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BIRDS OF JAÚ NATIONAL PARK, BRAZILIAN AMAZON: SPECIES CHECK-LIST, BIOGEOGRAPHY AND CONSERVATION

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Resumo. – Aves do Parque Nacional de Jaú, Amazônia brasileira: lista de espécies, biogeografia e conservação. – Este artigo apresenta uma listagem detalhada da avifauna do Parque Nacional do Jaú localizado a oeste do baixo Rio Negro, uma região muito mal conhecida do ponto de vista ornitológico. Durante os trabalhos de campo desenvolvidos nos últimos sete anos foram registradas 445 espécies de aves confirmadas e um adicional de oito espécies hipotéticas para o Parque o que representa mais de 50% da avifauna conhecida da Amazônia Central. Uma comparação com outra listagem de aves da margem leste do Rio Negro (reservas do Projeto Dinâmica Biológica de Fragmentos Florestais ou PDBFF), mostrou uma grande semelhança no número de espécies de aves de matas de terra firme nas duas áreas de estudo, com 257 espécies registradas para as reservas do BDFFP e 245 para o PNJ. Várias extensões importantes de distribuições geográficas foram documentadas no PNJ, em especial de aves consideradas restritas à região do alto Rio Negro (e.g., *Myrmotherula cherriei*, *M. ambigua* e *Rhegmatorhina cristata*). Além disso, várias espécies de vegetações não florestais da Amazônia tiveram suas distribuições ampliadas com os registros do PNJ (e.g., *Formicivora grisea*, *Emberizoides herbicola*, *Caprimulgus rufus*, *Asio stygius* e *Schistochlamys melanopis*). Este estudo apresenta o primeiro registro de *Myrmeciza disjuncta* para o Brasil, uma espécie de ave cuja biologia é muito mal conhecida. Aparentemente a única ameaça direta à avifauna do PNJ é a caça de algumas espécies de cracídeos pela pequena população residente no PNJ. O impacto humano sobre a cobertura florestal é muito pequena. O bom estado de conservação do PNJ aliado à representatividade regional de sua avifauna, tornam o PNJ uma importante área para a proteção da biodiversidade da Amazônia.

Abstract. – This article presents a detailed bird checklist of Jaú National Park (JNP) located at west bank of the lower Rio Negro, a region poorly known ornithologically. In the field work conducted during the last seven years, we recorded 445 bird species, with eight additional hypothetical records for the park, representing more than 50% of the known Central Amazonian avifauna. A comparison of the JNP and Biological Dynamics of Forest Fragments Project (BDFFP) reserves (eastern bank of the Rio Negro) show a high similarity in number of species of terra firme forest among the two study sites, with 257 species recorded from BDFFP reserves and 245 species from JNP. Several important range extensions were documented in JNP, especially for birds previously considered endemic to the upper Rio Negro (e. g. *Myrmothe-*

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rula cherriei, *M. ambigua*, *Rhegmatorhina cristata* and *Dolospingus fringilloides*). Moreover, several non-forest Amazonian birds have their distribution extended by JNP records (e. g. *Formicivora grisea*, *Emberizoides herbicola*, *Caprimulgus rufus*, *Asio stygius* and *Schistochlamys melanopis*). Also this study presents the first Brazilian record of *Myrmeciza disjuncta*, a poorly known antbird. Currently, the only threat to the JNP avifauna is the hunting of some cracids by the local residents. The actual human impact in the vegetation cover of the JNP is very small. The good conservation status in conjunction with the regional representation of their avifauna makes the JNP an important area for the protection of the Amazon biodiversity. *Accepted 20 August 2000.*

Key words: *Neotropical birds, Imeri refuge, Amazonia, Rio Negro, protected area, Jaú National Park, Brazil.*

INTRODUCTION

Biogeographical criteria were used to establish the conservation units of the Brazilian Amazon (Rylands 1991, Barreto Filho 1999), despite the lack of sufficient knowledge concerning the biological diversity of the region (Nelson *et al.* 1990, Oren & Albuquerque 1991). Therefore reserves, national parks and ecological stations in the Brazilian Amazon were created without previous fauna and flora inventories (Rylands 1991). It should be recognized that an inventory of plants and animals and their ecological requirements are prerequisites for establishing conservation priorities. However, it is difficult to compile complete species lists in the Amazon region due to the exceptional species richness and the small number of field researchers able to inventory large, poorly explored, and highly species-rich regions.

One of the conservation units established without local assessment of the biological diversity is the Jaú National Park (JNP), the largest Brazilian national park, located on the west bank of the lower Rio Negro. Although no biological inventories from the area were completed prior to creation of the JNP, recent biological inventories confirm the importance of the region in the protection of a representative portion of Amazonian biodiversity (Fundação Vitória Amazônica 1998a, 1998b).

This study presents a bird check-list of Jaú National Park (JNP) with emphasis on their distribution, biogeography and conservation. Bird surveys in JNP have been conducted since 1992 as a part of the biological research program that supports the management plan of the park (Carvalhaes 1996, Fundação Vitória Amazônica 1998a). Because the western portion of the lower Rio Negro has not been investigated from an ornithological perspective (Oren & Albuquerque 1991), we present information on poorly known bird species. Most of these species are found in vegetation types typical of the Rio Negro basin. e.g., forest flooded by black water rivers (Pires & Prance 1985) and sandy soil vegetation (Anderson 1981).

STUDY AREA

The Jaú National Park encompasses an area of the 2,272.000 ha located in the lower Rio Negro, 200 km northwest of Manaus (Fig. 1). The limits of JNP are defined by three black water rivers: the Jaú river (nuclear region of the park), the Unini river (north portion), and the Carabinani river (south portion). Thoroughly sampling this entire area for birds is logistically impossible; so we limited our efforts to only some portions of the JNP, especially from the mouth to middle course of the Jaú river (Fig. 2).

The climate in the JNP is warm and humid with a mean monthly temperature ranging from 26.3 to 27.2°C (Ferreira & Prance 1998). The annual precipitation ranges from 1750 to 2500 mm with a dry season extending from June to September, and a wet season from December to May (Fundação Vitória Amazônica 1998a).

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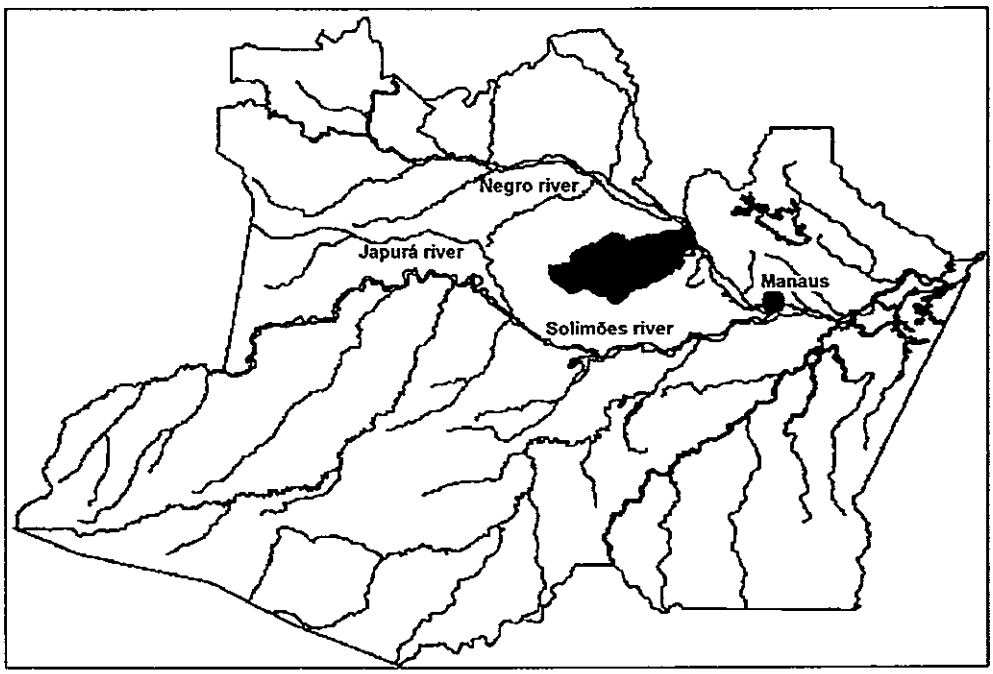

FIG. 1. Map of Amazonas State showing the general location of the Jaú National Park.

There is a marked seasonality in the water level of JNP rivers related to local relief. Generally, the low water season extends from September to November and the high water from May to August (Fundação Vitória Amazônica 1998a). However, the fluvial dynamics in JNP rivers are very complex due to the considerable spatial and temporal variability in the water cycle (Fundação Vitória Amazônica 1998a).

The most important vegetation types and habitats for birds at JNP are described in continuation.

Terra firme forest. Occupies some 70% of JNP (Fundação Vitória Amazônica 1998a) and is characterized by large trees in the order of 25 m in height, with some tallest ones reaching 35 m (Fig. 3). There is considerable heterogeneity in local plant communities in the terra firme forest related to soil mosaics in the region (Fundação Vitória Amazônica 1998a). This heterogeneity can also be related to human disturbance (Ferreira & Prance 1999). Some of our studies sites were located in secondary growth forest more than 40 years old. The understory of the terra firme forest is dominated by several palm species.

