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ARTICLE

Avifauna of the region of the Volta Grande Hydroelectric Power Plant in Southeast Brazil

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Abstract. The Volta Grande region in the Brazilian state of Minas Gerais is classified as of "High Biological Importance" for the conservation of birds in the state. Despite this, the avifauna of the region has yet to be adequately sampled, as evidenced by the few papers on the region in ornithological literature. The results of an avifaunal inventory conducted between March 2013 and January 2014 in five sites located throughout the region of the Volta Grande Hydroelectric Power Plant in Southeast Brazil are presented. Point-counts, *ad libitum* observations and mist-nets recorded 224 species for the region, with insectivorous and omnivorous being the predominant feeding habits. Species that are "independent" of forest habitats comprised 52% of the recorded species. Three species are endemics of the Cerrado, 85 are migratory and 33 are under some degree of threat of extinction. These findings demonstrate that the region of the Volta Grande Hydroelectric Power Plant is important for bird conservation. Additional inventories, adequate management plans and public policies aimed the preserving species are needed for more effective conservation of the biodiversity of the studied region.

Key-Words. Birds; *Cerrado;* Grande River Basin; Inventory; Threatened Species; Trophic Guilds.

INTRODUCTION

The states of Minas Gerais and São Paulo in the Southeast Region of Brazil have 785 (Drummond *et al.*, 2005) and 789 (Silveira *et al.*, 2009) recorded bird species, respectively. The greatest threat to these species in both states is the degradation of natural environments and the consequent fragmentation and loss of habitats (Drummond *et al.*, 2005; Bressan *et al.*, 2009).

The *Cerrado* is the second largest biome of Brazil, encompassing approximately 200 million ha located mainly in the center of the country but with small areas in northeastern Paraguay and eastern Bolivia (Silva, 1995a; Ratter *et al.*, 1997; Pinheiro & Monteiro, 2010). It is characterized by a mosaic of phytophysiognomies ranging from grasslands to forest formations (Silva, 1995a; MMA, 2007).

The diversity of the vegetation mosaic of the *Cerrado* is further enhanced by the influence of adjacent biomes, such as the Atlantic Forest, Amazon rainforest, *Caatinga* and *Chaco* (Ratter *et al.*, 1997; Myers *et al.*, 2000; Silva & Bates, 2002). This great species diversity accompanied by drastic loss of original vegetation over a relatively short period of time due to anthropic actions has led to the *Cerrado* being classified as one of 34 global terrestrial hotspots (Ratter *et al.*, 1997; Myers *et al.*, 2000; Myers, 2003). The *Cerrado* is also considered the largest, richest and probably most endangered tropical savanna in the world (Silva & Bates, 2002). The avifauna of the *Cerrado* comprises 837 species (Silva, 1995b; Stotz *et al.*, 1996), of which 30 are endemic and 34 endangered according to the Brazilian red list (Silva, 1995b; Zimmer *et al.*, 2001; ICMBio, 2018).

The Volta Grande Hydroelectric Power Plant (hereafter Volta Grande HPP) is located in the region of the lower Grande River at the boundary between the states of Minas Gerais and São Paulo in Southeast Brazil. This region is classified as of "High Biological Importance" for the conservation of birds in Minas Gerais (Drummond *et al.*, 2005). Despite its importance, the avifauna of the region has yet to be adequately sampled (Silva, 1995b), as evidenced by the low number of papers currently available in the ornithological literature (Silveira, 1998; Andrade & Marini, 2002; MMA, 2005; Marçal-Júnior *et al.*, 2009; Bessa *et al.*, 2011; IEF, 2011; Malacco *et al.*, 2013).

The objective of this study was to inventory the avifauna of the region of Volta Grande HPP, with the aim of increasing knowledge of its bird community. Specifically, the bird species of the community were characterized with regard to: (i) frequency of occurrence, (ii) trophic guild, (iii) dependence on forest habitat, (iv) endemism, (v) migratory condition and (vi) conservation status.

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Table 1. Characteristics, coordinates and municipality of the five study sites.

Site	Characteristics	Coordinates	Municipality
1	Native; 70 ha of riparian forest; 190 ha of shrub savannah; 16 ha of forested savannah; 85 ha of semideciduous seasonal forest and 30 ha of marsh vegetation	20°01′27″S, 48°12′45″W	Conceição das Alagoas, MG
2	Reforestation; 2.7 ha of riparian forest; *Tabebuia roseo alba* and *Syzygium jambolanum* are the most abundant trees; pastures, *veredas* and sugarcane and rubber tree monocultures also present	20°05′55″S, 48°09′00″W	Água Comprida, MG
3	Reforestation; 3.3 ha of riparian forest; *Clitoria fairchildiana* and *Schinus terebinthifolius* are the most abundant trees; pastures and sugarcane monocultures also present	20°09′30″S, 48°07′39″W	Miguelópolis, SP
4	Reforestation; 18 ha of riparian forest; *Anadenanthera peregrina* and *Leucaena* sp. are the most abundant trees; sugarcane monocultures and swamps also present	19°59′32″S, 47°48′53″W	Igarapava, SP
5	Reforestation; 8.8 ha of riparian forest; sugarcane monocultures and swamps also present	19°59′25″S, 47°46′53″W	Igarapava, SP

MG = state of Minas Gerais; SP = state of São Paulo; y = years; m = meters.

MATERIAL AND METHODS

Study area

Fieldwork was conducted in five sites distributed among four municipalities around the Volta Grande HPP reservoir (20°01′27″S, 48°12′45″W) (Table 1). The reservoir is located on the Grande River at the boundary between the states of Minas Gerais and São Paulo in Southeast Brazil. The reservoir is 46 years old, has an average elevation of 524 m and encompasses 19,800 ha (Fig. 1). The predominant morphoclimatic domain of the study region is *Cerrado* (Neotropical savanna). The region has a tropical climate with a dry winter (April to September) and a rainy summer (October to March) (Moreira *et al.*, 2008). Mean annual rainfall ranges 1400-1600 mm, with the rainiest months being December and January, and the driest months June and July (Fujaco & Leite, 2016). The mean annual temperature ranges from 22°C to 24°C (Filardi *et al.*, 2007).

The original vegetation of the region was mostly deforested or flooded during the construction of the Volta Grande HPP reservoir (from 1970 to 1974) (Pires *et al.*, 2016). Four out of the five study sites contain revegetated riparian forest patches that were the result of a reforestation program undertaken by the Minas Gerais state

