Birds of Sete Cidades National Park, Brazil: ecotonal patterns and habitat use

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O Parque Nacional de Sete Cidades (PNSC) é uma das poucas unidades de conservação no Brasil que possuem dentro de seus limites áreas de transição ecológica envolvendo dois dos principais biomas brasileiros: Cerrado e Caatinga. Portanto é um excelente laboratório natural para estudos que envolvam a dinâmica da biota em áreas ecotonais. Durante o período de agosto de 2002 a julho de 2009 estudamos a avifauna presente nos diversos hábitats existente no PNSC afim de se avaliar a dinâmica das comunidades de aves presentes na área. Como resultados foram registradas 238 espécies de aves, pertencentes a 57 famílias. Apesar do parque apresentar estrutura florística e fisionômica do bioma Cerrado, foram registradas apenas dois espécies endêmicas desse bioma, enquanto outras cinco endêmicas da Caatinga estão presentes no Parque. A maioria das espécies registradas no PNSC é independente de formações florestais. Isso sugere que no geral a avifauna registrada no PNSC, apesar de predomínio de vegetação típica do Bioma Cerrado, reflete uma comunidade típica da Caatinga, mas com a presença de espécies dois biomas. A avifauna presente no parque pode ser classificada em dois grandes grupos ecológicos, um grupo relacionado a formações arbóreas (floresta semidecídua, mata de galeria e cerradão) e outro relacionado a formações herbáceas arbustivas (campo limpo, cerrado típico e cerrado rupestre). De um modo geral o PNSC desempenha um papel importante na manutenção de uma comunidade de aves extremamente peculiar principalmente por representar uma área de transição ecológica entre dois dos maiores biomas brasileiros, o que a torna importante não só do ponto de vista biológico, como também do ponto de vista biogeográfico.

The state of Piauí, in north-east Brazil, lies within a unique ecological transition zone between three principally or uniquely Brazilian biomes, Amazonia, Cerrado and Caatinga[1,26]. This configuration results in a complex mosaic of vegetation types, ranging from xeric Caatinga, through mesic Cerrado to more humid habitats such as babaçu *Orbignya phalerata* forests and semi-deciduous rainforest at the periphery of the Amazonian Hylea[7,22]. This diverse environment supports a variety of plants and animals from all three biomes, with varied interspecific relationships and niche partitioning. For example, in the Caatinga–Cerrado transition zone in the south of the state, Santos[28] found bird species typical of the Cerrado to be restricted to plateaux summits, whereas Caatinga species occurred only in valleys and lowlands. Thus, while the two groups occur in the same zone, they are highly segregated ecologically.

The Cerrado and Caatinga biomes share much of their recent history, having endured major transformations in the Quaternary, reflected in the composition of their respective faunas[2,6,12,41]. Consequently, detailed study of the characteristics of the transition zone between these biomes can provide the key data to understanding ecological relationships between their biotas.

In the Neotropics, however, few data are available on the ecological dynamics of such transition zones, despite that many such ecotones have suffered intense anthropogenic impacts. Degradation of these areas impedes the systematic understanding of ecological and historical processes that have moulded their communities. However, one outstanding example of a transition zone that has been little impacted is northern Piauí's Sete Cidades National Park (SCNP), which encompasses the Caatinga–Cerrado ecotone, and provides an excellent natural laboratory to analyse ecological factors that determine the composition and dynamics of the communities inhabiting these areas. The present study focuses on three main questions: (i) the composition of the avian community of Sete Cidades National Park; (ii) the distribution of these species in an area of ecological transition, and (iii) the dynamics of this avifauna within the mosaic of habitat types inside the park.

Study area and Methods

Sete Cidades National Park (SCNP) is situated in the state of Piauí (Fig. 1), between the municipalities of Piracuruca and Brasileira (04°05'–04°15'S 41°30'–41°45'W). This region coincides with the transition between the Cerrado and Caatinga biomes. Climate is semi-arid equatorial, with a six-month dry season. Mean annual temperatures range from 24°C to 26°C, with mean annual precipitation of 1,000–1,250 mm.