Igapó forest. Is the second more extensive vegetation type in the park and occupies 12% of the area (Figs 4 & 5). This type of forest is seasonally flooded by black water rivers (Pires & Prance 1985). The vegetation structure and floristic composition of igapó forest are influenced by the flooding levels of rivers and lakes (Ferreira 1997). In sites exposed to severe and long duration flooding, the species richness is lower than in sites flooded only for short periods (Junk 1989, Ferreira 1997). Some places, such as oxbow lakes, tend to be mono-dominant with more widely spaced

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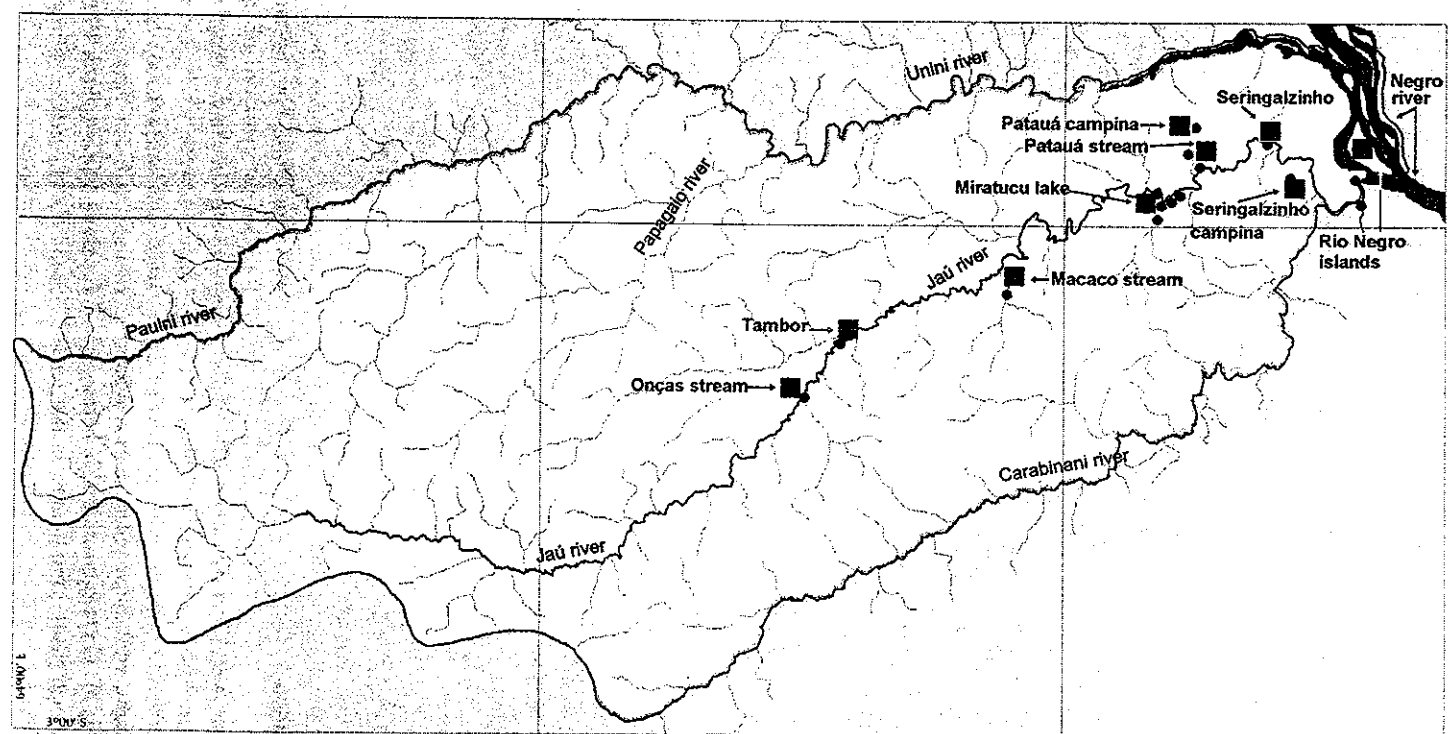

FIG. 2. Map of the Jaú National Park showing the localities where bird inventory was made.

FIG. 3. Aerial view of the canopy of terra firme forest.

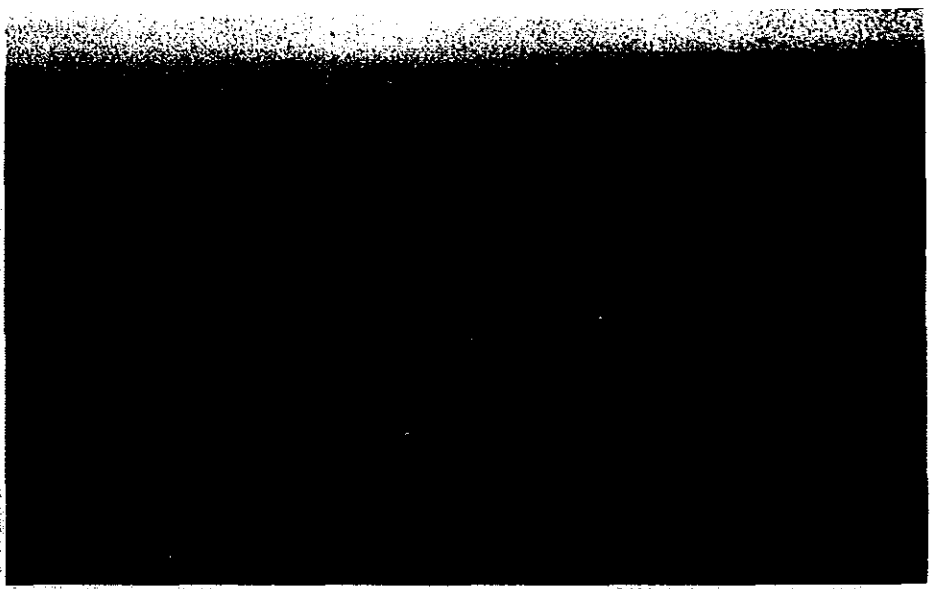

FIG. 4. Aerial view of contact of igapó (light areas) and terra firme (darker areas) forests.

trees (SHB, pers. observ.). Generally, the understory of this forest is open (Fig. 5), although some areas are very shrubby. The edges between the forest and the river channel and lakes are dominated by shrubby vegetation, mainly *Symeria paniculata*, an important micro-habitat for some bird species such as *Inezia subflava* and *Sakesphorus canadensis*. For a

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FIG. 5. Understory of igapó flooded forest during the dry season.

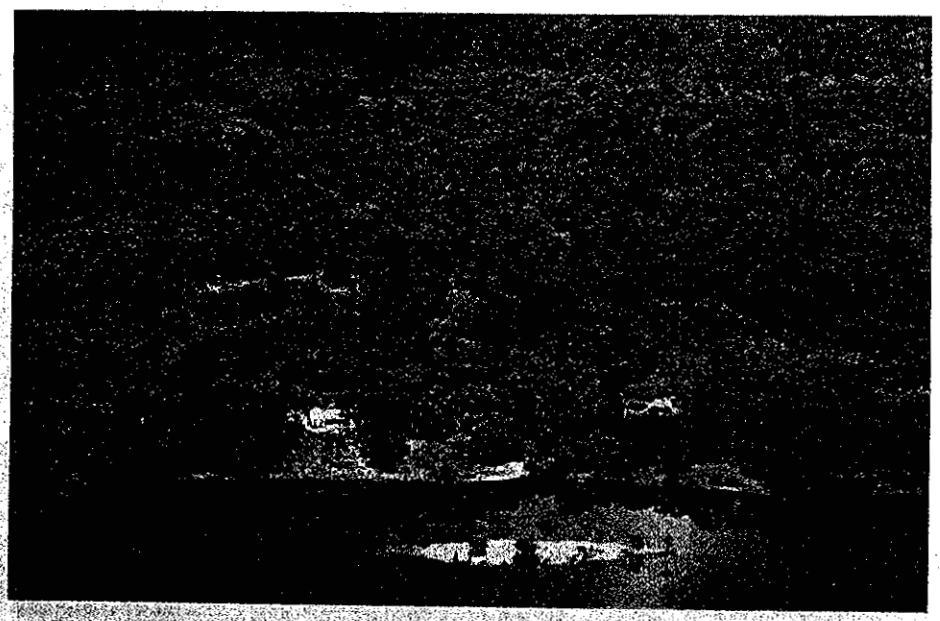

FIG. 6. Aerial fiew of small patches of young secondary forest and recent cut and burned areas.

more detailed discussion on the avifauna of this habitat, see Borges & Carvalhaes (2000).

Disturbed vegetation. The low human population (< 1000 inhabitants) that live in the JNP manage the terra firme forest for subsistence agriculture. The cut and burned areas average about one to two ha per family and are used

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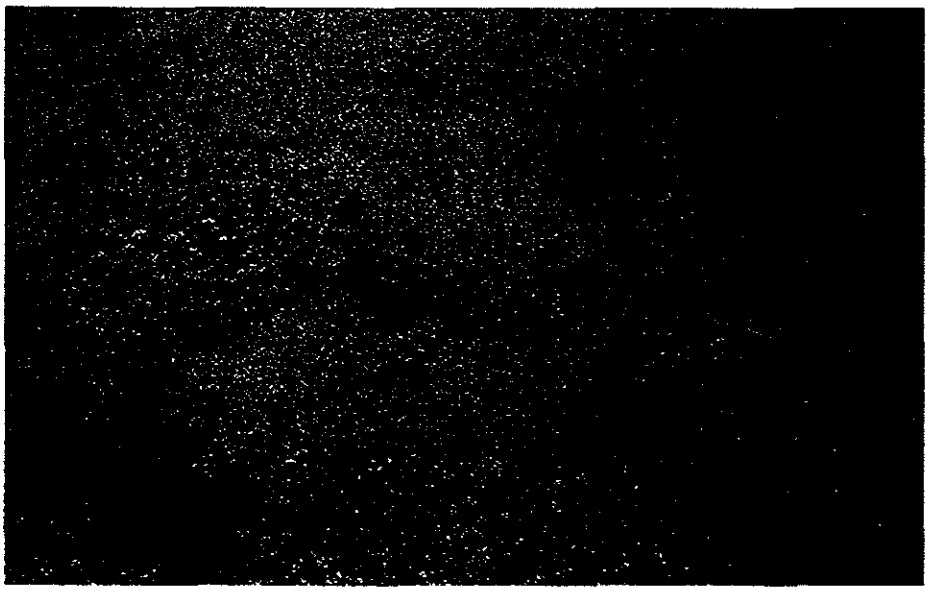

FIG. 7. Areal view of campina shrubby and small patch of campinarana forest.

in a more or less regular interval of three to five years, when new sites are cleared or old sites are reused (Fundação Vitória Amazônica 1998a, 1998b). This cyclic activity creates a mosaic of secondary forest of different ages along the river channels in the JNP (Fig. 6).

Palm swamps. Large areas of swampy vegetation dominated by *Mauritia* palms are found in the interfluvial region of Jaú/Carabinani rivers in the western portion of the park. The fauna and flora of this habitat are probably peculiar, but we have not yet been able to sample these swamps.

