activity and the cocoa plantation that followed during the first years of the 19th century were probably two early regional drivers of deforestation (Pastana, 1999). Logging activities continue in the region today, and the remnant fragments of forest are isolated and impoverished. It is possible that several forest bird species have disappeared from Monte Alegre; for example, a number of woodcreepers and antbirds of the Guianan area of endemism have not been observed despite our intense inventory (Appendix, see Cracraft, 1985; Cohn-Haft *et al*., 1997; Aleixo *et al*., 2011).

During our fieldwork, it was quite common to find traps and see people walking with shotguns, and we suspect that hunting and trapping activities are other strong human pressures on the native avifauna. For example, the only regional record for the Crested Bobwhite is based on two old specimens (see above). Furthermore, other researchers recently found several individuals of the Guianan endemic and threatened Sulfur-breasted Parakeet in captivity (A. C. Lees, N. Moura & B. J. W. Davis, personal communication).

An important area for bird conservation was recently identified in the 'várzeas' of Monte Alegre and adjacent regions, especially because it shelters restricted-range species such as *Myrmotherula klagesi* (Klages' Antwren) and *Cranioleuca muelleri* (Scaled Spinetail) (De Luca *et al*., 2009).

Fortunately, the Monte Alegre State Park was decreed in November 2001. This important 5,800 ha reserve protects significant tracts of savannas and forests (Pereira *et al*., 2003; Garcia *et al*., unpublished data 2008), and will hopefully protect the regional biodiversity in this unique area of Amazonia.

CONCLUSIONS

Although the avifaunal community of the Monte Alegre savannas is typical of other savanna habitats, we failed to record several open-country birds that occur in larger savanna areas located on the borders of Amazonia such as along the Atlantic coast or close to the 'cerrado' boundaries (southern Amazonian savannas). The isolated position and small area of the Monte Alegre savannas could explain their impoverished aspect in comparison to other, larger Amazonian savannas. Nevertheless, Monte Alegre savannas shelter the Guianan endemic Sulfur-breasted Parakeet, a vulnerable species in

Pará state (SECTAM, 2006). Furthermore, the high regional species richness associated with the mosaic of different vegetation types makes Monte Alegre a key area for avifaunal conservation in Brazilian Amazonia.

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APPENDIX. Birds recorded in the Monte Alegre region, Pará, Brazil. Evidence: s1 = specimen housed in MPEG; s2 = specimen housed in UFPE; s3 = specimen housed in MZUSP; s4 = specimen housed in MNRJ; s5 = specimen housed in AMNH; s6 = specimen housed in FMNH; p = photograph; t = tape-recording; when not documented records are presented as: o = observation (sight record) or v = record of vocalization (with or without observation). Habitat: C = 'campinarana'; F = flooded forest; L = open waterbodies (lakes and rivers); M = man-made, disturbed areas (pastures, agricultural fields, ranches and urban areas); S = savanna; T = 'terra firme' forest; V = 'campo de várzea'.

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Tinamiformes					
Tinamidae	Tinamous				