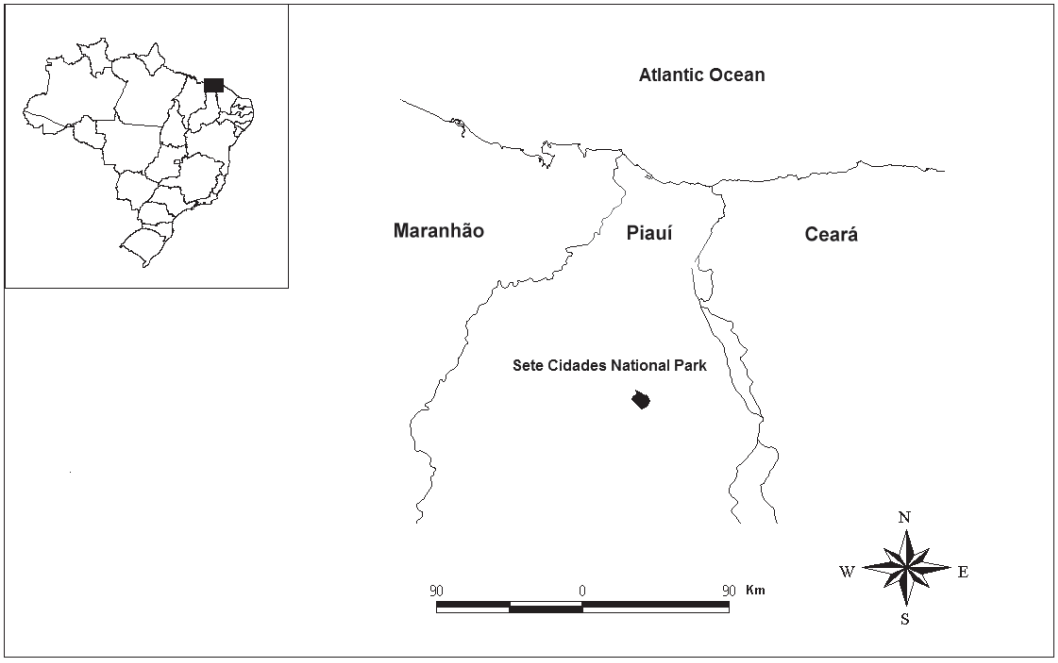

Figure 1. Location of Sete Cidades National Park in the Brazilian state of Piauí.

With an area of 6,221 ha and a 40-km perimeter, SCNP encompasses a series of sedimentary basins at altitudes of 100–300 m[16]. Some 22 freshwater springs occur within the park, giving rise to watercourses lined by marshes and gallery forest. Oliveira[22] classified the park's vegetation in three functional categories: forests, savannas and grassland. The same author recognised six distinct habitat types within these three categories: open grassland, savanna, rocky savanna, savanna woodland, gallery forest, and semi-deciduous scrub forest[22].

Open grassland (Og) is a predominantly herbaceous formation, with vegetation up to 1.5 m tall, and a predominance of plants belonging to the Gramineae, Leguminosae, Asteraceae and Amaranthaceae. Savanna (Sv) typically comprises two main strata, a low-lying herbaceous-shrubby layer and a taller arboreal stratum, reaching up to 5 m tall. The latter is composed of small, irregularly shaped trees with misshapen branches and dense, ridged bark, characteristic of the central Brazilian Cerrado. This is the commonest vegetation type in the park. Rocky savanna (Rs) possesses a unique flora, characterised by relatively small plants up to 2 m tall and well adapted to dry conditions. This vegetation occurs among outcrops of sedimentary and ferruginous rocks. Savanna woodland (Sw) is the commonest arboreal habitat within the park, where it is almost always contiguous with semi-deciduous scrub forest. It is similar to Sv, but has a sparser understorey and a better-developed arboreal layer, with straight-trunked trees up to 7 m tall, typically with thin, relatively smooth bark.

