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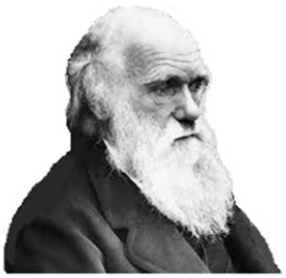

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Diversity and trophic structure of bird's communities in Brazilian Savanna areas of the Cuiabá River basin

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ABSTRACT

We analyzed the differences in composition, richness, and abundance of birds in different forest fragments of the Brazilian Savanna in the Cuiabá River basin, Mato Grosso State, Brazil, and we demonstrated the variations in richness and abundance of birds between different trophic guilds. We used point counts to characterize the avifauna. Sampling was conducted in two seasons: summer and winter of 2018 in a total of 36 hours distributed in 108 samples. A total of 743 contacts were obtained belonging to 87 bird species distributed among 17 orders and 33 families and categorized in 16 trophic guilds. The omnivorous and insectivorous birds composed most of the community. For each species, we calculated the abundance index value that showed our study site had a large number of species with low index and few species with intermediate to high index compared to the pattern observed in other surveys. Our study area was characterized by high species diversity for both periods studied. The Shannon-Weaver diversity index for our study areas was 3.90 for the summer period and 3.77 for the winter period. Equitability was high, 0.82 for the summer period and 0.79 for the winter period, suggesting the number of species registered in our study site represented the maximum capacity the areas can shelter. Our results show that despite being a secondary and fragmented forest the study area was characterized by a diverse avian community. The ciliary forest studied that follows the Cuiabá River, although fragmented and isolated by extensive degraded areas and occupied by pastures and agricultural crops, they are important natural environments to maintain bird diversity.

***Keywords*:** avifauna, bird, Brazil, ecology, Savanna

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1. INTRODUCTION

The Brazilian Savanna (Cerrado biome) presents a great diversity of several different groups of organisms and, for this reason, is considered one of the most important endemism areas of South America [1]. This fact, together with the high level of disturbance in this biome, resulted in the inclusion of the Cerrado among the 25 hotspots of world biodiversity.

The number of vascular plants is greater than that found in most regions of the world: herbaceous, shrubs and arboreal plants and vines represent more than 7,000 species [2].

It is the second-largest biome in Brazil, represented ca. 22% of the Brazilian land surface, and includes most of central Brazil and parts of northeastern Paraguay and eastern Bolivia [3], and covers about 2 million km^2, an area similar to the one occupied by Western Europe. The Cerrado is the most diverse tropical savanna [4], and its landscape presents also great variation with several vegetation physiognomies, from open areas with large fields up to a close and dry forest with trees reaching 10 to 12m tall, the "Cerradão"; the Cerrado sensu stricto composed mainly by shrubs and small trees; and "Veredas" or the palm tree wetlands [5]. The rainfall variability strongly influences the composition of the Cerrado vegetation, whose herbaceous component is during the dry season dead or dormant until the next wet season [6].

The distribution of the Cerrado biome is highly coincident with the plateau of central Brazil, which divides three of the largest South American water basins: those of the Amazon, Plata/Paraguay, and São Francisco rivers [7]. The Cuiabá River is a Brazilian river in the western state of Mato Grosso that flows in the Río de la Plata Basin. It is a major tributary of the Paraguay River; its basin is of great importance and encloses the Pantanal, the world's largest wetland.

The economic base in the Cuiabá River basin is agriculture and livestock production [8]. From the perspective of Brazilian domestic, as well as international agricultural production, the state of Mato Grosso is recognized as one of the largest global agricultural granaries. To guarantee extensive production, the current agricultural model combines monoculture, mechanization and intensive agrochemical usage [9].