Wood sandy soil vegetation (campinarana forest). This is a typical vegetation type of the Rio Negro basin over sandy and periodically wet podzol soils (Anderson 1981). This is a low forest with 7–15 m canopy height and open understory dominated by low diameter treelets (Figs 7 & 8). The majority of the plant species of this forest type are not found in the adjacent terra firme forest. This vegetation type covers small areas in the eastern part of JNP. Some characteristic tree species are *Pradosia schomburgkiana* and *Aldina* sp. (Alberto Vicentini, pers. com.).

Shrubby campina (campina). Also associated with sandy soil is an open field occupying some 900 ha. This field has a low shrubby vegetation with few treelets over 5-m tall (Figs 7 & 9). This shrubby campina is seasonally flooded by the waterbed. In the border between campinarana forest and shrubby campina, the vegetation is much denser.

Stone and sand banks. Occur along the rivers during the low water season. They are important microhabitats for foraging migratory birds (Scolopacidae) and foraging and breeding sites for some residents species (e.g., *Phaetusa simplex*).

A more detailed description of JNP vegetation can be found in Ferreira (1997), Ferreira & Prance (1998), and Fundação Vitória Amazônica (1998a). The appendix is a check-

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FIG. 8. Understory of campinarana forest. Note the low diameter of trees.

list which includes habitat associations of each species, based on our field observations. For some species, results are unclear, rending habitat classification preliminary.

METHODS

Differences between the methods for sampling tropical birds lead to difficulties in comparing local species lists (Remsen 1994). Mist-nets sample understory birds, and are especially useful to sample shy species, but cannot capture birds with large body mass, birds of the canopy or on birds that remain on the ground (Karr 1981). Quantitative censuses of birds (point counts, transect censuses) still are not widely used in tropical forest, partlly due to difficulties in recognizing the vocalizations of hundreds of species. The use of tape recorders can be of some help because tape records can be analyzed by more experienced ornithologists (Parker 1991, Remsen 1994).

In order to obtain a species list as complete as possible, we used the methods described in continuation: 1) *Binocular observation;* 2) *Mist netting:* a sampling effort of more than 5.000 net/h, including the photography of most of the captured species, was employed to capture birds in several habitats of JNP, including flooded forest, terra firme forest, secondary forests, woody and shrubby sandy soil vegetation; 3) *Specimen collection:* some birds were collected during the field work, and the voucher specimens were deposited in the bird collection of the Museu Paraense Emílio Goeldi; 4) *Tape recording:* we recorded bird vocalization with Sony TCM 5000 and Marantz PMD222 recorders using directional microphones ME-66 and ME-80. The recordings will be archived in Library of Natural Sounds, Cornell University and Arquivo Sonoro Elias Coelho (UFRJ).

The frequencies of species recording by each method was: specimens collection (21.4% of species, 95/445), tape recording (60.4%, 269/445), mist-netting (31.7%, 141/445), binocular observation and/or voice recognition without tape recording (32.6%, 145/445). Some 38 species were registered only by a single ornithologist. The check-list indicates all methods used to recorded the presence of each bird species at JNP (see Appendix).

BIRD STUDIES IN JNP

The first ornithological expedition to JNP took place in May 1992 by Andrew Whittaker (AW) who observed and tape recorded birds in the region of the Jaú river mouth. A year later, José Fernando Pacheco (JFP) and André Moraes Pereira Carvalhaes (AMPC) made observations in the same area for five days. In June 1993, the first specimens of birds were collected by a field expedition conducted by the Museu Paraense Emílio Goeldi. Over nine

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FIG. 9. Ground view of shrubby campina.

days, AW, AMPC and the Museu Goeldi technician Dionísio C.P. Neto collected birds in terra firme forest and woody sandy soil vegetation near the Patauá stream (the localities names cited in the text are indicated on Fig. 2). During the same expedition AMPC initiated a banding program and tape recorded birds at Miratucu lake. In October 1993, JFP and AMPC returned to the region of the Jaú river mouth to tape record and observe birds. During 1994, the field work in JNP was intensified. AMPC stayed in JNP for 58 days from January to February, capturing and tape recording birds near the Jaú river mouth, Macaco stream, Seringalzinho, Miratucu lake, and Patauá stream. A five days expedition was made by AMPC in July 1995 to Miratucu lake, Seringalzinho and Jaú river mouth. From September to November 1994, AMPC and Sérgio Henrique Borges (SHB) captured and tape recorded birds in the Jaú river mouth and Miratucu lake for 35 days. In March and April 1995, AMPC, SHB and Luiza Magalli Henriques (LMH) tape recorded and captured birds for 15 days in the Miratucu lake region. In June and July of that year, the same group of ornithologists worked in the Tambor region in the middle course of the Jaú river for 21 field days. In October 1995, SHB, LMH and Mario Cohn-Haft (MCH) returned to Tambor region for 25 days. A small bird collection was made, including important bird records for JNP. In October–November 1996, SHB and MCH tape recorded and collected birds in the Patauá campina, Jaú river mouth region and Rio Negro islands for 10 days. In 1998 and 1999, the regions of the Patauá campina and Seringalzinho campina were visited by SHB for 20 field days. We estimate that at least 3000 h were dedicated to field work by individuals or small groups of ornithologists over the last

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TABLE 1. Bird species richness in the major habitats of JNP. Percents in parentheses were calculated in relation to the total number of species in the park (445).

Major habitats	Total species[1]	Exclusive species
Terra firme forest	254 (57.2)	125 (28)
Igapó flooded forest	166 (37.4)	50 (11.2)
Disturbed vegetation	115 (26)	27 (6)
Campinarana forest	74 (16.6)	2 (0.45)
Campina shrubby	26 (5.8)	15 (3.4)

[1]Including species recording in other habitats.

seven years.

RESULTS AND DISCUSSION

Species richness

Some 445 bird species were recorded for JNP (see Appendix). In addition, eight species (*Crypturellus erythropus*, *Mitu tomentosa*, *Neomorphus* sp., *Chordeiles acutipennis*, *Sclerurus caudacutus*, *Elaenia parvirostris*, *Tolmomyias sulphurescens* and *Tityra semifasciata*) are considered hypothetical for JNP due inadequate level of documentation.

The habitat with the highest number of species was terra firme forest (Table 1). Igapó flooded forest was the second richest vegetation type followed by secondary forest, including recently cut and burned areas for agriculture practices. The proportion of habitat-restricted species was higher in igapó forest (11.3%) than in disturbed habitats (6%). Sandy soil vegetation (campina shrubby and campinarana forest) had a low species richness. However, most species recorded in campina shrubby were restricted to this habitat (Table 1).

In order to evaluate the regional representation of bird species richness of JNP, we compared our list with that of Cohn-Haft *et al.* (1997) for the Biological Dynamics of Forest Fragments Project (BDFFP) reserves north of Manaus. It should be noted that check-list comparisons between various research sites have severe limitations due to differences in methodology, unequal sampling effort and differences in habitat use, among other problems (Remsen 1994). There is notable differences in sampling efforts among the sites studied north of Manaus and JNP. For example, the effort in capturing birds in the BDFFP reserves was 30 times greater than in JNP (150,000 net/h vs 5000). Moreover, the avifauna of BDFFP reserve was studied intensively for more than 15 years (Cohn-Haft *et al.* 1997). To diminish the differences in comparing the two check-lists, we restricted our comparison to terra firme forest avifauna because several habitats found in the JNP are lacking in the BDFFP reserves (e.g., igapó forest). In the JNP, we listed all habitats where given species were observed without distinction of habitat preference. In contrast, Cohn-Haft *et al.* (1997) discriminated the habitat preference of each species. We selected all species indicated in the BDFFP as birds of primary terra firme forest (marked with number one), independently of their position on the habitat preference rank. The only exception was for species considered as casual, which were omitted. Species differing in their habitat use classification between the two lists were excluded from the comparison. For example, the swifts, vultures and swallows were classified in JNP list as aerial, but the BDFFP list separated these by habitats, such as primary or secondary forests. Aquatic birds (Phalacrocoracidae, Ardeidae, Scolopacidae etc.) also were eliminated.

These efforts resulted in a total of 257 terra firme species for the BDFFP reserves, and 245 for JNP. The Manaus region presents a remarkable species diversity in the families Accipitridae (12 species at Manaus vs 6 at PNJ), Strigidae (6 vs 3 species) and Tyrannidae (37 vs 29 species). In JNP, we recorded

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more species of Trochilidae (14 vs 10 species) and Thamnophilidae (29 vs 25 species). Although the comparison between BDFFP reserves and JNP resulted in small differences in species richness, it is important to consider the abundance "status" of birds in the two areas. Cohn-Haft *et al.* (1997) include species considered as vagrant in their study sites, but suggest that they are not part of core avifauna of BDFFP. As the sampling effort was much less intensive in the JNP, it was not possible to make such distinctions, so the JNP list may contain a mixture of core and casual elements in the park avifauna park.

No doubt the JNP list will be augmented over time. Cohn-Haft *et al.* (1997) added 49 species to the first list that was published for the BDFFP (Stotz & Bierregaard 1989) after additional eight years of field work. If the patterns of species richness are similar in the two regions, we expect an increase of bird species list of the JNP habitats with additional sampling, especially in the terra firme forests.

Species accounts

A number of poorly known bird species and new records to central Amazonia avifauna were found in JNP. Here we selected some of these species relevant from a biogeographic perspective or species poorly known in their natural habitats for a more detailed description. For the species with available tape recordings, the name of who made it is indicated.

Chordeiles pusillus. The presence of this small nighthawk in JNP was documented through a skin and several tape records (MCH, SHB) made in campina shrubby at Patauá campina (1°52'S, 61°46'W). This species is widely distributed in southeastern Brazil, Colombia and Venezuela (Cleere 1999). The formerly known distribution is on the periphery of Amazonia, occurring in savannas at Amapá (Silva *et al.* 1997) and Orinoco drainage (Zimmer & Hilty 1997). One subspecies (*C. p. esmeraldae*) is reported in extreme northwest Brazil (Cleere 1999).