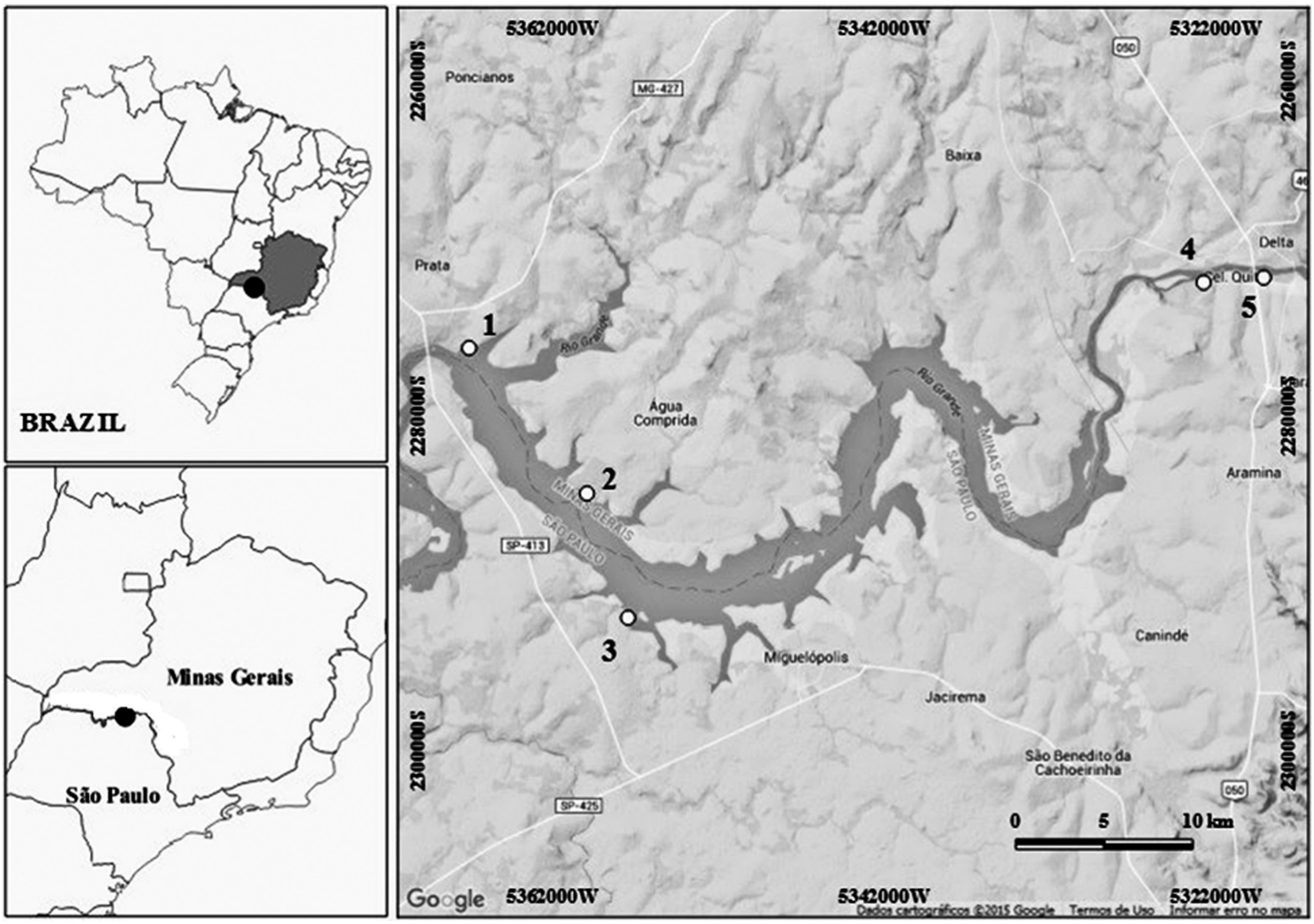

Figure 1. Grande River Basin located at the border between the states of Minas Gerais and São Paulo in Southeast Brazil. The five study sites are shown as: 1 and 2 located in Minas Gerais, and 3, 4 and 5 located in São Paulo.

energy company (CEMIG). One of the sites has fragments of native vegetation. Together the five sites encompass a total of 423.8 ha.

Sampling

Field surveys were conducted during four months of each climatic season: April, May, June and July 2013 (dry season), and October, November, December 2013 and January 2014 (rainy season). The five study sites were sampled over the course of five consecutive days each month such that each site was sampled once per month. Quantitative data were collected using the point-count method (Vielliard *et al.,* 2010), with six points in each site (three within riparian forest and three in surrounding areas) being sampled per campaign. Points were separated by 350 m to avoid overlapping of territory of some species (Ralph *et al.,* 1995; Vielliard *et al.,* 2010). Due to this distance it wasn't necessary to establish a limiting radius for the detection of bird individuals. Point-counts of a given site were performed in the mornings (between 06:00 and 09:00 h), with points being sampled in a randomly determined order. The number of individuals of all bird species seen and/or heard during 20 min at each point was recorded (six points × 20 min × eight monthly visits = 960 min for each site).

Qualitative bird surveys were conducted through *ad libitum* observations during and after quantitative sampling between 06:00 to 11:00 and 13:00 to 18:00 h, for a sampling effort of 10 h of sampling/day (10 h sampling × eight monthly visits = 80 h sampling per site; 400 h total for all five sites).

Ten mist-nets (12 m × 2.5 m, 20 mm mesh) (License ICMBio № 36758-2) were opened within riparian forests from 06:00 to 17:00 h and checked every 30 min, for a total effort of 132,000 $h.m^2$ (computed according to Straube & Bianconi, 2003). Captured birds were marked with standard CEMAVE/ICMBio metallic bands (License № 367581), photographed, measured and released at the point of capture.

Adequacy of sampling effort was evaluated by constructing a species accumulation curve (Santos, 2003). Bird richness was estimated by the Chao 1 index using EstimateS 9.1 software (Colwell, 2009), which is based on the number of singletons and doubletons in each point count (Hortal *et al.,* 2006).

Birds were identified visually with binoculars, by photography (Canon PowerShot SX50 HS) or audibly. A Sony ICD-PX312 recorder was used to document vocalizations. Photographs and recordings that were archived on WikiAves (2019) are identified in Table 2.

Data analysis

Frequency of Occurrence (FO) was determined for each bird species based on the proportion of effort units (days) during which a given species was detected (adapted from Costa & Rodrigues (2012)) as: C (common) – species recorded between 75-100% of sampling days; RC (relatively common) – species recorded between 50-74% of sampling days; UC (uncommon) – species recorded between 25-49% of sampling days; R (rare) – species recorded between 6-24% of sampling days and O (occasional) – species recorded in less than 5% of the sampling days (effort was one day per sampling site and the presence of each species was only recorded once per sampling day).

Bird species were grouped into 25 trophic guilds considering not only food items, but also the environment and vertical strata most utilized during foraging (adapted from Willis (1979) and Antunes (2005)): canopy frugivores (FRU-C), ground frugivores (FRU-G), canopy omnivores (OMNI-C), understory omnivores (OMNI-US), edge omnivores (OMNI-E), ground omnivores (OMNI-G), aquatic omnivores (OMNI-AQ), marsh omnivores (OMNI-M), nocturnal carnivores (CAR-N), diurnal carnivores (CAR-D), carrion eaters (CE), trunk and twig insectivores (INS-TT), predators of large ground arthropods (INS-LG), predators of small ground arthropods (INS-SG), predators of foliage arthropods (INS-F), bamboo or tangle insectivores (INS-BT), midlevel insectivores (INS-ML), canopy insectivores (INS-C), edge insectivores (INS-E), marsh insectivores (INS-M), aerial insectivores (INS-A), nocturnal insectivores (INS-N), nectarivores (NEC), granivores (GRA) and piscivores (PIS).

Bird species were classified into three categories of forest habitat dependence following Silva (1995a): (1) independent – species that forage and breed mainly in open vegetation; (2) semi-dependent – species that forage and breed in both forest habitats and open areas; and (3) dependent – species that forage and breed mainly in forest habitats. Endemism for the *Cerrado* was based on Silva (1995a) while endemism for riparian forest habitats followed Silva & Vielliard (2000).

The species were also classified according to their migratory condition according Chesser (1994), Sick (1997) and Somenzari *et al.* (2018) as: septentrional migrants (SM) – species from the northern hemisphere; and austral migrants (AM) – species that breed in temperate continental South America and migrate north, towards Amazonia, during the austral winter. Also included in this category are those resident species whose southernmost populations perform small-scale seasonal migrations.

