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UNDERSTORY BIRD COMMUNITY FROM WILDLIFE PROTECTED AREAS OF THE QUEDAS DO RIO BONITO ECOLOGICAL PARK

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Authors contributions: ASM had the idea, developed the methodology and wrote the manuscript; GTB, HF, JMN, SYOK, LSC and TCM developed the methodology and did in the execution of statistical analysis and data analysis; FSM, MALF had contributed to the idea, assisted in writing the manuscript first in Portuguese and later in English, as well as assisted in the analysis of the data.

Abstract. The bird diversity is threatened and many studies have focused on preservation and conservation efforts. For example, few public Wildlife Protected Areas are created, which increase the requirement for private initiatives to support the conservation challenge. The Quedas do Rio Bonito Ecological Park is a private protected areas located in the south of Minas Gerais, Brazil. Here, we present the median richness (54 bird species, 20 families and seven orders) of this protected area in relation to other studies in southeastern Brazil, as well as seasonal variations, similarities between areas and the estimation of understory stratum richness. Therefore, this article presents arguments to support future studies, since knowledge about the community in different areas is primordial to Biological Conservation projects.

Key words: Birdlife, Conservation Biology, understory, Quedas do Rio Bonito Ecological Park.

Resumo. Comunidade de aves de sub-bosque do Parque Ecológico Quedas do Rio Bonito. A diversidade de aves está ameaçada e muitos estudos têm se concentrado em esforços de preservação e conservação. No entanto, poucas áreas protegidas públicas de vida selvagem são criadas, o que aumenta a necessidade de iniciativas privadas para apoiar o desafio da conservação. O Parque Ecológico Quedas do Rio Bonito é uma dessas áreas privadas protegidas localizada no sul de Minas Gerais, Brasil. Aqui, apresentamos a riqueza mediana (54 espécies, 20 famílias alocadas em sete ordens) desta área protegida em relação a outros estudos no sudeste do Brasil, bem como foram observadas variações sazonais, semelhanças entre áreas e a estimativa de riqueza do estrato do subbosque. Portanto, este artigo apresenta argumentos para auxiliar futuros estudos, uma vez que o conhecimento sobre a comunidade em diferentes áreas é primordial para projetos de Conservação Biológica.

Palavras-chave: Avifauna, Biologia de conservação, Sub-bosque, Parque Ecológico Quedas do Rio Bonito.

INTRODUCTION

The bird community of the south of Minas Gerais state, Brazil, is well known. In the past years, a great number of studies regarding the topic have been conducted, for example, focusing on lists of species (RIBON, 2000; VASCONCELOS, 2008; MOURA *et al.,* 2010a), green urban areas and small forest fragments (CORRÊA & MOURA, 2009; BRAGA *et al.,* 2010; MOURA *et al.,* 2010b;

Moura *et al.,* 2015), new or notable records (Corrêa & Moura, 2010; Mazoni & Perillo, 2011; Moura & Corrêa, 2011a; Moura & Corrêa, 2011b; Lombardi *et al.,* 2012; Moura & Corrêa, 2012; Moura *et al.,* 2014), bird-plant interaction (Moura & Soares-Júnior, 2010; Moura, 2014), predation (Santos, 2012), leucism (Moura *et al.,* 2010c), and feeding guilds (D'Angelo Neto *et al.,* 1998; Corrêa *et al.,* 2012).

In order to protect the flora and faunal diversity, Wildlife Protected Areas were created in Brazil (Unidades de Conservação – SNUC, 2000). The Minas Gerais state has a total of 183 Wildlife Protected Areas, which represent 2.096.648 ha or 3.56% of the total territory (Camargos, 2001). In Minas Gerais, the state and the federal government have created many (N=183) Wildlife Protected Areas aiming at protecting the fauna, especially bird communities. However, new protected areas are needed. Some private initiatives, such as Quedas do Rio Bonito Ecological Park (QRBEP – officially called "Abraham Kasinski Municipal Forest Park"), have contributed with the conservation and protection efforts. This park is the only one in Campos das Vertentes messoregion with an area of potential ecological importance (see data in Santos *et al.,* 2016 and Machado *et al.,* 2017), providing support to the Atlantic Forest Fragment Corridor Program, as mentioned by Consórcio Mata Atlântica (1992).

The QRBEP is private initiative to wildlife conservation (still not formalized as conservation unit - Brasil, 2000; Morel & Rezende, 2007) has protected many species, as the mammals *Chrysocyon brachyurus* (Illiger, 1815) and *Callicebus nigrifrons* (Spix, 1823) classified as Near Threatened by IUCN (Santos *et al*., 2016), and the specie plants *Araucaria angustifolia* (Bertol.) Kuntze 1898 and *Podocarpus lambertii* (Klotzsh ex Eichler) (Dalanesi *et al*., 2004) classified as hardwood.

Even though the south of the State of Minas Gerais is ornithologically well studied, articles that involve bird community in the understory (using mist-nets) of forest fragments are inexistent. The studies commonly focusing on records and species ecology.

