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The avifauna of the Brazilian state of Roraima: bird distribution and biogeography in the Rio Branco basin

Luciano Nicolás Naka[1,4,5], **Mario Cohn-Haft**[1], **Francisco Mallet-Rodrigues**[2], **Marcos Pérsio Dantas Santos**[3], **and Marcela de Fátima Torres**[1]

[1] Instituto Nacional de Pesquisas da Amazônia (INPA), Coleções Zoológicas e Coordenação de Pesquisas em Ecologia, C.P. 478 (69011-970), Manaus, Amazonas, Brazil.

[2] Laboratório de Ornitologia, Departamento de Zoologia, Instituto de Biologia, UFRJ (21941-590), Rio de Janeiro, Rio de Janeiro, Brazil.

[3] Universidade Federal do Piauí, Departamento de Biologia. (64049-550), Teresina, Piauí, Brazil.

[4] Current Address: Museum of Natural Science, 119 Foster Hall, Louisiana State University, Baton Rouge, LA 70803, USA.

[5] Corresponding author: Luciano Nicolas Naka, e-mail: lnaka1@lsu.edu

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RESUMO. **A Avifauna do Estado de Roraima: distribuição e biogeografia na bacia do Rio Branco**. O Estado de Roraima representa uma importante unidade biogeográfica, que inclui toda a bacia do Rio Branco, um dos principais rios Amazônicos. Roraima é uma área de alta diversidade, onde florestas de terra firme, florestas alagadas, campinas, savanas, bosques secos e em galeria, e vegetação associada com os tepuis ocorrem em uma área relativamente pequena para padrões Amazônicos (225.000 km^2). Neste trabalho, apresentamos a primeira compilação em quarenta anos, das 741 espécies de aves registradas para o Estado de Roraima, 38 das quais representam as primeiras menções para a região. Os dados foram compilados a partir de informações obtidas durante nossas expedicões de campo (512 espécies), complementadas por informacões obtidas de material de museu e da literatura. Apresentamos uma lista com 15 espécies citadas para Roraima no passado, que não consideramos como registros válidos e achamos que sua presença em Roraima ainda deve ser confirmada, e uma outra lista com 69 espécies que acreditamos venham ser registradas em Roraima no futuro. Apresentamos também detalhes de alguns dos nossos registros de maior interesse, incluíndo o primeiro espécime para o Brasil de *Atalotriccus pilaris*, e a segunda localidade para o Brasil de *Myrmeciza disjuncta*. Uma análise dos padrões de distribuição da avifauna, em relação aos diferentes ambientes, revelou que a heterogeneidade ambiental (diversidade beta) é responsável por 60% da diversidade de Roraima, enquanto que o endemismo regional (diversidade gamma) responde por quase um terço das espécies de aves exclusivas de florestas de terra firme. Apresentamos também uma análise dos padrões biogeográficos das aves em Roraima, em relação aos diferente hábitats. E finalmente, discutimos os problemas de conservação desta região que encontra-se ameaçada pela crescente expansão de monoculturas (soja, acácias, arroz) principalmente nas áreas de savanas, florestas de galeria, e bosques secos, onde habitam algumas das espécies de aves endêmicas e mais ameaçadas da região.

PALAVRAS-CHAVE: Amazônia, Roraima, Rio Branco, avifauna, distribuição, biogeografia.

ABSTRACT. The Brazilian state of Roraima represents a meaningful biogeographical unit, enclosing the entire basin of the Rio Branco, a major river in the Amazon basin. Roraima is also an area of high habitat diversity where *terra firme* forest, seasonally flooded forest, white-sand forest, savanna, gallery and dry forest, and the vegetation associated with the tepuis, all occur within a relatively small area (225,000km^2) by Amazonian standards. We provide the first comprehensive compilation of the avifauna of the state in forty years. We integrated the results of our own field work, where we recorded 512 bird species, with data gathered from museum specimens and from published sources. We present a list of 741 bird species for the state of Roraima, 38 of which are mentioned for the first time for the state. We also provide a list of 15 species previously cited for Roraima that we consider hypothetical, and predict the presence of another 69 species that we consider likely to be recorded in the state with further field work. We also present details on some of our most interesting records, which include the first Brazilian specimen of *Atalotriccus pilaris*, and the second locality for Brazil of *Myrmeciza disjuncta*. We conclude that habitat heterogeneity (beta-diversity) is responsible for 60% of the avian diversity of Roraima, whereas regional endemism (gamma-diversity) accounts for about one third of the bird species occurring exclusively in *terra firme* forests. We analyze the biogeographical patterns of avian distributions within the state, in relation to the different habitats present in Roraima, and discuss some of the main conservation problems in the state of Roraima, driven by the expansion of monocultures such as soybean, acacia, and rice plantations which are putting at risk large expanses of savannas, wetlands, dry and gallery forests.

KEY WORDS: Amazonia, Roraima, Rio Branco, avifauna, distribution, biogeography.

At the northern edge of Amazonia, the Brazilian state of Roraima represents one of the most heterogeneous regions in the Neotropics. Distinct habitats, including *terra firme* forest, seasonally flooded forest (*várzea* and *igapó*), white-sand forest (*campina* and *campinarana*), savanna, gallery and dry forest, and various types of montane forests, all occur in an area roughly the size of the United Kingdom, relatively small by Amazonian standards. Avian diversity in Roraima reflects this high habitat heterogeneity, as each major habitat contributes with unique species. Regional diversity is also increased by the fact that different areas within Roraima are, to varying degrees, biogeographically distinct; at least three proposed areas of endemism extend into the state (Cracraft 1985).

Unlike most political units, the state of Roraima represents

a meaningful biogeographical unit, enclosing the entire basin of the Rio Branco, the most important tributary of the Rio Negro, which itself is the second largest tributary of the Amazon River (Goulding *et al.* 2003). The Rio Branco basin is unique in Amazonia because its main river, the Rio Branco, is a white-water river surrounded by black-water rivers, which differ in the amount of sediments, type of vegetation, and the structure of the plant community (Worbes 1997). These differences between the two should also influence the abundance and composition of the bird species that inhabit each type of river. Therefore, a study of the avifauna of Roraima not only sheds light on one of the least-studied areas of Brazilian Amazonia (Oren and Albuquerque 1991), but can also improve our understanding of Amazonian avian biogeography, generating insights on ecological and geographical patterns.

Until the mid-20th century, most of the ornithological material available for Roraima was that obtained by Johann Natterer in the early 1800s. During the second half of the 20th century, several ornithologists visited or analyzed bird specimens from the state, but these studies concentrated on a few areas, including savannas and forests near Boa Vista, the upper Rio Branco, a handful of tepuis on the Brazilian-Venezuelan border, and the Maracá Ecological Station (see History of ornithological studies in Roraima, below). Entire ecosystems and biogeographic areas remained virtually unexplored until now.

In 2001, three of us (LNN, MCH, and MFT) initiated a study of the avifauna of Roraima and made five field trips to the state. We explored poorly sampled habitats and previously neglected biogeographical areas, such as the seasonally flooded forest (*várzea* and *igapó*) along the lower Rio Branco and some of its tributaries, the white-sand forest (*campina* and *campinarana*) in central Roraima, and the *terra firme* forest east of the Rio Branco. We integrated our results with data obtained independently by MPDS, and with data from previous workers available from published sources and museums (data compiled by FMR).

In this paper, we provide a brief history of ornithological research in Roraima, present our field records, including 38 bird species recorded for the first time in Roraima, and provide the first comprehensive compilation of the avifauna of the state since Pinto (1966). We also make predictions on the species likely to be recorded in the state with further field work and describe the broad patterns of avian distributions within the Rio Branco basin in relation to the different habitats, discussing the implications of these patterns in a biogeographical perspective and giving special attention to the role of the Rio Branco as a biogeographical barrier.

HISTORY OF ORNITHOLOGICAL STUDIES IN RORAIMA

The study of the avifauna of Roraima began with the explorations of Natterer almost two centuries ago. Since then, a number of ornithologists have visited the region, mostly during the last 50 years, defining important periods of high productivity in terms of accumulation of ornithological data, and periods of relative stagnation (Figure 1).

The first naturalist to visit the Rio Branco basin appears to have been Alexandre Rodrigues Ferreira, a Brazilian explorer sent by the Portuguese crown in 1786 to investigate

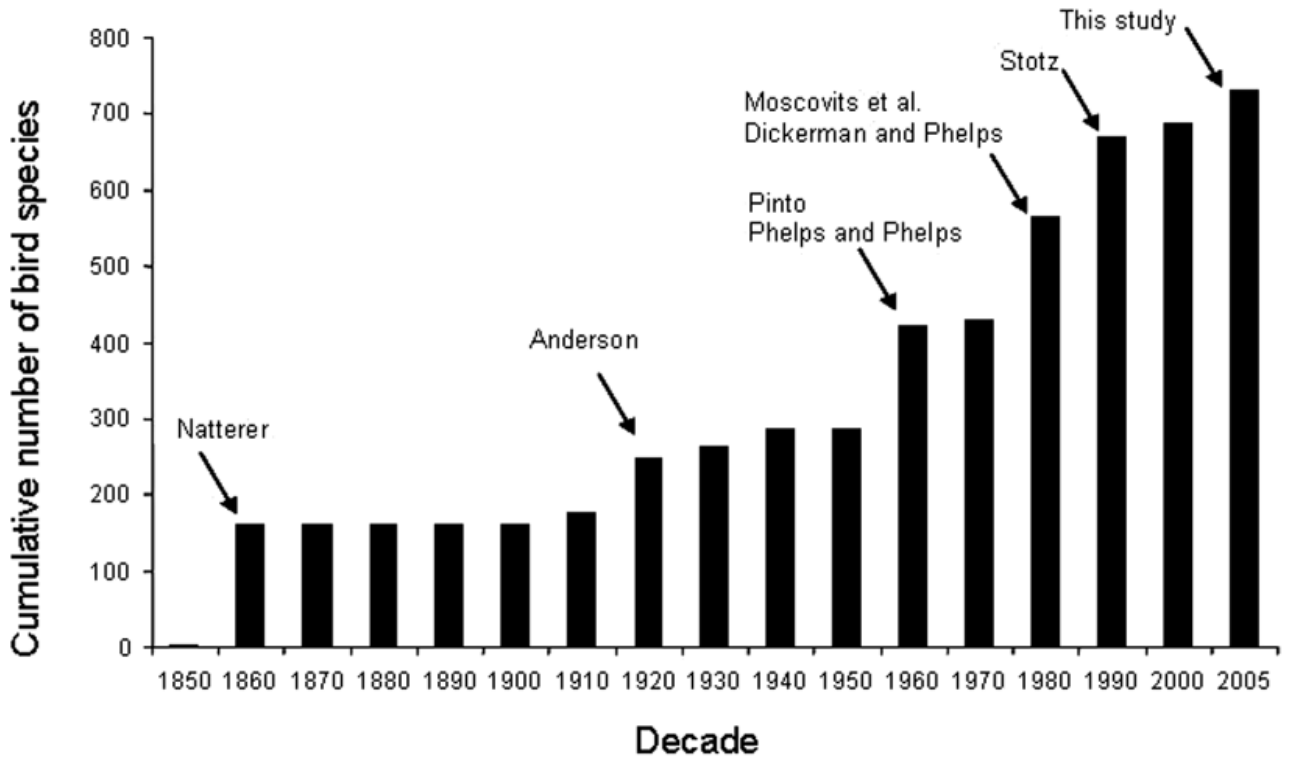

Figure 1. Cumulative number of bird species known from Roraima since the first related publication in 1850. Decades represent time of publication of lists of specimens or field records. Arrows indicate the explorers or ornithologists responsible for most of the additions during that decade.

the economic potential of the region (Barbosa and Ferreira 1997). Ferreira sailed the Rio Branco and some of its tributaries, collecting plants and animals. These valuable specimens were taken from Portugal by Saint-Hilaire in 1808 during the Napoleonic invasions and were purportedly deposited in the Paris Museum (Pinto 1966), but none of the material is present in Paris today.

Specimens taken by Natterer, who navigated the Rio Branco during 10 months in 1831-1832, formed the basis of study of the avifauna of Roraima for many years. Natterer explored the upper Rio Branco and some tributaries, and its associated savannas and forests, where he collected 157 bird species, held at the Naturhistoriches Museum of Vienna (Pelzeln 1956, 1859, 1861, 1862, 1863, 1868-1871).

The ornithologist Newton Dexter, a member of an expedition funded by Nathaniel Thayer from Harvard University, visited the Rio Branco and the Rio Negro in 1865 and 1866 (Barbosa and Ferreira 1997). Unfortunately, the material collected by Dexter (held at the Museum of Comparative Zoology in Cambridge) is of little use, as specimens lack precise locality data.

In 1912, M. P. Anderson visited Roraima, where he explored the savannas around Boa Vista and the forests of Serra da Lua, Serra Grande, and Conceição, collecting over 500 specimens of almost 200 bird species, presently held at the Field Museum of Natural History (FMNH) and analyzed by Cory (1918, 1919, 1920), Cory and Hellmayr (1924, 1925, 1927), Hellmayr (1929, 1934, 1935, 1936, 1937, 1938), and Hellmayr and Conover (1942, 1948a, 1948b, 1949). A decade later, George C. Shattuck published the results of the 1924-1925 Hamilton Rice expedition, where he made brief comments on the avifauna encountered during the trip, which included the villages of Boa Esperança and Vista Alegre along the Uraricoera River (Shattuck 1926).

In 1927, an expedition led by George H. Tate, sponsored by the American Museum of Natural History (AMNH), and another one led by General Mariano Rondon (supported by the Brazilian government), independently explored the surroundings of Mt. Roraima, collecting a small number of bird specimens from the savannas of northeastern Roraima. Much of the material collected by the AMNH expedition was included in studies by Zimmer (1933, 1936, 1937a, 1937b, 1938, 1939a, 1939b, 1940, 1941a, 1941b, 1941c, 1942a, 1942b, 1943a, 1943b, 1944), whereas the material from the Brazilian expedition (held at the Museu Nacional [MNRJ]) was listed by Miranda-Ribeiro (1929).

In January 1939, Albert Pinkus, a professional collector from New York, and P.S. Peberdy from the Museum de Georgetown, Guyana, made an expedition to Mt. Roraima. Although most of the trip was devoted to Guyana, the explorers spent a few days in Brazil, reaching the valley of the Rio Cotingo (Barbosa and Ferreira 1997), obtaining an important bird collection, most of which was deposited at the Museum of Georgetown. Part of this collection was later purchased by the Phelps Collection of Venezuela, where more than 140 specimens collected in Brazil are held.

During the following years, most of the attention given to Roraima came from Venezuela, mostly from explorers interested in the endemic avifauna associated with the tepuis. Félix Cardona, a Venezuelan Captain, explored the Brazilian-Venezuelan border, collecting several bird species, four of which were new to Brazil (Phelps and Phelps 1948). William H. Phelps and William H. Phelps, Jr. (1962) surveyed another Brazilian tepui, Cerro Uei-Tepui, adding 49 new species to Roraima and Brazil. The study of the tepuis cotinued by José Hidasi, who visited Serra Parima in 1962, collecting almost 30 bird species (Novaes 1965). However, with a later revision of the international limits of Brazil and Venezuela, the locality sampled by Hidasi (Posto Parima B) was confirmed to be in Venezuela. Two decades later, Robert Dickerman and William H. Phelps, Jr. (1982), made an expedition to Cerro Urutani, collecting 35 bird species, many of which were new to Roraima. This was the last ornithological expedition to any tepui in Roraima, and we believe that several other species are likely to be recorded in the tepuis with further field work (see Discussion).

In 1959, the Museu Paraense Emílio Goeldi (MPEG) organized an ornithological expedition to the Rio Mucajaí and to Boa Vista, led by C. Carvalho and M. Amaral. However, it wasn't until 1966 that a comprehensive study of the avifauna of Roraima was published, improved significantly by an expedition sponsored by the Instituto Nacional de Pesquisas da Amazônia (INPA) and the Museu de Zoologia da Universidade de São Paulo (MZUSP) to the Rio Mucajaí. During this expedition in 1962, Olivério Pinto collected more than 250 bird species (held at the MZUSP), and he later compiled the ornithological knowledge available until then on the avifauna of Roraima (Pinto 1966).

Emílio Dente, a professional collector who came to Roraima to join Pinto, decided to stay in Roraima after that trip and collected more material from the Rio Mucajaí. Dente obtained over 1200 specimens, most of which are held at the Natural History Museum of Los Angeles County (LACMNH), but also in at least seven other institutions, including the MPEG, MZUSP, the FMNH; the Museum of Comparative Zoology Harvard (MCZ); the Smithsonian National Museum of Natural History (USNM); the Academy of Natural Sciences (ANSP); and the University of Michigan Museum of Zoology (UMMZ).

During the 1980s and 1990s, more intensive fieldwork, including tape recording of vocalizations, behavioral observations, and use of newly available field guides as identification aids, was initiated at a few sites. In particular, the island of Maracá was the center of intensive studies (Moskovits *et al.* 1985, Silva and Oren 1990, Stotz 1997, Silva 1998), but other areas were also explored along an improved network of roads (Borges 1994, Forrester 1995, Zimmer *et al.* 1997).

Of special importance was the work of D. Stotz, who covered a range of habitats in northern Roraima. In 1987, he visited Maracá, Pacaraima, Apiaú, and the upper Rio Branco, collecting nearly 150 bird species, held at the FMNH and MZUSP (Stotz 1997). In 1992, he explored areas around Bonfim and Cantá, collecting over 350 bird specimens, held at the FMNH.

Figure 2. Map of the state of Roraima showing surrounding areas, major villages and towns, most important rivers, and study localities. Gray represents neighboring countries, light gray other Brazilian states. Numbers represent the following localities: 1= Conceição do Maú, 2= Serra da Onça, 3= Serra da Malacacheta, 4= Serra do Tracajá, 5= Serra Grande, 6= Vila União, 7= Caracaraí Ecological Station, 8= Viruá National Park, 9= Niquiá Ecological Station, 10= islands of Carneiro, 11= island of Inajatuba, 12= São Luiz, 13= São João da Baliza, 14= Caroebe, 15= Samaúma, 16= island of Cota, 17= Remanso, 18= Floresta. Map based on data from Ministério do Meio Ambiente (2001).

In the mid 1990s Fernando Pacheco (1995a) made a brief visit to the mouth of the Rio Branco, adding the first published bird records from the lower section of the river. Finally, in the 21st century, Trolle and Walther (2004) made observations along the Rio Jauaperí, and one of us (MPDS) made intensive collections near Caracaraí, Alto Alegre, and Boa Vista, obtaining almost 500 specimens (held at the MPEG), some of which represented the first records for the state (Santos 2004). Our field work began in 2001, and is presented in the following sections.

STUDY AREA AND METHODS

The state of Roraima

The Brazilian state of Roraima, with an area of 225,116 km^2, is located in northwestern Brazil, flanked by Guyana to the east, and Venezuela to the north and west, enclosing the entire basin of the Rio Branco (Figure 2). Geologically, Roraima lies on the ancient soils of the Guianan Shield, and most areas within the state are relatively flat and low, especially in central and southern Roraima, where low-lying depositional areas form the Rio Branco floodplains (Eden and McGregor 1998). In northern and western Roraima, elevated terrain, ranging from 1000 to almost 3000 m at Mt. Roraima, forms the divide between the Orinoco and Amazon basins. Northeastern Roraima is covered by large expanses of flat savannas, regularly broken by the presence of rocky outcrops known as 'inselbergs', such as Serra da Lua, Serra de Mucajaí, and Serra Grande, which reach up to a 1000 m in elevation (Ab'Saber 1997).

The climate of lowland Roraima is warm (with annual mean temperatures of 26-27ºC) but varies considerably at higher elevations (Eden and McGregor 1998). As a general rule, annual rainfall increases from the northeast (1,100-1,400 mm/year) to the southwest, where rainfall is more abundant (2,000-2,300 mm/year) and less seasonal (Barbosa 1997) (Figure 3).

Roraima can be divided in two main ecological domains: the savanna/dry forest domain and the humid forest or Amazonian domain; these are separated approximately at the 1700 mm/yr rainfall isocline, where there is a broad belt of transition between the two (Figure 3). As a general rule, savannas occur in areas with annual rainfall below 1700 mm, usually concentrated during a period of 100-130 days (Barbosa 1997). Within the savannas, some areas are covered by dry and gallery forests, whereas poorly drained areas support stands of Moriche palms (*Mauritia flexuosa*), locally known as *buritizais*. Humid forests generally occur in areas with more than 2,000 mm/year, but include open vegetation areas known as *campinas* on sandy soils (see Habitats).

