Revista Brasileira de Biociências
Brazilian Journal of Biosciences

ISSN 1980-4849 (on-line) / 1679-2343 (print)

ARTICLE

Avian communities in woodlots in Parque das Neblinas, Bertioga, São Paulo, Brazil

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Received: April 21 2010 Received after revision: August 27 2010 Accepted: November 5 2010
Available online at http://www.ufrgs.br/seerbio/ojs/index.php/rbb/article/view/1506

ABSTRACT: (Avian communities in woodlots in Parque das Neblinas, Bertioga, São Paulo, Brazil). Parque das Neblinas (PN) is a 2,800 ha nature reserve contiguous with an Atlantic Forest fragment known as Parque Estadual da Serra do Mar located in the municipality of Bertioga, in the state of São Paulo, Brazil. The area originally contained *Eucalyptus* trees grown for paper pulp production. The aims of the study were the following: (1) to characterize the diversity of the bird community in PN; (2) to compare bird species observed in PN to species found in the Atlantic Forest; and (3) to list the percentages of species endemic to the Atlantic Forest and present in PN. Quantitative surveys used the point count method. The number of avian species recorded in PN totaled 222, of which 150 (66.4%) were associated with forest environments, 66 (29.3%) with open areas, and 10 (4.3%) with aquatic environments. The quantitative survey recorded 141 species and 2,527 contacts in 120 samples for an average of 21.05 contacts per sample. The general diversity index was H´=3.82. The study identified 15 bird species that actively participated in mixed flocks and 25 species endemic to Atlantic Forest, two of which present some kind of concern relating to conservation. Areas with *Eucalyptus* trees and a dense understory displayed the greatest bird species diversity, as opposed to areas with less developed or non-existent understories.
Key words: Atlantic Forest, bird community, endemic species, Serra do Mar.

RESUMO: (Assembléia de aves em bosques de eucaliptos no Parque das Neblinas, Bertioga, São Paulo, Brasil). O Parque das Neblinas (PN), com 2800 ha, é contíguo ao Parque Estadual da Serra do Mar. O presente estudo teve por objetivos: (1) caracterizar a diversidade da comunidade de aves no Parque das Neblinas (PN); (2) comparar a comunidade de aves registrada no PN àquela da Mata Atlântica e (3) relacionar a porcentagem de espécies endêmicas de Mata Atlântica presentes no PN. Foram registradas 222 espécies de aves no Parque das Neblinas. Destas, 150 (66,4%) estão associadas a ambientes florestais, 66 (29,3%) a áreas abertas e 10 (4,3%,) associadas a ambientes aquáticos. No estudo quantitativo, foram registrados 141 espécies e 2527 contatos em 120 amostras, com uma média de 21,05 contatos/amostra. O índice geral de diversidade registrado foi H´=3,32. Registraram-se 15 espécies de aves presentes no PN que participaram ativamente de bandos mistos e 25 espécies são endêmicas da Mata Atlântica. Constatou-se que nas áreas onde a vegetação de eucalipto mostra-se acompanhada de um extenso sub-bosque apresentaram maior diversidade de espécies da comunidade de aves.
Palavras-chave: Assembléia de Aves, espécies endêmicas, Mata Atlântica, Serra do Mar.

INTRODUCTION

Brazil is one of the richest countries in the world in terms of biodiversity. It has two of the 25 hotspots with the greatest biodiversity and the highest degree of endemism found anywhere on Earth: the Atlantic Forest and the Cerrado (Mittermeier *et al*. 2000). The Atlantic Forest is a top-priority biome for study and research, a conservation priority among endemic bird areas (Stattersfield *et al*. 1998), and one of the most endangered ecosystems in the world (Fonseca 1985).

Originally, the Atlantic Forest occupied about 1.2 million km^2 in Brazil, extending from the northeastern states of Rio Grande do Norte and Ceará to the most southern state in the country, Rio Grande do Sul (Mittermeier *et al*. 2000). The area of this forest was larger in the Southeast Region, extending inland in some places for 500-600 km, than in the Northeast Region, where it occupied a narrow coastal strip that rarely exceeded 50-100 km. Today only 7% of the original area remains, mostly in the state of São Paulo (Galetti & Pizo 2002). Of the 688 avian species (451 rare) found in the Atlantic Forest, about 200 are endemic and just over 50% live in relatively unaltered habitats (Goerck 1997). Although this forest clearly rates as one of the highest-priority hotspots on Earth, and has already lost well over 90% of its original area, it is fair to say that the Brazilian Atlantic Forest region has perhaps the brightest outlook among the 16 hotspots found in developing countries (Mittermeier *op. cit*.).

Previous studies of Atlantic Forest bird communities have shown the impact of deforestation and consequent fragmentation for many tropical bird species (Christiansen & Pitter 1997, Anjos 2004), patterns of rarity (Goerck 1997), species extinction (Brooks *et al*. 1999, Ribon *et al*.

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2003), and the effects of selective logging (Aleixo 1999). Inventories of distinct parts of the fragmented landscape have also been the subject of analysis (Camargo 1946, Willis 1979, Willis & Oniki 1981, Motta Jr. 1990, Silva 1992, Höfling & Lencioni 1992, Olmos & Martuscelli 1995, Magalhães 1999, Willis 2002, 2003, Develey 2004, Donatelli *et al*. 2004, 2007), but studies in mixed areas comprising inland Atlantic Forest and *Eucalyptus* groves have been less common.

Therefore, the aims of this study, which was conducted at Parque das Neblinas, were to characterize the diversity of the bird community to diagnose the status of the community after approximately 40 years without the planting of new *Eucalyptus* trees, and to compare the bird species found to those present in an adjoining Atlantic Forest fragment.

MATERIALS AND METHODS

Research Area

The present study was conducted in an area contiguous with an Atlantic Forest fragment administered by municipality of São Sebastião, in the state of São Paulo. Parque das Neblinas (23º 44'S; 46º 09'W) (henceforth referred to as "PN") is a nature reserve of about 2,800 ha located in the municipality of Bertioga, in São Paulo. The elevation of this region ranges from 700 m to 1,200 m above sea level, and the Itatinga River runs through the area. The park belongs to Suzano Papel e Celulose S.A., a pulp and paper company, and was once part of Fazenda Sertão dos Freires. The southern portion of PN is contiguous with an Atlantic Forest reserve called Parque Estadual da Serra do Mar and contains floristic elements of this biome. PN was originally used to grow *Eucalyptus* trees for producing paper pulp, but part of the plantation was deactivated in 1966 and has changed substantially over the last 40 years. It was later transformed into a nature park for research and environmental education under the Ministry of the Environment's Private Natural Heritage Reserve Program (Reservas Particulares do Patrimônio Natural, RPPN).

Research conducted in areas undergoing regeneration, such as Parque das Neblinas, should take into account the surrounding habitats as well as the areas themselves because these areas are influenced by their surroundings in ways that can be more important than the processes occurring inside them (Terborgh 1980 a*pud* Loiselle & Blake 1992, Wiens 1994). The vegetation that PN now contains is made up of *Eucalyptus* trees and a dense understory in some areas, and characteristics of the Atlantic Forest can already be seen in many places.

Rainfall varied from 25 mm to 450 mm during the research period, with an annual average of 215 mm. August 2004 was the driest month and January 2005 the wettest. The heaviest rainfall period occurred between November 2004 and March 2005, and the lightest was between May and September 2004. The highest mean temperature was 27º C in February 2005; the lowest was 9º C in August 2004.

Bird surveying: qualitative and quantitative analyses

Qualitative studies of PN began with visits to several areas with differing vegetation physiognomies both in the interior of PN and in adjacent areas. The areas inside PN were comprised of (1) *Eucalyptus* only, (2) *Eucalyptus* with an understory at varying stages of development, or (3) secondary forest at varying stages of succession (altered areas). In addition, the following areas outside but adjacent to PN were visited: (1) roads passing through the entire vicinity of PN, (2) part of the forest in Parque Estadual da Serra do Mar (750 m), (3) secondary ombrophilous forest, (4) dry scrub (*capoeiras secas*) with temporary wetlands, and (5) anthropogenic areas. Visits were conducted monthly on foot using existing trails inside PN or by car using roads both inside the park and in adjoining areas.

The qualitative research also served as a basis on which to establish the frequency of occurrence of species registered in a given area, thus enabling an individual analysis of each local species during a given period. The resulting percentage frequency index is easy to compute and has become one of the most widely used methods to determine the status of species in bird communities (Donatelli *et al.* 2004).

Twelve expeditions to PN were carried out between January 2004 and February 2005. Visits were not made during April 2004, when it rained substantially, or in October, when the authors could not visit the area. The samples were taken during the dry season (April to September) and wet season (October to March). Visits lasted three days with about 12 hours of observation per visit, for a total of 156 hours that was used to produce the qualitative records. Frequency indices were calculated using records of observations (qualitative data) made from these visits.

Quantitative research used point counts, according to Donatelli *et al.* (2004), already demarcated within PN, which were 200 m apart. The estimated time per point count (or station) was 10 minutes. Ten points were sampled per period, giving a total of 100 minutes per monthly visit, always at a different location chosen by drawing lots at the moment of departure for fieldwork. The total number of samples was 120. Observation began about 20 minutes before sunrise. Contacts were recorded in an individual spreadsheet for each point count. Criteria, concepts and definitions relating to the status of conservation, endemism and occurrence, sensitivity, foraging stratum and relative abundance of species registered in the PN bird community followed Stotz *et al*. (1996), Sick (1997), and Stattersfield *et al.* (1998). The status of each species in the PN was assigned according to the following: A [abundant] - species recorded in at least 75% of the samples (x≥75%); C [common] - species recorded in 50% to 74% of the samples (50>x>74%); I [uncommon] - species recorded in 15% to 49% of the

samples (15≥x≥49%); R [rare] - species that were poorly recorded, and with low abundance (x≤14%); O [occasional] - species recorded only once in the study.