We highlighted those species considered threatened in the state of Minas Gerais (COPAM, 2010; Drummond *et al.,* 2008 for near threatened and data-deficient species), the state of São Paulo (Bressan *et al.,* 2009), nationally (ICMBio, 2018) and globally (IUCN, 2020). Scientific names followed Piacentini *et al.* (2015).

RESULTS

A total of 224 bird species distributed among 24 orders and 58 families was recorded (Table 2). Passeriformes was the most representative order with 113 species, corresponding to 50% of the total recorded. The most representative family was Tyrannidae, with 35

Table 2. Bird species recorded in the five study sites located in the region of the reservoir of the Volta Grande Hydroelectric Power Plant in Southeast Brazil, and their frequency of occurrence (FO), trophic guild (TG), forest habitat dependence (FHD), threat status, and migratory condition. Reference numbers for the online database www.wikiaves.com.br (WA) are also provided. Taxonomy and nomenclature follow Piacentini *et al.* (2015).

Taxon	FO (%)	TG	FHD	Threat Status	Migratory condition	Ref. WA
Rheiformes						
Rheidae						
Rhea americana (Linnaeus, 1758)	8	OMNI-G	1	**NT[1], CR[4]**		1227000
Tinamiformes						
Tinamidae						
Crypturellus undulatus (Temminck, 1815)	19	FRU-G	3	**EN[4]**		980891
Crypturellus parvirostris (Wagler, 1827)	65	FRU-G	1			1209843
Rhynchotus rufescens (Temminck, 1815)	5	OMNI-G	1	**VU[4]**		1207778
Nothura maculosa (Temminck, 1815)	5	OMNI-G	1			1226986
Anseriformes						
Anatidae						
Dendrocygna viduata (Linnaeus, 1766)	19	OMNI-Aq	1		AM	1204116
Dendrocygna autumnalis (Linnaeus, 1758)	16	OMNI-Aq	1		AM	1146862
Cairina moschata (Linnaeus, 1758)	30	OMNI-Aq	1			1209989
Amazonetta brasiliensis (Gmelin, 1789)	19	OMNI-Aq	1			1204120
Galliformes						
Cracidae						
Crax fasciolata Spix, 1825	19	FRU-G	3	**VU[1], EN[3], CR[4]**		1196990
Ciconiiformes						
Ciconiidae						
Mycteria americana Linnaeus, 1758	3	OMNI-G	1	**VU[3], NT[4]**	AM	1141345
Suliformes						
Phalacrocoracidae						
Nannopterum brasilianus (Gmelin, 1789)	76	PIS	1			1208099
Anhingidae						
Anhinga anhinga (Linnaeus, 1766)	27	PIS	1			1214157
Pelecaniformes						
Ardeidae						
Tigrisoma lineatum (Boddaert, 1783)	19	PIS	1			1194724
Nycticorax nycticorax (Linnaeus, 1758)	11	PIS	1		AM	
Butorides striata (Linnaeus, 1758)	68	PIS	1		AM	1135510
Bubulcus ibis (Linnaeus, 1758)	5	INS-LG	1			
Ardea cocoi Linnaeus, 1766	27	PIS	1			1141336
Ardea alba Linnaeus, 1758	35	PIS	1			1209321
Syrigma sibilatrix (Temminck, 1824)	24	INS-LG	1			1141321
Pilherodius pileatus (Boddaert, 1783)	3	PIS	1	**VU[4]**		
Egretta thula (Molina, 1782)	46	PIS	1		AM	934452
Threskiornithidae						
Mesembrinibis cayennensis (Gmelin, 1789)	49	INS-LG	2			1145820
Phimosus infuscatus (Lichtenstein, 1823)	3	INS-M	1		AM	
Theristicus caudatus (Boddaert, 1783)	84	OMNI-G	1			1225275
Platalea ajaja Linnaeus, 1758	3	OMNI-Aq	1	**VU[3]**	AM	1170340
Cathartiformes						
Cathartidae						
Cathartes aura (Linnaeus, 1758)	16	CE	1		AM	1145795
Coragyps atratus (Bechstein, 1793)	89	CE	1			1202881
Accipitriformes						
Pandionidae						
Pandion haliaetus (Linnaeus, 1758)	16	PIS	1		SM	1204128
Accipitridae						
Elanus leucurus (Vieillot, 1818)	5	CAR-D	1		AM	
Ictinia plumbea (Gmelin, 1788)	27	INS-A	2		AM	1196980
Busarellus nigricollis (Latham, 1790)	3	CAR-D	1	**CR[4]**		
Rostrhamus sociabilis (Vieillot, 1817)	38	CAR-D	1		AM	1194735
Heterospizias meridionalis (Latham, 1790)	5	CAR-D	1		AM	
Rupornis magnirostris (Gmelin, 1788)	76	CAR-D	1			1223450
Geranoaetus albicaudatus (Vieillot, 1816)	8	CAR-D	1		AM	1212235
Gruiformes						
Aramidae						
Aramus guarauna (Linnaeus, 1766)	38	CAR-D	1			1223460

Taxon	FO (%)	TG	FHD	Threat Status	Migratory condition	Ref. WA
Rallidae						
Aramides cajaneus (Statius Muller, 1776)	46	OMNI-G	2			
Laterallus viridis (Statius Muller, 1776)	65	INS-LG	2			945111
Laterallus melanophaius (Vieillot, 1819)	41	INS-M	2			1208054
Mustelirallus albicollis (Vieillot, 1819)	11	OMNI-G	1			1133544
Porphyrio martinicus (Linnaeus, 1766)	3	OMNI-M	1		AM	
Heliornithidae						
Heliornis fulica (Boddaert, 1783)	3	INS-M	1	**DD[3], CR[4]**		
Charadriiformes						
Charadriidae						
Vanellus chilensis (Molina, 1782)	100	INS-LG	1		AM	1114919
Recurvirostridae						
Himantopus melanurus Vieillot, 1817	3	INS-M	1			
Scolopacidae						
Tringa solitaria Wilson, 1813	3	INS-M	1		SM	
Jacanidae						
Jacana jacana (Linnaeus, 1766)	70	OMNI-Aq	1		AM	1206203
Columbiformes						
Columbidae						
Columbina talpacoti (Temminck, 1811)	95	GRA	1			984479
Columbina squammata (Lesson, 1831)	81	GRA	1			876838
Patagioenas picazuro (Temminck, 1813)	100	FRU-C	2		AM	1115652
Patagioenas cayennensis (Bonnaterre, 1792)	59	FRU-C	3		AM	1139446
Zenaida auriculata (Des Murs, 1847)	59	GRA	1		AM	984482
Leptotila verreauxi Bonaparte, 1855	95	FRU-G	2			1206204
Cuculiformes						
Cuculidae						
Piaya cayana (Linnaeus, 1766)	70	INS-ML	2			
Coccyzus melacoryphus Vieillot, 1817	3	INS-E	2		AM	1208057
Crotophaga major Gmelin, 1788	8	INS-E	2	**VU[4]**	AM	1209796
Crotophaga ani Linnaeus, 1758	73	INS-E	1			1140345
Guira guira (Gmelin, 1788)	57	INS-E	1			1133492
Tapera naevia (Linnaeus, 1766)	14	INS-E	1		AM	1208045
Strigiformes						
Tytonidae						
Tyto furcata (Temminck, 1827)	11	CAR-N	1			1222427
Strigidae						
Megascops choliba (Vieillot, 1817)	5	INS-N	2			
Glaucidium brasilianum (Gmelin, 1788)	5	INS-N	2		AM	1002905
Athene cunicularia (Molina, 1782)	35	INS-LG	1			1214144
Nyctibiiformes						
Nyctibiidae						
Nyctibius griseus (Gmelin, 1789)	3	INS-N	2			2059920
Caprimulgiformes						
Caprimulgidae						
Nyctiphrynus ocellatus (Tschudi, 1844)	3	INS-N	3			
Nyctidromus albicollis (Gmelin, 1789)	3	INS-N	2			1207588
Hydropsalis parvula (Gould, 1837)	3	INS-N	1		AM	
Apodiformes						
Apodidae						
Streptoprocne zonaris (Shaw, 1796)	8	INS-A	1			
Chaetura meridionalis Hellmayr, 1907	22	INS-A	2		AM	
Tachornis squamata (Cassin, 1853)	24	INS-A	1	**VU[4]**	AM	1224701
Trochilidae						
Phaethornis pretrei (Lesson & Delattre, 1839)	51	NEC	2			1137785
Eupetomena macroura (Gmelin, 1788)	35	NEC	1			876835
Anthracothorax nigricollis (Vieillot, 1817)	3	NEC	2		AM	1193196
Chlorostilbon lucidus (Shaw, 1812)	43	NEC	2		AM	1137797
Polytmus guainumbi (Pallas, 1764)	3	NEC	1	**VU[4]**		1046889
Amazilia fimbriata (Gmelin, 1788)	16	NEC	2			1209982
Amazilia lactea (Lesson, 1832)	16	NEC	3			
Heliomaster squamosus (Temminck, 1823)	5	NEC	3			
Heliomaster furcifer (Shaw, 1812)	3	NEC	2		AM	