Gallery forest (Gf) comprises narrow strips of forest at the margins of rivers and streams. This is the least common forest habitat in the park. The canopy is irregular, varying from 8 m to 12 m, with abundant palms and lianas, a herbaceous understorey and a dense layer of leaf litter. In the wet season, the water table rises above the soil surface, gradually subsiding in the dry season. Leaf litter accumulates from leaf fall within the habitat and horizontal transport from adjacent habitats.

Dry forest ('semi-deciduous scrub forest') (Df) is a relatively dense habitat with trees up to 9 m tall and abundant shrubs in the understorey. There is no herbaceous stratum or epiphytes, but abundant lianas, both in terms of individuals and species. Seasonally flooded pools (Sp) form during the wet season, in January–May.

The present study was conducted between August 2002 and July 2009. Fifteen field excursions were made, each of mean duration four days, with an overall total of 75 days of data collection in SCNP. Survey periods were: 8–15 August 2002, 12–19 September 2003, 9–12 April 2004, 23–26 July 2004, 13–16 May 2005, 7–10 April 2006, 25–28 August 2006, 9–13 May 2007, 11–16 October 2007, 8–11 February 2008, 2–5 May 2008, 24–27 October 2008, 5–9 February 2009, 3–7 April 2009 and 24–28 July 2009. Both visual and aural records of

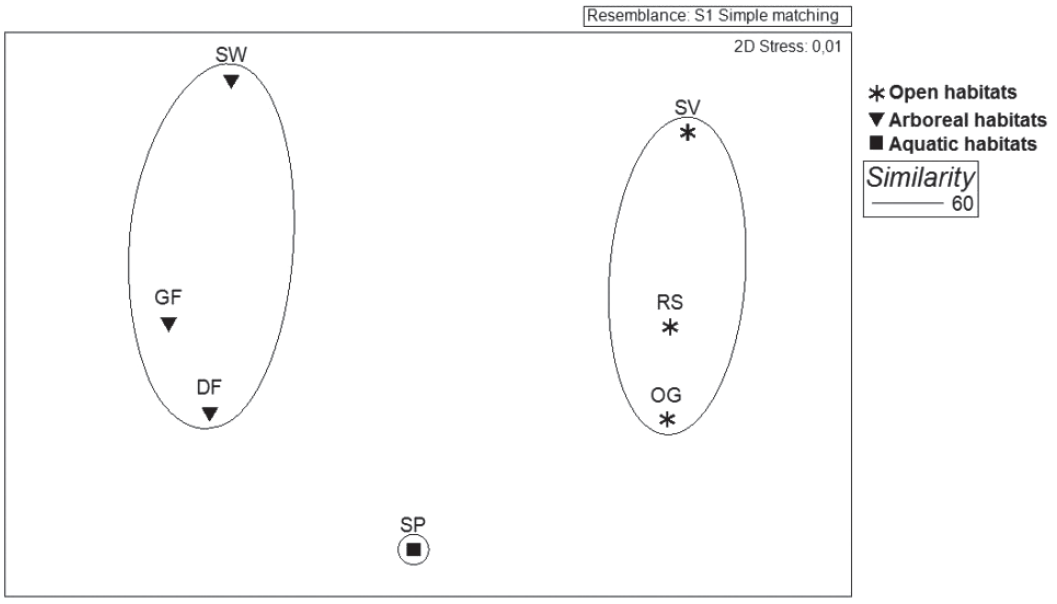

Figure 2. Non-metric multidimensional scaling for bird communities in SCNP, using data in the presence / absence form. Habitat: (Og) open grassland, (Rs) rocky savanna, (Sv) savanna proper, (Sw) Savanna woodland, (Gf) gallery forest, (Df) dry forest and (Sp) seasonal pools.

birds in the study area were also collected during periods other than these surveys, to maximise sampling effort. Data were collected using four complementary approaches.

Visual records: systematic observations preferentially conducted during mornings (05h00–11h00) and afternoons (16h00–18h00) to ensure the recording of both diurnal and nocturnal species. Observers walked pre-existing trails and roads within all six habitats at SCNP.

