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Birds of rural landscape in the Midwest region of the state of Minas Gerais, Brazil

Aves de paisagem rural na região Centro-oeste do estado de Minas Gerais, Brasil

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Abstract

In the Cerrado biome the areas are predominantly private. Most legally protected environments are in rural landscapes, thus implying changes in the use of these environments and conservation of biological groups, such as avifauna. In this paper we investigate bird assemblages from a rural landscape, based on samplings in private properties located in the Cerrado, Midwest region of the state of Minas Gerais, Brazil. We report a total of 143 bird species, about 65% of them being classified as less frequent or infrequent. The most representative trophic guilds were Insectivorous and Omnivorous. One species (*Aratinga auricapillus*) is classified in the category near threatened. Three species are endemic to the Cerrado, such as *Antilophia galeata*, which is restricted to Riparian Forests. Two species, namely *Baryphthengus ruficapillus* and *Hemithraupis ruficapilla*, are endemic to the Atlantic Forest. We observed that the most sensitive species recorded during the study use the environments present in the protection area. Private areas legally protected in altered environments become unique refuges for species dependent on natural areas. However, these environments suffer strong anthropogenic pressure. Our results underscore the importance of legally protected areas in private properties for the maintenance of several bird species.

Keywords: private protected areas, permanent preservation area, legal reserve, community structure, ornithological inventory, hotspot.

Resumo

No bioma Cerrado, as áreas são predominantemente privadas. Grande parte dos ambientes legalmente protegidos está em paisagens rurais, fato que implica em mudanças do uso desses ambientes e na conservação de grupos biológicos, como a avifauna. Neste artigo, avaliamos a assembleia de aves de uma paisagem rural com base em amostragens realizadas em propriedades privadas situadas no Cerrado, Centro-oeste de Minas Gerais, Brasil. Um total de 143 espécies de aves foram registradas, sendo cerca de 65% dessas classificadas como pouco frequente ou infrequente. Uma espécie (*Aratinga auricapillus*) encontra-se classificada na categoria de quase ameaçada. Três espécies são endêmicas do Cerrado, entre as quais destaca-se *Antilophia galeata*, ave restrita a matas ciliares. Duas espécies, *Baryphthengus ruficapillus* e *Hemithraupis ruficapilla,* são endêmicas da Mata Atlântica. Observamos que as espécies mais sensíveis registradas durante o estudo utilizam fragmentos presentes nas áreas protegidas. Áreas privadas legalmente protegidas em ambientes alterados tornam-se refúgios únicos para espécies dependentes de áreas naturais. No entanto, esses ambientes sofrem forte pressão antrópica. Os resultados aqui apresentados destacam a importância das áreas legalmente protegidas em propriedades privadas para a manutenção de várias espécies de aves.

Palavras-chave: áreas privadas protegidas, área de preservação permanente, reserva legal, estrutura da comunidade, levantamento ornitológico, *hotspot*.

Introduction

Brazil is one of the countries with the greatest richness of birds in the world. Currently a total of 1919 species is known for its territory (Piacentini *et al*., 2015). The group is considered excellent bioindicator (Stotz *et al*., 1996), besides promoting environmental services such as pollination, seed dispersal and population control of several species (Sick, 1997).

A large number of the Brazilian birds are found in the Cerrado. This Biome contains 837 bird species, of which 29 are endemic (Silva, 1995), being the second Biome with the highest number of threatened birds in Brazil (Marini and Garcia, 2005). This high number of endemic and threatened species, together with the strong threat that the Cerrado suffers, make it a world biodiversity Hotspot (Myers *et al*., 2000).

Fragmentation and habitat loss are among the main causes of high rates of decline in biodiversity (Fahrig, 1997). Advances in the occupation of natural environments by human activities affect habitats of various species and exert great pressure on biodiversity. These impacts may lead to reduction and even extinction of local populations dependent on these habitats if no compensatory measures are adopted (Turner, 1996), including best practices in the agricultural production system (Machado *et al.*, 2008).

Land tenure in tropical regions is a critical factor that determines both land use change and conservation strategies. Priority attention is given to the areas that are in the Hotspot Cerrado, a biome that is not designated as a National Heritage and the lands are predominantly private. Fact that implies in many areas that are not legally protected (Lahsen *et al*., 2016). This reduction in vegetation cover has negative consequences for avifauna. Among the most affected are those with a certain degree of endemism, habitat specificity and sensitive species (Mendonça *et al*., 2009). Because of these changes, there is a decrease in the number of more specialized species, mostly retaining only generalists (Saunders *et al*., 1991; D'Angelo Neto *et al*., 1998).

Environmental legislation appears as a conservation measure to protect native areas and their biodiversity. Like the Brazilian Forest Code (Law 12.651/2012) used in rural landscapes. This law establishes standards for the protection of native areas, including for example Permanent Protection Areas (PPA) that protect marginal environments to watercourses and Legal Reserve Areas (LRA) geared towards maintenance of vegetation with sustainable use, not covered by the PPA (Brasil, 2012).