Taxon	FO (%)	TG	FHD	Threat Status	Migratory condition	Ref. WA
Coraciiformes						
Alcedinidae						
Megaceryle torquata (Linnaeus, 1766)	57	PIS	1		AM	1114876
Chloroceryle amazona (Latham, 1790)	46	PIS	2			1213043
Chloroceryle americana (Gmelin, 1788)	30	PIS	2			1211021
Momotidae						
Momotus momota (Linnaeus, 1766)	19	OMNI-C	3	**VU**[4]		1196992
Galbuliformes						
Galbulidae						
Galbula ruficauda Cuvier, 1816	70	INS-ML	2			1137793
Bucconidae						
Nystalus chacuru (Vieillot, 1816)	11	OMNI-E	1		AM	866772
Nystalus maculatus (Gmelin, 1788)	8	OMNI-E	2	**NT**[4]		1201441
Monasa nigrifrons (Spix, 1824)	3	INS-ML	3	**CR**[4]		1299884
Piciformes						
Ramphastidae						
Ramphastos toco Statius Muller, 1776	70	OMNI-C	2			1223407
Picidae						
Picumnus albosquamatus d'Orbigny, 1840	97	INS-TT	2			1209990
Melanerpes candidus (Otto, 1796)	19	INS-TT	2			1226975
Veniliornis passerinus (Linnaeus, 1766)	76	INS-TT	2			1211006
Colaptes melanochloros (Gmelin, 1788)	68	INS-TT	2			1209291
Colaptes campestris (Vieillot, 1818)	57	INS-LG	1			980907
Dryocopus lineatus (Linnaeus, 1766)	5	INS-TT	2			1140341
Campephilus melanoleucos (Gmelin, 1788)	38	INS-TT	3	**VU**[4]		866791
Cariamiformes						
Cariamidae						
Cariama cristata (Linnaeus, 1766)	35	OMNI-G	1			1205752
Falconiformes						
Falconidae						
Caracara plancus (Miller, 1777)	89	OMNI-G	1			1139449
Milvago chimachima (Vieillot, 1816)	59	OMNI-G	1			1141325
Herpetotheres cachinnans (Linnaeus, 1758)	16	CAR-D	2		AM	
Micrastur semitorquatus (Vieillot, 1817)	5	CAR-D	2			1004589
Falco sparverius Linnaeus, 1758	16	CAR-D	1			1209316
Falco femoralis Temminck, 1822	16	CAR-D	1		AM	1211047
Psittaciformes						
Psittacidae						
Ara ararauna (Linnaeus, 1758)	5	FRU-C	2	**VU**[3], **CR**[4]		
Orthopsittaca manilatus (Boddaert, 1783)	32	FRU-C	2	**CR**[4]		1211043
Psittacara leucophthalmus (Statius Muller, 1776)	41	FRU-C	2			866775
Aratinga auricapillus (Kuhl, 1820)	35	FRU-C	3	**NT**[1]		876840
Eupsittula aurea (Gmelin, 1788)	86	FRU-C	1			1202917
Forpus xanthopterygius (Spix, 1824)	81	FRU-C	1			1213041
Brotogeris chiriri (Vieillot, 1818)	100	FRU-C	2			1194777
Amazona amazonica (Linnaeus, 1766)	24	FRU-C	3	**VU**[4]		1136890
Amazona aestiva (Linnaeus, 1758)	14	FRU-C	3	**NT**[2,4]		1141318
Passeriformes						
Thamnophilidae						
Herpsilochmus longirostris Pelzeln, 1868	95	INS-ML	3	**EN**[4]		1225199
Thamnophilus doliatus (Linnaeus, 1764)	92	INS-E	2			1208093
Thamnophilus pelzelni Hellmayr, 1924	73	INS-F	3			866789
Taraba major (Vieillot, 1816)	51	INS-F	2			1208064
Dendrocolaptidae						
Lepidocolaptes angustirostris (Vieillot, 1818)	73	INS-TT	1			1140359
Dendrocolaptes platyrostris Spix, 1825	3	INS-TT	3			1458556
Furnariidae						
Furnarius rufus (Gmelin, 1788)	73	INS-SG	1			1115665
Clibanornis rectirostris (Wied, 1831)	76	INS-SG	3	**NT**[4]		1115680
Phacellodomus rufifrons (Wied, 1821)	22	INS-E	2			1135540
Phacellodomus ruber (Vieillot, 1817)	43	INS-SG	2			1115682
Certhiaxis cinnamomeus (Gmelin, 1788)	73	INS-M	1			1211013
Synallaxis frontalis Pelzeln, 1859	95	INS-E	3		AM	984880

