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Birds of Serra de Santo Antônio State Park, Campo Maior, Piauí, Brazil

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ABSTRACT

This study was motivated by the need to understand the diversity, structure and conservation of the bird community in the Serra de Santo Antônio State Park, contributing to scientific knowledge, the elaboration of the Management Plan and the formulation of management strategies conservation. Its objectives were to identify which bird species are present in the area, what the structure and diversity of this community is like and how the species are distributed in the different trophic guilds. This study is aimed at researchers, managers of Conservation Units, ornithologists, and professionals involved in biodiversity conservation strategies in Caatinga, providing relevant information for decision-making. Two sampling campaigns were conducted during the dry and rainy seasons, using the Point Abundance Index (IPA) method, covering 105 sampling points, recording 161 birds species, of which six species are endemic to the Caatinga and one to the Cerrado. The bird community was characterized by high diversity, with a predominance of insectivorous species. No species were classified as threatened at the national level, but two were categorized as near-threatened globally. The results indicate the importance of the Serra de Santo Antônio State Park for the conservation of local avifauna and the presence of endemic species emphasizes the need for specific conservation measures, especially in the face of threats associated with deforestation, habitat loss, hunting, and illegal trade. The study contributes to the understanding of biodiversity in the region and provides support for effective preservation strategies.

Keywords: Birds, diversity, community structure, Conservation.

Aves do Parque Estadual da Serra de Santo Antônio, Campo Maior, Piauí, Brasil

RESUMO

Este estudo foi motivado pela necessidade de compreender a diversidade, estrutura e conservação da comunidade de aves no Parque Estadual da Serra de Santo Antônio, contribuindo para o conhecimento científico, a elaboração do Plano de Manejo e a formulação de estratégias de conservação. Teve como objetivos identificar quais espécies de aves estão presentes na área, como é a estrutura e diversidade dessa comunidade e como as espécies estão distribuídas nas diferentes guildas tróficas. Este estudo destina-se a pesquisadores, gestores de Unidades de Conservação, ornitólogos, e profissionais envolvidos em estratégias de preservação da biodiversida da Caatinga, fornecendo informações relevantes para tomadas de decisão. Foram conduzidas duas campanhas de amostragem durante as estações seca e chuvosa, utilizando o método de índice pontual de abundância (IPA), abrangendo 105 pontos amostrais, registrando 161 espécies de aves, destas seis são endêmicas da Caatinga e uma do Cerrado. A comunidade de aves foi caracterizada por uma alta diversidade, com predominância de espécies insetívoras. Nenhuma espécie foi classificada como ameaçada de extinção a nível nacional, mas duas foram categorizadas como quase ameaçadas de extinção a nível global. Os resultados indicam a importância do Parque Estadual da Serra de Santo Antônio para a conservação da avifauna, e a presença de espécies endêmicas ressalta a necessidade de medidas de conservação específicas, especialmente diante das ameaças associadas ao desmatamento, que leva à perda do habitat, à caça e ao comércio ilegal. O estudo contribui para o entendimento da biodiversidade na região e oferece subsídios para estratégias eficazes de preservação.

Palavras-chave**:** Avifauna, diversidade, estrutura da comunidade, Conservação.

Introduction

Brazil is home to one of the most diverse birds in the world, totaling approximately 1,971 species, including both residents and migratory birds (Pacheco et al., 2021). This richness is distributed across the entire Brazilian territory, showcasing a variety of specificities concerning feeding habits, reproduction, and habitat

preferences (Stotz, 1996; Sick, 1997). However, there are still numerous gaps in understanding of the bird community that have not been fully addressed, particularly in certain regions of the country (Piacentini et al., 2015; Pacheco et al., 2021).

In the Brazilian Northeast, specifically within the Caatinga biome, approximately 548 bird species have been cataloged, encompassing residents, visitors, and migratory species distributed throughout the complex vegetation gradient that defines this biome (Araújo e Silva, 2017; MMA, 2019). However, there is currently a significant debate regarding the true biodiversity of birds within the biome (Lima, 2021; Araújo et al., 2022).

Survey studies play a crucial role in identifying bird biodiversity and assessing potential changes in species in response to environmental alterations (Silveira et al., 2010). When it comes to conservation units, it is of utmost importance to identify present species and quantify them through faunal inventories. This tool is essential for the development of management and conservation strategies, as well as for making informed decisions (Silva, 2005).

In the state of Piauí, vegetation formations are influenced by different domains, such as the Amazon, Cerrado, and Caatinga, resulting in a significant diversity of ecosystems (CEPRO, 1996). Approximately 19% of the Piauí state's territory consists of transitional areas. Within these areas, a type of vegetation known as Campo Maior Complex stands out (Rivas, 1996), representing the largest phytogeographical domain in the Parnaíba River basin. The highest concentration of this vegetation type is found in the geo-environmental units of Vale do Gurguéia, Tabuleiros do Parnaíba, and Baixada de Campo Maior. This is an environment prone to frequent flooding, characterized by a transitional nature with a tendency towards instability. These characteristics highlight the dynamic and evolving nature of the landscape, influenced by factors such as water levels and ecological transitions.

The Serra de Santo Antônio State Park is part of the Vegetation Complex of Campo Maior, an area characterized by ecological tension, showcasing a diversity already cataloged in terms of floristic composition (Farias e Castro, 2004; Farias, 2003). However, studies related to wildlife are still limited (Sousa et al., 2016). In this context, the objective of this research was to conduct an inventory of the bird community present in the area of the State Park Serra de Santo Antônio, located in Campo Maior, Piauí, Brazil. The research focused on characterizing the degree of endemism, sensitivity, trophic structure, and conservation aspects of the local avifauna.