The taxonomic order of families and species nomenclature follows the resolutions of the Brazilian Ornithological Records Committee (CBRO 2009).

Data analysis

The bird community in PN was analyzed in terms of frequency of occurrence (frequency index according to Vielliard & Silva 1990), abundance (abundance index according to Aleixo & Vielliard 1995), diversity (Shannon-Wiener index) and evenness (according to Krebs 1999). The Shannon-Wiener index values obtained were calculated using a natural log base (ln), since $\log_2$ gave values 44% higher and was thus unrealistic (Vielliard & Silva 1990).

RESULTS

Qualitative survey

The number of avian species recorded at Parque das Neblinas (PN) and adjacent areas was 222 (Table 1). Two-thirds of these species (146) are associated with forest environments, 66 (29.3%) with open areas, and 10 (4.3%) with aquatic environments. All of these results appear more demanding with regard to forest cover (preferring dense ombrophilous vegetation to *Eucalyptus* with an understory), food (fewer fruit trees inside the park), and reproductive preferences (reproduction sites found in the current distribution of vegetation in PN).

The number of records obtained during the months of qualitative research totaled 1,034 for an average of 87 species recorded per visit. The highest number of species was recorded in November (n=113) and the lowest in July (n=68). The number of species registered per visit was higher in months when birds were reproducing and lower in cooler months (April-August). Variation in the number of contacts followed the same pattern (see below). There was a 60% difference between the wet season (reproductive period) and the dry season (cooler months). The difference between the two periods was statistically significant (t=10.28, P<0.0001).

In the present study, the most representative families were Tyrannidae (19.7%), Thraupidae (9.7%) and Thamnophilidae (7.4%). Among non-Passeriformes, the most frequent were Trochilidae (6.1%), Columbidae (3.1%) and Picidae (3.1%).

Quantitative survey

The number of species recorded at the point counts totaled 141 with 2,527 contacts in 120 samples, averaging 21.1 contacts per sample. The highest number of contacts was obtained in January 2004 (n=345) and the lowest in July (n=106). Again we observed variation between January 2004 and 2005 with 345 and 201 contacts, respectively (a difference of 144 contacts), and between February 2004 and 2005 with 212 and 218, respectively (a difference of 6). The mean number of contacts per month varied from 10.6 (July 2004) to 34.5 (January 2004). The overall mean per sample (n=21.1) was closest to the September average (n=22). The number of contacts for the rainy months (September 2004-February 2005) was 241; for the remaining months it was 137 (difference of n=104). The average for rainy months was 24.1, which is above the average for the remaining months (X=10.4) and slightly higher than the overall mean (n=21.1). No month of the non-breeding period (April-August) displayed a higher average than the reproductive months. In 2004 the number of contacts was higher than the overall mean (n= 211) in 6 months (January n= 345, February n= 212, March n= 221, September n= 220, November n= 281, December n= 285). In 2005 the number of contacts was higher than the average only in one month (February n= 218). The number of contacts was below the average (n= 221) in all other months (in 2004, May n= 144, June n= 134, July n= 106, August n= 165; in 2005, January n= 201). The highest number of species recorded in a single morning of point sampling was 72 (January 2004); the lowest was 26 (July 2004). The mean number of species recorded per month during sampling was 40, which matches the number recorded in November.

Table 1 shows abundance indices (AI) for species in the bird community of PN and adjacent areas, as calculated following the quantitative survey based on point counts and frequency indices (FI) from qualitative data. The quantitative survey recorded a total of 141 species or 63% of all those present in and near PN.

Seasonality of some species from Atlantic Forest areas are less known since researches normally do not describe in their papers the monthly presence of species year round. Considering the importance of knowing the seasonality of some species in Parque das Neblinas, we registered their seasonality based on our field experience (Table 2).

Abundance indices

Abundance indices ranged between 0.017 (2 contacts) and 1.767 (212 contacts) for the 141 species recorded by the point count method. The number of contacts was 5 or less (AI=0.042) for about 50% of these species, between 6 (AI=0.050) and 27 (AI=0.225) for 35%, and between 32 (AI=0.267) and 212 (AI=1.767) for 15% (Table 1). The mean number of contacts was 21.1, corresponding to AI=0.175. The cumulative curve of the number of species indicated that 72.7% (104 species) had an abundance index below the mean number of contacts, while 28% (39 species) had an index equal to or greater than the mean. It can be said that there are few abundant species having many individuals per species in PN. This profile is typical of tropical forest environments (Stotz *et al*. 1996). The most abundant species recorded in PN were: Golden-crowned Warbler (*Basileuterus culicivorus*) (Deppe, 1830), Blue Manakin (*Chiroxiphia caudata*) (Shaw & Nodder, 1793), Rufous-browed Peppershrike (*Cyclarhis*

gujanensis) (Gmelin, 1789), White-shouldered Fire-eye (*Pyriglena leucoptera*) (Vieillot, 1818), Red-eyed Vireo (*Vireo olivaceus*) (Linnaeus, 1766) and Southern Antpipit (*Corytopis delalandi*) (Lesson, 1830), all with more than 100 contacts. Species with more than 50 contacts accounted for about 53% of the total contacts. Thus, eight more species should be added to the list: Brown Tinamou (*Crypturellus obsoletus*) (Temminck, 1815), Plumbeus Pigeon (*Patagioenas plumbea*) (Vieillot, 1818), Olivaceous Woodcreeper (*Sittasomus griseicapillus*) (Vieillot, 1818), Gray-hooded Attila (*Attila rufus*) (Vieillot, 1819), Planalto Hermit (*Phaethornis pretrei*) (Lesson & Delattre, 1839), Streaked Flycatcher (*Myiodynastes maculatus*) (Statius Muller, 1776), Rufous Gnateater (*Conopophaga lineata*) (Wied, 1831) and Lesser Woodcreeper (*Xiphorhynchus fuscus*) (Vieillot, 1818).

The mean monthly variation in the number of contacts was 10.6 (July 2004) and 34.5 (January 2004), i.e., 325%. This coefficient is consistent with the smallest number of contacts recorded in the coolest month (July, n=106) and the warmest (January 2004, n=345). This variation reflected the lower detection of species in cooler months, outside the reproductive period when birds vocalize less, compared with higher detection in warmer months, during the reproductive period when bird activity and vocalization are more conspicuous. Moreover, in this case, temperatures were unusually low and rainfall was abnormally high in July.

Diversity

There was no significant variation in the diversity or evenness within the bird community in PN during the year (ns KW=5.6). In specific terms, diversity was highest in January 2004 followed by February 2005, despite constant rain during the months in question. On the other hand, diversity was lower in January 2005 than it had been during the same month of 2004 and lower in February 2004 than it was in February 2005. There is not any satisfactory explanation, however, for the differences between the diversity indices calculated for these months since evenness remained relatively constant. In other words, individuals were distributed uniformly across species regardless of the different numbers of species recorded in January and February of 2004 and 2005. In September, November, and December, diversity varied little, demonstrating a balance in detection and distribution of species at the start of the reproductive period. Evenness indices provided a clear demonstration of this balance, since values were similar and equivalent in the three months concerned. In May, June, July, and August diversity indices were lower than in other months, possibly because the four months in question are cooler and drier, comprising a period in which birds move about less, vocalize less and tend to be less detected. Moreover, this is not the typical reproductive period for most species, hence the decrease in activity and movement in general. The low species richness found in the same months, with the exception of August, with 30 species in May and June, and only 26 in July, is consistent with this picture. The general diversity index was H´= 3.82. Only the indices for February, March and May through August 2004 were below the mean. With the exception of February and March 2004 when the lower diversity was probably attributable to heavy rainfall, it can be inferred that bird conspicuousness and vocalizations were diminished during cooler months and outside the reproductive season. Furthermore, when the mean monthly temperatures are lower, birds move about less resulting in a lower rate of detection.

Mean annual evenness was 0.91. Monthly indices fell below the mean only in January and May 2004. The reduction observed in May could be explained by the low diversity index for that month, together with low temperatures and rainfall. During May we observed fewer species but counted a larger number of individuals for certain species (the Golden-crowned Warbler, *Basileuterus culicivorus*, and the Blue Manakin, *Chiroxiphia caudata*, with 33% of the individuals recorded for the month in question). In January, despite the fact that this was the warmest and wettest month, and the month with the highest richness, the log shows uneven distribution of individuals and many individuals recorded for some species (the Blue Manakin, *Chiroxiphia caudata*, the Red-eyed Vireo, *Vireo olivaceus*, the Red-eyed Antshrike, *Pyriglena leucoptera*, and the Streaked Flycatcher, *Myodynastes maculatus*). These species represented 25% of all individuals recorded for the month. As a result, the evenness index was lower than in all other months.

Numbers of species and individuals were highest in January 2004, followed by a downtrend in the cooler months (May-August), a rebound in September, and relative stability with a slight increase in the number of species until February 2005. Aside from January 2004, the number of individuals varied more than the number of species. Two typical patterns were observed: (a) one level between February and August 2004; and (b) a different, higher level between September 2004 and February 2005. In the first case, the number of individuals but not the number of species rose moderately in May, indicating a decrease in diversity and evenness for that month. In the second case, rising numbers of both species and individuals from September revealed that detection effectively increased during the reproductive period, either because birds moved and vocalized more, or because they were more conspicuous during that period. The number of species recorded during the year followed a typical and constant pattern coinciding with reproductive periods for bird species in PN.

