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Birds from cerradão woodland, an overlooked forest of the Cerrado region, Brazil

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ABSTRACT

The Cerrado region still receives relatively little ornithological attention, although it is regarded as the only tropical savanna in the world considered to be a biodiversity hotspot. Cerradão is one of the least known and most deforested Cerrado physiognomies and few recent bird surveys have been conducted in these forests. In order to rescue bird records and complement the few existing inventories of this under-studied forest type in the state of São Paulo, we looked for published papers on birds of cerradão. Additionally we surveyed birds at a 314-ha cerradão remnant located in central São Paulo, Brazil, from September 2005-December 2006 using unlimited distance transect counts. Out of 95 investigations involving cerradão bird studies, only 17 (18%) investigations teased apart bird species recorded inside cerradão from those recorded in other physiognomies of Cerrado. Except for one study, no research found more than 64 species in this type of forest, a result shared within many regions from Brazil and Bolivia. Differences in species richness do not seem be related with levels of disturbance of landscape or fragment size. Considering all species recorded in cerradão in Brazil and Bolivia, a compilation of data accumulated 250 species in 36 families and 15 orders. In recent surveys at central São Paulo, we recorded 48 species in 20 families, including the Pale-bellied Tyrant-Manakin Neopelma pallescens, *threatened in São Paulo, and the Helmeted Manakin* Antilophia galeata, *near threatened in the state and endemic to the Cerrado region. Among the most abundant species inside this fragment, none was considered to be neither threatened nor endemic.*

Key-Words: Cerrado *sensu lato;* Endemic species; Peripheral Cerrado areas; Transect counts.

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INTRODUCTION

Cerrado is the only tropical savanna among the 34 biodiversity hotspots of the world (Mittermeier *et al.,* 2005), and represents one of the richest but most poorly known South American ecological regions (Silva, 1995). It is the second largest biome in the continent and includes most of central Brazil and parts of northeastern Paraguay and eastern Bolivia (Ab'Saber, 1977). Many physiognomies occur throughout Cerrado, such as gallery forests, marshlands and Cerrado *sensu lato.* The latter, strictly considered as the Cerrado Biome (Coutinho, 2006), includes four open physiognomies (Cerrado *sensu stricto,* campo Cerrado, campo sujo and campo limpo) and cerradão (Eiten, 1972).

Two Cerrado physiognomies have distinct aspects: cerradão, where arboreal and shrubby components predominate, as opposed to campo limpo, where herbaceous and sub-arboreal components are more evident (Coutinho, 1978). Cerradão is the tallest Cerrado phytogeographical sub-unit, and its trees usually average less than 15 m in height, accounting for a continuous and relatively closed canopy; it occurs in seasonal tropical climates (Eiten, 1972; Veloso *et al.,* 1991; Andrade *et al.,* 2002) and can be distinguished from dry forests by its physiognomy (there are no grasses, for example) and floristic structure (Rizzini, 1976).

Currently the Cerrado region has less than 20% of its original vegetation undisturbed (Myers *et al.,* 2000). In 1962, all of the phytophysiognomical forms of Cerrado vegetation occupied 13.7% of its original area in the state of São Paulo (Borgonovi & Chiarini, 1965). In 1974, these values reduced to only 4.2% (Serra Filho *et al.,* 1975) and at the end of the last decade, the original vegetation cover comprised 11.5% distributed in less than 7,505 fragments of Cerrado *sensu stricto,* cerradão and campo cerrado (Kronka *et al.,* 2005). Formerly covering 14% of São Paulo, this domain has now less than 1% of original vegetation in this state (Durigan *et al.,* 2004).

The loss of Cerrado environments and typical Cerrado bird species have been reported over the last years (Cavalcanti, 1988; Willis & Oniki, 1988, 1992; Stotz *et al.,* 1996; Parker & Willis, 1997; Silva & Bates, 2002; Willis, 2004, 2006), but reduction of Cerrado in São Paulo due to deforestation makes it difficult to study and monitor bird diversity of its remnant vegetation. As cerradões probably are the least known and most protected physiognomies of Cerrado, information about the persisting species in cerradão remains extremely important as relatively few surveys have been conducted in this type of forest in Brazil (Sick, 1955; Fry, 1970; Willis & Oniki, 1981; Tubelis & Tomás, 1999; Dias, 2000; Develey *et al.,* 2005; Piratelli & Blake, 2006; Willis, 2006, Manica *et al.,* 2010; Telles & Dias, 2010).

In this paper we review all published papers to date listing Cerrado birds and additionally we present recent data on the avifauna of a cerradão fragment from the central-western region of the state of São Paulo, Brazil. Our aims were to acknowledge on whether researchers have properly distinguished cerradão birds (species occurring inside cerradão and not those found temporally using different habitats around it) instead of simply mentioning the birds from "Cerrado habitats", as well as to provide a new account of cerradão birds for the state.

MATERIAL AND METHODS

Literature review

We found papers, thesis and books on Cerrado birds by searching Web of Knowledge (http://sub3.isiknowledge.com) and Google Scholar (http://scholar.google.com.br) using combination of key words or title words: aves, avifauna, birds, Cerrado and cerradão.

Study site

The municipalities of Bauru (22°19'S, 49°04'W), Ribeirão Preto (21°10'S, 47°48'W), São José do Rio Preto (20°48'S, 49°23'W) and Presidente Prudente (22°07'S, 51°22'W) concentrate most of the Cerrado of the state of São Paulo, southeastern Brazil (Cavassan, 2002; Figure 1). Bauru is located at the central-western portion of the state, where climate is considered as "Cwag" according to Köppen's classification, with humid summers and moderately dry winters. There are two distinct seasons, a dry season that lasts from April to September, and a humid season which occurs from October to March (Cavassan *et al.,* 1984). Altitudes vary between 510-540 m (Pinheiro *et al.,* 2002).

We surveyed birds at a cerradão remnant (22°20'S, 49°00'W) located at Jardim Botânico Municipal de Bauru, at the eastern margin of the city (Pinheiro *et al.,* 2002). This fragment (314 ha) is classified as tropical semi-deciduous xeromorphic forest with an average 8-m closed canopy. Common understory herb and shrub species are