Ornithological inventories constitute the first step to work on conservation actions aimed at the maintenance of bird diversity (Sutherland, 2000; Vasconcelos *et al*., 2002). Such inventories may supply information on the occurrence of rare, inconspicuous and migrant species, besides provide subsidies for the knowledge of distribution patterns and seasonality (Vitorino *et al*., 2016). Although, due to the vast territorial extension of the Brazilian country, great diversity of habitats of the Neotropical region, and the small number of researchers working in the area, the distribution of birds in Brazil is still poorly known (Lopes and Marçal, 2016). The aim of the paper was to characterize the rural landscape birds, evidencing dependent species from a protection area in private properties in the Cerrado Biome in the Midwest of the state of Minas Gerais.

Materials and methods

Study area

The study area is in Midwest region of the state of Minas Gerais, Luz municipality, which has an area of about 1,171.659 km^2, where about 80,000 ha are destined to agricultural activities, according to the Instituto Brasileiro de Geografia e Estatística (IBGE, 2006). The main water courses in the municipality are São Francisco, Limoeiro, Bambuí, Jorge Grande, Jorge Pequeno and Córrego da Velha River. The region is located in the Cerrado Biome, a Neotropical Savanna hotspot (Figure 1). The climate is classified as Aw (tropical rainy) (Kottek *et al.*, 2006). The research was developed in a rural area of about 200 continuous hectares, comprising two farms, which is situated 8.5 km far from the urban perimeter. This rural landscape is composed of patches of Cerrado *sensu stricto* and a Riparian Forest that composes the Permanent Protection Areas and Legal Reserve, here denominated as Protected Areas. These phytophysiognomies are inserted in a pasture matrix.

Data collection and analysis

The ornithological inventory was held from May 2011 to May 2012, through 15 incursions, between rainy and dry season. Systematic data were collected through two complementary methods: Direct observation census and mist-net captures.

The direct observation census consisted of walks made in preexisting tracks, carried out in different habitats from the sunrise to register the species (Rodrigues *et al*., 2005). In some occasions the route was performed at dusk in order to find species of nocturnal crepuscular habits. The sample effort for this method was 75 hours. All the visual and auditory contacts were considered for identification of the species. Visual contacts were aided in the field with use of a Bushnell® 10x50 binocular and a digital camera SX-30is Canon®. The auditory contacts were aided by a RR-US551Panasonic® digital recorder and a HT-81 Yoga® directional microphone. Recordings obtained in the field that were not immediately identified were evaluated *a posteriori* from sound banks: (www.xeno-canto.org and www.wikiaves.com.br) to identify the species.

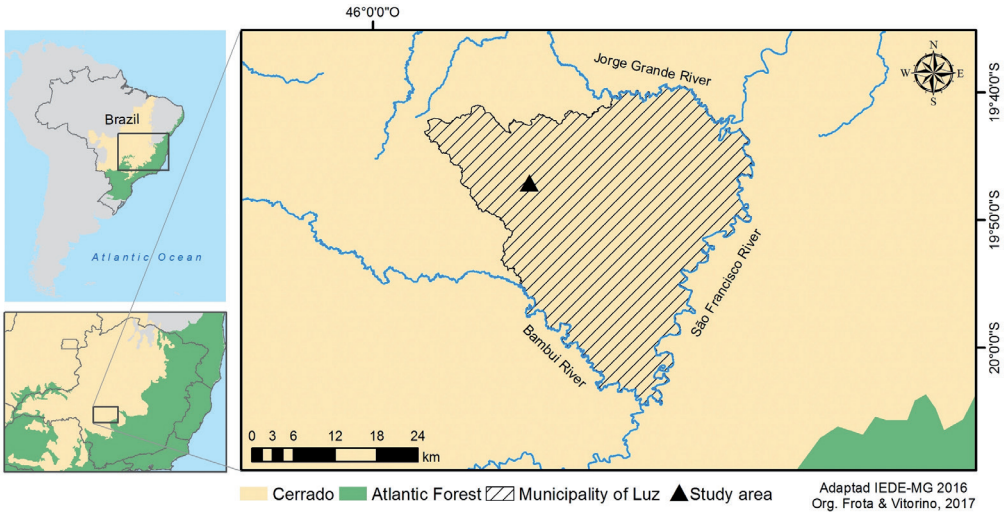

Figure 1. Location of the study area in state of Minas Gerais, Brazil.
Source: Adapted from IEDE-MG (2016) by Angélica Vilas Boas da Frota and Breno Dias Vitorino.