Habitats

Terra firme forest. Dominant habitat type in Amazonia. In contrast to flooded forests, *terra firme* or upland forests, never flood and generally occur at low elevations (below 600 m), in association with latosols and red-yellow podzols, well drained and poor in nutrients (Pires and Prance 1985). *Terra firme* forests are rich in plant species and have high tree biomass; the canopy reaches 20-25 m, with emergent trees of 35-40 m. There is considerable variation in plant species richness described, with forests at Maracá, northern Roraima, being less diverse than similar habitats elsewhere in Amazonia (Nascimento 1997). However, plant species richness in other forested areas within Roraima has not been studied in detail. On and around rocky outcrops within the range of *terra firme* forest in southern and central Roraima (such as near Vila União), the vegetation resembles that of the dry forests further north, containing large cacti and bromeliads and lower-stature forest within a mosaic of more typical tall, moist forest away from rocks.

Várzea. Typical flooded forest and other successional habitats occurring along rivers and their floodplains in Amazonia. *Várzeas* are seasonally flooded by "white-water" rivers, which are rich in suspended sediments and have a muddy appearance (Prance 1979, Goulding *et al.* 2003). Within Roraima, *várzeas* are associated exclusively with the lower Rio Branco (Figure 3). The sediments carried by the river supply enough nutrients to support large trees and a well-developed canopy, reaching 20-25 m; the understory is generally open and poorly developed. On white-water river islands, tree species diversity and complexity of vertical structure increase progressively through time (Robinson and Terborgh 1997), creating a se-

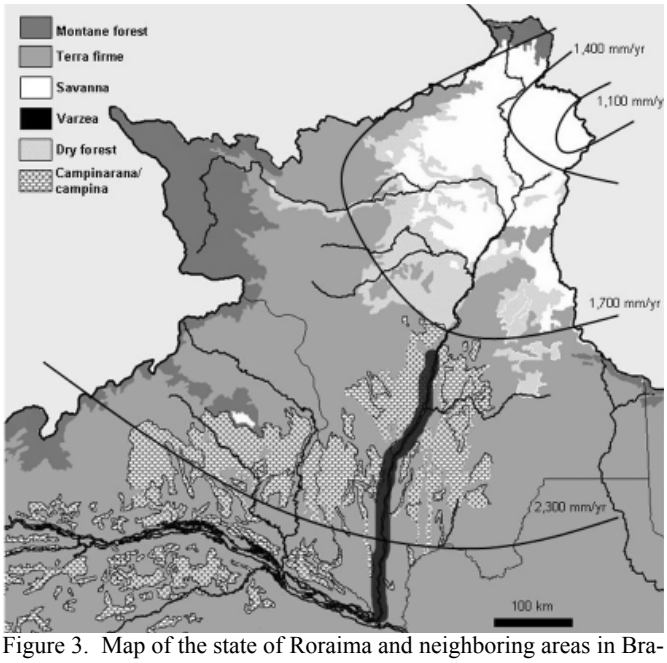

Figure 3. Map of the state of Roraima and neighboring areas in Brazil, with main habitats and rainfall isoclines. Map and distribution of habitats based on data from Ministério do Meio Ambiente (2001); rainfall isoclines taken from Barbosa (1997).

ries of successional stages that range from grassy sandbars to river-edge forest (dominated by *Cecropia*), to mature *várzea* forest, which has the highest number of tree species (Remsen and Parker 1985).

Igapó. Term generally applied to forests seasonally flooded by "black-water" and nutrient-poor rivers (Prance 1979). These rivers have high acidity, low sediment loads and drain areas of lowland forest or campinas (see below). We distinguish two types of *igapó*: tall, which resembles mature *várzea* forest, and low, sometimes referred to as *chavascal*, which has a dense growth of relatively thin trunks and a much more uniform canopy height, with physiognomy and floristic composition resembling those of *campinarana* (Anderson 1981). Low *igapó* is associated to sandy soils and has fewer tree species than tall *igapó* or *várzea* forests. In Roraima, *igapó* is associated with most tributaries of the lower Rio Branco, such as the Catrimani, Água Boa do Univini, Ajarani, Anauá, and Jauaperí rivers (the latter being a tributary of the Rio Negro).

Campina and campinarana. These habitats, also known as white-sand savanna and white-sand forest, respectively, develop in climates suitable for forests, but are associated with podzolized and oligotrophic quartzitic soils of extremely low nutrient content (Anderson 1981). They occur in areas with seasonally variable edaphic conditions, caused either by soil flooding as a result of water table rise during the rainy season, or by extreme dry soil conditions caused by the porosity of the sand (Pires and Prance 1985, Huber 1995). These habitats occur in low-lying areas in central Roraima, and extend further west towards the upper Rio Negro (Figure 3). The canopy of the *campinarana* is generally uniform and continuous, reaching 20-25 m in height (most often 10-15 m), having a distinctive physiognomy composed by shrubs and small trees, dwarf and rachitic in aspect, with reduced foliage volume, small crowns, and thin and twisted branches (Anderson 1981). The floor is often covered by bromeliads, epiphytes, and lichens, whereas mosses are common on trunks and branches. *Campinas* are shrubbier and lower in stature (4-5 m) than *campinaranas* and often contain open areas dominated by sedges (Cyperaceae) and can be devoid of woody vegetation. Despite their relatively low plant species diversity, *campinas* and *campinaranas* have a highly specialized plant community that includes several endemic taxa (Pires and Prance 1985).

Savannas. The savannas of Roraima are part of the "Rio Branco-Rupununi" formation, shared by Brazil and Guyana, covering over 50,000 km^2, and representing the largest continuous Amazonian savanna (Barbosa *et al.* 2005). Locally known as *lavrados*, the savannas of northeastern Roraima occur on well-drained soils and where rainfall is seasonal (concentrated between May and August) and less abundant (below 1,700 mm/year). These savannas are not uniform and include several vegetation types (Eden and McGregor 1998, Barbosa and Miranda 2005), being flatter to the south and more hilly to the north, where the landscape is covered by volcanic rocks (Pires and Prance 1985). Savannas are xerophytic formations dominated by herbaceous plants and scattered low trees of only a few fire-resistant species, such as *Curatella americana* and *Byrsonima crassifolia*. The main plant families in terms of number of species are Poaceae, Fabaceae, Cyperaceae, Rubiaceae, Caesalpinaceae, Melastomataceae, and Polygalaceae (Miranda and Absy 1997). Although the savannas of Roraima resemble the *cerrados* of central Brazil, they differ in their floristic composition (Ratter and Dargie 1992), being more closely related to the vegetation of the Gran Sabana in Venezuela (Berry *et al.* 1995). Within the savannas, poorly drained areas support stands of Moriche palms and grassy wetlands, whereas humid areas on better-drained and seasonally drier soils support gallery and dry forests (see below).

Gallery forests. Riparian woodlands associated with rivers flowing through the savannas of northeastern Roraima, such as the Surumu, Cotingo, Uraricoera, Tacutu, and the upper Rio Branco itself. Gallery forests usually cover a narrow (ca. 50 m wide) band along the margins of watercourses, tending to be low in stature (canopy reaching 10-15 m) and choked with vines. These periodically flooded forests differ from *várzea* and *igapó* of the humid Amazonian forest domain in that gallery forests flood for shorter periods and with less predictable seasonality.

Dry forests. Semi-deciduous forests that occur within the savannas domain in areas with higher humidity conditions. They are particularly common at the edges of Amazonia, where precipitation seasonality causes many trees to lose their leaves (Pires and Prance 1985). In Roraima, dry forests are patchily distributed (Silva 1997), occurring mainly around rocky outcrops along the transition between savanna and *terra firme* domains, but also on hills in *Curatella*-dominated savannas. Dry forests are physiognomically similar to gallery forests but are not necessarily linked to rivers.

Sub-montane and montane humid forests. Areas above

600 m in western Roraima are mostly covered by these habitats. As a general rule, areas above 1000 m can be considered montane, and are concentrated where Roraima borders Venezuela and Guyana (Figure 3). In these regions the landscape is dominated by steep and mountainous terrain, ranging from 600 to 2810 m on Mt. Roraima. Tepuis are spectacular, isolated, flat-topped mountains with humid and densely forested slopes and vertical sandstone cliffs that rise over the lowlands, with a particularly rich and endemic flora (Berry *et al.* 1995). Small treelets and bushes usually cover the plateaus, surrounded by large barren areas.

Areas of endemism for birds in Roraima

Many bird taxa in the Neotropics (species or subspecies) share well-defined and congruent distributions (Haffer 1969, 1974; Muller 1973). This spatial congruence was used to define centers of dispersal (Haffer 1969, 1974) or areas of endemism (Cracraft 1985), seven of which are located in the Amazon. These areas are generally delimited by major Amazonian rivers, such as the Amazon, Negro, Madeira, and Tapajós rivers. The state of Roraima lies at the confluence of three such areas: Guianan, Imeri, and Pantepui. The Guianan area of endemism roughly includes the lowland tropical forests of Guyana, Surinam, French Guiana, the state of Bolivar in Venezuela, and Brazilian Amazonia north of the Amazon River and east of the Rio Negro (Cracraft 1985). Although its western limit was defined by the Rio Branco by Cracraft (1985), this boundary is not explicit and is rather ambiguous, because many contact zones of birds are located between the Rio Negro and the Rio Branco valleys (Haffer 1974). The Imeri area of endemism is located in the vicinity of the Brazilian, Colombian, and Venezuelan borders, including Guainía and Vaupés in Colombia, the upper Rio Negro in Brazil, and the state of Amazonas in Venezuela (Cracraft 1985). Its endemic species and limits have been subject to criticism, mostly because several of the species that define this area are taxa with poorly known distributions, and in many cases have proven to represent habitat specialists rather than geographic endemics (Borges *et al*. 2001). The third area of endemism, which is characterized by birds associated with the tepuis, includes the Gran Sabana and Duida Subcenters, both of which have elements present in the mountains of northern Roraima. Additionally, several bird species from western Amazonia (generally absent from the core of the Guianan Shield) are present in western Roraima and their easternmost distributions seem to coincide with the Rio Branco (see Discussion).

Field work

During our expeditions to Roraima we conducted bird surveys in the early morning (0500-1200), late afternoon (1500-1830) and, sporadically, at night, using binoculars and tape-recorders. We explored most areas using roads, which we traveled by foot or car. In forested areas we generally used trails; to access river-created habitats (*várzea, igapó*, and gallery forests) we walked along the margins in times of low water, and used speed boats when these habitats were flooded. During the two expeditions in which MCH participated, he collected specimens, which are housed at the INPA Bird Collection in Manaus. MPDS also did extensive collecting in Roraima, and these specimens are housed at the MPEG (details on the sites and most important records obtained during MPDS's expeditions will be published elsewhere). Tape-recordings by MCH and LNN are archived at the INPA Bird Collection.

13-19 March 2001. LNN and MFT surveyed areas close to Boa Vista, gallery forests along the lower Mucajaí and Anauá rivers, the island of São José on the upper Rio Branco, and secondary *terra firme* forest near Alto Alegre (80 km west of Boa Vista), São Luiz, São João da Baliza, and Caroebe.

14-28 May 2001. LNN, MCH, and MFT surveyed savannas, dry forests, and gallery forests between Boa Vista and Normandia, including Bonfim, Serra do Tracajá, Serra da Onça, Contão, Conceição do Maú, Serra da Malacacheta, and *terra firme* forest and *campina/campinarana* at Serra Grande and Viruá National Park.

6-11 July 2001. LNN and MFT joined an expedition of the *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais* (IBAMA) covering by boat ca. 100 km of the lower Rio Branco, from Santa Maria do Boiaçu to the mouth of the river, and also visiting Paraná da Floresta, and a portion of the Rio Jauaperí.

8-9 August 2001. LNN and P. Coopmans made a short visit to Viruá National Park and the Rio Uraricoera, close to the BR 174 highway.

5-18 October 2001. LNN and J. Mazar Barnett joined another expedition sponsored by IBAMA, surveying the Ecological Stations of Niquiá and Caracaraí, and the Viruá National Park. This expedition covered by boat ca. 170 km of the lower Rio Branco, from Caracaraí south to the mouth of the Rio Catrimani, and also the rivers Água Boa do Univini, Viruá, Anauá, and Ajarani.

3-17 April 2003. LNN and MCH, accompanied for several days by M. J. Braun, revisited some areas explored in May 2001, particularly Serra do Tracajá. They also surveyed areas along the BR 174 highway and the Tacutu and Uraricoera rivers. LNN and MCH also dedicated four days to study the *terra firme* forests east of the Rio Branco, visiting Serra da Malacacheta and other forest patches along the RR 207 road (Boa Vista to Serra do Tracajá), and areas near Vila União.

Study Sites

We visited the following localities, which are in geographic order from north to south; numbers refer to the corresponding number of each locality on the map (Figure 2).

Contão (4° 12' N, 60° 32' W). Amerindian village along the Rio Cotingo, located at the southern end of hilly elevated lands, which rise from the lowlands and extend north towards the Gran Sabana, across the Venezuelan border. We focused primarily on a boulder-strewn hill covered by dry forest, rising out of a *Cu-*

ratella-dominated savanna, about 2 km east of the village. We also visited similar habitats along the first two km along the road heading from this village to Mt. Roraima, and along the road heading towards Boa Vista, where we made quick surveys at Serra da Memória, Surumu, and Pedra Pintada.

Normandia (3° 53' N, 59° 37' W). Area covered by wet grasslands and savannas characterized by extensive colonies of tall, terrestrial termite mounds.

Bonfim (3° 17' N, 59° 53' W). Town on the west bank of the Rio Tacutu, opposite Lethem in Guyana. We focused on the *Curatella*-dominated savannas surrounding Bonfim, characterized by treeless hills to the west, and grassy wetlands to the north, and on the gallery forests along the Rio Tacutu.

Conceição do Maú (1) (3° 34' N, 59° 53' W). Ranch located at the confluence of the Tacutu and Maú rivers, tributaries of the Rio Branco, and covered with gallery forest. We focused on these forests along both rivers, but also explored the extensive *Curatella*-dominated savannas around the ranch.

Serra da Onça (2) (3° 08' N, 60° 10' W). Small chain of isolated hills covered by dry forests, and surrounded by expanses of flat *Curatella*-dominated savannas and treeless rocky hills.

Boa Vista (2° 50' N, 60° 40' W). Economical and administrative capital of the state, inhabited by nearly 200,000 people. We surveyed areas in a 15-20 km radius around the city, giving special attention to the savannas south of the city, which include a mosaic of grasslands, Moriche palm stands, wetlands, and agricultural fields.

Serra da Malacacheta (3) (2° 41' N, 60° 31' W). Forested hills at the interface of Amazonian humid forest and savanna realms, where partially disturbed humid forest are surrounded by *Curatella*-dominated savannas (apparently influenced by grazing and burning). We include under these name similar lowland second-growth humid forests (2° 45' N, 60° 18' W) present along the road from Boa Vista to Serra do Tracajá.

Serra do Tracajá (4) (2° 36' N, 60° 03' W). Rocky hills cloaked in dry forest, which rise abruptly out of extensive *Curatella*-dominated savannas. With this name we refer to Serra do Tracajá itself, and other possibly unnamed nearby hills with similar vegetation and physiognomy, located to the west (2° 35' N, 60° 07' W) and southeast (2° 31' N, 60° 00' W and 2° 28' N, 60° 01' W).

Rio Mucajaí (02° 28' N, 60° 54' W). Tributary of the Rio Branco that we explored close to the village of Mucajaí. We visited both margins, covered by narrow stretches of disturbed gallery forest.

Serra Grande (5) (2° 34' N, 60° 46' W). Isolated mountain (898 m) located at the interface of Amazonian humid forest and savanna realms. Covered with partially disturbed humid forest in which we climbed to about 300 m.

Vila União (6) (02° 0' N, 60° 38' W). Small village surrounded by primary and secondary *terra firme* forest along the RR 170 road. Most areas around the village were logged or recently occupied by government-sponsored settlements. We worked along a 2-km trail within moderately disturbed primary forest with rock outcrops (see "Habitats" above) and along the road to Cantá.

Caracaraí Ecological Station (7). Protected area of 80,560 ha, situated to the west of the Rio Branco. The reserve is located in a savanna-*campinarana*-*terra firme* transitional area, with patches of secondary *terra firme* forests surrounded by agricultural lands and abandoned pastures. We focused our activities along the BR 210 road, and surveyed areas covered with *campinarana* and secondary *terra firme* forest.

Viruá National Park (8). Protected area of 227,011 ha, situated to the east of the Rio Branco and north of the Rio Anauá. The area, formerly planned for human settlement, became a national park because of its poor fertility and inappropriate quality for rural activities. Most of the area is located on sandy soils with poor drainage, covered by large expanse of *campina* and *campinarana*. It also contains an isolated ridge of low hills with *terra firme* forest. We surveyed all main habitats available at the park, including *campina* and *campinaranas* (along the park's main road), *terra firme* (next to the park's headquarters [1° 36' N, 61° 13' W]), *várzea* (along the Rio Branco), and *igapó* (along the Rio Anauá).

Niquiá Ecological Station (9). Protected area of 286,600 ha, limited by the Rio Branco to the west, Rio Água Boa do Univini to the east, and Rio Ajarani to the north. We surveyed all main habitats available at the reserve, including *várzea* (along the Rio Branco), *igapó* (along the Água Boa do Univini and Ajarani rivers), and *terra firme*. We concentrated our surveys at Ecotur Park (00° 47' 32'' N, 61° 40' 01'' W), a privately-owned lodge located opposite the reserve along the Rio Água Boa do Univini, from where we explored savannas, *campinaranas* and partially disturbed *terra firme* forest.

Upper Rio Branco. Section of the river delimited by the confluence of the Uraricoera and Tacutu rivers and Mucajaí. The margins of the upper Rio Branco are covered by narrow strips of gallery forest. Among other places, we visited the island of São José (02° 56' N, 60° 31' W), which is covered by a mosaic of gallery forest and *Cecropia*-dominated forest.

Lower Rio Branco. Section of the river south of Caracaraí. The margins of the lower Rio Branco are covered by *várzea*, including different successional stages, such as sandbars, low riparian scrub, *Cecropia*-dominated forest, and mature *várzea* forest. We intensively surveyed the whole extent of this part of the river, exploring by boat both margins and several river islands, such as the islands of Carneiro (10) (01° 24' N, 61° 16'W), Inajatuba (11) (01° 18' N, 61° 18' W), and Cota (16) (01° 16' S, 61° 50' W).

São Luiz (12), *São João da Baliza* (13), and *Caroebe* (14). Villages located along the BR 210 road, with disturbed *terra firme* forest. We focused our surveys on forests present along secondary roads. We explored relatively well-preserved *terra firme* forests at the edge of the Wai-Wai Indian Reservation (01° 05' N, 59° 56' W) and around the village of São Luiz.

Rio Jauaperí. Black-water tributary of the Rio Negro that forms the boundary between the states of Amazonas and Rorai-

ma. We navigated and explored the lower part of the river, from its mouth to the village of Samaúma (15). Most of the river was sparsely inhabited and covered by large expanses of tall *igapó*.

Paraná da Floresta. Narrow stretch of the Rio Negro, in southernmost Roraima, covered by tall *igapó*. We explored the villages of Remanso (17) and Floresta (18), and neighboring river islands.

Species List

We present a list of all bird species recorded in the state of Roraima, which include data obtained during our fieldwork in Roraima in 2001 and 2003, data gathered from museum specimens, and published and unpublished sources, all of which are acknowledged in the Appendix. Species are assigned to their main habitats, based on our experience in Roraima and complemented by published data from the state. We include notes on distribution and seasonality, which refer to general areas of endemism and to migratory species, respectively. We also present the physical evidence used for the inclusion of each species in the list (specimen or tape-recordings; species lacking objective evidence refer to sight or auditory records). Tape-recordings are exclusively of our own, because we did not have access to other recordings from the state. Taxonomy and species nomenclature follow the Brazilian Ornithological Records Committee (Comitê Brasileiro de Registros Ornitológicos 2006).

RESULTS

Avian diversity

We recorded 512 bird species, 38 of which were the first records for the state (see below). We list for the state of Roraima a total of 741 bird species, recorded as of the writing of this paper (Appendix). Specimens document 82% of the species recorded (604 species); 6% of the species (40 species) lack voucher specimens, but are documented by our tape-recordings. The remaining 12% (93 species) are listed based only on sight or auditory records, but we believe that their inclusion is acceptable because they are not especially difficult to identify and are likely to occur in Roraima. Undocumented species for which we judge records to be controversial were regarded as hypothetical (see below).