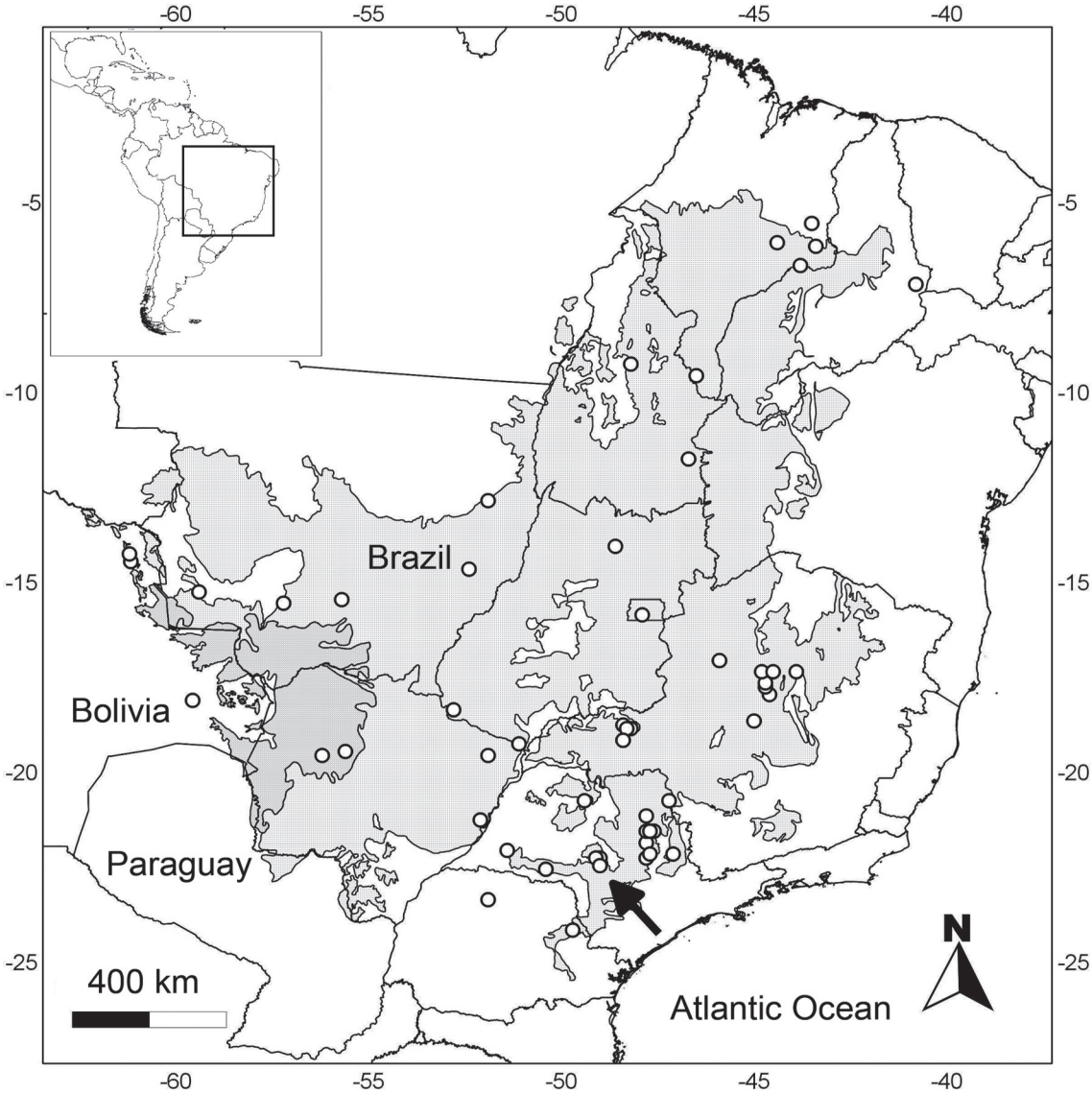

FIGURE 1: Locations (n = 49) where cerradão bird surveys have been conducted. An arrow indicates the region of Bauru, São Paulo State, southern Brazil. Cerrado is represented by light gray, while Pantanal is represented by dark gray.

Myrcia guianensis (Aubl.) DC, *Coussarea hydrangeifolia* (Benth.) Müll. Arg. and *Siparuna guianensis* Aubl. (Christianini & Cavassan, 1998), and in the herbaceous stratum common species are *Andropogon bicornis* L., *Urochloa plantaginea* (Link) R.D. Webster and *Setaria vulpiseta* (Lam.) Roem. & Schult. (Pinheiro *et al.,* 2002).

The matrix landscape around this fragment is greatly modified and composed of two small lakes, early stage regenerating secondary growth and anthropogenic habitats. The cerradão is also near an alluvial forest (1 ha) and surrounds a 5-ha seasonal semi-deciduous forest.

Data collection

We surveyed the cerradão fragment every 15 days from September 2005-December 2006 using unlimited-distance transect counts. We started field work at sunrise, interrupted our surveys two hours before midday and continued from 15:00 until dusk. The same observers always visited ca. 30% of the fragment (including both edges and its interior) due to locations of pre-existing transect lines. We observed birds using Nikon binoculars (8 × 42; 8 × 20) and some vocalizations were recorded with a Panasonic RQ-L31 (built-in microphone) cassette recorder

whenever possible. Copies of recordings have been deposited in Seção de Aves do Museu de Zoologia da Universidade de São Paulo, in São Paulo.

We estimated species richness using nonparametric randomization estimators (Chao2 and Jack2) to evaluate potential variation in sampling effort using the software EstimateS 8.2 (Colwell, 2009). A species accumulation curve was calculated by randomizing sample accumulation order 50 times with Estimates 8.2. We used the goodness-of-fit G test to compare distribution of number of species during the months we surveyed cerradão and to analyze differences between (non)disturbed habitats. The Mann-Whitney test was used to compare medians of ranked sizes of cerradão remnants with species richness. We further compared bird species richness between different cerradão inventories using the Sørensen incidence-based similarity index (Chao *et al.,* 2005). We estimated abundance by counting birds per 100 h of observations (see Willis & Oniki, 1981). Scientific nomenclature followed the Comitê Brasileiro de Registros Ornitológicos (CBRO, 2010).

RESULTS AND DISCUSSION

Literature

We found 95 papers listing Cerrado birds. Among these studies, 37 (39%) did not survey cerradão (habitats included semi-deciduous forests or Cerrado *sensu lato*), while another 41 (43%) sampled cerradão but never teased apart birds occupying other habitats from birds occupying cerradão. Only 17 (18%) papers surveyed cerradão or studied cerradão birds and distinguished all birds recorded inside this forest. These latter investigations could be further divided into three categories: qualitative lists, surveys (or species accounts) and biology studies. Qualitative lists accounted for five studies (29%), surveys summed up six investigations (35%) and biology studies accounted for the remainder (36%). Lopes & Braz (2007) reported the Black Hawk-Eagle *Spizaetus tyrannus* from cerradão while discussing Cerrado noteworthy bird records. Although Olmos & Boulhosa (2000) recorded the Bicolored Conebill *Conirostrum bicolor* at cerradões from the municipality of Assis, São Paulo, we decided to exclude this undocumented species as it is typical of mangroves. We used those information to generate a list of bird species that have actually been recorded using cerradão as habitat. Studies that mentioned birds from cerradão were developed in 49 municipalities and two South American countries (Figure 1). This compilation accumulated 250 species in 36 families and 15 orders (Appendix). The complete set of references compiled for this review is available upon request.

Bauru cerradão

Over a total of 190 h and approximately 90 km of transects, we recorded 48 species of 20 families only at cerradão (Appendix), which represented 5% of all bird species recorded for the Cerrado region (Silva, 1995; Silva & Santos, 2005). The randomized cerradão species accumulation curve rose quickly at first but tended to level off towards an asymptote five months before the end of the survey (Figure 2). Nonparametric species richness estimators Chao2 and Jack2 predicted 48.19 and 48.36 species, respectively. As no new species were detected prior to the end of the survey, and the predicted species richness were exactly the same as the empirical value, we concluded that the majority of bird species was recorded at our fragment.

Other studies that have discriminated birds recorded in the matrix habitat from cerradão birds obtained similar values of species richness. Therefore, bird species richness observed here (48) is considered to be low only if compared with gallery forests or Cerrado *sensu stricto* (Bagno & Marinho Filho, 2001). Furthermore, our species richness did not represent a sample artifact. We always recorded few species in cerradão (21 ± 4.56; mean ± SE) throughout the months we conducted this survey, and species richness was not greater during any particular month of the year than expected by chance (G = 10.62, df = 31, P = 0.224). Values of species richness of different bird inventories conducted in cerradão, as well as their sampling

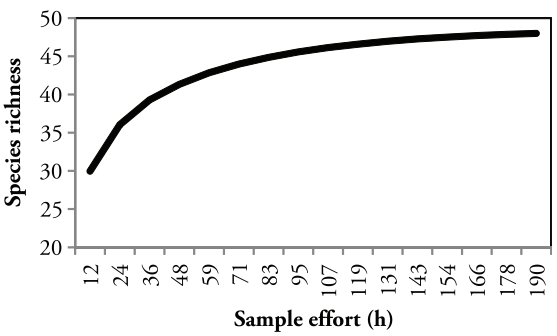

FIGURE 2: Accumulation curve for number of bird species in relation to sample effort from a cerradão fragment in the municipality of Bauru, São Paulo State, Brazil. Sample accumulation order was randomized 50 times.

TABLE 1: Location, number of species exclusively detected and field method used in several bird inventories conducted in cerradão woodland, Cerrado region, Brazil. When available by the study, habitat degradation (+ for very modified; – for less modified) and size of remnant (+ for larger than 500 ha; – for smaller than 500 ha) is given.

Location (reference)	Species richness	Habitat	Remnant size	Method
Mato Grosso, Brazil (Fry, 1970)	45	+	+	mist nets
São Paulo, Brazil (Almeida, 1979)	31	–	–	mist nets
Mato Grosso, Brazil (Silva & Oniki, 1988)	48	–	–	qualitative lists
Santa Cruz, Bolivia (Parker & Remsen Jr., 1993)	55	+	+	qualitative lists
Mato Grosso do Sul, Brazil (Melo & Piratelli, 1999)	1			biology study
São Paulo, Brazil (Olmos & Boulhosa, 2000)	1		+	biology study
São Paulo, Brazil (Marcondes-Machado, 2002)	11			biology study
Minas Gerais, Brazil (Melo *et al.*, 2003)	5		–	biology study
São Paulo, Brazil (Motta-Junior, 2006)	4	+	–	biology study
Mato Grosso do Sul, Brazil (Piratelli & Blake, 2006)	39	–		mist nets
Minas Gerais, Brazil (Kirwan *et al.*, 2004)	2			species account
São Paulo, Brazil (Willis, 2006)	56	–	–	transects
Goiás, Brazil (Faria *et al.*, 2007)	2			biology study
São Paulo, Brazil (Manica *et al.*, 2010)	29	+	–	qualitative lists
Assis, São Paulo, Brasil (Antunes, 2010)	64	+	+	qualitative lists
Maranhão, Brazil (Santos *et al.*, 2010)	110			qualitative lists
São Paulo, Brazil (this study)	48	–	–	transects

methods, can be seen in Table 1. They are only slightly different in spite of differences in sampling effort and field method. Only biology studies, basically fauna-flora interactions, accounted for fewer species. Mist-netting results accounted for the lowest richness values (mean = 38.3 species), while qualitative lists and transects seemed to record more species (61.2 and 52, respectively). It was an expected result due to the limitations of mist net sampling (Karr, 1981), which do not represent the entire community.