The conservation effort in the Cerrado has always been secondary to that in the Amazon [10]. Extensive areas of forests in the Cuiabá River basin have been destroyed in the last decades and converting cleared forest lands to pastures and agricultural lands [11]. Nowadays only 8% of the original Cerrado area is still preserved, but only 0.85% of its area is legally protected [12]. The environmental impacts of deforestation and forest fragmentation include soil degradation, water pollution, and loss of biodiversity because monocultures are inhospitable to many species of birds and invertebrates that require diverse habitats [13].

The Cerrado is a biome rich in bird species, accounting for about 50% of the total number of bird species in Brazil (856 species) [14], of which 30 species are endemic, and of these, 11.8% are threatened [15].

Among the many factors thought to contribute to the high bird species richness in the Neotropics is the high diversity of habitat and microhabitat types, some of which are unique to tropical [16, 17] regions. The increase in structural complexity of the vegetation on various vertical levels makes new forms of occupancy of the [18] environment possible. The increase in the number of bird species is principally due to the increase of both the new food [19] guilds and the number of species in the existing guilds.

The birds are considered the most important bioindicators of the quality of ecosystems because they are sensitive to the alterations of the environment [20]. The birds were group

together according to their alimentary diet and to their forest layers, classifying those species that present feeding and similar biotope [21] in distinct ecological groups (trophic guilds).

The main objective of this study was to know the composition of birds existing in forest fragments in areas of the Cuiabá River basin, their distribution in trophic guilds, and to analyze the groups of birds that were affected by the forest fragmentation.

2. MATERIALS AND METHODS

The studies were carried out in Cuiabá River basin areas, situated in the Mato Grosso State, Brazil, on a stretch of about 190 km of Cuiabá River. These areas are located in the Brazilian Savanna (Cerrado biome), which is a complex of phytophysiognomies, a complex of formations, which represents a gradient of ecologically related biomes, reason enough to consider this complex as a biological unit [22]. These are inserted in part of the municipalities of Cuiabá, Várzea Grande, Acorizal, Jangada, Rosário Oeste and Nobres. It lies between 14°42'S to 15°33'S latitude and 56°09'W to 56°30'W longitude (Figure 1).

The climate of the region is the Aw type according to Köppen's classification, with humid summers and moderately dry winters. The tropical semi-humid climate in the region is characterized by mean annual temperatures between 24 and 28 °C. The annual average rainfall is over 1,300 mm, concentrated in the summer. There are two distinct seasons, a dry season that lasts from April to September, and a humid season which occurs from October to March. The expressive seasonality of precipitation has a strong response in the Cuiabá River [23].

The Ciliary Forest that follows the Cuiabá River, where bird studies were conducted, is a forest that is relatively narrow on both side banks about than 100 meters width on each side. Vegetation structure was dominated by arboreal. The overstorey, the uppermost canopy level of the forest, formed by the tallest trees, is characterized by crowns of large-sized trees varying in average height between 8 and 20m, proportionating luminosity conditions that benefit the differentiated shrubs herbaceous stratus. Among the most ecological significant species in this forest layer recorded in this study included *Anadenanthera colubrina*, *Spondias mombin*, *Inga vera*, *Crateva tapia*, *Guazuma ulmifolia*, *Machaerium hirtum*, *Triplaris americana*, *Myracrodruon urundeuva*, *Cecropia pachystachya*, *Astronium fraxinifolium*, *Protium heptaphyllum*, *Annona sylvatica*, *Dilodendron bipinnatum*, *Aspidosperma discolor*, and *Sapium obovatum*. Most of these trees produce fruit used by local wildlife [24].

Understorey vegetation is characterized by saplings of trees and shrubs of the families Melastomataceae, Euphorbiaceae, Annonaceae, Moraceae, Connaraceae, Rubiaceae, Erythroxylaceae, Fabaceae, and Myrtaceae are common (varies from 0.80 to 3m tall) and dominated by *Attalea phalerata*, a palm species of great ecological importance; its seeds are dispersed by various birds, such as *Caracara plancus* (Southern Caracara), and the macaws consume the seeds and may disperse them, as well [25].