In this way, this study presents the first assessment of understory bird communities from a well-preserved Wildlife Private Protected Area (QRBEP) located in south of Minas Gerais state, Brazil. Furthermore, the richness and its richness estimative, seasonal variation and similarity are described.

Materials and Methods

Study area

The study was conducted in Quedas do Rio Bonito Ecological Park (21°19' S / 44°58' W), Lavras, south of Minas Gerais State, Southeastern Brazil (Figure 1). According to Köppen's Classification, the climatic pattern is Cwb, mesothermic with soft summers and dry winters with temperatures ranging from 13 to 23 °C. According to Oliveira-Filho & Fluminhan-Filho (1999), the QRBEP has notable plant species diversity and the area is composed of primitive vegetation of Alto Rio Grande region.

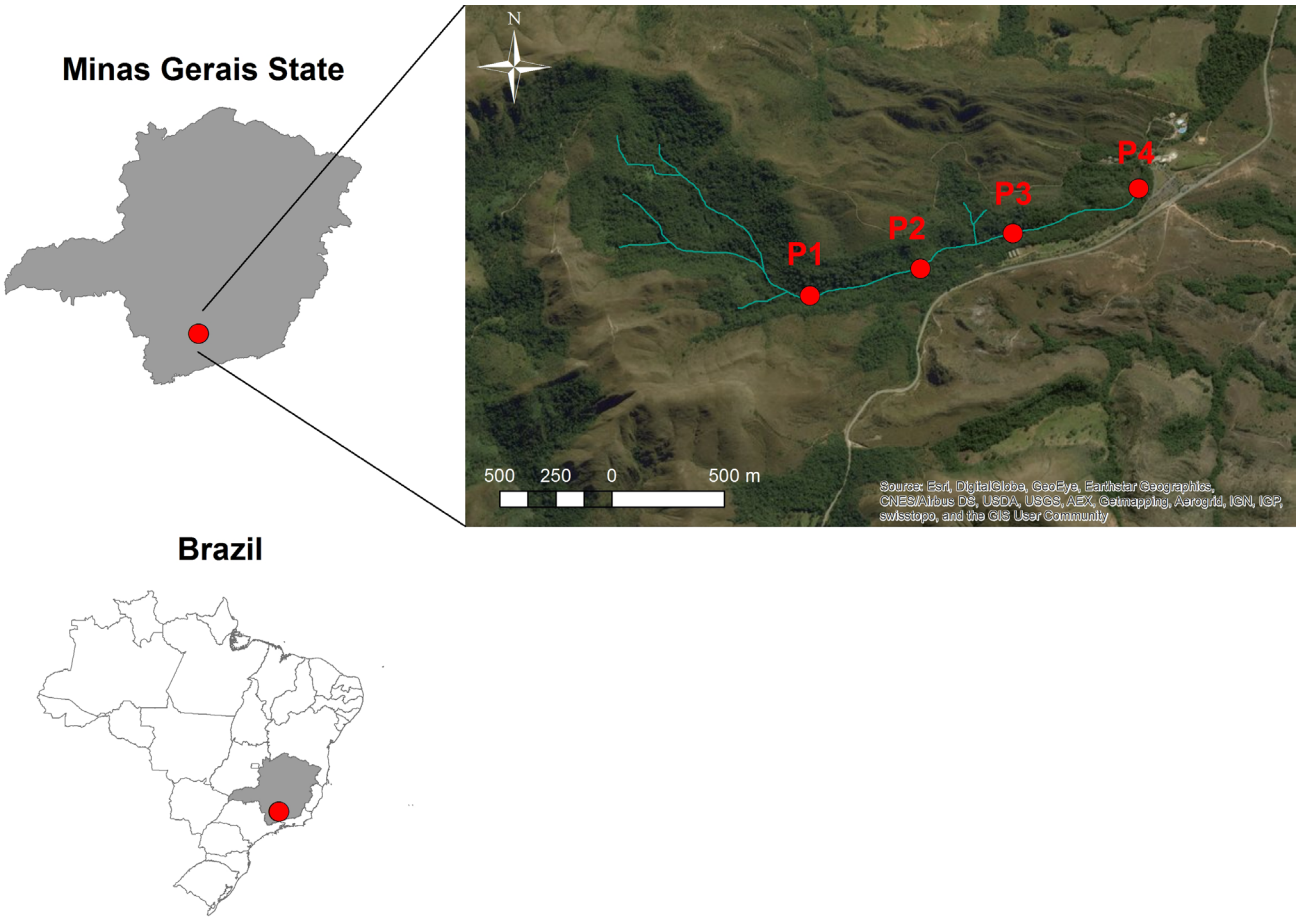

Figure 1. Map of Quedas do Rio Bonito Ecological Park, Lavras city, Minas Gerais state, showing its geographic situation. In black is the distribution in semidecidual forest that compose the riparian forest in Vilas Boas River and in red are the observation areas. Picture adapted from DALANESI *et al.* (2004).