Species status in PN

In accordance with the criteria proposed by Stotz *et al*. (1996) and based on frequency indices for the 141 species recorded at the point counts, 15% were found to be abundant in PN, 17% common, 29% uncommon, 27% rare, and 12% occasional (Table 1). Abundant, common and uncommon species are considered residents (of PN)

Table 1. Species of birds recorded in the Parque das Neblinas. Abundance Index (AI) and alongside the number of contacts (A) for all species recorded by point counts (quantitative survey) and Frequency of Occurrence [(FO) (qualitative survey)] **, Second recorded contact in São Paulo State; N, nests sighted; En, endemic (Sick 1997); NT, nearly threatened (Stattersfield *et al.* 1998); I, indicator species (Stotz *et al.* 1990); VU, vulnerable. Sensibility (SENS.): B, low; M, medium; A, high. Stratum (STR.): S, ground; SB, understory; C, canopy; A, aerial; AQ, aquatic. Abundance (ABUND.): R, Rare; I, uncommon; RC, reasonably common; C, common; O, ocasional. Habitats (HABIT.): AA, anthropogenic areas; EU, eucaliptus; EU+: eucaliptus with understory; DS, dry scrub; OF, ombrophilous forest; R, roads; SF, secondary forest. Priority for conservation: B, low; M, medium; A, high. Priority of research or study (RES.): B, low; M, medium; A, high. APN, Abundance and status in Parque das Neblinas. D, Type of documentation: DO, direct observation; V, voice; DO/V: both methods; N, nest. Voices deposited at Laboratório de Vertebrados (LV), Unesp, campus de Bauru, São Paulo. *[EN] 1st register in Taubaté by Alvarenga *et al.* (2006; The expantion of the distribution of *Furnarius figulus* (Lichteinstein, 1823) (Aves: Furnariidae) no Sudeste Brasileiro. *Atualidades Ornitológicas, 134*: 6-7).

TAXON	SENS.	STR.	ABUND.	HABIT.	C	RES.	A	AI	FO(%)	D
Tinamidae										
Tinamus solitariu [En/VU] (Vieillot, 1819)	M	S	I	OF	M	M			8.3	V
Crypturellus obsoletus (Temminck, 1815)	B	S	RC	SF/OF	B	B	74	0.617	100	V
Crypturellus tataupa (Temminck, 1815)	B	S	RC	SF	B	M			8.3	V
Cracidae										
Penelope obscura[NT] Temminck, 1815	M	S/C	RC	OF/SF	M	M	2	0.117	16.7	DO
Odontophoridae										
Odontophorus capueira[I] Spix, 1825	A	S	RC	OF/SF	M	M	6	0.050	41.7	V
Phalacrocoracidae										
Phalacrocorax brasilianus (Gmelin, 1789)	B	AQ	C	AA	B	B			8.3	DO
Fregatidae										
Fregata magnificens Mathews, 1914	A	AQ/A	C	---	B	B			8.3	DO
Ardeidae										
Ardea cocoi Linnaeus, 1766	B	S/AQ	RC	AA	B	B			8.3	DO
Cathartidae										
Coragyps atratus (Bechstein, 1793)	B	A/S	C	AA/DS/R	B	B	2	0.017	66.7	DO
Cathartes aura (Linnaeus, 1758)	B	A/S	C	AA	B	B	2	0.017	16.7	DO
Accipitridae										
Elanoides forficatus (Linnaeus, 1758)	M	C/A	I	DS	B	M	3	0.025	25.0	DO
Ictinia plumbea (Gmelin, 1788)	M	C/A	C	DS/SF	B	B	6	0.050	41.7	DO
Rupornis magnirostris (Gmelin, 1788)	M	C/A	RC	R/DS/AA	B	B			16.7	DO/V
Buteo brachyurus Vieillot, 1816	B	C	C	DS/SF	B	B	14	0.117	83.3	DO
Falconidae										
Caracara plancus (Miller, 1777)	B	C	RC	DS/AA	B	B			8.3	DO
Milvago chimachima (Vieillot, 1816)	B	S	C	DS/AA	B	B			8.3	DO/V
Herpetotheres cachinnans (Linnaeus, 1758)	M	SB	RC	SF/DS	B	B	3	0.025	33.3	V
Micrastur ruficollis (Vieillot, 1817)	B	S/C	C	SF	B	B	14	0.117	91.7	V
Rallidae										
Aramides saracura (Spix, 1825)	M	S	I	SF	B	B			16.7	V
Pardirallus nigricans (Vieillot, 1819)	M	S	I/P	SF	B	B	17	0.142	100	V
Charadriidae										
Vanellus chilensis[N] (Molina, 1782)	B	S	C	AA	B	B	2	0.017	66.7	DO/V
Scolopacidae										
Gallinago paraguaiae (Vieillot, 1816)	B	S	C	AA	B	B			8.3	DO
Columbidae										
Columbina talpacoti (Temminck, 1811)	M	C	C	AA/DS/R	B	B	9	0.075	83.3	DO
Patagioenas picazuro[N] (Temminck, 1813)	A	C	RC	AA/SF	B	B	66	0.550	83.3	DO/V
Patagioenas plumbea (Vieillot, 1818)	B	S	C	SF/EU+	B	B	2	0.017	16.7	DO/V
Leptotila verreauxi Bonaparte, 1855	B	S/SB	C	SF	B	B			8.3	V
Leptotila rufaxilla (Richard & Bernard, 1792)	M	S	C	SF	B	B	2	0.017	8.3	V
Geotrygon montana (Linnaeus, 1758)	M	S	RC	SF/OF	B	B	3	0.025	8.3	DO/V
Psittacidae										
Pyrrhura frontalis (Vieillot, 1817)	M	C	C	OF/SF	B	B			8.3	DO
Brotogeris tirica (Gmelin, 1788)	B	C	C	DS/SF	B	B			8.3	DO
Pionopsitta pileata[I] (Scopoli, 1769)	M	C	I	OF	M	M			8.3	DO
Pionus maximiliani[I] (Kuhl, 1820)	M	C	RC	OF/SF	B	B	26	0.217	50.0	DO/V
Cuculidae										
Piaya cayana (Linnaeus, 1766)	B	C	C	EU/EU+/ SF/R/OF	B	B	9	0.075	83.3	DO/V
Crotophaga ani Linnaeus, 1758	B	S/C	C	DS/AA/R	B	B	3	0.025	33.3	DO/V
Tapera naevia (Linnaeus, 1766)	B	S/ SB	C	SF	B	B	2	0.017	16.7	V
Strigidae										
Megascops choliba (Vieillot, 1817)	B	C	C	SF/AA	B	B			25.0	V
Athene cunicularia (Molina, 1782)	M	S	RC	AA	B	B			33.3	DO
Nyctibiidae										
Nyctibius griseus (Gmelin, 1789)	B	C	C	SF	B	B			16.7	V

Table 1. Cont.