Trees sheltered a high number of vines but few epiphytes including bromeliads, orchids, aroids and cacti. Marsh vegetation appeared on poorly drained soils. These areas periodically flooded, providing habitat for a large variety of wading birds.

The method used to sample the avifauna specimens was the technique of observations per point-counts [26]. The location of the points used for this census was randomly chosen and was representative of the whole area: for each sample, the point was sorted independently among

previously determined points covering the whole area. The points were marked at least 200 meters apart to avoid over-representation of species with long-range voices [27].

The bird's observations were realized in the first hours after the dawn and during the twilight. The samplings were accomplished in 12 days in two seasons: summer and winter of 2018 (in a total of 36 hours distributed in 108 samples). The duration of each point census is 20 minutes [27]. Bird species were identified by vocal recognition and by observations with binoculars. The birds that overflying the areas without to perch on a tree were not analyzed, because their dependence to the places was unlikely.

To the scientific nomenclature and taxonomic order was used the new systematic list of CBRO [28]. To determine if the samples were enough were plotted the accumulated number of species against the total number of hours of observation. Since the curve reached a plateau, it was possible to conclude that the samples were enough for the registration of most species existent in each site.

Figure 1. Localization of the studied areas. Point counts in red (Google Earth image).

This study was limited to trace the similar relationships of feeding habitats and preferred foraging strata in the vegetation for the following found trophic guilds: aerial insectivores, canopy frugivores, canopy insectivores, canopy omnivores, edge carnivores, open-area

detritivores, edge insectivores, edge omnivores, edge gramnivores, nectarivores, open-area insectivores, riparian carnivores, swamp omnivores, understory frugivores, understory insectivores, and understory omnivores [29]. These birds species são classified according to principal food items consumed: insectivores (arthropods), frugivores (fruits), omnivores (arthropods, fruits, and small vertebrates), gramnivores (seeds), nectarivores (nectar), carnivores (vertebrates captured alive), and detritivores (dead vertebrates).

For each species, we calculated the Point Abundance Index (PAI), by dividing the number of detections for each species by the total number of points sampled [26]. To characterize bird community metrics, we obtained the Shannon-Weaver diversity index (H′), where H' max is the maximum diversity possible in the sample [30], and the equitability index [31].

3. RESULTS AND DISCUSSION

A total of 87 bird species were recorded in our study (Table 1). Bird species detected were distributed among 17 orders and 33 families, and categorized in 16 trophic guilds (Table 2). The total number of detections was 743 and the density of birds in the area was 41.30 individuals/observation-hour. The most representative order was Passeriformes with 46 species which accounted for 52.8% of all species recorded.

Omnivores included 35 species occupying the edge and different strata of the forest such as canopy and understory. The great abundance of omnivores birds may be directly related to the abundant fruit resources. These results suggest the sensitivities of bird species to vegetation are associated with their dependence on a fruit diet [32]. Insectivores and nectar-feeders were represented by 32 species also as large distribution on the edge and inside the forest. The avian community in our study was similar to other Cerrado areas studied [33-37] with a predominance of omnivores and insectivores species.

The most abundant species (Table 1) were *Forpus xanthopterygius* (0.2037), *Tangara sayaca* (0.2037), *Diopsittaca nobilis* (0.1759) in the summer; and *Tangara sayaca* (0.2037), *Guira guira* (0.1296) and *Pitangus sulphuratus* (0.1574) in the winter, all synanthropic species and well adapted to the conditions of degraded environments.