Aural records: birds were also identified by their vocalisations, which were recorded using a Sony TCM 5000EV tape recorder and a Sennheiser ME-66 shotgun unidirectional microphone; when necessary, playback was used to stimulate additional vocalisations. If identification could not be achieved in the field, recordings were compared with those held privately or in public collections.

Mist-netting; birds were captured using mist-nets (12 m × 2.5 m; 36-mm mesh) set in the undergrowth in a linear sequence, to avoid overlap between them. Two sets of ten nets were employed simultaneously. During each survey, two habitats were sampled using mist-nets, which were set on three consecutive days within each area. This had two principal objectives: (i) to obtain data on species composition and richness in each habitat type, and (ii) to obtain specimens.

Specimens: some 124 individuals, of 40 species, were collected during mist-netting. Most were taxidermized, or fixed in formaldehyde and then conserved in ethanol. The carcasses of all of the taxidermized specimens were fixed and conserved in ethanol. Tissue samples (muscle, liver and blood, when possible) were also collected from all specimens, as well as biometric data (total length and mass). The *in vivo* coloration of the bare parts was also noted on the specimen labels. Specimen collection was authorised by IBAMA through special license DIREC 026/2007 (process no. 02001.006754/06-92) and specimens are deposited at the Museu Paraense Emílio Goeldi, Belém, Pará.

The degree of dependence of species on forested habitats in SCNP was evaluated using three categories: (1) Independent = found only in open habitats (Og, Sv, Rs); (2) Semi-dependent = recorded in at least one open (Og, Sv, Rs) and one forested habitat (Sw, Gf, Df); (3) Dependent = only in forested habitat (Sw, Gf, Sf). In addition to field observations, data on habitat use were obtained from Silva[31,33].

Multidimensional scaling (MDS) was used to visualise the community compositions of the habitats in two-dimensional space[17]. A one-way analysis of similarity (ANOSIM) was used to test for significant differences in community composition between diferent habitats. All multivariate analyses were conducted using PRIMER 6.0 (Plymouth Routines In Multivariate Ecological Research)

Taxonomic classification follows CBRO[8].

Results

Species richness and avian community of Sete Cidades National Park.—Some 238 bird species from 57 families were recorded in SCNP during the study. Just one—Bearded Bellbird *Procnias averano*—is included in the Brazilian list of threatened species. Three others, Buff-browed Chachalaca *Ortalis superciliaris*, Blue-winged Macaw *Primolius maracana* and Caatinga Antwren *Herpsilochmus sellowi*, are listed as Near Threatened. Our records of White-rumped Tanager *Cypsnagra hirundinacea* and Dull-coloured Grassquit *Tiaris fuliginosus* represent the northernmost records in the Cerrado. In Piauí, the previous northernmost record for *C. hirundinacea* involved three specimens taken by Emil Kaempfer in June 1926, in the vicinity of Teresina, c.180 km south of SCNP (AMNH 245580–82). *T. fuliginosus* was known in Piauí from just two records, one collected in 2001 by Silveira *et al*.[35] at Uruçuí-una Ecological Station in the south. In 2003, MPDS collected two at Nazareth Eco in the municipality of José de Freitas, in the north-centre of the state (MPEG 68788–89). The record from SCNP represents a northward extension of c.150 km. We also observed Short-tailed Swift *Chaetura brachyura* in SCNP, for the first time in Piauí: on 11 May 2007 eight were over the park's waterfall, and on 5 April 2009, six were seen over an area of savanna woodland. The species is common in Amazonia, with records from as close as coastal Maranhão, but the species might only be a vagrant to northern Piauí.