Material and Methods

Study Area

The Serra de Santo Antônio State Park was established by decree 18,345 on July 8, 2019, covering an area of approximately 4,000 hectares and integrating into the Territory of Carnaubais (Ivanov, 2020). The Campo Maior Vegetation Complex, where the State Park is located, is an area of ecological tension, characterized by significant biological diversity and varied floristic composition (Farias, 2003). This area allows for diverse arrangements and structures, encompassing different phytophysiognomies such as Cocais Forest, Caatinga, and Cerrado (Sousa et al., 2009; Farias and Castro, 2004). In this research, various areas were sampled between the Caatinga and Cerrado biomes with different conservation states (Figure 1).

Data Collection

To survey the avifauna in the area of the State Park, two sampling campaigns were conducted between August 21 and 28, 2021 (dry season) and February 2 to 9, 2022 (rainy season), totaling 100 hours of sampling effort. Sampling primarily occurred at dawn, as it corresponds to the peak activity of neotropical birds (Sick, 1997). Eight transects were selected to represent different phytophysiognomies in the region, with a total of 105 sampling points (IPA).

The field survey employed the IPA method, where equidistant points were marked at 200-meter intervals. The time spent at each point was 10 minutes, considered appropriate for recording a relevant number of species in neotropical regions (Bibby et al., 1993; O'dea et al., 2004; Vielliard et al., 2010). During the 10 minutes, all observed and/or heard bird species were recorded, along with the estimated number of individuals for each species. The relative abundance of species was obtained by calculating the IPA, which corresponds to the total number of contacts obtained for a particular species divided by the total number of samples (Vielliard et al., 2010).

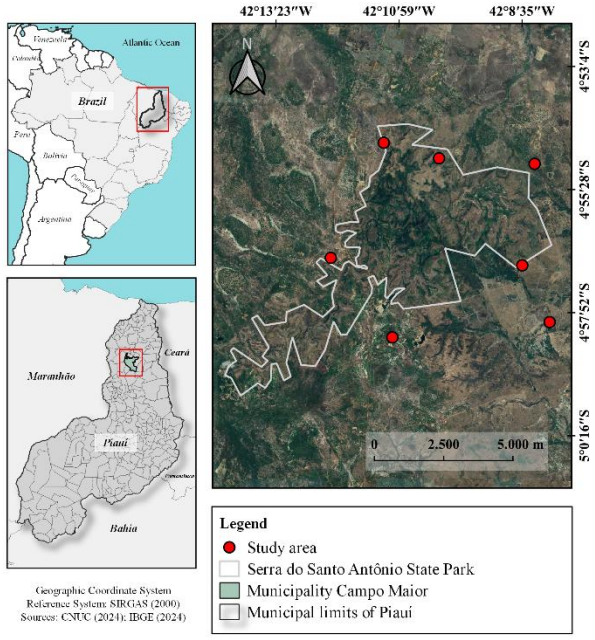

Figure 1. Location map of the Serra de Santo Antônio State Park, Campo Maior, Piauí, Brazil.

The trophic guilds of species were determined following Sick (1997). The degree of endemism for the Caatinga followed Silva et al. (2003) and Araújo and Silva (2017), and at the national level, Pacheco et al. (2021). Species were also classified based on their sensitivity to anthropogenic disturbances high, medium, or low sensitivity (Araújo e Silva, 2017; Silva et al., 2003).

Scientific nomenclature followed the list of the Brazilian Ornithological Records Committee - CBRO (Pacheco et al., 2021). Conservation status was verified through the International Union for Conservation of Nature (IUCN, 2022).

Data Analysis

Statistical analyses were employed to obtain the Shannon-Wiener Diversity Index (H') and Pielou's Evenness (J'). The Shannon index (H') and Pielou's evenness (J) are widely used to assess the diversity and ecological dominance of tree species communities. The higher the value of (H'), the greater the diversity. On the other hand, (J') ranges from 0 to 1, with the maximum value indicating a situation where all species have the same number of individuals, which would mean the absence of ecological dominance (Magurran, 2004). Species diversity estimation was assessed using the non-parametric Jackknife I estimator, calculated through the *EstimateS 9.10 Software* (Colwell, 2013).

Results and Discussion

Over 16 days of sampling, a total of 161 bird species were recorded in the area of the Serra de Santo Antônio State Park, distributed across 21 orders and 43 families (Table 1). Data collection occurred in two periods, the dry season in August and the rainy season in February. During the dry season, a total of 137 species were recorded, and during the rainy season, an additional 24 species were added to this list, totaling 161 bird species for the park area.

When comparing these results with other studies conducted in the same region, it is observed that the number of species is representative and within the expected range for the region. For example, 238 bird species were recorded for the Sete Cidades National Park (Santos et al., 2013), 138 species for the Ubajara National Park (Nascimento, 2022), and 174 species for the Serra das Almas (Farias et al., 2005). Studies conducted exclusively in the Caatinga biome have proven to be equally representative, e.g., 209 species recorded in eight Caatinga areas across the states of Ceará and Pernambuco (Olmos et al., 2005), 236 species recorded in the Serra da Capivara National Park (Olmos e Albano, 2012), 225 species recorded in the Serra das Confusões National Park (Santos and Silveira, 2012), and 179 species recorded in Serra Vermelha, in the southern region of the state of Piauí (Santos et al., 2012).

The rarefaction curve obtained through the Jackknife I richness estimator showed that more unrecorded species are likely to occur in the area. Thus, a total richness of 196 bird species can be estimated for the study area, with 82% of the estimated richness recorded (Figure 2).

Several factors can impact bird richness, distribution, and diversity in the Caatinga biome, such as fluctuations in food availability (Silva et al., 2003), habitat heterogeneity (Ricklefs e Lovette, 1999; Kodmon e Allouche, 2007), and climatic variations (Cueto, 2005; Marra et al., 2005), influencing food availability, nesting sites, vegetation cover, among other factors (Dean et al., 2009). Additionally, anthropogenic disturbances to the landscape have a consistent negative effect on the richness, diversity, and functional distribution of birds, potentially endangering their ecological functions and threatening ecosystem resilience (Matuoka et al., 2020; Callaghan et al., 2024).

