The bird assemblage of an urban fragment of the Atlantic Forest in Northeastern Brazil, and the performance difference between two ornithological surveys methods

A assembleia de aves em um fragmento urbano de Mata Atlântica no Nordeste do Brasil, e o desempenho entre dois métodos ornitológicos de amostragem

Williams Oliveira-Silva[I, II] | Tainá Karoline Guedes[I, II] | Priscilla Monteiro de Oliveira[I, II] | Rachel Maria de Lyra-Neves[III] | Wallace Rodrigues Telino-Junior[III] | Renato Gaban-Lima[I, II]

[I]Universidade Federal de Alagoas. Instituto de Ciências Biológicas e da Saúde, Laboratório de Morfologia, Sistemática e Ecologia de Aves Neotropicais. Maceió, Alagoas, Brasil

[II]Universidade Federal de Alagoas. Museu de História Natural. Setor de Ornitologia. Maceió, Alagoas, Brasil

[III]Universidade Federal do Agreste de Pernambuco. Laboratório de Ensino de Zoologia. Garanhuns, Pernambuco, Brasil

Abstract: The Atlantic Forest biome encompasses a major portion of Brazilian biodiversity, with a high species richness. The Pernambuco Center of Endemism, which is part of this biome, has undergone extensive deforestation, and now survives in the form of small and isolated remnants of the original forest cover. These remnants include Maceió Municipal Park, an important urban forest in the capital of Alagoas. The present study inventoried the bird fauna of this conservation unit, providing data on species composition, richness, and abundance, with samples being collected monthly between August 2014 and January 2016. Quantitative data were collected using MacKinnon list and point counts. A total of 103 bird species were recorded. Five of these species are endemic to the Pernambuco Center and two to the Atlantic Forest, while four are listed under some threat of extinction. The results indicated that the MacKinnon lists present better efficiency to obtain species richness, while point counts present the best performance for abundance estimates. Our findings also indicate that Maceió Municipal Park is a potentially important refuge for the local bird fauna. The presence of threatened and endemic *taxa* highlights the relevance of the study area for the conservation of the region's biodiversity.

Keyword: Avifauna. MacKinnon list. Point count. Rainforest. Richness estimation.

Resumo: O bioma Mata Atlântica engloba a maior parte da biodiversidade brasileira, com alta riqueza de espécies. O Centro de Endemismo Pernambuco, que faz parte desse bioma, passou por extenso desmatamento e hoje resiste com pequenos e isolados remanescentes de sua cobertura vegetal original. Esses remanescentes incluem o Parque Municipal de Maceió, importante floresta urbana da capital de Alagoas. O presente estudo inventariou a avifauna dessa unidade de conservação, fornecendo dados sobre composição, riqueza e abundância de espécies, com coletas mensais entre agosto de 2014 e janeiro de 2016. Os dados quantitativos foram coletados com listas de MacKinnon e pontos de contagem. Um total de 103 espécies de aves foram registradas. Cinco dessas espécies são endêmicas do Centro Pernambuco e duas da Mata Atlântica, enquanto quatro estão listadas sob alguma ameaça de extinção. Os resultados indicaram que as listas de MacKinnon apresentam melhor eficiência para obter a riqueza de espécies, enquanto os pontos de contagem apresentaram o melhor desempenho para estimativas de abundância. Esses resultados também indicam que o Parque Municipal de Maceió é um refúgio potencialmente importante para a avifauna local. A presença de táxons ameaçados e endêmicos destaca a relevância da área para a conservação da biodiversidade da região.

Palavras-chave: Avifauna. Lista de MacKinnon. Ponto de contagem. Floresta úmida. Estimadores de riqueza.

Oliveira-Silva, W., Guedes, T. K., Oliveira, P. M., Lyra-Neves, R. M., Telino-Junior, W. R., & Gaban-Lima, R. (2023). The bird assemblage of an urban fragment of the Atlantic Forest in Northeastern Brazil, and the performance difference between two ornithological surveys methods. *Boletim do Museu Paraense Emílio Goeldi. Ciências Naturais*, *18*(2), e2023-e917. http://doi.org/10.46357/bcnaturais.v18i2.917

Autor para correspondência: Williams Oliveira-Silva. Universidade Federal de Alagoas. Museu de História Natural. Setor de Ornitologia. Av. Amazonas, s/n, Prado. Maceió, AL, Brasil. CEP 57010-060 (oliveiraswilliams@gmail.com).

Recebido em 11/04/2023
Aprovado em 05/06/2023
Responsabilidade editorial: Leonardo de Sousa Miranda

INTRODUCTION

The Atlantic Forest biome once covered approximately 13% of Brazil, that is, more than one million square kilometers (Ab'Sáber, 2012), although it has now been reduced to less than 10% of its original cover (Solórzano et al., 2021). This biome supports a considerable proportion of the known species richness of Brazil, including not only a major diversity of both flora and fauna, but also high rates of endemism (Conservação Internacional do Brasil et al., 2000). Given these features, and the importance of the Atlantic Forest at a continental scale, recent impacts have resulted in this biome becoming one of the world's most threatened (Bogoni et al., 2021), leading to its inclusion in the original list of global biodiversity hotspots (Mittermeier et al., 2011).

Species are not distributed homogeneously within the Atlantic Forest, and observed distribution patterns have supported the recognition of a number of centers of endemism within this biome (Tabarelli et al., 2010). While Cracraft (1985) allocated the Atlantic Forest of the Brazilian state of Alagoas to the Serra do Mar center of endemism, which extends along the coast of Brazil from the state of Santa Catarina to Pernambuco, subsequent authors (Stattersfield et al., 1998; J. Silva et al., 2004) recognized the São Francisco River as a major biogeographic barrier, and assigned the northern most portion of the Serra do Mar center to a distinct unit, known as the Pernambuco Center of Endemism. This adjustment was based on the refinement of the alpha taxonomy of the region and a better understanding of the distribution patterns of the local *taxa* (J. Silva et al., 2004).

Deforestation has now reduced the Pernambuco Center of Endemism to a few isolated fragments of forest, located primarily on relatively inaccessible hilltops that are difficult to colonize (Nemésio & Santos-Junior, 2014; Iannuzzi et al., 2023). Most of the fragments in this Center are small, almost half of the fragments have a tiny size (less than 1 ha), and the largest fragments (larger than 100 ha) only represent 1.42% of the total number (A. M. Almeida & Souza, 2023). This intense deforestation has led to the widespread fragmentation of habitats, which has reduced the original, continuous forest cover to a series of ever-smaller and more isolated remnants (Legrand et al., 2017). This fragmentation pattern is typical of the conversion of natural environments into an anthropogenic matrix of agricultural and urban landscapes (Fahrig, 2003; Didham et al., 2012).

Araujo et al. (2023) estimated that the Pernambuco Center contains a total of 486 bird species, of which, 27 are endemic and around 50 are considered to be threatened with extinction by the Brazilian Ministry of the Environment (ICMBio, 2018). Data on the composition of the bird assemblages of the forest remnants of the Pernambuco Center have expanded considerably in recent years, through the results of a number of surveys (e.g., Silveira et al., 2003; Lyra-Neves et al., 2004; Telino-Junior et al., 2005; Magalhães et al., 2007; Farias, 2009; Lobo-Araújo et al., 2013; Toledo-Lima et al., 2014; Studer et al., 2015; Campos et al., 2018; Portes et al., 2018). However, most of these surveys have focused on larger forest fragments, which are less impacted by human activities, and there is clear lack of avian surveys in smaller remnants, in particular in urban areas.

Maceió Municipal Park is an important urban forest, located within the Pernambuco Center, and the present study investigate the bird species richness and abundance in this area, with emphasis on confirming the presence of endemic and/or threatened species. The relative performance of the different sampling methods employed in the study was also evaluated using richness estimators.

MATERIAL AND METHODS

STUDY AREA

Maceió Municipal Park (9° 36' 47.7" S, 35° 45' 37.1" W) is a fragment of approximately 82 hectares of forest located within the urban matrix of the city of Maceió (Auto, 1988) (Figure 1), capital of the Brazilian state of Alagoas. The region has a tropical monsoon (Am) climate (Alvares et al., 2013),

with total annual rainfall of approximately 1,808 mm, concentrated into a rainy season, from May to July, with a peak dry season from October to December (INMET, 2022). The mean annual minimum temperature is 21 °C and the maximum, 30 °C, with mean relative humidity of approximately 79% (INMET, 2022).