Ecotonal patterns.—Almost half (44.5%) of the species were classified as independent of forested habitat, while one-third (33.2%) were semi-dependent and just 22.3% dependent on this type of habitat. The number of species per category was significantly different from expected (χ^2 = 17.706, d.f. = 1, $p < 0.001$). Among Cerrado endemics, Curl-crested Jay *Cyanocorax cristatellus* is semi-dependent and Black-throated Saltator *Saltatricula atricollis* independent of forest habitat. Among Caatinga endemics Spotted Piculet *Picumnus pygmaeus* is dependent, Caatinga Antwren *Herpsilochmus sellowi* and Caatinga Antshrike *Thamnophilus capistratus* semi-dependent, and White-throated Seedeater *Sporophila albogularis* and Red-cowled Cardinal *Paroaria dominicana* independent of forest habitat.

Habitat use.—Savanna habitat had the highest species richness (n = 138), followed by savanna woodland with 125 species, gallery forest with 88, and rocky savanna with 73. Open grassland (n = 69) and scrub forest (n = 49) were the species-poorest of the main habitats, while seasonal pools supported just 21 species. Gallery and scrub forests were also the most similar in terms of composition of their avifauna, at 70%. Open grassland and rocky savanna were almost as similar (68%), as were savanna and rocky savanna (65%). The species distribution analysis among the different habitats revealed two main groups, one associated with arboreal habitats (Sw, Gf, Sf), the other to open habitats (Og, Sv, Rs). The marked similarity between habitats appears to be related to the fact that few species (32) were associated with a single type. By contrast, 86 species were associated with two habitats and 103 with three, i.e. c.80% of bird species recorded at SCNP were associated with 2–3 different habitats.

MDS supports the two distinct groups representing forested and open areas (Fig. 2), while ANOSIM provides statistical support, confirming that communities in the two habitats are significantly different (global R = 0.911; p = 0.01).

Discussion

Species richness and avian community of Sete Cidades National Park.—The total number of species in SCNP is among the highest in the region, including other sites in Piauí and Ceará which possess between 146 and 254 species. In Ceará, 146 species were recorded by Nascimento[20] in Ubajara National Park, while Farias[13] reported 174 species in Serra das Almas Natural Reserve. Surveys of another area in northern Piauí, Nazareth Eco, produced 230 species (MPDS pers. obs). Further south, several protected areas have been surveyed, including Serra da Capivara National Park, where 208 bird species were recorded by Olmos[23], and Serra das Confusões National Park, where Silveira & Santos[34] found 222 species. Zaher[42] also recorded 235 species in Uruçuí-uma Ecological Station, while Santos[27] listed 254 species for Nascentes do Rio Parnaíba National Park.

The relatively extended sampling period of the present study implies that the inventory was comprehensive, supported by the fact that the number of recorded species was the second highest among all of these studies. However, evidence from field work in the early 20th century suggests that 15 species not recorded during the present study probably occur within SCNP. In the 1920s, the German ornithologist Heinrich Snethlage collected birds at three localities close to the SCNP—Deserto (c.35 km north of the park), Arara (c.118 km south-east) and Ibiapaba, 70 km south-east of the park, and close to the border with Ceará. Fifteen species recorded at these sites[15,36,37], were not found in SCNP.

Vegetation at Deserto is very similar to that in SCNP, whereas Arara and Ibiapaba are typical of the Caatinga proper. Six of the 15 species are considered to be endemic to the Caatinga. Three—Broad-tipped Hermit *Anopetia gounellei*, Red-shouldered Spinetail *Gyalophylax hellmayri*

and Silvery-cheeked Antshrike *Sakesphorus cristatus*—were recorded at Arara, and two (Cactus Parakeet *Aratinga cactorum* and Moustached Woodcreeper *Xiphocolaptes falcirostris*) at Ibiapaba. The sixth, White-browed Guan *Penelope jacucaca*, was registered in ecotonal vegetation at Deserto. Including these species, a total of 11 species endemic to the Caatinga occur in northern Piauí.