Caprimulgus rufus. The nominate population of this species is distributed from southern Venezuela, eastern Guyana and Surinam to French Guyana, and southern tributaries of the Amazon river (Robbins & Parker 1997). In northwestern Brazil, it was known only from the upper tributaries of Rio Negro (Robbins & Parker 1997). There are also old records of *C. rufus* collected by Natterer in the Manaus region (Pelzeln 1868). This bird is very common on the campina shrubby at Patauá stream (1°52'S, 61°46'W), where several tape records were made (SHB, MCH).

Nyctibius bracteatus. Known from scattered localities in Ecuador, Brazil and Guyana, and Peru, but probably widely distributed in lowland Amazonia (Cohn-Haft 1999). Probably a local rare species. There are only two records from JNP: heard in a terra firme forest at Patauá stream (1°49'S, 61°46'W) and tape recorded (SHB) in a 10 years old secondary forest at Seringalzinho locality (1°52'S, 61°35'W).

Nyctibius leucopterus. A rare potoo species only recently rediscovered with several unpublished records scattered though lowland Amazonia (Cohn-Haft 1993, Cohn-Haft *et al.* 1997, Cohn-Haft 1999). Recorded at JNP with two skins collected near Patauá stream in a terra firme forest (1°49'S, 61°46'W).

Touit huetii. There are no published records of this parrotlet from the Rio Negro Basin (Forshaw 1989, Collar 1997), although there is mention to "a single record from Manaus" (Collar 1997). The known distribution of *T. huetii* includes several localities in southern and northeastern of Venezuela, eastern Colombia, Ecuador and Peru south to north-

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ern Bolivia (Collar 1997). In Brazil, there are records from the regions of the Aripuanã and Tocantins rivers, south of the Amazon river (Collar 1997). Recently recorded from the Orinoco drainage in Venezuela (Zimmer & Hilty 1997). Recorded by vocalization and observation in the Unini river by AW.

Polyplancta aurescens. In Brazil this hummingbird was recorded in the regions of the Juruá and Javari rivers in the western Amazon (Pinto 1978). There are field records from the Uaupés river (upper Rio Negro) along the Colombian/Brazilian border (Hilty & Brown 1986). It recently was reported near the Jiparaná river in Rondonia and from Marajó island in the mouth of the Amazon river (Stotz *et al.* 1997, Oren & Henriques 1994). A female was captured and photographed in June 1995 in terra firme forest around a stream along the middle Jaú river (2°14'S, 62°26'W).

Notharchus ordii. Records of this species are widely distributed in Venezuela, Peru, Bolivia and several regions of Brazil, suggesting that this species occurs at low density across a vast area in the Amazon (Zimmer *et al.* 1997). In Brazil, this puffbird was previously reported from the upper Rio Negro to the western portion of the Amazon river and the right margin of the lower Amazon (Pinto 1978). There is an old record from the Xingú/Tapajós interfluvial region (Sick 1997). Recent records include the Urucú river (Peres & Whittaker 1991), the Orinoco river in Venezuela (Zimmer & Hilty 1997) and the Alta Floresta region in the south of the Amazon river (Zimmer *et al.* 1997). Apparently, this species was not reported from central Amazônia and the lower Rio Negro. *N. ordii* was first reported in JNP in the middle Jaú river (2°14'S, 62°26'W) by MCH in June of 1996. In November 1996, a specimen was collected at Patauá stream (1°49'S, 61°46'W) in the eastern portion of JNP. Both records were from terra firme forest.

Nonnula amaurocephala. This bird was described from skins collected in the lower Solimões river in 1921. There are only 11 skins in museums, and the last time the species was recorded, before the 90's, was in 1936 (Whittaker *et al.* 1995). We observed it in May of 1992 in the Unini river in the northern region of JNP (1°35'S, 61°40'W). Later, the species was recorded in the regions of the Macaco stream in January of 1994 (2°05'S, 62°07'W) and Onças stream (2°20'S, 62°29'W) in June of 1995. Two individuals were captured and photographed by AMPC (Whittaker *et al.* 1995). All observations and captures of this puffbird were in igapó flooded forest, supporting Whittaker *et al.* (1995) suggestion that *N. amaurocephala* is restricted to this vegetation.

Micromonacha lanceolata. This species is known in Brazil from the upper Juruá river in western Amazonia (Sick 1997). Recent records are from the Urucú river (Peres & Whittaker 1991) and regions around Tefé (Johns 1991, Pacheco *fide* Sick 1997). Two individuals, probably a pair, were observed in a terra firme forest of the middle Jaú river (2°14'S, 62°26'W) in June of 1995.

Eubucco richardsoni. This species has been recorded south of Amazon river from Peru to the upper Madeira river (Pinto 1978, Sick 1997) and along the Colombian/Brazilian border (Hilty & Brown 1986). One individual was tape recorded (SHB) from a canopy mixed flock in June of 1996 from the middle Jaú river (2°14'S, 62°26'W). Although Hilty & Brown (1986) reported this species as found in "white water" (várzea), we recorded it in terra firme forest. Apparently, this is the first record of this species north of the Amazon river in central Amazônia.

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Selenidera nattereri. This species was recently recorded from the Orinoco river in Venezuela, where it occurs in terra firme forest and sandy soil vegetation (Zimmer *et al.* 1997). Three specimens were collected from terra firme forest in the middle Jaú river (2°14'S, 62°26'W).

Xiphorhynchus necopinus. This poorly known woodcreper was believed to be restricted to flooded vegetation in Amazonia (Stotz, *fide* Ridgely & Tudor 1994, Pacheco, *fide* Sick 1997). Because of its morphological similarity with *X. picus* (Ridgely & Tudor 1994), the specific status of *X. necopinus* was questioned by Pinto (1978). One individual of this woodcreeper was collected on a river island of the Rio Negro next to the mouth of the Jaú river in November of 1996. This island was dominated by igapó forest, reinforcing the association between *X. necopinus* and flooded vegetation (Stotz *fide* Ridgely & Tudor 1994).

Hyloctistes subulatus. Along the western and central Amazon, *H. subulatus* has been reported only south of the Amazon river. Records north of Amazon river were restricted to upper Rio Negro (Ridgely & Tudor 1994). The Emílio Goeldi Museum has two specimens collected from the left margin of the Japurá river. Apparently, these are the first records of this species from the left margin of Amazon river in central Amazon. We collected a pair near Patauá stream in the eastern portion of JNP (1°52'S, 61°46'W).

Myrmotherula cherriei. This antwren is common in the igapó forest of the eastern region of the JNP. It also was recorded in the campinarana and campina vegetation in Patauá and Seringalzinho campina regions. It is frequently associated with small mixed flocks of *Hylophilus semicinereus*, *Polioptila plumbea*, and *Hypocnemoides melanopogon*. The occurrence of this species in the JNP is supported by several tape recordings (SHB, MCH, AW) and two pairs collected in June of 1993 near Miratucu lake (1°57'S, 61°49'W). The previously reported presence of this antwren in Brazil was for the upper Rio Negro (Ridgely & Tudor 1994). The Emílio Goeldi Museum has two specimens collected some 50 km in northwest of the Jaú river mouth (Novaes 1994). Zimmer & Hilty (1997) recorded *M. cherriei* from the Orinoco river drainage in Venezuela. A more recent account of the distribution of *M. cherriei* can be found in Isler *et al.* (1999). Apparently, *M. cherriei* is replaced in the same habitat (igapó forest) of the middle course of the Jaú river by *M. surinamensis.*

Myrmotherula ambigua. We collected a specimen of this canopy antwren from the middle Jaú river (2°14'S, 62°26'W) following a mixed flock in terra firme forest in June of 1996. The known distribution of this species includes the upper Rio Negro and western Roraima (Ridgely & Tudor 1994, Stotz 1997). In Brazil, it was known from the Uaupés river (Pinto 1978). Stotz (1997) reported this species as common in canopy mixed flocks in terra firme forest and seasonally flooded forest near the Apiaú river in Roraima. In Colombia, it is known only from sandy soil vegetation (Hilty & Brown 1986). In JNP, *M. ambigua* was recorded only in terra firme forest.

Formicivora grisea. The presence of this species in campina vegetation around Patauá campina (1°49'S, 61°46'W) is supported by a female specimen and tape records (MCH, SHB) obtained in November of 1997. This is apparently the first record of this species for central Amazonia north of the Amazon river. South of the Amazon, *F. grisea* is widely distributed east of the Madeira river. In Colombia, it is known from the Uaupés river (Hilty & Brown 1986). Recent Brazilian records of *F. grisea* are from Amapá (Silva *et al.* 1997),

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Rondônia (Stotz *et al.* 1997) and Roraima (Stotz 1997).

Percnostola minor. This species is rare in JNP, with only three individuals captured in almost 5000 net/h. One of those individuals was captured and photographed near a stream in terra firme forest of Miratucu lake (1°57'S, 61°49'W). This specimen had a gray iris, a thinner bill than Manaus bird (Cohn-Haft *et al.* 1997), and clear gray crown feathers margins. These external morphological traits are similar to *Percnostola rufifrons minor* (Ridgely & Tudor 1994). The known distribution of this subspecies includes eastern Colombia, southern Venezuela and the upper Rio Negro (Caparella *et al.* 1997). Recently, Caparella *et al.* (1997) revised the taxonomic status of *Percnostola rufifrons* complex and recommended that birds recorded in eastern Colombia, northwestern Brazil, southern Venezuela and northeastern Peru be treated as *P. minor.* Caparella *et al.* (1997) also described a new subspecies of *P. minor* (*P. m. jensoni*) from the confluence of the Napo and Amazonas rivers. The crown feathers of *P. m. jensoni* have the same scaly appearance of *minor*, but differ from the latter by the wider gray margins. Moreover, the Putumayo and Içá rivers are considered as geographical barriers between the two forms (Caparella *et al.* 1997). Based on the known distribution of the *P. rufifrons* subspecies, it is reasonable that the specimens captured in JNP are *P. minor.* Unfortunately, no specimens were collected to confirm identification. The type locality of *P. r. minor* is Santa Isabel do Negro river (Pinto 1978), some 400 km north of Miratucu lake.

