

Birds of Fazenda Domiciana (São Paulo, Brazil): a valuable and overlooked remnant of the inland Atlantic Forest

Aves da Fazenda Domiciana (São Paulo, Brasil): um significativo e esquecido remanescente da Floresta Atlântica interiorana

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Abstract: The Semi-deciduous Seasonal Forest is the Atlantic Forest formation that has lost the greatest proportion of its original area and harbors an avifauna highly susceptible to distributional shifts and local extinctions. This study aimed to survey the bird species occurring at Fazenda Domiciana (2,595 ha), located in southwestern Brazil, to evaluate current management actions and to propose conservation measures for the restoration of its extensive Semi-deciduous Seasonal Forest remnant (1,705.4 ha). In the field, we assessed the property's management practices and recorded birds using standard ornithological methods. We recorded 242 species *in loco* and 10 additional species from the literature, totaling 252 species. Of these, 28 are endemic to the Atlantic Forest, and two are classified as threatened. Most recorded species are resident, rare, and forest-dependent. The secondary vegetation in an intermediate stage of regeneration supported the highest species richness. No signs of hunting, logging, or recent fires were observed, and tree regeneration in pasture areas has been vigorous for decades. Even with the reactivation of pastoral activities, the regenerating areas will be preserved. Fazenda Domiciana represents a significant opportunity for biodiversity conservation. We recommend implementing a rewilding program, establishing two forest corridors, and controlling the spread of exotic plant species.

Keywords: Seasonal Semi-deciduous Forest. Serra Geral. Forest regeneration. Management. Rewilding. Reintroduction.

Resumo: A Floresta Estacional Semidecidual é o ambiente da Floresta Atlântica que perdeu maior percentual de área e apresenta avifauna propensa a alterações distribucionais e extinções locais. Este estudo tem como objetivos levantar a avifauna da Fazenda Domiciana (2.595 ha), localizada no interior do estado de São Paulo, avaliar ações de manejo e propor medidas de conservação para a recuperação do seu grande remanescente de Floresta Estacional Semidecidual (1.705,4 ha). Em campo, avaliamos o manejo da propriedade e a presença de aves com métodos tradicionais de ornitologia. Registramos 242 espécies e compilamos registros de dez adicionais da literatura, totalizando 252 espécies, incluídas em 58 famílias. Dessas aves, 28 são endêmicas da Floresta Atlântica e duas estão ameaçadas de extinção. A maioria das espécies registradas é residente, pouco abundante e de hábito florestal. A vegetação secundária em estágio intermediário de regeneração apresentou a maior riqueza. A propriedade não apresentou sinais de caça, corte de árvores e incêndios recentes. A regeneração arbórea foi intensa sobre as pastagens, desde há décadas. A revitalização da atividade pastoril preservará as áreas em regeneração. A fazenda representa grande oportunidade de conservação. Sugerimos um programa de refaunação de aves, criação de dois corredores florestais e controle de plantas exóticas.

Palavras-chave: Floresta Estacional Semidecidual. Serra Geral. Regeneração florestal. Manejo. Refaunação. Reintrodução.

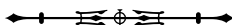
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INTRODUCTION

The Atlantic Forest is one of the seven Neotropical forests and the second largest in area, surpassed only by the Amazon Forest (Dov Por, 1992). It is widely recognized to extend along the Brazilian coast into eastern Paraguay and northeastern Argentina, although debates persist regarding the extent of its inland distribution within Brazil (e.g., Cabrera & Yepes, 1940; Mello-Leitão, 1947; Rizzini, 1963, 1997; Ab'Sáber, 1977; Veloso et al., 1991; Mattos, 1994; Olson et al., 2001; IBGE, 2004; Bornschein et al., 2007; Ribeiro et al., 2009, 2011; Coutinho, 2016; Muylaert et al., 2018). According to Brazilian law, the Atlantic Forest extends for more than 4,000 km along the coastline, from Ceará to southern Rio Grande do Sul, and reaches varying distances inland across the Northeast, Central-West, Southeast, and South regions of Brazil (Brazil, 2006; IBGE, 2012). However, even official Brazilian agencies disagree on the precise inland boundaries on the Atlantic Forest (IBGE, 2004, 2012).

Along its range, the Atlantic Forest encompasses a variety of environments, including mangroves, pioneer formations, grasslands, and several forest types. According to the classification criteria of the RADAMBRASIL Project, five major forest types are recognized within this domain (Veloso et al., 1991): Dense Ombrophilous Forest (*Floresta Ombrófila Densa*), Open Ombrophilous Forest (*Floresta Ombrófila Aberta*), Mixed Ombrophilous Forest (*Floresta Ombrófila Mista* or Araucaria Forest), Semi-deciduous Seasonal Forest (*Floresta Estacional Semidecidual*), and Deciduous Seasonal Forest (*Floresta Estacional Decidual*; IBGE, 2004, 2012). However, among these, only the Mixed Ombrophilous Forest is entirely restricted to the Atlantic Forest domain (Veloso et al., 1991; IBGE, 2004, 2012).

Due to its predominantly coastal distribution, the Atlantic Forest has been affected by human activities since the arrival of the Portuguese in Brazil in 1500. Just a few decades later, Brazilwood (*Paubrasilia echinata* (Lam.) Gagnon, H. C. Lima & G. P. Lewis) was already

being exported from this forest (Lorenzi, 1992). Over the following centuries, the major economic cycles that shaped the country's history took place primarily within the Atlantic Forest (Dean, 1997). Today, this region hosts about 70% of the Brazil's population, most of the cities, and the main industrial hubs, which together account for 80% of the nation's Gross Domestic Product (GDP; Consórcio Mata Atlântica, 1992; Dov Por, 1992; Lorenzi, 1992; Fundação SOS Mata Atlântica & INPE, 2023). As a consequence, only 12.4% of the original forest cover remains (Fundação SOS Mata Atlântica & INPE, 2023). However, not all forest types have been equally affected (Ribeiro et al., 2009): inland formations such as the Semi-deciduous and Deciduous Seasonal Forests have undergone the most severe reductions (Appendix 1).

The Semi-deciduous Seasonal Forest once covered vast areas of the interior of São Paulo and Paraná (IBGE, 2004, 2012; Ribeiro et al., 2009, 2011). However, as noted by Maack (1963), "the scale of deforestation conducted by humans in Paraná defies any description". In Paraná, a series of historical events led to the near-complete eradication of the inland Semi-deciduous Seasonal Forest. In the late 19th and early 20th centuries, the British company *Companhia de Terras Norte do Paraná* cleared extensive areas of this forest in northern and western Paraná. By 1934, the city of Londrina, currently the second most populous in the state, had been founded, followed 13 years later by Maringá, currently the third most populous city in Paraná. By the mid-1950s, the Xetá Indigenous people of northwestern Paraná had come into contact with non-Indigenous society and were decimated in the following years (e.g., Lima, 2018). In 1982, in the western part of the state, the filling of the Itaipu Reservoir was completed, extinguishing plans to establish a national park that would have preserved the Sete Quedas Waterfalls and some of the last remaining inland forests of Paraná, including those once inhabited by the Xetá (Maack, 1963, 1981). In São Paulo, deforestation

led to the almost complete eradication of the inland Semi-deciduous Seasonal Forest earlier than in Paraná (Victor et al., 2005). In this state, deforestation began in the early 20th century, intensified through the mid-20th century, and ultimately eliminated the remaining forest cover in the far west by the early 1960s (Victor et al., 2005).

The reduction of the Atlantic Forest and the transformation of its remnants into degraded fragments that are affected by various impacts such as edge effects, selective logging, hunting, and wildlife capture (e.g., Pizo & Tonetti, 2020), have resulted in the formation of “empty forests”, which are areas largely devoid of their original fauna (e.g., Silveira et al., 2003), and in species extinctions (Araújo et al., 2023). Three bird species from the Atlantic Forest are already extinct, *Glaucidium mooreorum* Silva, Coelho & Gonzaga, 2002, *Cichlocolaptes mazarbarnetti* Barnett & Buzzetti, 2014, and *Philydor novaesi* Teixeira & Gonzaga, 1983 (Brazil, 2022), all of which were endemic to the Dense Ombrophilous Forest.

The Semi-deciduous Seasonal Forest has not been treated as an area of endemism, but rather as a transitional formation known as the Interior Forest (Silva & Casteleti, 2003). Consequently, none of the 223 bird species considered endemic to the Atlantic Forest (Vale et al., 2018) would be endemic to the Semi-deciduous Seasonal Forest, although Lopes et al. (2025) provide a list of species that may be regarded endemic to this forest type. Therefore, bird extinctions in this inland Atlantic Forest represent local extinctions. In this regard, local bird extinctions have been more frequent in the Semi-deciduous Seasonal than in the Dense Ombrophilous Forest (Willis & Oniki, 1992). Furthermore, bird species endemic to the Atlantic Forest appear to be more sensitive to fragmentation in inland forests than in coastal ones (Dense Ombrophilous Forest; Anjos et al., 2011; Cavarzere & Silveira, 2024). Additionally, some local extinctions in the inland Semi-deciduous Seasonal Forest represent extinctions for the entire Atlantic Forest

domain, as in the case of the Red-throated Caracara *Ibycter americanus* (Boddaert, 1783), whose Atlantic population occurred in the interior of São Paulo and Paraná (Straube & Bornschein, 1989; Straube et al., 2002; Silveira et al., 2009; São Paulo, 2018).

Parallel to extinction processes, deforestation and large-scale environmental changes have fragmented continuous forest and created new habitats, facilitating the colonization and expansion of many bird species within the Atlantic Forest, particularly forest and grassland birds (e.g., Bornschein & Reinert, 2000; Klemann-Junior et al., 2017). Species as common as the Picazuro Pigeon *Patagioenas picazuro* (Temminck, 1813) have been expanding their range within the Atlantic Forest for decades (Bornschein & Reinert, 2000). The website WikiAves (s.d.b) further allows tracking the expansion of numerous other species, including austral birds moving northward (e.g., the Monk Parakeet *Myiopsitta monachus* (Boddaert, 1783) and the Greyish Baywing *Agelaioides badius* (Vieillot, 1819) and northern birds moving southward and colonizing the Atlantic Forest (e.g., the Scarlet-throated Tanager *Compsothraupis loricata* (Lichtenstein, 1819), and the white-throated seedeater White-throated Seedeater *Sporophila albogularis* (Spix, 1825).

The ongoing processes of local extinctions, species declines, colonization, and population increases make contemporary faunistic studies essential for assessing current species richness and population status, as well as for guiding appropriate management actions (Nichols & Williams, 2007). Given that the Semi-deciduous Seasonal Forest plays a key role in maintaining the biodiversity of the Atlantic Forest, this study aims to survey the bird species of Fazenda Domiciana, a property located in São Paulo, southeastern Brazil, and to highlight the importance of a significant but overlooked remnant of this forest type. Furthermore, we propose management actions to support the maintenance and restoration of regional avian diversity.

MATERIAL AND METHODS

STUDY AREA AND ENVIRONMENTS

The Fazenda Domiciana (c. 23° 14' 46" S, 49° 35' 43" W; 2,595 ha; Figure 1) is located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. It lies on the interfluvium of the Paranapanema and Itararé rivers and borders the state of Paraná along the latter river (Figure 1). The property was acquired in 1913 by Wenceslau Braz (Timburi, 2015) during his presidency of Brazil. Recently, it was sold to a new owner, who is a forest type is characterized by the loss of leaves on

20–50% of the trees during the winter period, when rainfall decreases and/or temperatures drop (Veloso et al., 1991). It is also marked by an abundance of vines and a reduced number of epiphytes (Veloso et al., 1991). Seasonal dynamics results from relatively low annual rainfall, averaging between 1,000 and 1,300 mm (Alvares et al., 2013). The mean annual temperature ranges from 18 °C to 20 °C at higher altitudes and from 20 °C to 22 °C at lower altitudes (Alvares et al., 2013). According to the Köppen classification, the regional climate is humid subtropical oceanic (Cfa), without dry season and with hot summers (Alvares et al., 2013).

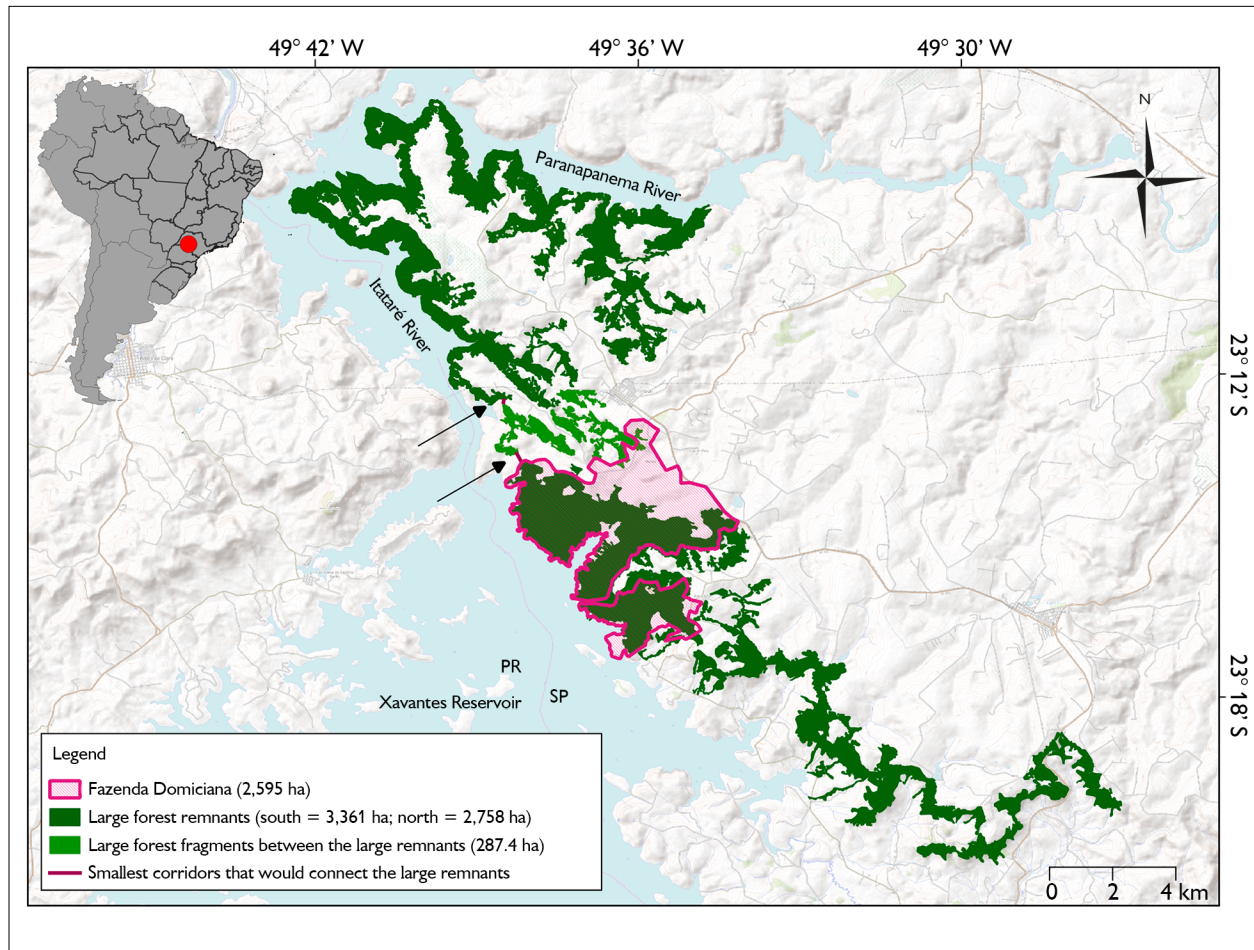


Figure 1. Boundaries of Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil, and its arboreal remnants. Abbreviations: SP = São Paulo; PR = Paraná. Source: National Water and Basic Sanitation Agency (ANA) and ©OpenStreetMap contributors.

Fazenda Domiciana exhibits a significant altitudinal range, from 476 m to 864 m above sea level (a.s.l.), and is intersected by the Serra Geral, which divides the terrain into three sectors: small flat areas at lower altitudes near the Itararé River, steep cliffs, and larger flat areas at higher altitudes. Due to this altitudinal variation, the forest of the property is classified as Submontane Semi-deciduous Seasonal Forest (*Floresta Estacional Semidecidual Submontana*) up to 500 m a.s.l, and as Montane Semi-deciduous Seasonal Forest (*Floresta Estacional Semidecidual Montana*) above this elevation, following the criteria of Veloso et al. (1991). Since this

distinction is based solely on altitude, no differences in vegetation structure or floristic composition are expected between the two forest types (Figure 3).