Almeida (1979) was one of the earliest researchers looking for differences on bird diversity between natural and man-made habitats, such as *Eucalyptus* plantations, in Brazil. His results yielded 31 species from cerradões in São Paulo, but also may have suffered from mist-netting limitations. Silva & Oniki (1988) surveyed for a short period of time a greatly modified cerradão fragment at Mato Grosso State, Brazil, but they could still record as many species as the present survey. Fry (1970) and Parker & Remsen Jr. (1993) also found roughly the same species richness at Mato Grosso and Bolivia, respectively, as other investigators have found in different cerradões. Fry (1970), however, based his cerradão list mainly on mist-netting data. As a result, many species that failed to be netted were not represented in his study, probably artificially decreasing his species richness. Using mist nets at Mato Grosso do Sul State, Brazil, Piratelli & Blake (2006) were able to record 39 species. These authors only mentioned those species with more than five captures. Willis (2006) recorded 56 species in São Paulo when border and flying over species are excluded. Manica *et al.* (2010) found 29 species in a cerradão remnant in São Paulo, but this cerradão was the least visited habitat by the authors.

Antunes (2010) and Santos *et al.* (2010) found 64 and 110 species occurring in cerradão. Some of this species may not use the forest itself, but be present in nearby habitats, such as the White-tailed Kite *Elanus leucurus* and Red-legged Seriema *Cariama cristata.* Furthermore, the latter authors surveyed three different cerradão fragments without discriminating the records of each locality. This may have inflated the overall number of species by the addition of many species present uniquely in one fragment.

Considering habitat level of disturbance given by these authors (Table 1), species richness did not seem to be related with landscape modifications where one would expect to find more species in undisturbed environments and matrix habitats ($G = 2.36$, $df = 1$, $P = 0.125$). Excluding biology studies, which would compromise this following analysis, size of remnant did not show an expected pattern either. Fragments larger than 500 ha (Table 1) did not harbor more species than smaller remnants ($U = 4.5$, $P = 0.592$).

Species richness composition greatly differed between our study and those obtained from other cerradões from Brazil and Bolivia. Cerradões from São Paulo obtained the highest similarity values, while São Paulo and Mato Grosso shared few species (Table 2).

TABLE 2: Sørensen incidence-based similarity indexes calculated for bird species richness in different cerradão woodlands from the Cerrado region of Brazil.

	São Paulo, Brazil (Antunes, 2010)	São Paulo, Brazil (this study)	Mato Grosso, Brazil (Fry, 1970)	São Paulo, Brazil (Manica *et al.*, 2010)	Mato Grosso, Brazil (Silva & Oniki, 1988)	Santa Cruz, Bolivia (Parker & Remsen Jr., 1993)	Mato Grosso do Sul, Brazil (Piratelli & Blake, 2006)	Maranhão, Brazil (Santos *et al.*, 2010)	São Paulo, Brazil (Willis, 2006)
São Paulo, Brazil (Almeida, 1979)	0.36	0.20	0.11	0.20	0.20	0.21	0.26	0.13	0.25
São Paulo, Brazil (Antunes, 2010)		0.54	0.26	0.39	0.27	0.25	0.43	0.34	0.50
São Paulo, Brazil (this study)			0.28	0.36	0.25	0.21	0.39	0.30	0.46
Mato Grosso, Brazil (Fry, 1970)				0.32	0.22	0.16	0.29	0.23	0.20
São Paulo, Brazil (Manica *et al.*, 2010)					0.23	0.12	0.32	0.27	0.35
Mato Grosso, Brazil (Silva & Oniki, 1988)						0.21	0.37	0.32	0.27
Santa Cruz, Bolivia (Parker & Remsen Jr., 1993)							0.34	0.24	0.27
Mato Grosso do Sul, Brazil (Piratelli & Blake, 2006)								0.24	0.32
Maranhão, Brazil (Santos *et al.*, 2010)									0.29

This is partly explained because many typical Amazonian elements of central Brazil's gallery forests are absent in São Paulo (Silva, 1996). Another reason is due to the transversal distribution pattern of the avifauna of central regions of the country. In peripheral areas, these species reach only the westernmost Cerrado of São Paulo (Sick, 1965). Furthermore, Atlantic Forest species, such as *Hylophilus poicilotis* (song recorded), absent in studies from Mato Grosso, Mato Grosso do Sul and Bolivia, also influenced and contributed for the low similarity values.

It would be expected to find more similarities between cerradões from São Paulo, whereas species richness should be less similar between central and peripheral areas of the Cerrado region. Although the sampling efforts differed considerably in these studies and comparing them seems inappropriate, these patterns were nonetheless corroborated (Table 2). Similarity indexes were highest between the municipalities of Bauru and Corumbataí, São Paulo (Willis, 2006), and lowest between Amazonia-influenced Serra do Roncador, Mato Grosso (Fry, 1970) and Agudos, São Paulo (Almeida, 1979). There were no species shared among all of the analyzed inventories, but some tended to be present in most locations, such as the Flavescent Warbler *Basileuterus flaveolus,* a very common species of both cerradões and semi-deciduous forests from the Cerrado domain (Sick, 1997).

We found that the 10 most abundant species during our survey at Bauru were *Turdus leucomelas, Basileuterus flaveolus, Patagioenas picazuro, Brotogeris chiriri, Vireo olivaceus, Myiodynastes maculatus, Leptotila verreauxi, Thamnophilus pelzelni, Picumnus albosquamatus* and *Herpsilochmus atricapillus* (Appendix). None of them is considered neither threatened nor endemic and only one (*T. pelzelni*) was exclusively recorded inside cerradão. These forests do not harbor a significant amount of typical Cerrado birds, a result constantly shared with other surveys analyzed herein (Appendix).

We recorded one species endemic to the Cerrado region (Silva, 1995; Appendix) that is also near threatened with extinction in the state of São Paulo (Helmeted Manakin *Antilophia galeata*). This species is typically found at Cerrado gallery forests (Sick, 1997) and in our study site it was rarely recorded in cerradão. Many individuals, however, could be detected in the nearby semi-deciduous forest. We recorded one vulnerable species in the state (Silveira *et al.,* 2009; Appendix), the Pale-bellied Tyrant-Manakin *Neopelma pallescens.* It was never commonly recorded, but it may have gone unnoticed several times as it was inconspicuous at the fragment.

Three species (*Baryphthengus ruficapillus, Automolus leucophthalmus* and *Hylophilus poicilotis*) are considered to be Atlantic Forest endemics (Parker *et al.,* 1996). In spite of suitable habitat in the 5-ha semi-deciduous forest, these birds were seen several times foraging far from it and inside the cerradão itself. These species are also recorded in other Cerrado localities from São Paulo (Willis & Oniki, 2003) and in the case of *B. ruficapillus,* even in forests of the Cerrado region (Straube & Bornschein, 1991). The same is valid for the Violet-capped Woodnymph *Thalurania glaucopis* and Rufous-capped Spinetail *Synallaxis ruficapilla,* both recorded by Willis (2006), Surucua Trogon *Trogon surrucura,* recorded by Antunes (2010), and Black Jacobin *Florisuga fusca,* recorded from São Paulo Cerrado landscapes (Motta-Junior *et al.,* 2008; Ubaid *et al.,* in prep.). Despite present in semi-deciduous forests, which share many Atlantic Forest elements (Silva, 1996), these seven species have been reported from peripheral areas of the Cerrado domain and we hereby suggest they should have their Atlantic Forest endemic status reevaluated.

Cerradão harbors fewer bird species compared to Cerrado *sensu stricto* or gallery forests as every available survey indicates that rarely more than 64 species use cerradão as permanent habitat. Furthermore, few Cerrado endemics were recorded from cerradões surveyed at Cerrado localities in Brazil and abutting countries. It is extremely important to preserve cerradão as much of its extent has been reduced in the state of São Paulo without proper bird surveys having been conducted. Besides conservation of threatened species, such as *N. palescens,* there should be more emphasis on the importance and urgency to conduct surveys in these scientifically under-explored and threatened forests, especially in Cerrado peripheral areas (Motta-Junior *et al.,* 2008). Cerradões must be considered as part of the diversity and environmental heterogeneity of Cerrado as birds use its different physiognomies on a seasonal basis. Therefore, all such physiognomies must readily be conserved.