Crypturellus cinereus (Gmelin, 1789)	Cinereous Tinamou	s1	C, F, T	X	
Crypturellus soui (Hermann, 1783)	Little Tinamou	s1	C, T	X	X
Crypturellus undulatus (Temminck, 1815)	Undulated Tinamou	o, v	C, F, T, V		X
Crypturellus erythropus (Pelzeln, 1863)	Red-legged Tinamou	s1	C, T	X	
Anseriformes					
Anhimidae	Screamers				
Anhima cornuta (Linnaeus, 1766)	Horned Screamer	o	L		X
Anatidae	Ducks				
Dendrocygna autumnalis (Linnaeus, 1758)	Black-bellied Whistling-Duck	o	L		X
Cairina moschata (Linnaeus, 1758)	Muscovy Duck	o	L		X
Amazonetta brasiliensis (Gmelin, 1789)	Brazilian Teal	p	L		X
Galliformes					
Cracidae	Guans and Currassows				
Ortalis motmot (Linnaeus, 1766)	Little Chachalaca	s1	C, F, S, T	X	X
Aburria cumanensis (Jacquin, 1784)	Blue-throated Piping Guan	s1	F, T	X	
Odontophoridae	New World Quails				
Colinus cristatus (Linnaeus, 1766)	Crested Bobwhite	s1	S	X	
Podicipediformes					
Podicipedidae	Grebes				
Tachybaptus dominicus (Linnaeus, 1766)	Least Grebe	s1	L	X	
Pelecaniformes					
Phalacrocoracidae	Cormorants				
Phalacrocorax brasilianus (Gmelin, 1789)	Neotropic Cormorant	o	L		X
Ciconiiformes					
Ardeidae	Herons				
Tigrisoma lineatum (Boddaert, 1783)	Rufescent Tiger-Heron	s1	L	X	X
Agamia agami (Gmelin, 1789)	Agami Heron	s1	L	X	
Ixobrychus exilis (Gmelin, 1789)	Least Bittern	s1	L	X	
Nycticorax nycticorax (Linnaeus, 1758)	Black-crowned Night-Heron	o	L		X
Butorides striata (Linnaeus, 1758)	Striated Heron	s1	L	X	X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Bubulcus ibis (Linnaeus, 1758)	Cattle Egret	o	L, M		X
Ardea cocoi Linnaeus, 1766	Cocoi Heron	o	L		X
Ardea alba Linnaeus, 1758	Great Egret	o	L		X
Pilherodius pileatus (Boddaert, 1783)	Capped Heron	s1	L	X	
Egretta thula (Molina, 1782)	Snowy Egret	o	L		X
Threskiornithidae	Ibises and Spoonbills				
Mesembrinibis cayennensis (Gmelin, 1789)	Green Ibis	o	F, L		X
Theristicus caudatus (Boddaert, 1783)	Buff-necked Ibis	o, v	S, V		X
Cathartiformes					
Cathartidae	Vultures				
Cathartes aura (Linnaeus, 1758)	Turkey Vulture	o	C, F, L, M, S, T, V		X
Cathartes burrovianus Cassin, 1845	Lesser Yellow-headed Vulture	o	S, V		X
Coragyps atratus (Bechstein, 1793)	Black Vulture	o	C, F, L, M, S, T, V		X
Falconiformes					
Accipitridae	Hawks and Eagles				
Gampsonyx swainsonii Vigors, 1825	Pearl Kite	s1, s2	S	X	X
Rostrhamus sociabilis (Vieillot, 1817)	Snail Kite	o	L		X
Buteogallus urubitinga (Gmelin, 1788)	Great Black-Hawk	o	F, S, T, V		X
Busarellus nigricollis (Latham, 1790)	Black-collared Hawk	o	F, L, V		X
Rupornis magnirostris (Gmelin, 1788)	Roadside Hawk	s1	C, F, L, M, S, T, V	X	X
Buteo albicaudatus Vieillot, 1816	White-tailed Hawk	p	S		X
Buteo nitidus (Latham, 1790)	Gray Hawk	o	F, M, S, V		X
Spizaetus tyrannus (Wied, 1820)	Black Hawk-Eagle	o	F, T		X
Falconidae	Falcons and Caracaras				
Daptrius ater Vieillot, 1816	Black Caracara	s1	C, F, T	X	
Caracara plancus (Miller, 1777)	Southern Caracara	o	C, F, L, M, S, T, V		X
Milvago chimachima (Vieillot, 1816)	Yellow-headed Caracara	s2	C, F, L, M, S, T, V		X
Herpetotheres cachinnans (Linnaeus, 1758)	Laughing Falcon	o, v	C, M, S, T, V		X
Micrastur semitorquatus (Vieillot, 1817)	Collared Forest-Falcon	s1	F, T	X	X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Falco rufigularis Daudin, 1800	Bat Falcon	o	C, F, S, T		X
Gruiformes					
Aramidae	Limpkins				
Aramus guarauna (Linnaeus, 1766)	Limpkin	p	L		X
Rallidae	Rails				