TAXON	SENS.	STR.	ABUND.	HABIT.	C	RES.	A	AI	FO(%)	D
Caprimulgidae										
Nyctidromus albicollis (Gmelin, 1789)	B	S	C	R/AA	B	B			41.7	DO/V
Nyctiphrynus ocellatus (Tschudi, 1844)	M	S	RC	OF/SF	B	M	6	0.050	8.3	V
Caprimulgus rufus Boddaert, 1783	B	S	RC	SF/DS	B	B			8.3	V
Hydropsalis torquata (Gmelin, 1789)	B	S	RC	DS/AA/R	B	B			8.3	DO
Macropsalis forcipata[NT] (Nitzsch, 1840)	M	S	I	R	M	M			33.3	DO
Apodidae										
Streptoprocne zonaris (Shaw, 1796)	B	A	RC	--- CAS	B	B	11	0.092	25.0	DO
Trochilidae										
Ramphodon naevius[En/NT] (Dumont, 1818)	M	SB	RC	OF	M	M			8.3	DO
Glaucis hirsutus (Gmelin, 1788)	B	SB	RC	OF/SF	B	B			8.3	DO
Phaethornis pretrei (Lesson & Delattre, 1839)	M	SB	RC	OF/SF/EU+	B	B	59	0.492	100	DO
Phaethornis eurynome[I] (Lesson, 1832)	M	SB	RC	SF	B	B	3	0.025	16.7	DO
Eupetomena macroura (Gmelin, 1788)	B	SB/C	RC	AA/R	B	B			8.3	DO
Florisuga fusca (Vieillot, 1817)	M	SB/C	RC	AA/SF/R	B	B	2	0.017	41.7	DO
Stephanoxis lalandi (Vieillot, 1818)	M	SB/ C	I	OF	B	B	2	0.017	8.3	DO
Chlorostilbon lucidus (Shaw, 1812)	B	SB/C	C	DS	B	B			16.7	DO
Thalurania glaucopis (Gmelin, 1788)	M	SB	C	SF	B	B	5	0.042	58.3	DO
Hylocharis chrysura (Shaw, 1812)	M	SB	RC	AA	B	B			8.3	DO
Leucochloris albicollis (Vieillot, 1818)	B	SB/C	C	OF/SF/AA	B	B	2	0.017	50.0	DO
Amazilia versicolor (Vieillot, 1818)	B	SB/C	RC	DS/AA	B	B			16.7	DO
Clytolaema rubricauda[En] (Boddaert, 1783)	M	SB	RC	OF	B	B	2	0.017	8.3	DO
Trogonidae										
Trogon surrucura[I] Vieillot, 1817	M	C	C	OF/SF/ EU+/EU	B	B	41	0.342	83.3	DO/V
Trogon rufus Gmelin, 1788	M	SB	I	SF	B	B	5	0.042	16.7	DO/V
Alcedinidae										
Chloroceryle amazona (Latham, 1790)	B	SB	C	AA	B	B			8.3	DO
Chloroceryle americana (Gmelin, 1788)	B	SB	C	SF	B	B			8.3	DO
Bucconidae										
Nystalus chacuru (Vieillot, 1816)	M	C	RC	DS	B	B			41.7	DO/V
Ramphastidae										
Ramphastos vitellinus[CR] Lichtenstein, 1823	A	C	RC	OF	B	B			8.3	DO
Ramphastos dicolorus Linnaeus, 1766	M	C	RC	OF	M	M			16.7	DO
Picidae										
Picumnus temminckii Lafresnaye, 1845	M	SB/C	RC	OF	B	B	6	0.050	41.7	DO
Melanerpes candidus (Otto, 1796)	B	SB/C	I	AAA/DS/R/ EU	B	B			8.3	DO/V
Veniliornis spilogaster (Wagler, 1827)	M	SB/C	C	OF/SF	B	B	3	0.025	41.7	V
Colaptes campestris (Vieillot, 1818)	B	S/C	C	DS/AA/R	B	B	2	0.017	66.7	DO/V
Celeus flavescens (Gmelin, 1788)	M	S/C	RC	SF	B	B	8	0.067	50.0	V
Dryocopus lineatus (Linnaeus, 1766)	B	C	C	OF/SF/AA	B	B	2	0.017	16.7	DO/V
Thamnophilidae										
Hypoedaleus guttatus (Vieillot, 1816)	A	C	I	SF	M	A			8.3	V
Batara cinérea (Vieillot, 1819)	M	SB	I	OF/SF	M	B	32	0.267	91.7	DO/V
Mackenziaena leachii (Such, 1825)	M	SB	I	OF	M	M			8.3	DO/V
Mackenziaena severa (Lichtenstein, 1823)	M	SB	I	SF	M	M	3	0.025	16.7	V
Thamnophilus doliatus (Linnaeus, 1764)	B	SB	C	DS/AA/R	B	B	2	0.017	25.0	DO/V
Thamnophilus ruficapillus Vieillot, 1816	B	SB	RC	DS/AA	B	M			16.7	DO
Thamnophilus pelzelni Hellmayr, 1924	B	SB	C	DS/SF/EU+	B	M	11	0.092	58.3	DO/V
Thamnophilus caerulescens Vieillot, 1816	B	SB	C	SF/EU+	B	M	27	0.025	58.3	DO/V
Dysithamnus mentalis (Temminck, 1823)	M	SB	C	OF/SF/EU+	B	B	27	0.0225	83.3	V
Herpsilochmus rufimarginatus (Temminck, 1822)	M	C	C	OF/SF/EU+	B	B	2	0.017	8.3	V
Drymophila ferruginea[En/I] (Temminck, 1822)	M	SB	C	SF	B	M	3	0.025	58.3	DO/V
Drymophila genei[En/NT] (Filippi, 1847)	M	SB	C	OF	M	M	2	0.017	25.0	DO
Drymophila ochropyga[En/NT] (Hellmayr, 1906)	M	SB	RC	SF	M	M	5	0.042	25.0	V
Drymophila malura (Temminck, 1825)	M	SB	RC	SF/EU+	M				41.7	DO/V
Pyriglena leucoptera (Vieillot, 1818)	M	SB	C	OF/SF/EU+	B	B	137	1.142	100	DO/V
Myrmeciza squamosa[En/I] Pelzeln, 1868	M	S	I	OF	M	M	21	0.175	83.3	DO
Conopophagidae										
Conopophaga lineata (Wied, 1831)	M	SB	C	SF	B	B	54	0.450	33.3	DO/V
Grallariidae										
Grallaria varia (Boddaert, 1783)	A	S	I	OF	B	B	12	0.100	91.7	DO
Hylopezus nattereri (Pinto, 1937)	A	S	RC	OF	M	M	8	0.067	25.0	DO/V
Rhinocryptidae										
Merulaxis ater[En/NT] Lesson, 1830	A	S	I	OF	M	M	3	0.025	75.0	V
Scytalopus speluncae (Ménétriès, 1835)	M	SB	C	OF	B	B	3	0.025	16.7	V

Table 1. Cont.

TAXON	SENS.	STR.	ABUND.	HABIT.	C	RES.	A	AI	FO(%)	D
Scytalopus indigoticus[En/NT] (Wied, 1831)	M	SB	I	OF/SF	M	A	36	0.300	16.7	V
Formicariidae										
Chamaeza campanisona[I] (Lichtenstein, 1823)	A	S	RC	SF	B	M	2	0.017	16.7	V
Chamaeza meruloides[En/I] Vigors, 1825	M	S	C	OF	B	B	27	0.225	83.3	V
Scleruridae										
Sclerurus scansor (Ménétriès, 1835)	A	S	I	OF/SF	M	M	5	0.042	33.3	DO/V
Dendrocolaptidae										
Sittasomus griseicapillus (Vieillot, 1818)	M	SB	C	OF/SF	B	M	65	0.542	100	DO/V
Xiphocolaptes albicollis[I] (Vieillot, 1818)	M	SB	I	OF	M	B	12	0.100	66.7	V
Dendrocolaptes platyrostris Spix, 1825	M	SB	RC	OF/SF	B	B	8	0.067	25.0	V
Xiphorhynchus fuscus (Vieillot, 1818)	A	SB	RC	OF/SF	B	B	50	0.417	91.7	DO/V
Lepidocolaptes squamatus (Lichtenstein, 1822)	A	SB/C	RC	DS/AA	B	B			33.3	DO/V
Furnariidae										
Furnarius figulus[**En] (Lichtenstein, 1823)	B	S	RC	DS	B	B			8.3	DO
Furnarius rufus[N] (Gmelin, 1788)	B	S	C	AA	B	B	3	0.025	75.0	DO/V
Synallaxis ruficapilla Vieillot, 1819	M	SB	RC	OF/SF	B	B	36	0.300	91.7	DO/V
Synallaxis albescens[NT] Temminck, 1823	B	SB	C	DS	B	B	3	0.025	16.7	DO
Synallaxis spixi Sclater, 1856	B	SB	C	DS/AA	B	B	11	0.092	83.3	DO/V
Cranioleuca pallida[En] (Wied, 1831)	M	SB/C	RC	SF	B	B			8.3	DO
Phacellodomus erythrophtalmus[N/En] (Wied, 1821)	M	SB	?	R/SF/DS	A	A	15	0.125	58.3	DO/ V/N
Syndactyla rufosuperciliata (Lafresnaye, 1832)	M	SB	C	OF	B	B	2	0.017	8.3	DO
Phylidor lichtensteini Cabanis & Heine, 1859	A	SB	C	OF/SF	M	M	2	0.017	25.0	DO
Phylidor atricapillus (Wied, 1821)	A	SB	RC	OF	B	B	2	0.017	16.7	DO
Phylidor rufum[I] (Vieillot, 1818)	M	C	RC	SF	B	B			16.7	DO
Anabazenops fuscus[En] (Vieillot, 1816)	A	SB	I	OF	B	B	11	0.092	58.3	DO/V
Automolus leucophthalmus (Wied, 1821)	M	SB	RC	OF/SF	B	M	35	0.292	100	DO/V
Lochmias nematura (Lichtenstein, 1823)	M	S	I	OF/SF	B	B	18	0.150	83.3	DO/V
Heliobletus contaminatus Berlepsch, 1885	A	C	RC	OF	B	B			8.3	DO
Xenops minutus (Sparrman, 1788)	M	SB	RC	OF	B	B			8.3	DO
Xenops rutilans Temminck, 1821	M	C	RC	SF	B	B	3	0.025	25.0	DO
Tyrannidae										
Phyllomyias burmeisteri[I] Cabanis & Heine, 1859	M	C	I	OF	M	M	2	0.017	16.7	DO
Camptostoma obsoletum (Temminck, 1824)	B	C	RC	DS/AA	B	M	5	0.042	16.7	V
Phaeomyias murina (Spix, 1825)	B	C	RC	DS	B	B	2	0.017	16.7	DO
Elaenia flavogaster (Thunberg, 1822)	B	C	C	DS/AA/R	B	B			25.0	DO/V
Elaenia obscura (d'Orbigny & Lafresnaye, 1837)	M	SB/C	I	SF	B	M	2	0.017	16.7	DO
Serpophaga subcristata (Vieillot, 1817)	B	SB/C	RC	DS/EU+/R	B	B	3	0.025	16.7	DO/V
Mionectes rufiventris[I] Cabanis, 1846	M	SB	RC	OF	B	B	3	0.025	8.3	V
Leptopogon amaurocephalus Tschudi, 1846	M	SB	RC	OF/SF	B	B	5	0.042	91.7	V
Phylloscartes ventralis (Temminck, 1824)	M	C	RC	OF	B	B	2	0.017	16.7	DO
Myiornis auricularis (Vieillot, 1818)	B	SB/C	RC	SF	B	B			25.0	DO
Corythopis delalandi (Lesson, 1830)	M	S	C	OF/SF	B	B			91.7	V
Hemitriccus nidipendulus[En] (Wied, 1831)	B	SB	RC	SF	B	B			8.3	DO
Hemitriccus orbitatus[En] (Wied, 1831)	M	SB	RC	OF/SF	M	M			8.3	DO
Poecilotriccus plumbeiceps[N] (Lafresnaye, 1846)	M	SB	RC	SF	B	B	8	0.067	16.7	DO
Tolmomyias sulphurescens (Spix, 1825)	M	C	RC	OF/SF	B	A	2	0.017	41.7	V
Platyrinchus mystaceus Vieillot, 1818	M	SB	RC	OF/SF	B	B	23	0.192	83.3	DO/V
Myiophobus fasciatus (Statius Muller, 1776)	B	SB	RC	DS/EU+/ AA	B	B	2	0.017	41.7	DO/V
Lathrotriccus euleri (Cabanis, 1868)	M	SB	RC	OF/SF/EU+	B	B	32	0.267	75.0	DO/V
Cnemotriccus fuscatus (Wied, 1831)	B	SB	RC	SF	B	B			8.3	DO/V
Contopus cinereus (Spix, 1825)	B	SB/C	RC	SF	B	M			8.3	DO
Muscipipra vetula (Lichtenstein, 1823)	M	C	I	OF	M	M			8.3	DO/V
Knipolegus nigerrimus (Vieillot, 1818)	M	SB/C	I	OF	B	B	2	0.017	8.3	DO
Fluvicola nengeta (Linnaeus, 1766)	B	S	RC	AA	B	M			16.7	DO
Satrapa icterophrys (Vieillot, 1818)	B	SB/C	RC	DS/AA	B	B			25.0	DO
Attila phoenicurus[I] Pelzeln, 1868	A	SB/C	I	OF	M	A	18	0.150	91.7	DO/V
Attila rufus[En] (Vieillot, 1819)	M	SB/C	RC	OF/SF/EU+	M	M	62	0.517	33.3	DO/V
Syristes sibilator (Vieillot, 1818)	M	C	RC	SF	B	M	2	0.017	8.3	V
Myiarchus ferox (Gmelin, 1789)	B	SB/C	RC	SF/DS	B	B			25.0	V
Myiarchus tyrannulus (Statius Muller, 1776)	B	SB/C	C	SF M/CA	B	B			8.3	DO
Myiarchus swainsoni Cabanis & Heine, 1859	B	SB/C	RC	DS	B	B			25.0	V
Pitangus sulphuratus (Linnaeus, 1766)	B	S/C	C	EU+/AA/R	B	B	5	0.042	66.7	DO/V
Philohydor lictor (Lichtenstein, 1823)	B	SB	RC	SF	B	B			8.3	DO
Megarynchus pitangua (Linnaeus, 1766)	B	C	RC	SF/AA	B	B	15	0.125	66.7	DO/V
Myiozetetes similis (Spix, 1825)	B	SB/C	C	SF	B	B			25.0	DO/V