Of the other species recorded by Snethlage at the three sites, but not observed in SCNP, Versicoloured Emerald *Amazilia versicolor* was recorded at Deserto and Arara. Pied Lapwing *Vanellus cayanus* was confirmed at Deserto, while three others were found at Arara; Little Wood Rail *Aramides mangle*, Stripe-backed Antbird *Myrmorchilus strigilatus* and Pied Water Tyrant *Fluvicola pica*. The other four species, Bicoloured Hawk *Accipiter bicolor*, Least Sandpiper *Calidris minutilla*, Collared Plover *Charadrius collaris* and Nacunda Nighthawk *Podager nacunda*, were all recorded at Ibiapaba. If most or all of these species are in fact present in SCNP, the species total would reach at least 250, close to the max. recorded in the region[27].

Ecotonal patterns.—While SCNP is dominated by Cerrado habitats, only two of the 30 species considered endemic to this biome by Silva[31] and Silva & Santos[32] were recorded in the present study; *Cyanocorax cristatellus* and *Saltatricula atricollis*. In addition, several other, widely distributed species recorded by us are normally associated with the Cerrado, e.g. Red-legged Seriema *Cariama cristata*, Peach-fronted Parakeet *Aratinga aurea*, Narrow-billed Woodcreeper *Lepidocolaptes angustirostris* and *Cypsnagra hirundinacea*.

Similarly, only five of the 24 species considered endemic to the Caatinga by Stotz[38] and Pacheco[25] were observed in SCNP: *Picumnus pygmaeus*, *Herpsilochmus sellowi*, *Thamnophilus capistratus*, *Sporophila albogularis* and *Paroaria dominicana.* Several other species recorded in the present study are also typically associated with the xeric formations of the Brazilian north-east, including Picui Ground Dove *Columbina picui*, Caatinga Cacholote *Pseudoseisura cristata*, White-naped Jay *Cyanocorax cyanopogon*, Long-billed Wren *Cantorchilus longirostris*, Scarlet-throated Tanager *Compsothraupis loricata*, Pileated Finch *Lanio pileatus* and Campo Troupial *Icterus jamacaii*.

An interesting pattern is observed in the juxtaposition of Caatinga and Cerrado avifaunas in this ecotonal region. The number of Cerrado endemics in bird communities of the central Brazilian plateau is generally 12–14[4,5,21], falling to 6–8 in the north, in northern Tocantins and southern Maranhão and Piauí[14,24,27]. In the northern transition zone, however, which includes SCNP, only four endemics occur[18]. In other words, there is a clear and systematic decline in the number of endemic Cerrado species, from the central nucleus to the periphery.

The pattern appears to be exactly the opposite in the Caatinga. While sites located in the centre of the biome possess c.5 endemics[13,39], this increases to eight in intermediate areas[13,19] and 10–15 in the transition zone with the Cerrado[23,28,34].

Despite the reduced number of endemics from either biome observed in the present study, the same general pattern was observed at SCNP, with more than twice as many Caatinga endemics as Cerrado species being recorded. This appears to reflect a dynamic process of historical fluctuations combined with present-day ecological factors.

The marginal nature of savanna formations in the northernmost Cerrado may explain the reduced number of endemics. This same habitat may not be appropriate for the majority of Caatinga endemics. The scenario recorded in SCNP appears distinct from that of other transitional areas in southern Piauí, where Santos[28] found that endemic Caatinga and Cerrado species segregated by habitat. At SCNP, in contrast, these species used the same habitats. This difference may be related to the greater ecological flexibility of Cerrado species found in northern Piauí, permitting them to exploit a wider variety of habitats in comparison to species observed in the south of the state[28].

An additional factor may be dependence of species on forested habitats. This contrasts with typical Cerrado communities, in which most species are dependent on forested habitat[30–32], and is more similar to the pattern observed in the Caatinga[33]. This suggests that, while Cerrado habitats predominate at SCNP, its avifauna is more typical of the Caatinga, despite the presence of species typical of both biomes. In other words, the avian community of the site is typical of the ecotone between the Caatinga and Cerrado, the two largest open-habitat formations in Brazil.