Aramides cajanea (Statius Muller, 1776)	Gray-necked Wood-Rail	s2	F, L, V		X
Porphyrio flavirostris (Gmelin, 1789)	Azure Gallinule	s1	L	X	
Heliornithidae	Finfoots				
Heliornis fulica (Boddaert, 1783)	Sungrebe	s1, t	L	X	X
Eurypygidae	Sunbitterns				
Eurypyga helias (Pallas, 1781)	Sunbittern	s1	F, L, V	X	X
Charadriiformes					
Charadriidae	Plovers				
Vanellus chilensis (Molina, 1782)	Southern Lapwing	o, v	L, M, S, V		X
Recurvirostridae	Stilts				
Himantopus mexicanus (Statius Muller, 1776)	Black-necked Stilt	s1	L, V	X	
Scolopacidae	Sandpipers				
Gallinago paraguaiae (Vieillot, 1816)	South American Snipe	s1	L, V	X	
Actitis macularius (Linnaeus, 1766)	Spotted Sandpiper	o	L		X
Tringa solitaria Wilson, 1813	Solitary Sandpiper	s1	L	X	X
Jacanidae	Jacanas				
Jacana jacana (Linnaeus, 1766)	Wattled Jacana	o, v	L, V		X
Sternidae	Terns				
Phaetusa simplex (Gmelin, 1789)	Large-billed Tern	s1	L	X	X
Columbiformes					
Columbidae	Pigeons and Doves				
Columbina passerina (Linnaeus, 1758)	Common Ground-Dove	s1, s2	M, S, V	X	X
Columbina minuta (Linnaeus, 1766)	Plain-breasted Ground-Dove	s1, s2	M, S		X
Columbina talpacoti (Temminck, 1811)	Ruddy Ground-Dove	s1	M, S	X	
Claravis pretiosa (Ferrari-Perez, 1886)	Blue Ground-Dove	o, v	C, S, T		X
Columba livia Gmelin, 1789	Rock Dove	o	M		X
Patagioenas speciosa (Gmelin, 1789)	Scaled Pigeon	s1	C, F, T	X	X
Patagioenas cayennensis (Bonnaterre, 1792)	Pale-vented Pigeon	o	C, F, M, S, T, V		X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Zenaida auriculata (Des Murs, 1847)	Eared Dove	s1, s2	C, F, M, S, T, V	X	X
Leptotila verreauxi Bonaparte, 1855	White-tipped Dove	s1	C, F, M, S, T, V	X	X
Leptotila rufaxilla (Richard & Bernard, 1792)	Gray-fronted Dove	s2	F, T		X
Geotrygon montana (Linnaeus, 1758)	Ruddy Quail-Dove	o	C, T		X
Psittaciformes					
Psittacidae	Parrots				
Anodorhynchus hyacinthinus (Latham, 1790)	Hyacinth Macaw	s1	T, V	X	
Ara macao (Linnaeus, 1758)	Scarlet Macaw	o	F, T, V		X
Orthopsittaca manilata (Boddaert, 1783)	Red-bellied Macaw	s1	C, T, V	X	X
Primolius maracana (Vieillot, 1816)	Blue-winged Macaw	p, t	V		X
Aratinga maculata (Statius Muller, 1776)	Sulfur-breasted Parakeet	s1, s2, s3, s4, s5, s6, p, t	S	X	X
Aratinga aurea (Gmelin, 1788)	Peach-fronted Parakeet	s1, s2, t	C, S	X	X
Pyrrhura amazonum Hellmayr, 1906	Hellmayr's Parakeet	s1	T	X	
Forpus passerinus (Linnaeus, 1758)	Green-rumped Parrotlet	s1, s2	C, S	X	X
Brotogeris versicolurus (Statius Muller, 1776)	Canary-winged Parakeet	o, v	S, V		X
Brotogeris chrysoptera (Linnaeus, 1766)	Golden-winged Parakeet	s1	C, F, T	X	
Brotogeris sanctithomae (Statius Muller, 1776)	Tui Parakeet	s1	F, T	X	
Graydidascalus brachyurus (Kuhl, 1820)	Short-tailed Parrot	s1	F	X	
Pionus menstruus (Linnaeus, 1766)	Blue-headed Parrot	o, v	F, T		X
Amazona festiva (Linnaeus, 1758)	Festive Parrot	s1	F, V	X	
Amazona amazonica (Linnaeus, 1766)	Orange-winged Parrot	t	C, F, T, V		X
Cuculiformes					
Cuculidae	Cuckoos				
Coccycua minuta (Vieillot, 1817)	Little Cuckoo	s1, s2, t	C, F	X	X
Piaya cayana (Linnaeus, 1766)	Squirrel Cuckoo	s1, s2	C, F, S, T	X	X
Coccyzus melacoryphus Vieillot, 1817	Dark-billed Cuckoo	s1	C, F, S	X	
Crotophaga major Gmelin, 1788	Greater Ani	o, v	F, V		X
Crotophaga ani Linnaeus, 1758	Smooth-billed Ani	o, v	M, S, V		X
Tapera naevia (Linnaeus, 1766)	Striped Cuckoo	s1	C, F, S, V	X	X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Dromococcyx pavoninus Pelzeln, 1870	Pavonine Cuckoo	o, v	C, F, T		X