OBSERVATIONAL AREAS

Two collects were conducted in four different areas: one during winter (August 27th to 29th, 2016) and another during summer (November 20th to 22nd, 2016), when four sample sites inside the riparian forest in Vilas Boas river were chosen. The sampling sites were 500 m apart from each other, with altitudes varying from 1087 m (Site 1) to 1004 m (site 4).

The records were obtained between 6:00am and 12:30pm, with a sampling effort of 39 hours, which represented 19.5 hours in dry-winter season and 19.5 hours in wet-summer season. We listed and analyzed individuals caught up to 3 m tall. During the field study, the birds were detected using visual records, with binoculars Nikon 08*x*40 e 10*x*50. Vocalization was also used for species identification the sounds were recorded using a Marantz PDM660 and a Seinheiser ME67 microphone. When possible, the individuals were photographed using either Canon

Power Shot SX50 HS or Nikon Coolpix 500 digitals cameras. Mist nets were used in each sample site for each season, a total of 2736 m².h (metric standardized as Straube & Bianconi, 2002). The individuals were weighted, photographed (Figures 2, 3 and 4) and immediately set free.

The estimated richness curve was esti-

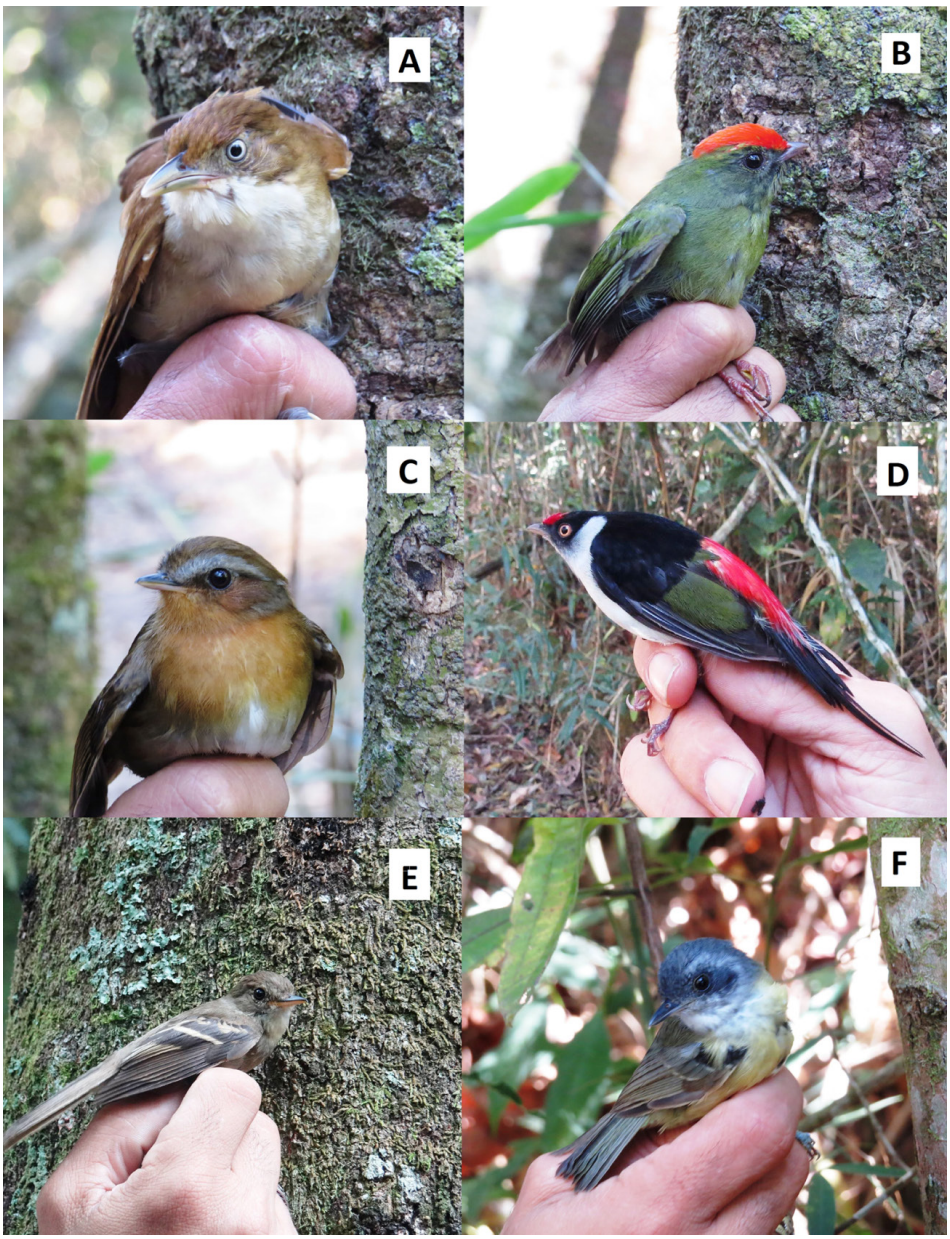

Figure 2. Understory birds from riparian forest in QRBEP, Lavras city, Minas Gerais state. A= *Automolus leucophthalmus* (Wied, 1821); B= *Chiroxiphia caudata* (Shaw & Nodder, 1793) male, young; C= *Conopophaga lineata* (Wied, 1831); D= *Ilicura militaris* (Shaw & Nodder, 1809) male; E= *Lathrotriccus euleri* (Cabanis, 1868) and F= *Dysithamnus mentalis* (Temminck, 1823) male. (Photos: Aloysio S. de Moura).