Myrmeciza disjuncta. This rare and poorly known antbird was previously considered as endemic to the Orinoco river region (Haffer 1974, Ridgely & Tudor 1994). After its description in 1945, *M. disjuncta* has been reported from only three sites: Puerto Inirida, Colombia (Hilty & Brown 1986), Baria river in Venezuelan-Brazilian border (Willard *et al.* 1991) and Yapacana National Park, Venezuela (Zimmer 1999). The natural history of this antbird was recently described by Zimmer (1999). We found *M. disjuncta* in a small patch (2 ha) of sand soil campina called Seringalzinho campina (01°54'S, 61°35'W). At least three individuals were vocalizing in very dense shrubby campina. Two good quality tape recording (SHB) were taken and a pair was collected. This is the first record of *Myrmeciza disjuncta* for Brazil. A more detailed description of this record will be presented elsewhere (Borges & Almeida, in prep.).

Hylophylax punctulata. This rare and locally distributed antbird species (Ridgely & Tudor 1994) was recently recorded from the Orinoco river and Roraima, in areas of seasonally flooded vegetation (Zimmer & Hilty 1997, Stotz 1997). In JNP, *H. punctulata* was observed in shrubby and flooded vegetation near a small stream (2°20'S, 62°29'W). This species appears associated with streams in areas of transition between igapó flooded forest and terra firme forest. This habitat is characterized by some structural peculiarities such tall trees (> than 25 m) and dense lianas covering the trees. This is the same microhabitat where *Nonnula amaurocephala* is found.

Megastictus margaritatus. In June 1995, four individuals were captured in the Tambor region (2°14'S, 62°26'W). In addition, one individual was tape recorded in the same locality. All records of *M. margaritatus* were in terra firme forest. In Brazil, *M. margaritatus* has been recorded from the upper Rio Negro, Purus and Madeira drainages (Ridgely & Tudor 1994, Pinto 1978). This antbird was apparently unknown to the north of Amazon in central Amazonia.

Rhegmatorhina cristata. The presence of this rare

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antbird was documented in JNP by two individuals captured and photographed in terra firme forest along the middle Jaú river (2°14'S, 62°26'W) in June 1995. In June 1996 another individual was observed and tape recorded (MCH) in the same region while following a group of army ants together with *Pithys albifrons*, *Gymnopithys leucaspis* and *Phlegopsis erythroptera* (see Willis 1969). In addition, a female was captured and photographed in a sand soil campina of the Seringalzinho region. The previously known distribution of *R. cristata* covers southeastern Colombia and extreme northeastern Brazil, in the areas of the Uaupés river (Pinto 1978, Ridgely & Tudor 1994). One specimen of *R. cristata* was collected by the Museu Emílio Goeldi team on the left bank of the Japurá river (Haffer 1992).

Hemitriccus minimus. This small flycatcher was recorded for the first time in JNP (AW) in June 1993 in the Patauá campina (1°49'S, 61°46'W). In October 1995, another tape recording (MCH, SHB) was made in a igapó flooded forest near the mouth of the Jaú river (1°54'S, 61°27'W). A pair of *H. minimus* was collected in the same region in November 1996. The distribution of this species is local in Amazonia with records in the lower Tapajós river and northeastern Bolívia (Ridgely & Tudor 1994). Novaes (1994) recorded this flycatcher in a igapó flooded forest some 50 km northwest of the Jaú river. The species has also been recorded in the Alta floresta region near the border of Mato Grosso and Pará (Zimmer *et al.* 1997). Apparently, *H. minimus* prefers sandy soil vegetation (Ridgely & Tudor 1994). In JNP *H. minimus* can be found in campinarana and igapó flooded forests with sandy soil.

Elaenia ruficeps. This is a savanna species of southern Venezuela, Colombia and the Guianas (Ridgely & Tudor 1994, Zimmer & Hilty 1997). In Brazil, *E. ruficeps* occurs along the lower Amazonas, the lower Madeira and along the Cururu river in southern Pará (Ridgely & Tudor 1994). In the Negro basin it is found in sandy soil vegetation (Oren 1981). One specimen was collected and several individuals were tape recorded (MCH, SHB) in the Patauá campina (1°49'S, 61°46'W).

Hylophilus brunneiceps. This poorly known species is apparently restricted to the Rio Negro basin (Ridgely & Tudor 1989). It was recorded in JNP by tape recordings in igapó forests at the mouth of Jaú river (SHB, MCH). In October of 1996, one specimen was collected in a campinarana forest near Patauá campina (1°49'S, 61°46'W). Two other specimens were collected near the mouth of the Jaú river in November of 1996. It is fairly common in low igapó forest along the Jaú river and in campinarana vegetation, where other typical birds of this vegetation are found, such as *H. minimus*, *Xenopipo atronitens* and *Galbula leucogastra.*

Emberizoides herbicola. This was one of the most surprising bird records for JNP. This open area bird is distributed in savannas along the periphery of the Amazon basin in southeastern Brazil, Colombia, Venezuela and Guiana (Ridgely & Tudor 1989). This species resulted as the most common bird in the campina vegetation near Patauá region. One specimen was collected and several individuals were tape recorded (SHB, MCH) in November 1996.

Dolospingus fringilloides. A little known seed-eater species whose distributional range includes southern Venezuela, the upper Rio Negro drainage in Brazil and eastern Colombia (Ridgely & Tudor 1989). Two males and one female were captured and photographed, and an adult male was tape recorded

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(SHB), in a small patch (2 ha) of sand soil of the Seringalzinho campina (01° 54'S, 61° 35'W).

Avian biogeography of JNP

The extensive inventories of birds in Central Amazônia (Cohn-Haft *et al.* 1997, this article) permit a preliminary evaluation of the biogeographical affinities of JNP. Few Guianan birds, such as *Polioptila guianensis* and *Pachyramphus surinamus*, are found in JNP. However, the JNP avifauna is basically composed of typical western Rio Negro elements (Haffer 1974) such as *Gymnopithys leucaspis*, *Tyrannentes stoltzmanni* and *Phoenicircus nigricollis*. These common species have fairly well-known distributions (Haffer 1974, Ridgely & Tudor 1989, 1994).

The most surprising and important contribution of the JNP avifauna to understanding the distribution of Amazonian birds are the records of several species previously considered endemic to the upper Rio Negro and Orinoco region (Ridgely & Tudor 1989, 1994). From a group of 16 bird species restricted to the upper Rio Negro and Orinoco river (Haffer 1974), 8 were registered in JNP (*Notharchus ordii*, *Selenidera nattereri*, *Heterocercus flavivertex*, *Myrmotherula cherriei*, *M. ambigua*, *Herpsilochmus dorsimaculatus*, *Myrmeciza disjuncta*, *Dolospingus fringilloides*). This group of species formed the faunal basis for the Haffer's proposed Imeri refuge (1974). The birds were not previously adequately sampled in the area of the lower course of the western Negro river (Oren & Albuquerque 1991), and this could explain why these birds were not reported before for this region. Moreover, the species *H. flavivertex*, *M. cherriei* and *Myrmeciza disjuncta* (Zimmer & Hilty 1997, Zimmer 1999) are restricted to igapó forest and sandy soil vegetation (campinas and campinaranas) which are widespread habitats in the Rio Negro basin, but poorly studied by ornithologists (for exceptions, see Borges & Carvalhaes 2000, Oren 1981). These distributional extensions reinforce the importance of the Rio Negro in delimiting the boundaries of bird distributions, as suggested by Haffer (1974). In fact there are several examples of related birds that replaced each other in the left (*Gymnopithys rufigula*, *Tyraneutes virescens*, *Hylophilus muscicapinus* and *Phoenicircus carnifex*) and right (*G. leucaspis*, *T. stolzmanni*, *H. hypoxantha* and *P. nigricollis*) margins of the Negro river.

The nonforest birds recorded in the campinas of JNP represent a group with complex distributional origins. The majority of bird species from the natural open vegetation in JNP are found in savanna vegetation in other parts of Amazonia, such as in Roraima and Amapá (e.g., *Emberizoides herbicola*, *Schistochlamys melanopis*, *Formicivora grisea*, some nightjar; see Silva *et al.* 1997, Stotz 1997). Other species, such as *Polytmus theresiae*, *Myrmeciza disjuncta*, *Tachyphonus phoenicius* and *Dolospingus fringilloides*, are more typical of sandy soil campinas (Oren 1981, Zimmer 1999). The campinas are isolated one from the others by hundreds of kilometers of terra firme forest. Due to this "island" distribution the most obvious question to ask is: how did these open area species disperse to this region? The historical interpretation of the nonforest bird distribution in the Amazonia has received less attention compared to that of forest birds (but see Haffer 1974, 1985; Oren 1981). Haffer (1974) suggested that the presence of nonforest birds in isolated open fields is explained by the ancient connections of nonforest areas across the Amazon valley. In the same way, Oren (1981) suggested a dry corridor connecting some parts of the middle Amazonia to the lower Rio Negro.

The geological history of the region of the JNP presents some peculiarities. The western portion of the park is on very old geological formations (Prosperança, Trombetas and

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Alter do Chão formations) with ages varying between 100 to more than 500 millions years (Fundação Vitória Amazônica 1998a). These old formations occupy some 35% of the JNP area (Fundação Vitória Amazônica 1998a). Most part of JNP, however, is above the much more recent Solimões formation, of some 2 to 6 millions years (Fundação Vitória Amazônica 1998a). This mixed scenario in the historical genesis of JNP can be related to some fauna and flora distributions in JNP. Some bird species (e.g., *Selenidera nattereri* and *Megastictus margaritatus*) were only recorded in the middle Jaú (Solimões formation) and never in the eastern part of JNP, although no physical barrier such as mountains or large rivers separated these major regions. Satellite images of the region show that sandy soil vegetation is more widely distributed in the eastern part of JNP. The soil origin of the region may have influenced the vegetation types, and indirectly the distribution of birds. This interaction between geology, vegetation and bird distribution in JNP, however, deserve further detailed studies.