Strigiformes					
Strigidae	Owls				
Megascops choliba (Vieillot, 1817)	Tropical Screech-Owl	s2	C, F, S, T		X
Pulsatrix perspicillata (Latham, 1790)	Spectacled Owl	s1	F, T	X	
Asio stygius (Wagler, 1832)	Stygian Owl	o	C, F, S		X
Caprimulgiformes					
Nyctibiidae	Potoos				
Nyctibius grandis (Gmelin, 1789)	Great Potoo	s1	F, T	X	
Nyctibius griseus (Gmelin, 1789)	Common Potoo	s2	C, F, S, T		X
Caprimulgidae	Nightjars				
Chordeiles pusillus Gould, 1861	Least Nighthawk	s1, s2	S		X
Chordeiles acutipennis (Hermann, 1783)	Lesser Nighthawk	s1, s2	C, S	X	X
Nyctiprogne leucopyga (Spix, 1825)	Band-tailed Nighthawk	s1	F, L, V	X	
Nyctidromus albicollis (Gmelin, 1789)	Pauraque	s1	C, F, M, S, T, V	X	X
Caprimulgus rufus Boddaert, 1783	Rufous Nightjar	t	C, S		X
Hydropsalis climacocerca (Tschudi, 1844)	Ladder-tailed Nightjar	s1	F	X	
Hydropsalis torquata (Gmelin, 1789)	Scissor-tailed Nightjar	s1	C, S		X
Apodiformes					
Apodidae	Swifts				
Chaetura brachyura (Jardine, 1846)	Short-tailed Swift	o	C, F, L, M, S, T, V		X
Tachornis squamata (Cassin, 1853)	Fork-tailed Palm-Swift	s1	C, F, L, M, S, T, V	X	
Trochilidae	Hummingbirds				
Phaethornis rupurumii Boucard, 1892	Streak-throated Hermit	s1, s4, t	C, F, S, T	X	X
Phaethornis ruber (Linnaeus, 1758)	Reddish Hermit	s1	C, F, T		X
Eupetomena macroura (Gmelin, 1788)	Swallow-tailed Hummingbird	s1, s2	C, F, M, S, T, V	X	X
Anthracothorax viridigula (Boddaert, 1783)	Green-throated Mango	s1	F, V	X	X
Anthracothorax nigricollis (Vieillot, 1817)	Black-throated Mango	s1	C, F, S, T, V	X	
Avocettula recurvirostris (Swainson, 1822)	Fiery-tailed Awlbill	s1	C, T	X	
Lophornis ornatus (Boddaert, 1783)	Tufted Coquette	s1	F, T	X	
Chlorostilbon notatus (Reich, 1793)	Blue-chinned Sapphire	s1	C, F	X	
Thalurania furcata (Gmelin, 1788)	Fork-tailed Woodnymph	s1	C, F, T		X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Hylocharis sapphirina (Gmelin, 1788)	Rufous-throated Sapphire	s1	C, T	X	
Amazilia versicolor (Vieillot, 1818)	Versicolored Emerald	p	T, V		X
Amazilia fimbriata (Gmelin, 1788)	Glittering-throated Emerald	s1, s2	S, T	X	X
Trogoniformes					
Trogonidae	Trogons				
Trogon melanurus Swainson, 1838	Black-tailed Trogon	s1	C, F, T	X	
Trogon viridis Linnaeus, 1766	White-tailed Trogon	s1, s2, p	C, F, T	X	X
Coraciiformes					
Alcedinidae	Kingfishers				
Megaceryle torquata (Linnaeus, 1766)	Ringed Kingfisher	o	L		X
Chloroceryle amazona (Latham, 1790)	Amazon Kingfisher	s1	L	X	X
Chloroceryle aenea (Pallas, 1764)	American Pygmy Kingfisher	s1	F, L	X	
Chloroceryle americana (Gmelin, 1788)	Green Kingfisher	s1	L	X	X
Momotidae	Motmots				
Momotus momota (Linnaeus, 1766)	Blue-crowned Motmot	s1	F, T	X	X
Galbuliformes					
Galbulidae	Jacamars				
Brachygalba lugubris (Swainson, 1838)	Brown Jacamar	s1	C, T	X	X
Galbula ruficauda Cuvier, 1816	Rufous-tailed Jacamar	s1	F, T	X	
Galbula galbula (Linnaeus, 1766)	Green-tailed Jacamar	s1, s2, p	F, T	X	X
Bucconidae	Puffbirds				
Notharchus ordii (Cassin, 1851)	Brown-banded Puffbird	s1	T	X	
Notharchus tectus (Boddaert, 1783)	Pied Puffbird	s1, s2	T	X	X
Bucco tamatia Gmelin, 1788	Spotted Puffbird	s1, s2, p	F, T	X	X
Monasa nigrifrons (Spix, 1824)	Black-fronted Nunbird	s1	F, T	X	
Monasa morphoeus (Hahn & Küster, 1823)	White-fronted Nunbird	s1	T	X	
Chelidoptera tenebrosa (Pallas, 1782)	Swallow-wing	s1	C, F, S, T, V	X	X