Abundance index values (PAI) showed our study site had a large number of species with low PAI and few species with intermediate to high PAI compared to the pattern observed in other surveys [38, 39]. The PAI varied, for both sample periods, from 0.0093 (one contact) to 0.2037 (22 contacts) for *Forpus xanthopterygius* in the summer and *Tangara sayaca* in both seasons. *Forpus xanthopterygius* is a Parrotlet specie that prefers semi-open areas and forest borders and flies in large groups. *Tangara sayaca*, an abundant species found in the different ecosystems of the Atlantic Rainforest and Cerrado. It lives in couples or small monospecific groups sometimes in association with other species in the genus *Tangara*, and other tanager species in the genera *Tachyphonus* and *Euphonia.*

Among the least abundant species in the study area were small frugivores, represented by eight species (Table 2), six of these species are parrots that preferentially occupy the canopy forest areas and only understory specie, *Penelope superciliaris*. Despite the reduced abundance of frugivores such as *Penelope superciliaris*, and understorey species such as *Synallaxis albescens*, *Tolmomyias sulphurescens*, *Basileuterus culicivorus* and some Antshrike species (family Thamnophilidae) the studies areas represented relatively well conserved, albeit secondary forest.

In tropical forest areas, communities of understorey birds are very dependent on forest environments and rarely move between forest patches in fragmented areas [40], and the composition and diversity of the understorey bird should vary mostly in response to fluctuations in the supply of food [41]. Insectivorous birds usually have greater spatial stability and are more site-attached than frugivorous ones [42], but this does not mean that fluctuations do not occur, since forest insectivorous birds may have spatial distribution related to the availability of arthropods [43, 44].

Others signs of adequate habitat conditions included the occurrence of mixed-species flocks [45] and army-ant swarm following birds (e.g., *Dysithamnus mentalis* and *Taraba major* - these are commons and confiding birds of primary and secondary forest that forage for small insects and other arthropods taken from twigs and foliage in the lower branches of trees). Among tropical forest birds, understory insectivores, such as some furnarids and formicarids, are particularly sensitive to habitat disturbance and fragmentation [46], and some of these important species were absent or rare in this study.

Mixed-species groups of these understory birds congregate around ant swarms, where they forage on insects flushed by the ants. Obligate ant-followers have specialized behaviors to track ant swarms and may serve as information sources for facultative ant-followers [47]. However, many of the species registered in our study were edge species (e.g., *Pitangus sulphuratus*, *Coereba flaveola*, *Tyrannus melancholicus*, *Tangara sayaca*, *Crotophaga ani*, and *Guira guira*), that represent 60.9% of all species recorded.

We observed several mixed-species flocks composed of large numbers of insectivore and omnivore species such as *Tangara sayaca, Tangara palmarum*, *Ramphocelus carbo*, *Coereba flaveola*, *Synallaxis albescens*, *Camptostoma obsoletum*, *Myiarchus swainsoni Euphonia chlorotica*, *Tachyphonus rufus,* and *Nemosia pileata*. The frequency and structure of mixed-species flocks also suggest habitat conditions at the study area were adequate for many common Brazilian Savanna bird species [48, 49].

However, the most of these birds species, because prefer to visit the forest edge, are less affected by forest fragmentation, especially when we consider that the anthropic transformations caused in natural environments produce environments favorable to the development of pioneer vegetation, which is characterized by great production of fruits, increasing the availability of food for many of these birds that have in them the base of the feeding [50].

Mixed-species flocks are common in many tropical forests and have been well described in the Neotropics. Mixed-species flocking birds may increase foraging efficiency [51, 52] and protection from predation [53]. Mixed-species flocks in tropical forests are maintained throughout the annual cycle despite seasonal differences in resource availability, breeding seasons, and ecological requirements of individual species [54].

In our study, seasonal variation in flock structure and composition may have been affected by the breeding seasons of different core and attendant species, as well as the availability of food resources. The observed richness of mixed-species flocks may have been related to both forest structure and available fruit and arthropod resources of the understorey [45].

The studied area was characterized by high species diversity for both periods studied. The Shannon-Weaver diversity index for our study areas was 3.90 for the summer period and 3.77 for the winter period. Equitability was high, 0.82 for the summer period and 0.79 for the winter period, suggesting the number of species registered in our study site represented the maximum capacity the areas can shelter.