In the Serra de Santo Antônio State Park area, we recorded six out of the 22 species considered endemic to the Caatinga: *Picumnus pygmaeus* (Little Spotted Woodpecker), *Pseudoseisura cristata* (Crested Black-Tyrant),

Icterus jamacaii (Campo Troupial), *Agelaioides fringillarius* (Pale-faced Blackbird), *Paroaria dominicana* (Red-cowled Cardinal), and *Sporophila albogularis* (White-throated Seedeater). These species are more generalist and are easily found in anthropized environments.

On the other hand, the predominant vegetation in the Campo Maior complex consists of herbaceous vegetation with a savanna-like African appearance, including carnauba palm groves in flooded plains, known as *Copernicia* savannas (Castro et al., 1998). This likely explains the absence of records of Caatinga species found about 100 km east of Serra de Santo Antonio, in the municipalities of Crateus and Ibiporanga, such as *Aratinga cactorum* (Cactus Parakeet), *Sakesphorus cristatus* (Silvery-cheeked Antshrike), *Hylopezus ochroleucus* (White-browed Antpitta), *Megaxenops parnaguae* (Great Xenops), *Synallaxis hellmayri* (Red-shouldered Spinetail), *Myrmochilus strigilatus* (Stripe-backed Antbird), *Anopetia gounellei* (Broad-tipped Hermit), *Xiphocolaptes falcirostris* (Moustached Woodcreeper), and *Heliomaster squamosus* (Stripe-breasted Starthroat).

On the other hand, only one endemic species of the Cerrado biome was recorded: *Saltatricula atricollis* (Black-collared Tanager). Others, although not endemic, have a wide distribution in the biome and are typical components of the Cerrado avifauna, such as *Cariama cristata* (Red-legged Seriema), *Eupsittula aurea* (Peach-fronted Parakeet), *Nystalus maculatus* (Spot-backed Puffbird), *Lepidocolaptes angustirostris* (Narrow-billed Woodcreeper), *Poecilotriccus fumifrons* (Smoky-fronted Tody-Flycatcher), *Elaenia flavogaster* (Yellow-bellied Elaenia), *Suiriri suiriri* (Suiriri Flycatcher), *Coryphospingus pileatus* (Pileated Finch), *Pachyramphus validus* (Crested Becard), *Casiornis fuscus* (Ash-throated Casiornis), *Casiornis rufus* (Rufous Casiornis), *and Schoeniophylax phryganophilus* (Chotoy Spinetail). The park presents a floristic composition typical of the Cerrado biome in Piauí and the east of Maranhão. However, this transitional nature of the areas found in the park and the difficulty of fitting them into a single biome are accentuated by the absence of floristic surveys for other regions of the Campo Maior Complex (Farias e Castro, 2003).

This same ecotonal pattern is also observed in the Seven Cities National Park, where floristically, the park shows little specific variation, with Cerrado being the dominant type, interrupted by open flooded fields. However, in terms of faunistic composition, the park has more species of endemic birds from the Caatinga biome (Santos et al., 2013). This observed pattern may be related to habitat use, where about 90 recorded bird species are independent, and 43 species are semi-dependent on forest environments. Among the species independent of forest environments, endemic species of the Caatinga biome were recorded, such as *Sporophila albogularis* (White-throated Seedeater), *Agelaioides fringillarius* (Pale-faced Blackbird), and *Paroaria dominicana* (Red-cowled Cardinal).

Out of the total number of bird species recorded, only 28 species are dependent on forest environments, such as *Picumnus pygmaeus* (Little Spotted Woodpecker), *Crypturellus tataupa* (Tataupa Tinamou), *Penelope superciliaris* (Rufous-bellied Guan), *Sarcoramphus papa* (King Vulture), *Amazona aestiva* (Blue-fronted Parrot), and *Pachyramphus validus* (Black-capped Becard) (Table 1). These forest-dependent species were recorded on the slopes of Serra de Santo Antônio, where the predominant vegetation is shrubby-arboreal with cerrado elements (Velloso et al., 2002).

The large number of species recorded belonging to the families Tyrannidae (n=26 spp.), Thraupidae (n=15), and Columbidae (n=10) is a pattern observed in other bird communities in the Caatinga biome, marginal cerrados in the Northeast, and ecotonal areas between these two biomes (Telino-Júnior et al., 2005; Roos et al., 2006, Nascimento et al., 2000; Santos, 2004, Santos et al., 2013). The prevalence of species from the Tyrannidae family is not surprising, as it is the largest bird family in the western hemisphere, occupying various types of environments and encompassing most of the species found in the country (Sick, 1997).

Table 1. List of bird species recorded in the Serra de Santo Antônio State Park area. Legend: Sensitivity: (A) high adaptive capacity to environmental disturbances, (M) medium adaptive capacity; (B) low adaptive capacity. Endemism: **R** (Resident); **E** (Endemic); **CAA** (Caatinga Endemic); **CE** (Endemic to the cerrado). Conservation *Status* (IUCN, 2022): **LC** (Least Concern); **NT** (Near Threatened). Guild: **FR** (Frugivores); **ON (**Omnivores); **PSI** (Psivores); **CAR** (Carnivores); **DENT** (Dendrivores); **INV** (Invertebrates); **GRAN** (Granivores); **NECT** (Nectarivores).