In addition to the method described above, birds were captured with mist-nets, with aim to diagnose the presence of inconspicuous species (Roos, 2010). The captures were made using 6 meters long by 3 meters high mist-nets, with 20 mm mesh and four shelves. The sample effort (Straube and Bianconi, 2002) was 2.088 h.m^2, divided into three distinct points in the study area: P1 (19°46'52.41"S/ 45°47'8.85"W), P2 (19°47'35.97"S/ 45°47'17.29"W) and P3 (19°47'27.25"S/ 45°46'24.52"W). This method was used mostly in the morning period. The procedure adopted for the captures follows the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA, 1994) and Sick (1997). All animals caught in mist-nets were tagged with metal leg bands provided by the Centro Nacional de Pesquisa e Conservação das Aves Silvestres (CEMAVE), authorization number 28512-1 (SISBio) and 3380/1 (CEMAVE/IBAMA).

To check inventory efficiency, we constructed a rarefaction curve of the species along the samples. The richness of the birds was estimated by *Jackknife* 1, using Estimates 9.0 software (Colwell *et al*., 2012). Occurrence Frequency (OF) of the species was stipulated through the total number of campaigns in which the species was recorded as a function of the total number of incursions (D'Angelo Neto *et al*., 1998). Species that presented OF between 75% and 100%, were considered as Highly Frequent (Hf), from 50% to 74% as Frequent (Fe), 25% to 49% as Less Frequent (Lf), and less than 25% as Infrequent (If).

Species recorded outside of the methods adopted were considered as random. These species were included in the analysis of the composition of the bird assemblages with a frequency lower than the observed frequency in relation to the systematic data, classified as Occasional (Oc). All registered species were grouped into trophic guilds: Insectivorous, Omnivorous, Frugivorous, Granivorous, Carnivorous, Piscivorous, Detritivorous and Nectarivorous according to Motta-Júnior (1990) and Sick (1997). The threat level of the species follows evaluation of the World Conservation Union, Red list of Threatened Species - IUCN (BirdLife International 2016) and Brazil Red Book of Threatened Species of Fauna (Brasil, 2016). The classification of a species as endemics followed Silva (1995), Stotz *et al.* (1996), Sick (1997) and Piacentini *et al.* (2015). The nomenclature adopted follows the Comitê Brasileiro de Registros Ornitológicos (Piacentini *et al*., 2015).

Results

The survey revealed a total of 143 bird species, 134 were recorded by the Direct Observation Census, 10 captured in mist-nets and eight recorded exclusively in a random manner (Table 1). The registered species are distributed in 46 families and 20 orders. The most representative family of the survey was Tyrannidae, with 18 species. The rarefaction curve showed a tendency for stability. The richness estimated for the area was 155 species (SD = 5.61), indicating a sample efficiency of 91.61% (Figure 2).

In relation to the frequency category, 49 were considered infrequent, 43 less frequent, 27 frequent, 15 highly frequent and nine occasional (Figure 3). Six species were recorded in all incursions: *Patagioenas picazuro* (Temminck 1813), *Ramphastos toco* Statius Muller 1776, *Cariama cristata* (Linnaeus 1766), *Psittacara leucophthalmus* (Statius Muller 1776), *Eupsittula aurea* (Gmelin 1788) and *Pitangus sulphuratus* (Linnaeus 1766). Twenty-three species were recorded exclusively in a single visit, including *Anhinga anhinga* (Linnaeus 1766), *Buteo brachyurus* Vieillot (1816), *Campephilus melanoleucos*

Table 1. Species of birds registered in a rural landscape, between May 2011 to May 2012, in the state of Minas Gerais, Brazil. At = Endemic of Atlantic Forest; Br = Endemic of Brazil; Ce = Endemic of Cerrado; Fe = Frequent; Hf = Highly Frequent; If = Infrequent; Lf = Less Frequent; Nt = Near Threatened; Oc = without standard.

Taxon name	English name	Status	Frequency category	Diet
Tinamiformes				
Tinamidae				
Crypturellus parvirostris (Wagler 1827)	Small-billed Tinamou		Fe	omnivorous
Anseriformes				
Anatidae				
Dendrocygna viduata (Linnaeus 1766)	White-faced Whistling-Duck		Oc	omnivorous
Cairina moschata (Linnaeus 1758)	Muscovy Duck		Lf	omnivorous
Amazonetta brasiliensis (Gmelin 1789)	Brazilian Teal		Lf	omnivorous
Suliformes				
Phalacrocoracidae				
Nannopterum brasilianus (Gmelin 1789)	Neotropic Cormorant		If	piscivorous
Anhingidae				
Anhinga anhinga (Linnaeus 1766)	Anhinga		If	piscivorous
Pelecaniformes				
Ardeidae				
Tigrisoma lineatum (Boddaert 1783)	Rufescent Tiger-Heron		Lf	omnivorous
Nycticorax nycticorax (Linnaeus 1758)	Black-crowned Night-Heron		Oc	carnivorous
Bubulcus ibis (Linnaeus 1758)	Cattle Egret		If	omnivorous
Ardea alba (Linnaeus 1758)	Great Egret		Oc	omnivorous
Syrigma sibilatrix (Temminck 1824)	Whistling Heron		If	omnivorous
Egretta thula (Molina 1782)	Snowy Egret		If	omnivorous
Threskiornithidae				
Theristicus caudatus (Boddaert 1783)	Buff-necked Ibis		If	omnivorous
Cathartiformes				
Cathartidae				
Coragyps atratus (Bechstein 1793)	Black Vulture		Hf	detritivorous
Accipitriformes				
Accipitridae				
Elanus leucurus (Vieillot 1818)	White-tailed Kite		Lf	carnivorous
Heterospizias meridionalis (Latham 1790)	Savanna Hawk		Lf	carnivorous
Urubitinga urubitinga (Gmelin 1788)	Great Black Hawk		Oc	carnivorous
Rupornis magnirostris (Gmelin 1788)	Roadside Hawk		Fe	carnivorous
Geranoaetus albicaudatus (Vieillot 1816)	White-tailed Hawk		Lf	carnivorous
Buteo brachyurus Vieillot 1816	Short-tailed Hawk		If	carnivorous
Gruiformes				
Rallidae				
Aramides cajaneus (Statius Muller 1776)	Gray-necked Wood-Rail		If	omnivorous
Gallinula galeata (Lichtenstein 1818)	Common Gallinule		If	omnivorous
Charadriiformes				
Charadriidae				
Vanellus chilensis (Molina 1782)	Southern Lapwing		Fe	omnivorous