Many problems can arise from the confusing terminologies of cerradão. Among the papers analyzed, this type of forest has been called dry forest, deciduous forest, Cerrado, dense cerrado, stunted forest and wooded cerrado. Some of them may not be suitable for properly identifying cerradão. Here we suggest that cerradão may be named hereafter as "cerradão woodland". We hope to motivate the continuity of bird monitoring in cerradão woodland, a very rare type of bird survey, in order to assess the diversity of these threatened habitats over time.

RESUMO

O Cerrado ainda recebe pouca atenção no que diz respeito à ornitologia embora seja a única savana tropical do mundo considerada um hotspot *de biodiversidade. O cerradão é uma das fisionomias menos conhecidas e mais desmatadas do bioma e poucos levantamentos avifaunísticos foram realizados nessas florestas. Para revisar os estudos sobre aves de cerradão e complementar os poucos inventários já existentes realizados nesse tipo florestal no estado de São Paulo, foi realizado um levantamento bibliográfico dos estudos publicados sobre aves de cerradão. Adicionalmente foi conduzido um levantamento das aves de um fragmento de cerradão de 314 ha localizado na região central do estado de São Paulo, Brasil, entre setembro de 2005 e dezembro de 2006 com a utilização de transecções lineares com raio ilimitado de detecção. De 95 estudos envolvendo aves de cerradão, apenas 17 (18%) discriminaram espécies registradas dentro desta fisionomia daquelas que obtiveram registros em outros ambientes de Cerrado. Exceto por um estudo, nenhuma outra investigação encontrou mais de 64 espécies de aves neste ambiente, resultado compartilhado com diversas regiões do Brasil e também da Bolívia. Diferenças no número de espécies entre cerradões não puderam ser atribuídas à degradação dos ambientes estudados ou tamanho de fragmento. Considerando os registros de cerradões no Brasil e na Bolívia, a compilação de dados acumulou 250 espécies distribuídas em 36 famílias e 15 ordens. Durante nossos trabalhos de campo em localidade do interior paulista foram registradas 48 espécies distribuídas em 20 famílias, incluindo o fruxu-do-cerradão (*Neopelma pallescens*), ameaçada em São Paulo, e o soldadinho (*Antilophia galeata*), quase ameaçada no estado e endêmica do Cerrado. Dentre as espécies mais abundantes no fragmento, nenhuma delas é ameaçada ou endêmica do bioma.*

Palavras-Chave: Áreas marginais de Cerrado; Cerrado *sensu lato;* Espécies endêmicas; Transecções lineares.

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REFERENCES

AB'SABER, A.N. 1977. Os domínios morfoclimáticos da América do Sul. Primeira aproximação. *Geomorfologia,* 52:1-21.

ALMEIDA, A.F. 1979. Influência do tipo de vegetação nas populações de aves em uma floresta implantada de Pinus spp. na região de Agudos, SP. *Instituto de Pesquisas e Estudos Florestais,* 18:59-77.

ANDRADE, L.A.Z.; FELFILI, J.M. & VIOLATTI, L. 2002. Fitossociologia de uma área de cerrado denso na RECOR-IBGE, Brasília, DF. *Acta Botanica Brasilica,* 16:225-240.

BORGONOVI, M. & CHIARINI, J.V. 1965. Cobertura vegetal do Estado de São Paulo. *Bragantia,* 24:159-172.

CAVALCANTI, R.B. 1988. Conservation of birds in the Cerrado of central Brazil. *In:* Goriup, P.D. (Ed.), *Ecology and conservation of grassland birds.* ICBP Technical Publication, Cambridge, p. 59-66.

CAVASSAN, O. 2002. O cerrado do Estado de São Paulo. *In:* Klein, A.L. (Org.). *Eugen Warming e o cerrado brasileiro um século depois.* Editora UNESP, Imprensa Oficial do Estado, São Paulo, p. 93-106.

CAVASSAN, O.; CESAR, O. & MARTINS, F.R. 1984. Fitossociologia da vegetação arbórea da Reserva Estadual de Bauru, Estado de São Paulo. *Revista Brasileira de Botânica,* 7:91-106.

CBRO – COMITÊ BRASILEIRO DE REGISTROS ORNITOLÓGICOS. 2009. *Lista das aves do Brasil.* Available at: www.cbro.org.br. Access in: 18/Jun/2010.

CHAO, A.; CHAZDON, R.L.; COLWELL, R.K. & SHEN, T.J. 2005. A new statistical approach for assessing similarity of species composition with incidence and abundance data. *Ecology Letters,* 8:148-159.

CHRISTIANINI, S.R. & CAVASSAN, O. 1998. O estrato herbáceo-subarbustivo de um fragmento de cerradão em Bauru, SP. *Salusvita,* 17:9-16.

COLWELL, R.K. 2009. *EstimateS:* statistical estimation of species richness and shared species from samples. Version 8.2. User's Guide and application. Available at: http://viceroy.eeb.uconn.edu/EstimateS. Access in: 20/May/2009.

COUTINHO, L.M. 1978. O conceito de Cerrado. *Revista Brasileira de Botânica,* 1:17-23.

DEVELEY, P.F.; CAVANA, D.D. & PIVELLO, V.R. 2005. Aves. *In:* Pivello, V.R. & Varanda, E.M. (Eds.). *O cerrado Pé-de-Gigante:* ecologia e conservação – Parque Estadual de Vassununga. Secretaria do Meio Ambiente, São Paulo, p. 122-134.

DIAS, M.M. 2000. Avifauna das Estações Ecológica de Jataí e Experimental de Luiz Antônio, São Paulo, Brasil. *In:* Santos, J.E & Pires, J.R.S. (Eds.). *Estação Ecológica de Jataí.* RIMA, São Carlos, p. 285-301.

DURIGAN, G.; FRANCO, G.A.D.C. & SIQUEIRA, M.F. 2004. A vegetação dos remanescentes de cerrado no estado de São Paulo. *In:* Bitencourt, M.D. & Mendonça, R.R. (Orgs.). *Viabilidade de Conservação dos remanescentes de cerrado no Estado de São Paulo.* Annablume/FAPESP, São Paulo, p. 29-56.

EITEN, G. 1972. The Cerrado vegetation of Brazil. *The Botanical Review,* 38:201-341.

FARIA, I.P.; ABREU, T.L.S. & BIANCHI, C.A. 2007. Seed and fruit predation of *Kyelmeira* (Guttiferae) and *Qualea* (Vochysiaceae) species by six psittacid species in the Brazilian cerradão. *Ecotropica,* 13:75-79.

FRY, C.H. 1970. Ecological distribution of birds in north-eastern Mato Grosso state, Brazil. *Anais da Academia Brasileira de Ciências,* 42:275-318.

KARR, J.R. 1981. Surveying birds with mist nets. *Studies in Avian Biology,* 6:62-67.

KRONKA, F.J.N.; NALON, A.M. & MATSUKUMA, C.K. 1998. *Áreas de domínio do cerrado no Estado de São Paulo.* Secretaria do Meio Ambiente, São Paulo.

LOPES, L.E. & BRAZ, V. 2007. Aves da região de Pedro Afonso, Tocantins, Brasil. *Revista Brasileira de Ornitologia,* 15:530-537.

MANICA, L.T.; TELLES, M. & DIAS, M.M. 2010. Bird richness and composition in a Cerrado fragment in the state of São Paulo. *Brazilian Journal of Biology,* 70:243-254.

MARCONDES-MACHADO, L.O. 2002. Comportamento alimentar de aves em *Miconia rubiginosa* (Melastomataceae) em fragmento de cerrado, São Paulo. *Iheringia, Série Zoologia,* 92:97-100.

MELO, C.; BENTO, E.C. & OLIVEIRA, P.E. 2003. Frugivory and dispersal of Faramea cyanea (Rubiacea) in cerrado woody plant formations. *Brazilian Journal of Biology,* 63:75-82.

MELO, F.P. & PIRATELLI, A.J. 1999. Biologia e ecologia do udu-de-cora-azul (Momotus momota: Aves: Momotidae). *Ararajuba,* 7:56-61.

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

MOTTA-JUNIOR, J.C.; GRANZINOLLI, M.A.M. & DEVELEY, P.F. 2008. As aves da Estação Ecológica de Itirapina, estado de São Paulo, Brasil. *Biota Neotropica,* 8:203-223.

MYERS, N.; MITTERMEIER R.A.; MITTERMEIER, C.G.; FONSECA, G.A.B. & KENT, J. 2000. Biodiversity hotspots for conservation priorities. *Nature,* 403:853-858.