The park's predominant vegetation is open rainforest, which has been greatly modified by human activities (Auto, 1988). The area of Maceió Municipal Park encompasses a number of springs and streams that feed into local bodies of water (Auto, 1988). A small artificial pond, known as Alligator Lake, has been formed by the damming of one of the springs, and the Silva Stream crosses approximately 2 km of the park (Auto, 1988). The park is located within a steep-sided valley, flanked by sedimentary rocks, up to 75 m deep, with very irregular topography (Assis, 2000).

FIELD METHODS AND DATA ANALYSIS

For data collection, Maceió Municipal Park was visited early in the morning (6:00–11:00 am) two to three times per month between August 2014 and January 2016 for the observation of the local avian fauna, using binoculars (8 x 42 mm). These data were complemented by the recording of vocalizations using a directional microphone to support the identification of the species. The species were identified on-site using guides and other ornithological publications (e.g., Sick, 1997; Ridgely & Tudor, 2009; Sigrist, 2009a, 2009b; BOW, 2020).

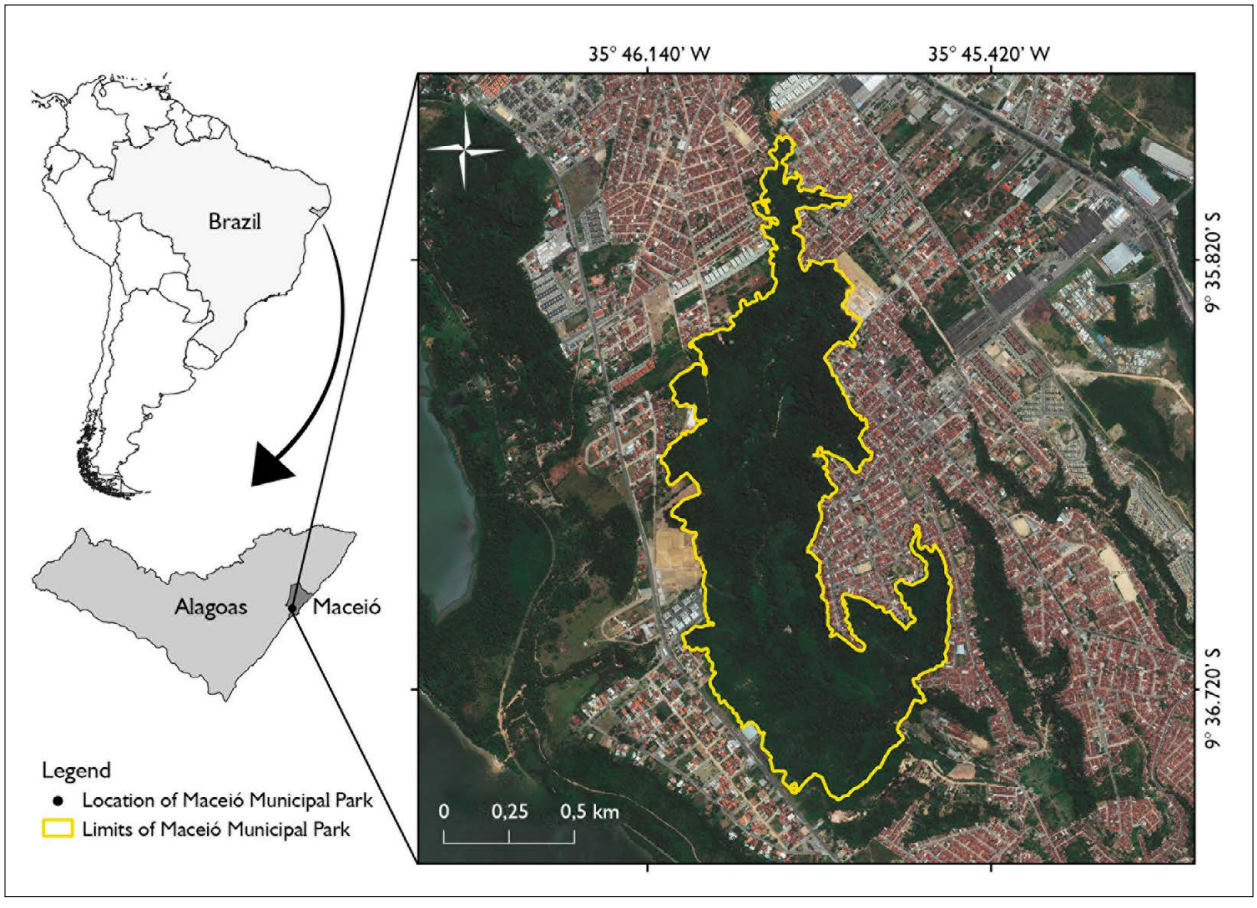

Figure 1. Location of Maceió Municipal Park in the city of Maceió (Alagoas state, Brazil), where the bird assemblage was surveyed in the present study. Map: Williams Oliveira-Silva (2023).

The nomenclature and taxonomic order of the bird species adopted in the present study followed the Brazilian Committee of Ornithological Records (Pacheco et al., 2021), and the tolerance of each species to habitat disturbance was based on Parker-III et al. (1996). Species endemism was defined based on the lists of Cracraft (1985) and Silveira et al. (2003), while their conservation status was obtained from ICMBio (2018).

The birds were sampled using two methods – MacKinnon lists, based on lists of 10 species (Ribon, 2010) and point counts of 20 minutes duration (Vielliard et al., 2010). On average, 22 MacKinnon lists were compiled each month, and a List Frequency Index (LFI) (Ribon, 2010) was calculated for each species. The number of individuals of each species recorded in each list was also recorded, and this database was used to calculate rarefaction curves, and richness estimates.

The data from the count points were used to calculate the Punctual Abundance Index (PAI), which is obtained by dividing the number of individuals of each species by the total number of sample points (Vielliard et al., 2010). A total of 12 points were established along existing trails in the study area, with a minimum distance of 200 m between neighboring points, to guarantee the independence of the samples. The points were selected randomly before each sampling day, and a mean of 10 point counts were obtained per month. To compose the monthly samplings, an average of 10 points were performed per month. Each MacKinnon list and point count was considered to be an independent sample.

These two datasets were used to plot rarefaction curves. Total species richness was also modeled using the Chao 1 and Jackknife 1 estimators, which were adopted here due to the reduced standard deviations of the data and the recommendations of Herzog et al. (2002) and Araujo (2009) for comparative studies of bird species richness. These analyses were run in the EstimateS software (version 9.1.0) (Colwell, 2016), with 100 replicates and the order of the samples being randomized. In these analyses, the records of the vultures of the genus *Cathartes* [represented by both *Cathartes aura* (Linnaeus, 1758) and *C. burrovianus* Cassin, 1845 in the study area] were considered to be a single species due to the difficulty of differentiating the two species reliably in the field.

To evaluate the sampling methods and the performance of the estimators, the total bird species richness of Maceió Municipal Park was determined by including the opportunistic data collected during the present study, together with the inventories of Leal (2010) and Oliveira et al. (2018). This total was compared with the field data and the results of the analyses.

RESULTS

A total of 103 species were recorded during the present study, representing 39 families in 19 orders (Appendix). During the sampling period, belonging to the most speciose families were the Tyrannidae and Thraupidae (each with 13 species), and the Trochilidae (eight species). Only six species [*Amazonetta brasiliensis* (Gmelin, 1789), *Bubulcus ibis* (Linnaeus, 1758), *Ardea alba* Linnaeus, 1758, *Cathartes aura*, *C. burrovianus*, *Buteo brachyurus* Vieillot, 1816, and *Glaucis hirsutus* (Gmelin, 1788)] were not recorded during the systematic observational sampling (MacKinnon lists and point counts).