Piciformes					
Ramphastidae	Toucans and Aracaris				
Ramphastos toco Statius Muller, 1776	Toco Toucan	s1	S, V	X	X
Ramphastos tucanus Linnaeus, 1758	Red-billed Toucan	o	T		X
Pteroglossus bitorquatus Vigors, 1826	Red-necked Aracari	s1	T	X	
Pteroglossus aracari (Linnaeus, 1758)	Black-necked Aracari	s1	F, T	X	X
Picidae	Woodpeckers				
Picumnus exilis (Lichtenstein, 1823)	Golden-spangled Piculet	s2	C, T		X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Picumnus cirratus Temminck, 1825	White-barred Piculet	s1, t	F, T	X	X
Melanerpes candidus (Otto, 1796)	White Woodpecker	s1	M, S, V	X	
Veniliornis cassini (Malherbe, 1862)	Golden-collared Woodpecker	s1	T	X	
Veniliornis passerinus (Linnaeus, 1766)	Little Woodpecker	s1, s2	C, F	X	X
Colaptes punctigula (Boddaert, 1783)	Spot-breasted Woodpecker	s1	F, T	X	
Colaptes campestris (Vieillot, 1818)	Campo Flicker	s1	S	X	X
Celeus flavescens (Gmelin, 1788)	Blond-crested Woodpecker	s1, t	C, T	X	X
Dryocopus lineatus (Linnaeus, 1766)	Lineated Woodpecker	o	C, F, S, T, V		X
Campephilus melanoleucos (Gmelin, 1788)	Crimson-crested Woodpecker	s1	C, F, S, T, V	X	X
Passeriformes					
Thamnophilidae	Typical Antbirds				
Taraba major (Vieillot, 1816)	Great Antshrike	s1	C, F	X	X
Sakesphorus luctuosus (Lichtenstein, 1823)	Glossy Antshrike	s1	F	X	X
Thamnophilus doliatus (Linnaeus, 1764)	Barred Antshrike	s1, s2	C, F	X	X
Thamnophilus nigrocinereus Sclater, 1855	Blackish-gray Antshrike	s1	F	X	
Thamnophilus punctatus (Shaw, 1809)	Northern Slaty-Antshrike	s1, t	C, T	X	X
Myrmotherula axillaris (Vieillot, 1817)	White-flanked Antwren	s1	C, F, T	X	X
Myrmotherula assimilis Pelzeln, 1868	Leaden Antwren	s1	F	X	
Formicivora grisea (Boddaert, 1783)	White-fringed Antwren	s1, s2, p	C, S	X	X
Formicivora rufa (Wied, 1831)	Rusty-backed Antwren	s1, p	S	X	X
Cercomacra tyrannina (Sclater, 1855)	Dusky Antbird	s1, t	C, T	X	X
Cercomacra laeta Todd, 1920	Willis' Antbird	s1	F, T		X
Myrmoborus lugubris (Cabanis, 1847)	Ash-breasted Antbird	s1	F	X	
Hypocnemoides melanopogon (Sclater, 1857)	Black-chinned Antbird	s1	F	X	
Sclateria naevia (Gmelin, 1788)	Silvered Antbird	v	F		X
Myrmeciza longipes (Swainson, 1825)	White-bellied Antbird	s1, s2, t	C	X	X
Formicariidae	Ground-antbirds				
Formicarius colma Boddaert, 1783	Rufous-capped Antthrush	s1	C, F, T	X	X
Formicarius analis (d'Orbigny & Lafresnaye, 1837)	Black-faced Antthrush	s1	T	X	
Dendrocolaptidae	Woodcreepers				
Dendrocincla fuliginosa (Vieillot, 1818)	Plain-brown Woodcreeper	s1, t	C, F, T		X
Nasica longirostris (Vieillot, 1818)	Long-billed Woodcreeper	s1	F	X	
Dendroplex picus (Gmelin, 1788)	Straight-billed Woodcreeper	s1, s2, p	C, F, S	X	X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Xiphorhynchus obsoletus (Lichtenstein, 1820)	Striped Woodcreeper	s1	C, F, T	X	
Xiphorhynchus guttatus (Lichtenstein, 1820)	Buff-throated Woodcreeper	s1, t	F, T	X	X
Lepidocolaptes angustirostris (Vieillot, 1818)	Narrow-billed Woodcreeper	s1	S	X	X
Campylorhamphus trochilirostris (Lichtenstein, 1820)	Red-billed Scythebill	s1	F, T	X	
Campylorhamphus procurvoides (Lafresnaye, 1850)	Curve-billed Scythebill	s1	T	X	
Furnariidae	Ovenbirds				
Furnarius figulus (Lichtenstein, 1823)	Wing-banded Hornero	s1	V	X	
Furnarius minor Pelzeln, 1858	Lesser Hornero	s1	V	X	
Synallaxis albescens Temminck, 1823	Pale-breasted Spinetail	s1, s2, t	S	X	X