OLMOS, F. & BOULHOSA, R.L.P. 2000. A meeting of opportunist: birds and other visitors to *Mabea fistulifera* (Euphorbiaceae) inflorescences. *Ararajuba,* 8:93-98.

PARKER, T.A. & REMSEN JR., J.V. 1993. Birds of the Serranía de Santiago. *In:* Parker, T.A.; Gentry, A.H.; Foster, R.B.; Emmons, L.H. & Remsen Jr., J.V. (Eds.). *The lowland dry forests of Santa Cruz, Bolivia:* a global conservation priority. Conservation International, RAP Working Papers 4, p. 49-52.

PARKER, T.A. & WILLIS, E.O. 1997. Notes on three tiny grasslands flycatchers with comments on the disappearance of South American fire-diversified savannas. *Ornithological Monographs,* 48:549-555.

PARKER, T.A.; STOTZ, D.F. & FITZPATRICK, J.W. 1996. Ecological and distributional databases. *In:* Stotz, D.F.; Fitzpatrick, J.W.; Parker, T.A. & Moskovits, D.K. (Eds.). *Neotropical birds:* ecology and conservation. The University of Chicago Press, Chicago, p. 118-436.

PINHEIRO, M.H.O.; MONTEIRO, R. & CESAR, O. 2002. Levantamento fitossociológico da floresta estacional semidecidual do Jardim Botânico de Bauru, São Paulo. *Naturalia,* 27:145-164.

PIRATELLI, A.J. & BLAKE, J.G. 2006. Bird communities of the southeastern Cerrado region, Brazil. *Ornitologia Neotropical,* 17:213-225.

RIZZINI, C.T. 1976. *Tratado de fitogeografia do Brasil.* Ed. EDUSP, São Paulo.

SERRA FILHO, R.; CAVALLI, A.C.; GUILLAUMON, J.R.; CHIARINI, J.V.; NOGUEIRA, F.P.; IVANCKO, C.M.A.M.; BARBIERI, J.L.; DONZELI, P.L.; COELHO, A.G.S. & BITTENCOURT, I. 1975. Levantamento da cobertura natural e do reflorestamento no Estado de São Paulo. *Boletim Técnico do Instituto Florestal,* 11:1-53.

SICK, H. 1955. O aspecto fitofisionômico da paisagem do médio Rio das Mortes, Mato Grosso, e a avifauna da região. *Arquivos do Museu Nacional,* 42:541-576.

Sick, H. 1965. A fauna do cerrado. *Arquivos de Zoologia,* 12:71-93.

Sick, H. 1997. *Ornitologia brasileira.* Nova Fronteira, Rio de Janeiro.

Silva, J.M.C. 1995. Birds of the Cerrado region, South America. *Steenstrupia,* 21:69-92.

Silva, J.M.C. 1996. Distribution of Amazonian and Atlantic birds in gallery forests of the Cerrado region, South America. *Ornitologia Neotropical,* 7:1-18.

Silva, J.M.C. & Bates, J.M. 2002. Biogeographic patterns and conservation in the South American Cerrado: a tropical savanna hotspot. *BioScience,* 52:225-233.

Silva, J.M.C. & Oniki, Y. 1988. Lista preliminar da avifauna da Estação Ecológica Serra das Araras, Mato Grosso, Brasil. *Boletim do Museu Paraense Emílio Goeldi. Zoologia,* 4:123-143.

Silva, J.M.C. & Santos, M.P.D. 2005 A importância relativa dos processos biogeográficos na formação da avifauna do Cerrado e de outros biomas brasileiros. *In:* Scariot, A.J.; Sousa Filho, C. & Felfili, J.M. (Eds.). *Cerrado:* ecologia, biodiversidade e conservação. Ministério do Meio Ambiente, Brasília, p. 224-233.

Silveira, L.F.; Benedicto, G.A.; Schunck, F. & Sugieda, A.M. 2009. Aves. *In:* Bressan, P.M.; Kierulff, M.C. & Sugieda, A.M. (Orgs.). *Fauna ameaçada de extinção no Estado de São Paulo:* vertebrados. Fundação Parque Zoológico de São Paulo e MMA São Paulo, p. 87-284.

Stotz, D.F.; Fitzpatrik, J.W.; Parker, T.A. & Moskovits, D.K. 1996. *Neotropical birds:* ecology and conservation. University of Chicago Press, Chicago.

Straube, F.C. & Bornschein, M.R. 1991. Revisão das subespécies de *Baryphthengus ruficapillus* (Coraciiformes: Momotidae). *Ararajuba,* 2:65-67.

Tubelis, D.P. & Tomás, W.M. 1999. Distribution of birds in a naturally patchy forest environment in the Pantanal wetland, Brasil. *Ararajuba,* 7:81-89.

Valadão, R.; Franchin, M.A.G. & Marchal Jr., O. 2006. A avifauna no Parque Municipal Victório Siquierolli, zona urbana de Uberlândia (MG). *Biotemas,* 19:81-91.

Veloso, H.P.; Rangel Filho, A.L.R. & Lima, J.C.A. 1991. *Classificação da vegetação brasileira, adaptada a um sistema universal.* Fundação Instituto Brasileiro de Geografia e Estatística, Departamento de Recursos Naturais e Estudos Ambientais, Rio de Janeiro.

Willis, E.O. 2004. Birds of a habitat spectrum in the Itirapina Savanna, São Paulo, Brazil (1982-2003). *Brazilian Journal of Biology,* 64:901-910.

Willis, E.O. 2006. Protected cerrado fragments grow up and lose even metapopulational birds in central São Paulo, Brazil. *Brazilian Journal of Biology,* 66:829-837.

Willis, E.O. & Oniki, Y. 1981. Levantamento preliminar de aves em treze áreas do Estado de São Paulo. *Revista Brasileira de Biologia,* 41:121-135.

Willis, E.O. & Oniki, Y. 1988. Bird conservation in open vegetation of São Paulo, Brazil. *In:* Goriup, P.D. (Ed.). *Ecology and conservation of grassland birds.* ICBP Technical Publication, Cambridge, p. 67-70.

Willis, E.O. & Oniki, Y. 1992. Losses of São Paulo birds are worse in the interior than on Atlantic forests. *Ciência e Cultura,* 44:326-238.

Willis, E.O. & Oniki, Y. 2003. *Aves do Estado de São Paulo.* Divisa, Rio Claro.

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APPENDIX

List of bird species reported from cerradão woodlands. Species recorded recently at a cerradão fragment located in the municipality of Bauru, São Paulo State, Brazil, from September 2005-December 2006 denote abundance, expressed as number of individuals recorded by 100 h of observations. Evidence: V = vocalization, S = sight record, R = tape recording. NT = near threatened with extinction in the state of São Paulo, VU = vulnerable in the state of São Paulo. * = Cerrado region endemic (Silva, 1995); ¶ = Atlantic Forest endemics (Parker *et al.,* 1996). Authors: A = Almeida (1979), An = Antunes (2010), C = this study, Fa = Faria *et al.* (2007), Fr = Fry (1970), K = Kirwan *et al.* (2004), L = Lopes & Braz (2007), Ma = Manica *et al.* (2010), MM = Marcondes-Machado (2002), MP = Melo & Piratelli (1999), Me = Melo *et al.* (2003), Mo = Motta-Junior (2006), O = Olmos & Boulhosa (2000), Pa = Parker & Remsen Jr. (1993), Pi = Piratelli & Blake (2006), S = Silva & Oniki (1988), St = Santos *et al.* (2010), W = Willis (2006).