The occurrence of many species commonly found in human-altered habitats reflects the continuing degradation of the Brazilian Savanna as more and more of these sites disappear. Some changes in vegetation structure and composition caused by deforestation may disrupt those interactions and change bird community composition [55, 56]. The conservation, restoration, and ecological studies of Brazilian Savanna represent important actions for conservation in this biome.

Table 1. List of the bird species registered in this study and presented in the taxonomic order by Brazilian Ornithological Records Committee [28] with English names, Point Abundance Index and Trophic Guilds (TG): aerial insectivores (AI), canopy frugivores (CF), canopy insectivores (CI), canopy omnivores (CO), edge carnivores (EC), open-area detritivores (OD), edge insectivores (EI), edge omnivores (EO), edge gramnivores (EG), nectarivores (NI), open-area insectivores (OI), riparian carnivores (RC), swamp omnivores (SO), understory frugivores (UF), understory insectivores (UI), and understory omnivores (UO).

ORDER **Family** Taxon names	**English names**	**TG**	**Point Abundance Index**	
			Summer	**Winter**
TINAMIFORMES				
Tinamidae				
Crypturellus undulatus	Undulated Tinamou	EO	-	0.0185
Crypturellus parvirostris	Small-billed Tinamou	EO	0.0093	-
ANSERIFORMES				
Anatidae				
Amazonetta brasiliensis	Brazilian Teal	SO	0.0185	-
GALLIFORMES				
Cracidae				
Penelope superciliaris	Rusty-margined Guan	UF	0.0278	-
PELECANIFORMES				
Ardeidae				
Tigrisoma lineatum	Rufescent Tiger-Heron	RC	-	0.0093
Threskiornithidae				
Theristicus caudatus	Buff-necked Ibis	OI	0.0185	-

CATHARTIFORMES				
Cathartidae				
Coragyps atratus	Black Vulture	OD	0.0370	0.0833
ACCIPITRIFORMES				
Accipitridae				
Gampsonyx swainsonii	Pearl Kite	EC	0.0185	-
Ictinia plumbea	Plumbeous Kite	EC	0.0093	0.0093
Rupornis magnirostris	Roadside Hawk	EC	0.0370	0.0278
GRUIFORMES				
Aramidae				
Aramus guarauna	Limpkin	RC	-	0.0185
COLUMBIFORMES				
Columbidae				
Columbina talpacoti	Ruddy Ground-Dove	EG	0.0093	0.0185
Columbina squammata	Scaled Dove	EG	0.0463	0.0278
Patagioenas picazuro	Picazuro Pigeon	EG	0.0463	0.0556
Leptotila verreauxi	White-tipped Dove	EO	0.0278	-
CUCULIFORMES				
Cuculidae				
Piaya cayana	Squirrel Cuckoo	CI	0.0463	0.0463
Crotophaga major	Greater Ani	EI	0.0556	0.0741
Crotophaga ani	Smooth-billed Ani	EI	0.0833	0.1481
Guira guira	Guira Cuckoo	EI	0.1296	0.1852
APODIFORMES				
Trochilidae				
Phaethornis pretrei	Planalto Hermit	NI	0.0185	-
Eupetomena macroura	Swallow-tailed Hummingbird	NI	0.0278	-
Chlorostilbon lucidus	Glittering-bellied Emerald	NI	0.0185	-
Leucochloris albicollis	White-throated Hummingbird	NI	0.0185	0.0185