Figure 3. Understory birds from riparian forest in QRBEP, Lavras city, Minas Gerais state. A= *Mionectes rufiventris* Cabanis, 1846; B= *Platyrinchus mystaceus* (Vieillot, 1818); C= Nest of *Lathrotriccus euleri* (Cabanis, 1868); D= *Pyriglena leucoptera* (Vieillot, 1818), female; E= *Schiffornis virescens* (Lafresnaye, 1838) and F= *Pyriglena leucoptera* (Vieillot, 1818), male. (Photos: Aloysio S. de Moura).

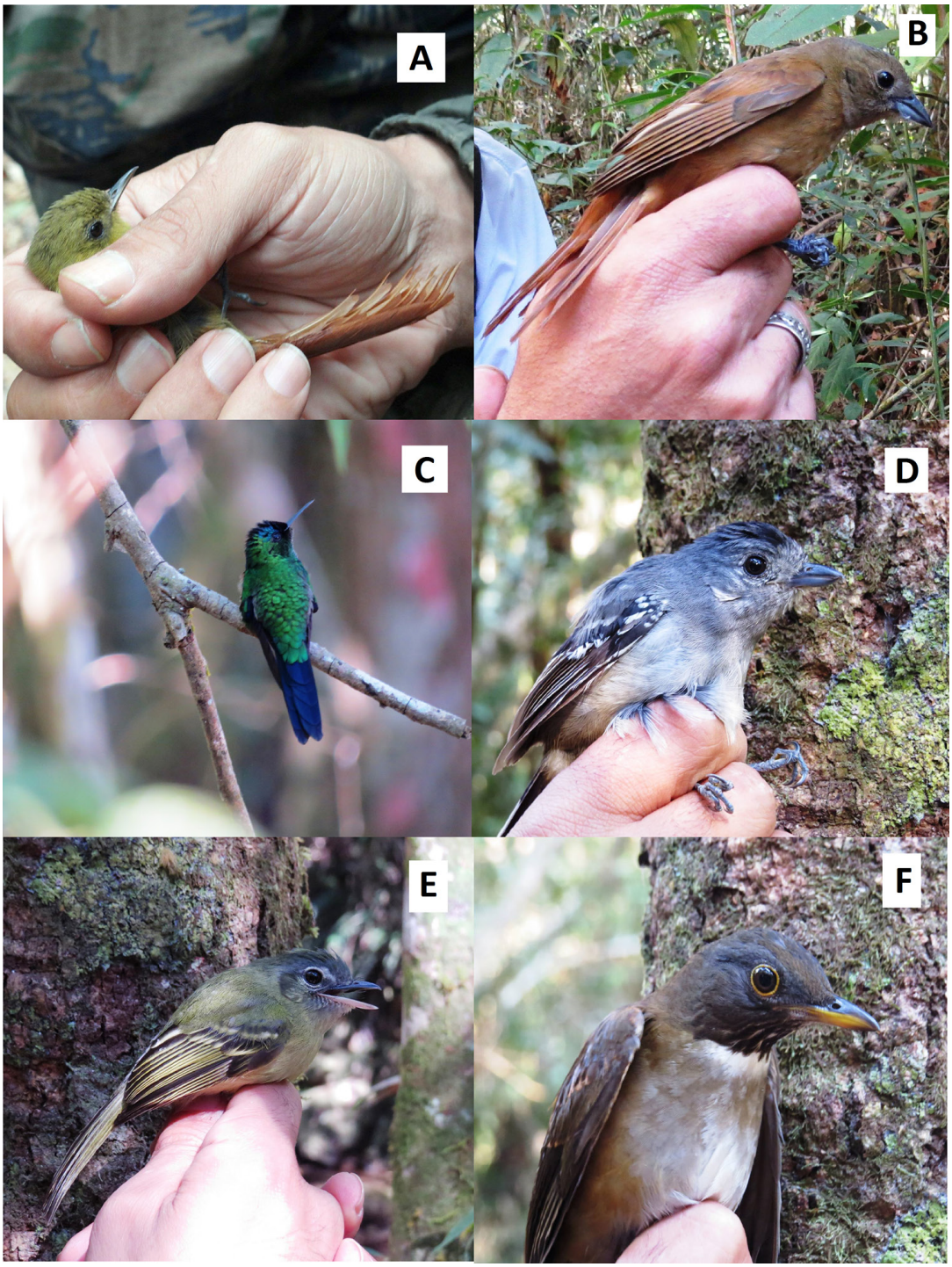

Figure 4. Understory birds from riparian forest in QRBEP, Lavras city, Minas Gerais state. A= *Sittasomus griseicapillus* (Vieillot, 1818); B= *Tachyphonus coronatus* (Vieillot, 1822), female; C= *Thalurania glaucopis* (Gmelin, 1788), male; D= *Thamnophilus caerulescens* (Vieillot, 1816), male; E= *Tolmomyias sulphurescens* (Spix, 1825) and F= *Turdus albicollis* (Vieillot), 1818. (Photos: Aloysio S. de Moura).