Taxon name/Order/Family/Species	**Popular name**	**Endemism**	**Conservacion Status IUCN (2022)**	**Sensitivity**	**Guild**
BIRDS					
Tinamiformes					
Tinamidae					
Crypturellus parvirostris (Wagler, 1827)	Inhambu-chororó	R	LC	A	FR
Crypturellus tataupa (Temminck, 1815)	Inhambu-chintã	R	LC	B	FR
Nothura boraquira (Spix, 1825)	Codorna-do-nordeste	R	LC	A	FR
Anseriformes					
Anatidae					
Dendrocygna viduata (Linnaeus, 1766)	Irerê	R	LC	M	ON
Dendrocygna autumnalis (Linnaeus, 1758)	Marreca-cabocla	R	LC	M	ON
Galliformes					
Cracidae					
Penelope superciliaris (Temminck, 1815)	Jacupemba	R	LC	B	FR
Ortalis superciliaris (Gray, 1867)	Aracuã-de-Sobrancelhas	R, E	LC	M	FR
Pelecaniformes					
Ardeidae					
Bubulcus ibis (Linnaeus, 1758)	Garça-vaqueira	R	LC	A	PSI
Butorides striata (Linnaeus, 1758)	Socozinho	R	LC	A	PSI
Ardea alba (Linnaeus, 1758)	Garça-branca	R	LC	A	PSI
Egretta thula (Molina, 1782)	Garça-branca-pequena	R	LC	A	PSI
Threskiornithidae					
Theristicus caudatus (Boddaert, 1783)	Curicaca	R	LC	A	CAR
Cathartiformes					

Cathartidae					
Sarcoramphus papa (Linnaeus, 1758)	Urubu-rei	R	LC	B	DENT
Cathartes aura (Linnaeus, 1758)	Urubu-de-cabeça-vermelha	R	LC	A	DENT
Cathartes burrovianus (Cassin, 1845)	Urubu-de-cabeça-amarela	R	LC	A	DENT
Coragyps atratus (Bechstein, 1793)	Urubu	R	LC	A	DENT
Accipitriformes					
Accipitridae					
Gampsonyx swainsonii (Vigors, 1825)	Gaviãozinho	R	LC	A	CAR
Heterospizias meridionalis (Latham, 1790)	Gavião-caboclo	R	LC	A	CAR
Rupornis magnirostris (Gmelin, 1788)	Gavião-carijó	R	LC	A	CAR
Geranospiza caerulescens (Vieillot, 1817)	Gavião-pernilongo	R	LC	M	CAR
Gruiformes					
Rallidae					
Aramides cajaneus (Statius Muller, 1776)	Saracura-três-potes	R	LC	M	ON
Charadriiformes					
Charadriidae					
Vanellus cayanus (Latham, 1790)	Mexeriqueira	R	LC	A	ON
Vanellus chilensis (Molina, 1782)	Quero-quero	R	LC	A	ON
Jacanidae					
Jacana jacana (Linnaeus, 1766)	Jaçanã	R	LC	A	INV
Columbiformes					
Columbidae					
Columbina passerina (Linnaeus, 1758)	Rolinha-cinzenta	R	LC	A	GRAN
Columbina minuta (Linnaeus, 1766)	Rolinha-de-asa-canela	R	LC	A	GRAN
Columbina talpacoti (Temminck, 1811)	Rolinha	R	LC	A	GRAN
Columbina squammata (Lesson, 1831)	Fogo-apagou	R	LC	A	GRAN
Columbina picui (Temminck, 1813)	Rolinha-picui	R	LC	A	GRAN
Uropelia campestris (Spix, 1825)	Rolinha-vaqueira	R	LC	M	GRAN
Patagioenas picazuro (Temminck, 1813)	Asa-branca	R	LC	M	GRAN
Zenaida auriculata (Des Murs, 1847)	Avoante	R	LC	A	GRAN

Leptotila verreauxi (Bonaparte, 1855)	Juriti-pupu	R	LC	M	GRAN
Leptotila rufaxilla (Richard & Bernard, 1792)	Juriti-de-testa-branca	R	LC	B	GRAN
Cuculiformes					
Cuculidae					
Piaya cayana (Linnaeus, 1766)	Alma-de-gato	R	LC	M	INV
Crotophaga major (Gmelin, 1788)	Anu-coroca	R	LC	M	INV
Crotophaga ani (Linnaeus, 1758)	Anu-preto	R	LC	A	INV
Guira guira (Gmelin, 1788)	Anu-branco	R	LC	A	INV
Tapera naevia (Linnaeus, 1766)	Saci	R	LC	A	INV
Strigiformes					
Strigidae					
Megascops choliba (Vieillot, 1817)	Corujinha-do-mato	R	LC	A	INV
Glaucidium brasilianum (Gmelin, 1788)	Caburé	R	LC	M	CAR
Athene cunicularia (Molina, 1782)	Coruja-buraqueira	R	LC	A	CAR
Caprimulgiformes					
Caprimulgidae					
Nyctidromus albicollis (Gmelin, 1789)	Bacurau	R	LC	M	INV
Hydropsalis parvula (Gould, 1837)	Bacurau-chintã	R	LC	A	INV
Hydropsalis torquata (Gmelin, 1789)	Bacurau-tesoura	R	LC	A	INV
Nannochordeiles pusillus (Gould, 1861)	Bacurauzinho	R	LC	A	INV
Apodiformes					
Apodidae					
Tachornis squamata (Cassin, 1853)	Andorinhão-do-buriti	R	LC	A	INV
Trochilidae					
Eupetomena macroura (Gmelin, 1788)	Beija-flor-tesoura	R	LC	A	NEC
Chlorostilbon lucidus (Shaw, 1812)	Besourinho-de-bico-vermelho	R	LC	M	NEC
Thalurania furcata (Gmelin, 1788)	Beija-flor-tesoura-verde	R	LC	M	NEC
Polytmus guainumbi (Pallas, 1764)	Beija-flor-de-bico-curvo	R	LC	M	NEC
Amazilia fimbriata (Gmelin, 1788)	Beija-flor-de-garganta-verde	R	LC	M	NEC
Trogoniformes					