Table 1. Continuation.

Taxon name	English name	Status	Frequency category	Diet
Jacanidae				
Jacana jacana (Linnaeus 1766)	Wattled Jacana		Lf	omnivorous
Columbiformes				
Columbidae				
Columbina talpacoti (Temminck 1810)	Ruddy Ground-Dove		Hf	granivorous
Columbina squammata (Lesson 1831)	Scaled Dove		Lf	granivorous
Patagioenas picazuro (Temminck 1813)	Picazuro Pigeon		Hf	frugivorous
Patagioenas cayennensis (Bonnaterre 1792)	Pale-vented Pigeon		Hf	frugivorous
Zenaida auriculata (Des Murs 1847)	Eared Dove		If	frugivorous
Leptotila verreauxi Bonaparte 1855	White-tipped Dove		Lf	frugivorous
Cuculiformes				
Cuculidae				
Piaya cayana (Linnaeus 1766)	Squirrel Cuckoo		Fe	insectivorous
Crotophaga ani Linnaeus 1758	Smooth-billed Ani		Hf	insectivorous
Guira guira (Gmelin 1788)	Guira Cuckoo		Lf	insectivorous
Tapera naevia (Linnaeus 1766)	Striped Cuckoo		If	insectivorous
Strigiformes				
Strigidae				
Megascops choliba (Vieillot 1817)	Tropical Screech-Owl		Oc	carnivorous
Bubo virginianus (Gmelin 1788)	Great Horned Owl		If	carnivorous
Glaucidium brasilianum (Gmelin 1788)	Ferruginous Pygmy-Owl		Lf	carnivorous
Athene cunicularia (Molina 1782)	Burrowing Owl		If	carnivorous
Caprimulgiformes				
Caprimulgidae				
Nyctidromus albicollis (Gmelin 1789)	Common Pauraque		Oc	insectivorous
Apodiformes				
Apodidae				
Streptoprocne zonaris (Shaw 1796)	White-collared Swift		Oc	insectivorous
Trochilidae				
Phaethornis pretrei (Lesson and Delattre 1839)	Planalto Hermit		Lf	nectarivorous
Eupetomena macroura (Gmelin 1788)	Swallow-tailed Hummingbird		Fe	nectarivorous
Chlorostilbon lucidus (Shaw 1812)	Glittering-bellied Emerald		Lf	nectarivorous
Thalurania furcata (Gmelin 1788)	Fork-tailed Woodnymph		If	nectarivorous
Amazilia fimbriata (Gmelin 1788)	Glittering-throated Emerald		If	nectarivorous
Amazilia lactea (Lesson 1832)	Sapphire-spangled Emerald		Lf	nectarivorous
Coraciiformes				
Alcedinidae				
Megaceryle torquata (Linnaeus 1766)	Ringed Kingfisher		If	piscivorous
Chloroceryle amazona (Latham 1790)	Amazon Kingfisher		Lf	piscivorous
Chloroceryle americana (Gmelin 1788)	Green Kingfisher		If	piscivorous

Table 1. Continuation.