mated based on the first order Jackknife estimator, recommended estimator, (Burnham & Overton, 1978) and the total species accumulation curve were constructed using presence and absence matrices with the EstimateS 9.10 program (Colwell *et al.,* 2012). The t-test (Zar, 1996) was used to compare the bird communities between different seasons (dry-winter/wet-summer). The similarity among observation sites was compared using a cluster with a Jaccard Index (Valentin, 2000) and the PAST program (Hammer *et al.,* 2008). The similarity between areas was checked to see if there is homogeneity among the collection points, relating them with environmental characteristics to the aim at creating arguments to future conservation studies since the knowledge on community composition of vertebrates in different areas is primordial when comparing the environment conditions in Biological Conservation projects (Lawton, 1996).

The feeding guilds were described using bars graphic and the bird guild classification are in accord with D'Angelo Neto (1996), Sick (1997), D'Angelo Neto *et al.* (1998) and Corrêa *et al.* (2012).

Results and Discussion

This brief study recorded a total of 54 bird species, 20 families and seven orders (Table 1), using only understory from the riparian forest of QRBEP. However, the results will increase the richness because the accumulation species curve did not reach asymptote and areas that surround QRBEP present high bird diversity (Figure 5) (e.g. D'Angelo Neto *et al.,* 1996; D'Angelo Neto *et al.,* 1998; Vasconcelos *et al.,* 2002; Lopes, 2006; Lombardi *et al.,* 2007; Corrêa & Moura, 2010; Moura & Corrêa, 2011a). The Jackknife estimator of first order also did not reach an asymptote and was maintained out of the confidence interval of 95% with the value of 61.5 species, suggesting that by increasing sampling effort we can find higher richness. The bird diversity showed here represents 87.80% of the first order Jackknife estimator. The proportion of the estimated richness value was high due the larger numbers of occasional species since the singletons influence the estimator (Heltshe & Forrester, 1983).

Table 1. Species list recorded in understory from riparian forest in QRBEP, Brazil.

Order	Family	Specie	Popular name
Galliformes	Cracidae	*Penelope obscura (*Temminck, 1815)	Dusky-legged guan
Columbiformes	Columbidae	*Leptotila* sp.	Grey-fronted dove
Cuculiformes	Cuculidae	*Piaya cayana* (Linnaeus, 1766)	Squirrel cuckoo
Apodiformes	Trochilidae	*Thalurania glaucopis* (Gmelin, 1788)	Violet-capped wood-nymph
		Heliothryx auritus (Gmelin, 1788)	Black-eared fairy
		Amazilia lactea (Lesson, 1832)	Sapphire-spangled emerald

Table 1. Continuation.

		Phaethornis pretrei (Lesson & Delattre, 1839)	Planalto hermit
GALBULIFORMES	Galbulidae	*Galbula ruficauda* Cuvier, 1816	Rufous-tailed jacamar
	Bucconidae	*Malacoptila striata* (Spix, 1824)	Crescent-chested puffbird
Pciiformes	Picidae	*Picumnus cirratus* Temminck, 1825	White-barred piculet
Passeriformes	Thamnophilidae	*Dysithamnus mentalis* (Temminck, 1823)	Plain antvireo
		Thamnophilus caerulescens Vieillot, 1816	Variable antshrike
		Herpsilochmus atricapillus Pelzeln, 1868	Black-capped antwren
		Pyriglena leucoptera (Vieillot, 1818)	White-shouldered fire-eye
	Conopophagidae	*Conopophaga lineata* (Wied, 1831)	Rufous gnateater
	Dendrocolaptidae	*Sittasomus griseicapillus* (Vieillot, 1818)	Olivaceous woodcreeper
		Xiphocolaptes albicollis (Vieillot, 1818)	White-throated woodcreeper
		Lepidocolaptes angustirostris (Vieillot, 1818)	Narrow-billed woodcreeper
	Pipridae	*Ilicura militaris* (Shaw & Nodder, 1809)	Pin-tailed manakin
		Chiroxiphia caudata (Shaw & Nodder, 1793)	Blue manakin
	Tityridae	*Schiffornis virescens (Lafresnaye, 1838)*	Greenish schiffornis
		Pachyramphus polychopterus (Vieillot, 1818)	White-winged becard
	Furnaridae	*Automolus leucophthalmus* (Wied, 1821)	White-eyed foliage-gleaner
		Synallaxis ruficapilla Vieillot*, 1819*	Rufous-capped spinetail
		Synallaxis spixi Sclater, 1856	Spix's spinetail
	Platyrinchidae	*Platyrinchus mystaceus* Vieillot, 1818	White-throated spadebill
	Rhynchocyclidae	*Todirostrum poliocephalum* (Wied, 1831)	Yellow-lored tody-flycatcher
		Poecilotriccus plumbeiceps (Lafresnaye*,* 1846)	Ochre-faced tody-flycatcher
		Scytalopus petrophilus Whitney 2010	Rock tapaculo

Table 1. Continuation.