Trogonidae					
Trogon curucui (Linnaeus, 1766)	Surucuá-de-barriga-vermelha	R	LC	B	INV
Coraciiformes					
Alcedinidae					
Megaceryle torquata (Linnaeus, 1766)	Martim-pescador-grande	R	LC	M	PSI
Chloroceryle amazona (Latham, 1790)	Martim-pescador-verde	R	LC	M	PSI
Galbuliformes					
Galbulidae					
Galbula ruficauda (Cuvier, 1816)	Ariramba	R	LC	M	INV
Família Bucconidae					
Nystalus maculatus (Gmelin, 1788)	Rapazinho-dos-velhos	R, E	LC	M	INV
Piciformes					
Ramphastidae					
Ramphastos toco (Statius Muller, 1776)	Tucanuçu	R	LC	M	ON
Picidae					
Picumnus pygmaeus (Lichtenstein, 1823)	Picapauzinho-pintado	R, CAA, E	LC	B	INV
Melanerpes candidus (Otto, 1796)	Pica-pau-branco	R	LC	A	INV
Dryobates passerinus (Linnaeus, 1766)	Pica-pau-pequeno	R	LC	A	INV
Colaptes melanochloros (Gmelin, 1788)	Pica-pau-verde-barrado	R	LC	A	INV
Colaptes campestris (Vieillot, 1818)	Pica-´pau-do-campo	R	LC	A	INV
Celeus ochraceus (Spix, 1824)	Pica-pau-ocráceo	R	LC	B	INV
Dryocopus lineatus (Linnaeus, 1766)	Pica-pau-de-banda-branca	R	LC	M	INV
Campephilus melanoleucos (Gmelin, 1788)	Pica-pau-de-topete-vermelho	R	LC	B	INV
Cariamiformes					
Cariamidae					
Cariama cristata (Linnaeus, 1766)	Seriema	R	LC	A	CAR
Falconiformes					
Falconidae					
Caracara plancus (Miller, 1777)	Caracará	R	LC	A	CAR
Milvago chimachima (Vieillot, 1816)	Carrapateiro	R	LC	A	CAR

Herpetotheres cachinnans (Linnaeus, 1758)	Acauã	R	LC	A	CAR
Micrastur ruficollis (Vieillot, 1817)	Falcão-caburé	R	LC	B	CAR
Psittaciformes					
Psittacidae					
Primolius maracana (Vieillot, 1816)	Maracanã	R	NT	M	FR
Eupsittula aurea (Gmelin, 1788)	Periquito-rei	R	LC	A	FR
Forpus xanthopterygius (Spix, 1824)	Tuim	R	LC	A	FR
Amazona aestiva (Linnaeus, 1758)	Papagaio-verdadeiro	R	NT	B	FR
Passeriformes					
Thamnophilidae					
Formicivora melanogaster (Pelzeln, 1868)	Formigueiro-de-barriga-preta	R	LC	M	INV
Herpsilochimus atricapillus (Pelzeln, 1868)	Chorozinho-de-chapéu-preto	R	LC	B	INV
Thamnophilus doliatus (Linnaeus, 1764)	Choca-barrada	R	LC	B	INV
Thamnophilus pelzelni (Hellmayr, 1924)	Choca-do-planalto	R, E	LC	B	INV
Taraba major (Vieillot, 1816)	Choró-boi	R	LC	A	INV
Dendrocolaptidae					
Sittasomus griseicapillus (Vieillot, 1818)	Arapaçu-verde	R	LC	B	INV
Campylorhamphus trochilirostris (Lichtenstein, 1820)	Arapaçu-beija-flor	R	LC	B	INV
Dendroplex picus (Gmelin, 1788)	Arapaçu-de-bico-branco	R	LC	B	INV
Lepidocolaptes angustirostris (Vieillot, 1818)	Arapaçu-de-cerrado	R	LC	A	INV
Furnariidae					
Furnarius figulus (Lichtenstein, 1823)	Casaca-de-couro-da-lama	R	LC	A	INV
Furnarius leucopus (Swainson, 1838)	Casaca-de-couro-amarelo	R	LC	A	INV
Pseudoseisura cristata (Spix, 1824)	Casaca-de-couro	R, CAA, E	LC	A	INV
Schoeniophylax phryganophilus (Vieillot, 1817)	Bichoita	R	LC	A	INV
Certhiaxis cinnamomeus (Gmelin, 1788)	Curutié	R	LC	A	INV
Synallaxis frontalis (Pelzeln, 1859)	Petrim	R	LC	A	INV
Synallaxis albescens (Temminck, 1823)	Uí-pi	R	LC	A	INV
Synallaxis scutata (Sclater, 1859)	Estrelinha-preta	R	LC	M	INV