Three of the bird species recorded in Maceió Municipal Park – *Aramides cajaneus* (Statius Muller, 1776), *Ceratopipra rubrocapilla* (Temminck, 1821), and *Chiroxiphia pareola* (Linnaeus, 1766) – were classified as highly sensitivity to habitat disturbance, and 22 species as being moderately sensitive (Appendix). Four *taxa* are considered to be at some risk of extinction threatened, with two *taxa* [*Leptodon forbesi* (Swann, 1922) and *Momotus momota marcgravianus* Pinto & Camargo, 1961] being listed as Endangered, and two [*Thamnophilus caerulescens pernambucensis* Naumburg, 1937 and *Tangara fastuosa* (Lesson, 1831)] as Vulnerable.

Five of the *taxa* recorded in the present study (*Leptodon forbesi*, *Momotus momota marcgravianus*, *Picumnus*

pernambucensis Zimmer, 1947, *Thamnophilus caerulescens pernambucensis*, and *Tangara fastuosa*) are endemic to the Pernambuco Center. Two other *taxa* – *Ortalis araucuan* (Spix, 1825) and *Ramphocelus bresilia* (Linnaeus, 1766) – are considered to be endemic to the Atlantic Forest, that is, including the Serra do Mar Center of Endemism.

A total of 97 species were recorded in the MacKinnon lists (N = 382 lists), and 77 species in the point counts, based on 142 counts and 3,298 contacts (Appendix). In both cases, the rarefaction curves had begun to level off by the end of the study period (Figure 2). Based on the MacKinnon list data, Chao 1 estimated a total of 103 ± 5.4 (Standard Deviation) species for the study area, while Jackknife 1 estimated a total of 106 ± 2.9 species (Figure 2A). In the case of the point count data, Chao 1 estimated a total of 92 ± 12.8 species, and Jackknife 1, a total of 87 ± 3.3 species (Figure 2B).

The most frequent species recorded in the present study was *Turdus leucomelas* Vieillot, 1818 (LFI = 67%), followed by *Galbula ruficauda* Cuvier, 1816 (LFI = 57%), *Elaenia flavogaster* (Thunberg, 1822) (LFI = 50%), and *Coereba flaveola* (Linnaeus, 1758) (LFI = 44%). The least frequent species were recorded in only one MacKinnon list (LFI = 0.3%). These species were *Geranospiza caerulescens* (Vieillot, 1817), *Aramus guarauna* (Linnaeus, 1766), *Glaucidium brasilianum* (Gmelin, 1788), *Nyctidromus albicollis* (Gmelin, 1789), *Furnarius leucopus* Swainson, 1838, *Legatus leucophaius* (Vieillot, 1818), *Empidonomus varius* (Vieillot, 1818), *Cacicus haemorrhous* (Linnaeus, 1766), and *Volatinia jacarina* (Linnaeus, 1766) (Appendix, Figure 3A).

Turdus leucomelas was also the most abundant species recorded in the present study (PAI = 2.6), followed by *Thraupis palmarum* (Wied, 1821) (PAI = 1.5), *Galbula ruficauda* and *Elaenia flavogaster* (PAI = 1.3 in both cases). The 10 least abundant species (PAI < 0.007) were *Ortalis araucuan*, *Leptodon forbesi*, *Aramus guarauna*, *Vanellus chilensis* (Molina, 1782), *Chlorostilbon lucidus* (Shaw, 1812), *Celeus ochraceus* (Spix, 1824), *Pachyramphus polychopterus* (Vieillot, 1818), *Legatus leucophaius*, *Megarynchus pitangua* (Linnaeus, 1766), and *Ramphocelus bresilia* (Appendix, Figure 3B).

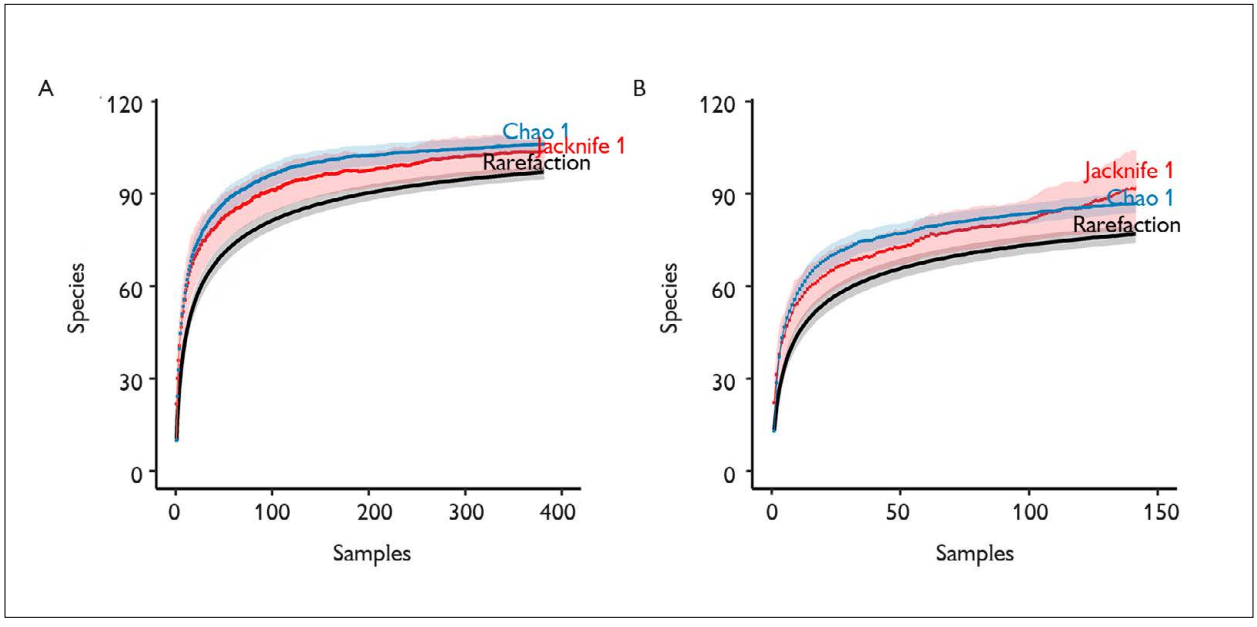

Figure 2. The species rarefaction curves, and the curves generated by the Chao 1 and Jackknife 1 estimators from the data on the bird assemblage of Maceió Municipal Park in northeastern Brazil collecting using (A) MacKinnon lists and (B) point counts.

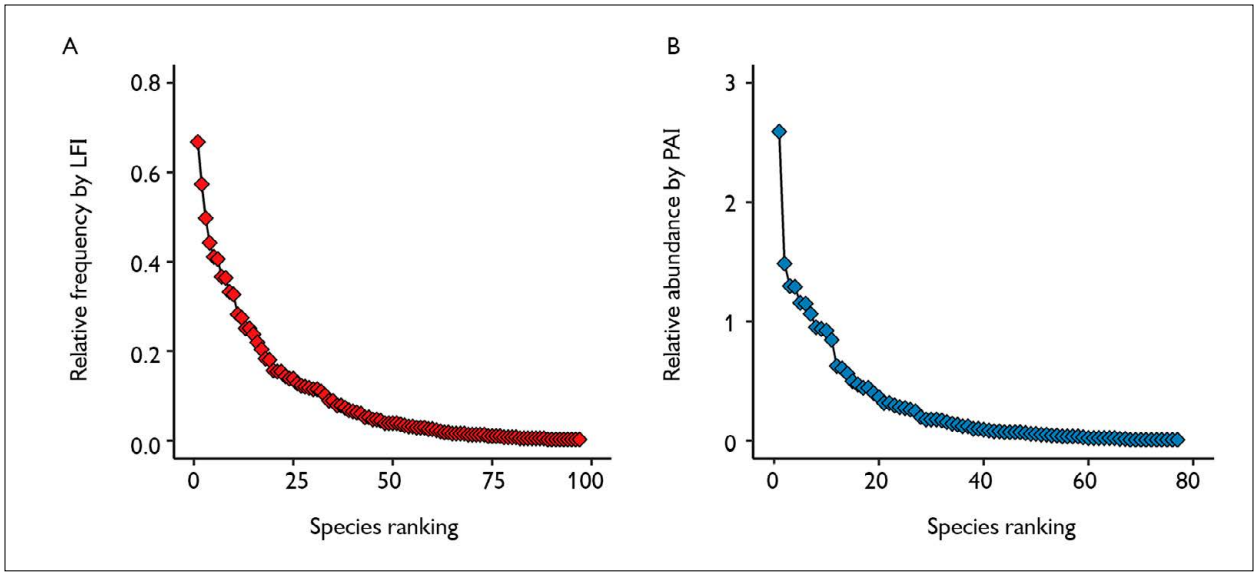

Figure 3. Rank abundance curve of the bird species recorded in Maceió Municipal Park in northeastern Brazil, showing (A) the List Frequency Index (LFI – red diamonds) and (B) the Punctual Abundance Index (PAI – blue diamonds).