Another important geographical aspect of JNP is its position in the interfluvial region among the Negro and Solimões/Japurá rivers (see Fig. 1). The floodplains of the Rio Negro and Solimões drainages are quite distinct in geology and vegetation types (Irion *et al.* 1997, Worbes 1997). The avifauna of JNP suggests an influence of the "white waters" (várzea) systems of the Solimões river in the local bird distribution. This influence is illustrated by some typical "white water" birds such as *Opisthocomus hoazin*, *Ramphocelus nigrogularis* and *Lamprospar tanagrinus*, recorded only in the region of the middle Jaú river. We suspect that the floodplain avifauna of JNP is a mixture of "white water" and "black water" (igapó) elements (see Zimmer 1997 for a discussion on the avifauna of these flooded forest types).

Species and habitat conservation in JNP

The JNP region encompasses some vegetation types characteristic of the Rio Negro basin. In the lower Rio Negro, the two most important conservation units, JNP and Anavilhanas Ecological Station, include extensive areas of black water flooded forest. The conservation units of the upper Rio Negro, such as Pico da Neblina National Park, include large expanses of sandy soil vegetation (Radambrasil 1978). This vegetation type has an endemic fauna and flora (Anderson 1981, Oren 1981). In the lower Rio Negro, sandy soil vegetation has a more restricted distribution. This habitat in JNP is important for the protection of several savanna and campina endemic birds such as *Myrmeciza disjuncta*, *Polytmus theresiae*, *Dolospingus fringilloides*, and *Elaenia ruficeps*.

Currently, there is no direct threat to the birds of JNP, although some species are hunted within the park boundaries. However, currassows (Cracidae) merit special attention. Currassows are sensitive to hunting, and local extinction has been documented from other localities in the Amazon (Silva & Sthral 1991, Santos 1998). Of the five species recorded in JNP, only *Nothocrax urumutum* and *Penelope jacquacu* are fairly common. *Pipile cumanensis*, *Mitu tuberosa* and *M. tomentosa* are rare in the park and were observed on few occasions. Local people say that these species are hard to find in the Jaú river, but are more common in the Carabinani river, a nearly unpopulated river with difficult access due to waterfalls (Fundação Vitória Amazônica 1998b). Local studies are needed to evaluate the population status of the Cracidae in JNP.

There are no great human impacts on the vegetation cover at JNP because the local human density is very low (0.04 inhabitants/km^2; Fundação Vitória Amazônica 1998b). Due to large areas of undisturbed forest, associated with the low human density, the JNP constitutes an important reserve for the

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conservation of the Amazon biodiversity. We consider continuous bird species inventory and study on the population status of threatened species (e.g., curassows) as priorities in the management plan of JNP (Fundação Vitória Amazônica 1998a).

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APPENDIX. Bird check-list of Jaú National Park. The sequence of non-Passeriformes families follow Sick (1997) with minor modifications. For Passeriformes, the sequence of families and species follow Ridgely & Tudor (1989, 1994), with the exception of Dendrocolaptidae, Furnariidae and Thraupinae for which we adopted the sequence of Sick (1997). The list includes eight hypothetical species (between parentheses).

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Tinamidae			
Tinamus major	obs, v	i	tf
Crypturellus cinereus	v5,tr1,3	r	ip,cm
Crypturellus soui	tr	f	tf,dv,cm
Crypturellus undulatus	tr	c	ip
(*Crypturellus erythropus*)	tr	r	ca

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Crypturellus variegatus	tr	c	tf
Phalacrocoracidae			
Phalacrocorax brasilianus	obs,ph	f	r
Anhingidae			
Anhinga anhinga	obs	i	r
Ardeidae			
Ardea cocoi	obs	c	r
Casmerodius albus	obs	i	r
Egretta thula	obs	r	r
Bubulcus ibis	obs,ph	i	r
Butorides striatus	obs,tr	f	r
Agamia agami	obs	r	r
Pilherodius pileatus	obs	i	r
Nycticorax nycticorax	obs	r	r
Tigrisoma lineatum	ph	r	r
Cochleariidae			
Cochlearius cochlearius	v6,obs7	r	r
Threskiornithidae			
Platalea ajaja	obs	am	r
Mesembrinibis cayennensis	tr	c	r
Ciconiidae			
Mycteria americana	obs	r	r
Jabiru mycteria	obs	am	r
Cathartidae			
Sarcoramphus papa	obs	f	a
Coragyps atratus	obs	i	a
Cathartes aura	obs	f	a
Cathartes burrovianus	obs	f	a
Cathartes melambrotos	obs	c	a
Anatidae			
Dendrocygna autumnalis	obs7	r	r
Cairina moschata	obs	c	r
Pandionidae			
Pandion haliaetus	obs	i	r
Accipitridae			
Elanoides forficatus	obs	i	tf,ca
Leptodon cayanensis	obs	r	ig
Ictinia plumbea	obs	f	tf,dv,ig
Accipiter bicolor	obs1,6	r	ig,dv
Asturina nitida	obs	i	ig,cm
Rupornis magnirostris	tr	f	tf,dv,ig,cm
Busarellus nigricollis	obs4	r	ig
Buteogallus urubitinga	tr	i	tf,ig
Harpia harpyja	obs5,7	r	tf
Spizaetus ornatus	obs	r	tf

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
S. tyrannus	obs,tr	i	ig
Geranospiza caerulescens	obs	r	ig
Falconidae			
Herpetotheres cachinnans	obs,v	r	tf
Micrastur semitorquatus	tr	i	tf,dv
M. ruficollis	tr,col,cap,ph	f	tf,dv
M. gilvicollis	tr,cap	f	tf
M. mirandollei	obs1,3	r	tf,ig
Daptrius ater	tr	c	ig,cm
Daptrius americanus	obs	r	tf
Milvago chimachima	tr1	i	ig,dv
Falco rufigularis	obs,tr1	f	ig
Falco columbarius	obs1,6	nm	ig
Cracidae			
Penelope jacquacu	obs,tr1,ph	i	tf
Pipile cumanensis	v,obs6	r	tf,ig
Mitu tuberosa	obs1,6	r	tf
(*M. tomentosa*)	obs1,6	r	tf
Nothocrax urumutum	v,tr3	f	tf
Phasianidae			
Odontophorus gujanensis	v,tr,col	f	tf,dv
Opisthocomidae			
Opisthocomus hoazin	obs	r	ig
Aramidae			
Aramus guarauna	obs,v	r	r
Psophiidae			
Psophia crepitans	obs,ph3	r	tf
Rallidae			
Aramides cajanea	v,tr	f	ig,dv
Laterallus melanophaius	v	r	ig
Heliornitidae			
Heliornis fulica	obs,v	c	r
Eurypygidae			
Eurypyga helias	obs,v,tr	i	r
Jacaniidae			
Jacana jacana	obs	r	r
Scolopacidae			
Tringa solitaria	obs1	nm	r
T. flavipes	obs1,3	nm	r
T. melanoleuca	obs1,3	nm	r
Actitis macularia	obs	nm	r
Calidris fuscicollis	obs	nm	r
C. melanotos	obs	nm	r
C. alba	obs	nm	r
Gallinago paraguaie	obs3	r	r

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Laridae			
Phaetusa simplex	obs,v,tr	c	r
Sterna superciliaris	obs,v,tr	f	r
Rynchopidae			
Rynchops niger	obs,v,tr	i	r
Columbidae			
Columba speciosa	obs,v,tr	f	dv,cm
C. cayennensis	obs,v,tr,ph	c	ig,dv
C. subvinacea	v,tr	c	tf,dv
C. plumbea	v,tr	f	tf,dv,cm
Columbina passerina	v,tr	c	dv
C. talpacoti	obs3	r	dv
Leptotila verreauxi	v,tr1	i	tf,dv
L. rufaxilla	v,tr1	f	tf,dv,ig
Geotrygon montana	tr,cap,ph	c	tf,cm
Psittacidae			
Ara ararauna	obs,tr,ph	c	tf,cm
A. macao	obs,tr	i	tf
A. chloroptera	obs	r	tf
Orthopsittaca manilata	obs,tr	c	tf,cm
Aratinga leucophthalmus	obs	i	ig,dv
A. pertinax	obs,tr	f	ig,cm
Pyrrhura melanura	obs,tr,ph	f	ig,tf,cm
Brotogeris chrysopterus	v,tr1	f	tf,cm
B. sanctithomae	obs1	r	ig
Touit purpurata	obs4	r	tf
T. huetii	obs,v	r	tf
Pionites melanocephala	obs,v	i	tf
Pionopsitta barrabandi	obs,tr	i	tf,ig,cm
Pionus menstruus	obs,tr	c	tf,dv,ig
P. fuscus	obs,tr	i	tf
Amazona autumnalis	obs,v	r	tf
A. festiva	obs,v,tr	c	ig
A. amazonica	obs,v,tr	c	ig,cm
A. farinosa	obs,v,tr	f	tf,cm
Deroptyus accipitrinus	obs2,3	r	tf
Cuculidae			
Coccyzus americanus	obs5	nm	ig
Coccyzus euleri	obs1,6	am	ig
Piaya cayana	obs,v,tr	f	tf,dv,ig
P. melanogaster	obs,tr	i	tf,cm
P. minuta	obs	r	tf,dv
Crotophaga ani	obs,v	f	dv
C. major	obs,v,tr	c	ig
Tapera naevia	obs,tr	i	ca