Taxa	English name	Abundance	Evidence	Authors
TINAMIFORMES				
TINAMIDAE (4)				
Crypturellus soui (Hermann, 1783)	Little Tinamou			S
Crypturellus undulatus (Temminck, 1815)	Undulated Tinamou			Fr
Crypturellus parvirostris (Wagler, 1827)	Small-billed Tinamou	17	R,S,V	C,Fr,Ma,St
Crypturellus tataupa (Temminck, 1815)	Tataupa Tinamou	2	S	An,C,Pa,St
GALLIFORMES				
CRACIDAE (3)				
Ortalis superciliaris (Gray, 1867)	Buff-browed Chachalaca			St
Penelope superciliaris Temminck, 1815	Rusty-margined Guan	18	S,V	An,C,Fr,W
Aburria cumanensis (Jacquin, 1784)	Blue-throated Piping Guan			Pa
CATHARTIFORMES				
CATHARTIDAE (2)				
Cathartes aura (Linnaeus, 1758)	Turkey Vulture			Pa,S,St
Sarcoramphus papa (Linnaeus, 1758)	King Vulture			Pa
ACCIPITRIFORMES				
ACCIPITRIDAE (12)				
Leptodon cayanensis (Latham, 1790)	Gray-headed Kite	2	R,S,V	C,St
Chondrohierax uncinatus (Temminck, 1822)	Hook-billed Kite	1	S	C
Gampsonyx swainsonii Vigors, 1825	Pearl Kite			S
Elanus leucurus (Vieillot, 1818)	White-tailed Kite			St
Accipiter striatus Vieillot, 1808	Sharp-shinned Hawk			Pa
Accipiter bicolor (Vieillot, 1817)	Bicolored Hawk			St
Ictinia plumbea (Gmelin, 1788)	Plumbeous Kite			An,St
Geranospiza caerulescens (Vieillot, 1817)	Crane Hawk			St
Rupornis magnirostris (Gmelin, 1788)	Roadside Hawk	30	R,S,V	C,S,St
Buteo nitidus (Latham, 1790)	Gray Hawk			St
Buteo platypterus (Vieillot, 1823)	Broad-winged Hawk			St
Spizaetus tyrannus (Wied, 1820)	Black Hawk-Eagle			L
FALCONIDAE (5)				
Ibycter americanus (Boddaert, 1783)	Red-throated Caracara			Fr
Caracara plancus (Miller, 1777)	Southern Caracara			Ma
Milvago chimachima (Vieillot, 1816)	Yellow-headed Caracara			St
Herpetotheres cachinnans (Linnaeus, 1758)	Laughing Falcon			St
Micrastur ruficollis (Vieillot, 1817)	Barred Forest-Falcon			St
CARIAMIDAE (1)				
Cariama cristata (Linnaeus, 1766)	Red-legged Seriema			An,St
COLUMBIFORMES				
COLUMBIDAE (9)				
Columbina talpacoti (Temminck, 1811)	Ruddy Ground-Dove			Pi
Columbina squammata (Lesson, 1831)	Ruddy Ground-Dove			St

Taxa	English name	Abundance	Evidence	Authors
Claravis pretiosa (Ferrari-Perez, 1886)	Blue Ground-Dove			Fr,Pi,S,St
Patagioenas speciosa (Gmelin, 1789)	Scaled Pigeon			Fr
Patagioenas picazuro (Temminck, 1813)	Picazuro Pigeon	142	R,S,V	An,C,Ma,St,W
Patagioenas cayennensis (Bonnaterre, 1792)	pomba-galega	1	S	C,W
Leptotila verreauxi Bonaparte, 1855	White-tipped Dove	69	S,V	An,C,Ma,Pa,Pi,St,W
Leptotila rufaxilla (Richard & Bernard, 1792)	Gray-fronted Dove	13	V	A,C,Ma,Pi,St
Geotrygon montana (Linnaeus, 1758)	Ruddy Quail-Dove	2	V	C
PSITTACIFORMES				
PSITTACIDAE (14)				
Ara ararauna (Linnaeus, 1758)	Blue-and-yellow Macaw			Fa
Primolius maracana (Vieillot, 1816)	Blue-winged Macaw			St
Primolius auricollis (Cassin, 1853)	Yellow-collared Macaw			Pa
Diopsittaca nobilis (Linnaeus, 1758)	Red-shouldered Macaw			St
Aratinga acuticaudata (Vieillot, 1818)	Blue-crowned Parakeet			Pa
Aratinga leucophthalma (Statius Muller, 1776)	White-eyed Parakeet			An,S
Aratinga jandaya (Gmelin, 1788)	Jandaya Parakeet			St
Aratinga aurea (Gmelin, 1788)	Peach-fronted Parakeet			Fa
Pyrrhura molinae (Massena & Souancé, 1854)	Green-cheeked Parakeet			Pa
Brotogeris versicolurus (Statius Muller, 1776)	Canary-winged Parakeet			Pa
Brotogeris chiriri (Vieillot, 1818)	Yellow-chevroned Parakeet	135	R,S,V	An,C,St
Pionus maximiliani (Kuhl, 1820)	Scaly-headed Parrot			Pa,St
Amazona amazonica (Linnaeus, 1766)	Orange-winged Parrot			St
Amazona aestiva (Linnaeus, 1758)	Blue-fronted Parrot			Pa
CUCULIFORMES				
CUCULIDAE (3)				
Piaya cayana (Linnaeus, 1766)	Squirrel Cuckoo	31	R,S,V	An,C,Fr,Ma,Pi,S,St,W
Dromococcyx phasianellus (Spix, 1824)	Pheasant Cuckoo			St
Dromococcyx pavoninus Pelzeln, 1870	Pavonine Cuckoo			An
STRIGIFORMES				
TYTONIDAE (1)				
Tyto alba (Scopoli, 1769)	Barn Owl			Mo
STRIGIDAE (4)				
Megascops choliba (Vieillot, 1817)	Tropical Screech-Owl			Mo,Pa,St,W
Glaucidium brasilianum (Gmelin, 1788)	Ferruginous Pygmy-Owl			Mo,Pa,St
Asio clamator (Vieillot, 1808)	Striped Owl			Mo
Asio stygius (Wagler, 1832)	Stygian Owl			Mo
CAPRIMULGIFORMES				
NYCTIBIIDAE (1)				
Nyctibius griseus (Gmelin, 1789)	Common Potoo			An,St,W
CAPRIMULGIDAE (5)				
Antrostomus rufus (Boddaert, 1783)	Rufous Nightjar			An
Lurocalis semitorquatus (Gmelin, 1789)	Short-tailed Nighthawk	2	S	An,C
Hydropsalis albicollis (Gmelin, 1789)	Pauraque	3	S,V	An,C,Fr,Pa,St
Chordeiles pusillus Gould, 1861	Least Nighthawk			K
Chordeiles acutipennis (Hermann, 1783)	Lesser Nighthawk			S
APODIFORMES				
TROCHILIDAE (15)				
Phaethornis nattereri Berlepsch, 1887	Cinnamon-throated Hermit			S,St
Phaethornis subochraceus Todd, 1915	Buff-bellied Hermit			Pa
Phaethornis pretrei (Lesson & Delattre, 1839)	Planalto Hermit			A,An,O,S,St
Eupetomena macroura (Gmelin, 1788)	Swallow-tailed Hummingbird			O,St
Aphantochroa cirrochloris (Vieillot, 1818)	Sombre Hummingbird			W
Florisuga mellivora (Linnaeus, 1758)	White-necked Jacobin			Fr
Florisuga fusca (Vieillot, 1817)	Black Jacobin			O,W

Taxa	English name	Abundance	Evidence	Authors
Anthracothorax nigricollis (Vieillot, 1817)	Black-throated Mango			O
Chlorostilbon lucidus (Shaw, 1812)	Glittering-bellied Emerald			An,St
Thalurania furcata (Gmelin, 1788)	Fork-tailed Woodnymph			S,St
Thalurania glaucopis (Gmelin, 1788)	Violet-capped Woodnymph			W
Hylocharis chrysura (Shaw, 1812)	Gilded Hummingbird			An,O
Leucochloris albicollis (Vieillot, 1818)	White-throated Hummingbird			O
Amazilia fimbriata (Gmelin, 1788)	Glittering-throated Emerald			Pi,S,St
Calliphlox amethystina (Boddaert, 1783)	Amethyst Woodstar			O
TROGONIFORMES				
TROGONIDAE (2)				
Trogon surrucura¶ Vieillot, 1817	Surucua Trogon			An
Trogon curucui Linnaeus, 1766	Blue-crowned Trogon			Pa,St
CARACIIFORMES				
MOMOTIDAE (2)				
Baryphthengus ruficapillus¶ (Vieillot, 1818)	Rufous-capped Motmot	6	S,V	C,Me,W
Momotus momota (Linnaeus, 1766)	Blue-crowned Motmot			Fr,MP,Pa?,Pi
GALBULIFORMES				
GALBULIDAE (1)				
Galbula ruficauda	Rufous-tailed Jacamar	10	R,S,V	C,St
BUCCONIDAE (6)				
Notharchus macrorhynchos (Gmelin, 1788)	Guianan Puffbird			Fr
Notharchus tectus (Boddaert, 1783)	Pied Puffbird			St
Nystalus chacuru (Vieillot, 1816)	White-eared Puffbird			S
Nystalus maculatus (Gmelin, 1788)	Spot-backed Puffbird			Pa,Pi,St
Nonnula rubecula (Spix, 1824)	Rusty-breasted Nunlet			Pi
Chelidoptera tenebrosa (Pallas, 1782)	Swallow-wing			Fr
PICIFORMES				
RAMPHASTIDAE (1)				
Ramphastos toco Statius Muller, 1776	Toco Toucan			S,W
PICIDAE (12)				
Picumnus pygmaeus (Lichtenstein, 1823)	Spotted Piculet			St
Picumnus cirratus Temminck, 1825	White-barred Piculet			Pa
Picumnus albosquamatus d'Orbigny, 1840	White-wedged Piculet	63	S,V	An,C,Ma,W
Melanerpes candidus (Otto, 1796)	White Woodpecker			An
Veniliornis passerinus (Linnaeus, 1766)	Little Woodpecker	34	R,S,V	An,C,St,W
Piculus chrysochloros (Vieillot, 1818)	Golden-green Woodpecker			Pa,St
Colaptes melanochloros (Gmelin, 1788)	Green-barred Woodpecker			St,W
Celeus lugubris (Malherbe, 1851)	Pale-crested Woodpecker			An,Pa,S
Celeus flavescens (Gmelin, 1788)	Blond-crested Woodpecker			St
Celeus obrieni Short, 1973	Kaempfer's Woodpecker			St
Dryocopus lineatus (Linnaeus, 1766)	Lineated Woodpecker	4	S,V	An,C,Fr,Ma,St,W
Campephilus melanoleucos (Gmelin, 1788)	Crimson-crested Woodpecker			St
PASSERIFORMES				
THAMNOPHILIDAE (15)				
Myrmorchilus strigilatus (Wied, 1831)	Stripe-backed Antbird			Pa
Myrmotherula hauxwelli (Sclater, 1857)	Plain-throated Antwren			S
Formicivora grisea (Boddaert, 1783)	White-fringed Antwren			Fr,S,St
Formicivora melanogaster Pelzeln, 1868	Black-bellied Antwren			Pa
Formicivora rufa (Wied, 1831)	Rusty-backed Antwren			An,Ma
Dysithamnus mentalis (Temminck, 1823)	Plain Antvireo			Pi,S
Herpsilochmus sellowi Whitney & Pacheco, 2000	Caatinga Antwren			St
Herpsilochmus atricapillus Pelzeln, 1868	Black-capped Antwren	56	R,S,V	C,Pa,St
*Herpsilochmus longirostris** Pelzeln, 1868	Large-billed Antwren			A
Thamnophilus doliatus (Linnaeus, 1764)	Barred Antshrike			An,Pi