Taxon	FO (%)	TG	FHD	Threat Status	Migratory condition	Ref. WA
Synallaxis albescens Temminck, 1823	8	INS-E	1	**NT**[4]	AM	1207922
Cranioleuca vulpina (Pelzeln, 1856)	65	INS-ML	1			1010452
Pipridae						
Antilophia galeata (Lichtenstein, 1823)	14	FRU-C	3	**NT**[4]		1214148
Tityridae						
Pachyramphus polychopterus (Vieillot, 1818)	3	OMNI-C	2		AM	
Rhynchocyclidae						
Leptopogon amaurocephalus Tschudi, 1846	22	INS-F	3			1208015
Corythopis delalandi (Lesson, 1830)	3	INS-SG	3			
Tolmomyias sulphurescens (Spix, 1825)	8	INS-ML	3			1193214
Todirostrum cinereum (Linnaeus, 1766)	100	INS-E	2			1208098
Poecilotriccus latirostris (Pelzeln, 1868)	14	INS-BT	3	**NT**[4]		1049833
Tyrannidae						
Camptostoma obsoletum (Temminck, 1824)	62	OMNI-C	1		AM	1207366
Elaenia flavogaster (Thunberg, 1822)	43	OMNI-E	2			1209824
Elaenia spectabilis Pelzeln, 1868	8	OMNI-E	3		AM	1594445/1299859
Elaenia mesoleuca (Deppe, 1830)	3	OMNI-E	3		AM	
Elaenia cristata Pelzeln, 1868	11	OMNI-E	1	**EN**[4]	AM	
Suiriri suiriri (Vieillot, 1818)	27	INS-E	1	**CR**[4]	AM	1004310
Myiopagis caniceps (Swainson, 1835)	30	INS-C	3		AM	1055089
Myiopagis viridicata (Vieillot, 1817)	8	INS-ML	3		AM	1207597
Phaeomyias murina (Spix, 1825)	8	INS-E	1		AM	1213028
Serpophaga subcristata (Vieillot, 1817)	3	INS-E	2		AM	1049913
Myiarchus swainsoni Cabanis & Heine, 1859	19	INS-C	1		AM	1136907/1207382
Myiarchus ferox (Gmelin, 1789)	97	INS-E	2			
Myiarchus tyrannulus (Statius Muller, 1776)	86	INS-E	2		AM	1050020
Pitangus sulphuratus (Linnaeus, 1766)	100	OMNI-E	1		AM	1142632
Philohydor lictor (Lichtenstein, 1823)	3	INS-M	3			1047942
Machetornis rixosa (Vieillot, 1819)	68	INS-SG	1		AM	1002887
Myiodynastes maculatus (Statius Muller, 1776)	43	OMNI-E	3		AM	1141359
Megarynchus pitangua (Linnaeus, 1766)	86	OMNI-E	2		AM	1046979
Myiozetetes cayanensis (Linnaeus, 1766)	51	OMNI-E	3		AM	934446/1208036
Myiozetetes similis (Spix, 1825)	92	OMNI-E	2		AM	1207369
Tyrannus albogularis Burmeister, 1856	11	INS-E	1		AM	1207343
Tyrannus melancholicus Vieillot, 1819	92	INS-E	1		AM	1140354
Tyrannus savana Vieillot, 1808	24	INS-E	1		AM	1208111
Empidonomus varius (Vieillot, 1818)	22	INS-C	2		AM	1114894
Colonia colonus (Vieillot, 1818)	5	INS-C	3		AM	
Myiophobus fasciatus (Statius Muller, 1776)	19	INS-E	1		AM	
Pyrocephalus rubinus (Boddaert, 1783)	3	INS-E	1		AM	
Fluvicola albiventer (Spix, 1825)	5	INS-SG	1		AM	1201390
Fluvicola nengeta (Linnaeus, 1766)	73	INS-SG	1			1226984
Arundinicola leucocephala (Linnaeus, 1764)	30	INS-M	1			1211016
Gubernetes yetapa (Vieillot, 1818)	3	INS-M	1			1135549
Cnemotriccus fuscatus (Wied, 1831)	35	INS-E	3			1209295
Lathrotriccus euleri (Cabanis, 1868)	5	INS-F	3		AM	1299861
Xolmis cinereus (Vieillot, 1816)	11	INS-SG	1		AM	1206219
Xolmis velatus (Lichtenstein, 1823)	35	INS-SG	1		AM	1226998
Vireonidae						
Cyclarhis gujanensis (Gmelin, 1789)	81	INS-C	2			1139443
Vireo chivi (Vieillot, 1817)	5	OMNI-C	3		AM	1209808
Corvidae						
Cyanocorax chrysops (Vieillot, 1818)	22	OMNI-C	2			1214155
Hirundinidae						
Pygochelidon cyanoleuca (Vieillot, 1817)	51	INS-A	1		AM	1207617
Stelgidopteryx ruficollis (Vieillot, 1817)	76	INS-A	1		AM	1141358
Progne tapera (Vieillot, 1817)	65	INS-A	1		AM	1115658
Progne chalybea (Gmelin, 1789)	22	INS-A	1		AM	1207376
Tachycineta albiventer (Boddaert, 1783)	41	INS-A	1		AM	1142638
Tachycineta leucorrhoa (Vieillot, 1817)	16	INS-A	1		AM	1195104
Hirundo rustica Linnaeus, 1758	16	INS-A	1		SM	1213036
Petrochelidon pyrrhonota (Vieillot, 1817)	8	INS-A	1		SM	1195109
Troglodytidae						
Troglodytes musculus Naumann, 1823	65	OMNI-E	1		AM	1208095

Taxon	FO (%)	TG	FHD	Threat Status	Migratory condition	Ref. WA
Cantorchilus leucotis (Lafresnaye, 1845)	97	OMNI-us	3			1228835
Donacobiidae						
Donacobius atricapilla (Linnaeus, 1766)	78	OMNI-M	1			1137808
Polioptilidae						
Polioptila dumicola (Vieillot, 1817)	86	INS-ML	2			1137803
Turdidae						
Turdus leucomelas Vieillot, 1818	97	OMNI-E	2			1137800
Turdus rufiventris Vieillot, 1818	14	OMNI-E	1			1202911
Turdus amaurochalinus Cabanis, 1850	14	OMNI-E	2		AM	1114909
Mimidae						
Mimus saturninus (Lichtenstein, 1823)	43	OMNI-G	1			1209890
Motacillidae						
Anthus lutescens Pucheran, 1855	24	INS-SG	1		AM	1212245/1208063
Passerellidae						
Zonotrichia capensis (Statius Muller, 1776)	22	GRA	1		AM	1211045
Ammodramus humeralis (Bosc, 1792)	46	GRA	1			1208062
Parulidae						
Setophaga pitiayumi (Vieillot, 1817)	3	INS-C	3			1010453
Geothlypis aequinoctialis (Gmelin, 1789)	14	INS-M	1		AM	1139445
Basileuterus culicivorus (Deppe, 1830)	32	INS-F	3			1207674
Myiothlypis flaveola Baird, 1865	38	INS-SG	3			1207594
Icteridae						
Icterus pyrrhopterus (Vieillot, 1819)	78	INS-E	2			1212238
Icterus jamacaii (Gmelin, 1788)	14	INS-E	2			1135530
Gnorimopsar chopi (Vieillot, 1819)	59	OMNI-E	1	**NT**[4]		1206202
Chrysomus ruficapillus (Vieillot, 1819)	11	OMNI-M	1			1201394
Molothrus rufoaxillaris Cassin, 1866	3	OMNI-E	1			1212421
Molothrus bonariensis (Gmelin, 1789)	54	OMNI-E	1			866779
Thraupidae						
Schistochlamys melanopis (Latham, 1790)	3	OMNI-C	1	**EN**[4]		
Tangara sayaca (Linnaeus, 1766)	86	FRU-C	2			
Tangara palmarum (Wied, 1823)	30	FRU-C	2			1202902
Tangara cayana (Linnaeus, 1766)	35	FRU-C	1			1222424
Nemosia pileata (Boddaert, 1783)	65	INS-C	3			1225306
Conirostrum speciosum (Temminck, 1824)	22	INS-C	3			1136882
Sicalis flaveola (Linnaeus, 1766)	68	GRA	1			1142648
Hemithraupis guira (Linnaeus, 1766)	3	OMNI-C	3			1320867
Volatinia jacarina (Linnaeus, 1766)	86	GRA	1		AM	1115679
Eucometis penicillata (Spix, 1825)	46	INS-ML	3	**EN**[4]		1224696
Coryphospingus cucullatus (Statius Muller, 1776)	46	INS-E	2			1114905
Ramphocelus carbo (Pallas, 1764)	16	INS-E	2			1142658
Tersina viridis (Illiger, 1811)	19	OMNI-C	3		AM	1136933
Dacnis cayana (Linnaeus, 1766)	22	OMNI-C	2			1213026
Coereba flaveola (Linnaeus, 1758)	65	NEC	2			1207620
Sporophila lineola (Linnaeus, 1758)	22	GRA	1		AM	1194764
Sporophila collaris (Boddaert, 1783)	11	GRA	1	**VU**[4]		1133609
Sporophila nigricollis (Vieillot, 1823)	27	GRA	1			1208092
Sporophila caerulescens (Vieillot, 1823)	57	GRA	1		AM	1205787
Sporophila leucoptera (Vieillot, 1817)	16	GRA	1			1195064
Sporophila angolensis (Linnaeus, 1766)	8	GRA	1	**CR**[3]**, VU**[4]		1319406
Saltator similis d'Orbigny & Lafresnaye, 1837	8	OMNI-E	2			1209815
Thlypopsis sordida (d'Orbigny & Lafresnaye, 1837)	3	OMNI-E	2			1351534
Fringillidae						
Euphonia chlorotica (Linnaeus, 1766)	95	OMNI-C	2			1223462
Passeridae						
Passer domesticus (Linnaeus, 1758)	41	OMNI-E	1			1194756