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
(*Neomorphus* sp)	obs3,7	r	tf
Tytonidae			
Tyto alba	obs1,3,v1	r	dv,ca,cm
Strigidae			
Otus choliba	obs,v,tr	c	ig,cm
O. watsonii	v,tr	c	tf
Pulsatrix perspicillata	obs,v,tr	c	tf,ig
Glaucidium brasilianum	obs,v,tr	i	ig
Ciccaba huhula	tr	t	tf,ig
Asio stygius	obs,tr	r	ig,ca,cm
Nyctibiidae			
Nyctibius grandis	obs,v,tr	r	tf
N. griseus	v,tr,col	f	tf,ig,cm
N. leucopterus	col,ph	r	tf
N. bracteatus	tr5	r	cm,dv
Caprimulgidae			
Lurocalis semitorquatus	obs,v	r	tf
Chordeiles pusillus	obs,v,tr,col	c	ca
(*C. acutipennis*)	obs,v	r	dv
C. minor	obs,v	nm	a
Nyctiprogne leucopyga	obs,v,tr,col,ph	c	ig
Nyctidromus albicollis	v,tr,cap	c	tf,ig,dv
Caprimulgus rufus	obs,tr	f	ca
C. cayennensis	tr3	r	ca
C. nigrescens	obs,v,col,ph	i	tf,dv,ca
Hydropsalis climacocerca	v,tr	f	ig
Apodidae			
Chaetura chapmani	obs4	r	a
C. cinereiventris	obs,tr	c	a
C. spinicauda	obs	r	a
C. brachyura	obs,tr	f	a
Panyptila cayannensis	obs	r	a
Tachornis squamata	obs,tr	f	a
Trochilidae			
Glaucis hirsuta	obs,cap	r	tf
Phaethornis superciliosus	tr,ph,cap	f	tf,ig,dv
P. bourcieri	col,cap	f	tf
P. ruber	tr,col,cap,ph	f	tf,dv,cm
Campylopterus largipennis	obs,cap	r	tf
Florisuga mellivora	obs,col,cap	c	tf,dv
Anthracothorax nigricollis	obs,tr1	i	tf,ig
Chrysolampis mosquitus	obs	r	ig
Chlorostilbon mellisugus	obs,cap	r	ig,dv
Thalurania furcata	obs,tr,cap	c	tf,ig,dv,cm
Hylocharis sapphirina	tr,col,cap	c	tf,dv

APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
H. cyanus	obs,col,cap	c	tf,dv,ig,cm
Polytmus theresiae	tr1,col,ph	r	ca
Amazilia versicolor	obs,tr1	r	tf,dv
A. fimbriata	obs	i	tf,dv
Polyplancta aurescens	cap,ph	r	tf
Heliothryx aurita	obs	r	tf,dv
Heliomaster longirostris	obs	i	tf,dv
Topaza pyra	cap	r	ca
Trogonidae			
Pharomachrus pavoninus	obs,v,tr	r	tf
Trogon melanurus	obs,v,tr	i	tf,dv,ig,cm
T. viridis	obs,v,tr	c	tf,dv,ig,cm
T. rufus	obs,v,cap,tr,ph	f	tf,dv
T. curucui	obs,v,tr	f	ig
T. violaceus	obs,tr	r	tf
Alcedinidae			
Ceryle torquata	obs,v,tr	c	r
Chloroceryle amazona	obs	c	r
C. americana	obs,tr,cap	c	r
C. inda	obs,tr,cap	c	r
C. aenea	obs,col,cap	c	r
Momotidae			
Momotus momota	obs,tr	f	tf
Galbulidae			
Galbula albirostris	obs,cap,tr	i	tf,dv
G. leucogastra	obs,tr,col	i	ig,cm
G. dea	obs,tr,col	c	tf,ig
Jacamerops aurea	obs,v,tr	i	tf
Bucconidae			
Notharchus macrorhynchus	obs	i	tf
N. ordii	v5,col	r	tf
N. tectus	obs	r	tf
Bucco tamatia	obs	r	tf,ig,cm
B. capensis	tr,cap,ph	r	tf
Malacoptila fusca	col,cap,ph	r	tf
Micromonacha lanceolata	obs	r	tf
Nonnula rubecula	obs,tr,col	r	tf
N. amaurocephala	obs,cap,ph	r	ig
Monasa nigrifrons	obs,cap,ph	c	ig
M. morphoeus	obs	i	tf
Chelidoptera tenebrosa	obs,ph	c	ig
Capitonidae			
Capito niger	tr	f	tf,ig
Eubucco richardsoni	obs,v	r	tf
Ramphastidae			

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Pteroglossus castanotis	obs	r	tf
P. azara	obs,tr	i	tf,ig
Selenidera nattereri	tr,col,ph	r	tf
Ramphastos vitellinus	obs,tr,col	c	tf
R. tucanus	obs,tr,ph	c	tf,cm
Picidae			
Picumnus cf. pumillus	obs,tr,col	i	ig
Colaptes punctigula	obs,tr	i	tf,ig
Piculus flavigula	obs,tr	f	tf,ig
P. chrysochloros	v,col	i	tf,ig
Celeus elegans	obs,tr,cap	f	tf,ig,cm
C. grammicus	obs,tr,ph	i	tf,ig,cm
C. flavus	obs,v	f	ig,dv
C. torquatus	obs,v,col	i	tf,cm
Melanerpes cruentatus	obs,tr	c	tf,dv,ig
Veniliornis affinis	obs	i	tf
Dryocopus lineatus	obs,v,tr	i	tf,dv,ig
Campephilus melanoleucos	obs,tr,ph	f	tf,dv,ig
C. rubricollis	obs,v	i	tf
Dendrocolaptidae			
Dendrocincla fuliginosa	obs,tr,col,cap	i	tf,ig,dv,cm
D. merula	obs,col,cap,ph	f	tf,ig,cm
Deconychura longicauda	obs,tr,cap	r	tf
D. stictolaema	tr,col	r	tf,ig
Sittasomus griseicapillus	obs,tr,cap	r	tf,ig
Glyphorynchus spirurus	obs,tr,col,cap	f	tf,ig
Nasica longirostris	obs,tr,cap,col	c	ig
Dendrexetastes rufigula	obs,tr	c	ig,tf
Hylexestastes stresemanni	obs,tr,col	i	tf
Xiphocolaptes promeropirhynchus	obs,tr,cap,ph	r	ig,tf
Dendrocolaptes certhia	obs,v,col	i	ig,tf,cm
D. picumnus	tr3	r	ig
Xiphorhynchus picus	obs,tr,cap,ph	c	ig,dv
X. necopinus	tr5,col	c	ig,dv
X. obsoletus	obs,v,tr,ph	r	ig
X. ocellatus	obs,col,cap,tr,ph	r	tf,cm
X. guttatus	obs,tr,cap	i	tf,ig
Lepidocolaptes albolineatus	obs5	r	tf
Furnariidae			
Synallaxis rutilans	obs,cap,tr,ph	f	tf
Cranioleuca vulpina	obs,tr3	i	ig
Xenops milleri	obs,tr,col	r	tf
X. minutus	obs,col,cap	f	tf,ig
Berlepschia rikeri	obs,tr	i	tf
Hylocistes subulatus	obs,tr,col	r	tf

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Philydor pyrrhodes	obs,cap	r	tf
Automolus infuscatus	obs,tr,col,cap,ph	c	tf
A. ochrolaemus	tr1,ph1	r	tf
A. rubiginosus	tr,ph	r	tf
Sclerurus rufigularis	col,cap	r	tf
(*S. caudacutus*)	obs6	r	tf
Thamnophilidae			
Cymbilaimus lineatus	tr,col,cap	f	tf
Taraba major	obs,tr	r	ig
Sakesphorus canadensis	obs,tr,cap,ph	c	ig
Thamnophilus nigrocinereus	obs,tr	r	ig
T. aethiops	obs,tr,col,cap,ph	c	tf
T. murinus	obs,tr,cap,ph	f	tf,cm
T. schistaceus	obs,tr,col	i	ig,tf
T. amazonicus	obs,tr,cap,ph	r	ig,dv,cm
Megastictus margaritatus	tr3,cap,ph	r	tf
Pygiptila stellaris	tr5	r	ig
Thamnomanes ardesiacus	obs,tr,cap	f	tf
T. caesius	obs,tr,col,cap	r	tf,ig,cm
Herpsilochmus dorsimaculatus	obs,tr,col	c	tf,ig
Myrmotherula brachyura	obs,tr,col	f	tf,cm
M. ambiqua	tr,col,ph3	r	tf
M. surinamensis	obs,tr	i	ig
M. cherriei	obs,tr,col,ph	i	ig,cm
M. haematonota	obs,tr,col,cap	f	tf
M. axillaris	obs,tr,col,cap	i	tf,dv,ig,cm
M. longipennis	obs,col,cap	f	tf
M. menetriesii	obs,tr,cap,ph	r	tf
M. assimilis	obs,tr	r	ig
Terenura spodioptila	obs,v	r	tf
Formicivora grisea	obs,tr,col	f	ca
Cercomacra cinerascens	obs,v,tr	c	tf,ig
C. tyrannina	v,col,cap,ph	f	tf,dv
Myrmoborus myiotherinus	obs,tr,col,cap,ph	c	tf,dv,cm
Hylophylax naevia	obs,tr,col,cap	c	tf
H. punctulata	obs,tr1	r	ig
H. poecilinota	obs,tr,col,cap,ph	f	tf,ig,cm
Hypocnemis cantator	v,tr,cap	f	tf,dv,ig
H. hypoxantha	obs,tr,col,cap,ph	f	tf
Hypocnemoides melanopogon	obs,tr,col,cap,ph	f	ig
Sclateria naevia	obs,v,tr1	r	ig
Percnostola minor	tr,cap,ph	r	tf,dv
Schistocichla leucostigma	tr,col,cap,ph	i	tf
Myrmeciza atrothorax	obs,v,tr	r	tf
M. disjuncta	obs,tr3,col,ph3	r	ca