Synallaxis rutilans Temminck, 1823	Ruddy Spinetail	s1	T	X	
Synallaxis gujanensis (Gmelin, 1789)	Plain-crowned Spinetail	s1	F	X	X
Cranioleuca vulpina (Pelzeln, 1856)	Rusty-backed Spinetail	s1, t	F	X	X
Cranioleuca muelleri (Hellmayr, 1911)	Scaled Spinetail	s1	F	X	
Certhiaxis cinnamomeus (Gmelin, 1788)	Yellow-chinned Spinetail	s1	L, V	X	X
Certhiaxis mustelinus (Sclater, 1874)	Red-and-white Spinetail	s1	L, V	X	
Berlepschia rikeri (Ridgway, 1886)	Point-tailed Palmcreeper	t	V		X
Xenops minutus (Sparrman, 1788)	Plain Xenops	t	F, T		X
Tyrannidae	Tyrant-flycatchers				
Lophotriccus galeatus (Boddaert, 1783)	Helmeted Pygmy-Tyrant	t	C, T		X
Poecilotriccus fumifrons (Hartlaub, 1853)	Smoky-fronted Tody-Flycatcher	s1	C, T		X
Todirostrum maculatum (Desmarest, 1806)	Spotted Tody-Flycatcher	s1	F, M	X	X
Todirostrum cinereum (Linnaeus, 1766)	Common Tody-Flycatcher	s1, s2	C, S	X	X
Tyrannulus elatus (Latham, 1790)	Yellow-crowned Tyrannulet	s1	C, F, T	X	X
Myiopagis gaimardii (d'Orbigny, 1839)	Forest Elaenia	o	C, F, T		X
Myiopagis flavivertex (Sclater, 1887)	Yellow-crowned Elaenia	s1	F	X	
Myiopagis viridicata (Vieillot, 1817)	Greenish Elaenia	o	C, T		X
Elaenia flavogaster (Thunberg, 1822)	Yellow-bellied Elaenia	s1, s2	S	X	X
Elaenia pelzelni Berlepsch, 1907	Brownish Elaenia	s1	F, V	X	
Elaenia cristata Pelzeln, 1868	Plain-crested Elaenia	s1, s2	S	X	X
Elaenia chiriquensis Lawrence, 1865	Lesser Elaenia	s1, s2, t	S		X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Camptostoma obsoletum (Temminck, 1824)	Southern Beardless-Tyrannulet	s1	C, M, S, V	X	X
Suiriri suiriri (Vieillot, 1818)	Suiriri Flycatcher	s1, s2, t	S	X	X
Phaeomyias murina (Spix, 1825)	Mouse-colored Tyrannulet	s1, s2	C, S	X	X
Sublegatus modestus (Wied, 1831)	Southern Scrub-Flycatcher	s1	S	X	X
Tolmomyias poliocephalus (Taczanowski, 1884)	Gray-crowned Flycatcher	o, v	F, T		X
Tolmomyias flaviventris (Wied, 1831)	Yellow-breasted Flycatcher	s1, s2	C	X	X
Cnemotriccus fuscatus (Wied, 1831)	Fuscous Flycatcher	s1, s2	C		X
Pyrocephalus rubinus (Boddaert, 1783)	Vermilion Flycatcher	s1	M, S, V	X	
Knipolegus poecilocercus (Pelzeln, 1868)	Amazonian Black-Tyrant	s1	F	X	
Xolmis velatus (Lichtenstein, 1823)	White-rumped Monjita	s1, s2	S	X	X
Fluvicola albiventer (Spix, 1825)	Black-backed Water-Tyrant	s1	L, V	X	
Arundinicola leucocephala (Linnaeus, 1764)	White-headed Marsh-Tyrant	s1	L, V	X	
Legatus leucophaius (Vieillot, 1818)	Piratic Flycatcher	s1, s2	C, F, M, T, V	X	X
Myiozetetes cayanensis (Linnaeus, 1766)	Rusty-margined Flycatcher	s2	V		X
Myiozetetes similis (Spix, 1825)	Social Flycatcher	s1	C, F, M, S, T, V	X	
Pitangus sulphuratus (Linnaeus, 1766)	Great Kiskadee	s1	C, F, M, S, T, V	X	X
Philohydor lictor (Lichtenstein, 1823)	Lesser Kiskadee	s1	L, V		X
Conopias trivirgatus (Wied, 1831)	Three-striped Flycatcher	s1, s2, p	C, F, S, T		X
Myiodynastes maculatus (Statius Muller, 1776)	Streaked Flycatcher	s1	C, F, M, S, T, V	X	X
Megarynchus pitangua (Linnaeus, 1766)	Boat-billed Flycatcher	s2, t	C, F, M, S, T, V		X
Tyrannopsis sulphurea (Spix, 1825)	Sulphury Flycatcher	p	V		X
Empidonomus varius (Vieillot, 1818)	Variegated Flycatcher	o	C, F, M, S, T, V		X
Tyrannus albogularis Burmeister, 1856	White-throated Kingbird	s1	C, F, M, S, T, V	X	
Tyrannus melancholicus Vieillot, 1819	Tropical Kingbird	o	C, F, M, S, T, V		X
Tyrannus savana Vieillot, 1808	Fork-tailed Flycatcher	s1, s2	S	X	X