Tityridae					
Pachyramphus viridis (Vieillot, 1816)	Caneleiro-verde	R	LC	M	INV
Pachyramphus polychopterus (Vieillot, 1818)	Caneleiro-preto	R	LC	M	INV
Pachyramphus validus (Lichtenstein, 1823)	Caneleiro-de-chapéu-preto	R	LC	B	INV
Rhynchocyclidae					
Tolmomyias flaviventris (Wied, 1831)	Bico-chato-amarelo	R	LC	B	INV
Todirostrum cinereum (Linnaeus, 1766)	Ferreirinho-relógio	R	LC	A	INV
Poecilotriccus fumifrons (Hartlaub, 1853)	Ferreirinho-de-testa-parda	R	LC	A	INV
Hemitriccus margaritaceiventer (d'Orbigny & Lafresnaye, 1837)	Sebinho-de-olho-de-ouro	R	LC	A	INV
Tyrannidae					
Hirundinea ferruginea (Gmelin, 1788)	Gibão-de-couro	R	LC	A	INV
Euscarthmus meloryphus (Wied, 1831	Barulhento	R	LC	A	INV
Camptostoma obsoletum (Temminck, 1824)	Risadinha	R	LC	A	INV
Elaenia flavogaster (Thunberg, 1822)	Guaracava-de-barriga-amarela	R	LC	M	INV
Suiriri suiriri (Vieillot, 1818)	Sauiriri-cinzendo	R	LC	A	INV
Myiopagis viridicata (Vieillot, 1817)	Guaracava-de-crista-alaranjada	R	LC	B	INV
Phaeomyias murina (Spix, 1825)	Bagageiro	R	LC	A	INV
Myiarchus swainsoni (Cabanis & Heine, 1859)	Irré	R	LC	A	INV
Myiarchus ferox (Gmelin, 1789)	Maria-cavaleira	R	LC	M	INV
Myiarchus tyrannulus (Statius Muller, 1776)	Maria-cavaleira-de-rabo-enferrujado	R	LC	M	INV
Casiornis rufus (Vieillot, 1816)	Maria-ferrugem	R	LC	B	INV
Casiornis fuscus (Sclater & Salvin, 1873)	Caneleiro-enxofre	R	LC	B	INV
Pitangus sulphuratus (Linnaeus, 1766)	Bem-te-vi	R	LC	A	ON
Myiodynastes maculatus (Statius Muller, 1776)	Bem-te-vi-rajado	R	LC	B	INV
Machetornis rixosa (Vieillot, 1819)	Suiriri-cavaleiro	R	LC	A	INV
Megarynchus pitangua (Linnaeus, 1766)	Neinei	R	LC	A	INV
Myiozetetes cayanensis (Linnaeus, 1766)	Bentevizinho-de-asa-ferrugínea	R	LC	M	INV
Myiozetetes similis (Spix, 1825)	Bentevizinho-de-penacho-vermelho	R	LC	M	INV
Tyrannus melancholicus (Vieillot, 1819)	Suiriri	R	LC	A	INV

Empidonomus varius (Vieillot, 1818)	Peitica	R	LC	A	INV
Griseotyrannus aurantioatrocristatus (d'Orbigny & Lafresnaye, 1837)	Peitica-de-chapéu-preto	R	LC	A	INV
Sublegatus modestus (Wied, 1831)	Guaracava-modesta	R	LC	M	FR
Fluvicola nengeta (Linnaeus, 1766)	Lavadeira-mascarada	R	LC	A	INV
Cnemotriccus fuscatus (Wied, 1831)	Guaracavuçu	R	LC	B	INV
Lathrotriccus euleri (Cabanis, 1868)	Enferrujado	R	LC	B	INV
Xolmis velatus (Lichtenstein, 1823)	Noivinha	R	LC	M	INV
Vireonidae					
Cyclarhis gujanensis (Gmelin, 1789)	Pitiguari	R	LC	A	INV
Corvidae					
Cyanocorax cyanopogon (Wied, 1821)	Gralha-cancã	R, E	LC	M	ON
Hirundinidae					
Progne chalybea (Gmelin, 1789)	Andorinha-doméstica-grande	R	LC	A	INV
Tachycineta albiventer (Boddaert, 1783)	Andorinha-do-rio	R	LC	M	INV
Troglodytidae					
Troglodytes musculus (Naumann, 1823)	Corruíra	R	LC	A	ON
Cantorchilus longirostris (Vieillot, 1819)	Garrinchão-de-bico-grande	R	LC	B	INV
Polioptilidae					
Polioptila atricapilla (Swainson, 1831)	Balança-rabo-de-chapéu-preto	R	LC	A	INV
Turdidae					
Turdus leucomelas (Vieillot, 1818)	Sabiá-barranco	R	LC	A	ON
Turdus rufiventris (Vieillot, 1818)	Sabiá-laranjeira	R	LC	A	ON
Mimidae					
Mimus saturninus (Lichtenstein, 1823)	Sabiá-do-campo	R	LC	A	ON
Passerellidae					
Ammodramus humeralis (Bosc, 1792)	Tico-tico-do-campo	R	LC	A	GRAN
Icteridae					
Psarocolius decumanus (Pallas, 1769)	Japu	R	LC	M	FR
Procacicus solitarius (Vieillot, 1816)	Iraúna-de-bico-branco	R	LC	M	FR

Icterus pyrrhopterus (Vieillot, 1819)	Encontro	R	LC	M	FR
Icterus jamacaii (Gmelin, 1788)	Corrupião	R, CAA, E	LC	A	FR
Gnorimopsar chopi (Vieillot, 1819)	Pássaro-preto	R	LC	A	FR
Chrysomus ruficapillus (Vieillot, 1819)	Garibaldi	R	LC	A	FR
Agelaioides fringillarius (Spix, 1824)	Asa-de-telha-pálido	R, CAA, E	LC	A	FR
Molothrus rufoaxillaris (Cassin, 1866)	Chupim	R	LC	A	FR
Thraupidae					
Paroaria dominicana (Linnaeus, 1758)	Cardeal-do-nordeste	R, CAA, E	LC	A	GRAN
Thraupis sayaca (Linnaeus, 1766)	Sanhaçu-cinzento	R	LC	A	FR
Thraupis palmarum (Wied, 1821)	Sanhaçu-do-coqueiro	R	LC	M	FR
Stilpnia cayana (Linnaeus, 1766)	Saíra-amarela	R	LC	A	FR
Nemosia pileata (Boddaert, 1783)	Saíra-de-chapéu-preto	R	LC	B	FR
Compsothraupis loricata (Lichtenstein, 1819)	Tiê-caburé	R	LC	M	ON
Conirostrum speciosum (Temminck, 1824)	Figuinha-de-rabo-castanho	R	LC	B	INV
Sicalis flaveola (Linnaeus, 1766)	Canário-da-terra-verdadeiro	R	LC	A	GRAN
Coryphospingus pileatus (Wied, 1821)	Tico-tico-rei-cinza	R	LC	A	GRAN
Hemithraupis guira (Linnaeus, 1766)	Saíra-de-papo-preto	R	LC	B	FR
Volatinia jacarina (Linnaeus, 1766)	Tiziu	R	LC	A	GRAN
Coereba flaveola (Linnaeus, 1758)	Cambacica	R	LC	A	NEC
Sporophila lineola (Linnaeus, 1758)	Bigodinho	R	LC	A	GRAN
Sporophila albogularis (Spix, 1825)	Golinho	R, CAA, E	LC	A	GRAN
Saltatricula atricollis (Vieillot, 1817)	Batuqueiro	R, CE, E	LC	M	INV
Cardinalidae					
Piranga flava (Vieillot, 1822)	Sanhaçu-de-fogo	R	LC	M	FR
Fringillidae					
Euphonia chlorotica (Linnaeus, 1766)	Fim-fim	R	LC	A	FR