DISCUSSION

The bird assemblage of Maceió Municipal Park includes 118 species, of which, 103 were recorded in the present study, while 12 were documented by Leal (2010), and three by Oliveira et al. (2018). This number of species represents approximately 23% of the bird *taxa* known to occur in the state of Alagoas, given the total of approximately 520 species estimated by Lima et al. (2022). This considerable species richness, which includes threatened, endemic, and highly sensitive *taxa*, highlights the role of the park as a refuge for the local avian fauna. In addition to providing cover and food, the park may contribute to the dispersal of birds across the urban environment, through the numerous green corridors that persist in the area surrounding the park. Considering its size, the number of species recorded in Maceió Municipal Park was consistent with that expected, in comparison with other urban remnants of Atlantic Forest in northeastern Brazil (e.g., Pereira et al., 2011; Rodrigues, 2014; A. C. Almeida, 2021).

The diversity of the most speciose families, i.e., the Tyrannidae and Thraupidae, was similar to that recorded in other remnants of Atlantic Forest in northeastern Brazil (e.g., Farias, 2009; Lobo-Araújo et al., 2013; Toledo-Lima et al., 2014; Portes et al., 2018; A. C. Almeida, 2021). However, most tyrannids and thraupids are generalist omnivores, and the reduced diversity of families with most specialized habits, such as the Thamnophilidade, as observed in both Maceió Municipal Park and other Atlantic Forest remnants in northeastern Brazil, is likely related to the formation of anthropogenic environments (Willis, 1976; Telino-Junior et al., 2005).

Considering the total species richness recorded at Maceió Municipal Park (including previous records), that is, 118 species, the MacKinnon list recorded 82% (97 species) of the total, while the point counts returned 65% of the total, that is, 77 species. In a comparison of the two approaches used to survey bird assemblages in Atlantic Forest fragments in southeastern Brazil, Cavarzere et al. (2012), also found that MacKinnon lists were more effective, recording 74% of the total richness, in comparison with 71% in the case of the point counts.

The application of the Chao 1 richness estimator to the MacKinnon list data returned an estimate of 103 species (87% of the total richness, considering the previous records). The same analysis of the point count

data provided an estimate of 92 species, that is, 78% of the richness. This indicates that this estimator provides relatively reliable estimates of the total species richness. Cavarzere et al. (2012) also applied the Chao 1 estimator to their data, and found that 83% of the total species richness was recorded by the MacKinnon lists, and 90% by the point counts. Herzog et al. (2002) supported the use of Chao 1 for comparisons with the total observed richness and recommended that data collection should continue until the Chao 1 estimate approaches 90% of the observed species richness. Overall, then the results of these analyses, together with the fact that the rarefaction curves approach the asymptote by the end of the sampling period indicate that the survey conducted in the present study provided a relatively reliable picture of the true species diversity of the study area.

The Jackknife 1 estimator indicated that 90% (106 species) of the total species richness would have been recorded by the MacKinnon lists, and 74% (87 species) by the point counts. Ruiz-Esparza et al. (2015) recorded 80% of the expected species richness from the MacKinnon list data, as estimated by Jackknife 1. Araujo (2009) concluded that Jackknife 1 provides a better estimate of tendencies and is more accurate than other estimators, based on survey data from the Brazilian Caatinga dry forest. The author also found that Jackknife 1 provided estimates similar to the total richness in most cases evaluated. As the estimates recorded in the present study were highly to the species richness recorded in the qualitative surveys, in particular the MacKinnon lists, it is reasonable to conclude that the results of these surveys were closely similar to the true species diversity of the bird assemblage of Maceió Municipal Park.

The MacKinnon lists detected more species than point counts (97 *versus* 77, respectively). However, the number of samples per method must be considered, as many more lists were made than points. It should be mentioned that for the estimates of the MacKinnon lists the number of individuals was considered. The number of samples can certainly affect the greater richness of species recorded by the lists. In addition, differences in species detection between the methods may be the result of several other factors, i.e., the spatial and temporal mismatch in which the surveys were carried out, the high turnover between samples, or, the similar nature of the detection methods (Cavarzere et al., 2012). O'Dea et al. (2004) suggest that the points method needs more samples to reach the same species richness as the lists. In general terms, the greatest advantage of using points is for better abundance estimates, as lists are more efficient in obtaining the species richness of a given location, especially in rapid assessments (O'Dea et al., 2004; Cavarzere et al., 2012). That said, it is recommended that the two methods be applied together as if one complements the other (O'Dea et al., 2004; MacLeod et al., 2012; Cavarzere et al., 2012).

The variation in abundance observed during the present study must be treated with caution due to differences in the detectability of the different species, with the more detectable species also tending to present the highest PAIs (Vielliard et al., 2010). In particular, the foraging mode and vocal behavior of *Turdus leucomelas*, which had the highest PAI of the species recorded in the present study, favor its detection, in addition to the fact that this species is very abundant in the study area (Collar & Garcia, 2020). *Thraupis palmarum* had the second highest PAI value in the present study, as observed by Lyra-Neves et al. (2004) in a different Atlantic Forest remnant in northeastern Brazil. This species occurs in a wide variety of habitats, and is locally abundant in humid forest, patches of scrubby woodland, and the edge of gallery forest (Hilty, 2020). Another species with a high PAI was Galbula ruficauda, which is also easily detected due to its very characteristic vocalizations (Chaine, 2020). The lowest PAI values were recorded for occasional visitors, such as *Aramus guarauna*, *Vanellus chilensis* and *Legatus leucophaius*. In general, these species inhabit more open environments, and exploit forest resources only sporadically. Behavioral and demographic factors may also account for the variation in the PAI values recorded for some species, although it would

only be possible to identify the specific determinants through more detailed ecological studies (Aleixo & Vielliard, 1995).

The ranked abundance curves indicate that the LFI values were distributed more equitably among the species than the PAIs. As these indices represent similar parameters of the same bird assemblage, the difference may be due to the way the LFI is calculated, given that this index does not consider the number of individuals recorded, whereas the PAI includes all the contacts with the target species (Ribon, 2010; Vielliard et al., 2010). The abundance pattern observed in Maceió Municipal Park, that is, a few very abundant species and many species that are medium in abundance or rare, is typical of the findings of other point count surveys in Atlantic Forest remnants (e.g., Aleixo & Vielliard, 1995; Lyra-Neves et al., 2004; Campos et al., 2018).

Momotus momota marcgravianus, a threatened taxon endemic to the Pernambuco Center of Endemism, was observed during 14 of the 17 months of the study period. This bird builds its nests in holes in the ground, within ravines (Pesquero et al., 2014; Orzechowski & Schulenberg, 2020), and is threatened primarily by the loss of habitat (S. Silva et al., 2018). As Maceió Municipal Park encompasses a number of ravines, it is likely to be a favorable environment for *M. m. marcgravianus*. *Tangara fastuosa* a threatened species that is also endemic to the Pernambuco Center, was recorded in September and November, 2014 and January, February, and July, 2015, which implies that this bird was present in Maceió Municipal Park primarily during its breeding season, which is known to extend from October to March (Gussoni et al., 2021). *Tangara fastuosa* nests in the middle forest strata, where it typically occupies bromeliads (Roda et al., 2011). Birds of this species were observed visiting bromeliads on three occasions (in September and November, 2014, and January, 2015), which may have been related to the presence of a brood. Together, these observations indicate that *T. fastuosa* may be using the park as a breeding area. The presence of both *T. fastuosa* and *M. m. marcgravianus* in Maceió Municipal Park further reinforces the importance of this site as an urban refuge for the region's wild bird fauna.