Table 1. Cont.

TAXON	SENS.	STR.	ABUND.	HABIT.	C	RES.	A	AI	FO(%)	D
Myiodynastes maculatus (Statius Muller, 1776)	B	SB/C	C	OF/SF/DS	B	M	56	0.467	50.0	DO/V
Legatus leucophaius (Vieillot, 1818)	B	C	C	SF/DS	B	B			33.3	DO/V
Tyrannus savana Vieillot, 1808	B	C	C	AA/R	B	B			16.7	DO
Tyrannus melancholicus Vieillot, 1819	B	C	C	DS/AA/R	B	B	15	0.125	75.0	DO/V
Cotingidae										
Procnias nudicollis[NT/I] (Vieillot, 1817)	M	C	RC	OF	M	A	21	0.175	41.7	V
Pyroderus scutatus[VU] * (Shaw, 1792)	M	SB	R	OF/SF	A	M	5	0.042	66.7	DO
Pipridae										
Chiroxiphia caudata (Shaw & Nodder, 1793)	B	SB	C	SF	B	B	174	1.450	50.0	DO/V
Neopelma chrysolophum[nEn] Pinto, 1944	M	SB	I	OF/SF	M	M	15	0.125	50.0	DO/V
Ilicura militaris[En/I] (Shaw & Nodder, 1809)	M	SB/C	RC	OF	M	M	5	0.042	16.7	DO
Manacus manacus (Linnaeus, 1766)	B	SB	RC	OF	B	B	2	0.017	75	DO
Tityridae										
Oxyruncus cristatus[I] Swainson, 1821	A	C	I	SF	M	M			8.3	V
Schiffornis virescens (Lafresnaye, 1838)	M	SB	RC	SF	B	B	3	0.025	66.7	V
Pachyramphus viridis[I] (Vieillot, 1816)	M	C	I	DS	B	M			16.7	V
Pachyramphus castaneus (Jardine & Selby, 1827)	M	C	RC	SF	B	B			25.0	DO
Pachyramphus polychopterus (Vieillot, 1818)	B	C	C	SF	B	B	21	0.175	50	DO/V
Pachyramphus validus (Lichtenstein, 1823)	M	C	I	SF	B	B	2	0.017	41.7	DO
Tityra inquisitor (Lichtenstein, 1823)	M	C	RC	SF	B	B			8.3	V
Vireonidae										
Cyclarhis gujanensis (Gmelin, 1789)	B	SB/C	C	OF/SF	B	B	147	1.225	66.7	DO/V
Vireo olivaceus (Linnaeus, 1766)	B	C	C	OF/SF	B	M	123	1.025	66.7	DO/V
Hylophilus poicilotis Temminck, 1822	M	SB/C	C	OF	B	B	12	0.100	91.7	DO/V
Hirundinidae										
Progne chalybea (Gmelin, 1789)	B	A	C	AA/R	B	B			8.3	DO
Pygochelidon cyanoleuca (Vieillot, 1817)	B	A	C	AA/R	B	B	17	0.142	8.3	DO
Stelgidopteryx ruficollis (Vieillot, 1817)	B	A	C	AA/R	B	B	2	0.017	41.7	DO
Troglodytidae										
Troglodytes musculus Naumann, 1823	B	S/SB	C	AA	B	M	2	0.017	16.7	DO/V
Polioptilidae										
Ramphocaenus melanurus Vieillot, 1819	B	SB	RC	OF	B	B	2	0.017	91.7	DO
Turdidae										
Turdus flavipes (Vieillot, 1818)	M	SB/C	C	OF/SF	B	M	8	0.067	58.3	DO/V
Turdus subalaris (Seebohm, 1887)	B	C	RC	OF	B	M			8.3	V
Turdus rufiventris Vieillot, 1818	B	S/C	C	AA	B	B	26	0.217	50.0	DO/V
Turdus leucomelas Vieillot, 1818	B	S/C	C	DS/AA/R	B	B	8	0.067	50.0	DO/V
Turdus amaurochalinus Cabanis, 1850	B	S/C	C	DS/AA	B	B	9	0.075	100	DO/V
Turdus albicollis Vieillot, 1818	M	SB	RC	OF	B	M	26	0.217	75.0	DO/V
Mimidae										
Mimus saturninus (Lichtenstein, 1823)	B	C	C	AA/R	B	B			41.7	DO/V
Coerebidae										
Coereba flaveola (Linnaeus, 1758)	B	C	C	SF/AA	B	B	18	0.150	83.3	DO/V
Thraupidae										
Orchesticus abeillei[En/NT] (Lesson, 1839)	M	C	I	OF	M	M	2	0.017	58.3	DO
Thlypopsis sordida (d'Orbigny & Lafresnaye, 1837)	B	SB/C	RC	SF	B	B			8.3	DO
Hemithraupis ruficapilla[En] (Vieillot, 1818)	B	C	C	OF/SF	M	B			16.7	DO
Tachyphonus coronatus (Vieillot, 1822)	B	SB/C	C	OF/SF	B	B	26	0.217	50.0	DO/V
Trichothraupis melanops (Vieillot, 1818)	M	SB	RC	OF/SF	B	B	3	0.025	50.0	DO
Habia rubica (Vieillot, 1817)	A	SB	RC	OF/SF	B	B	15	0.125	91.7	DO/V
Ramphocelus bresilius[En] (Linnaeus, 1766)	B	SB	RC	DS	B	M			8.3	DO
Thraupis sayaca (Linnaeus, 1766)	B	C	C	SF/AA/R	B	B	8	0.067	16.7	DO/V
Thraupis cyanoptera[En/NT/I] (Vieillot, 1817)	M	C	I	OF	M	M	5	0.042	58.3	DO
Thraupis ornata[En] (Sparrman, 1789)	M	C	C	OF	B	B	2	0.017	25.0	DO
Stephanophorus diadematus (Temminck, 1823)	B	SB/C	RC	AA/EU+	B	B			25.0	DO
Pipraeidea melanonota (Vieillot, 1819)	B	SB/C	RC	DS	B	B			8.3	DO
Tangara seledon (Statius Muller, 1776)	M	C	C	OF	B	B			83.3	DO
Tangara cyanocephala (Statius Muller, 1776)	M	C	C	OF	B	B	5	0.042	33.3	DO
Tangara desmaresti[En] (Vieillot, 1819)	M	C	C	OF	B	B	14	0.117	100	DO
Tangara cayana (Linnaeus, 1766)	M	SB/C	RC	AA/R	B	B			8.3	DO/V
Dacnis cayana (Linnaeus, 1766)	B	C	RC	AA	B	B	3	0.025	58.3	DO
Tersina viridis (Illiger, 1811)	B	C	RC	SF	B	M			8.3	DO
Emberizidae										
Zonotrichia capensis[N] (Statius Muller, 1776)	B	S/ SB	C	AA	B	B	9	0.075	83.3	DO/V
Sicalis flaveola (Linnaeus, 1766)	B	S	C	DS	B	B			33.3	DO
Volatina jacarina (Linnaeus, 1766)	B	S/ SB	C	R	B	B			8.3	DO/V

Table 1. Cont.