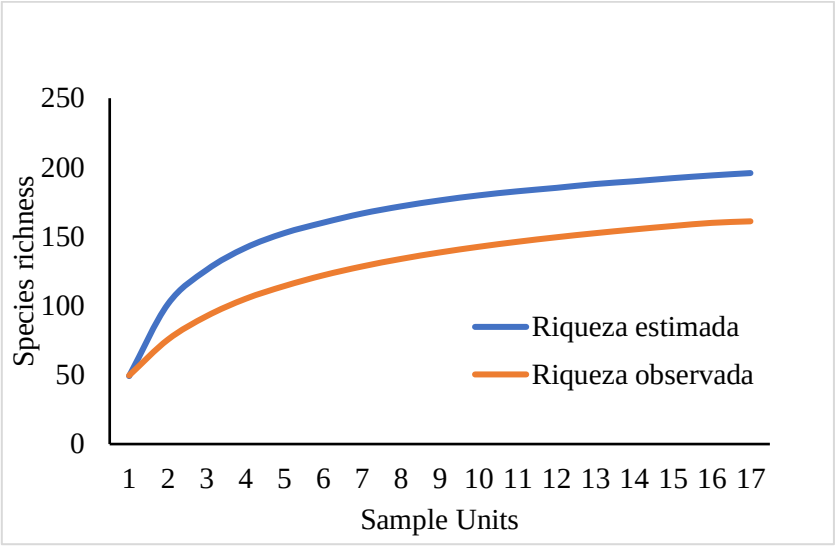

Figure 2. Rarefaction curve of bird species obtained in the area of the Serra de Santo Antônio State Park, Campo Maior, Piauí, Brazil. Source: Authors (2023).

The Shannon-Wiener diversity index was high (H'=4.17) when compared to values typically indicated for the bird group. According to Souto et al. (2008), Shannon's index values (H') can range from 0 to 5. For instance, Vielliard et al. (2010) recorded diversity values ranging from 3.31 to 4.43 in different regions of Brazil. In this sense, we suggest that in the study area, there is no greater dominance of groups over others, as diversity is high. The obtained equitability index (J'=0.82) was high, suggesting a uniform distribution concerning the number of individuals among the recorded species, with no dominant species in the study area.

According to Magurran (2004), H' values above 4 generally indicate well-preserved habitats and balanced ecosystems. In environments with strong anthropogenic influence, the indices tend to be lower due to species loss and the increased dominance of a few generalist species that are tolerant to disturbances (Ferreira et al., 2018). Therefore, the results may suggest that the area maintains a relatively high diversity, possibly due to the presence of heterogeneous habitats and abundant resources.

The absence of dominance by specific groups, indicated by the high evenness index (J′=0.82J' = 0.82J′=0.82), suggests that the recorded species share the environment's resources relatively evenly. Evenness values close to 1 indicate a more uniform distribution of individuals among species, while lower values suggest that some species dominate over others (Pielou, 1975).

High evenness may be related to the presence of multiple ecological niches and the diversity of available resources (Krebs, 1999). This can reflect a diverse vegetation structure, food availability, and distinct microhabitats in the study area, factors that promote species coexistence (Wiens, 1989). Moreover, low dominance may indicate a resilient ecosystem, with less impact from invasive species or severe environmental disturbances.

Several factors may contribute to the values observed in the study, including habitat heterogeneity (Martins and Santos, 2015), absence or low anthropogenic pressure (Ferreira et al., 2018), and ecological connectivity (Silva and Tabarelli, 2000).

Regarding the abundance index, we recorded a total of 2,777 contacts in the 105 IPAs, with an average of 26.44 contacts per sample. Among the species with the most contacts, *Eupsitulla aurea* (Golden Parakeet) (n=367 contacts) and *Columbina squammata* (Scaled Dove) (n=205) stand out. These results reflect the adaptability of these species to various types of environments, having an extensive ecological distribution, not restricted to a single location. Additionally, it's worth noting that these species occur in quite numerous flocks throughout their distribution.

Regarding trophic guilds, we identified a predominance of Insectivorous birds (n=78 spp.; 48.4%), followed by Frugivores (n=25; 15.5%), Granivores (n=17; 10.5%) and Omnivores (n=13; 8.0 % (Figure 3). The prevalence of insectivores may be related to both the availability of food throughout the year and a greater adaptation to different types of environments (Scherer et al., 2005). This shows that anthropogenic

environments, such as pastures, along with the loss of native forest cover, and climate variability modify the filtering of functional traits among insectivorous birds (Manzoli et al., 2024; Pollock et al., 2023). Thus, degraded environments may favor generalist species (Karp et al., 2012). Most of the environments sampled in this study have a high degree of degradation, being mainly used for extensive cattle ranching.