CONCLUSION

Our results indicated that the MacKinnon list method showed a better performance to obtain species richness in the Parque Municipal de Maceió. While the point counts, considering the number of individuals, were better for obtaining estimates of the abundance of the species in the area. From the park data, we consider the two methods should be used together for avifauna studies. In the analysis of richness estimators, it can be concluded that the MacKinnon lists were also better for obtaining the best estimates of species richness than those obtained by point counts.

Despite the fragmentation and environmental impacts suffered by Maceió Municipal Park, its bird fauna is still a potentially valuable asset for the conservation of local biodiversity, especially in the urban context. The presence of threatened, endemic, and highly sensitive *taxa* indicates that this forest remnant may be an important urban refuge for many forest-dwelling species that are facing increasing habitat loss and degradation. As there are also a number of other forest fragments in its immediate vicinity, Maceió Municipal Park may also contribute to the consolidation of green corridors that facilitate the dispersal of birds through the urban matrix. The adequate management of this conservation unit will thus be essential to ensure the protection of its resources, providing an important urban refuge for its birds and other fauna and flora, which are faced with multiple anthropogenic pressures in the urban environment.

ACKNOWLEDGMENTS

We thank Maceió City Hall and the administration of Maceió Municipal Park, in particular, the administrator Karla Gama for permitting fieldwork in the study area. We thank the *Pró-reitora Estudantil* and the *Museu de História Natural* of the *Universidade Federal de Alagoas* for providing a scholarship to W. Oliveira-Silva during part of their undergraduate course. We would also like to thank Camila Mendes, Evelyne Barros, Gabriela Santos, Henrique Lemos, Hewryanne Barreto,

Jonas Morais, Julianna Santana, and Morgana Melo for their assistance in the field.

REFERENCES

Ab'Sáber, A. N. (2012). *Os domínios de natureza no Brasil: pontencialidades paisagístas* (7. ed.). Ateliê Editorial.

Aleixo, A., & Vielliard, J. M. E. (1995). Composição e dinâmica da avifauna da Mata de Santa Genebra, Campinas, São Paulo, Brasil. *Revista Brasileira de Zoologia*, *12*(3), 493-511. https://doi.org/10.1590/S0101-81751995000300004

Almeida, A. C. C. (2021). Avifauna no Refúgio de Vida Silvestre Mata do Buraquinho, João Pessoa, Paraíba, Brasil, com notas naturalísticas sobre as espécies ameaçadas. *Revista Brasileira de Gestão Ambiental e Sustentabilidade*, *8*(18), 37-75. https://doi.org/10.21438/rbgas(2021)081803

Almeida, A. M., & Souza, A. F. (2023). Northern Atlantic forest: Conservation status and perspectives. In G. A. Pereira Filho, F. G. R. França, R. R. N. Alves & A. Vasconcellos (Eds.), *Animal biodiversity and conservation in Brazil's Northern Atlantic Forest* (pp. 7-22). Springer International Publishing. https://doi.org/10.1007/978-3-031-21287-1_2

Alvares, C. A., Stape, J. L., Sentelhas, P. C., Gonçalves, J. L. M., & Sparovek, G. (2013). Köppen's climate classification map for Brazil. *Meteorologische Zeitschrift*, *22*(6), 711-728. https://doi.org/10.1127/0941-2948/2013/0507

Araujo, H. F. P. (2009). *Amostragem, estimativa de riqueza de espécies e variação temporal na diversidade, dieta e reprodução de aves em área de Caatinga, Brasil* [Tese de doutorado, Universidade Federal da Paraíba]. https://repositorio.ufpb.br/jspui/handle/tede/7939?locale=pt_BR

Araujo, H. F. P., Vilela, H. A. L. S., Phalan, B., & Develey, P. F. (2023). Bird diversity and conservation of the Northern Atlantic Forest. In G. A. Pereira Filho, F. G. R. França, R. R. N. Alves & A. Vasconcellos (Eds.), *Animal biodiversity and conservation in Brazil's Northern Atlantic Forest* (pp. 185-200). Springer International Publishing. https://doi.org/10.1007/978-3-031-21287-1_12

Assis, J. S. (2000). *Biogeografia e conservação da biodiversidade: projeções para Alagoas*. Catavento.

Auto, P. C. C. (1988). *Unidades de conservação em Alagoas*. IBAMA.

Birds of the World (BOW). (2020). *Birds of the World*. https://birdsoftheworld.org/

Bogoni, J. A., Carvalho-Rocha, V., Ferraz, K. M. P. M. B., & Peres, C. A. (2021). Interacting elevational and latitudinal gradients determine bat diversity and distribution across the Neotropics. *Journal of Animal Ecology*, *90*(12), 2729-2743. https://doi.org/10.1111/1365-2656.13594

Campos, L. F. A. S., Teixeira, B. P., & Efe, M. A. (2018). The importance of isolated patches for maintaining local bird biodiversity and ecosystem function: a case study from the Pernambuco Center of Endemism, Northeast Brazil. *Iheringia. Série Zoologia*, *108*, e2018021. https://doi.org/10.1590/1678-4766e2018021

Cavarzere, V., Costa, T. V. V., & Silveira, L. F. (2012). On the use of 10-minute point counts and 10-species lists for surveying birds in lowland Atlantic Forests in southeastern Brazil. *Papéis Avulsos de Zoologia*, *52*(28), 333-340. https://doi.org/10.1590/S0031-10492012002800001

Chaine, N. M. (2020). Rufous-tailed Jacamar (*Galbula ruficauda*). In T. S. Schulenberg (Ed.), *Birds of the World*. Cornell Lab of Ornithology. https://doi.org/10.2173/bow.rutjac1.01

Collar, N., & Garcia, E. (2020). Pale-breasted Thrush (*Turdus leucomelas*). In J. del Hoyo, A. Elliott, J. Sargatal, D. Christie & E. de Juana (Eds.), *Birds of the World*. Cornell Lab of Ornithology. https://doi.org/10.2173/bow.pabthr1.01

Colwell, R. K. (2016). *EstimateS: biodiversity estimation*. EstimateS 9.1.0. http://viceroy.eeb.uconn.edu/estimates/index.html

Conservação Internacional do Brasil, Fundação SOS Mata Atlântica, Fundação Biodiversitas, Instituto de Pesquisas Ecológicas, Secretaria do Meio Ambiente do Estado de São Paulo & SEMAD/Instituto Estadual de Florestas-MG. (2000). *Avaliação e ações prioritárias para a conservação da biodiversidade da Mata Atlântica e Campos Sulinos*. MMA/SBF.

Cracraft, J. (1985). Historical biogeography and patterns of differentiation within the South American avifauna: Areas of endemism. *Ornithological Monographs*, *36*, 49-84. https://doi.org/10.2307/40168278

Didham, R. K., Kapos, V., & Ewers, R. M. (2012). Rethinking the conceptual foundations of habitat fragmentation research. *Oikos*, *121*(2), 161-170. https://doi.org/10.1111/j.1600-0706.2011.20273.x

Fahrig, L. (2003). Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution, and Systematics*, *34*, 487-515. https://doi.org/10.1146/annurev.ecolsys.34.011802.132419

Farias, G. B. (2009). Variação temporal em uma comunidade de aves em área de Mata Atlântica na Estação Ecológica de Caetés, Pernambuco, Brasil. *Atualidades Ornitológicas*, *147*, 40-45.