In terms of species richness, habitat heterogeneity (beta-diversity) is responsible for 60% of the avian diversity of Roraima, given that 446 bird species are restricted to single habitats (Table 1). *Terra firme* forests have the highest number of species among all habitats, contributing with nearly 300 species (348 including predicted species, see Discussion). Flooded forests, montane forests and tepuis, and savannas each account for 11% of the avifauna, whereas *campinas* (3%), gallery and dry forests (4%), and wetlands (9%) are responsible for a minor proportion of the avifauna (Table 1).

Forty-five species are migratory in the state of Roraima. Twelve of these reach Roraima during the austral winter (austral migrants), between April and August, whereas 29 species are nearctic migrants, occurring in Roraima between September and April (Appendix). Four species seem to have both resident and migratory populations, the latter coming either from the south (*Tyrannus savana*, *Progne tapera*, and *Myiodynastes maculatus*) or the north (*Vireo olivaceus*). The record of *Stercorarius parasiticus* and *Pelecanus occidentalis* probably represent vagrants. Another two species, *Coccyzus euleri* and *Tersina viridis*, may also be migratory, but little data are available for these species in Roraima.

Hypothetical Species

Fifteen species previously reported for Roraima are here included as hypothetical and removed from the state's list because

Table 1. Relative importance of habitats in terms of bird species richness in Roraima.

Habitat[a]	*Terra firme* forest			Flooded forest	Montane forest & tepui	Savanna	Campina & campinaranas	Gallery & dry forests	Wetlands & rivers	Generalists[f]	Migr.[g]
	Wam[c]	General[d]	Gui[e]								
Number of taxa[b] (exclusive spp.)	31 (25)	190 (117)	75 (53)	87 (41)	85 (75)	85 (41)	21 (12)	32 (19)	70 (63)	45	42
% of total	4	26	10	12	11	11	3	4	9	5	6

[a] Information derived from Appendix. Taxa occurring in more than one habitat were assigned to their preferred one (first one mentioned in their respective column).
[b] Includes different subspecies, thus the sum of the number of taxa is higher that the number of species recorded in Roraima.
[c] Western Amazonian taxa (species or subspecies typical of western Amazonia, generally absent east of the Rio Branco).
[d] Widespread Amazonian taxa.
[e] Guianan taxa (species or subspecies typical of the Guianan area of endemism, generally absent south of the Amazon River and west of the Rio Negro).
[f] Species found in numerous habitat types without clear preference.
[g] Migratory species using a variety of habitats.

they are either unlikely to occur in the state or species difficult to identify in the field without physical documentation.

Anas georgica (Yellow-billed Pintail). Included in Roraima based on a sight record made by G. Shattuck (1926) near Boa Esperança along the Uraricoera River. This record was admitted by Pinto (1966, 1978). However, we suspect that these records may represent a misidentification. This duck is not known either from Venezuela (Hilty 2003) or Guyana (Braun *et al.* 2000), and breeds thousands of km to the south of the study area. However, it does migrate north from southern South America to winter in large numbers in southern Brazil, and there is always a slight possibility of a vagrant occurring in Roraima, but this hypothesis should be supported with specimens.

Phaethornis augusti (Sooty-capped Hermit), *Colibri thalassinus* (Green Violet-ear), *Avocettula recurvirostris* (Fiery-tailed Awlbill), and *Klais guimeti* (Violet-headed Hummingbird). These four species of hummingbirds were cited for Roraima based on data from Augusto Ruschi's collection, held at the Museu de Biologia Melo Leitão (Ruschi 1961). The general accuracy of the data on the specimens at this collection has been heavily criticized (Pacheco 1995b, Stotz 1998, Pacheco and Bauer 2001), and the source of those specimens remains dubious. Note that *P. augusti* and *C. thalassinus* would represent the first documented Brazilian records, but have been dismissed by Pacheco (1995b) and the Comitê Brasileiro de Registros Ornitológicos (2006), who we follow in excluding them from Roraima. Three other species (*Doryfera johannae*, *Colibri delphinae*, and *Lophornis ornata*) are also present in Ruschi's collection, but were included in the list based on documented records from other sources.

Colibri coruscans (Sparkling Violet-ear). Cited for Roraima by Sick (1997) based on an alleged record from Cerro Urutaní by Dickerman and Phelps (1982). This citation appears to be erroneous, as this species is not mentioned in the original article.

Electron platyrhynchum (Broad-billed Motmot). Cited for Maracá Ecological Station by Moskovits *et al.* (1985), but dismissed by Silva (1998), who suggested an identification problem. This species is not known from anywhere near Roraima; its distribution being mostly restricted to the south of the Amazon River (Snow 2001).

Celeus flavescens (Blond-crested Woodpecker). Listed for Roraima by Pinto (1966) based on an alleged Boa Vista specimen mentioned by Cory (1919). However, this specimen refers to another locality formerly known as Boa Vista in the Brazilian state of Maranhão and now called Santo Amaro (Paynter and Traylor 1991). According to D. Willard (*in litt.*) the original label refers simply to Boa Vista, but a secondary label assumed that the specimen was from Roraima; thus, the species was subsequently reported as such by Cory (1919) and Pinto (1966). The label has since been corrected to Boa Vista, Maranhão.

Celeus undatus (Waved Woodpecker). Included for Maracá Ecological Station by Moskovits *et al.* (1985), but dismissed by Silva (1998), based on the confirmed presence (specimens) of its allospecies *C. grammicus* at that site. We agree with Silva's conclusions and exclude it from the list. On the other hand, it is plausible (and even likely) that *C. undatus* will eventually be recorded in the state, but probably to the east of the Rio Branco. Two species previously dismissed by Silva (1998) for Maracá based on the same criteria (*Pteroglossus aracari* and *Tyranneutes virescens*) have subsequently been recorded in Roraima east of the Rio Branco (see species accounts for *T. virescens*).

Campylorhamphus sp. (Scythebill). Birds belonging to this genus were observed by Stotz (1997) in Sorocaima and by Trolle and Walther (2004) along the Rio Jauaperí, but none was either identified to species or tape-recorded. The most plausible species at Sorocaima is *C. trochilirostris,* which has been collected very close to that locality in Venezuela (Hilty 2003; A. Whittaker, unpubl. data). We believe that records from Rio Jauaperí may represent *C. procurvoides*, the species typically present in *terra firme* forest and *igapó*.

Grallaria guatimalensis (Scaled Antpitta). Cited for Roraima by Sick (1997), based on a specimen from "Serra do Curupira, Estado de Roraima". The specimen was finally re-identified as *Grallaria varia cinereiceps*, and its locality corrected to Amazonas state (Mallet-Rodrigues and Pacheco 2003); therefore, there are no known documented records for *G. guatimalensis* in Brazil, or for *G. varia* in Roraima.

Tyrannus dominicensis (Gray Kingbird). Included in Roraima by Moskovits *et al.* (1985), based on a sight record at the island of Maracá. However, this would represent the only known record for Brazil, and has been dismissed by the Comitê Brasileiro de Registros Ornitológicos (2006) until documented records are available. We expect this species to occur in the area as a migrant, but here follow the Committee in excluding it from the main list.

Progne elegans (Southern Martin) and *Progne subis* (Purple Martin). More than 20 adult males and one female-plumaged bird believed to be *P. elegans* (a taxon previously considered a subspecies of *P. modesta*) were observed by A. Whittaker (pers. comm.) on 20 August 1993 along the lower Rio Branco. He noted deep-forked tails on all birds as well as the distinct dark ventral area of the female. Subsequently, on 9 June 1995, A. Whittaker also found four adult males perched with *Progne tapera* on a dead tree along the lower Rio Branco. These birds probably represent austral migrants from southern South America, but distinguishing between this taxon and *Progne subis* can be challenging in the field. Likewise, Trolle and Walther (2004) recorded birds that they identified as *P. subis*, but lack any objective evidence. Although we believe that both species are likely to be present in Roraima, we prefer to keep their presence as hypothetical until specimens are obtained.

Tachyphonus rufus (White-lined Tanager) and *Euphonia laniirostris* (Thick-billed Euphonia). Both species were cited for Roraima by Borges (1994) near Boa Vista, but the author suggested that they may have been misidentified (S. Borges, pers. comm.). *E. laniirostris* has also been mentioned by Moskovits *et al.* (1985) for Maracá, but that record was also dismissed by Silva (1998).

New records

We obtained 38 new state records during our field work in Roraima. As expected, most of our additions are represented by species occurring in habitats or biogeographical regions poorly sampled (or not sampled at all) previously. Among these are the *terra firme* forests east of the Rio Branco, the *várzeas* of the lower Rio Branco, and the *igapó*, *campinas* and *campinaranas* of central Roraima.

Within *terra firme* forests we include 13 species previously unknown from the state: *Forpus modestus*, *Trogon rufus*, *Selenidera piperivora*, *Piculus chrysochloros, Sclerurus mexicanus, Myrmotherula gutturalis*, *Formicarius analis, Myiopagis caniceps*, *Hemitriccus zosterops*, *Cotinga cotinga*, *Tyranneutes virescens*, *Hylophilus thoracicus,* and *Euphonia cayennensis*. With the exception of *F. modestus*, all other species occur both in Manaus and Guyana (Cohn-Haft *et al.* 1997, Braun *et al.* 2000) and were expected to occur in Roraima. Taxa such as *S. piperivora*, *M. gutturalis*, *T. virescens*, and *Euphonia cayennensis* represent eastern elements, being restricted to the Guianan area of endemism, and we suggest that they are restricted to the east of the Rio Branco (Table 2).

We found 13 new species for the state in riverine habitats (either in *várzea* or *igapó*): *Leucopternis schistaceus*, *Monasa nigrifrons*, *Cranioleuca gutturata*, *Myrmotherula klagesi*, *Myrmotherula assimilis*, *Cercomacra nigrescens*, *Sclateria naevia, Inezia subflava, Hemitriccus minor*, *Schiffornis major*, *Hylophilus semicinereus*, *Ammodramus aurifrons*, and *Sicalis columbiana.* Most of these species are widespread and common in *várzea* forests elsewhere in Amazonia, and all are present along the lower Rio Negro or the Solimões-Amazonas river systems. In many cases our records extend the known distribution of *várzea* species approximately 300 km northward, from the mouth of the Rio Branco up to Caracaraí (details of these records will be published elsewhere, Naka *et al.* in prep).

The *campinas*, which were previously unexplored in Roraima also presented new species for the state: *Myrmeciza disjuncta*, *Hemitriccus inornatus*, and *Rhytipterna immunda*.

Apart from unexplored habitats, we made nine additions in relatively well-sampled areas such as the savannas of northeastern Roraima, including *Buteo brachyurus*, *Micropygia schomburgkii*, *Calidris melanotos*, *Berlepschia rikeri*, *Picumnus cirratus*, and *Basileuterus flaveolus*. Near Boa Vista in heavily degraded areas, we recorded *Podilymbus podiceps*, *Gallinula chloropus*, and *Tyto alba*.

Species Accounts

Here we present details on 22 species which present special interest, either by representing new records for Roraima with some biogeographical significance, poorly-known and restricted species, or bird species of conservation concern.

Table 2. Pairs of taxa (allospecies or subspecies) whose distribution boundaries apparently coincide with the Rio Branco.

Taxon west of the Rio Branco	Taxon east of the Rio Branco
Tinamus major zuliensis	*T. m. major*
Gypopsitta barrabandi	*G. caica*
Notharchus macrorhynchos	*N. hyperrhynchus*
Capito auratus	*C. niger*
Ramphastos tucanus cuvieri	*R. t. tucanus*
Ramphastos vitellinus culminatus	*R. v. vitellinus*
*Selenidera nattereri**	*S. piperivora*
Celeus elegans jumanus	*C. e. elegans*
Cymbilaimus lineatus intermedius	*C. l. lineatus*
Myrmotherula haematonota	*M. gutturalis*
Myrmotherula menetriesii pallida	*M. m. cinereiventris*
Hypocnemis cantator flavescens	*H. c. cantator*
Percnostola rufifrons minor	*P. r. subcristata*
Schistocichla leucostigma infuscata	*S. l. leucostigma*
Dendrocincla fuliginosa phaeochroa	*D. f. fuliginosa*
Sittasomus griseicapillus amazonus	*S. g. axillaris*
Glyphorynchus spirurus rufigularis	*G. s. spirurus*
Lepidocolaptes albolineatus duidae	*L. a. albolineatus*
*Phoenicircus nigricollis**	*P. carnifex**
Tyranneutes stolzmanni	*T. virescens*
Hylophilus ochraceiceps ferrugineifrons	*H. o. luteifrons*
Euphonia rufiventris	*E. cayennensis*

* Species not known from Roraima, but likely to be recorded with further sampling.

Details of those species found in flooded forest will be dealt with elsewhere (Naka *et al.*, in prep).

Micropygia schomburgkii (Ocellated Crake). MCH, LNN, and MFT heard at least two individuals vocalizing in seasonally inundated savannas near Serra do Tracajá on 22 May 2001. Subsequently, in November 2004, A. Whittaker and K. Zimmer saw and tape-recorded three different birds 22 km south of Pacaraima (A. Whittaker, *in litt.*). This secretive species is known from several sites in neighboring Venezuela (Hilty 2003), French Guiana (Tostain *et al.* 1992), and Guyana (Robbins *et al.* 2004), but these are the first records for Roraima, suggesting that its presence has been overlooked in the past.

Forpus modestus (Dusky-billed Parrotlet). MCH observed and tape-recorded two individuals in *terra firme* forest with interspersed rocky outcrops near Vila União on 17 April 2003. Although this parrotlet is widespread in Amazonia, its distributional patterns are not yet well understood (Collar 1997). We believe that its distribution may be linked to areas with considerable topographical relief and rocky soils, which may explain its presence in Roraima and its apparent absence near Manaus. Although new to Roraima, its presence was expected, as it occurs in neighboring Venezuela (Hilty 2003) and Guyana (Braun *et al.* 2000).

Gypopsitta caica (Caica Parrot). A flock of nine individuals was tape-recorded and one of them collected by MCH on 17 April 2003 in *terra firme* forest near Vila União. The only other specimen available from the state was collected by D. Stotz near fazenda Santa Cecilia (FMNH #389173). Both specimens were collected east of the Rio Branco. Its allospecies, *G. barrabandi,* seems to replace *G. caica* west of this river. However, MCH also observed a flock of *G. barrabandi* on the east (left) bank of the lower Rio Branco, near the mouth of the river in July 1999. Throughout most of their distribution, species in the genus *Gypopsitta* are parapatrically distributed; therefore having both species in possible contact on the lower Rio Branco is an interesting issue requiring further study. The presence of *G. barrabandi* east of the Rio Branco also represents an exception to the observed pattern of western elements being restricted to west of the Rio Branco (see Discussion).

Chordeiles pusillus (Least Nighthawk). We found and collected two morphotypes with distinct vocalizations, within the boundaries of the state. One appears to be resident in the cerrado-like vegetation in the north and the other in the campinas of the south. Cohn-Haft will present a taxonomic revision of Amazonian *Chordeiles pusillus* elsewhere.

Galbula leucogastra (Bronzy Jacamar). Two individuals were tape-recorded by LNN and J. Mazar Barnett in tall *campinarana* forest at Viruá National Park on 16 October 2001. Although we have found this species to be common in *campinas* and *campinaranas* elsewhere in Amazonia, it appears to be rare and local in Roraima. Surprisingly,*Galbula galbula*, on the other hand, was fairly abundant in *campinas*, savannas, and *várzeas* throughout the state. In Guyana, *G. leucogastra* has also only been found in areas where *G. galbula* was absent (Robbins *et al.* 2004), suggesting that both species may be excluding each other ecologically and geographically. These represent the first records for the state of Roraima.

Capito niger (Black-spotted Barbet). MCH and LNN heard the distinctive vocalizations of nominate *C. niger* in *terra firme* forest near Vila União on 17 April 2003. Until recently, most classifications in the last half-century treated *C. niger* as a widespread polytypic Amazonian species. Current authors (e.g. Hilty 2003, Dickinson 2003, Comitê Brasileiro de Registros Ornitológicos 2006, but not Short and Horne 2002), however, have followed Haffer (1997) in reverting to an older classification that restricts the name *niger* to the nominate form and elevates *auratus* to species level, including most of the other subspecies in the group. With the exception of Pinto (1966) and Dickerman and Phelps (1982), who specifically mention either *C. auratus* or a subspecies currently considered to belong to the *auratus* group, authors that mention *C. niger* for Roraima (Borges 1994, Moskovits *et al.* 1985, Stotz 1997, Silva 1998) may be assumed to be referring to the broad concept of the species. All these records are from west of the Rio Branco, which we believe represents the divide between *C. niger* and *auratus*, an idea also championed by Haffer (1997). Therefore, we believe that all previous records from Roraima refer to *C. auratus*, and ours (the only one east of the Rio Branco) should represent the first record of *C. niger* for the state.

Selenidera piperivora (Guianan Toucanet). A single individual was heard by MCH in *terra firme* forest near Vila União on 17 April 2003. This represents the first record for the state of Roraima. We agree with Haffer (1974) envisioning the distribution of this species as being restricted in Roraima to the east of the Rio Branco, being replaced by *S. nattereri* further west. Note that *S. nattereri* has not yet been recorded in Roraima, but we suspect that its absence may represent poor sampling in western Roraima (see Discussion).

Picumnus cirratus (White-barred Piculet). MCH, LNN, and MFT tape-recorded and collected pairs in gallery forest along the Rio Tacutu, near Conceição do Maú, and in dry forest at Serra do Tracajá and north of Boa Vista. These birds may refer to the form *confusus*, known from southwestern Guyana, French Guiana, and extreme northern Brazil (Winkler and Christie 2002). Although the latter authors include Roraima as the range of this race, we could find no previous record of this species for the state.

Lepidocolaptes albolineatus (Lineated Woodcreeper). LNN and MCH tape-recorded several individuals in *terra firme* forest near Vila União on 17 April 2003. There are two distinct and well-marked allopatric subspecies north of the Amazon River, which differ in morphology and vocalization (Marantz *et al.* 2004). Our observations and tape-recordings in Roraima match specimens and recordings from Manaus, where the nominate race occurs (Marantz *et al.* 2004). All previous records from Roraima are from west of the Rio Branco (Cory and Hellmayr 1925, Pelzeln 1868-71, Stotz 1997, Silva 1998, Silva and Oren 1990), and whenever subspecies were mentioned, authors refer

to *L. albolineatus duidae*. Therefore, we believe that the Rio Branco separates the range of these taxa, and our records appears to be the first of the nominate race in the state.

Synallaxis kollari (Hoary-throated Spinetail). A poorly known, local, and endemic species found exclusively in gallery forests from northeastern Roraima and adjacent Guyana, along the upper Rio Branco and some of its tributaries (Tacutu, Surumu, and Cotingo rivers) (Ridgely & Tudor 1994, Collar *et al.* 1992, BirdLife International 2000). Described from five specimens collected by Natterer in 1831-1832 along the Rio Branco near Boa Vista (Pelzeln 1956), this species was rediscovered over a century later on the Rio Surumu (Pinto 1966). Recent records come from Conceição do Maú (Forrester 1995) and the Rio Uraricoera (Grosset and Minns 2002). In 27 May 2001 MCH, LNN, and MFT found and tape-recorded one bird along the Rio Cotingo at the village of Contão (one of the historical localities mentioned by Pinto 1966). Subsequently, in August 2001 and April 2003, LNN and P. Coopmans, and MCH and LNN, respectively, found several birds at the Rio Uraricoera at the site reported by Grosset and Minns (2002). At all sites, birds were found in or near vine tangles in gallery forests, and were highly responsive to playback. At the Rio Uraricoera, birds were common, and at least five different individuals were counted within 200 m of gallery forest. Given its restricted distribution and the very low number of records, *S. kollari* is presently considered threatened (BirdLife International 2000), but was excluded based on deficiency of data from the Brazilian list of threatened birds (Ministério do Meio Ambiente 2003). An accurate assessment of its distribution and ecological requirements its being undertaken at present (Vale *et al.*, in prep.). This new information is important to assess the level of threat to which this species is subject throughout its small range (see Discussion).

Myrmotherula gutturalis (Brown-bellied Antwren). MCH and LNN observed and tape-recorded a pair in a mixed-species flock in the understory of *terra firme* forest near Vila União on 17 April 2003, representing the first record for Roraima. We suspect that this species is limited in Roraima to *terra firme* forests east of the Rio Branco, being replaced by *M. haematonota* further west.