Of the 1,971 bird species found in Brazil, about 198 species are migratory, and of these, 71 are considered partially migratory (Pacheco et al., 2021). The Tyrannidae family represents about 17% of the species (33) that perform these migratory movements in the country. Of the 161 bird species recorded in this study, 26 species are from the Tyrannidae family. Of these, 6 were recorded exclusively during the dry period, e.g., *Euscarthmus meloryphus* (Tawny-crowned Pygmy-Tyrant), *Myiopagis viridicata* (Greenish Elaenia), *Casiornis rufus* (Rufous Casiornis), *Casiornis fuscus* (Ash-throated Casiornis), *Sublegatus modestus* (Southern Scrub-Flycatcher), and *Lathrotriccus euleri* (Euler's Flycatcher). Additionally, 4 other species were recorded only during the rainy period, e.g., *Elaenia flavogaster* (Yellow-bellied Elaenia), *Myiodynastes maculatus* (Streaked Flycatcher), *Empidonomus varius* (Variegated Flycatcher). Several insectivorous bird species perform migratory movements between the Brazilian Caatinga and other tropical regions, especially during the dry season, e.g., species from the Tyrannidae family (Olmos et al., 2005; Pereira e Azevedo-Júnior, 2013).

Migratory movements of some species are well documented in the literature, e.g., *Casiornis fuscus*, *Empidonomus varius*, *Pachyramphus polychopterus* and *Pachyramphus validus* have a migratory pattern in part of the Caatinga and adjacent ecotones, where the records are concentrated during the rainy season between December and March (Jahn et al., 2020; Sick, 1997, Somenzari et al., 2018; Pereira e Azevedo-Júnior, 2013).

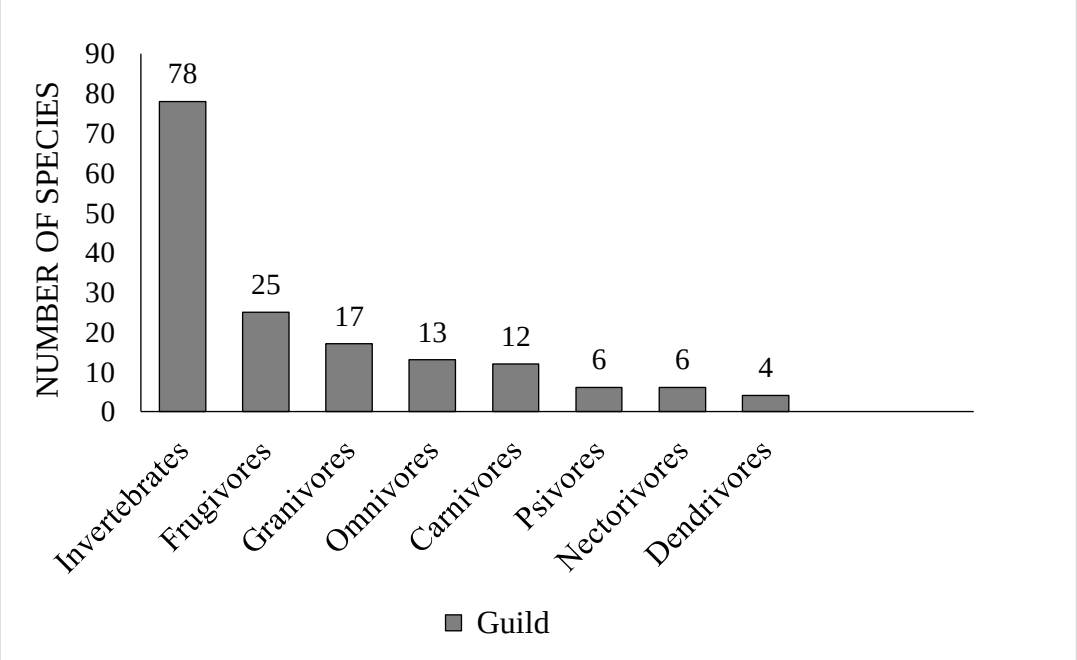

Figure 3. Distribution of bird species according to trophic guilds recorded in the area of Serra de Santo Antônio State Park, Campo Maior, Piauí, Brazil. Source: Authors (2023).

Out of the total bird species recorded in the area of Serra de Santo Antônio State Park, none were classified in any category of extinction threat at the national level. Furthermore, the species *Amazona aestiva* (Parrot) and *Primolius maracanã* (Blue-winged Macaw) are classified as near-threatened (NT) globally (IUCN, 2022). Although we recorded few species in any degree of threat, it does not imply that the more mentioned species in the study area are not undergoing processes of population decline. Several species of bird considered hunted for food and/or pets were reported by hunters in the study area. Studies suggest that habitat loss and illegal capture of birds for the *pet* trade are the main threats faced by Neotropical avifauna, with significant impacts on biodiversity and species conservation (Alves; Lopes and Alves, 2016; Bezerra et al., 2019; Oliveira et al., 2018). In this context, it is crucial to intensify conservation and environmental protection efforts to reverse this situation and ensure the survival of bird species at risk of extinction.

Therefore, it is recommended to implement and enhance public policies aimed at wildlife management and conservation, seeking a model based on the regional social reality. Actions such as generating income for hunters and families living around the park, as well as increasing access to education and recreational activities (ecotourism), are essential to ensure a more sustainable scenario for the use and conservation of wildlife. Furthermore, participatory environmental education strategies can, in turn, address different levels of the illegal hunting issue in the region, with initiatives focused on raising public awareness about the risks and excessive consumption of bushmeat.

Conclusion

Os findings obtained through the sampling methods were deemed satisfactory, with a high sampling effort for species richness assessment. This research compiled detailed information on the richness and structure of the bird community, as well as the composition, sensitivity, and conservation of species. The analysis of the bird community structure in the park region revealed the presence of a community characteristic of the Cerrado biome, including the Cerrado/Caatinga ecotone and adjacent open areas. The recording of more endemic species of the Caatinga biome, along with the adaptive capacity to anthropogenic disturbances, was highlighted as a significant discovery. Therefore, the information gathered in this study has the potential to play a crucial role in formulating and implementing strategies aimed at preserving the local avifauna diversity. The study reinforces the importance of conserving the analyzed area, as the high diversity and evenness may indicate a relatively healthy environment. However, it is essential to consider that continuous monitoring is necessary to assess possible changes over time, especially in response to environmental changes and human pressures.

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