The property contains a substantial remnant of tree cover, including both mature forest and regenerating arboreal vegetation (see below), covering 1,705.4 ha (own mapping using Google Earth Pro 7.3.6.10201 – 64-bit, with 2024 imagery; Figures 1 and 2; Table 1). This remnant connects with those on neighboring properties, forming a large, continuous expanse of tree cover totaling 3,361 ha (own mapping using Google Earth, 2024 imagery; Figure 1)

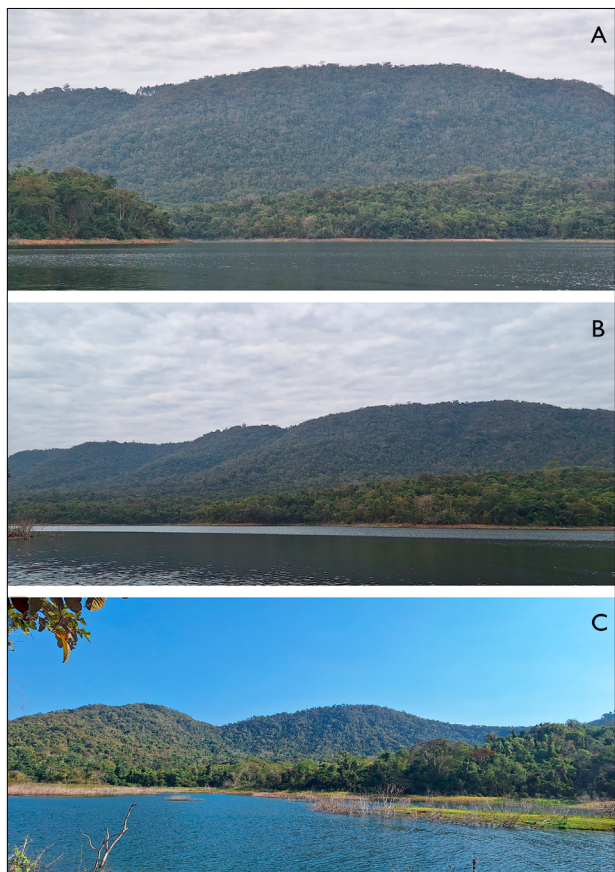


Figure 2. A-C) Extensive Semi-deciduous Seasonal Forest (*sensu* Veloso et al., 1991) and arboreal formations at different stages of regeneration at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil, along the banks of the Itararé River, dammed by the Xavantes Reservoir. Photos: M. R. Bornschein (July 2024).



Figure 3. Structure of the Semi-deciduous Seasonal Forest (*sensu* Veloso et al., 1991) at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Prominent presence of lianas; B) absence of lianas; C) high abundance of Palm Heart *Euterpe edulis* Mart. Photos: M. R. Bornschein (July 2024).

along the Serra Geral. Discontinuous arboreal remnants separated by no more than 20 m were included in this assessment. The steeper regions of Fazenda Domiciana (own assessment; Figures 2A, 4A) feature rock cliffs, talus deposits within the arboreal vegetation, and areas of shallow soil over nearly exposed bedrock. In these talus zones and shallow-soil regions, the arboreal vegetation appears drier (Figure 4), and the understory is sparsely populated with herbaceous and shrub species (Figure 4B). Due to these characteristics,



Figure 4. Arboreal vegetation with a high proportion of deciduous trees at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Forest on the slope of the Serra Geral, exhibiting characteristics of Deciduous Seasonal Forest; B) forest interior showing a low density of green leaves in the understory; C) secondary vegetation in an advanced stage of regeneration (fifth phase of natural succession, or *capoeirão*), with a high proportion of deciduous trees. Vegetation classification follows Veloso et al. (1991). Photos: M. R. Bornschein (October 2024).

this vegetation resembles Deciduous Seasonal Forest (*Floresta Estacional Decidual*, *sensu* Veloso et al., 1991) and warrants further investigation.

The arboreal remnant within Fazenda Domiciana is composed of mature forest as well as tree environments in different stages of regeneration that have not yet reached the mature forest stage (*sensu* Veloso et al., 1991; see Bornschein, 2015; Figure 5). According to our assessments, these environments include: the “third phase of natural succession” (or *capoeira-rala*; Figure 5A),



Figure 5. Arboreal vegetations undergoing regeneration at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Secondary vegetation in an intermediate stage of regeneration (third phase of natural succession, or *capoeira-rala*; October 2024); B) secondary vegetation in an intermediate stage of regeneration (fourth phase of natural succession, or *capoeira*; July 2024); C) secondary vegetation in an advanced stage of regeneration (fifth phase of natural succession, or *capoeirão*), which has expanded beyond the original forest edge, delimited by a wire fence, into former pasture areas (July 2024). Vegetation classification follows Veloso et al. (1991). Photos: M. R. Bornschein.

dominated by shrubs and small trees up to 3 m tall; the “fourth phase of natural succession” (or *capoeira*; Figure 5B), dominated by small trees and shrubs up to 5 m tall; and the “fifth phase of natural succession” (or *capoeirão*; Figure 5C), characterized by two tree layers (upper and lower) rather than three (upper, middle, and lower), as found in mature forests (Veloso et al., 1991).

Fazenda Domiciana contains pastures (Figure 6) established several decades ago, primarily in areas that were once forests, although a smaller portion may have developed over natural grasslands (see below). According to our assessments, these pastures are dominated by herbaceous plants and can be classified as the “first phase of natural succession” (*sensu* Veloso et al., 1991; Figures 6A and 6B). Pastures at lower altitudes (below 550 m a.s.l.) are mainly composed of native herbaceous species, whereas those at higher altitudes (above 600 m a.s.l.) are predominantly composed by tanner grasses.

Small regeneration patches of vegetation, ranging from the second to the fourth stages of natural succession (*sensu* Veloso et al., 1991), are scattered across pastures where rocks or other landscape features (e.g., riverbanks or early-stage erosion) have created favorable conditions for the establishment of shrubs and trees (Figure 6B). These patches are also found along the edges of agricultural areas (Figure 7C). The “second stage of natural succession” (or *capoeirinha*) is characterized by herbaceous plants, shrubs, and small trees, all under 3 m in height (Veloso et al., 1991).

The pastures and post-harvest plantation areas (Figure 7B) resemble grasslands and remain in this condition as long as human management persists. Another situation that promotes grasslands development in the study area is the growth of herbaceous vegetation on the bed of the Itararé River when the water level of the Xavantes Reservoir drops (Figure 7A). However, this represents a temporary stage of ecological succession that is interrupted once the reservoir’s water level is restored.

Fazenda Domiciana also contains small areas of natural grasslands (above 750 m a.s.l.; Figure 8A) and rocky outcrops with sparse vegetation (Figure 8B), such as bromeliads (*Dyckia* sp.) and cacti, which are referred to as Ecological Refuges (*Refúgio Ecológico*, *sensu* Veloso et al., 1991). Additionally, it includes a few areas of tree monocultures (pine and eucalyptus), as well as orchards and several buildings (houses and sheds; Figure 8C).

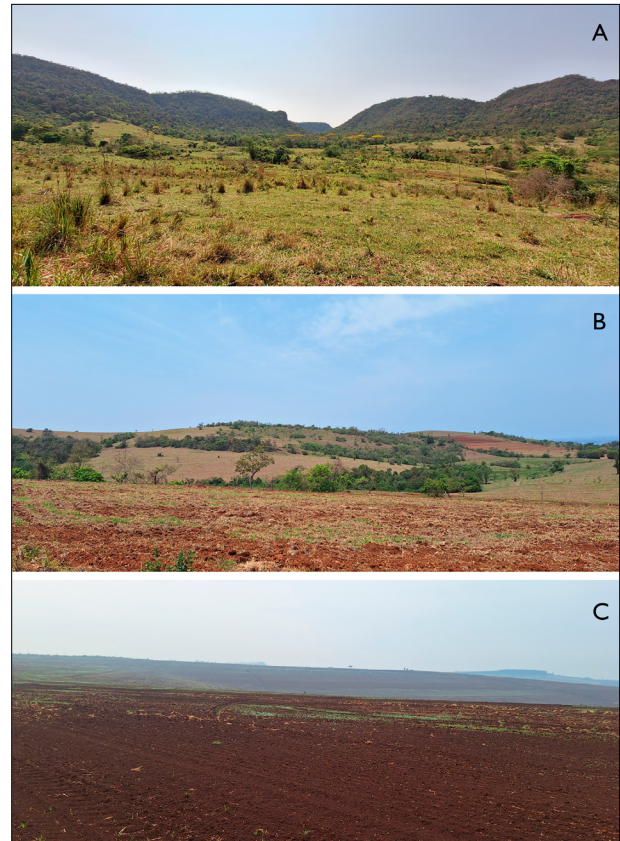


Figure 6. Pasture management at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Pastures at lower altitudes, dominated by native herbaceous vegetation. B) Pastures at higher altitudes, dominated by exotic herbaceous species (*Urochloa* spp.). Part of the area is being disked as an initial stage of management in preparation for planting the exotic grass Tifton *Cynodon dactylon* (L.) Pers.). Note also, in the background, the regeneration process with the establishment of shrubs and trees. C) Managed pastures ready for the planting of Tifton grass. Pastures shown in panels A and B were classified as the grassland environment (first phase of natural succession, *sensu* Veloso et al., 1991) for the purpose of bird records. The environment in panel C was classified as exposed soil for the purpose of bird records. Photos: M. R. Bornschein.

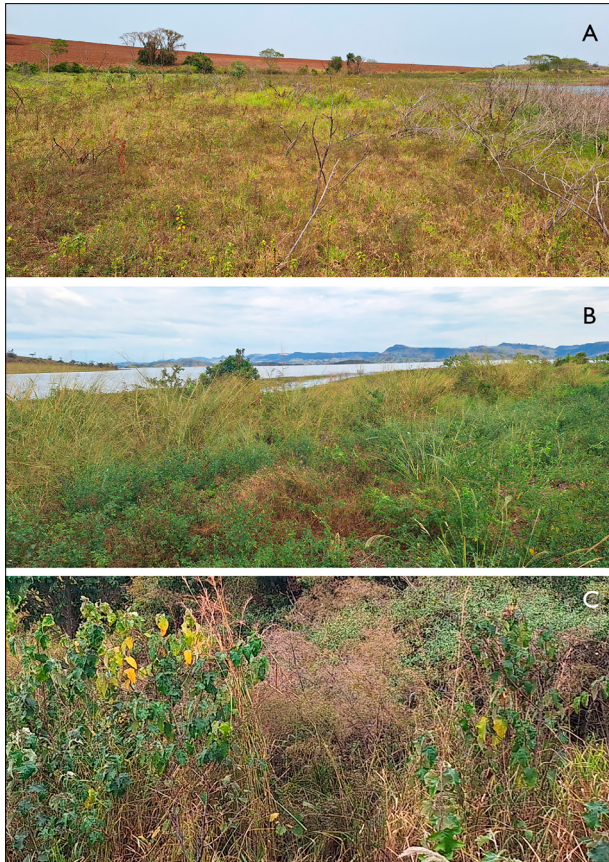


Figure 7. Other features of secondary vegetation in early stages of regeneration at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Grassland (first phase of natural succession) formed following the retreat of waters from the Xavantes Reservoir; B) grassland (first phase of natural succession) along the edges of cultivated areas. This grassland type showed the highest bird abundances recorded at Fazenda Domiciana; C) Secondary vegetation in an early stage of regeneration (second phase of natural succession, or *capoeirinha*), also located along the edges of cultivated areas. Vegetation classification follows Veloso et al. (1991). Photos: M. R. Bornschein.

The property contains small areas of natural floodplain marshes (Figure 9A, 9B), as well as secondary marshes (i.e., formed after the removal of the original vegetation in water-accumulating areas; Figure 9C), classified as pioneer formations with fluvial influence (*Formação Pioneira de Influência Fluvial*, sensu Veloso et al., 1991). Finally, Fazenda Domiciana also includes aquatic environments in rivers and ponds within the arboreal vegetation, as well as along the right bank of the Itaré River, extending for 17,051.6 m (Figure 10).



Figure 8. Environments with limited spatial representation at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Grassland (natural, referred to as *Refúgio ecológico*, sensu Veloso et al., 1991); B) Rocky outcrop (*Refúgio Ecológico*, sensu Veloso et al., 1991); C) environment classified as "anthropic" for bird recording purposes. Photos: M.R. Bornschein.

FIELDWORK

We conducted the bird surveys with three people over 10 days of fieldwork in 2024, divided into two campaigns: July 6–9 and July 15 (campaign one), and October 7–11 (campaign two). Observations were made using binoculars (10 x 40 mm), vocalization recordings (Tascam digital recorder with a Sennheiser ME66 directional microphone), and 13 hours of mist-netting (using up to 15 nets, each 12 m in length and with mesh sizes of 28 mm, 32 mm, and 36 mm), as Bornschein and Reinert (2000). Bird samplings was carried out by walking or motorboat. We worked from half an hour before dawn until about one hour after dusk, with a break of approximately

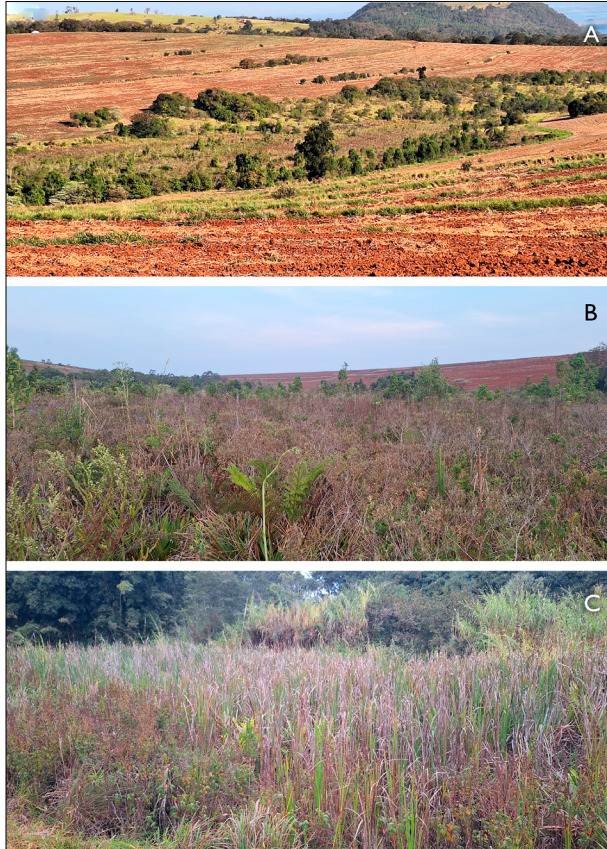


Figure 9. Marshes (pioneer formation with fluvial influence; *sensu* Veloso et al., 1991) at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Environment classified as “natural floodplain marsh”, occurring naturally (diagonal strip in the center of the image); B) highly diverse flora of the natural floodplain marsh; C) secondary marsh formed after anthropogenic alterations to the landscape, with the presence of the exotic White Ginger Lily *Hedychium coronarium* J.Koenig. Photos: M. R. Bornschein.

two hours between 12:00 and 14:00 h. However, the actual daily survey time varied depending on the travel time different points within Fazenda Domiciana and on rainfall conditions. Due to access difficulties in some areas of the property, bird sampling could not be conducted in the central portions of the large remnants (Appendix 2).

To assess sighting frequency, we recorded species occurrences per day of fieldwork during each campaign, regardless of the total observation time on that day. To estimate abundance, we counted distinct individuals detected visually and/or audibly in each daily period



Figure 10. Aquatic environments at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. A) Stream running through arboreal vegetation, with the exotic White Ginger Lily *Hedychium coronarium* J. Koenig present on both stream banks in the foreground; B) shallow margin of the Itararé River, dammed by the Xavantes Reservoir, showing abundant aquatic vegetation; C) shallow margin of the Itararé River, lacking aquatic vegetation and characterized by mud and dead vegetation. Birds observed on bare sediment and within dead vegetation were classified as associated with the “aquatic” environment. Photos: M. R. Bornschein.