Gussoni, C. O., Cabrero, A., Walsh, S. E., Burns, K. J., & Boesman, P. F. D. (2021). Seven-colored Tanager (*Tangara fastuosa*). In S. M. Billerman & B. K. Keeney (Eds.), *Birds of the World*. Cornell Lab of Ornithology. https://doi.org/10.2173/bow.sectan1.02

Herzog, S. K., Kessler, M., & Cahill, T. M. (2002). Estimating species richness of tropical bird communities from rapid assessment data. *The Auk*, *119*(3), 749-769. https://doi.org/10.2307/4089971

Hilty, S. (2020). Palm Tanager (*Thraupis palmarum*). In J. del Hoyo, A. Elliott, J. Sargatal, D. Christie & E. de Juana (Eds.), *Birds of the World*. Cornell Lab of Ornithology. https://doi.org/10.2173/bow.paltan1.01

Iannuzzi, L., Liberal, C. N., Reis, A. B., Nunes, J. P., Souza, T. B., Costa, F. C., . . . Lopes, P. P. (2023). Dung beetles from the Atlantic Forest North of the São Francisco river: An overview of a fragile fauna. In G. A. Pereira Filho, F. G. R. França, R. R. N. Alves & A. Vasconcellos (Eds.), *Animal biodiversity and conservation in Brazil's Northern Atlantic Forest* (pp. 47-84). Springer International Publishing. https://doi.org/10.1007/978-3-031-21287-1_5

Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). (2018). *Livro vermelho da fauna brasileira ameaçada de extinção*. ICMBio/MMA.

Instituto Nacional de Meteorologia (INMET). (2022). *Normais climatológicas do Brasil*. https://portal.inmet.gov.br/normais

Leal, S. (2010). *Guia de aves do Parque Municipal de Maceió*. Poligraf.

Legrand, D., Cote, J., Fronhofer, E. A., Holt, R. D., Ronce, O., Schtickzelle, N., Travis, J. M. J., & Clobert, J. (2017). Eco-evolutionary dynamics in fragmented landscapes. *Ecography*, *40*(1), 9-25. https://doi.org/10.1111/ecog.02537

Lima, R. D., Silveira, L. F., Lemos, R. C. A., Lobo-Araújo, L. W., Andrade, A. B., Francisco, M. R., & Efe, M. A. (2022). An annotated avian inventory of the Brazilian state of Alagoas, one of the world's most threatened avifauna. *Papéis Avulsos de Zoologia*, *62*, e202262034. https://doi.org/10.11606/1807-0205/2022.62.034

Lobo-Araújo, L. W., Toledo, M. T. F., Efe, M. A., Malhado, A. C. M., Vital, M. V. C., Toledo-Lima, G. S., . . . Ladle, R. J. (2013). Bird communities in three forest types in the Pernambuco Centre of Endemism, Alagoas, Brazil. *Iheringia, Série Zoologia*, *103*(3), 85-96. https://doi.org/10.1590/S0073-47212013000200002

Lyra-Neves, R. M., Dias, M. M., Azevedo-Júnior, S. M., Telino-Junior, W. R., & Larrazábal, M. E. L. (2004). Comunidade de aves da Reserva Estadual de Gurjaú, Pernambuco, Brasil. *Revista Brasileira de Zoologia*, *21*(3), 581-592. https://doi.org/10.1590/S0101-81752004000300021

MacLeod, C. J., Greene, T. C., MacKenzie, D. I., & Allen, R. B. (2012). Monitoring widespread and common bird species on New Zealand's conservation lands: a pilot study. *New Zealand Journal of Ecology*, *36*(3), 300-311.

Magalhães, V. S., Azevedo-Júnior, S. M., Lyra-Neves, R. M., Telino-Junior, W. R., & Souza, D. P. (2007). Biologia de aves capturadas em um fragmento de Mata Atlântica, Igarassu, Pernambuco, Brasil. *Revista Brasileira de Zoologia*, *24*(4), 950-964. https://doi.org/10.1590/S0101-81752007000400011

Mittermeier, R. A., Turner, W. R., Larsen, F. W., Brooks, T. M., & Gascon, C. (2011). Global biodiversity conservation: the critical role of hotspots. In F. Zachos & J. Habel (Eds.), *Biodiversity hotspots* (pp. 3-22). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-20992-5_1

Nemésio, A., & Santos-Junior, J. E. (2014). Is the "Centro de Endemismo Pernambuco" a biodiversity hotspot for orchid bees? *Brazilian Journal of Biology*, *74*(3 suppl. 1), S078-S092. https://doi.org/10.1590/1519-6984.26412

O'Dea, N., Watson, J. E., & Whittaker, R. J. (2004). Rapid assessment in conservation research: a critique of avifaunal assessment techniques illustrated by Ecuadorian and Madagascan case study data. *Diversity and Distributions*, *10*(1), 55-63. https://doi.org/10.1111/j.1472-4642.2004.00050.x

Oliveira, P. M., Oliveira-Silva, W., Campêlo, M. R., & Gaban-Lima, R. (2018). Aves ameaçadas do Parque Municipal de Maceió (Alagoas, Brasil). *Congresso Brasileiro de Ornitologia*, *25*, 135.

Orzechowski, S. C., & Schulenberg, T. S. (2020). Amazonian Motmot (*Momotus momota*). In T. S. Schulenberg (Ed.), *Birds of the World*. Cornell Lab of Ornithology. https://doi.org/10.2173/bow.bucmot4.01

Pacheco, J. F., Silveira, L. F., Aleixo, A., Agne, C. E., Bencke, G. A., Bravo, G. A., . . . Piacentini, V. Q. (2021). Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee—second edition. *Ornithology Research*, *29*(2), 94–105. https://doi.org/10.1007/s43388-021-00058-x

Parker-III, T. A., Stotz, D. F., & Fitzpatrick, J. W. (1996). Ecological and distribuitional databases. In D. F. Stotz, J. W. Fitzpatrick, T. A. Parker-III & D. K. Moskovits (Eds.), *Neotropical birds: ecology and conservation* (pp. 113-436). University of Chicago Press.

Pereira, G. A., Periquito, M. C., Brito, M. T., & Menezes, M. (2011). Estrutura trófica da avifauna no Jardim Botânico do Recife, Pernambuco, Brasil. *Atualidades Ornitológicas*, (164), 57-63.

Pesquero, M. A., Corrêa, A. G., Pesquero, M. F., & Paula, H. M. (2014). Feeding of nestlings of the Amazonian Motmot (*Momotus momota*) in southern Goiás, Brazil. *Revista Brasileira de Ornitologia*, *22*(3), 288-291.

Portes, C. E. B., Godoy, F. I., & Kuniy, A. A. (2018). Avifauna de três fragmentos de vegetação no litoral norte do estado de Alagoas, com ênfase em novos registros de aves ameaçadas. *Atualidades Ornitológicas*, *204*, 33-42.

Ribon, R. (2010). Amostragem de aves pelo métedo de listas de Mackinnon. In S. V. Matter, F. C. Straube, I. A. Accordi, V. Q. Piacentini & J. F. Cândido-Jr. (Eds.), *Ornitologia e conservação: ciência aplicada, técnicas de pesqusias e levantamento* (pp. 33-44). Technical Books.

Ridgely, R. S., & Tudor, G. (2009). *Field guide to the songbirds of South America: the passerines*. University of Texas Press.

Roda, S. A., Pereira, G. A., & Albano, C. (2011). *Conservação de aves endêmicas e ameaçadas do Centro de Endemismo Pernambuco*. Editora Universitária da UFPE.

Rodrigues, M. F. (2014). Avifauna do Parque Estadual de Dois Irmãos. In M. F. Rodrigues & S. P. V. Silva (Eds.), *Plano de manejo: Parque Estadual de Dois Irmãos* (pp. 142-161). Secretaria de Meio Ambiente e Sustentabilidade de Pernambuco.

Ruiz-Esparza, J., Santos, C. S., Cunha, M. A., Ruiz-Esparza, D. P. B., Rocha, P. A., Beltrão-Mendes, R., & Ferrari, S. F. (2015). Diversity of birds in the Mata do Junco State Wildlife Refuge, a remnant of the Atlantic Forest of Northeastern Brazil. *Check List*, *11*(3), 1-10. https://doi.org/http://dx.doi.org/10.15560/11.3.1647

Sick, H. (1997). *Ornitologia brasileira*. Nova Fronteira.

Sigrist, T. (2009a). *Guia de Campo Avis Brasilis - avifauna brasileira: panchas e mapas* (Vol. 1). Avis Brasilis.

Sigrist, T. (2009b). *Guia de Campo Avis Brasilis - avifauna brasileira: descrição das espécies* (Vol. 2). Avis Brasilis.