TAXON	SENS.	STR.	ABUND.	HABIT.	C	RES.	A	AI	FO(%)	D
Sporophila caerulescens (Vieillot, 1823)	B	SB	C	DS/AA	B	B	3	0.025	50.0	DO
Cardinalidae										
Saltator fuliginosus[I] (Daudin, 1800)	M	C	I	OF/SF	B	B	11	0.092	8.3	DO/V
Saltator similis d'Orbigny & Lafresnaye, 1837	B	SB/C	C	OF/SF	B	B	27	0.225	33.3	DO/V
Parulidae										
Parula pitiayumi (Vieillot, 1817)	M	C	C	EU+/AA	B	B			41.7	DO/V
Geothlypis aequinoctialis (Gmelin, 1789)	B	SB	C	DS	B	M	5	0.042	83.3	DO/V
Basileuterus culicivorus (Deppe, 1830)	M	SB	C	OF/SF	B	M	212	1.767	58.3	DO/V
Basileuterus leucoblepharus (Vieillot, 1817)	M	SB	C	OF/SF	B	B	44	0.367	83.3	DO/V
Phaeothlypis rivularis (Wied, 1821)	M	S	RC	OF	B	B	17	0.142	16.7	DO/V
Icteridae										
Cacicus chrysopterus (Vigors, 1825)	M	C	RC	SF	B	B	5	0.042	83.3	DO
Gnorimopsar chopi[NT] (Vieillot, 1819)	B	S/C	C	AA	B	B			33.3	DO
Molothrus bonariensis (Gmelin, 1789)	B	S	C	AA	B	M	2	0.017	8.3	DO
Fringillidae										
Carduelis magellanica (Vieillot, 1805)	B	C	C	DS	B	B			25.0	DO
Euphonia chlorotica (Linnaeus, 1766)	B	C	C	DS/AA/ EU+	B	B			8.3	V
Euphonia violacea (Linnaeus, 1758)	B	C	C	SF	B	B			8.3	DO
Euphonia pectoralis (Latham, 1801)	M	C	C	OF	B	B			25.0	DO/V
Passeridae										
Passer domesticus (Linnaeus, 1758)	B	S/C	C	AA	B	M			8.3	DO/V

in accordance with the above-mentioned definitions. About 60% of the species fell within these three categories, matching the findings for frequency. Roughly 40% were rare or occasional, with frequencies below 25%. The latter can be classified as follows: occasional and non-resident, having been recorded during four visits at most (e.g., the Sharpbill, *Oxyruncus cristatus* Swainson, 1821), and migratory (e.g., the Magnificent Frigatebird, *Fregata magnificens* Mattews, 1914; the White-necked Heron, *Ardea cocoi* Linnaeus, 1766; the Neotropic Cormorant, *Phalacrocorax brasilianus* (Gmelin, 1789); the Southern Rough-winged Swallow, *Stelgidopteryx ruficollis* (Vieillot, 1817)). Other species were hardly detected (one visit or less) either because they were inconspicuous or vocalized little during sampling periods (e.g., the Saw-billed Hermit, *Ramphodon naevius* (Dumont, 1818) and the Large-tailed Antshrike, *Mackenziaena leachii* (Such, 1825)), or because their numbers were lower than those of other species (pronounced differences in the activities of such species and reduction in density), making detection difficult (e.g., the Rufous-breasted Hermit, *Glaucis hirsutus* (Gmelin, 1788), and the Ocellated Poorwill, *Nyctiphrynus ocellatus* (Tschudi, 1844)). Frequency indices were equal to or more than 75% for 17.4% of the species observed, and equal to or less than 24% for 39.3% of the species.

In all these categories, understory insectivorous birds accounted for the largest proportion, followed by canopy frugivores, canopy and understory omnivores, and understory nectarivores. Detritivores were classified as rare. These findings ratify once again the importance of an understory and canopy to the development of the bird community distributed in the respective foraging categories, which are fundamental to an environmental diagnosis of PN.

Endemic species and conservation

Among the species recorded in PN, 24 (10.6% of the total, e.g., *Ramphodon naevius, Clytolaema rubricauda, Drymophila genei, Merulaxis ater, Neopelma chrysolophum*) can be considered endemic to the Atlantic Forest (13.7% of all bird species endemic to Brazil according to Sick 1997 and Stattersfield *et al*. 1998), while 7 (3.1% of the total for PN) present some kind of concern relating to their conservation (see Stattersfield *et al*. 1998, SMA 1998, Birdlife International 2000). *Drymophila genei* was surprisingly registered once every four visits (the rufous tail is a diagnostic character for this species). It is a bamboo specialist and was found mainly in the understory and in secondary woodland. It was registered in Campos de São Domingos (Minas Gerais) and is normally found at Serra de Itatiaia (Rio de Janeiro). Among non-endemic species, two are classified as vulnerable (0.9% of the total for PN) and three are Near Threatened (2.2% of the total for PN). Altogether, 12 species (5.3%) present some kind of concern relating to conservation. The status of each species is shown in table 1.

Indicator species

Stotz *et al*. (1996) define indicator species as those that, taken as a group, exclusively define a specific ecological and geographical province. The ideal list of indicator species would be made up of several species: (1) those that are restricted to a given habitat, (2) those that are relatively common, (3) those that are highly sensitive to habitat disturbance, and (4) those that are easily detected. Thus for pristine areas, indicator species are those that are most intimately associated with or specialized in certain habitats, and consequently they are more sensitive to disturbance, albeit sufficiently common to serve as indicators. The indicator species registered in this

Table 2. Some important species in terms of seasonality in Parque das Neblinas and their monthly record.

Especies	Jan. 2004	Feb.	Mar.	May	Jun.	Jul.	Aug.	Sep.	Nov.	Dec.	Jan. 2005	Feb.
Buteo brachyurus				X					X			
Ictinia plumbea	X									X	X	X
Elanoides forficatus	X								X	X		
Pionopsitta pileata	X											
Tapera naevia	X										X	
Hydropsalis torquata							X					
Nyctiphrynus ocellatus											X	
Caprimulgus rufus										X		
Streptoprocne zonaris					X			X		X		
Ramphodon naevius										X		
Glaucis hirsuta								X				
Phaetornis pretrei	X	X	X	X	X	X	X	X	X	X	X	X
Florisuga fusca	X			X					X	X	X	
Hylocharis chrysura											X	
Leucochloris albicollis			X				X	X	X	X		X
Nystalus chacuru				X	X		X		X	X		X
Ramphastos vitellinus											X	
Phyllomyias burmeinsteri							X		X			
Elaenia flavogaster							X		X	X		
Elaenia obscura	X						X					
Serpophaga subcristata					X		X					
Phaeomyias murina		X			X					X		
Myiophobus fasciatus			X						X	X	X	X
Lathrotriccus euleri		X	X	X		X	X	X	X	X	X	X
Corythopis delalandi	X	X	X	X	X	X	X	X	X	X	X	X
Contopus cinereus												X
Muscipipra vetula										X		
Attila phoenicurus	X		X	X	X		X	X	X	X	X	X
Syristes sibilator			X									
Myiarchus ferox									X		X	X
Myiarchus swainsoni					X	X					X	X
Myiarchus tyrannulus					X							
Megarynchus pitangua	X	X	X						X	X	X	X
Myiozetetes similis					X						X	X
Satrapa icterophrys								X	X	X		
Myiodinastes maculatus	X	X	X					X	X	X	X	X
Legatus leucophaius								X	X	X	X	
Tyrannus savana									X	X		
Tyrannus melancholicus	X	X	X					X	X	X	X	X
Pachyramphus castaneus					X	X						X
Pachyramphus polychopterus	X	X							X	X	X	X
Pachyramphus validus		X		X					X	X	X	
Pachyramphus viridis				X						X		
Tytira inquisitor											X	
Pyroderus scutatus				X	X		X	X	X	X	X	X
Procnias nudicollis	X	X						X		X	X	X
Stelgidopteryx ruficollis	X						X		X	X	X	X
Turdus flavipes	X	X							X	X	X	X
Turdus subalaris									X			
Vireo olivaceus	X	X	X						X	X	X	X
Hylophilus poecilotis	X	X	X	X		X	X	X	X	X	X	X
Hemithraupis ruficapilla						X			X			
Ramphocelus bresilius							X					
Pipraedea melanonota							X					
Tersina viridis					X							
Sporophila caerulescens		X	X	X					X	X		X
Sicalis flaveola									X	X	X	X
Molothrus bonariensis	X											
Gnorimopsar chopi		X							X	X	X	

work share many of these characteristics and are shown in table 1, such as, *Pionopsitta pileata, Phaethornis eurynome, Myrmeciza squamosa, Chamaeza meruloides, Xiphocolaptes albicollis, Phyllomyias burmeisteri, Atilla phoenicurus, Ilicura militaris*, and *Thraupis cyanoptera.*

Data from the seasonality of some species showed that the majority of these species were registered from September to February and just one, *Tersina viridis,* exclusively during the driest seasons. Moreover, hummingbirds were commonly found from September to February, except for *P. pretei*, which was registered year round. Typical species from secondary and ombrophilous

forests and from *Eucalyptus* forests with well-developed understories were registered all year round. On the other hand, species from dry scrubs, roads and anthropogenic areas were inconsistently registered.