Myrmotherula cherriei (Cherrie's Antwren). MCH, LNN, and MFT encountered and tape-recorded several individuals in a *campina* at Viruá National Park on 25 May 2001. In July 2001, LNN and MFT saw and tape-recorded a female in *várzea* forest near Santa Maria do Boiaçu. Subsequently, in October 2001, LNN and J. Mazar Barnett found this species to be fairly common in tall and low *igapó* along the Água Boa do Univini and Jauaperí rivers, and in a *campinarana* at the Caracaraí Ecological Station. This antwren is known to occur locally in eastern Colombia, southern Venezuela, and northeastern Peru, whereas in Brazil it was only known from the Rio Negro basin (Isler *et al.* 1999, Zimmer and Isler 2003), but not from the Rio Branco basin. Although its presence in *campina*, *campinarana*, and *igapó* was not unexpected in Roraima, its appearance in *várzea* forests along the lower Rio Branco was somewhat surprising, as this species is apparently absent from other white-water rivers in Amazonia.

Myrmeciza disjuncta (Yapacana Antbird). MCH, LNN, and MFT tape-recorded and collected a pair, but noted at least another three different individuals in a *campina* covered by clumps of tall sedges interspersed with low bushes at Viruá National Park on 25 March 2001. In October 2001, LNN and J. Mazar Barnett located another pair at a nearby site within Viruá. The pair collected represents the first record for Roraima, and the second Brazilian locality. *M. disjuncta* is a rare and poorly known species, until recently only known from two sites in Venezuela and one in Colombia (Zimmer 1999). The only other Brazilian locality is Jaú National Park (Borges and Almeida 2001), where this species was found in a *campina* located more than 500 km southwest of our site. Despite the large distance between sites, the *campinas* of Viruá and Jaú are physiognomically similar. Not only do our records represent a considerable range extension on the north side of the Rio Negro, suggesting that the species occurs throughout the upper Negro basin in appropriate habitat, but they are the first from east of the Rio Branco, suggesting that the river is not a barrier to its distribution and that the species may occur considerably further east still.

Sublegatus modestus (Southern Scrub-Flycatcher). MCH and LNN, accompanied by M. Braun, tape-recorded and collected a pair of *Sublegatus* flycatchers on 9 March 2003 in the savannas of Serra do Tracajá, finding several others on subsequent days. These birds were morphologically and vocally similar to birds collected from the Rupununi savannas in Guyana (M. Braun pers. comm.), which may represent a resident form of *S. modestus* (M. Robbins, *in litt*.). The race *brevirostris*, which breeds from southern Bolivia to Argentina, is an austral migrant in Amazonia, but is mostly recorded south of the Amazon (Fitzpatrick 2004). Three specimens from the Roraima savannas held at the FMNH were identified as *S. modestus* and were taken in March and December, outside the main austral migrant season. These records, along with those of the Rupununi (Robbins *et al.* 2004), suggest the existence of a resident form in these savannas, extending the former breeding area several hundred km northward. Further field work is being conducted to assess the proper taxonomic status of these populations (Robbins *et al.*, unpubl. data).

Polystictus pectoralis (Bearded Tachuri). LNN and MFT found one bird on March 2001 in natural grasslands 50 km south of Boa Vista, and in May 2001, MCH, LNN, an MFT tape-recorded several individuals in the savannas near Serra do Tracajá. This poorly known species is apparently undergoing severe population declines both in northern and southern South America as a result of grassland conversion into pastures and crop fields (Parker and Willis 1997). At present, this species is considered near-threatened (BirdLife International 2000) and the drastic conversions of natural grasslands in Roraima represent a clear threat for these populations (see Discussion).

Atalotriccus pilaris (Pale-eyed Pygmy-Tyrant). In May 2001, MCH, LNN, and MFT tape-recorded and collected one individual in dry forest on a boulder-strewn hill near the

village of Contão, representing the first Brazilian specimen. This species seems to be restricted in Brazil to a savanna type found only in northeastern Roraima, characterized by rocky boulders, barren soil, and large termite mounds. *Atalotriccus pilaris* was first observed in Brazil by Forrester (1993) along the Rio Cotingo and subsequently tape-recorded by A. Whittaker (pers. comm.) on a hill with low dry forests along the BR 174 highway, 35 km south of the Venezuelan border, and by Willis (2003) at a nearby locality.

Hemitriccus zosterops (White-eyed Tody-Tyrant). LNN and MFT saw and tape-recorded one bird in disturbed *terra firme* forest near Samaúma on 8 July 2001. In April 2003, MCH and LNN heard another individual vocalizing in *terra firme* forest near Vila União. The vocalizations recorded at both sites are similar to those known from Manaus (Cohn-Haft *et al.* 1997) and presumably refer to the taxon *rothschildi* (Cohn-Haft 2000; MCH will revise the taxonomy of this and other *Hemitriccus* spp. elsewhere).

Hemitriccus inornatus (Pelzeln's Tody-Tyrant). LNN and J. Mazar Barnett found and tape-recorded two individuals on 9 and 10 October 2001 in tall *campinarana* along the Rio Agua Boa do Univini at the Niquiá Ecological Station, and up to four birds on 14 October 2001 within the Caracaraí Ecological Station. Until recently, this species was only known from the type specimen (Ridgely and Tudor 1994), but recent field work has led to its rediscovery (Whittaker 1994) and ample range extensions (Zimmer, Whittaker, and Cohn-Haft, *in prep*.)

Cnemotriccus fuscatus (Fuscous Flycatcher). We found two distinct forms within the state, one associated with gallery forests and the other with *campinas*. In March 2001, MCH, LNN, and MFT encountered and collected what apparently represented *Cnemotriccus f. fumosus* (a taxon well documented by specimens from the savannas of Roraima) in gallery forests along the upper Rio Branco and its tributaries, the Uraricoera and Urubú rivers. A few days later, MCH, LNN, and MFT tape-recorded a second vocal type in a *campina* at the Viruá National Park. The latter bird appears to be closest to individuals found in other *campinas*, which apparently represent the form *C. f. duidae* (Whitney, unpubl. data), not previously recorded in Roraima.

Rhytipterna immunda (Pale-bellied Mourner). LNN and J. Mazar Barnett observed and tape-recorded individuals in a *campinarana* at the Caracaraí Ecological Station on 14 October 2001. A few days later, they tape-recorded another bird in a *campina* at the Viruá National Park. The distribution of this species seems to be tied to sandy soils (Sick 1997, Zimmer and Hilty 1997), and although these represents the first records for Roraima, we were expecting to find this species in the state.

Tyranneutes virescens (Tiny Tyrant-Manakin). MCH and LNN tape-recorded several individuals in *terra firme* forest near Vila União on 17 April 2003. This species seems to be limited to *terra firme* forests east of the Rio Branco, possibly being replaced by *T. stolzmanni* to the west of this river. The only previous record of *T. virescens* within Roraima was represented by a sight record from Maracá Ecological Station (Moskovits *et al.* 1985), but this record was dismissed by Silva (1998), arguing that a specimen of *T. stolzmanni* from the same site was enough evidence to suspect a misidentification. We agree with Silva, and believe that the presence of both allospecies in syntopy would be, at best, unlikely. We suspect that the Rio Branco represents the distributional limit for both species, and therefore our records east of the Rio Branco must represent the first for Roraima.

Basileuterus flaveolus (Flavescent Warbler). MCH, LNN, and MFT found and tape-recorded one bird in gallery forest along the Rio Tacutu, near Conceição do Maú, on 20 May 2001. Subsequently, they found this species in several sites dominated by dry forests, tape-recording and collecting specimens at Serra da Onça, Rio Uraricoera, and along the BR 174 highway, 40 km north of Boa Vista. In 1989 this species was found at Dadanawa, along the Rupununi River in Guyana (Mees and Mees-Balchin 1990), which represented an extraordinary range extension of over 1000 km from previously described populations in northern Venezuela and central Brazil (Ridgely and Tudor 1989). Ours are the first records for Roraima but are likely to represent the same population sampled in Guyana.

DISCUSSION

Predicted avifauna of Roraima

A complete avifaunal survey of an area the size of Roraima, with its many ecological and biogeographical complexities, represents an overwhelming task. If we are to fully understand the distribution patterns and biogeographical aspects of all birds occurring in the state, we need much more intensive field work, especially in remote regions that continue to receive little or no coverage, and more intensive collecting (with tape recordings and tissue samples) to allow recognition of the true taxonomic or population-level diversity present.

Although we are far from having a complete list of all bird species occurring in Roraima, we can make inferences and predictions about the species that are expected to occur there. We have a good idea of the species present in neighboring regions, such as Manaus (Cohn-Haft *et al.* 1997), the states of Amazonas and Bolivar in Venezuela (Hilty 2003), Guyana (Braun *et al.* 2000), the Rupununi savannas (Robbins *et al.* 2004), the upper Rio Negro (MCH, LNN, and colleagues, unpubl. data), and the right bank of the middle Rio Negro (Borges *et al.* 2001).

Taking into account our results and the biogeographical affinities of the avifauna of Roraima, we estimate conservatively that over 800 species occur within the state boundaries. Based on a direct comparison with Cohn-Haft *et al.* (1997), Hilty (2003), Braun *et al.* (2003), and Robbins *et al.* (2004), we include a list of 69 species that are likely to be recorded in Roraima with further field work (Table 3). Among these are 39 species that inhabit *terra firme* forests (20 species widely distributed in Amazonia, 12 species representing western elements present on the upper Rio Negro and extreme southern Venezuela, and 7 species known from the Guianan area of en-

Table 3. Bird species predicted to occur in Roraima. Includes species known from areas near Roraima and not separated by any apparent biogeographical barrier; based on Mayr and Phelps (1967), Stotz *et al.* (1992), Cohn-Haft *et al.* (1997), Zimmer and Hilty (1997), Braun *et al.* (2000 and 2003), Borges *et al.* (2001), Hilty (2003), and Robbins *et al.* (2004).

Bird species from *terra firme* forest		
Amazona autumnalis [c]	*Celeus undatus* [c]	*E. aurantioatrocristatus* [b]
Nyctibius leucopterus [b]	*Megastictus margaritatus* [a]	*Phylloscartes virescens* [c]
N. bracteatus [b]	*Schistocichla caurensis* [ae]	*Lophotriccus vitiosus* [b]
Lurocalis semitorquatus [b]	*Myrmeciza pelzelni* [a]	*Neopipo cinnamomea* [b]
Chaetura chapmani [b]	*Dichrozona cincta* [a]	*Iodopleura isabellae* [a]
Phaethornis malaris [a]	*Phlegopsis nigromaculata* [a]	*Phoenicircus nigricollis* [a]
Topaza pyra [a]	*Grallaria varia* [b]	*Phoenicircus carnifex* [c]
Avocettula recurvirostris [b]	*Deconychura stictolaema* [b]	*Haematoderus militaris* [c]
Discosura longicauda [b]	*Campylorhamphus procurvoides* [b]	*Lepidothrix serena* [c]
Pharomachrus pavoninus [b]	*C. trochilirostris* [b]	*Turdus lawrencii* [a]
Notharchus ordii [b]	*Philydor erythrocercum* [b]	*Lamprospiza melanoleuca* [b]
Malacoptila fusca [b]	*P. erythropterum* [b]	*Periporphyrus erythromelas* [c]
Selenidera nattereri [a]	*Xenops milleri* [b]	*Schistocichla caurensis* [ae]
Bird species associated with tepuis adjacent to Roraima		
*Amazona dufresniana** [d]	*Grallaria guatimalensis**	*Xenopipo uniformis*
Campylopterus duidae	*Grallaricula nana**	*Cichlopsis leucogenys*
Colibri coruscans	*Elaenia dayi**	*Diglossa duidae*
*Polytmus milleri**	*Pachyramphus viridis*	*Euphonia cyanocephala*
Heliodoxa aurescens	*Pipreola whitelyi** [f]	
Nearctic migrants that regularly visit Guyana, southern Venezuela, or Manaus		
Calidris himantopus	*Tyrannus tyrannus*	*Catharus ustulatus*
Falco columbarius	*Tyrannus dominicensis*	*Dolichonyx oryzivorus*
Buteo platypterus	*Vireo altiloquus*	
Savanna bird species found in the southern Rupununi		
Oxyura dominica	*Bubo virginianus*	*Carduelis cucullata**
*Phaethornis augusti**	*Neopelma pallescens*	
Bird species associated with *campina/campinarana*		
Crypturellus duidae	*Attila citriniventris*	*Dolospingus fringilloides*

* Species not yet recorded in Brazil.

[a] Western taxa present on the upper Rio Negro and known from extreme southern Venezuela, but generally absent from Guyana or Manaus.

[b] Widespread taxa present throughout Amazonia, including the state of Amazonas, Brazil, and southern Venezuela.

[c] Eastern elements, or Guianan endemics, present in Guyana and/or Manaus.

[d] Although not especially linked to tepuis, Venezuelan records in Bolivar state come from the tepui foothills.

[e] Associated to rocky areas, specially in sub-montane humid forest.

[f] Reported twice near Manaus (Cohn-Haft *et al.* 1997), but lacking documentation for Brazil.

demism). Other species that will probably be recorded include 5 species reported from the southern Rupununi savannas in Guyana; 3 species typical of *campina*/*campinarana*; 14 species associated with the tepuis and reported from mountains adjacent to Roraima in Venezuela or Guyana; and 8 Nearctic migrants that regularly visit southern Venezuela, southern Guyana, or Manaus. Note that seven of the species included in Table 3 would also represent new Brazilian records, showing the need for general collections in this poorly sampled region.

Avian diversity

The diversity of birds in the state of Roraima is a result of high habitat heterogeneity (beta-diversity) and regional endemism (gamma-diversity), and understanding both these factors is central to recognizing the patters of avian diversity within the Rio Branco basin. Habitat heterogeneity is responsible for 60% of the bird species found in Roraima (446 species occur exclusively in single habitats; Table 1). As expected, beta–diversity is highest in ecotone areas, where major habitats encounter one another such as within the savanna-dry forest-*terra firme* interface. Regional endemism (species in similar habitats related to different biogeographical regions) plays a major role within *terra firme* forests, accounting for more than a third of the species richness found in this habitat (see Table 1).

The diversity of birds in a given site (alpha-diversity) is also highest within *terra firme* forests. Although we lack intensive surveys at single *terra firme* forest localities, we estimate that between 260 and 280 bird species probably occur at any given site with continuous forest (Table 1 and 2), a value similar to other *terra firme* forests throughout the Amazon (Cohn-Haft *et al.* 1997).

Biogeographical affinities: Patterns of Avian Distribution in Roraima

Below, we present the patterns of avian distribution in Roraima associated with major habitats (we excluded montane forests and tepuis because we did not sample those habitats and have little to add to the existing literature).

Terra firme forest. The Rio Branco, which dissects Roraima in an eastern and a western half, also seems to separate many closely related taxa of forest birds on its opposite banks (Table 2). Although the general pattern suggests the importance of the Rio Branco as a biogeographical barrier, lack of studies on opposite sides of the river prevents us from specifying if the river itself represents the barrier, or whether large expanses of habitats other than *terra firme* forests also function as barriers for those birds. The margins of the lower Rio Branco are mostly covered by *várzea*, and further north large expanses of *campina*, *campinarana*, and savanna also prevent *terra firme* forests from opposite sides of the Rio Branco from coming into direct contact one with another (Figure 3). Whether the Rio Branco itself or the sum effect of the river in conjunction with other habitats are responsible for the presence of contact zones, the valley of the Rio Branco seems to be an important biogeographical barrier for Amazonian birds.

As a general rule, *terra firme* forests east of the Rio Branco show avian biogeographical affinities with the Guianan area of endemism, similar in terms of species composition to the avifauna of Manaus (see Cohn-Haft *et al.* 1997) and Guyana (see Braun *et al.* 2000). Forests west of the Rio Branco are more closely related to western Amazonia (with elements of Imeri and Napo areas of endemism), and have species composition similar to that of areas in the state of Amazonas in Venezuela (Zimmer and Hilty 1997, Hilty 2003) or the upper Rio Negro (MCH and LNN, unpubl. data).

Savanna-like open habitats. Two distinctive but physiognomically similar habitats dominated by herbaceous communities are present in Roraima. Savannas and *campina*s structurally resemble one another, but have a radically different geological history and plant species composition (Brown and Prance 1987). Although both habitats have several species of birds in common, which do not occur in any other habitats, such as *Formicivora grisea*, *Schistochlamys melanopis*, and *Emberizoides herbicola*, they also have many species that seem to occur in one habitat but not in the other. Examples of bird species that occur in savannas but not in *campinas* include: *Cercibis oxycerca*, *Theristicus caudatus*, *Ramphastos toco*, *Polystictus pectoralis*, *Turdus nudigenis*, *Anthus lutescens*, *Ammodramus humeralis*, *Parula pitiayumi*, *Icterus croconotus*, *Sturnella magna*, and *Euphonia finschi*. Whereas species typical of *campinas*, but not present in savannas include: *Crypturellus erythropus*, *Polytmus theresiae*, *Elaenia ruficeps*, *Thamnophilus punctatus*, *Myrmotherula cherriei*, *Myrmeciza disjuncta*, *Heterocercus flavivertex*, and *Tachyphonus phoenicius*.

The savannas of Roraima-Rupununi represent the largest continuous savanna in Amazonia. Its flora and avifauna are reported to be more closely related to the *llanos* of Colombia and Venezuela than to other Amazonian savannas (Huber 1995, Silva 1995), such as Sipaliwini, Amapá, or Alter do Chão. Robbins *et al.* (2004) presented a list of bird species from these areas, including the *cerrados* of central Brazil, showing that the Gran Sabana represents a subset of the Roraima-Rupununi savannas, whereas Sipaliwini is a subset of the savannas of Amapá, more closely related to the *cerrados* of central Brazil.

South of Caracaraí, at about the same latitude where savannas are replaced by forests, large areas of poorly drained sandy soils are covered by *campina/campinarana*. These habitats extend westwards reaching the upper Rio Negro, creating the largest continuous area of white-sand forests in the Neotropics. In general, *campinas* are patchily distributed within Amazonia, but their avifaunas seem to remain surprisingly uniform. The *campinas* of Roraima present clear avian similarities with other well studied, isolated *campinas* elsewhere in Amazonia, such as those present near Manaus (MCH and

LNN, unpubl. data), Jaú National Park (Borges 2004), and those of southern Venezuela (Zimmer and Hilty 1997).

Riverine forests. Soil composition, flooding regimes, and rainfall are important in defining habitats along the margins of the Rio Branco. While the upper Rio Branco, located within the savanna domain, is margined by narrow stretches of gallery forests, the lower Rio Branco, south of Caracaraí, have extensive tracts of *várzea* forests along the river. Gallery and *várzea* forests differ in bird species composition. Examples of bird species that inhabit *várzea* forests but are absent from gallery forest include *Leucopternis schistaceus*, *Amazona festiva*, *Phaethornis rupurumii*, *Thamnophilus nigrocinereus*, *Myrmmtherula klagesi*, *Cercomacra nigpescens*, *Myrmoborus lugubris*, *Xiphorhynchus kienerii*, *Synallaxis propinqua*, *Cranioleuca vulpina*, *Serpophaga hypoleuca*, *Stigmatura napensis*, *Schiffornis major*, and *Conirostrum bicolor*. On the other hand, among the species that occur in gallery forests but are absent from *várzea* we can mention *Phaethornis hispidus*, *Picumnus spilogaster*, *Picumnus cirratus*, *Lepidocolaptes souleyetii*, *Synallaxis kollari*, *Myiopagis viridicata*, *Inezia caudata*, *Poecilotriccus sylvia*, *Conirostrum speciosum*, and *Basileuterus flaveolus*. The avifauna of the gallery forests is more closely related to the avifauna present in dry forests, whereas the avifauna of the *várzeas* is similar to that found in flooded forests along white-water rivers elsewhere in Amazonia, such as the Amazon and Madeira rivers.

The Rio Branco is unique in representing a white-water river surrounded by black-water rivers (for ex., the Negro, Jauaperí, Anauá, Agua Boa do Univini, and Catrimani rivers). In general, bird communities found in *várzea* along the Rio Branco are similar in species composition to the avifauna inhabiting tall *igapó* on the lower Rio Negro (such as the Anavilhanas archipelago). On the other hand, and somewhat surprisingly, the lower Rio Branco has several elements typical of white-water rivers, absent from the entire Rio Negro basin. Species such as *Synallaxis propinqua*, *Cercomacra nigrescens*, *Stigmatura napensis*, *Serpophaga hypoleuca*, and *Conirostrum bicolor* seem to have isolated populations along the Rio Branco (Pacheco 1995a, Naka *et al.* in prep.).