(pre-dawn, morning, afternoon, and post-dusk) each day. For each species, the highest count obtained in a single period per day was considered. Abundance was categorized into four levels: I - rare (1–5 individuals); II - uncommon (6–25); III - common (26–50); and IV - very common (51–500). Species were classified as Atlantic Forest endemics following Vale et al. (2018). Taxonomy, nomenclature, and common names followed the Brazilian Ornithological Records Committee (Pacheco et al., 2021).

DATA ANALYSIS

Secondary data from the literature were incorporated into the compilation of bird records by searching for “Domiciana”, “Fazenda Domiciana”, and “Domiciana Farm”, provided that the records were collected within the property boundaries. Willis and Oniki (2003) surveyed Fazenda Domiciana but did not specify which records were obtained at this locality or at Fazenda Conceição, instead reporting records from both sites collectively under “Timburi”, the municipality where both properties are located. For this reason, we did not include Willis and Oniki (2003) as a source of bird records specifically for Fazenda Domiciana. Hasui et al. (2018) compiled the records from Willis and Oniki (2003) and mentioned occurrences from Fazenda Domiciana *sensu lato*, that is, a locality encompassing records also obtained at Fazenda Conceição or exclusively at that property. The only exceptions are two records cited by Hasui et al. (2018) for Fazenda Domiciana, which can be confidently attributed to this property: *Psilorhamphus guttatus* (Ménétries, 1835) and *Eleoscytalopus indigoticus* (Wied, 1831). Additionally, secondary data from the eBird platform (eBird, s.d.) were included, comprising 23 checklists compiled up to March 18, 2025. These records were contributed by Fernando Zurdo, Júlio César Machado, Martha Argel, Rodrigo Ferronato, Ronaldo Lebowski, and Thiago Martins, covering the months of January, February, March, April, May, July, October, November, and December in the years 1990, 2013, 2015–2017, 2019–2020, and 2024–2025.

We indicated the type of evidence of each species record, including data from the literature, as follows: visual records (v), auditory records (a), photographic records (p), audio recordings (r), and captures in mist-nets (c). Additionally, we conducted interviews with local residents about species occurrences; however, we chose not to include new unverified reports (see below). We also indicated the confirmed or presumed status of occurrence of species at the property as resident,

summer resident, northern migrant, southern migrant, visitor, and undetermined. The regionalization of occurrence status was adapted from Bornschein (2001), which in turn adapted Sick (1997) and Belton (1994). The occurrence status of migratory species was based on Sick (1997). Resident species are those that breed (or are presumed to breed) at the property and remain there year-round. Summer residents breed (or are presumed to breed) at the property but migrate north after the breeding season. Northern migrants breed in the Northern Hemisphere and pass through the study area during migration in the warm months of the Southern Hemisphere, whereas southern migrants breed south of the study area and pass through it during the colder months. Visitors are species that breed, or are presumed to breed, near the property and are observed there at different times of the year; this category includes species that nest in habitats not available within the property. The term undetermined was used for species whose local occurrence status could not be clearly classified. We also indicated the conservation status of each species at the global (IUCN, 2025), national (Brazil, 2022), and state (São Paulo, 2018) levels.

We assigned a habitat-use classification to each species, based on the authors' previous knowledge of the species and by consulting habitat descriptions in the literature (e.g., Sick, 1997). For each species, we indicate the type of environment to which it is most closely associated, at least regionally, as follows: forest-dwelling, semi-forest-dwelling, grassland-dwelling, marsh-dwelling, aquatic, urban-dwelling, and aerial. Forest-dwelling species are those birds that reproduce in forests and obtain all or most of their food resources there. Semi-forest-dwelling species reproduce and feed primarily in arboreal formations that have not yet regenerated to the forest stage. Grassland-dwelling species reproduce in environments such as fields and obtain all or most of their food from herbaceous vegetation or the soil in these areas. Marsh-dwelling species primarily reproduce and

feed in wetland herbaceous vegetation. Aquatic species obtain most of their food resources from the water, either within the water column or on the surface. Urban-dwelling species reproduce and obtain most of their food resources in areas dominated by anthropogenic structures. Finally, aerial species obtain all or most of their food while in flight; this category also includes birds regularly observed flying at high altitudes without any apparent association with the environment below.

Twelve environments for birds were identified at Fazenda Domiciana. Vegetation types were classified following the criteria of Veloso et al. (1991) (see above). The environments are as follows: 1- Semi-deciduous Seasonal Forest (Figures 2-4); 2- secondary vegetation in an advanced stage of regeneration (fifth phase of natural succession; Figures 4C and 5C); 3- secondary vegetation in an intermediate stage of regeneration (fourth and third phases of natural succession; Figures 5A and 5B); 4- secondary vegetation in an early stage of regeneration (second phase of natural succession; Figure 7C); 5- grassland (natural ones, called *Refúgio Ecológico*, or of anthropogenic origin, referred to as first phase of natural succession, *sensu* Veloso et al., 1991; Figures 6A, 6B, 7A, 7B, and 8A); 6- secondary marsh (pioneer formation with fluvial influence; Figure 9C); 7- natural floodplain marsh (pioneer formation with fluvial influence; Figures 9A and 9B); 8- plantation; 9- exposed soil (Figure 6C); 10- aquatic (Figure 10); 11- anthropic (buildings and vegetation among them; Figure 8C); and 12- aerial. In aquatic environments, birds were recorded on the water surface, flying over the water, perched on wood above the water, standing on the ground at the shore or in shallow water, or perched on rocks in rivers. In anthropic environments, birds were observed on human-made structures or in trees within these areas. In aerial environments, species were recorded flying at high altitudes without any apparent association with the environment below. Due to access difficulties, rocky outcrops (Figure 8B) could not be sampled.

MANAGEMENT AND CONSERVATION

During our fieldwork at Fazenda Domiciana, we searched for evidence of forest fires, selective logging, and wildlife hunting or capture. To complement these observations, we conducted interviews with local residents. We also documented management practices within the study area, including road maintenance (both internal and surrounding the property), as well as soil and pasture management.

RESULTS

We recorded 242 species, excluding six whose records we could not confirm (Table 2). These species belong to 58 families, with Tyrannidae (37 species), Thraupidae (21), Trochilidae and Thamnophilidae (11 each), Furnariidae (10), and Columbidae, Accipitridae, and Picidae (nine each) (Table 2) being the most species-rich (Table 2). During the first campaign, we recorded 201 species, and 217 during the second (Table 2). Twenty-nine species were recorded only in the first campaign, 43 only in the second, and the remainder in both campaigns (Table 2). Interviews with local residents indicated the presence of four additional species that we did not detect: Roseate Spoonbill *Platalea ajaja* Linnaeus, 1758 (one individual), Red-breasted Toucan *Ramphastos dicolorus* Linnaeus, 1766 (a few individuals), Bare-throated Bellbird *Procnias nudicollis* (Vieillot, 1817) (last heard around 2019–2020), and Magpie Tanager *Cissopis leverianus* (Gmelin, 1788). These species were not included in our list pending further confirmation. Secondary data report 144 species for the property (Table 2), 10 of which were not recorded in this study, resulting in a total of 252 species (Table 2).

Twenty-eight of the recorded species (including secondary data) are endemic to the Atlantic Forest (Table 2). Two species are classified as threatened (Table 2): the Vinaceous-breasted Parrot *Amazona vinacea* (Kuhl, 1820) and the Red-billed Scythebill *Campylorhamphus trochilirostris* (Lichtenstein, 1820). In addition, two species with unconfirmed occurrences are also considered threatened (Table 2): the Solitary Tinamou *Tinamus solitarius* (Vieillot, 1819) and the Rufous-faced Crake *Laterallus xenopterus*

Conover, 1934, the latter of which was heard over several days in floodplain marshes.

Most of the recorded species breed, or are presumed to breed, within the study area (191 resident species; Figure 11). Fifteen species are summer residents, three are northern migrants, including the Osprey *Pandion haliaetus* (Linnaeus, 1758), and two are southern migrants, including the Vermilion Flycatcher *Pyrocephalus rubinus* (Boddaert, 1783). Additionally, four species are classified as visitors (Table 2; Figure 11). The occurrence status within the study area was classified as undetermined for 37 species (Figure 11).

Most of the recorded species are forest-dwelling (101 species; Figure 12), followed by semi-forest-dwelling

(62), grassland-dwelling (50), and aquatic species (26; Figure 12). Species richness was highest in secondary vegetation at intermediate stage of regeneration (fourth and third stages of natural succession), with 143 species, followed by secondary vegetation at an advanced stage of regeneration (fifth stage of natural succession) with 96 species, Semi-deciduous Seasonal Forest with 92 species, and grassland (first stage of natural succession and ecological refuge areas) with 90 species (Figure 13). Forty-one species were recorded on a single survey day, whereas 10 species were detected on all 10 survey days (Figure 14). The majority of species were classified as rare (167 species), while only five were classified as very common (Figure 15).

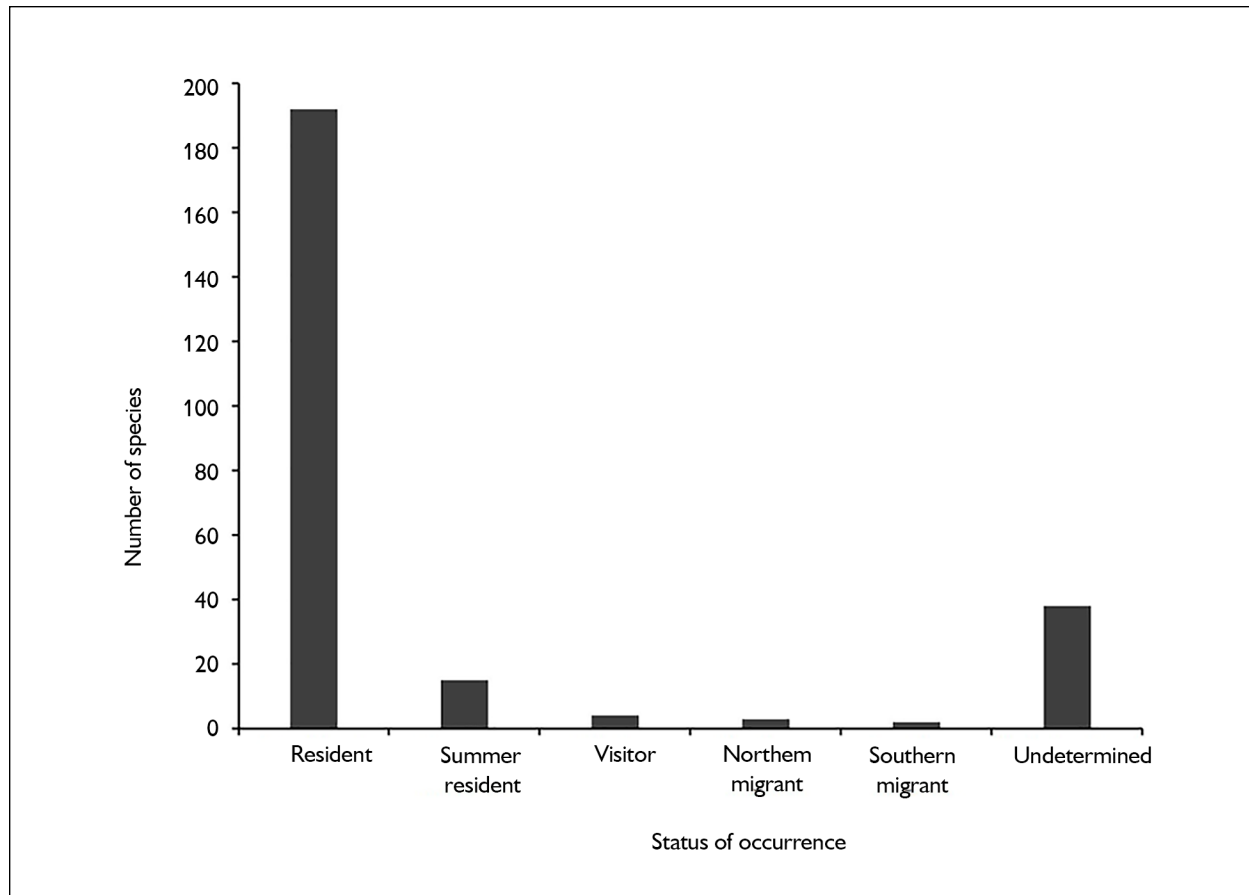


Figure 11. Number of bird species recorded at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil, based on field observations and secondary data, categorized by status of occurrence.

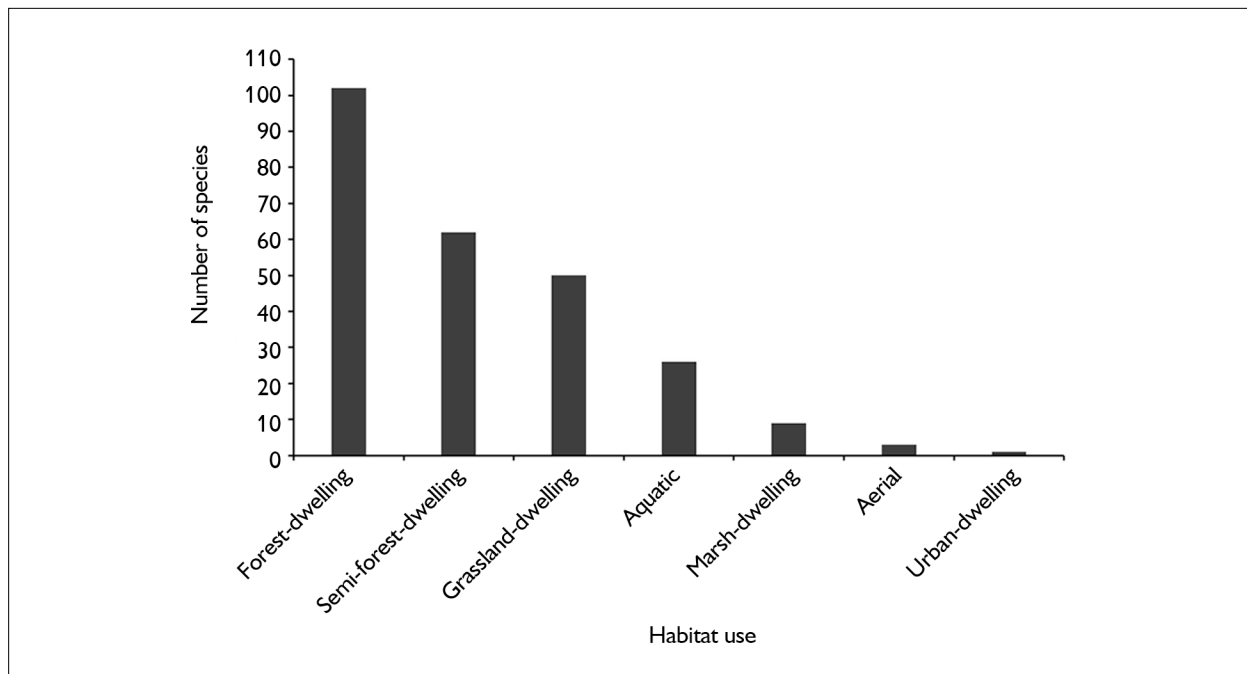


Figure 12. Number of bird species recorded at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil, based on field observations and secondary data, categorized according to habitat use.