Trophic Guild (TG): (FRU-C) canopy frugivores, (FRU-G) ground frugivores, (OMNI-C) canopy omnivores, (OMNI-US) understory omnivores, (OMNI-E) edge omnivores, (OMNI-G) ground omnivores, (OMNI-AQ) aquatic omnivores, (OMNI-M) marsh omnivores, (CAR-N) nocturnal carnivores, (CAR-D) diurnal carnivores, (CE) carrion eaters, (INS-TT) trunks and twigs insectivores, (INS-LG) predators of large ground arthropods, (INS-SG) predators of small ground arthropods, (INS-F) predators of foliage arthropods, (INS-BT) bamboo or tangle insectivores, (INS-ML) midlevel insectivores, (INS-C) canopy insectivores, (INS-E) edge insectivores, (INS-M) marsh insectivores, (INS-A) aerial insectivores, (INS-N) nocturnal insectivores, (NEC) nectarivores, (GRA) granivores and (PIS) piscivores. **Forest Habitat Dependence (FHD):** (1) independent, (2) semi-dependent and (3) dependent. Threat Status – Threatened Species Lists: 1 = Global (IUCN, 2020), 2 = Brazil (ICMBio, 2018), 3 = state of Minas Gerais (Drummond et al., 2008; COPAM, 2010), 4 = state of São Paulo (Bressan et al., 2009). Threat Category: CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened and DD = data deficient. **Migratory Condition:** (AM) austral migrants and (SM) septentrional migrants.

species (16%), followed by Thraupidae (23 species; 10%). Among non-Passeriformes, the most representative families were Ardeidae, Psittacidae and Trochilidae, each one with nine species (4%).

The species richness curve produced by the Chao 1 index estimated (mean ± SD) 232 ± 8.7 species for the study area (Fig. 2). Thus, the observed richness represented 97% of the estimated richness.

According to the FO estimates, only 16% (n = 36) of the recorded species were considered common in the study area (Table 2). Among the common species, only five (2%) had an FO of 100% by being present in all samples (Table 2). The majority of the species (50%, n = 113) were classified as occasional or rare. Thirty-two species (14%) were recorded only once in the study area (single records) (Table 2).

Fifty-two percent of the bird species recorded (n = 117) were forest independent, while 19% (n = 42) were strictly dependent on forest habitats for breeding or foraging. Three recorded species were endemic to the Cerrado: *Herpsilochmus longirostris, Clibanornis rectirostris,* and *Antilophia galeata.* These three species were also considered endemic of the Central Brazil riparian forests (Silva & Vielliard, 2000).

Eighty-five migratory species were recorded, corresponding to 38% of the total sampled. Only four species came from the Northern Hemisphere (Table 2), while the remaining migratory species came from the southernmost regions of South America. Thirty-three of the recorded species appeared in at least one of the lists of endangered, near threatened and data-deficient species considered in this study (Table 2). In study sites located in the state of Minas Gerais three species were considered threatened in the state: *Crax fasciolata, Mycteria americana,* and *Ara ararauna* (COPAM, 2010). *C. fasciolata* also appears on the IUCN red list, in the "vulnerable" category (IUCN, 2020). Two other species present in the Minas Gerais red list were registered only in areas located in the state of São Paulo: *Platalea ajaja* and *Sporophila angolensis.*

According to the red list of threatened species of the state of São Paulo, 24 species recorded in study sites located in this state were under some degree of threat of extinction (Table 2). *Amazona aestiva* was classified as Near Threatened in the Brazilian national list (ICMBio, 2018) (Table 2).

The trophic guilds with the greatest number of species were edge insetivores (n = 25), edge omnivores (n = 21), canopy frugivores (n = 15), piscivores (n = 13) and granivores (n = 13) (Table 3). Bamboo or tangle insectivores, understory omnivores and nocturnal carnivores were the least representative trophic guilds with only one species each.

DISCUSSION

The region of the lower Grande River was found to possess high bird species richness, with various threatened (almost exclusively locally, present only in State lists; with the exception of *C. fasciolata,* present in the global list) and some endemic species. The area was also found to be a feeding and resting area for migratory birds, confirming its status as an area of "High Biological Importance" for the conservation of birds in the states of Minas Gerais (Drummond *et al.,* 2005). The species accumulation curve indicated that the sampling effort satisfactorily detected a significant portion of the region's avifauna. In fact, at 50% of the total sampling effort, 89% (n = 200) of the species had already been recorded. It is

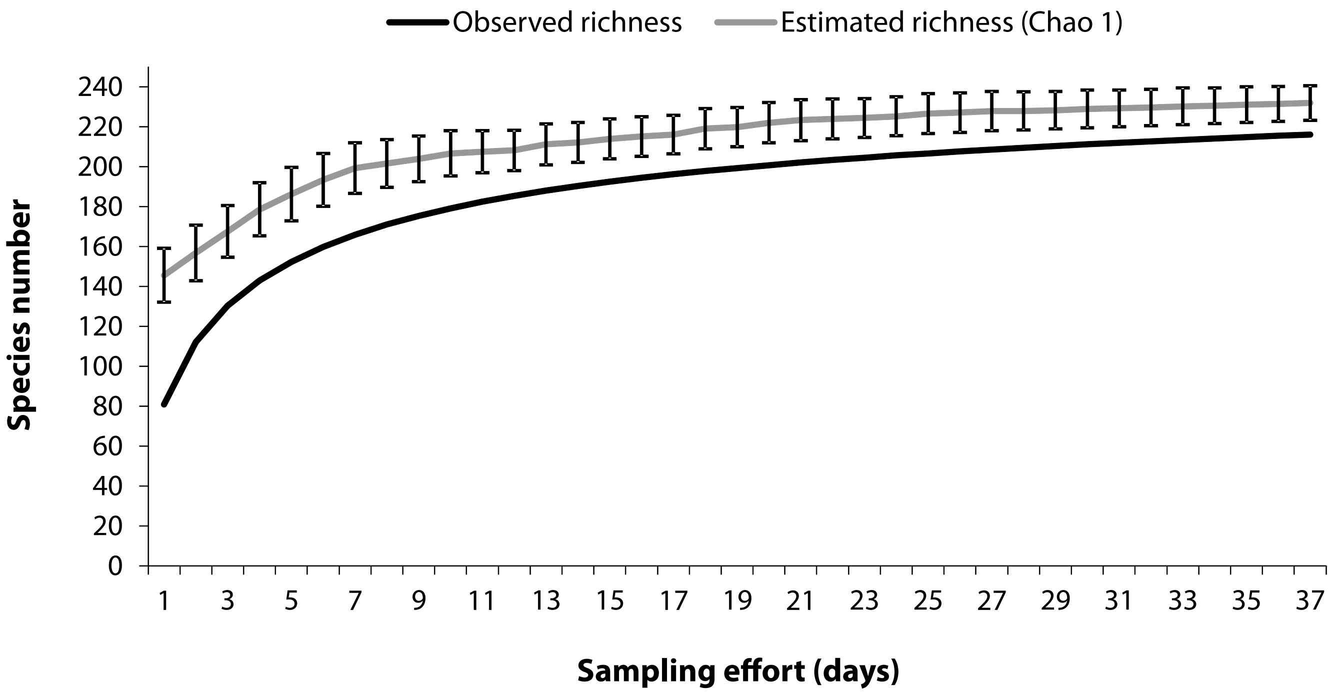

Figure 2. Bird species accumulation curve and estimated richness curve obtained from the Chao 1 index for the study area located throughout the reservoir of the Volta Grande Hydroelectric Power Plant in Southeast Brazil. Vertical bars represent the standard deviation of the estimate.