Taxa	English name	Abundance	Evidence	Authors
Thamnophilus capistratus Lesson, 1840	Caatinga Antshrike			St
Thamnophilus pelzelni Hellmayr, 1924	Planalto Slaty-Antshrike	68	R,S,V	An,C,Fr,Ma,Pi,S,St,W
Thamnophilus caerulescens Vieillot, 1816	Variable Antshrike			A,An,,Pa,W
Taraba major (Vieillot, 1816)	Great Antshrike			A,An,,Pi,S,St
Pyriglena leuconota (Spix, 1824)	White-backed Fire-eye			Pa
CONOPOPHAGIDAE (1)				
Conopophaga lineata	Rufous Gnateater			An,W
DENDROCOLAPTIDAE (9)				
Sittasomus griseicapillus (Vieillot, 1818)	Olivaceous Woodcreeper			Fr,Pa,Pi,S
Xiphorhynchus guttatus (Lichtenstein, 1820)	Buff-throated Woodcreeper			St
Campylorhamphus trochilirostris (Lichtenstein, 1820)	Red-billed Scythebill			St
Dendroplex picus (Gmelin, 1788)	Straight-billed Woodcreeper			S,St
Lepidocolaptes angustirostris (Vieillot, 1818)	Narrow-billed Woodcreeper			Pa,Pi,S,St
Dendrocolaptes picumnus Lichtenstein, 1820	Black-banded Woodcreeper			Pa
Dendrocolaptes platyrostris Spix, 1825	Planalto Woodcreeper			Pi
Xiphocolaptes falcirostris (Spix, 1824)	Moustached Woodcreeper			St
Xiphocolaptes major (Vieillot, 1818)	Great Rufous Woodcreeper			Pa
FURNARIIDAE (7)				
Xenops rutilans[INCERTAE SEDIS] Temminck, 1821	Streaked Xenops			Pa,S,St,W
Automolus leucophthalmus[¶] (Wied, 1821)	White-eyed Foliage-gleaner	17	R,S,V	An,C,Pi,W
Synallaxis ruficapilla[¶] Vieillot, 1819	Rufous-capped Spinetail			W
Synallaxis frontalis Pelzeln, 1859	Sooty-fronted Spinetail			A,An,Pa,St,W
Synallaxis gujanensis (Gmelin, 1789)	Plain-crowned Spinetail			S
Synallaxis scutata Sclater, 1859	Ochre-cheeked Spinetail			Fr,Pa,Pi,St
Cranioleuca vulpina (Pelzeln, 1856)	Rusty-backed Spinetail			S
PIPRIDAE (6)				
Neopelma pallescens[VU] (Lafresnaye, 1853)	Pale-bellied Tyrant-Manakin	3	R,S,V	C,Fr
Pipra fasciicauda Hellmayr, 1906	Band-tailed Manakin			Pi
Pipra rubrocapilla Temminck, 1821	Red-headed Manakin			Fr
Xenopipo atronitens Cabanis, 1847	Black Manakin			Fr
Chiroxiphia caudata (Shaw & Nodder, 1793)	Blue Manakin			W
*Antilophia galeata** (Lichtenstein, 1823)	Helmeted Manakin	86	R,S,V	A,An,C,Me,S,W
TITYRIDAE (6)				
Terenotriccus erythrurus (Cabanis, 1847)	Ruddy-tailed Flycatcher			Fr
Tityra cayana (Linnaeus, 1766)	Black-tailed Tityra			St
Tityra semifasciata (Spix, 1825)	Masked Tityra			Fr
Pachyramphus polychopterus (Vieillot, 1818)	White-winged Becard			St
Pachyramphus validus (Lichtenstein, 1823)	Crested Becard			MM
Xenopsaris albinucha (Burmeister, 1869)	White-naped Xenopsaris			St
INCERTEA SEDIS (1)				
Platyrinchus mystaceus Vieillot, 1818	White-throated Spadebill	9	R,S,V	An,C,Pi
RYNCHOCYCLIDAE (11)				
Mionectes oleagineus (Lichtenstein, 1823)	Ochre-bellied Flycatcher			S
Leptopogon amaurocephalus Tschudi, 1846	Sepia-capped Flycatcher			An,Pi,St
Corythopis delalandi (Lesson, 1830)	Southern Antpipit			Pi
Phylloscartes eximius (Temminck, 1822)	Southern Bristle-Tyrant			A
Phylloscartes ventralis (Temminck, 1824)	Mottle-cheeked Tyrannulet			A
Tolmomyias sulphurescens (Spix, 1825)	Yellow-olive Flycatcher			Ma,Pa,W
Tolmomyias flaviventris (Wied, 1831)	Yellow-breasted Flycatcher			Fr,St
Todirostrum cinereum (Linnaeus, 1766)	Common Tody-Flycatcher			S,St
Hemitriccus striaticollis (Lafresnaye, 1853)	Stripe-necked Tody-Tyrant			St
Hemitriccus nidipendulus (Wied, 1831)	Hangnest Tody-Tyrant			A
Hemitriccus margaritaceiventer (d'Orbigny & Lafresnaye, 1837)	Pearly-vented Tody-tyrant	8	R,S,V	A,An,C,Pa,Pi,S,St,W