Casiornis rufus (Vieillot, 1816)	Rufous Casiornis	s1	C, T	X	X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Casiornis fuscus Sclater & Salvin, 1873	Ash-throated Casiornis	s2	C, T		X
Myiarchus tuberculifer (d'Orbigny & Lafresnaye, 1837)	Dusky-capped Flycatcher	o, v	C, F, T		X
Myiarchus ferox (Gmelin, 1789)	Short-crested Flycatcher	s1, s2	C, F, M, S, T, V	X	X
Myiarchus tyrannulus (Statius Muller, 1776)	Brown-crested Flycatcher	s1, s2	C, S, T	X	X
Attila cinnamomeus (Gmelin, 1789)	Cinnamon Attila	s1	C, F, T	X	
Attila bolivianus Lafresnaye, 1848	Dull-capped Attila	s1	F	X	
Attila spadiceus (Gmelin, 1789)	Bright-rumped Attila	s1	T	X	
Cotingidae	Cotingas				
Gymnoderus foetidus (Linnaeus, 1758)	Bare-necked Fruitcrow	s1	F, T	X	
Perissocephalus tricolor (Statius Muller, 1776)	Capuchinbird	s1	T	X	
Pipridae	Manakins				
Neopelma pallescens (Lafresnaye, 1853)	Pale-bellied Tyrant-Manakin	s1, s2	C		X
Manacus manacus (Linnaeus, 1766)	White-bearded Manakin	s1, s2, p	C, T	X	X
Chiroxiphia pareola (Linnaeus, 1766)	Blue-backed Manakin	s1	C, T	X	X
Pipra aureola (Linnaeus, 1758)	Crimson-hooded Manakin	s1, s2, p, t	C, F, T	X	X
Pipra erythrocephala (Linnaeus, 1758)	Golden-headed Manakin	s1	C, T	X	
Tityridae	Tityras				
Schiffornis olivacea (Ridgway, 1906)	Olivaceus Schiffornis	o	C, T		X
Tityra cayana (Linnaeus, 1766)	Black-tailed Tityra	s1	C, F, T	X	
Tityra semifasciata (Spix, 1825)	Masked Tityra	s1	T	X	
Pachyramphus rufus (Boddaert, 1783)	Cinereous Becard	s1	F, T	X	
Pachyramphus castaneus (Jardine & Selby, 1827)	Chestnut-crowned Becard	s1	T	X	
Pachyramphus polychopterus (Vieillot, 1818)	White-winged Becard	s1	C, T	X	X
Vireonidae	Vireos				
Cyclarhis gujanensis (Gmelin, 1789)	Rufous-browed Peppershrike	s1, s2	C, F, S, T	X	X
Vireo olivaceus (Linnaeus, 1766)	Red-eyed Vireo	s1, s2	C, F, T	X	X
Hylophilus pectoralis Sclater, 1866	Ashy-headed Greenlet	s1, s2, p	C, F, S, T	X	X
Corvidae	Crows and Jays				
Cyanocorax cayanus (Linnaeus, 1766)	Cayenne Jay	t	C, T		X
Hirundinidae	Swallows				

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Progne tapera (Vieillot, 1817)	Brown-chested Martin	s1	F, L, M, S, V	X	
Progne chalybea (Gmelin, 1789)	Gray-breasted Martin	s1	F, L, M, S, V	X	
Tachycineta albiventer (Boddaert, 1783)	White-winged Swallow	s3, p	L, V		X
Riparia riparia (Linnaeus, 1758)	Bank Swallow	o	L		X
Hirundo rustica Linnaeus, 1758	Barn Swallow	p	L, M, S		X
Troglodytidae	Wrens				
Troglodytes musculus Naumann, 1823	Southern House-Wren	s1	M, S	X	X
Cantorchilus leucotis (Lafresnaye, 1845)	Buff-breasted Wren	s1, s2, p	F	X	X
Donacobiidae	Donacobius				
Donacobius atricapilla (Linnaeus, 1766)	Black-capped Donacobius	s1	L, V	X	
Polioptilidae	Gnatcatchers				
Polioptila plumbea (Gmelin, 1788)	Tropical Gnatcatcher	s1, s2	C, F, V	X	X
Turdidae	Thrushes				
Turdus nudigenis Lafresnaye, 1848	Bare-eyed Thrush	s1, s2, p, t	C, F, T		X
Turdus leucomelas Vieillot, 1818	Pale-breasted Thrush	s1, s2	C, F, M, S	X	X
Turdus fumigatus Lichtenstein, 1823	Cocoa Thrush	s1	F, T		X
Turdus ignobilis Sclater, 1858	Black-billed Thrush	s1	C, T	X	
Mimidae	Mockingbirds				
Mimus saturninus (Lichtenstein, 1823)	Chalk-browed Mockingbird	s1, s2	S	X	X
Coerebidae	Bananaquits				
Coereba flaveola (Linnaeus, 1758)	Bananaquit	s1, s2	C, F, M, S, T, V	X	X
Thraupidae	Tanagers				
Saltator maximus (Statius Muller, 1776)	Buff-throated Saltator	s1, s2	C, T	X	X