Silva, J. M. C., Sousa, M. C., & Castelletti, C. H. M. (2004). Areas of endemism for passerine birds in the Atlantic forest, South America. *Global Ecology and Biogeography*, *13*(1), 85-92. https://doi.org/10.1111/j.1466-882X.2004.00077.x

Silva, S. B. L., Marques, F. P., & Leal, D. C. (2018). *Momotus momota marcgraviana* Pinto & Camargo, 1961. In Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) (Ed.), *Livro vermelho da fauna brasileira ameaçada de extinção* (pp. 220-221). ICMBio/MMA.

Silveira, L. F., Olmos, F., & Long, A. J. (2003). Birds in Atlantic Forest fragments in north-east Brazil. *Cotinga*, *20*, 32-46.

Solórzano, A., Brasil, L. S. C. A., & Oliveira, R. R. (2021). The Atlantic Forest ecological history: from pre-colonial times to the Anthropocene. In M. C. M. Marques & C. E. V. Grelle (Eds.), *The Atlantic Forest* (pp. 25-44). Springer International Publishing. https://doi.org/10.1007/978-3-030-55322-7_2

Stattersfield, A. J., Crosby, M. J., Long, A. J., & Wege, D. C. (1998). *Endemic bird areas of the World: Priorities for biodiversity conservation* (Vol. 7). BirdLife International.

Studer, A., Leal, S., Lévêque, R., Bassin, A., Laesser, J., Buzzetti, D., & Sousa, M. C. (2015). Inventários da Reserva Biológica de Pedra Talhada - Aves (Aves). In A. Studer, L. Nusbaumer & R. Spichiger (Eds.), *Biodiversidade da Reserva Biológica de Pedra Talhada: Alagoas, Pernambuco - Brasil* (pp. 377-408). Conservatoire et Jardin Botaniques de la Ville de Genève.

Tabarelli, M., Aguiar, A. V., Ribeiro, M. C., Metzger, J. P., & Peres, C. A. (2010). Prospects for biodiversity conservation in the Atlantic Forest: Lessons from aging human-modified landscapes. *Biological Conservation*, *143*(10), 2328-2340. https://doi.org/10.1016/j.biocon.2010.02.005

Telino-Junior, W. R., Dias, M. M., Azevedo-Júnior, S. M., Lyra-Neves, R. M., & Larrazábal, M. E. L. (2005). Estrutura trófica da avifauna na Reserva Estadual de Gurjaú, Zona da Mata Sul, Pernambuco, Brasil. *Revista Brasileira de Zoologia*, *22*(4), 962-973. https://doi.org/10.1590/S0101-81752005000400024

Toledo-Lima, G. S., Macario, P., Lyra-Neves, R. M., Teixeira, B. P., Lima, L. A. F., Sugliano, G. O. S., & Telino-Junior, W. R. (2014). Richness, composition and trophic groups of an avian community in the Pernambuco Endemism Centre, Alagoas, Brazil. *Anais da Academia Brasileira de Ciências*, *86*(3), 1207-1220. https://doi.org/10.1590/0001-3765201420130129

Vielliard, J. M. E., Almeida, M. E. C., Anjos, L., & Silva, W. R. (2010). Levantamento quantitativo por pontos de escuta e o Índice Pontual de Abudância (IPA). In S. V. Matter, F. C. Straube, I. A. Accordi, V. Q. Piacentini & J. F. Cândido-Jr. (Eds.), *Ornitologia e conservação: ciência aplicada, técnicas de pesquisas e levantamento* (pp. 47-60). Technical Books.

Willis, E. O. (1976). Effects of a cold wave on an Amazonian avifauna in the upper Paraguay drainage, Western Mato Grosso, and suggestions on Oscine-Suboscine relationships. *Acta Amazonica*, *6*(3), 379-394. https://doi.org/10.1590/1809-43921976063379

AUTHORS' CONTRIBUTIONS

W. Oliveira-Silva contributed to conceptualization, methodology, data curation, formal analysis and writing (original draft); T. K. Guedes with data curation, and writing (review and editing); P. M. Oliveira with data curation and writing (review and editing); R. M. Lyra-Neves with methodology and writing (review and editing); W. R. Telino-Junior with methodology and writing (review and editing); R. Gaban-Lima with conceptualization, methodology, writing (review and editing) and supervision.

Appendix. Bird species recorded in Maceió Municipal Park in Maceió (Alagoas state, Brazil) between 2014 and 2016 based on sample collected using MacKinnon lists and point counts. LFI = List Frequency Index; PAI = Punctual Abundance Index. Conservation status (CS): LC = Least Concern; VU = Vulnerable; EN =Endangered. Area of endemism (AE): AF = Atlantic Forest; PC = Pernambuco Center of Endemism. SD = Sensitivity to habitat Disturbance. Species marked with an asterisk (*) were recorded opportunistically during informal observations. ** = species recorded by Leal (2010); *** = species recorded by Oliveira et al. (2018); the habitat sensitivity, conservation status, and endemism of these species were not evaluated here. (Continue)

Taxa	LFI	PAI	CS	EA	SD
Tinamiformes					
Tinamidae					
Crypturellus soui (Hermann, 1783)	0.005	-	LC		L
Anseriformes					
Anatidae					
Amazonetta brasiliensis (Gmelin, 1789)*	-	-	LC		L
Galliformes					
Cracidae					
Ortalis araucuan (Spix, 1825)	0.010	0.007	LC	AF	M
Columbiformes					
Columbidae					
Leptotila verreauxi Bonaparte, 1855	0.128	0.317	LC		L
Columbina talpacoti (Temminck, 1811)	0.047	0.099	LC		L
Columbina picui (Temminck, 1813)	0.005	-	LC		L
Cucoliformes					
Cucolidae					
Guira guira (Gmelin, 1788)	0.021	0.014	LC		L
Crotophaga ani Linnaeus, 1758	0.139	0.444	LC		L
Piaya cayana (Linnaeus, 1766)	0.073	0.120	LC		L
Caprimulgiformes					
Caprimulgidae					
Nyctidromus albicollis (Gmelin, 1789)	0.003	-	LC		L
Apodiformes					
Trochilidae					
Glaucis hirsutus (Gmelin, 1788)*	-	-	LC		L
Phaethornis ruber (Linnaeus, 1758)	0.026	0.063	LC		M
Phaethornis pretrei (Lesson & Delattre, 1839)**					
Chlorostilbon lucidus (Shaw, 1812)	0.013	0.007	LC		L
Eupetomena macroura (Gmelin, 1788)	0.039	0.056	LC		L
Chlorestes notata (Reich, 1793)	0.026	0.070	LC		L
Chrysuronia versicolor (Vieillot, 1818)	0.013	-	LC		L
Chrysuronia leucogaster (Gmelin, 1788)	0.031	0.049	LC		L
Chionomesa fimbriata (Gmelin, 1788)	0.005	-	LC		L

Appendix. (Continue)

Taxa	LFI	PAI	CS	EA	SD
Gruiformes					
Aramidae					
Aramus guarauna (Linnaeus, 1766)	0.003	0.007	LC		M
Rallidae					
Porphyrio martinica (Linnaeus, 1766)	0.144	0.845	LC		L
Aramides cajaneus (Statius Muller, 1776)	0.045	0.056	LC		H
Charadriiformes					
Charadriidae					
Vanellus chilensis (Molina, 1782)	0.008	0.007	LC		L
Pelecaniformes					
Ardeidae					
Tigrisoma lineatum (Boddaert, 1783)	0.016	-	LC		M
Butorides striata (Linnaeus, 1758)	0.079	0.049	LC		L
Bubulcus ibis (Linnaeus, 1758)*	-	-	LC		L
Ardea alba Linnaeus, 1758*	-	-	LC		L
Cathartiformes					
Cathartidae					
Coragyps atratus (Bechstein, 1793)	0.366	1.148	LC		L
Cathartes sp.	0.102	0.275	-		-
Cathartes aura (Linnaeus, 1758)*	-	-	LC		L
Cathartes burrovianus Cassin, 1845*	-	-	LC		M
Accipitriformes					
Accipitridae					
Chondrohierax uncinatus (Temminck, 1822)	0.010	0.021	LC		L
Leptodon forbesi (Swann, 1922)	0.008	0.007	EN	PC	M
Geranospiza caerulescens (Vieillot, 1817)	0.003	-	LC		M
Rupornis magnirostris (Gmelin, 1788)	0.154	0.261	LC		L
Buteo brachyurus Vieillot, 1816*	-	-	LC		M
Buteo albonotatus Kaup, 1847**					
Strigiformes					
Strigidae					
Pulsatrix perspicillata pulsatrix (Wied, 1820)***					
Glaucidium brasilianum (Gmelin, 1788)	0.003	0.021	LC		L
Coraciiformes					
Momotidae					
Momotus momota marcgravianus Pinto & Camargo, 1961	0.079	0.134	EN	PC	M
Alcedinidae					