Taxa	English name	Abundance	Evidence	Authors
TYRANNIDAE (34)				
Camptostoma obsoletum (Temminck, 1824)	Southern Beardless-Tyrannulet			An,Ma,Pi,S
Elaenia flavogaster (Thunberg, 1822)	Yellow-bellied Elaenia			A,MM,O,S
Elaenia cristata Pelzeln, 1868	Plain-crested Elaenia			Fr
Elaenia chiriquensis Lawrence, 1865	Lesser Elaenia			Fr,O
Elaenia obscura (d'Orbigny & Lafresnaye, 1837)	Highland Elaenia			A,An,W
Myiopagis viridicata (Vieillot, 1817)	Greenish Elaenia	4	V	C,St
Capsiempis flaveola (Lichtenstein, 1823)	Yellow Tyrannulet			An
Phaeomyias murina (Spix, 1825)	Mouse-colored Tyrannulet	24	R,S,V	An,C,S,W
Phyllomyias fasciatus (Thunberg, 1822)	Planalto Tyrannulet			A
Serpophaga subcristata (Vieillot, 1817)	White-crested Tyrannulet			Pa
Serpophaga munda Berlepsch, 1893	White-bellied Tyrannulet			Pa
Legatus leucophaius (Vieillot, 1818)	Piratic Flycatcher			S
Myiarchus swainsoni Cabanis & Heine, 1859	Swainson's Flycatcher	2	S,V	An,C
Myiarchus ferox (Gmelin, 1789)	Short-crested Flycatcher			Ma,S,St,W
Myiarchus tyrannulus (Statius Muller, 1776)	Brown-crested Flycatcher			An,Pa,Pi,St,W
Sirystes sibilator (Vieillot, 1818)	Sirystes			Fr
Casiornis rufus (Vieillot, 1816)	Rufous Casiornis	3	S,V	A,An,C,Pa,Pi
Casiornis fuscus Sclater & Salvin, 1873	Ash-throated Casiornis			St
Pitangus sulphuratus (Linnaeus, 1766)	Great Kiskadee	77	R,S,V	C,Fr,MM,S,St,W
Myiodynastes maculatus (Statius Muller, 1776)	Streaked Flycatcher	75	R,SV	An,C,Fr,Ma,MM,Pi,S,St
Megarynchus pitangua (Linnaeus, 1766)	Boat-billed Flycatcher			Fr,Ma,S,St
Myiozetetes cayanensis (Linnaeus, 1766)	Rusty-margined Flycatcher			St
Myiozetetes similis (Spix, 1825)	Social Flycatcher	43	S,V	C,St,W
Tyrannus melancholicus Vieillot, 1819	Tropical Kingbird			An,Fr,Ma,MM
Tyrannus savana Vieillot, 1808	Fork-tailed Flycatcher			Fr
Griseotyrannus aurantioatrocristatus (d'Orbigny & Lafresnaye, 1837)	Crowned Slaty Flycatcher			St
Empidonomus varius (Vieillot, 1818)	Variegated Flycatcher			An,Fr,St
Colonia colonus (Vieillot, 1818)	Long-tailed Tyrant	37	S,V	C
Myiophobus fasciatus (Statius Muller, 1776)	Bran-colored Flycatcher			S
Sublegatus modestus (Wied, 1831)	Southern Scrub-Flycatcher			St
Cnemotriccus fuscatus (Wied, 1831)	Fuscous Flycatcher	26	R,S,V	An,C,Fr,Pa,Pi,W
Lathrotriccus euleri (Cabanis, 1868)	Euler's Flycatcher	12	R,S,V	An,C,W
Contopus cinereus (Spix, 1825)	Tropical Peewee			W
Knipolegus striaticeps (d'Orbigny & Lafresnaye, 1837)	Cinereous Tyrant			Pa
VIREONIDAE (5)				
Cyclarhis gujanensis (Gmelin, 1789)	Rufous-browed Peppershrike			A,An,Pa,Pi,S,St,W
Vireo olivaceus (Linnaeus, 1766)	Red-eyed Vireo	116	S,V	An,C,Ma,Pi,S,St,W
Hylophilus poicilotis¶ Temminck, 1822	Rufous-crowned Greenlet	17	R,S,V	C
Hylophilus amaurocephalus (Nordmann, 1835)	Gray-eyed Greenlet			W
Hylophilus pectoralis Sclater, 1866	Ashy-headed Greenlet			St
CORVIDAE (3)				
*Cyanocorax cristatellus** (Temminck, 1823)	Curl-crested Jay			St,W
Cyanocorax chrysops (Vieillot, 1818)	Plush-crested Jay	40	R,S,V	A,An,C,Fr,Ma,Pa,Pi
Cyanocorax cyanopogon (Wied, 1821)	White-naped Jay			St
POLIOPTILIDAE (2)				
Polioptila plumbea (Gmelin, 1788)	Tropical Gnatcatcher			St
Polioptila dumicola (Vieillot, 1817)	Masked Gnatcatcher			Pa,S
TURDIDAE (7)				
Catharus fuscescens (Stephens, 1817)	Veery			W
Turdus flavipes Vieillot, 1818	Yellow-legged Thrush			W
Turdus rufiventris Vieillot, 1818	Rufous-bellied Thrush	2	S	C,Ma,MM,S,St
Turdus leucomelas Vieillot, 1818	Pale-breasted Thrush	245	R,S,V	A,An,C,Ma,MM, Me,O,Pi,S,St,W

Taxa	English name	Abundance	Evidence	Authors
Turdus amaurochalinus Cabanis, 1850	Creamy-bellied Thrush	44	R,S,V	A,An,C,Fr,MM, Me,Pa,Pi,S,W
Turdus subalaris (Seebohm, 1887)	Eastern Slaty-Thrush	12	V	An,C
Turdus albicollis Vieillot, 1818	White-necked Thrush			A,W
COEREBIDAE (1)				
Coereba flaveola (Linnaeus, 1758)	Bananaquit			Fr,Ma,St,W
THRAUPIDAE (26)				
Saltator coerulescens Vieillot, 1817	Grayish Saltator			St
Saltator similis d'Orbigny & Lafresnaye, 1837	Green-winged Saltator			An,C,Pi,W
Compsothraupis loricata (Lichtenstein, 1819)	Scarlet-throated Tanager			K
Nemosia pileata (Boddaert, 1783)	Hooded Tanager	5	S,V	C,MM,O,St
Thlypopsis sordida (d'Orbigny & Lafresnaye, 1837)	Orange-headed Tanager			St
Tachyphonus rufus (Boddaert, 1783)	White-lined Tanager			Fr,Pa,Pi,S,St
Tachyphonus coronatus (Vieillot, 1822)	Ruby-crowned Tanager			W
Ramphocelus carbo (Pallas, 1764)	Silver-beaked Tanager			St,W
Lanio pileatus (Wied, 1821)	Pileated Finch			St
Lanio cucullatus (Statius Muller, 1776)	Red-crested Finch			A,Pa
Lanio penicillatus (Spix, 1825)	Gray-headed Tanager			Me,Pi
Lanio melanops (Vieillot, 1818)	Black-goggled Tanager			A
Tangara sayaca (Linnaeus, 1766)	Sayaca Tanager			A,An,Ma,MM,O,St
Tangara palmarum (Wied, 1823)	Palm Tanager			O,St
Tangara cyanicollis (d'Orbigny & Lafresnaye, 1837)	Blue-necked Tanager			Fr
Tangara peruviana (Desmarest, 1806)	Black-backed Tanager			A
Tangara cayana (Linnaeus, 1766)	Burnished-buff Tanager			A,An,Fr,Ma,MM,O,St
Schistochlamys ruficapillus (Vieillot, 1817)	Cinnamon Tanager			A,Ma
Paroaria dominicana (Linnaeus, 1758)	Red-cowled Cardinal			St
Tersina viridis (Illiger, 1811)	Swallow Tanager			An,W
Dacnis cayana (Linnaeus, 1766)	Blue Dacnis			Fr,Ma,O,St,W
Cyanerpes cyaneus (Linnaeus, 1766)	Red-legged Honeycreeper			Fr,O
Chlorophanes spiza (Linnaeus, 1758)	Green Honeycreeper			S
Hemithraupis guira (Linnaeus, 1766)	Guira Tanager			An,Fr,St
Hemithraupis flavicollis (Vieillot, 1818)	Yellow-backed Tanager			Fr
Conirostrum speciosum (Temminck, 1824)	Chestnut-vented Conebill			An,Ma,St
EMBERIZIDAE (3)				
Zonotrichia capensis (Statius Muller, 1776)	Rufous-collared Sparrow			A,Fr
Haplospiza unicolor Cabanis, 1851	Uniform Finch			A
Arremon flavirostris Swainson, 1838	Saffron-billed Sparrow	35	R,S,V	A,An,C,Pa,Pi,W
CARDINALIDAE (1)				
Cyanoloxia brissonii (Lichtenstein, 1823)	Ultramarine Grosbeak			Pa
PARULIDAE (4)				
Parula pitiayumi (Vieillot, 1817)	Tropical Parula			An,Pa,S,W
Basileuterus culicivorus (Deppe, 1830)	Golden-crowned Warbler			A,An
Basileuterus hypoleucus Bonaparte, 1830	White-bellied Warbler			Ma,Pa,Pi,W
Basileuterus flaveolus (Baird, 1865)	Flavescent Warbler	171	R,S,V	An,C,Fr,Ma,Pa,Pi,W
ICTERIDAE (4)				
Psarocolius decumanus (Pallas, 1769)	Crested Oropendola			Pa
Cacicus chrysopterus (Vigors, 1825)	Golden-winged Cacique			Pa
Icterus pyrrhopterus (Vieillot, 1819)	Epaulet Oriole			Pa,St
Icterus jamacaii (Gmelin, 1788)	Campo Troupial			St
FRINGILIIDAE (1)				
Euphonia chlorotica (Linnaeus, 1766)	Purple-throated Euphonia			An,Ma,St,W

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