Saltator coerulescens Vieillot, 1817	Grayish Saltator	o	F, V		X
Schistochlamys melanopis (Latham, 1790)	Black-faced Tanager	o	S		X
Nemosia pileata (Boddaert, 1783)	Hooded Tanager	s1	C, F, S, V	X	X
Tachyphonus rufus (Boddaert, 1783)	White-lined Tanager	s2	C, S		X
Ramphocelus nigrogularis (Spix, 1825)	Masked Crimson Tanager	s1	F, V	X	
Ramphocelus carbo (Pallas, 1764)	Silver-beaked Tanager	s1, s2	C, F, M, T, V	X	X
Thraupis episcopus (Linnaeus, 1766)	Blue-gray Tanager	s2	C, F, M, S, T		X
Thraupis palmarum (Wied, 1823)	Palm Tanager	s1	C, F, M, S, T, V	X	X
Tangara mexicana (Linnaeus, 1766)	Turquoise Tanager	s1	C, F, T	X	
Tangara cayana (Linnaeus, 1766)	Burnished-buff Tanager	s1, s2	C, F, M, S, T, V	X	X

(Continued)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Dacnis cayana (Linnaeus, 1766)	Blue Dacnis	s1	C, F, M, S, T, V	X	X
Cyanerpes cyaneus (Linnaeus, 1766)	Red-legged Honeycreeper	s1	C, T	X	
Conirostrum speciosum (Temminck, 1824)	Chestnut-vented Conebill	s1	C, F, S, T	X	X
Conirostrum bicolor (Vieillot, 1809)	Bicolored Conebill	s1	F	X	
Emberizidae	Seedeaters				
Zonotrichia capensis (Statius Muller, 1776)	Rufous-collared Sparrow	s1, s2	M, S	X	X
Ammodramus humeralis (Bosc, 1792)	Grassland Sparrow	s1, s2	M, S	X	X
Sicalis citrina Pelzeln, 1870	Stripe-tailed Yellow-Finch	s1	S		X
Sicalis columbiana Cabanis, 1851	Orange-fronted Yellow-finch	s1	F, V	X	
Sicalis luteola (Sparrman, 1789)	Grassland Yellow-Finch	s1	M, S, V	X	
Volatinia jacarina (Linnaeus, 1766)	Blue-black Grassquit	v	M, S, V		X
Sporophila plumbea (Wied, 1830)	Plumbeous Seedeater	s1	S, V		X
Sporophila americana (Gmelin, 1789)	Wing-barred Seedeater	s1	M, V	X	
Sporophila lineola (Linnaeus, 1758)	Lined Seedeater	s1	M, V		X
Sporophila nigricollis (Vieillot, 1823)	Yellow-bellied Seedeater	s1, s2	M, S, V	X	X
Sporophila castaneiventris Cabanis, 1849	Chestnut-bellied Seedeater	s1	V	X	
Sporophila angolensis (Linnaeus, 1766)	Chestnut-bellied Seed-Finch	s1	S, V		X
Arremon taciturnus (Hermann, 1783)	Pectoral Sparrow	s1, s2	F, T		X
Paroaria gularis (Linnaeus, 1766)	Red-capped Cardinal	s1	F, V	X	X
Cardinalidae	Cardinals				
Piranga flava (Vieillot, 1822)	Hepatic-Tanager	s1	S	X	
Cyanoloxia cyanoides (Lafresnaye, 1847)	Blue-black Grosbeak	s1	F, T	X	X
Parulidae	New World Warblers				
Phaeothlypis mesoleuca (Sclater, 1866)	Riverside Warbler	s1	F, T		X
Icteridae	New World Blackbirds				
Psarocolius decumanus (Pallas, 1769)	Crested Oropendola	s1, s2	C, F, S, T	X	X
Procacicus solitarius (Vieillot, 1816)	Solitary Cacique	s1	V	X	
Cacicus cela (Linnaeus, 1758)	Yellow-rumped Cacique	s1, t	C, F, S, T, V	X	X
Icterus croconotus (Wagler, 1829)	Orange-backed Troupial	s1	V	X	
Gymnomystax mexicanus (Linnaeus, 1766)	Oriole Blackbird	s1, t	V	X	X
Chrysomus icterocephalus (Linnaeus, 1766)	Yellow-hooded Blackbird	s1	V	X	
Molothrus oryzivorus (Gmelin, 1788)	Giant Cowbird	s1	M, V	X	
Molothrus bonariensis (Gmelin, 1789)	Shiny Cowbird	s1	M, S, V	X	

(Conclusion)

Order/Family/Species	English name	Evidence	Habitat	Previous fieldworkers	Present study
Sturnella militaris (Linnaeus, 1758)	Red-breasted Blackbird	s1	M, S, V	X	X
Fringillidae	Finches				
Euphonia chlorotica (Linnaeus, 1766)	Purple-throated Euphonia	s1, s2	C, F, M, S, T, V	X	X
Euphonia violacea (Linnaeus, 1758)	Violaceous Euphonia	o, v	F, S		X
Passeridae	Old World Sparrows				
Passer domesticus (Linnaeus, 1758)	House Sparrow	o	M		X