Apart from gallery forest and *várzea*, riverine environments flooded by black-water rivers are covered by *igapó*, which occurs along most Rio Branco tributaries. Tall *igapó* has an avifauna similar to that of mature *várzea* forest, whereas low *igapó*, locally known as *chavascal*, has bird species in common with white-sand forests (*campina*/*campinarana*), such as *Polytmus theresiae*, *Thamnophilus amazonicus*, *Myrmotherula cherriei*, *Hemitriccus inornatus*, *Heterocercus flavivertes*, and *Hylophilus brunneiceps*.

Conservation

The state of Roraima is unique in Brazil in that more than half of its territory is protected either by Indian Reservations (45%) or natural reserves (7%) (Ministério do Meio Ambiente 2001). Indian Reservations are concentrated in western and extreme southeastern Roraima, protecting areas of montane and sub-montane forests and lowland *terra firme* forests, respectively. Fortunately, these areas are well protected from immediate development. Natural reserves are mostly restricted to areas near Caracaraí, but entire habitats such as savannas, dry forests, gallery forests, and *várzeas*, are inadequately protected.

Outside protected areas, the state of Roraima is experiencing serious environmental problems. At present, savannas, natural grasslands, and gallery forests are being converted to soybean (Gianluppi and Smiderle 2005), acacia (Arco-Verde *et al.* 2005), and rice plantations (Cordeiro 2005) at alarming rates. The conversion of gallery forests into rice fields is of special concern to the survival of *Synallaxis kollari*, a gallery forest specialist endemic to northeastern Roraima.

In addition, natural savannas are subject to anthropogenic fires, which affect 38% of the entire area of the savannas every year (Barbosa and Fearnside 2005). An increase in the frequency of burning in areas well adapted to fire, such as the savannas, can have strong effects on the structure and dynamics of the plant community (Miranda and Absy 1997), and has been responsible for the spread of fires in habitats not adapted to natural burnings, such as humid forests (Barbosa and Fearnside 1999). The effects of anthropogenic fires on the avian communities of the savannas have not been studied in Roraima, and deserve investigation.

Environmental problems in the southern part of the state are linked to human settlements and state-sponsored colonization programs in forested areas. As a general rule, peasants are allocated to small areas of land, which are logged and subsequently burned to promote subsistence agricultural activities for a couple of years (Fearnside 1997). However, the unsuitability of these areas for agriculture has been known for decades (Fearnside 1985), and after a few years of slash-and-burn agriculture, these now sterile lands are abandoned, producing a vicious cycle creating social unrest that the government attempts to solve by encouraging new settlements under similar conditions. The situation in southeastern Roraima is critical, where large areas of abandoned pastures dominate the landscape. In fact, our own research activities near São Luiz, São João da Baliza, and Caroebe were obstructed by difficulty accessing undisturbed primary forests.

The present development model in Roraima is clearly unsustainable, and the lack of concerted public policies is exacerbating the situation. Environmental agencies should work together with development organizations, focusing on the long-term sustainability of economic activities throughout the state. We suggest creating natural reserves in neglected habitats, such as savannas, gallery and dry forests, and the creation of large areas of National Forests (FLONAs) or Sustainable Development Reserves (RDSs) in the *várzeas* and forests in

the southeastern corner of the state, where sustainable activities could be developed and controlled, as an alternative to uncontrolled logging and disordered human settlement. If the government of Roraima fails to work toward more sustainable economic activities, this region may lose an important part of its biodiversity in the next few years.

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Appendix 2. List of bird species recorded in the state of Roraima.

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
TINAMIDAE						
Tinamus tao	TF	WAM			28, 50	
Tinamus major	TF	(WAM)/(GUI?)	S	T	#, 2, 28, 42, 50, 54, 57	MPEG, MZUSP
Tinamus guttatus	TF	WAM			54	
Crypturellus cinereus	TF SF DF CAM VZ			T	#, 2, 28, 50, 54	
Crypturellus soui	TF SF CAM		S	T	#, 2, 11, 28, 50, 54, 57	CP
Crypturellus undulatus	VZ DF GF CAM		S	T	#, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Crypturellus erythropus	CAM TF		S	T	#, 28, 36, 37, 50, 54	MNHW, MPEG
Crypturellus variegatus	TF		S	T	#, 2, 28, 50, 54	MPEG
ANATIDAE						
Dendrocygna viduata	W R		S		#, 2, 23, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Dendrocygna autumnalis	W R		S		#, 2, 28, 37, 45, 50, 54	MNHW
Neochen jubata	R		S		#, 42, 45, 54, 57	MZUSP
Cairina moschata	W R		S		#, 28, 45, 50, 54, 57	MPEG
Amazonetta brasiliensis	W		S		2, 22, 37, 42, 50	FMNH, LACMNH, MNHW, MPEG, MZUSP
CRACIDAE						
Ortalis motmot	TF SF DF VZ CAM		S	T	#, 2, 11, 21, 28, 37, 42, 50, 54, 57	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Penelope marail	TF	GUI	S		28, 42, 50, 54	MPEG, LACMNH, MZUSP
Penelope jacquacu	TF MF		S		11, 48, 57	CP, MPEG
Aburria cumanensis	VZ		S		#, 11, 21, 28, 42, 50, 54, 57	CP, FMNH, MPEG, MZUSP
Mitu tomentosum	VZ IG CAM		S	T	#, 21, 37, 50, 51, 57	MNHW
Crax alector	TF DF	GUI	S		#, 2, 11, 21, 28, 37, 42, 50, 57	CP, FMNH, MNHW, MPEG, MZUSP
ODONTOPHORIDAE						
Colinus cristatus	SAV CAM		S	T	#, 2, 27, 28, 37, 42, 49, 50, 54	FMNH, MNRJ, MNHW, MPEG, MZUSP, LACMNH
Odontophorus gujanensis	TF MF		S	T	#, 11, 28, 41, 50, 54, 57	CP
PODICIPEDIDAE						
Tachybaptus dominicus	W		S		#, 37	MNHW
Podilymbus podiceps	W				#	
PELECANIDAE						
Pelecanus occidentalis	vagrant				45	
PHALACROCORACIDAE						
Phalacrocorax brasilianus	W R		S		#, 28, 45, 50, 54, 57	MPEG
ANHINGIDAE						
Anhinga anhinga	R W				#, 28, 42, 50, 54, 57	
ARDEIDAE						
Tigrisoma lineatum	W R		S		#, 28, 42, 50, 54, 57	FMNH, MZUSP
Agamia agami	R		S	T	#, 42	MZUSP
Cochlearius cochlearius	W R		S		13, 28, 37, 50, 54	MNHW
Zebrilus undulatus	VZ		S		28, 50, 54	MPEG
Botaurus pinnatus	W			P	#, 28, 50	
Ixobrychus exilis	W				28, 50	

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Ixobrychus involucris	W				28, 50	
Nycticorax nycticorax	W R				#, 28, 50	
Butorides striata	W R		S		#, 2, 28, 45, 50, 54, 57	MPEG
Bubulcus ibis	W AA				#, 2, 28, 49, 50, 54	
Ardea cocoi	W R		S		#, 2, 28, 37, 45, 50, 54, 57	FMNH, MNHW
Ardea alba	W R		S		#, 2, 28, 42, 50, 54, 57	FMNH
Pilherodius pileatus	W R		S		#, 28, 50, 54, 57	FMNH
Egretta thula	W R		S		#, 2, 28, 37, 45, 50, 54	MNHW
Egretta caerulea	W R		S		#, 2, 28, 42, 45, 50, 54	MZUSP
THRESKIORNITHIDAE						
Cercibis oxycerca	SAV		S	T	#, 23, 28, 37, 49, 50, 54	FMNH, MNHW
Mesembrinibis cayennensis	VZ IG		S	T	#, 28, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Phimosus infuscatus	W				45	
Theristicus caudatus	SAV		S	T	#, 2, 28, 42, 45, 50, 54	FMNH
Platalea ajaja	W R		S		#, 2, 37, 42, 57	MNHW
CICONIIDAE						
Ciconia maguari	W R		S		#, 12, 13, 50, 54	FMNH
Jabiru mycteria	W R		S		#, 2, 28, 37, 42, 50, 54, 57	MNHW
Mycteria americana	W R		S		#, 2, 28, 42, 45, 50, 57	FMNH
CATHARTIDAE						
Cathartes aura	X		S		#, 28, 37, 42, 50, 54, 57	MNHW
Cathartes burrovianus	SAV		S		#, 28, 34, 37, 42, 50, 54	LACMNH, MNHW
Cathartes melambrotos	TF DF				#, 2, 28, 50, 54, 57	
Coragyps atratus	X				#, 2, 28, 42, 50, 54, 57	
Sarcoramphus papa	TF DF SAV		S		#, 28, 37, 45, 50, 54, 57	MNHW
PANDIONIDAE						
Pandion haliaetus	R	NEA	S		#, 28, 37, 50, 54, 55, 57	MNHW
ACCIPITRIDAE						
Leptodon cayanensis	TF MF		S		28, 50, 57	MPEG
Chondrohierax uncinatus	DF		S		#, 11, 37	CP, MNHW
Elanoides forficatus	SAV TF MF	NEA			#, 28, 50, 57	
Gampsonyx swainsonii	SAV AA R		S	T	#, 2, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Elanus leucurus	SAV AA		S		#, 28, 37, 50	LACMNH, MNHW, MPEG, UMMZ
Rostrhamus sociabilis	W R				#, 2, 28, 50, 54	
Harpagus bidentatus	TF				#, 28, 50, 54, 57	
Harpagus diodon	TF		S		37	MNHW
Ictinia plumbea	SAV VZ DF	NEA	S		#, 28, 50, 54, 57	MPEG
Circus buffoni	SAV				12, 13	
Accipiter poliogaster	TF				28, 50	
Accipiter superciliosus	TF				#, 54	
Accipiter bicolor	TF		S		28, 50	MPEG
Geranopsiza caerulescens	DF VZ		S		#, 37, 42, 50, 51, 57	MNHW, MZUSP
Leucopternis schistaceus	VZ			T	#	
Leucopternis melanops	TF				28, 50	

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Leucopternis albicollis	TF		S		28, 37, 50, 54	MNHW
Buteogallus urubitinga	SAV R		S	T	#, 2, 28, 35, 37, 42, 50, 54, 57	MNHW, MZUSP
Heterospizias meridionalis	SAV R		S	T	#, 2, 28, 37, 42, 50, 54	FMNH, MNHW, MZUSP
Busarellus nigricollis	W R		S	T	#, 24, 28, 35, 37, 50, 54, 57	FMNH, MNHW, MPEG
Rupornis magnirostris	X		S	T	#, 2, 24, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Buteo albicaudatus	SAV		S		#, 2, 24, 28, 37, 49, 50, 54	FMNH, MNHW, MPEG
Buteo nitidus	SAV VZ SF AA		S		#, 2, 28, 50, 54	FMNH
Buteo swainsoni	TF SF	NEA			54, 55	
Buteo brachyurus	DF				#	
Buteo albonotatus	SAV				#, 28, 49, 50, 54	
Morphnus guianensis	TF				24, 28, 50	
Harpia harpyja	TF				#, 28, 42, 50	
Spizaetus tyrannus	VZ				#, 28, 50	
Spizaetus melanoleucus	TF DF		S		#, 24, 37	FMNH, MNHW
Spizaetus ornatus	TF		S	T	#, 28, 37, 50, 54	MNHW
FALCONIDAE						
Daptrius ater	TF VZ IG		S	T	#, 2, 28, 50, 54, 57	FMNH
Ibycter americanus	TF VZ			T	#, 28, 45, 50, 54, 57	
Caracara cheriway	X		S	T	#, 2, 28, 37, 42, 50, 54	FMNH, MNHW, MPEG, MZUSP
Milvago chimachima	X		S	T	#, 2, 28, 50, 54	FMNH, MPEG
Herpetotheres cachinnans	SAV VZ DF		S	T	#, 28, 42, 50, 54, 57	MZUSP
Micrastur ruficollis	TF			T	#, 2, 28, 50, 54	
Micrastur gilvicollis	TF				50	
Micrastur mirandollei	TF CAM		S	T	#, 37	MNHW
Micrastur semitorquatus	TF CAM GF VZ		S	T	#, 28, 37, 50, 54	MNHW
Falco sparverius	SAV		S		#, 2, 24, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Falco rufigularis	TF SF VZ CAM		S		#, 2, 28, 50, 54, 57	MPEG
Falco deiroleucus	VZ				60	
Falco femoralis	SAV		S		#, 24, 28, 37, 42, 50, 54	FMNH, MNHW, MZUSP
Falco peregrinus	SAV	NEA			J. Mazar Barnett (*in litt.*)	
ARAMIDAE						
Aramus guarauna	W R		S		#, 2, 28, 37, 42, 50, 54, 57	MNHW, MZUSP
PSOPHIIDAE						
Psophia crepitans	TF	(GUI)	S		#, 2, 28, 37, 42, 50, 54, 57	LACMNH, MNHW, MPEG, MZUSP
RALLIDAE						
Micropygia schomburgkii	SAV			T	#	
Aramides cajanea	W		S	T	#, 2, 28, 42, 50, 54, 57	LACMNH, MPEG, MZUSP
Laterallus viridis	W				#, 28, 50, 54	
Laterallus exilis	W			T	#, 50	
Porzana albicollis	W SAV			T	#, 28, 50, 54	
Gallinula chloropus	W				#	
Porphyrio martinica	W R		S		#, 28, 50, 54	MPEG
Porphyrio flavirostris	W R				50	

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
HELIORNITHIDAE						
Heliornis fulica	R		S		#, 37, 50, 54, 57	MNHW, MPEG
EURYPYGIDAE						
Eurypyga helias	VZ IG GF		S	T	#, 21, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
CHARADRIIDAE						
Vanellus cayanus	R W		S	T	#, 2, 23, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Vanellus chilensis	SAV W R AA		S	T	#, 2, 23, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Pluvialis dominica	W R	NEA		T, P	#, 54, 55	
Charadrius collaris	W R		S		#, 23, 42, 54, 57	FMNH, LACMNH, MPEG, MZUSP
BURHINIDAE						
Burhinus bistriatus	SAV		S		#, 13, 23, 27, 28, 37, 42, 49, 50	FMNH, LACMNH, MNHW, MNRJ, MPEG, MZUSP
SCOLOPACIDAE						
Gallinago paraguaiae	SAV W		S	T	#, 23, 28, 42, 50, 54	FMNH, LACMNH, MZUSP
Gallinago undulata	SAV W		S	T	#, 28, 37, 50	MNHW
Limosa haemastica	W R	NEA			54, 55	
Bartramia longicauda	W R	NEA	S		42, 49	MZUSP
Tringa melanoleuca	W R	NEA	S		#, 28, 45, 50, 54, 55	LACMNH
Tringa flavipes	W R	NEA	S		#, 28, 42, 45, 50, 55	MPEG, MZUSP
Tringa solitaria	W R	NEA	S	T	#, 23, 28, 50, 54, 55, 57	FMNH, MPEG
Actitis macularius	W R	NEA	S		#, 2, 28, 42, 50, 54, 55	LACMNH, MPEG, MZUSP
Calidris minutilla	W R	NEA	S		54, 55	FMNH, LACMNH, MPEG
Calidris fuscicollis	W R	NEA			54, 55	
Calidris melanotos	W R	NEA			#	
Tryngites subruficollis	W R	NEA			54, 55	
JACANIDAE						
Jacana jacana	W R AA		S		#, 2, 21, 28, 42, 50, 54	FMNH, MPEG, MZUSP
STERCORARIIDAE						
Stercorarius parasiticus	vagrant		S		56	MPEG
STERNIDAE						
Sternula superciliaris	R		S		#, 28, 42, 50, 54, 57	MZUSP
Phaetusa simplex	W R		S	T	#, 2, 23, 28, 45, 50, 54, 57	FMNH
RINCHOPIDAE						
Rynchops niger	R		S		#, 23, 42, 50, 54, 57	FMNH, LACMNH, MZUSP
COLUMBIDAE						
Columbina passerina	X		S		#, 2, 21, 27, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Columbina minuta	SAV AA		S		#, 2, 28, 50, 54	FMNH, MPEG
Columbina talpacoti	SAV AA		S		#, 2, 21, 28, 37, 42, 50, 54	FMNH, MNHW, MPEG, MZUSP
Claravis pretiosa	DF GF		S		#, 28, 42, 50, 54	MZUSP
Columba livia	AA				#, 54	
Patagioenas speciosa	CAM DF		S	T	#, 2, 21, 42, 45, 54, 57	CP, FMNH, MPEG, MZUSP
Patagioenas fasciata	MF	TEP	S		11, 41	CP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Patagioenas cayennensis	X		S	T	#, 21, 28, 37, 41, 42, 50, 54	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Patagioenas plumbea	TF VZ IG CAM				#, 54	
Patagioenas subvinacea	TF IG CAM DF		S	T	#, 2, 21, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Zenaida auriculata	X		S	T	#, 2, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MZUSP
Leptotila verreauxi	DF GF SF SAV VZ CAM		S	T	#, 2, 21, 42, 50, 51, 54	FMNH, LACMNH, MPEG, MZUSP
Leptotila rufaxilla	DF GF SF		S		#, 11, 28, 42, 50, 54	CP, LACMNH, MPEG, MZUSP
Geotrygon montana	TF		S		#, 11, 28, 50, 54, 57	CP, FMNH, MPEG
PSITTACIDAE						
Ara ararauna	TF VZ IG		S	T	#, 28, 37, 42, 50, 54, 57	MNHW, MPEG
Ara macao	TF VZ IG		S	T	#, 28, 37, 45, 50, 54, 57	MNHW
Ara chloropterus	TF VZ IG		S	T	#, 2, 11, 28, 45, 50, 54, 57	CP
Ara severus	VZ		S	T	#, 2, 28, 42, 50, 54, 57	MPEG, MZUSP
Orthopsittaca manilata	SAV DF GF CAM		S	T	#, 2, 5, 13, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Diopsittaca nobilis	SAV DF CAM		S	T	#, 2, 5, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Aratinga leucophthalma	GF SAV				28, 50, 57	
Aratinga solstitialis	SAV		S	T	#, 2, 13, 14, 25, 37, 50, 51, 53	MNHW
Aratinga pertinax	SAV IG VZ GF CAM		S	T	#, 2, 5, 13, 28, 37, 42, 49, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Pyrrhura picta	TF		S		11, 28, 50, 54	CP, FMNH, MPEG
Pyrrhura egregia	MF	TEP	S		41, 49	CP
Pyrrhura melanura	TF	WAM	S			MPEG
Forpus passerinus	SAV GF		S	T	#, 2, 5, 28, 37, 46, 49, 50, 54	FMNH, MNHW
Forpus modestus	TF	WAM		T	#	
Brotogeris chrysoptera	TF VZ IG	GUI	S	T	#, 2, 28, 50, 54, 57	FMNH, MPEG
Brotogeris cyanoptera	TF MF	WAM	S			CP
Nannopsittaca panychlora	MF	TEP			49, 54	
Touit huetii	TF			T	P. Coopmans (*in litt.*)	
Touit purpuratus	TF VZ		S		#, 44	MPEG
Pionites melanocephala	TF	(GUI)	S	T	#, 2, 28, 38, 42, 50, 54	FMNH, LACMNH, MPEG, MZUSP
Gypopsitta barrabandi	TF VZ	WAM	S		#, 37, 50, 54, 57	MNHW, MPEG
Gypopsitta caica	TF	GUI	S	T	#	FMNH, INPA
Pionus menstruus	TF VZ DF		S	T	#, 2, 3, 28, 50, 54, 57	MPEG
Pionus fuscus	TF VZ		S		#, 37, 54	MNHW
Amazona festiva	VZ		S	T	#, 14, 37, 57	MNHW
Amazona ochrocephala	SAV VZ DF		S	T	#, 5, 27, 28, 37, 42, 50, 54	FMNH, MNHW, MNRJ, MPEG, MZUSP
Amazona amazonica	DF VZ		S	T	#, 2, 5, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Amazona farinosa	TF		S	T	#, 2, 28, 45, 50, 54	MPEG
Deroptyus accipitrinus	TF		S	T	#, 2, 37, 50, 54, 57	MNHW, MPEG
OPISTHOCOMIDAE						
Opisthocomus hoazin	VZ IG GF		S		#, 28, 42, 45, 50, 54, 57	LACMNH, MZUSP
CUCULIDAE						
Coccyzus americanus	GF	NEA			28, 50	
Coccyzus euleri	DF	AUS?	S		#, 42, 54	FMNH, MZUSP
Coccyzus melacoryphus	DF GF VZ SF	AUS	S		#, 28, 42, 50, 54, 57	LACMNH, MZUSP, MPEG
Piaya cayana	X		S		#, 2, 5, 28, 41, 42, 50, 54, 57	CP, LACMNH, FMNH, MPEG, MZUSP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Piaya melanogaster	TF CAM		S		#, 28, 42, 49, 50, 54	MPEG, MZUSP
Coccycua minuta	VZ		S	T	#, 6, 28, 42, 50, 54	FMNH, LACMNH, MPEG, MZUSP
Coccycua pumila	GF				49, 59	
Crotophaga major	VZ IG		S	T	#, 28, 42, 50, 54, 57	LACMNH, MPEG, MZUSP
Crotophaga ani	X		S		#, 2, 27, 28, 42, 50, 54, 57	FMNH, LACMNH, MNRJ, MPEG, MZUSP
Tapera naevia	SAV VZ DF		S	T	#, 2, 28, 42, 50, 54	LACMNH, MPEG, MZUSP
Dromococcyx pavoninus	TF		S		37	MNHW
Neomorphus rufipennis	TF		S		2, 28, 37, 42, 49, 50	MNHW, MPEG, MZUSP
TYTONIDAE						
Tyto alba	SAV AA			T	#	
STRIGIDAE						
Megascops choliba	DF GF VZ IG MF		S	T	#, 2, 28, 37, 50, 54	FMNH, LACMNH, MNHW, MPEG
Megascops watsonii	TF		S	T	#, 28, 50	MPEG
Megascops guatemalae	MF	TEP	S		11, 39, 49	CP
Lophostrix cristata	TF			T	#, 54	
Pulsatrix perspicillata	TF		S		#, 28, 42, 50, 54	MPEG, MZUSP
Bubo virginianus	TF		S		28, 37, 50	MNHW
Strix virgata	TF				#, 28, 50	
Glaucidium hardyi	TF		S	T	#, 28, 37, 50	MNHW
Glaucidium brasilianum	DF GF MF		S	T	#, 28, 50, 54	LACMNH
Athene cunicularia	SAV AA		S		#, 2, 5, 28, 42, 50, 54	FMNH, MPEG, MZUSP
Rhinoptynx clamator	SAV				28, 50	
Asio stygius	VZ				A. Whittaker (in litt)	
STEATORNITHIDAE						
Steatornis caripensis	MF		S		11, 49	CP
NYCTIBIIDAE						
Nyctibius grandis	TF VZ				28, 50, 54	
Nyctibius aethereus	TF				28, 50	
Nyctibius griseus	TF VZ IG DF GF			T	#, 28, 50, 54, 57	
CAPRIMULGIDAE						
Chordeiles pusillus	SAV CAM AA		S	T	#, 5, 28, 37, 50, 54	FMNH, INPA, MNHW
Chordeiles rupestris	R				28, 50	
Chordeiles acutipennis	SAV CAM AA		S	T	#, 5, 28, 37, 42, 50, 54	FMNH, INPA, LACMNH, MNHW, MPEG, MZUSP
Chordeiles minor	VZ SAV	NEA			#, 28, 50	
Nyctiprogne leucopyga	VZ IG R		S	T	#, 50, 54, 57	FMNH
Podager nacunda	SAV	AUS	S		#, 5, 28, 37, 42, 50, 54	FMNH, INPA, LACMNH, MNHW, MPEG, MZUSP
Nyctidromus albicollis	X		S	T	#, 2, 5, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Caprimulgus rufus	CAM SAV			T	#, 2	
Caprimulgus longirostris	MF	TEP	S		41, 49	CP
Caprimulgus cayennensis	SAV		S	T	#, 5, 28, 37, 41, 42, 49, 50, 54	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Caprimulgus maculicaudus	DF SAV		S	T	#, 50	INPA
Caprimulgus nigrescens	TF		S	T	#, 54, 57	FMNH, INPA, MPEG