Taxon name	English name	Status	Frequency category	Diet
Momotidae				
Baryphthengus ruficapillus (Vieillot 1818)	Rufous-capped Motmot	At	Oc	omnivorous
Galbuliformes				
Galbulidae				
Galbula ruficauda Cuvier 1816	Rufous-tailed Jacamar		Lf	insectivorous
Bucconidae				
Nystalus chacuru (Vieillot 1816)	White-eared Puffbird		If	insectivorous
Piciformes				
Ramphastidae				
Ramphastos toco Statius Muller 1776	Toco Toucan		Hf	omnivorous
Picidae				
Picumnus cirratus Temminck 1825	White-barred Piculet		If	insectivorous
Melanerpes candidus (Otto 1796)	White Woodpecker		Lf	insectivorous
Veniliornis passerinus (Linnaeus 1766)	Little Woodpecker		Lf	insectivorous
Colaptes melanochloros (Gmelin 1788)	Green-barred Woodpecker		Fe	insectivorous
Colaptes campestris (Vieillot 1818)	Campo Flicker		Hf	insectivorous
Dryocopus lineatus (Linnaeus 1766)	Lineated Woodpecker		Lf	insectivorous
Campephilus melanoleucos (Gmelin 1788)	Crimson-crested Woodpecker		If	insectivorous
Cariamiformes				
Cariamidae				
Cariama cristata (Linnaeus 1766)	Red-legged Seriema		Hf	omnivorous
Falconiformes				
Falconidae				
Caracara plancus (Miller 1777)	Southern Caracara		Hf	omnivorous
Milvago chimachima (Vieillot 1816)	Yellow-headed Caracara		Fe	omnivorous
Herpetotheres cachinnans (Linnaeus 1758)	Laughing Falcon		Lf	carnivorous
Falco sparverius Linnaeus 1758	American Kestrel		If	carnivorous
Psittaciformes				
Psittacidae				
Orthopsittaca manilatus (Boddaert 1783)	Red-bellied Macaw		If	frugivorous
Psittacara leucophthalmus (Statius Muller 1776)	White-eyed Parakeet		Hf	frugivorous
Aratinga auricapillus (Kuhl 1820)	Golden-capped Parakeet	Br, Nt	Fe	frugivorous
Eupsittula aurea (Gmelin 1788)	Peach-fronted Parakeet		Hf	frugivorous
Forpus xanthopterygius (Spix 1824)	Blue-winged Parrotlet		Lf	frugivorous
Brotogeris chiriri (Vieillot 1818)	Yellow-chevroned Parakeet		Lf	frugivorous
Pionus maximiliani (Kuhl 1820)	Scaly-headed Parrot		If	frugivorous
Amazona aestiva (Linnaeus 1758)	Turquoise-fronted Parrot		If	frugivorous
Passeriformes				
Thamnophilidae				
Taraba major (Vieillot 1816)	Great Antshrike		Oc	insectivorous
Dendrocolaptidae				

Table 1. Continuation.

Taxon name	English name	Status	Frequency category	Diet
Sittasomus griseicapillus (Vieillot 1818)	Olivaceous Woodcreeper		If	insectivorous
Lepidocolaptes angustirostris (Vieillot 1818)	Narrow-billed Woodcreeper		Fe	insectivorous
Furnariidae				
Furnarius rufus (Gmelin 1788)	Rufous Hornero		Hf	insectivorous
Phacellodomus rufifrons (Wied 1821)	Rufous-fronted Thornbird		Fe	insectivorous
Anumbius annumbi (Vieillot 1817)	Firewood-Gatherer		If	insectivorous
Certhiaxis cinnamomeus (Gmelin 1788)	Yellow-chinned Spinetail		Lf	insectivorous
Synallaxis frontalis Pelzeln 1859	Sooty-fronted Spinetail		Lf	insectivorous
Synallaxis albescens Temminck 1823	Pale-breasted Spinetail		If	insectivorous
Pipridae				
Antilophia galeata (Lichtenstein 1823)	Helmeted Manakin	Ce	If	frugivorous
Tityridae				
Pachyramphus polychopterus (Vieillot 1818)	White-winged Becard		If	insectivorous
Rhynchocyclidae				
Tolmomyias sulphurescens (Spix 1825)	Yellow-olive Flycatcher		Lf	insectivorous
Todirostrum cinereum (Linnaeus 1766)	Common Tody-Flycatcher		If	insectivorous
Tyrannidae				
Camptostoma obsoletum (Temminck 1824)	Southern Beardless-Tyrannulet		Lf	insectivorous
Elaenia flavogaster (Thunberg 1822)	Yellow-bellied Elaenia		Fe	omnivorous
Myiarchus swainsoni Cabanis and Heine 1859	Swainson's Flycatcher		If	insectivorous
Myiarchus ferox (Gmelin 1789)	Short-crested Flycatcher		Fe	insectivorous
Myiarchus tyrannulus (Statius Muller 1776)	Brown-crested Flycatcher		If	insectivorous
Casiornis rufus (Vieillot 1816)	Rufous Casiornis		If	insectivorous
Pitangus sulphuratus (Linnaeus 1766)	Great Kiskadee		Hf	omnivorous
Machetornis rixosa (Vieillot 1819)	Cattle Tyrant		Fe	insectivorous
Myiodynastes maculatus (Statius Muller 1776)	Streaked Flycatcher		If	omnivorous
Megarynchus pitangua (Linnaeus 1766)	Boat-billed Flycatcher		Hf	insectivorous
Myiozetetes similis (Spix 1825)	Social Flycatcher		Fe	insectivorous
Tyrannus melancholicus Vieillot 1819	Tropical Kingbird		If	insectivorous
Pyrocephalus rubinus (Boddaert 1783)	Vermilion Flycatcher		If	insectivorous
Fluvicola nengeta (Linnaeus 1766)	Masked Water-Tyrant		Fe	insectivorous
Arundinicola leucocephala (Linnaeus 1764)	White-headed Marsh Tyrant		Lf	insectivorous
Gubernetes yetapa (Vieillot 1818)	Streamer-tailed Tyrant		Lf	insectivorous
Xolmis cinereus (Vieillot 1816)	Gray Monjita		If	insectivorous
Xolmis velatus (Lichtenstein 1823)	White-rumped Monjita		Lf	insectivorous
Vireonidae				
Cyclarhis gujanensis (Gmelin 1789)	Rufous-browed Peppershrike		If	omnivorous
Corvidae				
Cyanocorax cristatellus (Temminck 1823)	Curl-crested Jay	Ce	Lf	omnivorous
Cyanocorax cyanopogon (Wied 1821)	White-naped Jay	Br	Fe	omnivorous