Table 3. Number of species per each trophic guild recorded on the region of reservoir of Volta Grande Hydroelectric Power Plant in Southeast Brazil.

Trophic Guild	Number of bird species
Edge insectivores	25
Edge omnivores	21
Canopy frugivores	15
Granivores	13
Piscivores	13
Predators of small ground arthropods	12
Aerial insectivores	12
Canopy omnivores	11
Ground omnivores	11
Diurnal carnivores	11
Marsh insectivores	10
Nectarivores	10
Midlevel insectivores	9
Trunk and twig insectivores	8
Canopy insectivores	8
Predators of large ground arthropods	7
Nocturnal insectivores	6
Aquatic omnivores	6
Predators of foliage arthropods	5
Ground frugivores	4
Marsh omnivores	3
Carrion eaters	2
Bamboo or tangle insectivores	1
Understory omnivores	1
Nocturnal carnivores	1

important to emphasize that most of the sampling sites were reforested areas, reaffirming their importance to bird communities.

Studies addressing the bird community of non-urban areas of the region of the lower Grande River and Paranaíba River (Triângulo Mineiro region) are extremely scarce in the scientific literature. The few that do exist have found 403 bird species for Serra da Canastra National Park (2,000,000 ha, and 90 km from the study area) (Silveira, 1998; Andrade & Marini, 2002; MMA, 2005; Bessa *et al.,* 2011); 231 species for RPPN Panga Ecological Reserve (410 ha, and 130 km from the study area) (Marçal-Júnior *et al.,* 2009); 202 species for a private reserve located in the municipality of Uberlândia (640 ha, and about 130 km from the study area) (Malacco *et al.,* 2013), 221 species for Pau Furado State Park (2,000 ha, and 140 km from the study area) (IEF, 2011), and 328 species for the 17 forest remnants in northwestern São Paulo state (Bispo *et al.,* 2011).

Two-percent of the species encountered in the present study had 100% FO. Studying rural forest fragments in the state of São Paulo, Almeida *et al.* (1999) and Donatelli *et al.* (2004) also found a very low number of species with 100% FO, with 1% and 3%, respectively. The majority of bird species recorded (50%) in our study were classified as occasional and rare, with FOs of less than 25%. A similar result was obtained by Almeida *et al.* (1999) in two areas located in the Jacaré-Pepira River Basin (rural state of São Paulo), and by Lyra-Neves *et al.* (2004) in a study in the Gurjau State Reserve, state of Pernambuco. The low percentage of species with 100% FO, and the high percentage with FOs of less than 25%, can be explained by the presence of wandering species that remain in areas for a few days, species with inconspicuous vocalizations and/or behaviors, accidental species from neighboring habitats and migratory species. It can also be explained by the possibility that the studied sites do not possess the resources and conditions necessary to maintain larger bird populations (Aleixo & Vielliard, 1995; Donatelli *et al.,* 2007).

The guild of edge insectivores is commonly favored by small patches because birds of this guild possesses foraging plasticity, being able to search for food among different strata such as in tangled vegetation and in the middle and canopy levels (Willis, 1979; Borges & Stouffer, 1999; Stouffer *et al.,* 2009). The data obtained in the present study support this assertion because the guild edge insectivores was the trophic guild with the greatest number of species. This result is also likely due to the sampling performed in surrounding open areas, which included edges of the forest fragments. In contrast, insectivorous species foraging in the lower strata, such as predators of small ground arthropods, predators of foliage arthropods and understory omnivores, tend to be more susceptible to habitat degradation due to the consequent structural simplification of the environment, and, thus, are less common in small patches (Willis, 1979; Castaño-Villa *et al.,* 2014; Cid & Caviedes-Vidal, 2014). Structural simplification of the environment and the inability to adapt to the surrounding open habitat has a greater influence on species of these guilds than the availability of arthropods as a food resource (Sekercioglu *et al.,* 2002). Predators of foliage arthropods and understory omnivores were among the guilds with the lowest number of species in the present study. In contrast, the guild of edge omnivores has been shown to be favored by small patches due to the larger proportion of edge environments in these habitats (Willis, 1979; Austen *et al.,* 2001; Anjos *et al.,* 2007), which likely explains why this guild was well represented (second greatest number of species) in the present study.

Species of the guild bamboo or tangle insectivores can be considered specialized microhabitat foragers (Goerck, 1997; Areta & Cockle, 2012; Lebbin, 2013), and thus tend to be rare in small patches since they are competitively excluded by edge insectivores (Willis, 1979; Cockle & Areta, 2013). The only species of the bamboo or tangle insectivores guild recorded in the present study was *Poecilotriccus latirostris.* This species is the most widely distributed species of its genus in western Brazil, and is characteristic of middle and lower strata of tangled vegetation in riparian forests of Central Brazil (Sick, 1997; Sigrist, 2013).

It is important to highlight the occurrence of only one species of more specialized insectivorous as regards the foraging site: *Dendrocolaptes platyrostris.* The woodcreepers are trunk and twig insectivores that forage preferentially on senile trees. They are also sensitive to environmental disturbances, and thus are the first to disappear locally when environmental degradation occurs (Laurance *et al.,* 2002; Cleary *et al.,* 2007; Dahal *et al.,* 2015).

Large frugivores (*e.g., Crypturellus* spp., *Crax* spp. and *Penelope* spp.) which feed mostly on the ground were poorly represented in the present study. Overall, frugivores are more susceptible to local extinction because their populations are possibly limited by the availability of fruit during periods of scarcity (Antunes, 2005; Cleary *et al.,* 2007; Kennedy *et al.,* 2010) and by hunting (Peres, 2001). Thus, species belonging to this guild tend to disappear from small patches, since they require areas with a wide variety of tree species that produces fruit at different seasons of the year (Willis, 1979; Piratelli *et al.,* 2005; Ferger *et al.,* 2014). Also, large frugivores are cinegetic species, i.e, species that suffer from hunting pressure by humans (Pereira & Schiavetti, 2010), and this impact associated with habitat loss can drive these species to extinction (Simberloff, 1995; Symes *et al.,* 2018). In the study region occurs the Speckled chachalaca *(Ortalis remota)* in São Paulo state. Deforestation caused mainly by the construction of the Lower Grande reservoir may be responsible for the extinction of this species in Minas Gerais state (Silveira *et al.,* 2017).