DISCUSSION

Qualitative survey

We recorded 222 species in PN, and the most representative families were Tyrannidae, Thraupidae, and Thamnophilidae. Camargo (1946) collected 78 species at Boraceia and Varjão de Guaratuba, (an area of Atlantic Forest in the Serra do Mar, about 100 km from Parque das Neblinas). Among the total of 86 species that Camargo registered, only 15% were distinct species from our list: *Leptodon cayanensis* (at that time either gen. *Odontotriorchis;* or later, *Falco palliatus*), *Columba cayennensis*, *Lophornis magnificus*, *Triclaria malachitacea, Piculus aurulentus*, *Cichlocolaptes leucophrus*, *Knipolegus cyanirostris*, *Platyrhynchus platyrhynchus*, *Hemitriccus diops*, *Phylloscartes oustaleti*, Mache*tornius rixosa*, *Haplospizia unicolor* and *Laniisoma elegans*. Höfling & Lencioni (1992) reported 188 species in an area of Atlantic Forest in the region of Salesópolis (also administered by the municipality of São Sebastião), with the most representative families being Tyrannidae, Thamnophilidae, Emberezidae and Furnariidae. Small differences can be observed between the two studies (according to the classification used by those authors, Emberezidae included the subfamily Thraupinae, whereas this study opted for Thraupidae in accordance with CBRO 2008). In the interior of São Paulo, Willis (2003) reported 255 species in 2,314 ha of *Eucalyptus* forest that had a native understory and adjacent areas of forest. Of these, 97 were forest-interior species. The values were lower than those found by the same author in a nearby woodlot of semi-deciduous forest. He also observed the disappearance of many species during the period of the study. In a 15-year study of 43 Atlantic Forest fragments in the region of Viçosa, Minas Gerais, Ribon *et al*. (2003) recorded 221 bird species. Of these, 163 species were from the forest areas within the study site and 58 species were vagrants from nearby areas. Faria *et al*. (2006) reported 231 species in an Atlantic Forest fragment in the upper Rio Doce valley, in the Santa Bárbara municipality. The 226 species recorded in the present study, of which 150 were non-vagrant species, reflect the richness of PN within the Atlantic Forest biome and the importance of completely conserving this forest fragment.

Frequency indices were equal to or more than 75% for 17.4% of the species observed; this is similar to the findings reported by Lyra-Neves *et al*. (2004) (19,6%) for an Atlantic Forest fragment in northeastern Brazil. The frequency was equal to or less than 24% for 39.3% of the species observed here; Aleixo & Vielliard (1995) report 44% and Lyra-Neves *et al*. (2004) report 46.8%. To prove the actual status of species with low detection indices, it would be necessary to compare the same community in the future. Donatelli *et al*. (2004 2007) observed the same proportion of species in their study of communities in mesophilous forest fragments (inland Atlantic Forest relicts) in the interior of the state of São Paulo, but many species are not comparable because they live in different habitats. For example, the White-tipped Dove, *Leptotila verreauxi* Bonaparte, 1855, is abundant in mesophilous forest in the interior of the state but rare in PN.

The 60% of difference in the number of species between the wet season (reproductive period) and the dry season (cooler months) is far less than the variation reported by other authors (Aleixo & Vielliard 1995, Lyra-Neves *et al*. 2004). This is possibly because the area concerned here is Atlantic Forest that has been in regeneration for approximately 40 years and also because of its proximity to Parque Estadual da Serra do Mar, which arguably enhances species stability across reproductive and non-reproductive periods. The difference between the two periods was statistically significant ($t=10.28$, $P<0.0001$), and may also explain the lower percentage of species with frequencies of occurrence equal to or lower than 24% in our study in contrast with findings by other authors that studied fragmented environments (see Lyra-Neves *et al*. 2004).

Quantitative survey

The quantitative survey recorded a total of 141 species, or 63% of all those present in and near PN. This percentage can be considered in line with the average for major Brazilian studies of bird communities using point counts (72% in Aleixo & Vielliard 1995, 79.5% in Lyra-Neves *et al*. 2004, 34.2% in Donatelli *et al*. 2004). Marsden *et al*. (2001) recorded eight species in *Eucalyptus* plantations (Sooretama/Linhares complex of east-central Espírito Santo state) and reported that "bird species richness in <30-year-old *Eucalyptus* plantations around Sooretama was extremely poor and much lower than that in *Eucalyptus* plantations elsewhere in Brazil." However, 255 bird species have been recorded from an 80-year-old 2800 ha *Eucalyptus* forest in the state of São Paulo (Willis 2003), but according to Marsden *et al*. (2001), this species richness can be considered a reflection of "the size of the plantation, corridors between natural forest and plantation, and the rich vegetative understory beneath the mature trees." Probably the high number of species in PN is due to its close proximity to Parque estadual da Serra do Mar (an Atlantic Forest reserve) and its native understory. The most abundant species recorded in PN (e.g., *Basileuterus culicivorus*, *Chiroxiphia caudata*, *Cyclarhis gujanensis*) corresponded to 35% of the total number of contacts recorded and have also been found to be abundant by other researchers elsewhere (see Aleixo & Vielliard 1995, Faria *et al*. 2006, Donatelli *et al*. 2004, 2007).

There was no significant variation in the diversity or evenness of the bird community in PN during the year. This demonstrates the stability of the community due to

variables such as climate (mean temperature and rainfall), habitat constancy (forest), and lack of direct or indirect anthropic disturbances in PN and surrounding areas. Stability is a key factor for the conservation of PN as a whole and greatly contributes to the constancy of the community, which is not subject to the kind of strong fluctuations commonly observed in open environments with seasonal weather changes, such as the Pantanal (Donatelli 2002, 2003). Studying various fragments of Atlantic forest in the same biome, Vielliard (2000) found diversity indices varying between H'= 3.53 and H'= 4.43. Lyra-Neves *et al*. (2004) registered H'= 4.25. Donatelli *et al*. found H'= 3.10 (2004) and H'= 3.04 and H'= 2.85 (2007). In this study we found H'= 3.82, which reflects the high diversity of the Atlantic Forest biome.

Three patterns can be discerned in the diversity of forest bird species found in PN: (1) areas in which *Eucalyptus* vegetation is accompanied by a dense understory display the greatest bird species diversity, to the detriment of areas with less developed or a non-existent understory; (2) bird species diversity in areas adjacent to PN is not significantly different from the diversity in PN; (3) bird species diversity is greater in areas of Parque Estadual da Serra do Mar, which is adjacent to the PN.

Our identification of a total of 222 species demonstrates the potential of the bird community, which was expected to be far smaller. The proximity to Parque Estadual da Serra do Mar and the warm wet climate during most of the year, in addition to approximately 40 years without planting, logging or clearing in the area, favor colonization by plants of all kinds within PN. In addition, there is a vast network of waterways (e.g., rivers, streams, and canals) in the area studied. The abundance of the populations detected, especially the 141 species recorded by the quantitative survey, illustrates a process of development and evolution of the bird community made possible by the understory present and the mosaic of habitats in PN and nearby forest areas. This finding parallels the findings of research in other Atlantic Forest areas where large numbers of species have also been found with few individuals per species, except for some species whose populations are larger than the overall pattern. The advantage of PN is that the area is not fragmented and displays continuity between habitats, a key factor for the mobility and continuity of populations.

We found 24 endemic species and 19 species considered to be indicators in the PN. Rajão and Cerqueira (2006) studied the elevational distribution and sympatry of birds in the genus *Drymophila*. They found sympatry patterns between sister species of *D. ochropyga-D. genei* and *D. ferruginea-D. rubricollis* in regions of the Serra do Mar and Serra da Mantiqueira, along narrow elevational bands, never wider than 300 m. We found the same results considering the first two species but we could not confirm *D. ferruginea-D. rubricollis* because the latter was not registered at Parque das Neblinas. Considering our data, *D. ochropyga-D. genei* showed the same frequency (25%) while *D. ferruginea* was registered as much as two times more than others (58,3%). The latter was found at lower elevations while *D. genei* was found at higher altitudes and *D. ochropyga* at intermediate elevations in Parque das Neblinas. These data match exactly the observations of Rajão & Cerqueira (2006), when considering the sympatry and distribution patterns of the *Drymphila* species registered in this work. The simple register of *D. genei* is outstanding for Parque das Neblinas.

These data show the importance of preserving PN and its bird community. The numbers and percentages of endemic and indicator species recorded in PN increases the responsibility of the park's management to conserve the entire park and nearby areas in order to maintain the communities of plants and animals that live there. For this reason it is vitally important to carry out periodic monitoring of the bird community and other groups of vertebrates living in PN.

ACKNOWLEDGEMENTS

Warmest thanks to Suzano Papel and Celulose S.A. and to the non-governmental organization EcoFuturo/ Instituto Eco Futuro, especially its managing director Marcos B. Egydio Martins, for the opportunity to undertake research at Parque das Neblinas, a wonderful place. Thanks also to Paulo Groke for his kindness and attention throughout the period when I was conducting the research, and to Guilherme and Sandro for their help with all of the practical and dynamic issues this work involved.

REFERENCES

ALEIXO, A., VIELLIARD, J.M.E. 1995. Composição e dinâmica da avifauna da mata de Santa Genebra, Campinas, São Paulo, Brasil. *Revista Brasileira de Zoologia 12*(3): 493-511.

AMERICAN ORNITHOLOGISTS UNION (A.O.U.). 1998. *Check-List of North American Birds*. 7th ed. Washington: American Ornithologists Union.

BIBBY, C. J.; BURGESS, N. D. 1993. *Bird Census Techniques*. San Diego: Academic Press Inc.

BIERREGAARD, R.O., LOVEJOY, T.E. 1989. Effects of forest fragmentation on Amazonian understory bird communities. *Acta amazonica 19*: 215-241.

BIRDLIFE INTERNATIONAL. 2000. *Threatened birds of the world*. Barcelona: Lynx Editions & Birdlife International.

BLONDEL, J., FERRY, C., FROCHOT, B. 1970. La méthode des indices ponctuels d'abondance (I.P.A.) ou des relevés d'avifaune par "stations d'écoute". *Alauda, 38*: 55-71.

CAMARGO, H.F.A. 1946. Sobre uma pequena coleção de aves de Boracéia e do Varjão de Guaratuba (Estado de São Paulo). *Pap. Avul. Zool.*, São Paulo, *7*(1):143-164.

CBRO (COMITE BRASILEIRO DE REGISTROS ORNITOLÓGICOS). 2009. *Listas das Aves do Brasil. Versão 05/10/2008.* Disponível em: <http://www.cbro.org.br>. Acesso em: 13/07/2010.