	Leptopogon amaurocephalus Tschudi, 1846	Sepia-capped flycatcher
	Tolmomyias sulphurescens (Spix, 1825)	Yellow-olive flatbill
	Mionectes rufiventris Cabanis, 1846	Grey-hooded flycatcher
Tyrannidae	*Camptostoma obsoletum* (Temminck, 1824)	Southern beardless tyrannulet
	Myiarchus ferox (Gmelin, 1789)	Short-crested flycatcher
	Lathrotriccus euleri (Cabanis, 1868)	Euler's flycatcher
	Serpophaga nigricans (Vieillot, 1817)	Sooty tyrannulet
	Contopus cinereus (Spix, 1825)	Tropical pewee
	Elaenia flavogaster (Thunberg, 1822)	Yellow-bellied elaenia
Turdidae	*Turdus amaurochalinus* Cabanis, 1850	Creamy-bellied thrush
	Turdus albicollis Vieillot, 1818	White-necked thrush
	Turdus leucomelas Vieillot, 1818	Pale-breasted thrush
Passerelidae	*Zonotrichia capensis* (Statius Muller, 1776)	Rufous-collared sparrow
	Arremon flavirostris Swainson, 1838	Saffron-billed sparrow
Parulidae	*Myiothlypis leucoblephara* (Vieillot, 1817)	White-rimmed warbler
	Myiothlypis flaveola Baird, 1865	Flavescent Warbler
	Basileuterus culicivorus (Deppe, 1830)	Golden-crowned warbler
	Geothlypis aequinoctialis (Gmelin, 1789)	Masked yellowthroat
Thraupidae	*Saltator similis* d'Orbigny & Lafresnaye, 1837	Green-winged saltator
	Tangara cyanoventris (Vieillot, 1819)	Gilt-edged tanager
	Tangara cayana (Linnaeus, 1766)	Burnished-buff tanager
	Tachyphonus coronatus (Vieillot, 1822)	Ruby-crowned tanager
	Dacnis cayana (Linnaeus, 1766)	Blue dacnis
	Haplospiza unicolor Cabanis, 1851	Uniform finch
	Coereba flaveola (Linnaeus, 1758)	Bananaquit

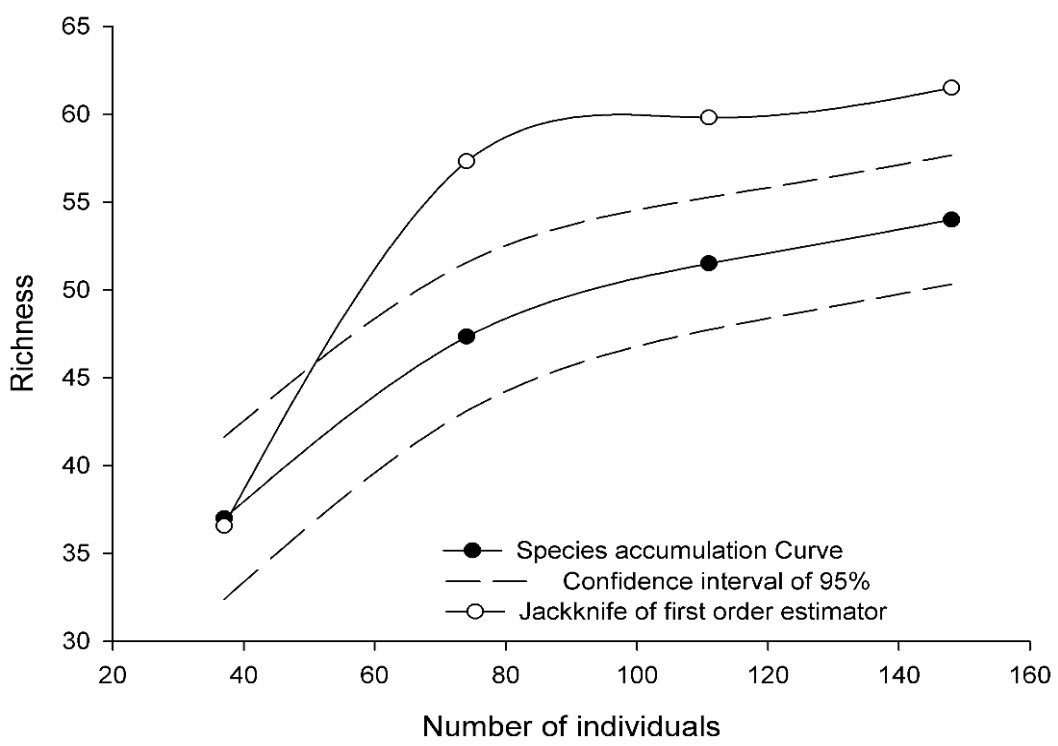

Figure 5. Species Accumulation Curve, confidence interval of 95% and Jackknife of first order estimator curve to bird community, Quedas do Rio Bonito Ecological Park, Brazil.