Like large frugivores, nectarivores birds are also dependent on plant species that contribute with food resources throughout the year (Bennett *et al.,* 2014; Rodrigues & Rodrigues, 2015). According to Willis (1979) and Bowen *et al.* (2009), the few plant diversity and the structural simplification in small patches probably explains the tendency to the nectarivores to disappear from these habitats. On the other hand, there is evidence that in the Neotropical region nectarivores birds are not very sensitive to the habitat fragmentation effects, and may even be benefited by the high abundance of light-dependent plants and the increase of flower production in clearings and forest edges (Vetter *et al.,* 2011). Still according to Vetter *et al.* (2011), nectarivores often travel long distances to find their food resources and are able to cross open areas. Thus, to better understand this relationship, future studies are needed to evaluate how these trophic guild responds to the consequences of the fragmentation processes and habitat loss.

According to Silva (1995a), 52% of the 759 bird species that reproduce in the Cerrado are dependent on forest habitat. However, species dependent on forest habitat corresponded to only 19% of all the species recorded in the present study (see Table 2). According to Laurance *et al.* (2002), a reduced number of forest bird species in small, isolated and impacted patches can be due to morphological and behavioral constraints.

Another possible explanation for the reduced number of forest species in isolated fragments is the reluctance of these species to cross open areas, possibly due to the increased predation risk (Watson *et al.,* 2004; Piratelli *et al.,* 2005). These studies reported that the probability that an individual will cross an open field between two forest fragments decreases rapidly as the distance between fragments increases.

The most important action for the conservation of species dependent on forest habitats is to prevent future forest losses, and to conduct habitat restoration. These two activities should be the most effective conservation strategies for ensuring the persistence of forest birds in fragmented landscapes (Mortelliti *et al.,* 2010; Mendoza *et al.,* 2014). In the long-term, conservation of the species dependent on forest habitats in the area of the present study, like *C. fasciolata, M. nigrifrons,* and *C. rectirostris,* is unfavorable because the few forest remnants remaining are small, isolated from each other, and among a habitat matrix that is predominantly impermeable to forest species displacements (mostly sugar cane plantations). Furthermore, most of the remnants do not receive effective conservation measures.

On the other hand, most of the birds recorded in the present study were classified as forest independent (52%) or semi-dependent (29%) species (see Table 2). For these species, the matrix may be more permeable, allowing movements among different isolated forest patches (Yabes *et al.,* 2010). Characteristics of the matrix will then favor or not bird movements. In our study area, most of the matrix was composed by sugar cane crops and pasture lands (≈ 90%). This structure will limit movements or modify movements of the birds. In pasture lands, for example, forest-dependent and semi-dependent birds will probably perform fast and straight flights direct to the nearest forest patch, while in sugar cane crops, flights would be slowly because birds could use sugar cane as cover to protection against predators (Biz *et al.,* 2017). Thus, in our study area, due to the structure of the matrix and the isolation of the forest patches, movements across the matrix would be performed mostly by independent bird species, decreasing the genetic flow and persistence of the forest dependent species (Braunisch *et al.,* 2010; Prevedello & Vieira, 2010). The disappearance of forest-dependent birds in the region, like *Arremon semitorquatus* and *Chordeiles pussillus,* have been already recorded (Willis & Oniki, 2002; Silveira & Uezu, 2011).

Some authors have indicated that the adverse effects of vegetation degradation and the isolation of the resultant fragments affect more negatively endemic species than species with broad geographic distributions (Aleixo & Vielliard, 1995; Ribon *et al.,* 2003). These authors refer to geographic endemism and not ecological endemism, because data from the literature show that ecologically endemic species of riparian forests often maintain linear territories along riverbanks and, for this reason, do not suffer significant changes due to variation in riparian forest size (Shirley & Smith, 2005; Lees & Peres, 2008).

Of the three Cerrado endemic species recorded in this study, only *A. galeata* was not recorded in all sampled areas. It is a predominantly frugivores species and forages mainly in the canopy of riparian forests (Marini, 1992). In addition to being considered a rare species in the state of São Paulo (Donatelli *et al.,* 2004) and included in the Near Threatened category in the state (Bressan *et al.,* 2009), it was also classified as a rare for the study region of the present study according to its FO (14%).

Although most species that occur in the Cerrado depend on forest habitats for reproduction, the majority of migratory species are considered to be independent of these environments. Indeed, according to Silva (1995a), 88% of the septentrional migrants and 67% of the austral migrants already recorded in the Cerrado do not depend on forest habitats. The data obtained in the present study corroborate this assertion, since 66% of the migratory species recorded were classified as independent of forest habitat. Other authors have affirmed that migratory species, independent of trophic guild, preferentially exploit open areas for breeding and foraging (Alves, 2007; Robertson *et al.,* 2013).

The Blue-tufted Starthroat (*Heliomaster* furcifer), recorded only once in the present study (a male with post-nuptial plumage), in the municipality of Igarapava, state of São Paulo, appears to be a low-density species, with few records in the literature (Macarrão *et al.,* 2011). The first documented record of these species in São Paulo occurred only in 2010, in a rural environment of the municipality of Brotas (Macarrão *et al.,* 2011). According to these author, *H. furcifer* appears in São Paulo during his migratory movements, which probably occur during the dry season, suggesting that these species may occur as a winter migrant in the southeastern region of Brazil (Mazzoni & Perillo, 2014). Thus, the record made in the present study, on July 28, 2013, coincides with this period of occurrence described in the literature.

Three of the septentrional migrant species *(Tringa solitaria, Hirundo rustica,* and *Petrochelidon pyrrhonota)* were observed only in the rainy season, which corresponds to winter in the Northern Hemisphere. This pattern of occurrence is consistent with that described in the literature (Sick, 1997). The Cliff Swallow *(P. pyrrhonota)* was observed forming extremely large flocks of more than 150 individuals when foraging through the aerial stratum. The Barn Swallow *(H. rustica)* was also observed in very numerous groups, but less numerous than the Cliff Swallow. The Solitary Sandpiper *(T. solitaria)* was recorded only once in November 2013 when two individuals foraged in the midst of swamp vegetation within the sampled area.

The only septentrional migrant recorded during all months of the study, and thus in both in the dry and rainy seasons, was the Osprey *(P. haliaetus)*. This rapinant species, which feeds almost exclusively on fish (Mestre & Bierregaard-Jr., 2009), is most frequently recorded at the end and the beginning of each year in its wintering places, but can be seen during any season in Brazil, with records existing for every month of the year (Sick, 1997).

It is also important to highlight the record of the Greater Rhea *(Rhea americana),* observed on three occasions only in the municipality of Igarapava, São Paulo: on November 13, 2013, an adult was observed when foraging in the middle of sugarcane monoculture accompanied by eight immature individuals. In January 2014, this family group was recorded again, being possible to notice the development of the immatures. Habitat destruction and fragmentation, hunting, pesticide contamination and few localities with recent records of the species in the state justify their inclusion in the threatened species list of São Paulo as a critically endangered species (Bressan *et al.,* 2009). Thus, the records made in the present study are important because they provide data about its occurrence (with evidence of reproduction) in a new locality in the state of São Paulo.

CONCLUSION

According to Drummond *et al.* (2005), the region of the lower Grande River is currently considered as of "High Biological Importance" for bird conservation in the state of Minas Gerais because it has a high number of threatened species. The results of the present study corroborate this statement since a great number of endangered species were recorded in the sampled areas, at least locally (in the State level). The main cause of decline for all threatened species is habitat destruction, mining, dam's constructions and agricultural activities (Drummond *et al.,* 2005; Faria *et al.,* 2008; Bressan *et al.,* 2009). Additional research, with bird inventories, adequate management plans and public policies aimed at conserving habitats, with the creation of conservation units, are needed for more effective conservation of local biodiversity (Drummond *et al.,* 2005).

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