COLLAR, N.J., GONZAGA, L.P., KRABBE, N., MADRONO NIETO, A., NARANJO, L.G., PARKER, T.A. & WEGE, D.C. 1992. *Threatened birds of the Americas: the ICBP/IUCN Red Data Book.* Cambridge: International Council for Bird Preservation.

DEL HOYO, J. ELLIOT, A. & CHRISTIE, D.A. 2004. *Handbook of the birds of the world. Vol. 9.* Cotinga to Pipits and Wagtails. Barcelona: Lynx Editions.

DE LA PENA, M.R. & RUMBOLL, M. 1998. *Birds of Southern South America and Antarctica*. London: HarperCollins Publishers Ltd.

DEVELEY, P.F. 2004. As aves da Estação Ecológica Juréia-Itatins. In:

Marques, O. A.V. & DULEBA, W. (Eds.). *Estação Ecológica Juréia-Itatins*. Ambiente físico, flora e fauna. Ribeirão Preto: Holos. p. 278-295.

DONATELLI, R.J. 2002. *Birds and dynamic habitat mosaics in the Pantanal*. Boston: Earthwatch Institute. Pantanal Conservation research initiative. *Annual Report 2003*: 31-39.

DONATELLI, R.J. 2003. *Birds and dynamic habitat mosaics in the Pantanal*. Boston: Earthwatch Institute. Pantanal Conservation research initiative. *Annual Report 2004* : 43-46.

DONATELLI, R.J., COSTA, T.V.V. & FERREIRA, C.D. 2004. Dinâmica da avifauna em fragmento de mata na fazenda Rio Claro, Lençóis Paulista, São Paulo. *Revista Brasileira de Zoologia, 21*(1): 97-114.

DONATELLI, R.J., FERREIRA, C.D., DALBETO, A.C. & POSSO, S.R. 2007. Análise comparativa da assembléia de aves em dois remanescentes florestais no interior do Estado de São Paulo, Brasil. *Revista Brasileira de Zoologia, 24*(2): 362-375.

DUNNING, J.S. 1988. *South American Birds*. 2 ed. New York: Harrowood Books.

FONSECA, G.A.B. 1985. The vanishing Brazilian Atlantic Forest. *Biological Conservation, 34*: 17-34.

GALETTI, M. & PIZO, M.A. 2002. *Ecologia e conservação de psitacídeos no Brasil.* Belo Horizonte: Melopsittacus Publicações Científicas.

GOERCK, J.M. 1997. Patterns of rarity in the birds of the Atlantic forest of Brazil. *Conservation Biology, 11:*112-118.

HÖFLING, E., LENCIONI, F. 1992. Avifauna da floresta Atlântica, região de Salesópolis, Estado de São Paulo. *Revista Brasileira de Zoologia, 41*(1): 121-135.

INSTITUTO BRASILEIRO DE RECURSOS NATURAIS RENOVÁVEIS, 2003. *Lista das espécies de aves ameaçadas de extinção*. Brasília: IBAMA.

KREBS, C.J. 1999. *Ecological methodology*. 2nd ed. Menlo Park: Addison Wesley Longman, Inc.

KRICHER, J. C. 1972. Bird species diversity: the effect of species richness and equitability on the diversity index. *Ecology, 53*: 278-282.

LOISELLE, B. A. & BLAKE, J. G. 1992. Population variation in a tropical bird community. Implications for conservation. *BioScience, 42*: 838-845.

LYRA-NEVES, R.M., DIAS, M.M., AZEVEDO-JR., S.M., TELINO-JR., W.R. & LARRAZÁBAL, M.E.L. 2004. Comunidade de aves da Reserva de Gurjaú, Pernambuco, Brasil. *Revista Brasileira de Zoologia, 21*(3): 581-592.

MAGALHÃES, J.C.R. 1999. *As aves na fazenda Barreiro Rico*. São Paulo: Ed. Plêiade.

MAGURRAN, A.E. 1988. *Ecological diversity and its measurements*. New York: Croom Helm.

MARSDEN, S.J., WHIFFIN, M. & GALETTI, M. 2001. Bird diversity and abundance in forest fragments and Eucalyptus plantations around an Atlantic forest reserve, Brazil. *Biodiversity and Conservation 10*: 737-751.

MITTERMEIER, R.A., MYERS, W., GIL, P.R. & MITTERMEIER, C.G. 2000. *Hotspots. Earth's biologically richest and most endangered terrestrial ecoregions*. Washington: Cemex, Conservation International.

MOTTA-JUNIOR, J.C. 1990. Estrutura trofica e composição das avifaunas de três habitats na região cenral do Estado de São Paulo. *Ararajuba, 1*: 65-71.

OLMOS, F. & MARTUSCELLI, P. 1995. Cubatão - an important Brazilian mangrove swamp under threat. *Oryx, 29*: 154-157.

PEARSON, D. L. 1971. Vertical stratification of birds in a tropical dry forest. *Condor, 73*: 46-55.

POUGH, F. H.; HEISER, J. B. & MCFARLAND, W. N. 1993. *A vida dos vertebrados*. São Paulo: Atheneu.

POWELL, G.V.N. 1985. Sociobiology and adaptative significance of heterospecific foraging flocks in the neotropics. *Ornithological Monographs,* 36: 713-732.

RAJÃO, H. & CERQUEIRA, R. 2006 Distribuição altitudinal e simpatria das aves do gênero *Drymophila* Swainson (Passeriformes, Thamnophilidae) na Mata Atlântica. *Revista Brasileira de Zoologia, 23*(3): 362-375.

RIBON, R., SIMON, J.E. & MATTOS, G.T. 2003. Bird extinctions in Atlantic forest fragments of the Viçosa region, southeastern Brazil. *Conservation Biology, 17*: 1827-1839.

RIDGELY, R.S. & TUDOR, G. 1994. *The Birds of South America*. Oxford: Oxford University Press.

SICK, H. 1997. *Birds in Brazil: a natural history*. New Jersey: Princeton University Press.

SILVA, J.M.C. 1995. Birds of the cerrado region, South America. *Steentrupia, 21*: 69-92.

SILVA, J.M.C., SOUZA, M.C. & CASTELLETI, C.H.M. 2004. Areas of endemism for passerine birds in the Atlantic forest, South America. *Global Ecological Biogeography, 13*: 85-92.

SILVA, W.R. 1992. As aves da Serra do Japi. In: MORELLATO, L.P.C. (Ed.*) História natural da Serra do Japi*. Campinas: UNICAMP/FAPESP. p. 238-263.

SILVA, W.R. 1998. Bases para o diagnóstico e o monitoramento de aves no Estado de São Paulo. In: CASTRO, R.M.C., JOLY, C.A. & BICUDO, C.E.M. (Eds.). *Biodiversidade do Estado de São Paulo, Brasil: síntese do conhecimento ao final do século XX: vertebrados*. São Paulo: Winnergraph-FAPESP. p. 39-50.

SMA-SECRETARIA DE ESTADO DE MEIO AMBIENTE 1996. *Atlas das unidades de conservação ambiental do Estado de São Paulo*. *Parte I - Litoral.* São Paulo: CESP.

SMA - SECRETARIA DO MEIO AMBIENTE DO ESTADO DE SÃO PAULO 2009. *Fauna ameaçada de extinção no Estado de São Paulo. Vertebrados* (atualização em 18/06/2010). Governo do Estado de São Paulo, Secretaria do Meio Ambiente e Zoológico Municipau de São Paulo. 648 p.

STATTERSFIELD, A.J., CROSBY, M.J., LONG, A.J. & WEDGE, D.C. 1998. *Endemic bird areas of the world: priorities for bird conservation.* Birdlife International (Birdlife Conservation Series 7). Cambridge, UK.

STOTZ, D.F., FITZPATRICK, J.W. PARKER, T.A. & MOSKOVITZ, D.K. 1996. *Neotropical birds*. Ecology and conservation. Chicago: University of Chicago Press.

STRAUBE, F. 2004. *Listas faunísticas: matéria prima em extinção*. Disponível em: <http://www.ambientebrasil.com.br> Acesso em: 23/04/2007.

VERNER, J. 1981. Measuring responses of avian communities to habitat manipulation. *Studies in Avian Biology, 6*: 543-547.

VIELLIARD, J.M.E. 2000. Bird community as an indicator of biodiversity: results from quantitative surveys in Brazil. *Anais da Academia Brasileira de Ciências, 72*: 1-11.

VIELLIARD, J. M. E. & SILVA, W. R. 1990. Nova metodologia de levantamento quantitativo e primeiros resultados no interior de São Paulo. *Anais do IV* Enav, Pernambuco: Universidade Federal de Pernambuco.

WIENS, J.A. 1990. Habitat fragmentation: island v. landscape perspectives on bird conservation. *Ibis, 137*: 97-104.

WIENS, J.A. 1994. *The ecology of bird communities*. Cambridge: Cambridge Univ. Press.

WILLIS, E.O. 1979. The composition of avian communities in remanescent woodlots in Southern Brazil. *Papéis Avulsos de Zoologia, 33*: 1-25.

WILLIS, E.O. 2003. Birds of a eucalyptus woodlot in interior São Paulo. *Brazil Journal of Biology, 63*: 141-158.

WILLIS, E.O. & ONIKI, Y. 1981. Levantamento preliminar de aves em treze áreas do Estado de São Paulo. *Revista Brasileira de Zoologia, 41*: 112-35.

WILLIS, E.O. & ONIKI, Y. 2002. Birds of a central São Paulo woodlot: 1. Censuses 1982-2000. *Brazilian Journal of Biology, 62*: 197-210.

WILLIS, E.O. & ONIKI, Y. 2003. *Aves do Estado de São Paulo*. Rio Claro: Editora Divisa.