The richness can be considered as median when compared others studies and its respective sampling efforts, Moura *et al*. (in press) found 25 species to Rio Paranaiba and São Gotardo (MG) (no sampling effort), and Moura *et al*. (2015) found 189 species to Conceição do Rio Verde with effort of 30 meters of mist net in 10 days (all of these studies was done at understory). Other studies present greater richness by the use to others methodologies as playback, as 287 species to adjacencies of Lavras city (Vasconcelos *et al*., 2002).

The most representative families were Thraupidae (N= 7), Tyrannidae and Rynchocyclidae (N= 6), and Thamnophilidae and Trochilidae (N= 4). This result was expected because those families are the larger bird families in Brazil (Sick, 1997; Piacentini *et al.,* 2015). Since the study area is next the urban area, we expected to find the Tyrannidae and Thraupidae families because of the insects, which are abundant during the year in urban areas (Poulin *et al.,* 1994) and fruits, which are found in gardens and public squares (Villanueva & Silva, 1996), beyond these families are the most abundant in Brazil (Sick, 1997). Furthermore, this information corroborates with feeding guilds. We found insectivorous and frugivorous as the most predominant feeding guilds. The less representative guild was granivorous (Figure 6). According to Matarazzo-Neuberger (1995), Scherer *et al.* (2005) and Rodrigues *et al.* (2005) the trophic structure of a

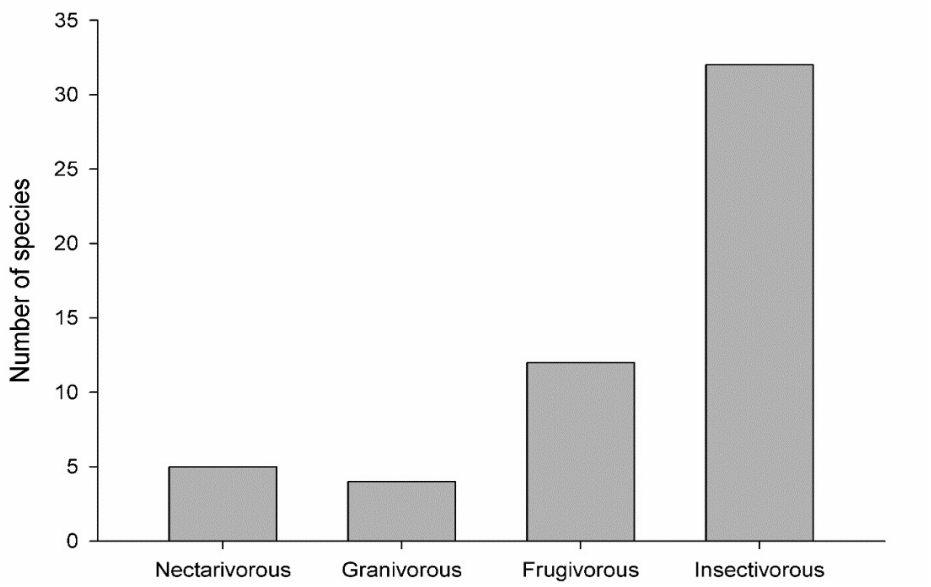

Figure 6. Feeding guilds to bird community, Quedas do Rio Bonito Ecological Park, Brazil.

community based in qualitative data is important because it offers a base to previous analyses on communities.

No significant differences (p>0.05) were found when comparing the community in the two studied seasons (Figure 7). This result was not expected because larger records of species during summer and wet season are common. Since summer is considered to be a reproductive

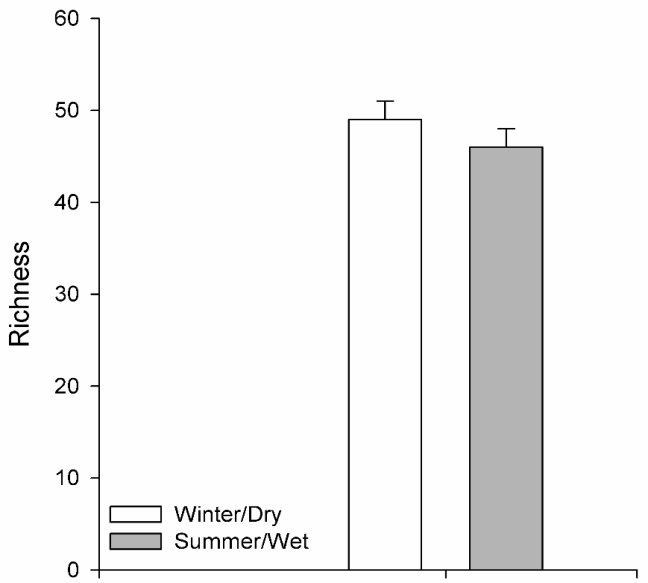

Figure 7. Richness and standard deviance in seasons (dry-winter/wet-summer) to bird community, Quedas do Rio Bonito Ecological Park, Brazil. No omnivorous were recorded.

period (Sick, 1997; Marini & Durães, 2001), with migratory species, we believe that anthropic activities around the QRBEP had an influence on the similarity of both seasons. In addition, the sampling method has influences on the results. The majority of migrants are in canopy or open areas. Then, the method underestimate the bird migrant assemblage.