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Caprimulgus whitelyi	MF	TEP	S		11, 49	CP
Hydropsalis climacocerca	VZ IG		S	T	#, 42, 50, 51, 54	MPEG, MZUSP
APODIDAE						
Streptoprocne phelpsi	MF	TEP	S		11, 49, 54	CP
Streptoprocne zonaris	TF MF		S		#, 28, 42, 50, 54	MPEG, MZUSP
Chaetura spinicaudus	TF CAM				#, 2, 50, 54, 57	
Chaetura cinereiventris	VZ				J. F. Pacheco and A. Carvalhães (*in litt.*)	
Chaetura meridionalis	SAV	AUS?	S		#, 42, 49, 50	INPA, MZUSP
Chaetura brachyura	X		S	T	#, 2, 42, 50, 54	MZUSP
Aeronautes montivagus	MF	TEP	S		11, 49	CP
Tachornis squamata	X		S		#, 2, 28, 42, 50, 54	FMNH, MZUSP
Panyptila cayennensis	SAV DF SF				#, 54	
TROCHILIDAE						
Glaucis hirsutus	SF		S		43, 54	FMNH, MPEG
Threnetes leucurus	TF		S		2, 28, 42, 49, 50, 54	MPEG, MZUSP
Phaethornis rupurumii	TF SF VZ		S		2, 5, 28, 43, 50, 54	FMNH, MPEG
Phaethornis griseogularis	MF	TEP	S		43, 54	CP
Phaethornis ruber	TF SF CAM VZ		S	T	#, 28, 50, 54, 57	FMNH, MPEG
Phaethornis hispidus	GF SF				49, 54	
Phaethornis bourcieri	TF VZ CAM		S		#, 11, 41, 43, 54	CP, MPEG
Phaethornis superciliosus	TF DF MF	(WAM?)/(GUI)	S		#, 2, 5, 28, 50, 54	FMNH, MPEG
Doryfera johannae	MF	TEP	S		11, 40	CP
Campylopterus largipennis	TF				#, 54, 57	
Campylopterus hyperythrus	MF	TEP	S		41, 49	CP
Florisuga mellivora	TF DF VZ IG CAM		S		#, 2, 42, 54	FMNH, MPEG, MZUSP
Colibri delphinae	MF	TEP	S		11, 40, 43, 49	CP
Anthracothorax nigricollis	VZ		S		#, 2, 5, 28, 50, 54	FMNH, MPEG
Topaza pella	TF	GUI			49, 54	
Chrysolampis mosquitus	CAM		S	T	#, 11, 13, 28, 50	CP, FMNH, LACMNH, MPEG
Lophornis ornatus	MF	TEP	S		43, 54	FMNH, MPEG
Lophornis chalybeus	MF	TEP			11, 49	
Lophornis pavoninus	MF	TEP	S		49	CP
Chlorestes notata	VZ IG CAM		S		#, 28, 37, 42, 50, 54	FMNH, MNHW, MPEG, MZUSP
Chlorostilbon mellisugus	GF DF SAV		S		#, 11, 28, 50, 54	CP
Thalurania furcata	TF		S		#, 11, 40, 41, 43, 50, 54, 57	CP, FMNH, MPEG
Hylocharis sapphirina	TF CAM			T	#, 54	
Hylocharis cyanus	TF CAM		S	T	#, 43, 54	FMNH, MPEG
Polytmus guainumbi	SAV		S		#, 28, 54	FMNH, INPA, MPEG
Polytmus theresiae	CAM IG		S	T	#	FMNH, LACMNH, MPEG
Amazilia versicolor	IG SAV		S		#, 2, 11, 28, 50, 54	CP, FMNH, MPEG
Amazilia brevirostris	SAV		S		42, 49, 50, 54	MZUSP
Amazilia fimbriata	SAV GF DF AA		S	T	#, 5, 28, 42, 50, 54	FMNH, LACMNH, MPEG, MZUSP
Amazilia viridigaster	MF		S		2, 11, 41, 43, 49, 54	CP, FMNH
Heliodoxa xanthogonys	MF	TEP	S		11, 41, 49	CP
Heliothryx auritus	TF		S		#, 5, 28, 43, 50, 54, 57	FMNH, MPEG

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Heliomaster longirostris	SF				#, 2, 28, 50, 54	
Calliphlox amethystina	SAV SF MF		S		11, 54	CP
TROGONIDAE						
Trogon viridis	TF DF VZ CAM		S	T	#, 2, 5, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Trogon violaceus	TF		S	T	#, 28, 50, 54, 57	FMNH
Trogon collaris	MF		S		11	CP, MPEG
Trogon personatus	MF	TEP	S		39, 41, 49	CP
Trogon rufus	TF	(GUI)		T	#	
Trogon melanurus	TF		S		#, 2, 28, 50, 54, 57	MPEG
ALCEDINIDAE						
Ceryle torquatus	R W		S	T	#, 2, 28, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Chloroceryle amazona	R		S		#, 2, 5, 28, 42, 50, 54, 57	FMNH, LACMNH, MZUSP
Chloroceryle americana	R W		S		#, 2, 5, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Chloroceryle inda	R GF VZ		S		28, 42, 45, 50, 54, 57	FMNH, MPEG, MZUSP
Chloroceryle aenea	R GF VZ		S		#, 28, 50, 54	MPEG
MOMOTIDAE						
Momotus momota	TF VZ DF	(GUI)	S		#, 2, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
GALBULIDAE						
Brachygalba lugubris	GF SF		S	T	#, 2, 6, 37, 42, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Galbula albirostris	TF	(GUI)	S	T	#, 54, 57	FMNH, MPEG
Galbula ruficauda	GF		S	T	#, 37, 49	MNHW
Galbula galbula	VZ DF GF IG		S	T	#, 2, 6, 13, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Galbula leucogastra	CAM			T	#, 57	
Galbula dea	TF	(GUI)	S	T	#, 28, 50, 57	FMNH
Jacamerops aureus	TF	(GUI)	S		#, 28, 50, 54	FMNH, MPEG
BUCCONIDAE						
Notharchus hyperrhynchus	TF	WAM	S		(50, 54)[a]	
Notharchus macrorhynchos	TF	GUI		T	#, 37	MNHW
Notharchus tectus	TF SF		S		#, 2, 6, 42, 50, 54	FMNH, LACMNH, MPEG, MZUSP
Bucco macrodactylus	TF				28, 50, 54	
Bucco tamatia	TF IG		S	T	#, 6, 37, 42, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Bucco capensis	TF				54	
Nonnula rubecula	TF	(WAM)	S		54	
Monasa atra	TF DF	GUI	S		#, 2, 6, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Monasa nigrifrons	VZ IG			T	#	
Chelidoptera tenebrosa	X		S	T	#, 2, 6, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
CAPITONIDAE						
Capito niger	TF	GUI			#, 57	
Capito auratus	TF VZ	WAM	S	T	#, 11, 42 (2, 28, 50, 54)[b]	CP, MPEG, MZUSP
RAMPHASTIDAE						
Ramphastos toco	SAV DF		S	T	#, 28, 37, 42, 50, 54	LACMNH, MNHW, MPEG, MZUSP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Ramphastos tucanus	TF VZ IG DF	(WAM)/(GUI)	S	T	#, 2, 28, 37, 42, 50, 54, 57	LACMNH, MNHW, MPEG, MZUSP
Ramphastos vitellinus	TF	(WAM)/(GUI)	S	T	#, 2, 28, 50, 54, 57	LACMNH, MPEG
Aulacorhynchus derbianus	MF	TEP	S		11, 41	CP
Selenidera piperivora	TF	GUI			#	
Pteroglossus viridis	TF	GUI	S	T	#, 2, 28, 37, 42, 50, 54, 57	MNHW, MPEG, MZUSP
Pteroglossus azara	TF SF GF	WAM	S		28, 50, 54	MPEG
Pteroglossus aracari	TF VZ	(GUI)	S		#, 28, 54	MPEG
Pteroglossus pluricinctus	TF SF GF	WAM	S		28, 50, 54	FMNH, MPEG
PICIDAE						
Picumnus exilis	TF SF		S		#, 6, 11, 28, 41, 42, 50, 54	CP, FMNH, LACMNH, MPEG, MZUSP
Picumnus spilogaster	DF GF		S	T	#, 6, 28, 37, 49, 50, 54, 78	FMNH, INPA, MNHW
Picumnus cirratus	GF DF		S	T	#	INPA
Melanerpes cruentatus	TF SF VZ IG		S	T	#, 2, 28, 42, 50, 54	LACMNH, MPEG, MZUSP
Veniliornis passerinus	VZ GF DF		S	T	#, 28, 42, 50, 54, 73	AMNH, FMNH, LACMNH, MZUSP
Veniliornis kirkii	MF	TEP	S		41, 49	CP
Veniliornis affinis	TF	WAM	S		51	MPEG
Veniliornis cassini	TF	GUI	S		#, 41, 50, 54	FMNH, LACMNH, MPEG
Piculus flavigula	TF VZ		S		#, 2, 6, 28, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Piculus chrysochloros	TF				#	
Piculus rubiginosus	MF	TEP	S		11, 39, 49, 54	CP, FMNH
Colaptes punctigula	VZ GF		S		#, 42, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Celeus grammicus	TF VZ IG	WAM	S	T	#, 50, 54	MPEG
Celeus elegans	TF VZ CAM		S	T	#, 6, 28, 37, 50, 51, 54, 57	FMNH, LACMNH, MNHW, MPEG
Celeus flavus	TF VZ DF		S		#, 28, 42, 50, 54, 57	LACMNH, MPEG, MZUSP
Celeus torquatus	TF CAM DF		S	T	#, 28, 50, 54	FMNH, MPEG
Dryocopus lineatus	TF SF DF GF VZ IG		S	T	#, 2, 6, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Campephilus rubricollis	TF VZ IG MF		S	T	#, 2, 6, 11, 28, 42, 50, 54, 57	CP, FMNH, LACMNH, MPEG, MZUSP
Campephilus melanoleucos	TF SF VZ IG CAM DF		S	T	#, 6, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
THAMNOPHILIDAE						
Cymbilaimus lineatus	TF SF		S	T	#, 2, 54	MPEG
Frederickena viridis	TF	GUI	S			MPEG
Taraba major	VZ DF SF		S	T	#, 8, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Sakesphorus canadensis	SAV VZ IG DF GF CAM		S	T	#, 2, 8, 13, 28, 37, 42, 50, 54, 62, 57, 78	ANSP, FMNH, LACMNH, MNHW, MPEG, MZUSP, UMMZ
Thamnophilus doliatus	VZ GF DF		S	T	#, 8, 28, 37, 42, 50, 54, 62	AMNH, FMNH, LACMNH, MNHW, MPEG, MZUSP
Thamnophilus nigrocinereus	VZ IG		S	T	#, 44	MPEG
Thamnophilus aethiops	TF	WAM	S	T	#, 28, 42, 50, 54	FMNH, MNHW, MPEG, MZUSP
Thamnophilus murinus	TF		S	T	#, 2, 28, 50, 54	FMNH, MPEG
Thamnophilus punctatus	DF GF CAM TF	GUI	S	T	#, 8, 28, 37, 41, 42, 50, 54, 57	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Thamnophilus amazonicus	TF IG CAM	(WAM)	S	T	#, 57	FMNH
Thamnophilus insignis	MF	TEP	S		41, 49	CP
Dysithamnus mentalis	MF	TEP	S		11, 41, 54	CP
Thamnomanes ardesiacus	TF		S		2, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Thamnomanes caesius	TF		S	T	#, 2, 8, 42, 54	FMNH, MPEG, MZUSP
Pygiptila stellaris	TF VZ	WAM		T	#, 28, 50, 54	
Myrmotherula gutturalis	TF	GUI		T	#	

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Myrmotherula haematonota	TF	WAM	S		49, 50, 54	FMNH, MPEG
Myrmotherula brachyura	TF VZ IG		S	T	#, 28, 50, 54	FMNH
Myrmotherula ambigua	TF	WAM	S		49, 54	FMNH
Myrmotherula surinamensis	SF	GUI	S	T	#, 8	FMNH
Myrmotherula cherriei	CAM IG			T	#, 57	
Myrmotherula klagesi	VZ			T	#	
Myrmotherula guttata	TF	GUI	S		2, 28, 50, 54, 57	FMNH, MPEG
Myrmotherula axillaris	TF DF GF CAM	(GUI)	S	T	#, 2, 8, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Myrmotherula longipennis	TF		S	T	#, 54	FMNH, MPEG
Myrmotherula behni	MF	TEP	S		11	CP
Myrmotherula menetriesii	TF	(WAM)/(GUI)?	S	T	#, 50, 54	FMNH, MPEG
Myrmotherula assimilis	VZ IG			T	#	
Herpsilochmus dorsimaculatus	TF CAM		S	T	#, 54	FMNH, INPA, MPEG
Herpsilochmus roraimae	MF	TEP	S		11, 40, 41, 49	CP
Herpsilochmus rufimarginatus	TF VZ		S	T	#, 28, 50, 51, 54	FMNH, INPA, MPEG
Microrhopias quixensis	TF GF		S	T	# , 57	FMNH, MPEG
Formicivora grisea	CAM SAV GF DF		S	T	#, 28, 29, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Terenura spodioptila	TF		S	T	#, 54	FMNH
Cercomacra cinerascens	TF SF VZ IG		S	T	#, 2, 50, 54	FMNH, MPEG
Cercomacra tyrannina	SF CAM	(GUI)	S	T	#, 2, 28, 50, 54	LACMNH, MPEG
Cercomacra laeta	SF	(GUI)	S	T	#, 1	FMNH
Cercomacra nigrescens	VZ		S	T	#	MPEG
Cercomacra carbonaria	GF VZ		S	T	#, 4, 12, 13, 37, 42, 44, 49, 54, 78	FMNH, INPA, LACMNH, MNHW, MPEG, MZUSP
Myrmoborus leucophrys	TF GF		S	T	#, 8, 28, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Myrmoborus lugubris	VZ		S	T	#, 44	MPEG
Myrmoborus myotherinus	TF		S		54	FMNH, MPEG
Hypocnemis cantator	TF	(WAM)/(GUI)	S	T	#, 2, 8, 28, 40, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Hypocnemoides melanopogon	VZ IG GF CAM		S	T	#, 8, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Sclateria naevia	IG SF			T	#	
Percnostola rufifrons	TF	(WAM)?/(GUI)	S	T	#, 57	MPEG
Schistocichla leucostigma	TF	(WAM)?/(GUI)	S		41	CP, FMNH
Schistocichla saturata	MF	TEP	S		41	CP
Myrmeciza longipes	TF DF GF		S	T	#, 8, 13, 28, 42, 49, 50, 54	FMNH, LACMNH, MPEG, MZUSP
Myrmeciza ferruginea	TF	GUI	S	T	#, 57	FMNH, MPEG
Myrmeciza atrothorax	TF SF	(GUI)	S	T	#, 2, 28, 42, 50, 54	LACMNH, MPEG, MZUSP
Myrmeciza disjuncta	CAM		S	T	#	INPA
Myrmornis torquata	TF		S		2, 57	MPEG
Pithys albifrons	TF	(GUI)	S		50, 54, 57	FMNH, MPEG
Gymnopithys rufigula	TF CAM	GUI	S	T	#, 2, 28, 37, 42, 50, 54, 57	FMNH, MNHW, MPEG, MZUSP
Hylophylax naevius	TF		S		42, 54	FMNH, MPEG, MZUSP
Hylophylax punctulatus	VZ		S	T	#, 54	FMNH, MPEG
Hylophylax poecilinotus	TF CAM	(GUI)	S	T	#, 2, 11, 28, 50, 54	CP, FMNH, MPEG
CONOPOPHAGIDAE						
Conopophaga aurita	TF		S		44	MPEG
GRALLARIIDAE						
Hylopezus macularius	TF				57	