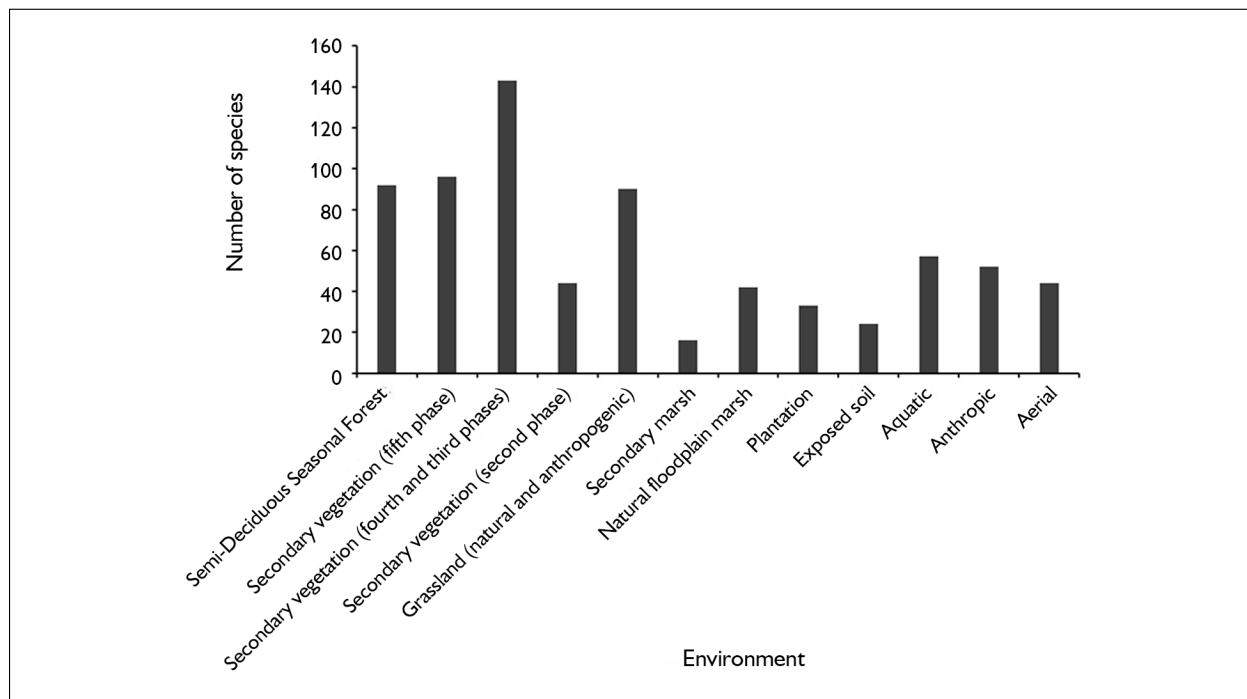


Figure 13. Number of bird species recorded (field observations only) at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil, by habitat of observation.

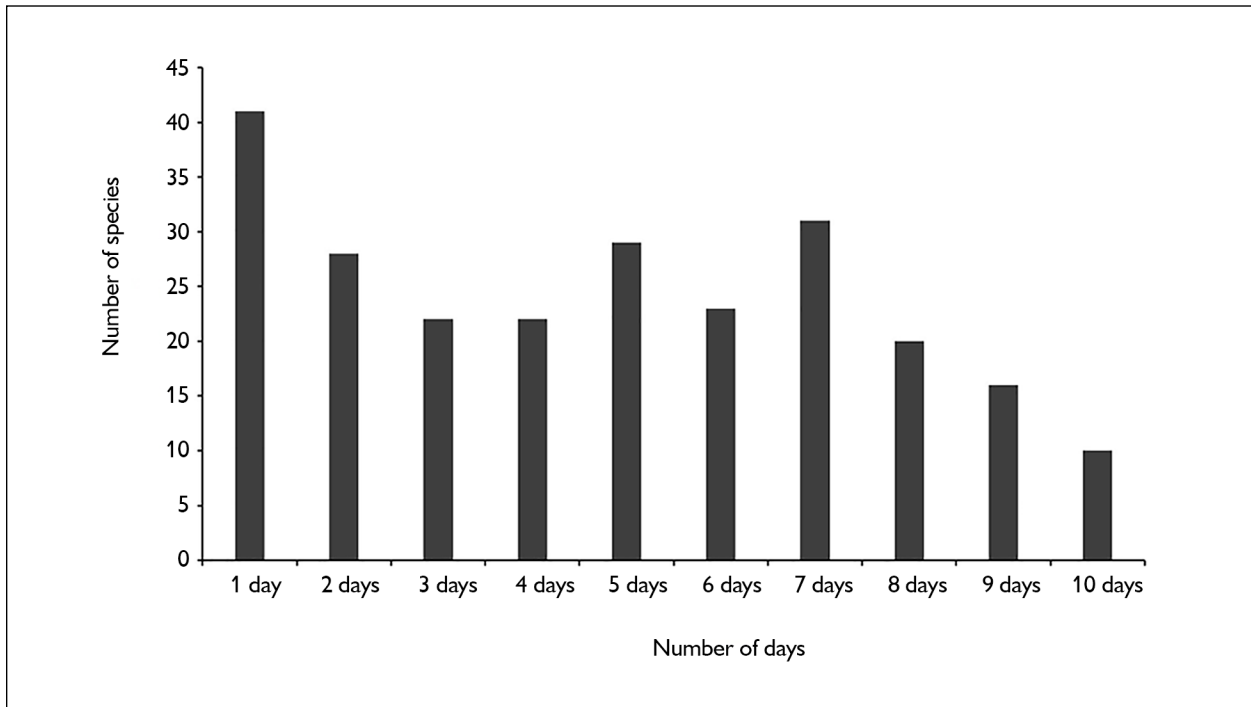


Figure 14. Number of days (out of 10) on which bird species were recorded at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil.

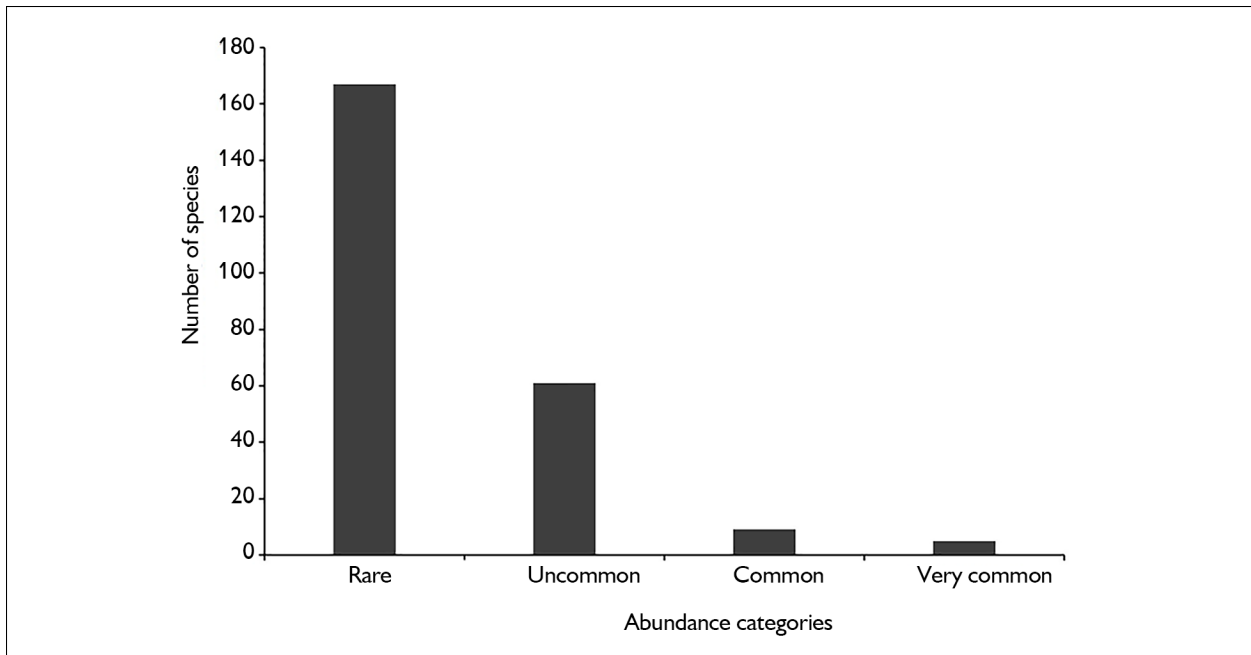


Figure 15. Abundance categories of bird species recorded at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil.

MANAGEMENT AND CONSERVATION

For at least five years, the property has been monitored by staff traveling by land or water. Internal roads have been revitalized, with proper drainage management to prevent erosion. While isolated trees have been removed, forest cover has not declined. These improved roads facilitate enforcement against illegal logging, Palm Heart harvest (*Euterpe edulis* Mart.), hunting, and trapping. Long-time residents reported that hunting is no longer practiced on the property. This activity, once common, has declined over the years regardless of surveillance. During our fieldwork, we observed no signs of hunting, such as traps, baiting sites, holes for trapping armadillos, or used ammunition, consistent with these reports. However, the low abundance of game bird species, such as Guans (Cracidae; Table 2), suggests lingering effects of past hunting (Table 3). We also found no evidence of tree cutting or palm heart harvesting: cut trunks can remain visible for decades, whereas Palm Heart stipes persist for approximately three years in very humid Atlantic Forest conditions (MRB, personal observation, 2021).

According to local residents, forest fires have occasionally affected parts of the property over the past 30 years, but none have occurred in the last five years. There are no fire brigades on the property; however, such brigades are typically found on properties with tree monocultures rather than on lands used for beef production.

The cutting and/or removal of shrubs and trees for pasture management was poorly implemented for decades, allowing a significant expansion of arboreal formations. Analysis of a 40-year time series of satellite images from Google Earth shows that tree-dominated environments have been regenerating over pastures at Fazenda Domiciana. This regeneration is also evident along the wire fences that prevent cattle from accessing the forest. Beyond these fences, within the pastures, tree vegetation has advanced 5 to 25 m (Figure 5C). While cattle graze and trample in these areas, this activity

appears to limit vine growth, which may indirectly benefit forest regeneration.

With the reactivation and expansion of beef production at Fazenda Domiciana throughout 2024 and early 2025, the land was leveled, early-stage regenerating vegetation was cleared, and the soil was fertilized and seeded with the exotic grass Tifton (*Cynodon dactylon* (L.) Pers.) in pastures above 600 m a.s.l. Some isolated trees within the pastures were also removed. Additionally, new areas were incorporated into pasturelands, including former exotic fruit orchards and cultivated zones. This process, typical of pastures management, homogenizes the landscape (Figure 6C), although it will not be applied to the lower-altitude pastures (Figure 6A).

DISCUSSION

The arboreal remnants of Fazenda Domiciana, along with those extending into neighboring properties, represents the fifth largest remnant of Semi-deciduous Seasonal Forest and regenerating arboreal formations in São Paulo and Paraná (Table 1). The proportion of Atlantic Forest endemic species recorded on the property (11.1%, Table 2) is similar to that found in a survey of 38 municipalities in São Paulo (11%; Cavarzere & Silveira, 2024). These authors recorded 26 Atlantic Forest endemics in the municipality of Timburi, two species less than we recorded in our study. Of those 26 species, we recorded 19, while seven were not observed (Table 2). Additionally, we recorded nine endemic species not listed by Cavarzere and Silveira (2024) for Timburi. Considering that inland Semi-deciduous Seasonal Forest harbor fewer endemic bird species than coastal Dense Ombrophilous Forest (Vale et al., 2018), and that the inland Atlantic Forest has experienced the most significant biodiversity loss (Aleixo & Vielliard, 1995; Antunes, 2005; Cavarzere et al., 2017; Klemann-Junior et al., 2017; Cavarzere & Silveira, 2024), the number of Atlantic Forest endemics

recorded at Fazenda Domiciana is noteworthy and includes threatened species.

The total number of bird species recorded at Fazenda Domiciana is likely lower than the property's actual potential. First, the survey was not exhaustive in terms of field days and did not cover the central areas of the large forest remnants (Appendix 2). Second, fieldwork was conducted under adverse conditions, likely due to a combination of low rainfall and high temperatures, which caused birds to remain unusually silent and hindered their detection. During the first campaign, the interior São Paulo experienced droughts lasting over 80 consecutive days, along with intense heat and frequent wildfires. Prior to the second campaign, rainfall was weak, and the initial sampling days coincided with a new dry period. According to the WikiAves (s.d.b) platform, 87 bird species not detected in the present study have been recorded in the municipalities of Timburi and Fartura, where Fazenda Domiciana is located. This highlights the property's high potential species richness, with the total number potentially reaching at least 339 species.

The study area lies within a distinct biogeographical context, representing the northernmost extent of a southern species' range and the easternmost boundary of a western species' distribution. In the first case, the property marks the northern geographic limit of the Violet-crowned Plovercrest *Stephanoxis loddigesii* (Gould, 1831), a semi-forest-dwelling species (WikiAves, 2021). In the second case, it constitutes the easternmost known distribution limit of *C. trochilirostris*, another semi-forest-dwelling species, within the interfluvial region between the Paranapanema/Itararé and Tietê Rivers. Within the state of São Paulo, this species is primarily associated with riparian habitats in the western portion of the state (Silveira et al., 2009; WikiAves, 2025). Fazenda Domiciana is also located near the eastern distributional boundary of the Gray-backed Sparrow *Arremon polionotus* Bonaparte, 1850 (WikiAves, 2023). The presence of *C. trochilirostris* and *A. polionotus* may indicate an avifaunal assemblage associated with drier arboreal environments, as illustrated in Figure 4, a possibility that warrants further investigation.

Table 1. Largest remnants of Semi-deciduous Seasonal Forest and arboreal formations at different regeneration stages in São Paulo (SP) and Paraná (PR), southeastern and southern Brazil. Legends: ¹ = continuous forest areas in Argentina were excluded; ² = includes a small portion of Mixed Ombrophilous Forest (Caxambu et al., 2014); ³ = according Cavarzere et al. (2024); ⁴ = surrounding arboreal formations were not considered due to the difficulty of identifying forest types from satellite imagery available on Google Earth Pro.

Remnant	Name	State	Area (ha)
1	Iguaçu National Park (<i>Parque Nacional do Iguaçu</i>)	PR	169,774 ¹
2	Morro do Diabo State Park (<i>Parque Estadual do Morro do Diabo</i>)	SP	36,667
3	Perobas Biological Reserve (<i>Reserva Biológica das Perobas</i>)	PR	8,737 ²
4	Mata dos Godoy State Park (<i>Parque Estadual Mata dos Godoy</i>) and surroundings	PR	7,443
5	Fazenda Domiciana and surroundings	SP	3,361
6	Caetetus Ecological Station (<i>Estação Ecológica dos Caetetus</i>) and surroundings	SP	3,178 ³
7	Rio Guarani State Park (<i>Parque Estadual Rio Guarani</i>)	PR	2,223 ⁴
8	Mico-Leão-Preto Ecological Station (<i>Estação Ecológica Mico-Leão-Preto</i>) – fragment 1	SP	2,121
9	Mico-Leão-Preto Ecological Station (<i>Estação Ecológica Mico-Leão-Preto</i>) – fragment 2	SP	2,064

Table 2. Birds species recorded at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. Abbreviation: Sec. data = secondary data (from the literature and online databases). Symbols: # = species endemic to the Atlantic Forest (Vale et al., 2018); + = species with locally confirmed reproduction. Evidence: v = visual record; a = auditory record; p = photographic record; r = sound recording; c = capture in mist-nets. Environments: 1 = Semi-deciduous Seasonal Forest; 2 = secondary vegetation in an advanced stage of regeneration (fifth phase of natural succession, or *capoeirão*); 3 = secondary vegetation in an intermediate stage of regeneration (fourth and third phases of natural succession, or *capoeira* and *capoeira-rala*, respectively); 4 = secondary vegetation in an early stage of regeneration (second phase of natural succession, or *capoeirinha*); 5 = grassland (natural ones, called *refúgio ecológico*, or of anthropogenic origin, referred to as first phase of natural succession); 6 = secondary marsh (pioneer formation with fluvial influence); 7 = natural floodplain marsh (pioneer formation with fluvial influence); 8 = plantation; 9 = exposed soil; 10 = aquatic; 11 = anthropic; and 12 = aerial. Environment terminology follows Veloso et al. (1991). Campaigns: 1 - July 6-9 and 15, 2024; 2 - October 7-11, 2024. Columns indicate the number of days (5 per campaign) on which each species was recorded, with the abundance category shown in parentheses. Abundance categories per period: I = rare (1-5 individuals); II = uncommon (6-25 individuals); III = common (26-50 individuals); IV = very common (51-500 individuals). Periods were defined as: pre-dawn, morning, afternoon, and post-dusk. Taxonomy and common names follow Pacheco et al. (2021). Note: some literature records are incomplete and lack specific details.