Amazilia versicolor	Versicolored Emerald	NI	-	0.0093
TROGONIFORMES				
Trogonidae				
Trogon curucui	Blue-crowned Trogon	EI	-	0.0093
CORACIIFORMES				
Alcedinidae				
Chloroceryle americana	Green Kingfisher	RC	0.0278	0.0370
Momotidae				
Momotus momota	Amazonian Motmot	UO	0.0185	-
GALBULIFORMES				
Galbulidae				
Galbula ruficauda	Rufous-tailed Jacamar	EI	0.0556	-
PICIFORMES				
Ramphastidae				
Ramphastos toco	Toco Toucan	CO	0.0370	0.0370
Picidae				
Melanerpes cruentatus	Yellow-tufted Woodpecker	EO	-	0.0093
Veniliornis passerinus	Little Woodpecker	EI	0.0370	0.0093
Dryocopus lineatus	Lineated Woodpecker	EI	0.0278	0.0185
FALCONIFORMES				
Falconidae				
Caracara plancus	Southern Caracara	EO	0.0463	0.0741
Milvago chimachima	Yellow-headed Caracara	EC	0.0741	0.0278
Falco sparverius	American Kestrel	EC	0.0556	0.0278
PSITTACIFORMES				
Psittacidae				
Ara ararauna	Blue-and-yellow Macaw	CF	0.0556	-
Diopsittaca nobilis	Red-shouldered Macaw	CF	0.1759	0.0463
Eupsittula aurea	Peach-fronted Parakeet	CF	0.1389	0.0370

Psittacara leucophthalmus	White-eyed Parakeet	CF	0.0833	0.0741
Forpus xanthopterygius	Blue-winged Parrotlet	CF	0.2037	0.1296
Brotogeris chiriri	Yellow-chevroned Parakeet	CF	-	0.0185
PASSERIFORMES				
Thamnophilidae				
Dysithamnus mentalis	Plain Antvireo	UI	0.0370	-
Thamnophilus doliatus	Barred Antshrike	UI	0.0278	0.0278
Thamnophilus pelzelni	Planalto Slaty-Antshrike	UI	-	0.0185
Taraba major	Great Antshrike	UI	-	0.0185
Dendrocolaptidae				
Xiphorhynchus guttatoides	Lafresnaye's Woodcreeper	UI	-	0.0093
Furnariidae				
Furnarius rufus	Rufous Hornero	EI	0.0926	0.0278
Synallaxis albescens	Pale-breasted Spinetail	UI	0.0556	0.0278
Tityridae				
Tityra cayana	Black-tailed Tityra	CF	-	0.0185
Pachyramphus polychopterus	White-winged Becard	UI	0.0093	-
Rhynchocyclidae				
Tolmomyias sulphurescens	Yellow-olive Flycatcher	UI	-	0.0185
Todirostrum cinereum	Common Tody-Flycatcher	EI	0.0185	0.0278
Tyrannidae				
Camptostoma obsoletum	Southern Beardless-Tyrannulet	EO	0.0185	-
Elaenia flavogaster	Yellow-bellied Elaenia	EO	0.0093	-
Elaenia cristata	Plain-crested Elaenia	EO	0.0093	-
Myiopagis caniceps	Gray Elaenia	EO	0.0370	-
Serpophaga subcristata	White-crested Tyrannulet	EO	0.0463	-
Myiarchus swainsoni	Swainson's Flycatcher	EO	-	0.0185
Myiarchus ferox	Short-crested Flycatcher	EO	0.0648	0.0185
Pitangus sulphuratus	Great Kiskadee	EO	0.1574	0.1759