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Myrmothera campanisona	TF CAM		S	T	#, 2, 28, 54	FMNH, MPEG
Myrmothera simplex	MF	TEP	S		11, 41, 49	CP
FORMICARIIDAE						
Formicarius colma	TF		S	T	#, 2, 8, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Formicarius analis	TF				#	
Chamaeza campanisona	MF	TEP	S		11, 50	CP
SCLERURIDAE						
Sclerurus mexicanus	TF		S		#	MPEG
Sclerurus rufigularis	TF		S		54	FMNH
Sclerurus caudacutus	TF		S		11, 28, 50	CP, MPEG
DENDROCOLAPTIDAE						
Dendrocincla fuliginosa	TF CAM	(WAM)/(GUI)	S	T	#, 9, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Dendrocincla merula	TF CAM	(WAM)?/(GUI)	S		#, 2, 28, 50, 51, 54	LACMNH, MPEG
Deconychura longicauda	TF	(WAM)?/(GUI)	S		28, 50, 54	MPEG
Sittasomus griseicapillus	TF MF	(WAM)/(GUI)?	S	T	#, 9, 11, 28, 41, 50, 51, 54	CP, FMNH, MPEG
Glyphorynchus spirurus	TF	(WAM)/(GUI)	S	T	#, 2, 9, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Nasica longirostris	VZ IG GF		S	T	#, 42, 57	LACMNH, MPEG, MZUSP
Dendrexetastes rufigula	TF				2, 28, 50	
Hylexetastes perrotii	TF	GUI	S	T	#, 28, 50, 54	INPA
Xiphocolaptes promeropirhynchus	TF MF			T	#, 28, 50	
Dendrocolaptes certhia	TF CAM	(GUI)	S	T	#, 9, 28, 37, 50, 54	FMNH, LACMNH, MNHW, MPEG
Dendrocolaptes picumnus	TF MF	(GUI)	S	T	#, 9, 28, 37, 42, 49, 50, 54	MNHW, MPEG, MZUSP
Xiphorhynchus picus	VZ IG DF GF		S	T	#, 2, 9, 28, 37, 42, 50, 54, 78	FMNH, LACMNH, MNHW, MPEG, MZUSP
Xiphorhynchus kienerii	VZ IG		S	T	#, 44	MPEG
Xiphorhynchus obsoletus	VZ IG CAM		S	T	#, 9, 42, 54	FMNH, LACMNH, MPEG, MZUSP
Xiphorhynchus pardalotus	TF	GUI	S	T	#, 2, 11, 41, 42, 50, 54	CP, FMNH, LACMNH, MPEG
Xiphorhynchus guttatus	TF CAM DF GF MF		S	T	#, 9, 28, 42, 50, 54	FMNH, INPA, LACMNH, MPEG, MZUSP
Lepidocolaptes souleyetii	GF DF		S	T	#, 9, 13, 49, 54	FMNH
Lepidocolaptes albolineatus[c]	TF	(WAM/GUI)	S	T	#, (9, 37, 50, 51, 54)[c]	FMNH, MNHW, MPEG
Campylorhamphus sp.[d]	TF				54, 57	
FURNARIIDAE						
Furnarius leucopus	GF VZ		S	T	#, 9, 27, 28, 29, 37, 42, 50, 54, 78	FMNH, INPA, LACMNH, MNHW, MNRJ, MPEG, MZUSP
Synallaxis albescens	SAV DF GF CAM		S	T	#, 9, 37, 41, 42, 54	CP, FMNH, MNHW, MPEG, MZUSP
Synallaxis rutilans	TF	(GUI)	S	T	#, 2, 9, 28, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Synallaxis propinqua	VZ				31	
Synallaxis macconnelli	MF	TEP	S		11, 39, 41	CP
Synallaxis gujanensis	VZ		S	T	#, 28, 50, 54	MPEG, LACMNH
Synallaxis kollari	GF		S	T	#, 4, 9, 12, 13, 32, 37, 42, 47, 49, 58	INPA, MPEG, MZUSP
Cranioleuca vulpina	VZ IG		S	T	#, 33, 37, 42	LACMNH, MNHW, MPEG, MZUSP
Cranioleuca demissa	MF	TEP	S		11, 41, 49	CP
Cranioleuca gutturata	VZ			T	#	
Certhiaxis cinnamomeus	VZ W		S	T	#, 28, 33, 37, 50, 54	MNHW, MPEG
Roraimia adusta	MF	TEP	S		11, 41, 49	CP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Berlepschia rikeri	SAV			T	#	
Hyloctistes subulatus	TF MF	WAM	S			CP
Philydor ruficaudatum	TF		S		42, 54	FMNH, MPEG, MZUSP
Philydor pyrrhodes	TF		S		54	FMNH
Automolus ochrolaemus	TF CAM		S	T	#	FMNH, MPEG
Automolus infuscatus	TF	(GUI)	S		50, 54	FMNH, LACMNH, MPEG
Automolus roraimae	MF	TEP	S		11, 39, 49	CP
Automolus rubiginosus	TF		S		54	CP, FMNH, MPEG
Automolus rufipileatus	VZ TF		S	T	#, 28, 50, 54	MPEG, MZUSP
Lochmias nematura	MF	TEP	S		41	CP
Xenops tenuirostris	TF		S			FMNH
Xenops minutus	TF	(GUI)	S		#, 2, 9, 11, 28, 42, 50, 54, 57	CP, FMNH, MPEG, MZUSP
TYRANNIDAE						
Phyllomyias griseiceps	SF		S		54	FMNH
Tyrannulus elatus	TF VZ IG CAM		S	T	#, 2, 28, 50, 54, 57	LACMNH, MPEG
Myiopagis gaimardii	TF VZ IG DF CAM		S	T	#, 2, 28, 50, 51, 54, 78	FMNH, LACMNH, MPEG
Myiopagis caniceps	TF			T	#	
Myiopagis flavivertex	VZ IG		S	T	#, 54	FMNH
Myiopagis viridicata	GF DF		S	T	#, 54	FMNH, INPA
Elaenia flavogaster	SAV		S	T	#, 2, 10, 28, 42, 50, 54, 71	AMNH, FMNH, LACMNH, MZUSP
Elaenia parvirostris	GF DF SF	AUS	S		#, 37, 42, 54	MNHW, MZUSP
Elaenia cristata	SAV		S	T	#, 10, 37, 41, 42	CP, FMNH, MNHW, MZUSP
Elaenia chiriquensis	SAV		S	T	#, 10, 28, 37, 50, 54	FMNH, INPA, MNHW, MPEG
Elaenia ruficeps	CAM		S	T	#, 11, 28, 50	CP, FMNH
Elaenia pallatangae	MF	TEP	S		11, 40, 41, 49	CP
Ornithion inerme	TF		S	T	#, 28, 50, 54	FMNH, MPEG
Camptostoma obsoletum	SAV VZ GF DF AA		S	T	#, 2, 28, 42, 50, 54	MPEG, MZUSP
Mecocerculus leucophrys	MF	TEP	S		41, 49	CP
Serpophaga hypoleuca	VZ				#, 31	
Phaeomyias murina	SAV GF DF AA		S	T	#, 2, 10, 28, 37, 42, 50, 54, 70	AMNH, FMNH, INPA, LACMNH, MNHW, MPEG, MZUSP
Capsiempis flaveola	VZ GF		S	T	#, 10, 54	FMNH, LACMNH, MPEG
Polystictus pectoralis	SAV		S	T	#, 30, 42	FMNH, MPEG, MZUSP
Corythopis torquatus	TF		S		2, 42, 54	FMNH, LACMNH, MPEG, MZUSP
Stigmatura napensis	VZ				A. Whittaker (in litt.)	
Zimmerius gracilipes	TF GF VZ	(GUI)	S	T	#, 2, 42, 54	FMNH, MPEG, MZUSP
Phylloscartes chapmani	MF	TEP	S		11, 39, 49	CP
Phylloscartes nigrifrons	MF	TEP	S		11, 49	CP
Mionectes oleagineus	TF		S	T	#, 10, 28, 50, 54, 57	FMNH, MPEG
Mionectes macconnelli	TF MF		S		#, 11, 54	CP
Leptopogon amaurocephalus	MF		S		54	FMNH, MPEG
Sublegatus obscurior	SF		S		54	FMNH
Sublegatus modestus	SAV		S	T	#	FMNH, INPA
Inezia subflava[e]	VZ IG			T	#	
Inezia caudata	GF		S	T	#, 10, 42, 68 (13, 28, 50, 54, 78)[e]	FMNH, INPA, LACMNH, MPEG, MZUSP
Myiornis ecaudatus	TF			T	#, 28, 50, 54	
Lophotriccus galeatus	TF DF SF CAM		S	T	#, 28, 42, 50, 54	FMNH, LACMNH, MPEG, MZUSP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Atalotriccus pilaris	DF		S	T	#, 12, 13, 49, 61	INPA
Hemitriccus minor	VZ IG			T	#	
Hemitriccus zosterops	TF	(GUI)		T	#	
Hemitriccus margaritaceiventer	CAM		S		#, 11	CP
Hemitriccus inornatus	CAM			T	#	
Poecilotriccus russatus	MF	TEP	S		41, 49	CP
Poecilotriccus sylvia	GF DF		S	T	#, 5, 8, 24, 44, 48	FMNH, INPA, LACMNH, MPEG
Taeniotriccus andrei	GF		S		7, 10, 28, 44, 50, 54	CP, MPEG
Todirostrum maculatum	VZ IG DF AA		S	T	#, 10, 28, 37, 42, 50, 54, 69, 57, 78	AMNH, FMNH, LACMNH, MNHW, MPEG, MZUSP
Todirostrum cinereum	SAV DF GF		S	T	#, 10, 37, 41, 42, 50, 51, 54	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Todirostrum pictum	TF	GUI	S	T	#, 28, 50, 54	FMNH
Rhynchocyclus olivaceus	TF		S			MPEG
Tolmomyias sulphurescens	VZ IG GF		S	T	#, 28, 42, 50, 51, 54	CP, FMNH, MPEG
Tolmomyias assimilis	TF	(GUI)	S	T	#, 2, 54	FMNH, MPEG
Tolmomyias poliocephalus	TF VZ SF	(GUI)	S	T	#, 2, 28, 50, 54	MPEG, LACMNH
Tolmomyias flaviventris	DF GF VZ IG CAM		S	T	#, 10, 28, 29, 42, 50, 54, 67	AMNH, FMNH, LACMNH, MPEG, MZUSP
Platyrinchus saturatus	TF		S		54	MPEG
Platyrinchus coronatus	TF		S		42, 54	MPEG, MZUSP
Platyrinchus platyrhynchos	TF		S		10, 37, 54	FMNH, MNHW, MPEG
Onychorhynchus coronatus	TF	(GUI)	S	T	#, 10, 37, 42	FMNH, MNHW, MPEG, MZUSP
Myiophobus roraimae	MF	TEP	S		11, 39, 49	CP
Myiophobus fasciatus	SF				#, 28, 50, 54	
Myiobius barbatus	TF		S		#, 28, 50, 54	FMNH, MPEG
Myiobius atricaudus	TF		S		50	MPEG
Terenotriccus erythrurus	TF	(GUI)	S	T	#, 2, 10, 50, 51, 54	FMNH, MPEG
Hirundinea ferruginea	MF	TEP	S		41	CP
Lathrotriccus euleri	VZ SF		S	T	#, 28, 42, 50, 54	MPEG, MZUSP
Cnemotriccus fuscatus	GF CAM		S	T	#, 37, 42, 54	FMNH, INPA, LACMNH, MNHW, MPEG, MZUSP
Contopus cooperi	SF	NEA			54, 55	
Contopus fumigatus	MF	TEP	S		11, 49	CP
Contopus virens	MF TF	NEA				CP
Pyrocephalus rubinus	SAV	AUS?	S	T	#, 2, 10, 27, 28, 42, 50, 54	FMNH, LACMNH, MNRJ, MPEG, MZUSP
Knipolegus poecilocercus	VZ IG GF		S		10, 37, 42	FMNH, LACMNH, MNHW, MPEG, MZUSP
Knipolegus poecilurus	IG MF	TEP	S		41, 49	CP
Ochthornis littoralis	VZ R		S	T	#, 10, 28, 49, 50	FMNH, LACMNH, MNHW, MPEG
Fluvicola pica	VZ W R		S		#, 10, 28, 37, 42, 50	FMNH, LACMNH, MNHW, MPEG, MZUSP
Arundinicola leucocephala	VZ W R		S		#, 2, 28, 50, 54	FMNH, LACMNH, MPEG
Colonia colonus	MF SF		S		54	MPEG
Legatus leucophaius	X		S	T	#, 2, 10, 28, 50, 54, 57	FMNH, MPEG
Myiozetetes cayanensis	X		S	T	#, 2, 10, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Myiozetetes similis	VZ SF AA		S		28, 50, 54	MPEG
Myiozetetes granadensis	SF				49, 54	
Myiozetetes luteiventris	SF				54	
Pitangus sulphuratus	X		S	T	#, 2, 10, 27, 28, 37, 42, 50, 54, 65, 57	AMNH, FMNH, LACMNH, MNHW, MNRJ, MPEG, MZUSP
Philohydor lictor	VZ IG R W		S	T	#, 2, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Conopias parvus	TF IG CAM		S	T	#, 2, 11, 28, 50, 54	CP, FMNH

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Conopias trivirgatus	VZ			T	A. Whittaker (*in litt.*)	
Myiodynastes maculatus	DF GF VZ IG	AUS?	S	T	#, 2, 10, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Megarynchus pitangua	X		S	T	#, 2, 10, 28, 41, 50, 54	CP, FMNH, MPEG
Tyrannopsis sulphurea	SAV		S	T	#, 2, 28, 42, 50	MZUSP
Empidonomus varius	X	AUS	S	T	#, 2, 10, 28, 42, 50, 54	FMNH, MPEG, MZUSP
Tyrannus albogularis	SAV VZ AA	AUS	S	T	#, 50, 54	FMNH, MPEG, LACMNH
Tyrannus melancholicus	X	AUS	S	T	#, 2, 10, 28, 41, 42, 50, 54, 57, 64	AMNH, CP, LACMNH, FMNH, MPEG, MZUSP
Tyrannus savana	X	AUS/RES?	S	T	#, 2, 10, 28, 41, 42, 50, 54, 57, 64	AMNH, CP, FMNH, INPA, LACMNH, MPEG, MZUSP
Tyrannus dominicensis	SAV	NEA			28, 49	
Rhytipterna simplex	TF IG		S	T	#, 2, 28, 42, 50, 54	MPEG, MZUSP
Rhytipterna immunda	CAM			T	#	
Sirystes sibilator	TF		S		#, 2, 54	FMNH
Myiarchus tuberculifer	SAV GF DF		S	T	#, 10, 28, 50, 54, 66	AMNH, FMNH, MPEG
Myiarchus swainsoni	SAV	AUS	S	T	#, 10, 11, 41, 42, 66	AMNH, CP, FMNH, INPA, MZUSP
Myiarchus ferox	X		S	T	#, 28, 42, 50, 54, 66	AMNH, LACMNH, MPEG, MZUSP
Myiarchus tyrannulus	SAV DF GF		S	T	#, 10, 37, 42, 54, 66	AMNH, FMNH, INPA, MNHW, MZUSP
Ramphotrigon ruficauda	TF CAM		S	T	#, 28, 42, 50, 54	FMNH, MPEG, MZUSP
Attila cinnamomeus	VZ IG TF CAM		S	T	#, 28, 42, 50, 54	MPEG, MZUSP
Attila spadiceus	TF		S	T	#, 2, 28, 50, 54	MPEG
OXYRUNCIDAE						
Oxyruncus cristatus	MF	TEP	S		11, 39	CP
COTINGIDAE						
Rupicola rupicola	MF		S		2, 11, 27, 42, 54	CP, MNRJ, MPEG, MZUSP
Cotinga cotinga	TF				#	
Cotinga cayana	TF		S		#, 54	FMNH, MPEG
Procnias albus	MF TF		S			MPEG
Procnias averano	MF	TEP	S		11, 41, 49, 54	CP, MPEG
Lipaugus vociferans	TF		S	T	#, 2, 15, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Lipaugus streptophorus	MF	TEP	S		41, 49	CP
Xipholena punicea	TF		S		2, 54, 57	FMNH
Gymnoderus foetidus	VZ TF DF				#, 28, 50, 57	
Querula purpurata	TF		S	T	#, 2, 11, 15, 28, 37, 50, 54	CP, FMNH, MNHW, MPEG
Perissocephalus tricolor	TF	GUI	S	T	#, 11, 28, 37, 49, 50, 54, 57	CP, MNHW
Cephalopterus ornatus	VZ GF		S		15, 28, 37, 50	FMNH, MNHW
PIPRIDAE						
Neopelma chrysocephalum	CAM		S	T	#, 54	FMNH
Tyranneutes stolzmanni	TF	WAM	S		42, 50, 54	FMNH, MPEG, MZUSP
Tyranneutes virescens	TF	GUI		T	#	
Piprites chloris	TF			T	#, 54	
Corapipo gutturalis	TF MF	GUI	S		40, 54	CP, MPEG
Machaeropterus regulus	MF	WAM	S		54	FMNH
Machaeropterus pyrocephalus	TF		S		28, 50	MPEG
Lepidothrix coronata	TF	WAM	S		50, 54	FMNH, MPEG
Lepidothrix suavissima	MF	TEP	S		41, 49	CP
Manacus manacus	TF SF		S		#, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Chiroxiphia pareola	DF GF TF CAM	(GUI)	S	T	#, 15, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Xenopipo uniformis	MF	TEP	S		11, 41, 49	CP
Xenopipo atronitens	CAM		S	T	#, 37	FMNH, MNHW
Heterocercus flavivertex	CAM IG		S	T	#, 42, 49, 57	MPEG, MZUSP
Dixiphia pipra	TF SF CAM		S	T	#, 2, 15, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Pipra filicauda	VZ GF		S		#, 15, 28, 42, 50, 54	FMNH, MPEG, MZUSP
Pipra cornuta	MF	TEP	S		11, 41, 49	CP
Pipra erythrocephala	TF SF CAM MF		S	T	#, 2, 15, 27, 28, 42, 50, 54, 57	FMNH, LACMNH, MNRJ, MPEG, MZUSP
TITYRIDAE						
Schiffornis major	VZ		S	T	#	MPEG
Schiffornis turdina	TF CAM	(WAM)?/(GUI)	S	T	#, 54	FMNH, MPEG
Laniocera hypopyrra	TF		S	T	#, 2, 28, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Iodopleura fusca	TF	GUI			2, 49, 50, 54	
Tityra inquisitor	TF		S		2, 28, 50, 54	MPEG
Tityra cayana	TF SF VZ IG VZ		S	T	#, 2, 28, 29, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Pachyramphus rufus	VZ SF		S	T	#, 37, 42, 50, 54	LACMNH, MNHW, MPEG, MZUSP
Pachyramphus polychopterus	DF GF VZ TF SF		S	T	#, 15, 28, 37, 42, 50, 54, 63	AMNH, FMNH, MNHW, MPEG, MZUSP
Pachyramphus marginatus	TF		S		#, 42, 54	FMNH, MZUSP
Pachyramphus surinamus	TF		S	T	#	FMNH
Pachyramphus minor	TF		S		#, 2, 54	FMNH, MPEG
Xenopsaris albinucha	SAV		S	T	#, 49, 50, 51	MPEG
VIREONIDAE						
Cyclarhis gujanensis	X		S	T	#, 28, 37, 41, 42, 50, 54, 78	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Vireolanius leucotis	TF				28, 50, 54	
Vireo olivaceus[f]	X	RES/NEA	S	T	# (2, 17, 28, 41, 42, 50, 54, 72)[f]	(CP, FMNH, LACMNH, MPEG, MZUSP)[e] AMNH
Hylophilus thoracicus	TF SF			T	#	
Hylophilus semicinereus	VZ IG			T	#	
Hylophilus pectoralis	GF DF		S	T	#, 17, 28, 37, 42, 50, 54, 78	FMNH, LACMNH, MNHW, MPEG, MZUSP
Hylophilus sclateri	MF	TEP	S		11, 41, 49	CP
Hylophilus brunneiceps	CAM		S		49, 54	FMNH
Hylophilus muscicapinus	TF	GUI	S	T	#, 2, 50, 54	FMNH, MPEG
Hylophilus ochraceiceps	TF	(WAM)/(GUI)	S		54	FMNH, MPEG
CORVIDAE						
Cyanocorax violaceus	TF SF		S		#, 28, 49, 50, 54	MPEG
Cyanocorax cayanus	TF		S	T	#, 2, 37, 49	MNHW
HIRUNDINIDAE						
Tachycineta albiventer	R W		S	T	#, 2, 17, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Progne tapera	R SAV W AA	AUS/RES	S		#, 28, 42, 50, 54, 57	LACMNH, MZUSP
Progne chalybea	R SAV AA		S		#, 2, 17, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Pygochelidon cyanoleuca	MF	TEP	S		41	CP
Atticora fasciata	R		S	T	#, 17, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Atticora melanoleuca	R				#, 50	
Neochelidon tibialis	TF		S			MPEG