Table 1. Continuation.

Taxon name	English name	Status	Frequency category	Diet
Hirundinidae				
Pygochelidon cyanoleuca (Vieillot 1817)	Blue-and-white Swallow		Fe	insectivorous
Stelgidopteryx ruficollis (Vieillot 1817)	Southern Rough-winged Swallow		Fe	insectivorous
Progne tapera (Vieillot 1817)	Brown-chested Martin		If	insectivorous
Troglodytidae				
Troglodytes musculus Naumann 1823	Southern House Wren		Fe	insectivorous
Donacobiidae				
Donacobius atricapilla (Linnaeus 1766)	Black-capped Donacobius		Fe	insectivorous
Polioptilidae				
Polioptila dumicola (Vieillot 1817)	Masked Gnatcatcher		If	insectivorous
Turdidae				
Turdus leucomelas Vieillot 1818	Pale-breasted Thrush		Hf	omnivorous
Turdus rufiventris Vieillot 1818	Rufous-bellied Thrush		If	omnivorous
Turdus amaurochalinus Cabanis 1850	Creamy-bellied Thrush		If	omnivorous
Mimidae				
Mimus saturninus (Lichtenstein 1823)	Chalk-browed Mockingbird		Fe	omnivorous
Passerellidae				
Ammodramus humeralis (Bosc 1792)	Grassland Sparrow		Lf	granivorous
Icteridae				
Psarocolius decumanus (Pallas 1769)	Crested Oropendola		Fe	omnivorous
Cacicus haemorrhous (Linnaeus 1766)	Red-rumped Cacique		If	omnivorous
Icterus pyrrhopterus (Vieillot 1819)	Variable Oriole		Lf	omnivorous
Gnorimopsar chopi (Vieillot 1819)	Chopi Blackbird		Fe	omnivorous
Chrysomus ruficapillus (Vieillot 1819)	Chestnut-capped Blackbird		Lf	omnivorous
Pseudoleistes guirahuro (Vieillot 1819)	Yellow-rumped Marshbird		Lf	omnivorous
Sturnella superciliaris (Bonaparte 1850)	White-browed Meadowlark		If	omnivorous
Thraupidae				
Tangara sayaca (Linnaeus 1766)	Sayaca Tanager		Fe	omnivorous
Tangara palmarum (Wied 1821)	Palm Tanager		Lf	omnivorous
Tangara cayana (Linnaeus 1766)	Burnished-buff Tanager		Fe	omnivorous
Nemosia pileata (Boddaert 1783)	Hooded Tanager		Lf	omnivorous
Conirostrum speciosum (Temminck 1824)	Chestnut-vented Conebill		Lf	omnivorous
Sicalis flaveola (Linnaeus 1766)	Saffron Finch		Lf	granivorous
Hemithraupis ruficapilla (Vieillot 1818)	Rufous-headed Tanager	At, Br	If	omnivorous
Volatinia jacarina (Linnaeus 1766)	Blue-black Grassquit		Lf	granivorous
Coryphospingus pileatus (Wied 1821)	Pileated Finch		Lf	omnivorous
Tersina viridis (Illiger 1811)	Swallow Tanager		Fe	omnivorous
Dacnis cayana (Linnaeus 1766)	Blue Dacnis		Lf	omnivorous
Sporophila nigricollis (Vieillot 1823)	Yellow-bellied Seedeater		If	granivorous
Sporophila caerulescens (Vieillot 1823)	Double-collared Seedeater		If	granivorous
Sporophila leucoptera (Vieillot 1817)	White-bellied Seedeater		If	granivorous
Emberizoides herbicola (Vieillot 1817)	Wedge-tailed Grass-Finch		Lf	granivorous

Table 1. Continuation.