Philohydor lictor	Lesser Kiskadee	EI	0.0741	0.0556
Myiodynastes maculatus	Streaked Flycatcher	EO	0.0463	0.0370
Myiozetetes cayanensis	Rusty-margined Flycatcher	EO	0.0185	0.0463
Tyrannus melancholicus	Tropical Kingbird	EO	0.0648	0.0185
Empidonomus varius	Variegated Flycatcher	EO	0.0833	0.0278
Colonia colonus	Long-tailed Tyrant	EI	-	0.0463
Myiophobus fasciatus	Bran-colored Flycatcher	UI	0.0093	-
Megarynchus pitangua	Boat-billed Flycatcher	EO	0.0370	-
Vireonidae				
Cyclarhis gujanensis	Rufous-browed Peppershrike	EO	0.1111	0.1574
Corvidae				
Cyanocorax cyanomelas	Purplish Jay	CO	0.0648	0.0648
Hirundinidae				
Stelgidopteryx ruficollis	Southern Rough-winged Swallow	AI	0.0278	-
Troglodytidae				
Troglodytes musculus	Southern House Wren	EI	0.0463	0.0370
Campylorhynchus turdinus	Thrush-like Wren	EI	0.0370	0.0185
Parulidae				
Basileuterus culicivorus	Golden-crowned Warbler	UI	0.0556	-
Icteridae				
Cacicus cela	Yellow-rumped Cacique	EO	-	0.0926
Icterus pyrrhopterus	Variable Oriole	EO	-	0.0370
Icterus croconotus	Orange-backed Troupial	EO	-	0.0463
Thraupidae				
Paroaria capitata	Yellow-billed Cardinal	EO	0.0370	0.0278
Tangara sayaca	Sayaca Tanager	EO	0.2037	0.2037
Tangara palmarum	Palm Tanager	EO	0.1389	0.1667
Nemosia pileata	Hooded Tanager	EO	0.0648	-
Conirostrum speciosum	Chestnut-vented Conebill	EI	0.0741	0.0463

Coryphospingus cucullatus	Red-crested Finch	EO	-	0.0926
Tachyphonus rufus	White-lined Tanager	EO	-	0.0278
Ramphocelus carbo	Silver-beaked Tanager	EO	-	0.0463
Coereba flaveola	Bananaquit	EO	0.1667	0.0741
Fringillidae				
Euphonia chlorotica	Purple-throated Euphonia	EO	0.1111	-

Table 2. Number of bird species in different trophic guilds.

Trophic guilds	Number of species
Edge carnivores	05
Riparian carnivores	03
Total carnivores	**08**
Open-area detritivores	01
Total detritivores	**01**
Canopy frugivores	07
Understory frugivores	01
Total Frugivores	**08**
Aerial insectivores	01
Canopy insectivores	01
Edge insectivores	14
Open-area insectivores	01
Understory insectivores	10
Total Insectivores	**27**
Nectarivores	**05**
Canopy omnivores	02
Edge omnivores	31
Swamp omnivores	01
Understory omnivores	01
Total Omnivores	**35**
Edge gramnivores	03
Total Gramnivores	**03**
Total	**87**

Figure 2. (A) Cuiabá River, (B) Ciliary Forest that follows the Cuiabá River, where bird studies were conducted, and examples of birds registered in these studies: (C) Trogon curucui, (D) couple of the woodpecker specie Dryocopus lineatus, (E) Icterus croconotus, (F) Blue-and-yellow Macaw Ara ararauna, (G) Cyanocorax cyanomelas, (H) Hawk Rupornis magnirostris

4. CONCLUSIONS

The forest remnants that present the study area appear to contribute effectively to the high birds' species richness. The results of this study showed evidence that Savanna forest remnants are significantly important in Cuiabá River basin studied areas as an available habitat for birds.

Among the trophic guilds analyzed, understory insectivores are particularly sensitive to habitat disturbance and fragmentation. Bird species less affected by forest fragmentation are, in general, those that use the forest edge. The impacts of forest fragmentation, even for a group with a notorious dispersion power such as that of birds, cause a territorial decrease, thus influencing a series of blocks to the interactions that this group presents concerning the environment. Most of the species that are very sensitive to anthropogenic changes were generally registered in large forest fragments, but with a reduced number in populations. Many of these bird species have probably disappeared from most small forest fragments. One of the greatest threats to biological diversity is the loss of habitats, due to fragmentation, which changes the dynamics of the area by increasing its amount of border. Analyzing the fragmentation and the size of the forest fragments existing in the study areas, the lack of connection between them, and the degree of anthropism, it is likely that the population dynamics of many bird species recorded in this study is already seriously compromised.

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