The bird community of this study was composed by species that presents regional movements (as categorized by Sick, 1997, and mentioned by Alves, 2007), leaving out long migratory species of open areas and savannah (Cerrado *stricto sensu* and montane fields) as: *Tyrannus savana* (Daudin, 1802), *Elaenia chiriquensis* (Lawrence, 1865), *Satrapa icterophrys* (Vieillot, 1818) *Sporophila lineola* (Linnaeus, 1758) e *Myiodynastes maculatus* (Statius Muller, 1776). These short migrations were related to hydric and food resources (Alves, 2007), then, not influences the statistical dissimilarity.

The cluster of similarity based on Jaccard Index showed that sample sites One and Four are more similar, and the same happens for sites Two and Three (Figure 8). The similarity between site One and Four is related to floristic composition (see Oliveira-Filho & Fluminhan, 1999) and both are Cerrado *strictu sensu* phytophysiognomies with presence of edge plant pioneers. Sites Two and Three present a forest environment with a more closed understory and high grasses and bamboos.

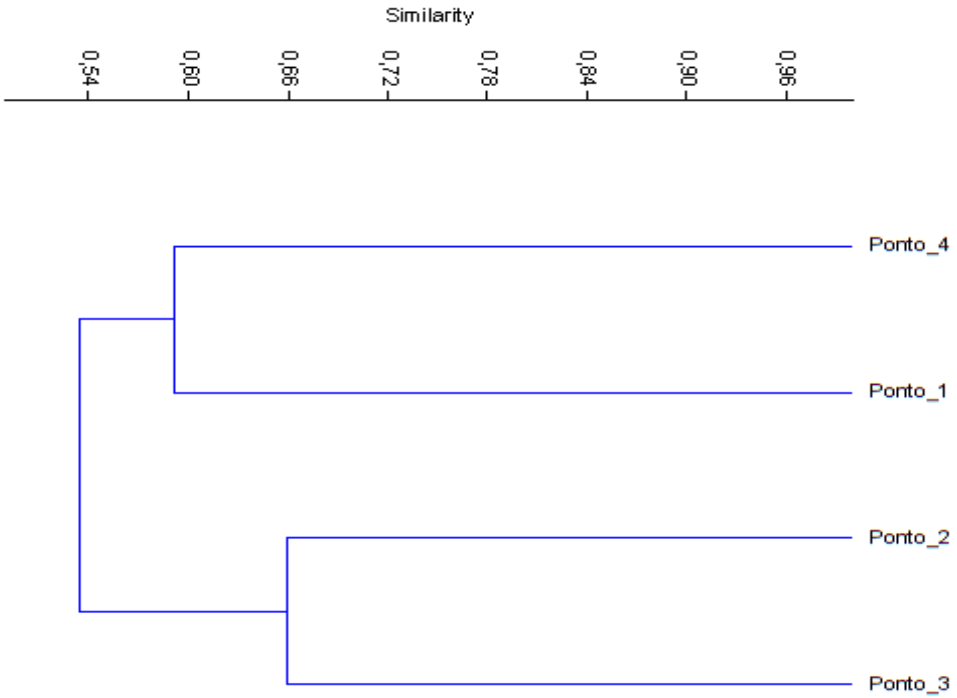

Figure 8. Similarity cluster using Jaccard Index to compare observation sites to bird community, Quedas do Rio Bonito Ecological Park, Brazil. Ponto_1, Ponto_2, Ponto_3 and Ponto_4 represents respectively observations sites one, two, three and four.

Some species recorded are notable and bioindicators, such as: *Heliothryx auritus* (Gmelin, 1788), Black-eared fairy, described as a specie with uncommon occurrence (Sick, 1997; Souza, 2004), with few records published for the south of Minas Gerais state (Moura & Corrêa, 2012). *Malacoptila striata* (Spix, 1824), Crescent-chested puffbird, endemic (Ridgely *et al.,* 2015), typical bird of Atlantic Forest (Sick, 1997), and classified as near threatened (NT) in global scale (Iucn, 2017). *Scytalopus petrophilus* (Whitney *et al.,* 2010), Rock tapaculo, specie described recently as Cadeia do Espinhaço (Brazil) and others sites in Minas Gerais state between 900 to 2.100 m height. The present study demonstrates a new record in specie distribution.

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