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
Tinamidae									
cf. <i>Tinamus solitarius</i> (Vieillot, 1819) #	Solitary Tinamou		a	Resident	VU (state)	Forest-dwelling	1		1 (I)
<i>Crypturellus obsoletus</i> (Temminck, 1815)	Brown Tinamou	x	v, a	Resident		Forest-dwelling	1	1 (I)	5 (I)
<i>Crypturellus parvirostris</i> (Wagler, 1827)	Small-billed Tinamou		v, a	Resident		Semi-forest-dwelling	3, 5	1 (I)	1 (I)
<i>Crypturellus tataupa</i> (Temminck, 1815)	Tataupa Tinamou	x	a	Resident		Forest-dwelling	1, 3	1 (I)	4 (II)
<i>Rhynchotus rufescens</i> (Temminck, 1815)	Red-winged Tinamou	x	a	Resident		Grassland-dwelling	5		2 (I)
<i>Nothura maculosa</i> (Temminck, 1815)	Spotted Nothura	x	v, a	Resident		Grassland-dwelling	5, 9		2 (I)
Anatidae									
<i>Cairina moschata</i> (Linnaeus, 1758)	Muscovy Duck		v, p	Resident		Aquatic	2, 3, 10, 12	2 (III)	2 (II)
<i>Amazonetta brasiliensis</i> (Gmelin, 1789)	Brazilian Teal	x	v, a, p	Resident		Aquatic	10	4 (I)	2 (I)
Cracidae									
<i>Penelope obscura</i> Temminck, 1815	Dusky-legged Guan	x	v	Resident		Forest-dwelling	2		1 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
Podicipedidae									
<i>Podilymbus podiceps</i> (Linnaeus, 1758) +	Pied-billed Grebe		v, a	Resident		Aquatic	10	3 (II)	2 (I)
Columbidae									
<i>Patagioenas picazuro</i> (Temminck, 1813)	Picazuro Pigeon	x	v, a	Resident		Semi-forest-dwelling	1, 2, 3, 4, 5, 8, 9, 10, 11	5 (III)	5 (II)
<i>Patagioenas cayennensis</i> (Bonnaterre, 1792)	Pale-vented Pigeon		v	Summer resident		Forest-dwelling	1, 4, 10	1 (I)	2 (I)
<i>Geotrygon montana</i> (Linnaeus, 1758)	Ruddy Quail-Dove	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	3 (I)	2 (I)
<i>Leptotila verreauxi</i> Bonaparte, 1855	White-tipped Dove	x	v, a	Resident		Forest-dwelling	1, 2, 3, 8, 9, 10	5 (III)	4 (III)
<i>Leptotila rufaxilla</i> (Richard & Bernard, 1792)	Gray-fronted Dove	x	v, a, p	Resident		Forest-dwelling	2, 3	1 (I)	1 (I)
<i>Zenaida auriculata</i> (Des Murs, 1847)	Eared Dove	x	v, a, p	Resident		Grassland-dwelling	3, 4, 5, 7, 8, 9, 10, 11	5 (III)	5 (IV)
<i>Claravis pretiosa</i> (Ferrari-Perez, 1886)	Blue Ground-Dove		v	Resident		Semi-forest-dwelling	5	2 (I)	
<i>Columbina talpacoti</i> (Temminck, 1811)	Ruddy Ground-Dove	x	v, a	Resident		Semi-forest-dwelling	3, 4, 5, 7, 8, 9, 10, 11	5 (IV)	3 (IV)
<i>Columbina squammata</i> (Lesson, 1831)	Scaled Dove		v, a	Resident		Grassland-dwelling	11	2 (I)	1 (I)
Cuculidae									
<i>Guirra guirra</i> (Gmelin, 1788)	Guirra Cuckoo	x	v, a	Resident		Grassland-dwelling	3, 5, 8, 12	3 (II)	2 (II)
<i>Crotophaga ani</i> Linnaeus, 1758	Smooth-billed Ani	x	v, a	Resident		Marsh-dwelling	3, 4, 5, 6, 7, 8	2 (II)	3 (II)
<i>Tapera naevia</i> (Linnaeus, 1766)	Striped Cuckoo		a	Resident		Semi-forest-dwelling	1, 2, 3, 4	2 (I)	5 (I)

Table 2.

(Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Dromococcyx pavoninus</i> Pelzel, 1870	Pavonine Cuckoo		a	Resident		Forest-dwelling	1, 2		2 (I)
<i>Playa cayana</i> (Linnaeus, 1766)	Squirrel Cuckoo	x	v, a	Resident		Forest-dwelling	2, 3, 11	2 (I)	3 (I)
Nyctibiidae									
<i>Nyctibius griseus</i> (Gmelin, 1789)	Common Potoo		a	Undetermined		Forest-dwelling	3		2 (I)
Caprimulgidae									
<i>Nyctiphrynus ocellatus</i> (Tschudi, 1844)	Ocellated Poorwill		a	Resident		Forest-dwelling	1		2 (I)
<i>Anrostomus rufus</i> (Boddaert, 1783)	Rufous Nightjar		v	Resident		Forest-dwelling	3		1 (I)
<i>Lurocalis semitorquatus</i> (Gmelin, 1789)	Short-tailed Nighthawk		v, a	Summer resident		Forest-dwelling	1, 3, 11, 12		3 (I)
<i>Nyctidromus albigalis</i> (Gmelin, 1789)	Common Pauraque		v, a	Resident		Semi-forest-dwelling	1, 3, 5, 9	4 (II)	4 (I)
Apodidae									
<i>Gypseloides senex</i> (Temminck, 1826)	Great Dusky Swift	x	v	Visitor		Aerial	12		1 (I)
<i>Sireptoprocne zonaris</i> (Shaw, 1796)	White-collared Swift		v, a	Resident		Aerial	1, 5, 10, 12	2 (II)	5 (I)
Trochilidae									
<i>Florisuga fusca</i> (Vieillot, 1817)	Black Jacobin	x	v	Summer resident		Forest-dwelling	11		1 (I)
<i>Phaethornis pretrei</i> (Lesson & Delattre, 1839)	Planalto Hermit	x	v, a	Resident		Forest-dwelling	2, 3, 7	4 (I)	2 (I)
<i>Phaethornis eurynome</i> (Lesson, 1832) #	Scale-throated Hermit		v	Resident		Forest-dwelling	3		1 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Colibri serrirostris</i> (Vieillot, 1816)	White-vented Violetear		v	Undetermined		Grassland-dwelling	7	1 (I)	
cf. <i>Helionaster</i> sp.			v	Undetermined		Semi-forest-dwelling	1, 2	2 (I)	
<i>Chlorostilbon lucidus</i> (Shaw, 1812)	Glittering-bellied Emerald	x	v, a	Resident		Semi-forest-dwelling	2, 3, 4, 5	2 (I)	3 (I)
<i>Stephanoxis loddigesii</i> (Gould, 1831) #	Violet-crowned Plovercrest		v, a	Undetermined		Semi-forest-dwelling	3, 7	1 (I)	1 (I)
<i>Thalurania glaucopis</i> (Gmelin, 1788) #	Violet-capped Woodnymph	x	v, a, c	Resident		Forest-dwelling	1, 2, 11	2 (I)	2 (I)
<i>Eupetomena macroura</i> (Gmelin, 1788)	Swallow-tailed Hummingbird	x	v	Resident		Semi-forest-dwelling	5, 8	2 (I)	
<i>Leucochloris albicollis</i> (Vieillot, 1818)	White-throated Hummingbird		v	Undetermined		Forest-dwelling	3	1 (I)	
<i>Chionomesa fimbriata</i> (Gmelin, 1788)	Glittering-throated Emerald		v	Undetermined		Semi-forest-dwelling	1		1 (I)
<i>Chionomesa lactea</i> (Lesson, 1832)	Sapphire-spangled Emerald	x	v	Undetermined		Semi-forest-dwelling	1, 3		1 (I)
<i>Hylodcharis chrysura</i> (Shaw, 1812)	Gilded Hummingbird	x	?	Resident		Semi-forest-dwelling	?		
Aramidae									
<i>Aramus guarana</i> (Linnaeus, 1766)	Limpkin		v, a, p	Resident		Aquatic	3, 10	3 (II)	4 (II)
Rallidae									
<i>Porphyrio martinica</i> (Linnaeus, 1766)	Purple Gallinule		v	Undetermined		Aquatic	10		1 (I)
<i>Laterallus melanophaius</i> (Vieillot, 1819)	Rufous-sided Crane		a	Resident		Marsh-dwelling	6, 7	3 (I)	1 (I)

Table 2.

(Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Laterallus</i> sp. cf. <i>L. xenopterus</i> Conover, 1934	Rufous-faced Crane		a, r	Resident	CR (state), EN (national), VU (global)	Marsh-dwelling	7	2 (I)	2 (I)
<i>Mustelirallus albicollis</i> (Vieillot, 1819)	Ash-throated Crane		a	Resident		Marsh-dwelling	6, 7, 10	2 (I)	3 (I)
<i>Pardirallus nigricans</i> (Vieillot, 1819)	Blackish Rail		a	Resident		Marsh-dwelling	6	2 (I)	1 (I)
<i>Aramides saracura</i> (Spix, 1825) #	Slaty-breasted Wood-Rail		v, a, f	Resident		Forest-dwelling	3, 5, 8, 10	3 (I)	4 (I)
<i>Gallinula galeata</i> (Lichtenstein, 1818)	Common Gallinule		v, a, f	Resident		Aquatic	10	3 (II)	3 (II)
Charadriidae									
<i>Vanellus chilensis</i> (Molina, 1782)	Southern Lapwing	x	v, a	Resident		Aquatic	5, 8, 9, 10, 12	5 (II)	5 (II)
Recurvirostridae									
<i>Himantopus melanurus</i> Vieillot, 1817	White-backed Stilt		v, a	Undetermined		Aquatic	10		2 (I)
Scolopacidae									
<i>Tringa solitaria</i> Wilson, 1813	Solitary Sandpiper		v, a	Northern migrant		Aquatic	10		2 (I)
Jacaniidae									
<i>Jacana jacana</i> (Linnaeus, 1766)	Wattled Jacana		v, a, p	Resident		Aquatic	10	3 (II)	3 (II)
Phalacrocoracidae									
<i>Nannopterum brasilianum</i> (Gmelin, 1789)	Neotropic Cormorant		v, p	Visitor		Aquatic	10	2 (I)	2 (II)
Ardeidae									
<i>Tigrisoma lineatum</i> (Boddaert, 1783)	Rufescent Tiger-Heron		v, p	Resident		Semi-forest-dwelling	3, 6, 10	1 (I)	3 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Nycticorax nycticorax</i> (Linnaeus, 1758)	Black-crowned Night-Heron		v, p	Undetermined		Aquatic	10	1 (I)	
<i>Butorides striata</i> (Linnaeus, 1758)	Striated Heron		v, a, p	Resident		Aquatic	6, 10	2 (I)	3 (I)
<i>Bubulcus ibis</i> (Linnaeus, 1758)	Cattle Egret		v, a	Visitor		Grassland-dwelling	5	3 (III)	4 (II)
<i>Ardea coccy</i> Linnaeus, 1766	Cocoi Heron		v, p	Undetermined		Aquatic	2, 3, 10	2 (I)	1 (II)
<i>Ardea alba</i> Linnaeus, 1758	Great Egret		v, a, p	Undetermined		Aquatic	3, 5, 6, 10	3 (I)	3 (II)
<i>Syrigma sibilatrix</i> (Temminck, 1824)	Whistling Heron		v, a, p	Undetermined		Grassland-dwelling	5, 10, 12	1 (I)	1 (I)
<i>Egretta thula</i> (Molina, 1782)	Snowy Egret		v, p	Undetermined		Aquatic	3, 10	3 (II)	3 (II)
Threskiornithidae									
<i>Mesembrinibis cayennensis</i> (Gmelin, 1789)	Green Ibis		v, a, p	Resident		Semi-forest-dwelling	3, 10, 12	1 (I)	4 (I)
<i>Phimosus infuscatus</i> (Lichtenstein, 1823)	Bare-faced Ibis		v	Visitor		Aquatic	10	1 (I)	
<i>Theristicus caudatus</i> (Boddaert, 1783)	Buff-necked Ibis		v, a, p	Undetermined		Grassland-dwelling	5, 9, 11, 12	5 (II)	5 (I)
Cathartidae									
<i>Sarcoramphus papa</i> (Linnaeus, 1758)	King Vulture		v, p	Undetermined		Semi-forest-dwelling	3, 9, 12	1 (I)	1 (I)
<i>Coragyps atratus</i> (Bechstein, 1793)	Black Vulture	x	v	Undetermined		Semi-forest-dwelling	2, 3, 5, 9, 10, 12	4 (II)	4 (II)
<i>Cathartes aura</i> (Linnaeus, 1758)	Turkey Vulture	x	v, p	Undetermined		Forest-dwelling	1, 2, 3, 12	3 (II)	4 (II)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
Pandionidae									
<i>Pandion haliaetus</i> (Linnaeus, 1758)	Osprey		v, p	Northern migrant		Aquatic	10, 12	1 (I)	
Accipitridae									
<i>Elanus leucurus</i> (Vieillot, 1818)	White-tailed Kite	x	?	Undetermined		Grassland-dwelling	?		
<i>Lepidodon cayanensis</i> (Latham, 1790)	Gray-headed Kite	x	p	Resident		Forest-dwelling	?		
<i>Rostrhamus sociabilis</i> (Vieillot, 1817)	Snail Kite		v, a, p	Resident		Aquatic	3, 10, 12	3 (I)	3 (II)
<i>Ictinia plumbea</i> (Gmelin, 1788) +	Plumbeous Kite	x	v, a, p	Resident		Forest-dwelling	1, 3, 5, 11, 12		4 (I)
<i>Accipiter striatus</i> Vieillot, 1808	Sharp-shinned Hawk		v	Resident		Forest-dwelling	12	1 (I)	
<i>Urubitinga urubitinga</i> (Gmelin, 1788)	Great Black Hawk		v, p	Resident		Semi-forest-dwelling	5, 10		1 (I)
<i>Rupornis magnirostris</i> (Gmelin, 1788)	Roadside Hawk	x	v, a, p	Resident		Semi-forest-dwelling	1, 2, 3, 5, 12	5 (I)	3 (I)
<i>Geranoaetus albicaudatus</i> (Vieillot, 1816)	White-tailed Hawk	x	v, p	Undetermined		Grassland-dwelling	1, 5, 12	1 (I)	1 (I)
<i>Buteo brachyurus</i> Vieillot, 1816	Short-tailed Hawk		v	Resident		Forest-dwelling	3, 5, 12	1 (I)	2 (I)
Tytonidae									
<i>Tyto furcata</i> (Temminck, 1827)	American Barn Owl		a	Resident		Grassland-dwelling	12	1 (I)	
Strigidae									
<i>Megascops choliba</i> (Vieillot, 1817)	Tropical Screech-Owl		a	Resident		Semi-forest-dwelling	3		1 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Pulsatrix koeniswaldiana</i> (Bertoni & Bertoni, 1901) #	Tawny-browed Owl		v, a, r	Resident		Forest-dwelling	1		1 (I)
<i>Athene cunicularia</i> (Molina, 1782)	Burrowing Owl	x	v, a	Resident		Grassland-dwelling	5	4 (I)	
<i>Asio flammeus</i> (Pontoppidan, 1763)	Short-eared Owl	x	?	Undetermined		Grassland-dwelling	?		
Trogonidae									
<i>Trogon surrucura</i> Vieillot, 1817	Surucua Trogon		a	Resident		Forest-dwelling	1	1 (I)	2 (I)
Momotidae									
cf. <i>Baryphthengus ruficapillus</i> (Vieillot, 1818) #	Rufous-capped Motmot		a	Resident		Forest-dwelling	1		1 (I)
Alcedinidae									
<i>Megaceryle torquata</i> (Linnaeus, 1766)	Ringed Kingfisher		v, a	Resident		Aquatic	2, 3, 10, 12	3 (I)	3 (I)
<i>Chloroceryle amazona</i> (Latham, 1790)	Amazon Kingfisher		v, a	Resident		Aquatic	3, 10	2 (I)	
<i>Chloroceryle americana</i> (Gmelin, 1788)	Green Kingfisher		v, a	Resident		Aquatic	10	1 (I)	2 (I)
Bucconidae									
<i>Malacoptila striata</i> (Spix, 1824) #	Crescent-chested Puffbird	x	?	Resident		Forest-dwelling	?		
Ramphastidae									
<i>Ramphastos toco</i> Statius Muller, 1776	Toco Toucan	x	v, a, p	Resident		Forest-dwelling	1, 2, 3, 5, 12	5 (II)	5 (I)
Picidae									
<i>Picumnus temminckii</i> Lafresnaye, 1845 # +	Ochre-collared Piculet	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3, 4, 5, 7, 11	5 (II)	4 (II)

Table 2.

(Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Melanerpes candidus</i> (Otto, 1796)	White Woodpecker	x	v, a	Resident		Semi-forest-dwelling	3, 12	2 (I)	4 (I)
<i>Veniliornis passerinus</i> (Linnaeus, 1766)	Little Woodpecker	x	v, a	Resident		Forest-dwelling	2, 3, 5, 11	3 (I)	2 (I)
<i>Veniliornis spilogaster</i> (Wagler, 1827)	White-spotted Woodpecker		a	Resident		Forest-dwelling	1, 2, 3, 11	3 (I)	3 (I)
<i>Campephilus robustus</i> (Lichtenstein, 1818) #	Robust Woodpecker		a	Resident		Forest-dwelling	1, 2, 3	3 (I)	2 (I)
<i>Dryocopus lineatus</i> (Linnaeus, 1766)	Lineated Woodpecker	x	v, a	Resident		Forest-dwelling	1, 2, 3, 5	4 (I)	3 (I)
<i>Ceulex flavescens</i> (Gmelin, 1788)	Blond-crested Woodpecker		a	Resident		Forest-dwelling	2	1 (I)	
<i>Colaptes melanochloros</i> (Gmelin, 1788)	Green-barred Woodpecker	x	v, a, p	Resident		Semi-forest-dwelling	3, 5	4 (I)	3 (I)
<i>Colaptes campestris</i> (Vieillot, 1818)	Campo Flicker		v, a	Resident		Grassland-dwelling	3, 5, 8, 9, 11, 12	5 (I)	5 (I)
Cariamidae									
<i>Cariama cristata</i> (Linnaeus, 1766)	Red-legged Seriema	x	v, a, p	Resident		Grassland-dwelling	5, 9	5 (II)	4 (I)
Falconidae									
<i>Herpetotheres cachinnans</i> (Linnaeus, 1758)	Laughing Falcon	x	a	Resident		Semi-forest-dwelling	1, 2, 3	3 (I)	3 (I)
<i>Caracara plancus</i> (Miller, 1777)	Crested Caracara	x	v, a	Resident		Grassland-dwelling	1, 2, 3, 5, 9, 11, 12	5 (II)	5 (II)
<i>Milvago chimachima</i> (Vieillot, 1816)	Yellow-headed Caracara	x	v, a, p	Resident		Grassland-dwelling	3, 4, 5, 10, 12	4 (I)	4 (I)
<i>Falco sparverius</i> Linnaeus, 1758	American Kestrel	x	v	Resident		Grassland-dwelling	5	1 (I)	

Table 2.

(Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Falco femoralis</i> Temminck, 1822	Aplomado Falcon		v, a	Resident		Grassland-dwelling	5, 9, 12	2 (I)	1 (I)
Psittacidae									
<i>Bratogeris chiriri</i> (Vieillot, 1818)	Yellow-chevroned Parakeet	x	v, a	Resident		Forest-dwelling	1, 2, 3, 11, 12	5 (III)	5 (II)
<i>Pionus maximiliani</i> (Kuhl, 1820)	Scaly-headed Parrot	x	v, a	Resident		Forest-dwelling	1, 2, 3, 11, 12	5 (I)	2 (I)
<i>Amazona vinacea</i> (Kuhl, 1820) #	Vinaceous-breasted Parrot		a	Undetermined	CR (state), EN (global), VU (national)	Forest-dwelling	1	1 (I)	
<i>Amazona aestiva</i> (Linnaeus, 1758)	Turquoise-fronted Parrot		v, a	Resident		Forest-dwelling	1, 2, 5, 12	3 (I)	4 (I)
<i>Forpus xanthopterygius</i> (Spix, 1824)	Blue-winged Parrotlet		v, a	Resident		Forest-dwelling	2, 3	1 (I)	1 (I)
<i>Psittacara leucophthalmus</i> (Statius Muller, 1776)	White-eyed Parakeet	x	v, a	Resident		Semi-forest-dwelling	1, 2, 3, 12	3 (I)	3 (I)
Thamnophilidae									
<i>Formicivora rufa</i> (Vied, 1831)	Rusty-backed Antwren		v, a, p, r, c	Resident		Semi-forest-dwelling	7	2 (I)	1 (I)
<i>Dysithamnus mentalis</i> (Temminck, 1823)	Rusty-backed Antwren	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	4 (II)	4 (II)
<i>Herpilochmus rufimarginatus</i> (Temminck, 1822)	Southern Rufous-winged Antwren	x	a	Resident		Forest-dwelling	1, 2, 3	2 (I)	3 (I)
<i>Thamnophilus doliatus</i> (Linnaeus, 1764)	Barred Antshrike		v, a, p, c	Resident		Semi-forest-dwelling	2, 3, 4, 5	3 (I)	3 (I)
<i>Thamnophilus ruficapillus</i> Vieillot, 1816	Rufous-capped Antshrike		v, a, p, c	Resident		Semi-forest-dwelling	4, 5, 7	4 (I)	3 (I)

Table 2.

(Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Thamnophilus caerulescens</i> Vieillot, 1816 +	Variable Antshrike	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3, 5	4 (I)	5 (II)
<i>Hypodaedalus guttatus</i> (Vieillot, 1816) #	Spot-backed Antshrike	x	v, a	Resident		Forest-dwelling	1, 2, 3	3 (I)	4 (I)
<i>Mackenziaena severa</i> (Lichtenstein, 1823) #	Tufted Antshrike	x	a	Resident		Forest-dwelling	1, 2, 3	2 (I)	4 (I)
<i>Pyriglena leucoptera</i> (Vieillot, 1818) #	White-shouldered Fire-eye	x	v, a, p, c	Resident		Forest-dwelling	1, 3	2 (I)	5 (II)
<i>Drymophila ferruginea</i> (Temminck, 1822) #	Ferruginous Antbird	x	v, a, p	Resident		Forest-dwelling	1, 2, 3	4 (I)	3 (I)
<i>Drymophila ochropyga</i> (Hellmayr, 1906) #	Ochre-rumped Antbird	x	?	Resident		Forest-dwelling	?		
cf. <i>Drymophila malura</i> (Temminck, 1825) #	Dusky-tailed Antbird		a	Resident		Forest-dwelling	3	1 (I)	
Conopophagidae									
<i>Conopophaga lineata</i> (Wied, 1831) +	Rufous Gnateater	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	3 (I)	5 (II)
Rhinocryptidae									
<i>Psilorhamphus guttatus</i> (Ménétries, 1835) #	Spotted Bamboowren	x	a	Resident		Forest-dwelling	1		1 (I)
<i>Eleoscytalopus indigoticus</i> (Wied, 1831) #	White-breasted Tapaculo	x	a	Resident		Semi-forest-dwelling	1		1 (I)
Scleruridae									
<i>Sclerurus scansor</i> (Ménétries, 1835) #	Rufous-breasted Leafhopper	x	a	Resident		Forest-dwelling	1	1 (I)	1 (I)
Dendrocolaptidae									
<i>Sittasomus griseicapillus</i> (Vieillot, 1818)	Olivaceous Woodcreeper	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	3 (I)	4 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Xiphorhynchus fuscus</i> (Vieillot, 1818) #	Lesser Woodcreeper	x	v, a, p, c	Resident		Forest-dwelling	1, 2	2 (I)	4 (II)
<i>Campylorhamphus trochilirostris</i> (Lichtenstein, 1820)	Red-billed Scythebill		v, a, r	Resident	EN (state)	Semi-forest-dwelling	2		1 (I)
<i>Campylorhamphus falcularius</i> (Vieillot, 1822) #	Black-billed Scythebill	x	a	Resident		Forest-dwelling	1	1 (I)	
<i>Lepidocolaptes angustirostris</i> (Vieillot, 1818)	Narrow-billed Woodcreeper	x	v, a	Resident		Semi-forest-dwelling	3, 5, 11	4 (I)	3 (I)
Xenopidae									
<i>Xenops rutilans</i> Temminck, 1821	Streaked Xenops	x	v, a	Resident		Forest-dwelling	1, 2, 3	3 (I)	
Furnariidae									
<i>Furnarius rufus</i> (Gmelin, 1788)	Rufous Hornero	x	v, a	Resident		Grassland-dwelling	4, 5, 8, 9, 10, 11	3 (I)	4 (II)
<i>Lochmias nematura</i> (Lichtenstein, 1823)	Sharp-tailed Streamcreeper		v, a	Resident		Forest-dwelling	2, 3	3 (I)	4 (I)
<i>Syndactyla rufosuperciliata</i> (Lafresnaye, 1832)	Buff-browed Foliage-gleaner		a	Resident		Forest-dwelling	1, 2, 3	2 (I)	3 (I)
<i>Automolus leucophthalmus</i> (Wied, 1821) # +	White-eyed Foliage-gleaner	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	3 (I)	5 (II)
<i>Anumbius annumbi</i> (Vieillot, 1817) +	Firewood-Gatherer	x	v, a	Resident		Grassland-dwelling	5	1 (I)	1 (I)
<i>Certhiaxis cinnamomeus</i> (Gmelin, 1788)	Yellow-chinned Spinetail		v, a	Resident		Marsh-dwelling	4, 5, 6, 10	3 (I)	3 (I)
<i>Synallaxis ruficapilla</i> Vieillot, 1819 #	Rufous-capped Spinetail	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	4 (I)	3 (I)
<i>Synallaxis spixi</i> Sclater, 1856	Spix's Spinetail	x	v, a	Resident		Grassland-dwelling	1, 2, 3, 4, 5, 7	4 (I)	4 (I)

Table 2.

(Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Synallaxis albescent</i> Temminck, 1823	Pale-breasted Spinetail		a	Undetermined		Grassland-dwelling	5	2 (I)	
<i>Synallaxis frontalis</i> Pelzelin, 1859	Sooty-fronted Spinetail	x	v, a	Resident		Semi-forest- dwelling	3	1 (I)	2 (I)
Plridae									
<i>Chiroxipha caudata</i> (Shaw & Nodder, 1793) #	Swallow-tailed Manakin	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	4 (II)	5 (II)
Cotingidae									
<i>Phibalura flaviviridis</i> Vieillot, 1816 #	Swallow-tailed Cotinga		v	Undetermined		Forest-dwelling	12	1 (I)	
Tityridae									
d. <i>Pachyrhamphus</i> <i>polychropterus</i> (Vieillot, 1818)	White-winged Becard		v	Summer resident		Forest-dwelling	2		1 (I)
Platyrinchidae									
<i>Platyrinchus mystaceus</i> Vieillot, 1818	White-throated Spadebill	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	2 (I)	4 (I)
Rhynchoyclidae									
<i>Leptopogon amaurocephalus</i> Tschudi, 1846 +	Sepia-capped Flycatcher	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	2 (I)	2 (I)
<i>Corythopsis delalandi</i> (Lesson, 1830)	Southern Antpitt	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3		3 (I)
<i>Tolmomyias sulphurescens</i> (Spix, 1825) +	Yellow-olive Flycatcher	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	4 (I)	1 (I)
<i>Todirostrum poliocephalum</i> (Vied, 1831) #	Gray-headed Tody- Flycatcher	x	v, a	Resident		Forest-dwelling	1, 2, 3	4 (II)	5 (II)
<i>Todirostrum cinereum</i> (Linnaeus, 1766) +	Common Tody- Flycatcher	x	v, a, p	Resident		Semi-forest- dwelling	2, 3, 5, 11	5 (II)	3 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Poecilatriccus plumbeiceps</i> (Lafresnaye, 1846)	Ochre-faced Tody-Flycatcher		a	Resident		Forest-dwelling	2		1 (I)
<i>Myiornis auricularis</i> (Vieillot, 1818) #	Eared Pygmy-Tyrant	x	v, a	Resident		Forest-dwelling	1, 2, 3	2 (I)	2 (I)
<i>Henricus diops</i> (Temminck, 1822) #	Drab-breasted Pygmy-Tyrant	x	v, a	Resident		Forest-dwelling	1, 2	2 (I)	2 (I)
Tyrannidae									
<i>Hirundinea ferruginea</i> (Gmelin, 1788)	Cliff Flycatcher	x	v, a, p	Resident		Grassland-dwelling	2, 3, 5, 7, 11	4 (I)	3 (II)
<i>Euscarthmus melophphus</i> Wied, 1831	Tawny-crowned Pygmy-Tyrant	x	?	Undetermined		Semi-forest-dwelling	?		
<i>Camptostoma obsoletum</i> (Temminck, 1824)	Southern Beardless-Tyrannulet	x	v, a, p, c	Resident		Semi-forest-dwelling	1, 2, 3, 7, 11	5 (I)	5 (I)
<i>Elaenia flavogaster</i> (Thunberg, 1822)	Yellow-bellied Elaenia	x	v, a	Resident		Semi-forest-dwelling	3, 5, 6, 7, 8, 11	3 (II)	4 (II)
<i>Elaenia spectabilis</i> Pelzel, 1868	Large Elaenia		v, a	Summer resident		Semi-forest-dwelling	3, 6		3 (I)
<i>Elaenia parvirostris</i> Pelzel, 1868	Small-billed Elaenia		a	Summer resident		Forest-dwelling	2, 3, 11		2 (I)
<i>Elaenia chiriquensis</i> Lawrence, 1865	Lesser Elaenia		v, a	Summer resident		Semi-forest-dwelling	3, 4	1 (I)	2 (I)
<i>Elaenia obscura</i> (d'Orbigny & Lafresnaye, 1837)	Small-headed Elaenia		v, a	Resident		Semi-forest-dwelling	3, 7	2 (I)	2 (I)
<i>Myiophaps viridicata</i> (Vieillot, 1817)	Greenish Elaenia	x	a, p	Resident		Forest-dwelling	1		1 (I)
<i>Capsempis flaveola</i> (Lichtenstein, 1823)	Yellow Tyrannulet	x	a	Resident		Semi-forest-dwelling	3	1 (I)	