Taxon Name	English Name	Status	Frequency Category	Diet
Saltatricula atricollis (Vieillot 1817)	Black-throated Saltator	Ce	Lf	frugivorous
Fringillidae				
Euphonia chlorotica (Linnaeus 1766)	Purple-throated Euphonia		Fe	frugivorous
Passeridae				
Passer domesticus (Linnaeus 1758)	House Sparrow		If	omnivorous

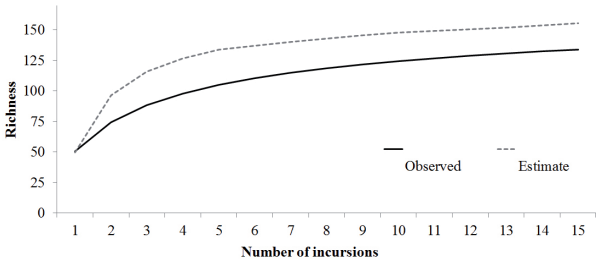

Figure 2. Species accumulation curve and estimated richness for the birds registered in a rural landscape, between May 2011 to May 2012, in the state of Minas Gerais, Brazil.

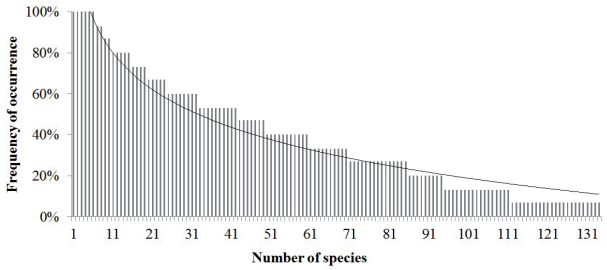

Figure 3. Frequency of occurrence of birds registered in a rural landscape, between May 2011 to May 2012, in the state of Minas Gerais, Brazil.

(Gmelin 1788), *Sittasomus griseicapillus* (Vieillot 1818) and *Anumbius annumbi* (Vieillot 1817).

The most representative trophic guilds were insectivores and omnivores, with 48 and 46 species respectively. Both corresponded to 65.73% of the recorded species. Among the insectivorous, few species exhibit specialized behavior, such as *Sittasomus griseicapillus* (Vieillot 1818) and *Campephilus melanoleucos* (Gmelin 1788). The frugivores constitute the third most representative guild with 15 species (Figure 4), underscoring the presence of potential seed dispersal birds in the disturbed area.

Three bird species are endemics of the Cerrado, namely *Antilophia galeata* (Lichtenstein 1823), *Cyanocorax cristatellus* (Temminck 1823) and *Saltatricula atricollis* (Vieillot, 1817). Two species, *Baryphthengus ruficapillus* (Vieillot 1818) and *Hemithraupis ruficapilla* (Vieillot 1818), are endemics to the Atlantic Forest. *Cyanocorax cyanopogon* (Wied 1821), *H. ruficapilla* and *Aratinga auricapillus* (Kuhl 1820) are the endemics for the Brazilian territory, being the latter also classified in the category Near Threatened (NT) (Birdlife international, 2016).

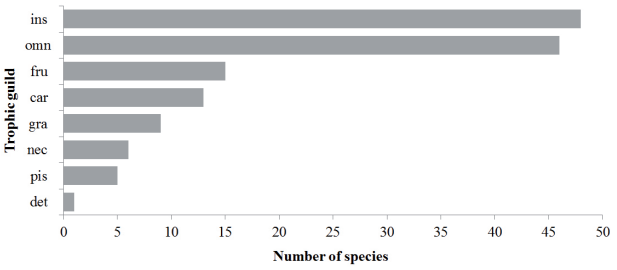

Figure 4. Trophic composition of the bird community registered in a rural landscape, between May 2011 to May 2012, in the state of Minas Gerais, Brazil. car = carnivorous; det = detritivorous; fru = frugivorous; gra = granivorous; ins = insectivorous; nec = nectarivorous; omn = omnivorous; pis = piscivorous.

Discussion

The data presented here, compiled to the study carried out in the Environmental Protection Area of the Córrego da Velha Basin (Gonçalvez and Andrade, 2015), records a total of 177 bird species for the Luz municipality. This number represents 28.83% of the recorded birds for the São Francisco Basin, in the portion comprising the state of Minas Gerais (Diniz *et al.*, 2013), 22.87% of the richness found for the entire state (Mattos *et al*., 1993) and 21.15% of the birds found in the Cerrado Biome (Silva, 1995).

The large representativeness of the family Tyrannidae was expected, since this is the richest family of birds of the Neotropical region (Sick, 1997). Some authors have already hypothesized that species of this family are more tolerant to anthropically altered environments (Motta-Júnior, 1990; Krugel and Anjos, 2000). According to Ponço *et al.* (2013), this fact may be related to the generalist feeding

habit of most of the species of this family, which adapt to a wide variety of food, as well as to use the most different spaces for nesting.