Appendix. (Continue)

Taxa	LFI	PAI	CS	EA	SD
Megaceryle torquata (Linnaeus, 1766)	0.029	0.042	LC		L
Chloroceryle amazona (Latham, 1790)	0.016	-	LC		L
Chloroceryle americana (Gmelin, 1788)	0.024	0.021	LC		L
Galbuliformes					
Galbulidae					
Galbula ruficauda Cuvier, 1816	0.573	1.296	LC		L
Bucconidae					
Nystalus maculatus (Gmelin, 1788)	0.039	0.021	LC		M
Piciformes					
Picidae					
Picumnus pernambucensis Zimmer, 1947	0.016	0.014	LC	PC	M
Veniliornis passerinus (Linnaeus, 1766)**					
Celeus ochraceus (Spix, 1824)	0.008	0.007	LC		M
Falconiformes					
Falconidae					
Caracara plancus (Miller, 1777)	0.029	0.021	LC		L
Milvago chimachima (Vieillot, 1816)	0.008	-	LC		L
Psittaciformes					
Psittacidae					
Touit surdus (Kuhl, 1820)***					
Forpus xanthopterygius (Spix, 1824)	0.010	0.028	LC		L
Aratinga jandaya (Gmelin, 1788)	0.013	0.035	LC		M
Diopsittaca nobilis (Linnaeus, 1758)	0.181	0.951	LC		M
Passeriformes					
Thamnophilidae					
Formicivora grisea (Boddaert, 1783)	0.139	0.282	LC		L
Herpsilochmus atricapillus Pelzeln, 1868	0.063	0.077	LC		M
Thamnophilus caerulescens pernambucensis Naumburg, 1937	0.327	0.472	VU	PC	L
Dendrocolaptidae					
Sittasomus griseicapillus (Vieillot, 1818)	0.115	0.176	LC		M
Dendroplex picus (Gmelin, 1788)	0.238	0.444	LC		L
Xenopidae					
Xenops minutus alagoanus Pinto, 1954***					
Furnariidae					
Furnarius leucopus Swainson, 1838	0.003	-	LC		L
Pipridae					
Chiroxiphia pareola (Linnaeus, 1766)	0.089	0.176	LC		H

Appendix. (Continue)

Taxa	LFI	PAI	CS	EA	SD
Manacus manacus (Linnaeus, 1766)	0.123	0.070	LC		L
Ceratopipra rubrocapilla (Temminck, 1821)	0.154	0.092	LC		H
Tityridae					
Pachyramphus polychopterus (Vieillot, 1818)	0.018	0.007	LC		L
Rhynchocyclidae					
Leptopogon amaurocephalus Tschudi, 1846	0.065	0.035	LC		M
Tolmomyias flaviventris (Wied, 1831)	0.411	1.063	LC		L
Todirostrum cinereum (Linnaeus, 1766)	0.332	0.317	LC		L
Tyrannidae					
Camptostoma obsoletum (Temminck, 1824)	0.089	0.141	LC		L
Elaenia flavogaster (Thunberg, 1822)	0.497	1.289	LC		L
Capsiempis flaveola (Lichtenstein, 1823)	0.204	0.246	LC		L
Legatus leucophaius (Vieillot, 1818)	0.003	0.007	LC		L
Myiarchus ferox (Gmelin, 1789)**					
Myiarchus tyrannulus (Statius Muller, 1776)	0.047	0.120	LC		L
Pitangus sulphuratus (Linnaeus, 1766)	0.406	1.155	LC		L
Myiodynastes maculatus (Statius Muller, 1776)	0.013	-	LC		L
Megarynchus pitangua (Linnaeus, 1766)	0.037	0.007	LC		L
Myiozetetes similis (Spix, 1825)	0.157	0.366	LC		L
Tyrannus melancholicus Vieillot, 1819	0.068	0.176	LC		L
Empidonomus varius (Vieillot, 1818)	0.003	-	LC		L
Conopias trivirgatus (Wied, 1831)	0.005	-	LC		M
Fluvicola nengeta (Linnaeus, 1766)	0.115	0.169	LC		L
Vireonidae					
Cyclarhis gujanensis (Gmelin, 1789)	0.283	0.627	LC		L
Vireo chivi (Vieillot, 1817)	0.251	0.606	LC		L
Hirundinidae					
Stelgidopteryx ruficollis (Vieillot, 1817)	0.034	0.077	LC		L
Troglodytidae					
Troglodytes musculus Naumann, 1823	0.110	0.197	LC		L
Pheugopedius genibarbis (Swainson, 1838)	0.183	0.401	LC		L
Polioptilidae					
Ramphocaenus melanurus Vieillot, 1819	0.010	-	LC		L
Polioptila plumbea (Gmelin, 1788)	0.052	0.070	LC		L
Turdidae					
Turdus leucomelas Vieillot, 1818	0.668	2.592	LC		L
Turdus rufiventris Vieillot, 1818	0.039	0.035	LC		L

Appendix. (Conclusion)

Taxa	LFI	PAI	CS	EA	SD
Turdus amaurochalinus Cabanis, 1850	0.118	0.296	LC		L
Estrildidae					
Estrilda astrild (Linnaeus, 1758)	0.005	0.099	LC		?
Passeridae					
Passer domesticus (Linnaeus, 1758)**					
Fringillidae					
Spinus yarrellii (Audubon, 1839)**					
Euphonia chlorotica (Linnaeus, 1766)	0.275	0.500	LC		L
Euphonia violacea (Linnaeus, 1758)	0.029	0.070	LC		L
Passerellidae					
Arremon taciturnus (Hermann, 1783)	0.120	0.155	LC		M
Icteridae					
Cacicus haemorrhous (Linnaeus, 1766)	0.003	-	LC		L
Parulidae					
Myiothlypis flaveola Baird, 1865**					
Basileuterus culicivorus (Deppe, 1830)	0.364	0.563	LC		M
Thraupidae					
Nemosia pileata (Boddaert, 1783)**					
Hemithraupis guira (Linnaeus, 1766)	0.039	0.042	LC		L
Tersina viridis (Illiger, 1811)	0.005	-	LC		L
Cyanerpes cyaneus (Linnaeus, 1766)**					
Dacnis cayana (Linnaeus, 1766)	0.060	0.085	LC		L
Saltator maximus (Statius Muller, 1776)	0.031	-	LC		L
Coereba flaveola (Linnaeus, 1758)	0.442	0.937	LC		L
Volatinia jacarina (Linnaeus, 1766)	0.003	0.035	LC		L
Tachyphonus rufus (Boddaert, 1783)	0.016	-	LC		L
Ramphocelus bresilia (Linnaeus, 1766)	0.005	0.007	LC	AF	L
Sporophila nigricollis (Vieillot, 1823)**					
Sporophila leucoptera (Vieillot, 1817)**					
Sporophila angolensis (Linnaeus, 1766)**					
Thlypopsis sordida (d'Orbigny & Lafresnaye, 1837)	0.013	-	LC		L
Thraupis sayaca (Linnaeus, 1766)	0.220	0.923	LC		L
Thraupis palmarum (Wied, 1823)	0.251	1.486	LC		L
Stilpnia cayana (Linnaeus, 1766)	0.052	0.021	LC		M
Tangara fastuosa (Lesson, 1831)	0.018	-	VU	PC	M
Total number of species (118)	97	77			