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Phylomyias fasciatus</i> (Thunberg, 1822)	Planalto Tyrannulet		a	Undetermined		Semi-forest-dwelling	3	1 (I)	
<i>Serpophaga subcristata</i> (Vieillot, 1817)	White-crested Tyrannulet	x	v, a, p, c	Resident		Semi-forest-dwelling	3, 4, 5, 7, 11	5 (I)	3 (I)
<i>Myiarchus swainsoni</i> Cabanis & Heine, 1859	Swainson's Flycatcher		a	Summer resident		Forest-dwelling	1, 2, 3		4 (I)
<i>Myiarchus ferox</i> (Gmelin, 1789)	Short-crested Flycatcher	x	v, a	Resident		Semi-forest-dwelling	1, 2, 3, 11	4 (II)	3 (II)
<i>Myiarchus tyrannulus</i> (Statius Muller, 1776)	Brown-crested Flycatcher	x	v, a, p	Undetermined		Semi-forest-dwelling	3, 4, 5	5 (I)	
<i>Pitangus sulphuratus</i> (Linnaeus, 1766)	Great Kiskadee	x	v, a	Resident		Semi-forest-dwelling	1, 3, 4, 5, 8, 10	4 (II)	5 (I)
<i>Machetornis rixosa</i> (Vieillot, 1819)	Cattle Tyrant		v, a	Resident		Grassland-dwelling	3, 5, 8	3 (I)	
<i>Myiodynastes maculatus</i> (Statius Muller, 1776)	Streaked Flycatcher	x	v, a	Summer resident		Forest-dwelling	2, 3, 11		5 (II)
<i>Megarynchus pitangua</i> (Linnaeus, 1766)	Boat-billed Flycatcher	x	a	Resident		Forest-dwelling	2, 3	1 (I)	3 (I)
<i>Myiozetetes similis</i> (Spix, 1825) +	Social Flycatcher	x	v, a, p	Resident		Semi-forest-dwelling	3, 4, 5, 10	2 (II)	3 (II)
<i>Tyrannus melancholicus</i> Vieillot, 1819	Tropical Kingbird	x	v, a	Summer resident		Semi-forest-dwelling	3, 4, 5, 10		4 (II)
<i>Tyrannus savana</i> Daudin, 1802	Southern Fork-tailed Flycatcher	x	v, a	Summer resident		Grassland-dwelling	3, 5, 10, 11		5 (I)
<i>Empidonomus varius</i> (Vieillot, 1818)	Variegated Flycatcher	x	v, a	Summer resident		Semi-forest-dwelling	1, 3		4 (II)
<i>Colonia colonus</i> (Vieillot, 1818)	Long-tailed Tyrant	x	v, a	Resident		Forest-dwelling	1, 2, 3	4 (II)	5 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Arundinicola leucocephala</i> (Linnaeus, 1764)	White-headed Marsh Tyrant		v, p	Resident		Aquatic	10	2 (I)	2 (II)
<i>Fluvicola albiventer</i> (Spix, 1825)	Black-backed Water-Tyrant		v	Undetermined		Aquatic	8	1 (I)	
<i>Fluvicola nengeta</i> (Linnaeus, 1766)	Masked Water-Tyrant		v, a	Resident		Aquatic	4, 5, 10, 11	3 (II)	3 (II)
<i>Pyrocephalus rubinus</i> (Boddaert, 1783)	Vermilion Flycatcher		v, p	Southern migrant		Grassland-dwelling	5	1 (I)	
<i>Gubernates yetapa</i> (Vieillot, 1818)	Streamer-tailed Tyrant	x	v, a, p	Resident		Marsh-dwelling	4, 5, 6, 7, 10	4 (II)	3 (I)
<i>Myiophobus fasciatus</i> (Statius Muller, 1776)	Bran-colored Flycatcher		v, a	Resident		Semi-forest-dwelling	3, 5, 7	5 (I)	3 (I)
<i>Cremotriccus fuscatus</i> (Wied, 1831)	Fuscous Flycatcher	x	?	Resident		Semi-forest-dwelling	?		
<i>Lathrotriccus euleri</i> (Cabanis, 1868) +	Euler's Flycatcher	x	v, a, p, c	Summer resident		Forest-dwelling	1, 2, 3		4 (II)
<i>Contopus cinereus</i> (Spix, 1825)	Tropical Pewee		v, a	Undetermined		Forest-dwelling	1		1 (I)
<i>Satrapa icterophrys</i> (Vieillot, 1818)	Yellow-browed Tyrant		v	Undetermined		Semi-forest-dwelling	4	1 (I)	
<i>Knipolegus lophotes</i> Boie, 1828	Crested Black-Tyrant		v	Resident		Grassland-dwelling	3, 5	1 (I)	1 (I)
<i>Knipolegus cyanirostris</i> (Vieillot, 1818)	Blue-billed Black-Tyrant		v	Undetermined		Semi-forest-dwelling	7		1 (I)
<i>Xolmis velatus</i> (Lichtenstein, 1823)	White-rumped Monjita	x	v, p	Resident		Grassland-dwelling	5, 9, 12	5 (I)	3 (I)
<i>Nergetus cinereus</i> (Vieillot, 1816)	Gray Monjita	x	?	Undetermined		Grassland-dwelling	?		

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
Vireonidae									
<i>Cyclarhis gujanensis</i> (Gmelin, 1789)	Rufous-browed Peppershrike	x	v, a	Resident		Forest-dwelling	1, 2, 3, 11	4 (I)	4 (I)
<i>Myiophobus amaurocephalus</i> (Nordmann, 1835)	Gray-eyed Greenlet		a	Resident		Forest-dwelling	2		1 (I)
<i>Vireo chivi</i> (Vieillot, 1817)	Chivi Vireo	x	v, a, p, c	Summer resident		Forest-dwelling	1, 2, 3		4 (II)
Corvidae									
<i>Granocorax cristatellus</i> (Temminck, 1823)	Curl-crested Jay		a	Resident		Semi-forest-dwelling	12	1 (I)	
<i>Granocorax chrysops</i> (Vieillot, 1818)	Plush-crested Jay	x	v, a	Resident		Forest-dwelling	1, 3		2 (I)
Hirundinidae									
<i>Ptychocheilidon cyanoleuca</i> (Vieillot, 1818)	Blue-and-white Swallow	x	v, a	Resident		Aerial	1, 3, 5, 7, 8, 9, 10, 11, 12	4 (III)	5 (II)
<i>Altophaga fucata</i> (Temminck, 1822)	Tawny-headed Swallow		v	Undetermined		Grassland-dwelling	5, 10, 12	2 (I)	
<i>Stelgidopteryx ruficollis</i> (Vieillot, 1817)	Southern Rough-winged Swallow	x	v, a	Resident		Semi-forest-dwelling	4, 5, 7, 8, 9, 10, 11, 12	5 (II)	4 (II)
<i>Progne tapera</i> (Linnaeus, 1766)	Brown-chested Martin		v, a	Resident		Grassland-dwelling	5, 7, 8, 10, 11, 12	4 (I)	2 (I)
<i>Progne chalybea</i> (Gmelin, 1789)	Gray-breasted Martin	x	v, a	Resident		Grassland-dwelling	5, 11, 12	1 (I)	3 (I)
<i>Tachycineta albiventer</i> (Boddaert, 1783)	White-winged Swallow		v	Resident		Aquatic	10, 12	2 (I)	1 (I)
<i>Tachycineta leucorhoa</i> (Vieillot, 1817)	White-rumped Swallow	x	v, a	Resident		Grassland-dwelling	4, 5, 7, 8, 9, 10, 12	4 (II)	4 (II)
<i>Petrochelidon pyrrhonota</i> (Vieillot, 1817)	Cliff Swallow		v	Northern migrant		Grassland-dwelling	5		1 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
Troglodytidae									
<i>Troglodytes musculus</i> Naumann, 1823	Southern House Wren	x	v, a	Resident		Grassland-dwelling	3, 4, 5, 6, 7, 8, 11	5 (I)	4 (I)
Turdidae									
<i>Turdus leucomelas</i> Vieillot, 1818 +	Pale-breasted Thrush	x	v, a, p, c	Resident		Semi-forest-dwelling	1, 2, 3, 4, 5, 7, 8, 11	4 (II)	4 (II)
<i>Turdus rufiventris</i> Vieillot, 1818	Rufous-bellied Thrush	x	v, a, p	Resident		Forest-dwelling	2, 3, 4, 8, 11	4 (I)	5 (I)
<i>Turdus amaurochalinus</i> Cabanis, 1850	Creamy-bellied Thrush	x	v, a	Undetermined		Semi-forest-dwelling	2, 3, 4, 7, 8, 11	3 (II)	4 (I)
<i>Turdus subalaris</i> (Seebohm, 1887)	Eastern Slaty Thrush		v, a	Southern migrant		Semi-forest-dwelling	1, 2		2 (I)
<i>Turdus albicollis</i> Vieillot, 1818	White-necked Thrush	x	v, a, p, c	Resident		Forest-dwelling	1, 2	2 (I)	4 (I)
Mimidae									
<i>Mimus saturninus</i> (Lichtenstein, 1823)	Chalk-browed Mockingbird	x	v, a	Resident		Grassland-dwelling	5, 7, 8, 9, 11	5 (II)	4 (I)
Passeridae									
<i>Passer domesticus</i> (Linnaeus, 1758)	House Sparrow		v, a	Resident		Urban-dwelling	9, 11	2 (I)	1 (II)
Motacillidae									
<i>Anthus chii</i> Vieillot, 1818	Yellowish Pipit	x	v, a	Resident		Grassland-dwelling	5, 8, 9, 10	3 (I)	2 (I)
Fringillidae									
<i>Spinus magellanicus</i> (Vieillot, 1805)	Hooded Siskin		v, a	Resident		Grassland-dwelling	3, 5, 11, 12	1 (I)	4 (I)
<i>Euphonia chlorotica</i> (Linnaeus, 1766)	Purple-throated Euphonia	x	v, a	Resident		Forest-dwelling	1, 2, 3, 11	3 (I)	4 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
Passerellidae									
<i>Ammodramus humeralis</i> (Bosc, 1792)	Grassland Sparrow	x	v, a, p, c	Resident		Grassland-dwelling	4, 5, 7, 8, 9	3 (IV)	2 (II)
<i>Arremon palionotus</i> Bonaparte, 1850	Gray-backed Sparrow	x	v, a, p	Resident		Forest-dwelling	1, 2, 3	2 (I)	2 (I)
<i>Zonotrichia capensis</i> (Statius Muller, 1776)	Rufous-collared Sparrow	x	v, a, p, c	Resident		Grassland-dwelling	3, 4, 5, 6, 7, 8, 9, 10, 11	5 (IV)	5 (II)
Icteridae									
<i>Leistes supercilialis</i> (Bonaparte, 1850)	White-browed Meadowlark	x	?	Undetermined		Grassland-dwelling	?		
<i>Cacic us haemorrhous</i> (Linnaeus, 1766)	Red-rumped Cacique		v, a	Resident		Forest-dwelling	2		1 (I)
<i>Icterus pyrrhopterus</i> (Vieillot, 1819)	Variable Oriole		v, a	Resident		Forest-dwelling	3	1 (I)	
<i>Molothrus bonariensis</i> (Gmelin, 1789)	Shiny Cowbird		v, a	Summer resident		Semi-forest-dwelling	3, 4, 5, 10, 11	1 (I)	3 (II)
<i>Chrysomus ruficapillus</i> (Vieillot, 1819)	Chestnut-capped Blackbird		v, a, p	Undetermined		Marsh-dwelling	10		2 (I)
<i>Pseudoleistes guirahuro</i> (Vieillot, 1819)	Yellow-rumped Marshbird	x	v, a	Resident		Marsh-dwelling	5, 6, 7, 8	3 (II)	2 (I)
Parulidae									
<i>Geothlypis aequinoctialis</i> (Gmelin, 1789)	Masked Yellowthroat	x	v, a	Resident		Marsh-dwelling	2, 3, 4, 6, 7	5 (I)	3 (I)
<i>Setophaga pitaiayumi</i> (Vieillot, 1817)	Tropical Parula	x	a, p	Resident		Semi-forest-dwelling	2, 3, 11	2 (I)	4 (I)
<i>Myiothlypis flaveola</i> Baird, 1865	Flavescent Warbler		v, a, p, c	Resident		Forest-dwelling	1, 2, 3	3 (II)	4 (I)

Table 2. (Continue)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Myiothlypis leucoblephara</i> (Vieillot, 1817)	White-browed Warbler	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	4 (II)	5 (I)
<i>Basileuterus culicivorus</i> (Deppe, 1830)	Golden-crowned Warble	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3, 4, 11	4 (II)	5 (II)
Cardinalidae									
<i>Habia rubica</i> (Vieillot, 1817) +	Red-crowned Ant-Tanager	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3	4 (I)	4 (II)
<i>Gyanoloxia glaucocerulea</i> (d'Orbigny & Lafresnaye, 1837)	Glaucous-blue Grosbeak		v, a	Undetermined		Grassland-dwelling	7	1 (I)	
<i>Gyanoloxia brissonii</i> (Lichtenstein, 1823)	Ultramarine Grosbeak	x	v, a	Resident		Semi-forest-dwelling	2, 3, 4, 7	5 (I)	2 (I)
Thraupidae									
<i>Emberizoides herbicola</i> (Vieillot, 1817)	Wedge-tailed Grass-Finch	x	v, a, p	Resident		Grassland-dwelling	4, 5, 6	3 (II)	2 (I)
<i>Hemithraupis guira</i> (Linnaeus, 1766)	Guira Tanager	x	v, a	Resident		Forest-dwelling	1, 2, 3	2 (I)	3 (I)
<i>Tersina viridis</i> (Illiger, 1811) +	Swallow Tanager	x	v, a	Resident		Forest-dwelling	1, 2, 3, 5, 11, 12	1 (I)	5 (II)
<i>Dacnis cayana</i> (Linnaeus, 1766)	Blue Dacnis	x	v, a, p, c	Resident		Forest-dwelling	1, 3	3 (I)	2 (I)
<i>Saltator similis</i> d'Orbigny & Lafresnaye, 1837	Green-winged Saltator	x	v, a	Resident		Forest-dwelling	1, 2, 3	1 (I)	2 (I)
<i>Saltator fuliginosus</i> (Daudin, 1800) #	Black-throated Grosbeak	x	v, a	Resident		Forest-dwelling	1, 2, 3	4 (II)	4 (I)
<i>Coereba flaveola</i> (Linnaeus, 1758)	Bananaquit	x	v, a	Resident		Forest-dwelling	1, 2, 3, 8, 11	4 (I)	3 (I)
<i>Volatinia jacarina</i> (Linnaeus, 1766)	Blue-black Grassquit	x	v, a	Resident		Grassland-dwelling	4, 5, 7, 8, 10	4 (III)	2 (II)

Table 2. (Conclusion)

Species	Common name	Sec. data	Evidence	Status of occurrence	Status of conservation	Habitat use classification	Recorded environments	Campaign	
								1	2
<i>Trichothraupis melanocephala</i> (Vieillot, 1818) +	Black-goggled Tanager		v, a, p, c	Resident		Forest-dwelling	1, 2, 3	3 (II)	4 (II)
<i>Coryphospingus cucullatus</i> (Statius Muller, 1776)	Red-crested Finch	x	v, a, p, c	Resident		Semi-forest-dwelling	3, 4, 5, 7	1 (I)	1 (I)
<i>Tachyphonus coronatus</i> (Vieillot, 1822) #	Ruby-crowned Tanager	x	v, a, p, c	Resident		Forest-dwelling	1, 2, 3, 4, 7, 8	3 (I)	4 (I)
<i>Ramphocelus carbo</i> (Pallas, 1764)	Silver-beaked Tanager	x	v, a	Resident		Semi-forest-dwelling	2, 3	1 (I)	1 (I)
<i>Sporophila caerulea</i> (Vieillot, 1823)	Double-collared Seedeater	x	v, a	Summer resident		Grassland-dwelling	4, 5, 7, 11	4 (I)	1 (I)
<i>Sporophila leucoptera</i> (Vieillot, 1817)	White-bellied Seedeater		v, a	Undetermined		Grassland-dwelling	4, 5	3 (I)	1 (I)
<i>Thlypopsis sordida</i> (d'Orbigny & Lafresnaye, 1837)	Orange-headed Tanager	x	v, a	Resident		Semi-forest-dwelling	2, 3, 5		3 (I)
<i>Conirostrum speciosum</i> (Temminck, 1824)	Chestnut-vented Conebill	x	v, a	Resident		Forest-dwelling	1, 2, 3, 11	1 (I)	4 (I)
<i>Scalis flaveola</i> (Linnaeus, 1766)	Saffron Finch	x	v, a, p, c	Resident		Grassland-dwelling	4, 5, 7, 8, 10, 11	5 (IV)	3 (II)
<i>Scalis luteola</i> (Sparman, 1789)	Grassland Yellow-Finch	x	v, a	Resident		Grassland-dwelling	4, 5, 7, 12	3 (III)	4 (II)
<i>Schistochlamys ruficapillus</i> (Vieillot, 1817)	Cinnamon Tanager		v, a	Resident		Semi-forest-dwelling	3, 4, 5, 7	2 (I)	1 (I)
<i>Thraupis sayaca</i> (Linnaeus, 1766) +	Sayaca Tanager	x	v, a	Resident		Forest-dwelling	1, 2, 3, 5, 7, 8, 11	5 (III)	4 (II)
<i>Stipnia cayana</i> (Linnaeus, 1766)	Burnished-buff Tanager	x	v, a	Resident		Forest-dwelling	3	2 (I)	1 (I)

The forest avifauna recorded in the area is typical of Semi-deciduous Seasonal Forest. For instance, *Arremon polionotus* does not occur in Dense Ombrophilous Forest. Several other species recorded have a broader geographic distribution in Semi-deciduous Seasonal Forest than in Dense Ombrophilous Forest, including the Ocellated Poorwill *Nyctiphrynus ocellatus* (Tschudi, 1844), Rufous Nightjar *Antrostomus rufus* (Boddaert, 1783), Plumbeous Kite *Ictinia plumbea* (Gmelin, 1788), Little Woodpecker *Veniliornis passerinus* (Linnaeus, 1766), Yellow-chevoned Parakeet *Brotopogon chiriri* (Vieillot, 1818), Turquoise-fronted Parrot *Amazona aestiva* (Linnaeus, 1758), Southern Antpiper *Corythopis delalandi* (Lesson, 1830), and Flavescent Warbler *Myiothlypis flaveola* Baird, 1865. The aquatic avifauna appears to have benefited from the formation of the Xavantes Reservoir, potentially facilitating short-distance colonization by some species (*sensu* Bornschein & Reinert, 2000). A similar pattern of short-distance colonization may also apply to grassland bird species (see below).