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Pithys albifrons	obs,tr,col,cap,ph	c	tf,cm
Gymnopithys leucaspis	obs,tr,col,cap,ph	c	tf,ig,cm
Rhegmatorhina cristata	cap,tr5,ph,col	i	tf,ca
Phlegopsis erythroptera	obs,tr,col,cap	f	tf,cm
Formicariidae			
Formicarius analis	obs,v	r	tf
F. colma	tr,col,cap,ph	f	tf,ig,cm
Grallaria varia	v	r	tf
Myrmothera campanisona	tr,cap,ph	r	tf
Hylopezus macularius	v,tr	i	tf
Conopophagidae			
Conopophaga aurita	cap,ph	i	tf
Tyrannidae			
Tyranninae			
(*Elaenia parvirostris*)	obs6	r	dv
E. ruficeps	obs,tr,ph,col	c	ca
Myiopagis gaimardii	obs,tr	c	dv,tf,ig
M. caniceps	obs,v,col	r	tf
Phaeomyias murina	obs,v	r	dv
Camptostoma obsoletum	obs,tr	f	dv
Tyrannulus elatus	v,tr,cap,ph	i	dv
Ornithion inerme	v,tr	f	tf
Zimmerius gracilipes	obs,v,tr	i	tf,ig,cm
Inezia subflava	obs,tr,cap	f	ig,dv
Mionectes oleagineus	obs,tr,col,cap,ph	f	tf,ig
M. macconnelli	tr1,cap	r	tf
Myiornis ecaudatus	tr3	i	tf
Hemitriccus zosterops	tr,col,cap,ph	f	tf,cm
H. minor	tr,col,cap	f	ig
H. minimus	obs,tr,col	r	ig,cm
Todirostrum maculatum	obs,tr,cap	f	ig,dv
T. chrysocrotaphum	obs,tr,col,cap	i	ig
Corythopis torquata	obs,tr,col,cap	f	tf,ig,cm
Platyrinchus platyrhynchos	obs,v,tr	r	tf
(*Tolmomyias sulphurescens*)	obs,v	r	tf
T. poliocephalus	obs,v,tr	c	tf,ig
T. assimilis	v,tr3	r	tf
Ramphotrigon ruficauda	tr,col,cap,ph	i	tf,ig,cm
Cnipodectes subbrunneus	tr,col,cap	r	tf
Onychorhynchus coronatus	tr,cap,ph	r	tf,ig
Myiobius barbatus	col,cap	r	tf
Terenotriccus erythrurus	tr,col,cap	i	tf,cm
Cnemotriccus fuscatus	obs,tr,cap,col	i	cm
Lathrotriccus euleri	obs,v	r	tf
Phaeotriccus poecilocercus	obs,tr3,ph3	i	ig

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Attila citriniventris	v5	r	cm
A. cinnamomeus	obs,v,tr	c	ig
A. spadiceus	obs,v,tr	r	tf
Rhytipterna simplex	obs,v,tr,col	f	tf,ig,cm
R. immunda	tr4,cap,ph3	r	ca
Myiarchus swainsoni	obs,tr	i-s	tf
M. ferox	obs,tr	f	ig,dv,cm
M. tuberculifer	obs,tr3	r	ig,tf,cm
Megarynchus pitangua	obs,v	r	dv
Pitangus sulphuratus	obs,tr,cap,ph	c	dv,ig
Philohydor lictor	obs,v,tr	f	ig
Myiozetetes cayanensis	obs,v,tr,cap,ph	f	dv,ig
M. similis	obs,v	r	dv
Conopias trivirgata	obs,v	f	tf,ig,dv
C. parva	obs,v,tr	f	tf,cm
Myiodynastes maculatus	obs	r-s	dv,ig
Legatus leucophaius	obs,v,tr	f	tf,ig,dv,cm
Empidonomus varius	obs,tr1	i	dv
Tyrannopsis sulphurea	obs,tr	r	dv
T. melancholicus	obs,tr	c	dv,ig,cm,ca
Tyrannus savana	obs	i-s	ig,dv
Pachyramphus surinamus	obs,tr4	r	tf
P. polychopterus	obs6,v	r	tf,dv
P. marginatus	obs,v,tr1	r	tf,dv
P. rufus	obs,tr1	r	dv
P. castaneus	obs6	r	tf,dv
Tityra inquisitor	obs	r	tf
T. cayana	obs,tr1	f	tf,ig,dv
(*T. semifasciata*)	obs6	r	tf
Piprinae			
Schiffornis major	obs,v	r	ig
S. turdinus	tr,col,cap	f	tf,dv,cm
Tyranneutes stolzmanni	tr,col	c	tf
Neopelma chrysocephalum	obs,tr,col,cap	i	tf,ig,cm
Neopipo cinnamomea	tr5,cap,ph3	r	cm,ca
Piprites chloris	obs,tr	i	tf
Heterocercus flavivertex	v,tr,cap,ph	f	ig,dv
Xenopipo atronitens	tr,col,cap,ph	i	ig,cm
Chiroxiphia pareola	tr,cap	r	tf
Pipra coronata	tr,col,cap,ph	c	tf,dv,ig,cm
P. pipra	tr,col,cap,ph	i	tf,ig,dv,cm
P. erythrocephala	obs,cap,tr	c	tf,dv,cm
P. filicauda	cap,ph	r	tf
Cotinginae			
Cotinga cayana	obs	r	ig,tf

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Xipholena punicea	obs,tr	f	tf,ig
Laniocera hypopyrra	obs,v,tr	f	tf,ig
Lipaugus vociferans	obs,v,tr	c	tf,ig,cm
Gymnoderus foetidus	obs	i-s	ig
Perissocephalus tricolor	v1	r	tf
Phoenicircus nigricollis	v5	r	tf
Hirundinidae			
Phaeoprogne tapera	obs,tr1	c	a
Progne chalybea	obs,tr1	i-s	a
P. subis	obs,tr1	i-s	a
Tachycineta albiventer	obs,tr1,ph	c	a
Atticora fasciata	obs,col	i	a
A. melanoleuca	obs3	r	a
Stelgidopteryx ruficollis	obs	i	a
Riparia riparia	obs	r-s	a
Hirundo rustica	obs	r-s	a
Troglodytidae			
Thryothorus coraya	obs,tr,col	i	tf,dv
T. leucotis	obs,tr	c	ig
Troglodytes aedon	obs,tr,cap	c	dv,ig,ca
Cyphorhinus aradus	obs,tr,cap	r	dv
Microcerculus bambla	tr,cap,ph	f	tf
Sylviidae			
Microbates collaris	tr,col,cap	i	tf,cm
Ramphocaenus melanurus	obs4	r	tf
Polioptila plumbea	obs,tr,col	f	ig
P. guianensis	obs,v,tr	r	tf
Turdidae			
Catharus sp	obs1	r-s	dv
Turdus leucomelas	obs1	r	dv
T. albicollis	obs,tr,cap,ph	c	tf,ig
T. fumigatus	obs,tr,cap,ph	i	tf,dv,ig
Vireonidae			
Cyclarhis gujanensis	obs,tr,cap,ph	f	dv,ig
Vireolanius leucotis	obs,v	r	tf
Vireo olivaceus	obs,tr	r	dv,ig
V. altiloquus	obs6	r-s	tf
Hylophilus semicinereus	obs,tr,ph	f	ig,tf
H. thoracicus	obs,tr	r	tf
H. hypoxantha	obs,tr,col	c	tf
H. brunneiceps	obs,tr,col	f	cm,ig
H. ochraceiceps	obs,tr	r	tf
Emberizidae			
Parulinae			
Dendroica fusca	obs	r-s	tf

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Setophaga ruticilla	obs3	r-s	dv
Thraupinae			
Schistochlamys melanopis	obs,tr	r	ca
Cissopis leveriana	obs1	r	dv
Hemithraupis flavicollis	obs	r	tf
Lanio fulvus	obs	r	tf
Tachyphonus cristatus	obs,col	r	tf
T. surinamus	ob6	r	tf
T. phoenicius	obs,tr,col,ph	f	ca
T. luctuosus	obs1	r	tf
Habia rubica	obs,cap,ph	r	tf,dv
Ramphocelus nigrogularis	obs	r	ig
R. carbo	obs,cap,tr	c	dv
Thraupis episcopus	obs,tr1	c	dv
T. palmarum	obs,tr6	c	dv,tf
Euphonia plumbea	obs6	r	tf
E. chlorotica	obs,tr3	f	ig,dv
E. chrysopasta	obs,tr1	r	tf,ig
E. minuta	obs2	r	ig
E. rufiventris	v,tr3	i	tf
Tangara mexicana	obs	i	tf,dv
T. chilensis	obs,col	f	tf
T. punctata	obs,tr1	f	tf
T. cayana	obs3	r	ig
Tangara velia	obs5	r	tf
Dacnis cayana	obs,tr1	r	tf,dv
D. flaviventer	obs,v	i	ig,dv
Chlorophanes spiza	obs	r	tf
Cyanerpes nitidus	obs6	r	tf
C. caeruleus	obs,col	r	tf
C. cyaneus	obs,tr1	r	tf
Tersina viridis	obs1,v1	r-s	dv
Coerebinae			
Coereba flaveola	obs,tr	r	dv,ig,cm
Icterinae			
Sturnella militaris	obs	i	ca
Lampropsar tanagrinus	obs	r	ig
Scaphidura oryzivora	obs	r	dv
Icterus chrysocephalus	obs,tr,ph	r	tf,dv,ig,ca
Cacicus haemorrhous	obs,tr	r	tf
C. cela	obs,tr,ph	c	dv,ig
Psarocolius decumanus	obs,tr	r	tf,ig
P. bifasciatus	obs6	r	tf
Cardinalinae			
Caryothraustes canadensis	obs,v,col	r	tf,cm

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APPENDIX. Continuation.

Families and species	Documentation[1]	Abundance[2]	Habitat[3]
Saltator maximus	obs,tr,ph	i	tf
Paroaria gularis	obs,tr	f	ig,dv
Cyanocompsa cyanoides	tr,cap,ph	f	tf,ig
Emberizinae			
Oryzoborus angolensis	obs,cap,tr	f	dv,ca
Volatinia jacarina	obs	r	dv
Dolospingus fringilloides	cap,ph3,tr3	r	ca
Sporophila lineola	obs,tr1	r	dv
S. americana	obs	r	dv
S. castaneiventris	obs,v	r	dv
Arremon taciturnus	obs4,v	r	tf,dv
Ammodramus aurifrons	obs4	r	dv
Emberizoides herbicola	obs,tr,col,ph	c	ca
Sicalis columbiana	obs,v	r	ig

[1]Documentation: obs = species recorded by observation, v = species recorded by voice without tape recording, ph = birds photographed, tr = voice recording, col = specimens collected, cap = captured birds. The numbers after some records are the credits to the following ornithologists: 1 = André Carvalhaes, 2 = Luiza Magalli Henriques, 3 = Sérgio Borges, 4 = Andrew Whittaker, 5 = Mario Cohn-Haft, 6 = José Fernando Pacheco, 7 = others (researchers or local residents).

[2]Abundance: u = infrequently recorded, r = rare, f = frequent, c = common, am = austral migrant, nm = neartic migrant.

[3]Habitat: tf = terra firme forest, ig = igapó flooded forest, ca = shrubby campina (campina), cm = wooded campina (campinarana), dv = disturbed vegetation including recent and old secondary growth., r = rivers, lakes and streams, a = aerial, including birds frequently observed in flight.