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Alopochelidon fucata	SAV		S		41, 50, 54	CP
Stelgidopteryx ruficollis	SAV R		S		#, 28, 42, 50, 54, 57	LACMNH, MPEG, MZUSP
Riparia riparia	R	NEA			#, 28, 50, 54, 55	
Hirundo rustica	SAV CAM W R	NEA	S		#, 17, 28, 42, 50, 54, 55	FMNH, LACMNH, MPEG, MZUSP
TROGLODYTIDAE						
Microcerculus ustulatus	MF	TEP	S		11, 39, 41, 49	CP
Microcerculus bambla	TF	(GUI)			28, 50, 54	
Troglodytes musculus	X		S	T	#, 2, 16, 28, 37, 41, 42, 50, 54, 57	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Troglodytes rufulus	MF	TEP	S		41, 49	CP
Cistothorus platensis	MF	TEP	S		41	CP
Campylorhynchus griseus	SAV DF GF		S	T	#, 2, 16, 27, 28, 37, 42, 49, 50, 54	FMNH, LACMNH, MNHW, MNRJ, MPEG, MZUSP
Thryothorus coraya	TF VZ		S	T	#, 2, 11, 41, 50, 54, 57	CP, MPEG
Thryothorus leucotis	VZ IG GF DF		S	T	#, 2, 16, 28, 37, 42, 50, 54, 57, 78	FMNH, LACMNH, MNHW, MPEG,MZUSP
Henicorhina leucosticta	TF		S		11, 49, 54	CP, FMNH, MPEG
Cyphorhinus arada	TF	(GUI)	S		28, 50, 57	MPEG
POLIPTILIDAE						
Microbates collaris	TF		S		50, 54	FMNH, MPEG
Ramphocaenus melanurus	TF CAM		S	T	#, 28, 50, 54	CP, MPEG
Polioptila plumbea	SAV DF GF VZ IG		S	T	#, 2, 16, 27, 28, 37, 42, 50, 54, 74, 78, 57	AMNH, FMNH, MNHW, MNRJ, MPEG, MZUSP
Polioptila guianensis	TF CAM		S		54	FMNH
INCERTAE SEDIS[g]						
Donacobius atricapilla	VZ W		S		#, 16, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
TURDIDAE						
Catharus fuscescens	SF	NEA	S		50, 51, 54	MPEG
Catharus minimus	SF SAV	NEA			50	
Platycichla flavipes	MF	TEP	S		41	CP
Platycichla leucops	MF	TEP	S		40, 49	CP
Turdus olivater	MF	TEP	S		28, 41, 49, 50	CP
Turdus leucomelas	SAV GF DF AA		S	T	#, 2, 16, 27, 28, 37, 42, 50, 54	FMNH, MNHW, MNRJ, MPEG, MZUSP
Turdus ignobilis	CAM MF		S		#, 11, 41, 54	CP
Turdus fumigatus	VZ		S	T	#, 42, 50, 51, 54, 57	MPEG, MZUSP
Turdus nudigenis	DF GF		S	T	#, 16, 28, 37, 42, 50, 54	MNHW, MPEG, MZUSP
Turdus albicollis	TF VZ IG CAM		S	T	#, 2, 16, 28, 42, 50, 54	FMNH, MPEG, MZUSP
MIMIDAE						
Mimus gilvus	SAV AA		S	T	#, 2, 16, 27, 28, 37, 42, 49, 50, 54	FMNH, INPA, LACMNH, MNHW, MNRJ, MPEG, MZUSP
MOTACILIIDAE						
Anthus lutescens	SAV		S		#, 17, 28, 41, 42, 50, 54	CP, FMNH, MPEG, MZUSP
COEREBIDAE						
Coereba flaveola	X		S	T	#, 2, 11, 17, 28, 41, 42, 50, 54, 57	CP, FMNH, LACMNH, MPEG, MZUSP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
THRAUPIDAE						
Schistochlamys melanopis	CAM SAV		S	T	#, 28, 41, 50, 54	CP, FMNH, MPEG
Cissopis leverianus	TF SF		S		#, 2, 42, 50, 54	MZUSP
Nemosia pileata	SAV GF DF VZ		S	T	#, 2, 37, 50, 54	FMNH, LACMNH, MNHW, MPEG
Eucometis penicillata	VZ GF		S	T	#, 18, 42, 54	FMNH, MPEG, MZUSP
Tachyphonus cristatus	TF	(GUI)	S		#, 27, 50, 54	MNRJ, MPEG
Tachyphonus luctuosus	VZ GF DF		S		#, 2, 18, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Tachyphonus surinamus	TF SF		S	T	#, 50, 54	FMNH, MPEG
Tachyphonus phoenicius	CAM		S		#, 11, 41, 54	CP
Lanio fulvus	TF	GUI	S			CP, MPEG
Ramphocelus carbo	X		S	T	#, 2, 18, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
Thraupis episcopus	X		S	T	#, 2, 18, 27, 28, 41, 42, 50, 54, 57, 77	AMNH, CP, FMNH, LACMNH, MNRJ, MPEG, MZUSP
Thraupis palmarum	X		S		#, 2, 18, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Cyanicterus cyanicterus	TF CAM				54	
Pipraeidea melanonota	MF	TEP	S		40	CP
Tangara mexicana	TF SF MF VZ GF		S		#, 2, 28, 42, 50, 54	FMNH, LACMNH, MPEG, MZUSP
Tangara chilensis	TF	(GUI)	S		2, 27, 50, 54	FMNH, MNRJ, MPEG
Tangara schrankii	MF	WAM			54	
Tangara xanthogastra	MF TF	WAM	S		49, 50, 54	CP
Tangara punctata	TF MF		S		#, 2, 54	FMNH, MPEG
Tangara guttata	MF	TEP	S		41, 49, 54	CP, MPEG
Tangara gyrola	MF TF		S		40, 41, 54	CP
Tangara varia	TF MF	GUI	S			CP
Tangara cayana	SAV GF DF		S	T	#, 2, 18, 27, 41, 42, 50, 54, 76	AMNH, FMNH, LACMNH, MNRJ, MPEG, MZUSP
Tangara nigrocincta	TF	WAM	S		2, 49, 54	FMNH, MPEG
Tangara cyanoptera	MF	TEP	S		11, 27, 41, 49	CP, MNRJ
Tangara velia	TF	(GUI)	S		#, 50, 54	FMNH, MPEG
Tersina viridis	SF	AUS?	S		#, 28, 50, 54	MPEG
Dacnis cayana	TF SAV GF DF VZ IG CAM		S		#, 2, 28, 37, 42, 50, 54, 57	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Dacnis lineata	TF		S		50, 54, 57	MPEG
Dacnis flaviventer	VZ				57	
Cyanerpes nitidus	TF		S		#, 54	FMNH, MPEG
Cyanerpes caeruleus	TF DF	(GUI)	S		#, 2, 42, 50, 54, 57	FMNH, MPEG, MZUSP
Cyanerpes cyaneus	TF DF			T	#, 28, 50, 54	
Chlorophanes spiza	TF		S		#, 2, 28, 42, 50, 54, 57	MPEG, MZUSP
Hemithraupis guira	TF DF		S		#, 2, 28, 42, 50, 54	FMNH, MZUSP
Hemithraupis flavicollis	TF		S		#, 28, 50, 54	FMNH, MPEG
Conirostrum speciosum	GF DF		S	T	#, 37, 42, 54	FMNH, MNHW, MPEG, MZUSP
Conirostrum bicolor	VZ			T	#, 31	
Diglossa major	MF	TEP	S		27, 41, 49	CP, MNRJ
INCERTAE SEDIS[h]						
Piranga flava	SAV DF MF		S	T	#, 2, 18, 27, 28, 41, 42, 50	CP, FMNH, LACMNH, MNRJ, MPEG, MZUSP
Piranga rubra	SAV	NEA			55	
Piranga leucoptera	MF	TEP	S		41, 49	CP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Mitrospingus oleagineus	MF	TEP	S		41, 49	CP
EMBERIZIDAE						
Zonotrichia capensis	MF CAM		S	T	#, 11, 41, 54	CP, FMNH, MPEG
Ammodramus humeralis	SAV		S	T	#, 2, 20, 28, 37, 41, 42, 49, 50, 54	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Ammodramus aurifrons	VZ			T	#	
Sicalis citrina	SAV W		S		28, 41, 50, 54	CP
Sicalis columbiana	VZ			T	#	
Sicalis luteola	SAV		S	T	#, 20, 28, 37, 42, 50, 54	FMNH, INPA, LACMNH, MNHW, MPEG, MZUSP
Emberizoides herbicola	CAM SAV		S	T	#, 28, 41, 50, 54	CP, FMNH, MPEG
Volatinia jacarina	SAV SF VZ AA		S	T	#, 2, 28, 42, 50, 51, 54	LACMNH MPEG, MZUSP
Sporophila schistacea	VZ W		S	T	#, 28, 50, 54	FMNH, LACMNH
Sporophila intermedia	SAV W		S		#, 2, 13, 49, 50, 51, 52, 54	FMNH, MPEG
Sporophila plumbea	SAV W		S	T	#, 28, 49, 50, 51, 54	FMNH, MPEG
Sporophila americana	SAV		S			LACMNH
Sporophila bouvronides	SAV W				50	
Sporophila lineola	VZ W		S		#, 2, 28, 42, 50, 54	FMNH, MZUSP
Sporophila nigricollis	SF		S		20, 41, 54	CP
Sporophila leucoptera	SAV W				2	
Sporophila minuta	SAV SF W		S		#, 2, 28, 41, 42, 50, 51, 54	CP, FMNH, LACMNH, MPEG, MZUSP
Sporophila castaneiventris	VZ SAV W				28, 50	
Sporophila angolensis	SAV CAM SF		S		#, 2, 20, 28, 42, 50, 51, 54	FMNH, LACMNH, MPEG,MZUSP
Sporophila crassirostris	SAV				28, 50, 54	
Catamenia homochroa	MF	TEP	S		41, 49	CP
Arremonops conirostris	VZ		S	T	#, 28, 42, 49, 50, 54	ANSP, LACMNH, MZUSP
Arremon taciturnus	TF		S	T	#, 2, 11, 28, 37, 41, 42, 50, 54	CP, FMNH, LACMNH, MNHW, MPEG, MZUSP
Atlapetes personatus	MF	TEP	S		11, 49	CP
Paroaria gularis	VZ IG GF R AA		S		#, 2, 20, 28, 42, 50, 54, 57	FMNH, LACMNH, MPEG, MZUSP
CARDINALIDAE						
Caryothraustes canadensis	TF		S	T	#, 2, 54	FMNH, MPEG
Saltator grossus	TF CAM				#, 50, 54	
Saltator maximus	TF SF		S	T	#, 2, 28, 42, 50, 54	MPEG, MZUSP
Saltator coerulescens	VZ GF DF SF		S	T	#, 20, 27, 28, 37, 42, 50, 54	LACMNH, MNHW, MNRJ, MPEG, MZUSP
Cyanocompsa cyanoides	TF SF		S	T	#, 28, 50, 54	FMNH, MPEG
Spiza americana	SAV	NEA	S		30, 49	MPEG
PARULIDAE						
Parula pitiayumi	SAV DF MF		S	T	#, 11, 37, 41, 49	CP, MNHW
Dendroica petechia	GF SF	NEA	S		#, 17, 28, 37, 49, 50, 54, 55	FMNH, LACMNH, MNHW, MPEG
Dendroica striata	GF DF SF	NEA	S		#, 2, 28, 37, 42, 49, 50, 54	MNHW, MZUSP
Dendroica fusca	TF SF DF MF	NEA	S		39, 49	CP
Setophaga ruticilla	DF TF SF MF	NEA	S		11, 40, 49, 50, 54, 55	CP, LACMNH
Geothlypis aequinoctialis	SAV VZ W		S		28, 37, 50, 54	FMNH, MNHW
Myioborus miniatus	MF	TEP	S		11, 49	CP
Myioborus castaneocapillus	MF	TEP	S		41, 49	CP

Family and bird species	Habitat	Dist/Migr.	Evidence		References	Ornithological collections
Basileuterus bivittatus[i]	MF	TEP	S		11, 40, 41, 49	CP
Basileuterus culicivorus	MF DF		S		41, 54	CP
Basileuterus flaveolus	DF GF		S	T	#	INPA
Phaeothlypis rivularis	TF		S		#, 17, 28, 42, 50, 54	FMNH, MPEG, MZUSP
INCERTAE SEDIS[j]						
Granatellus pelzelni	TF CAM		S	T	#, 17, 54	FMNH
ICTERIDAE						
Psarocolius viridis	TF MF		S		2, 19, 28, 37, 50, 54, 57	FMNH, MNHW, MPEG
Psarocolius decumanus	TF VZ IG CAM		S	T	#, 28, 42, 50, 54, 57	LACMNH, MPEG, MZUSP
Psarocolius bifasciatus	VZ		S		#, 54	FMNH, MPEG
Procacicus solitarius	VZ GF				#, 28, 50	
Cacicus cela	X		S	T	#, 2, 19, 28, 37, 42, 50, 54, 57	FMNH, LACMNH, MNHW, MPEG, MZUSP
Cacicus haemorrhous	TF		S		#, 28, 50, 54, 57	MPEG
Icterus croconotus	GF DF		S	T	#, 27	FMNH, MNRJ
Icterus chrysocephalus	SAV CAM		S	T	#, 2, 19, 27, 28, 42, 49, 50, 54, 57	FMNH, LACMNH, MNRJ, MPEG, MZUSP
Icterus nigrogularis	SAV DF GF		S	T	#, 2, 19, 27, 28, 37, 42, 49, 50, 54	FMNH, LACMNH, MNHW, MNRJ, MPEG, MZUSP
Macroagelaius imthurnii	MF	TEP	S		41, 49, 54	CP
Lampropsar tanagrinus	GF VZ				28, 50	
Chrysomus icterocephalus	VZ W		S		28, 50	MPEG
Gymnomystax mexicanus	VZ R				28, 50	
Molothrus bonariensis	VZ IG GF		S		#, 2, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Molothrus oryzivorus	VZ IG SF		S		#, 2, 19, 50, 54, 57	FMNH, MPEG
Sturnella militaris	SAV W SF		S	T	#, 2, 19, 28, 37, 42, 50, 54	FMNH, LACMNH, MNHW, MPEG, MZUSP
Sturnella magna	SAV		S	T	#, 2, 26, 27, 28, 37, 41, 42, 49, 50, 54	CP, FMNH, LACMNH, MNHW, MNRJ, MPEG, MZUSP
FRINGILLIDAE						
Carduelis magellanica	MF	TEP	S		41, 49, 54	CP
Euphonia plumbea	CAM		S	T	#, 54	FMNH
Euphonia chlorotica	TF SF			T	50 (2, 28)[k]	
Euphonia finschi	SAV		S	T	#, 18, 37, 49, 50, 54, 75	AMNH, FMNH, MNHW, MPEG
Euphonia violacea	TF SF		S	T	#, 2, 27, 28, 42, 50, 54	LACMNH MNRJ, MPEG, MZUSP
Euphonia chrysopasta	TF		S		2, 50, 54	MPEG
Euphonia minuta	TF		S	T	#, 54	FMNH
Euphonia xanthogaster	MF		S		11, 28, 41, 50	CP
Euphonia rufiventris	TF	WAM	S		54	MPEG
Euphonia ceyennensis	TF	GUI			#	
Chlorophonia cyanea	MF	TEP	S		11, 41	CP

[a] Previous sight records from Maracá are likely to represent *N. hyperrhynchus*, which should be present west of the Rio Branco.

[b] Previous records mention *Capito niger*, but are likely to represent *C. auratus*.

[c] Our records represent *L. a. albolineatus*; previous records likely to represent *L. a. duidae*.

[d] Unidentified to species by Stotz (1997) and Trolle and Walther (2004).

[e] Previous records mention *Inezia subflava*, but are likely to represent *I. caudata.*

[f] Our records are likely to refer to the resident form *Vireo olivaceus chivi* (as well as a skin at AMNH); previous records referred as belonging to the nominate migratory form.

[g] Included within the Troglodytidae by the CBRO, but we follow the SACC (Remsen et al. 2006) and place it as *Incertae sedis* until its taxonomic relationships are better understood.

[h] Included within the Thraupidae by the CBRO, but we follow the SACC (Remsen et al. 2006) and place it as *Incertae sedis* until its taxonomic relationships are better understood.

[i] The records for the state represent the form *roraimae*, which has been suggested to represent a valid species (Hilty 2003)

[j] Included within the Parulidae by the CBRO, but we follow the SACC (Remsen et al. 2006) and place it as *Incertae sedis* until its taxonomic relationships are better understood.

[k] Original records mention *E. laniirostris*, but are likely to represent *E. chlorotica (see Hypothetical species)*

Habitat

TF: terra firme forest; SF: secondary forest, forest edge, and clearings within terra firme forest; MF: montane forest (includes humid forests above 600 m, and all montane habitats present in the Tepuis); VZ: varzea forest; IG: igapo forest; CAM: campina and campinarana; SAV: savanna; GF: gallery forest; DF: dry forest; R: associated to rivers; W: wetlands; AA: antropic areas; X: virtually all habitats.

Distribution/migration

GUI: species restricted to the Guianan area of endemism; (GUI): subspecies restricted to the Guianan area of endemism; WAM: species with distributions typical of western Amazonia, and generally absent from the Guianan area of endemism; (WAM) subspecies with distributions typical of western Amazonia, and generally absent from the Guianan area of endemism; ?: taxon possibly present (but not confirmed) in Roraima; TEP: species or subspecies restricted to the Tepuis; NEA: Nearctic migrant (species breeding in North America that reach Roraima during the boreal winter [Sept-April]); AUS: Austral migrant (species breeding in southern South America that spend the Austral winter [April-August] in Amazonia and northern South America).

Evidence

S: specimen available (see Ornithological collections); T: tape-recordings available at the INPA Archive of Bird Sounds; P: photograph available.

References

1: Bierregaard et al. (1997), 2: Borges (1994), 3: Cohn-Haft et al. (1997), 4: Collar et al. (1992), 5: Cory (1918), 6: Cory (1919), 7: Cory (1920), 8: Cory and Hellmayr (1924), 9: Cory and Hellmayr (1925), 10: Cory and Hellmayr (1927), 11: Dickerman and Phelps (1982), 12: Forrester (1993), 13: Forrester (1995), 14: Hellmayr (1906), 15: Hellmayr (1929), 16: Hellmayr (1934), 17: Hellmayr (1935), 18: Hellmayr (1936), 19: Hellmayr (1937), 20: Hellmayr (1938), 21: Hellmayr and Conover (1942), 22: Hellmayr and Conover (1948a), 23: Hellmayr and Conover (1948b), 24: Hellmayr and Conover (1949), 25: Joseph (1992), 26: Joseph (2001), 27: Miranda-Ribeiro (1929), 28: Moskovits et al. (1985), 29: Naumburg (1930), 30: Novaes (1967), 31: Pacheco (1995a), 32: Pelzeln (1856), 33: Pelzeln (1859), 34: Pelzeln (1861), 35: Pelzeln (1862), 36: Pelzeln (1863), 37: Pelzeln (1868-71), 38: Peters (1937), 39: Phelps (1973), 40: Phelps and Phelps (1948), 41: Phelps and Phelps (1962), 42: Pinto (1966), 43: Ruschi (1961), 44: Santos (2004), 45: Schattuck (1926), 46: Schlegel (1864), 47: Sclater (1874), 48: Sick (1965), 49: Sick (1997), 50: Silva (1998), 51: Silva and Oren (1990), 52: Silva and Willis (1986), 53: Spix (1824-25), 54: Stotz (1997), 55: Stotz et al. (1992), 56: Teixeira et al. (1986), 57: Trolle and Walther (2004), 58: Vaurie (1980), 59: Whittaker (1995), 60: Whittaker (1996), 61: Willis (2003), 62: Zimmer (1933), 63: Zimmer (1936), 64: Zimmer (1937a), 65: Zimmer (1937b), 66: Zimmer (1938), 67: Zimmer (1939a), 68: Zimmer (1939b), 69: Zimmer (1940), 70: Zimmer (1941a), 71: Zimmer (1941b), 72: Zimmer (1941c), 73: Zimmer (1942a), 74: Zimmer (1942b), 75: Zimmer (1943a), 76: Zimmer (1943b), 77: Zimmer (1944), 78: Zimmer et al. (1997).

Ornithological collections

AMNH: American Museum of Natural History; ANSP: Academy of Natural Science of Philadelphia; CP: Colección Phelps; FMNH: Field Museum of Natural History; INPA: Instituto Nacional de Pesquisas da Amazônia; LACMNH: Los Angeles County Museum of Natural History; MNHW: Museum of Natural History of Wien; MNRJ: Museu Nacional de Rio de Janeiro; MPEG: Museu Paraense Emílio Goeldi; MZUSP: Museu de Zmologia da Universidade de São Paulo; UMMZ: University of Michigan Museum of Zoology.