The rigorous recording of species according to the specific environments in which they were observed at Fazenda Domiciana, combined with the inherent mobility of birds, explains the occurrence of certain records in “atypical” habitats. For example, some aquatic birds were associated with arboreal environments when observed perching in trees along the margins of water bodies. Similarly, one aerial species was recorded in an aquatic environment after descending through the forest and perching on rocks along a river (Table 2). The highest species richness among the different environment type was found in secondary vegetation in an intermediate stage of regeneration (Figure 13). This can be attributed to the presence of forest-dwelling, semi-forest-dwelling, grassland-dwelling, and aquatic birds within this habitat (Table 2). Secondary vegetation regenerates rapidly and is widely dispersed across the property, often bordering other habitat types, which facilitates the occurrence of a high number of species within these areas.

The high number of forest-dwelling bird species that are rare and recorded on only a few survey days (Figures

12, 14, and 15) aligns with patterns typically observed in tropical forest environment (e.g., MacArthur et al., 1966; Bornschein & Reinert, 2000; Robinson et al., 2000). Only five species were classified as very common, most of them grassland-dwelling, with one semi-forest-dwelling species. Large flocks of these very common birds were observed along the edges of agricultural fields at Fazenda Domiciana (Figure 7B), likely linked to the high availability of seeds, possibly resulting from elevated biomass production driven by nutrient leaching from the crops. Because the resident and visitor status of occurrence categories depend on both the sampled area and the sampling effort, their use carries some subjectivity when direct evidence of reproduction is absent. Moreover, species may shift nesting-site preferences in response to seasonal or occasional environmental changes (e.g., Favretto et al., 2022), potentially transitioning between these occurrence categories at a given locality.

CONSERVATION

The historical debt society owed to the Semi-deciduous Seasonal Forest calls for large-scale reforestation efforts, as well as a firm commitment to preserving its remaining fragments and restoring, at least partially, the biodiversity that has been lost. Fazenda Domiciana represents a significant opportunity for the conservation of forest bird species. The management of the arboreal remnants in the property is comparable to a Brazilian strict protection conservation unit (*Unidade de Conservação de Proteção Integral*, see Brazil, 2000), ensuring the long-term preservation of its environmental attributes and the improvement of habitat quality through active protection and the allocation of land for natural regeneration. The rotational grazing system planned for Fazenda Domiciana, which includes the planting of Tifton grass on nutrient-enriched soil, will increase stocking rate while reducing the total area required for grazing. Consequently, all pastureland currently undergoing regeneration, some for decades, will be preserved. The property’s substantial arboreal cover (Table 1) will be maintained and is expected to progressively increase forests (*sensu* Veloso et al., 1991) as regeneration continues.

Due to the lack of historical ornithological data from Fazenda Domiciana, it is not possible to determine whether local species losses have occurred. However, the absence of bird species typically targeted for hunting and trapping suggests that past local extinctions of forest species may have taken place (Table 3). It is also plausible that species losses resulted from a combination of factors, such as hunting and trapping during atypical drought periods following large-scale forest fires, for example. Given that current environmental conditions have improved and are likely to remain stable, we propose the development of one program aimed at enriching the local avifauna, structured around two main actions. The first action should focus on flora restoration within regenerating areas using the seeding of plant species important for birds, such as Palm Heart, as recommended by Bornschein and Reinert (2000). The second action should target the restoration of forest bird communities (Table 3). We foresee the potential reintroduction of 13 forest bird species that are regionally extinct or possibly extinct, along with the introduction of individuals from two additional species with currently reduced local populations. We considered species historically recorded within 50 km of Fazenda Domiciana. Among these, six species are threatened with extinction, one is extinct in the state of São Paulo, and one is extinct throughout the Atlantic Forest biome (Table 3).

We propose this program in accordance with the Resolution that established the State Refauna Program of São Paulo ("RefaunaSP"; SEMIL n° 22; São Paulo, 2025) and in line with the rewilding framework (Rosa & Gonçalves, 2023). Rewilding aims to conserve wildlife species and prevent their extinction by combining scientific ideas with practical innovations to revive ecological processes, while also benefiting humans and fostering a closer connection with nature (Pérez, 2019; Rosa & Gonçalves, 2023; Dias, 2025). Furthermore, under the scope of the aforementioned Resolution (Article 4, paragraph III), we propose that Fazenda Domiciana be designated as a priority area within the RefaunaSP program. These reintroduction efforts should also be aligned with and approved by the National Action Plan

for the Conservation of Atlantic Forest Birds (ICMBio, 2023). The source of birds for repopulation may include individuals obtained from wildlife seizures, certified scientific breeding facilities, or translocated wild individuals (see Resolução SEMIL n° 25; São Paulo, 2024). For individuals originating from seizures or breeding facilities, acclimatization structures must be constructed at Fazenda Domiciana, supported by appropriate technical infrastructure and trained personnel. Translocated individuals, on the other hand, should be released into the wild as promptly as possible, with restraint limited strictly to what is necessary for safe transport.

Cavarzere and Silveira (2024) pointed out biogeographical limitations for the recolonization of avifauna in western São Paulo from the coastal forest belt, arguing that the forest continuum in the state is bisected north to south by a Cerrado strip. The predominantly non-forest vegetation of the Cerrado, along with the presence of large rivers, would prevent the recolonization of birds into the Semi-deciduous Seasonal Forest of western São Paulo (Cavarzere & Silveira, 2024). The authors further noted that this situation would not apply to the state of Paraná, due to the east-west continuity of forest cover there. However, the assumed impermeability of Cerrado arboreal vegetation to forest bird dispersal and the role of rivers as regional barriers must still require empirically testing. Moreover, Cerrado and grasslands also divide the forest component of Paraná into eastern and western portions (Roderjan et al., 2002). Finally, barriers to forest bird recolonization in western regions have already been demonstrated, at least indirectly, through the effects of environmental degradation that have led to species and diversity loss in Semi-deciduous Seasonal Forest (e.g., Ribon et al., 2003; Silveira et al., 2003; Anjos et al., 2011; Del-Rio et al., 2015; Oliveira, 2015; Hasui et al., 2018; Pizo & Tonetti, 2020; Cavarzere & Silveira, 2024). Therefore, we do not view the location of Fazenda Domiciana west of the Cerrado longitudinal belt as an additional justification for the proposed repopulation program. Instead, we argue that the justification lies solely in the improvement of local environmental conditions (see above).

Table 3. Forest bird species proposed for introductions or reintroductions at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. Legend: ¹ = Brazil (2022) and São Paulo (2018).

Species	Occurrence at Fazenda Domiciana	Planned management	Conservation status ¹
Solitary Tinamou <i>Tinamus solitarius</i> (Vieillot, 1819)	Expected historical occurrence (Straube et al., 2002); current record pending confirmation	Reintroduction (or introduction, if presence confirmed)	São Paulo: Vulnerable (VU)
Dusky-legged Guan <i>Penelope obscura</i> Temminck, 1815	Rare (Table 2)	Introduction	
Three-toed Jacamar (<i>Jacamaralcyon tridactyla</i>)	Expected historical occurrence (Straube et al., 2002); locally extinct	Reintroduction	São Paulo: Regionally extinct (RE)
Red-breasted Toucan <i>Ramphastos dicolorus</i> Linnaeus, 1766	Expected historical occurrence (Straube et al., 2002); current record pending confirmation	Reintroduction (or introduction, if presence confirmed)	
Black-necked Aracari <i>Pteroglossus aracari</i> (Linnaeus, 1758)	Expected historical occurrence (Straube et al., 2002); possibly extinct locally	Reintroduction	São Paulo: Critically endangered (CR)
Chestnut-eared Aracari <i>Pteroglossus castanotis</i> Gould, 1834	Expected historical occurrence (WikiAves, s.d.a); possibly extinct locally	Reintroduction	São Paulo: Vulnerable (VU)
Red-throated Caracara <i>Ibycter americanus</i> (Boddaert, 1783)	Expected historical occurrence (Straube et al., 2002); locally extinct	Reintroduction	São Paulo: Regionally extinct (RE)
Vinaceous-breasted Parrot <i>Amazona vinacea</i> (Kuhl, 1820)	Rare (Table 2)	Introduction	Brazil: Vulnerable (VU); São Paulo: Critically endangered (CR)
Maroon-bellied Parakeet <i>Pyrhura frontalis</i> (Vieillot, 1817)	Expected historical occurrence (Straube et al., 2002; Willis & Oniki, 2003); possibly extinct locally	Reintroduction	
Golden-capped Parakeet <i>Aratinga auricapillus</i> (Kuhl, 1820)	Expected historical occurrence (Straube et al., 2002); possibly extinct locally	Reintroduction	
Blue-winged Macaw <i>Primolius maracana</i> (Vieillot, 1816)	Expected historical occurrence (Straube et al., 2002); possibly extinct locally	Reintroduction	São Paulo: Vulnerable (VU)
Red-and-green Macaw <i>Ara chloropterus</i> Gray, 1859	Expected historical occurrence (Bornschein & Reinert, 2000); locally extinct	Reintroduction	São Paulo: Critically endangered (CR)
Bare-throated Bellbird <i>Procnias nudicollis</i> (Vieillot, 1817)	Expected historical occurrence (Straube et al., 2002); possibly extinct locally	Reintroduction	
Yellow-legged Thrush <i>Turdus flavipes</i> Vieillot, 1818	Expected historical occurrence (Straube et al., 2002); possibly extinct locally	Reintroduction	
Neotropical River Warbler <i>Myiothlypis rivularis</i> (Wied, 1821)	Expected historical occurrence (Straube et al., 2002); possibly extinct locally	Reintroduction	

A regional program aimed at restoring and expanding forest areas on the steeper slopes of the Serra Geral could be considered. Two proposed forest corridors, measuring 310 m and 60 m in length, would connect the large 3,361 ha arboreal remnant, of which Fazenda Domiciana is a part, to another arboreal remnant farther north measuring 116 ha, which in turn connects to an additional 2,758 ha arboreal remnant (mapped using Google Earth Pro imagery from 2024; Figure 1). This configuration would result in a continuous arboreal remnant totaling 6,235 ha, a highly significant area given the current extent of remaining Semi-deciduous Seasonal Forest (Table 1). At this scale, the region could also become suitable for population management initiatives involving medium-sized mammals, including the possible reintroduction of the Black Lion Tamarin *Leontopithecus chrysopygus* (Mikan, 1823), a species known to occur within the Paranapanema–Itararé interfluvium (Garbino et al., 2016; Forero-Sánchez et al., 2025).

Financial incentives for landowners engaging in environmental programs remain limited, though the conditions are improving compared to past decades (Bornschein & Reinert, 2000). Opportunities include value-added product certification through green labels, exemption from the Rural Land Tax (ITR), carbon credit trading, and payments for environmental services (PES). PES, in particular, has strong potential to support natural area conservation by benefiting landowners while decentralizing governmental responsibilities. However, municipal and state policies enabling direct payments to private landowners are still underdeveloped. Nonetheless, this should not prevent the municipalities of Timburi and Fartura from beginning to coordinate efforts to address these opportunities.

Beyond the forest areas, the homogenization of pastures may negatively affect the richness and/or abundance of grassland bird species at Fazenda Domiciana. Species such as the Firewood-Gatherer (*Anumbius anumbi*, Vieillot, 1817) may no longer occur in the area or could shift their status from resident to visitor. However, none of the potentially

impacted species are currently classified as threatened (Table 2), and many of the grassland birds recorded in the study area are likely short-distance colonizers (*sensu* Bornschein & Reinert, 2000) originating from the Cerrado biome, such as the Red-winged Tinamou *Rhynchotus rufescens* (Temminck, 1815), Spotted Nothura *Nothura maculosa* (Temminck, 1815), Short-eared Owl *Asio flammeus* (Pontoppidan, 1763), and Red-legged Seriema *Cariama cristata* (Linnaeus, 1766). In this context, maintaining the lowland pastures under their current management, with no soil mechanization and dominated by native herbaceous vegetation (Figure 6A), should be sufficient to support the local presence of most grassland bird species.

The natural floodplain marshes (Figure 9A, 9B), which may harbor populations of the threatened *L. xenopterus*, warrant additional field surveys to confirm the species' presence. Regardless of confirmation, management of the invasive White Ginger Lily *Hedychium coronarium* J. Koenig along the marsh margins should be initiated (see Figures 9 and 10), during which the extent of exotic grasses' invasion could also be assessed. In this context, the behavior of Tifton grass deserves continued monitoring, as it is a highly invasive species that is difficult to control and eradicate (Lorenzi, 2000).

CONCLUSIONS

The nearly 6,000 ha of Semi-deciduous Seasonal Forest and regenerating arboreal formations at Fazenda Domiciana and its surroundings constitute a significant remnant of the inland Atlantic Forest, yet they remain largely overlooked by governmental conservation initiatives. The efficient management of cattle ranching at Fazenda Domiciana demonstrates that it is possible to maintain, or even increase, livestock productivity while reducing pasture areas and allocating land for environmental restoration. These areas designated for environmental recovery do not represent a finite gain but rather a continuous benefit, due to the ongoing regeneration they will undergo over the coming years.

Certification programs for regional products, particularly beef, may provide a pathway to incentivize the expansion of conservation areas on private properties. Additionally, the management of portions of private land as strict protection conservation units has been gaining increasing traction in Brazil, as illustrated by the growing establishment of Private Natural Heritage Reserves (*Reservas Particulares do Patrimônio Natural* - RPPNs; Brazil, 2000). A major discouragement to expanding these initiatives, however, is the lack of mechanisms to financially compensate landowners who dedicate their land to conservation.

Although the brief bird inventory conducted at Fazenda Domiciana recorded a considerable number of species, the sampling effort was insufficient to fully capture the richness of forest-dwelling birds. Nevertheless, the study provided an initial assessment of species that may have become locally extinct or whose populations may have been depleted. Given the improved environmental conditions within the arboreal remnants of Fazenda Domiciana, combined with enhanced oversight against hunting and extractive activities, there is a clear opportunity to develop projects aimed at restoring species and populations.

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AUTHOR CONTRIBUTIONS

M. R. Bormschein contributed to conceptualization, methodology, data curation, formal analysis, project administration, supervision and writing (original draft, revision and editing); G. Villalobo contributed to formal analysis and writing (original draft, revision and editing); G. Sandretti-Silva contributed to formal analysis and writing (original draft, revision and editing); L. B. N. de Pinho contributed to formal analysis and writing (original draft, revision and editing); S. G. Mühringer contributed to formal analysis and writing (revision and editing); S. A. A. Morato contributed to conceptualization, methodology, formal analysis, project administration, funding acquisition, supervision and writing (original draft).

Appendix 1. Forest types occurring in the biogeographical subregions of the Atlantic Forest by Silva and Casteleti (2003), according to the classification criteria for Brazilian vegetation from the RADAMBRASIL Project (Veloso et al., 1991; IBGE, 2004, 2012).

Subregion	Forest type	Remaining vegetation area (% of the subregion's original total area; Ribeiro et al., 2009)
Araucaria	Mixed Ombrophilous Forest	12.6
Bahia	Dense Ombrophilous Forest and Semi-deciduous Seasonal Forest	17.7
Brejos Nordestinos	Semi-deciduous Seasonal Forest	16.0
Diamantina	Semi-deciduous Seasonal Forest and Deciduous Seasonal Forest	13.5
Interior	Semi-deciduous Seasonal Forest and Deciduous Seasonal Forest	7.1
Pernambuco	Dense Ombrophilous Forest, Open Ombrophilous Forest, and Semi-deciduous Seasonal Forest	12.1
Serra do Mar	Dense Ombrophilous Forest	36.5
São Francisco	Semi-deciduous Seasonal and Deciduous Seasonal Forest	4.7

Appendix 2. Areas sampled for bird records at Fazenda Domiciana, located in the municipalities of Timburi and Fartura, São Paulo, southeastern Brazil. Abbreviations: SP = São Paulo; PR = Paraná. Source: National Water and Basic Sanitation Agency (ANA) and ©OpenStreetMap contributors.