The evaluation of frequency in which the species were recorded during the study, indicated that about 65% of the avifauna in the rural landscape are classified as Less Frequent and Infrequent. This result may be related to presence of migratory species, such as *Myiodynastes maculatus* (Statius Muller, 1776), *Pyrocephalus rubinus* (Boddaert 1783) and *Tyrannus melancholicus* Vieillot (1819), which are recorded only at certain periods of the year. According to Anjos (1990), the low frequency of some species may also be associated with the presence of small fragments that do not support many birds, causing some species to use neighboring areas. A greater proportion of species Infrequent in relation to Frequent species may also be observed in several anthropically affected environments (Morante-Filho and Silveira, 2012; Mencato and Treco 2016; Vitorino *et al*., 2017). Some birds classified as Highly Frequent or Frequent may be considered typical elements of rural landscape, such as *Vanellus chilensis* (Molina 1782), *Columbina talpacoti* (Temminck 1810), *Gnorimopsar chopi* (Vieillot 1819) *Furnarius rufus* (Gmelin 1788). In addition, other species with low frequencies may also benefit in rural environments, for example: *Bubulcus ibis* (Linnaeus 1758), *Guira guira* (Gmelin 1788), and *Progne tapera* (Vieillot 1817) due to their adaptation to these environments.

A higher proportion of insectivorous followed by omnivorous, is reported for altered environments (Silva *et al*., 2014; Godoi *et al*., 2016; Ruiz-Esparza *et al*., 2016; Cosac and Silvano, 2016; Vitorino *et al*., 2017). In rural landscapes, groups composed mostly of generalist species benefit from open areas, such as pasture and border of small forest fragments that are kept as preservation areas.

Sick (1997) indicates insectivorous birds as abundant and commonly found in tropical regions. We observed a low number of insectivorous birds with specialized diet, such as species of the families Dendrocolaptidae and Picidae. According to Almeida (1982), insectivorous birds tend to decrease in more structured habitats, whereas the number of species with more specialized diet increases.

A trophic group of great relevance for anthropically affected areas is that of the frugivorous birds, which may be potential seed dispersals. This group is classified according to Lundberg and Moberg (2003) as mobile links, which are species that move actively in the landscape, and become a connecting element between fragments or small biotopes that are separated. Some species, such as *Tangara sayaca* (Linnaeus 1766), *Tangara palmarum* (Wied 1821) and *Euphonia chlorotica* (Linnaeus 1766), mentioned by Gonçalves and Vitorino (2014), act on seed dispersal process in anthropically affected environments, being of great importance for propagation of propagules in habitats with low number of specialized frugivores.

Among the endemic species of the Cerrado, *A. galeata* shows a distribution restricted to riparian areas (Sick, 1997). Due to their ecological importance, Riparian Forests are considered Permanent Protection Areas, with legal support in Brazil. However, according to Aquino *et al.* (2012), such areas are threatened in rural landscapes by the cutting and felling of trees, cattle trampling, intensive traffic of agricultural machinery, occupation of areas unfit for cultivation, indiscriminate use of pesticides, among others.

In relation to the endemism of the Atlantic Forest, both *B. ruficapillus* and *H. ruficapilla* were recorded in small forest remnants in the study area, which can be considered Atlantic Forest enclaves still present in the Luz municipality. These fragments are part of the Legal Reserve of the evaluated rural landscape, evidencing the importance of the legally protected areas for the maintenance of species dependent on natural areas.

Aratinga auricapillus is the only species classified by the IUCN as Near Threatened (NT). Willis (1979) evidences the sensitivity of frugivorous birds, including representatives of the family Psittacidae. According to the author, this group is quickly extinct in small fragments, because they need different species of trees that bear fruit in different seasons of the year. As observed by Gimenes and Anjos (2000) for other Psittacidae, *A. auricapillus* is certainly not restricted to the study area, but it explores it in different periods to obtaining certain resources.

Another species worth mentioning is *Orthopsittaca manilatus* (Boddaert 1783). This bird has a close relationship with areas of *Veredas*, which are areas with hydromorphic soils and prevalence of herbaceous vegetation, usually with the occurrence of *Mauritia flexuosa* L.f. *Orthopsittaca manilatus* feeds almost exclusively on the fruits of *M. flexuosa*, besides using this vegetation for nesting, rest and shelter (Roth, 1984). *Veredas*, as well as Riparian Forest, are also classified as permanent preservation ecosystems and ecological reserves. However, this environment in rural landscapes also suffers from anthropic pressures, such as pasture formation and latter cattle occupation, which cause soil compaction and suppresses herbaceous vegetation, triggering degradation processes (Bahia *et al*., 2009). Due to the absence of *Veredas* in the evaluated rural landscape, it is believed that *O. manilatu*s only moves through it to make use of *Veredas* located nearby.

The present study raises important information about the composition of bird assemblages in rural landscape in the Hotspot Cerrado, with a community composed mostly by generalist species, but with some elements sensitive to anthropogenic processes. Private areas that are legally protected in altered environments become unique refuges for species dependent on natural areas. We highlight the importance of public policies that involve landowners for the preservation of these environments, in the domains of the Cerrado Biome.

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