The relationship between the two communities reflects the complex evolutionary processes that occurred during the Quaternary, and influenced the present-day distribution of species in both biomes[29]. During this period, especially due to glacial events, the distribution and configuration of habitats fluctuated considerably[2,3]. During glacial periods, the climate of South America was colder and drier, favouring the expansion of Caatinga and Chaco scrublands, replacing denser *cerrado* and the Atlantic and Amazon forests, which shrank into isolated refuges either on the central Brazilian plateau (Cerrado) or its periphery, such as the foothills of the Andes and coastal eastern Brazil, in the case of forests. The opposite process occurred during warmer and more humid interglacial periods, with forest ecosystems expanding into areas previously occupied by xeric

scrublands. During these periods, the Caatinga and Chaco retreated into the dry lowlands of north-east and central / south-west South America, respectively[2,6,41].

Overall, Caatinga species are commoner in the transition zone than Cerrado species, which may reflect the relative availability of different habitats in the region, but may also be related to the complex recent history of the two biomes. The current geomorphological scenario is one of progressive erosion of plateaux, which are being substituted by peripheral lowlands. Within this context, the Caatinga is gaining ground over the Cerrado within the transition zone[11], and the diversity of birds within this zone is consistent with this process. As Caatinga species expand into newly formed lowland areas, Cerrado species are restricted to residual plateaux.

Habitat use.—The apparent preference for open habitats is consistent with a predominance of Caatinga species, which are generally less dependent on forest formations. The two Cerrado endemics recorded at SCNP (*Cyanocorax cristatellus* and *Saltatricula atricollis*) occurred in savanna and rocky savanna. Three Caatinga endemics—*Thamnophilus capistratus*, *Sporophila albogularis* and *Paroaria dominicana*—also preferred open habitats, e.g. savanna, open grassland and rocky savanna, whereas *Picumnus pygmaeus* and *Herpsilochmus sellowi* occurred mainly in gallery and scrub forests.

One of the characteristics of the Cerrado is the marked seasonality of precipitation, which provokes considerable variation in the availability of essential food resources, e.g. winged insects and flowers. This cycle is reflected in reproductive patterns and migratory movements between habitats and geographic areas[9,10,21]. Proximity of different *cerrado* habitats also facilitates movements among areas to access seasonally available resources[10,40].

Overall, the avifauna of SCNP is more typical of the Caatinga than the Cerrado, despite that the park's vegetation is dominated by Cerrado formations. From an ecological viewpoint, the avifauna conforms to the characteristic pattern displayed in north-eastern Brazil, indicating that this protected area plays a fundamentally important role in the conservation of the unique avifauna of this complex transition zone, reinforcing its significance from biological and zoogeographic perspectives.

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References

1. Ab'Saber, A. N. (1977) Os domínios morfoclimáticos na América do Sul. *Geomorfologia* 52: 1–21.
2. Ab'Saber, A. N. (1977) Espaços ocupados pela expansão dos climas secos na América do Sul, por ocasião dos períodos glaciais quaternários. *Paleoclimas* 3: 1–18.
3. Ab'Saber, A. N. (1982) The paleoclimate and paleoecology of Brazilian Amazonia. In: Prance, G. T. (ed.) *Biological diversification in the tropics*. New York: Columbia University Press.
4. Antas, P. T. Z. (1995) *Aves do Parque Nacional de Brasília*. Brasília: IBAMA.
5. Bagno, M. A. (1988) As aves da Estação Ecológica de Águas Emendadas. In: Marinho-Filho, J., Rodrigues, F. & Guimarães, M. (eds.) *Vertebrados da Estação Ecológica de Águas Emendadas*. Brasília: SEMATEC / IEMA / IBAMA.
6. Bigarella, J. J. & Andrade-Lima, D. (1982) Paleoenvironmental changes in Brazil. In: Prance, G. T. (ed.) *Biological diversification in the tropics*. New York: Columbia University Press.
7. Castro, A. A. J. F., Castro, N. M. C. F., Costa, J. M., Farias, R. R. S., Mendes, M. R. A., Albino, R. S., Barros, J. S. & Oliveira, M. E. A. (2007) Cerrados marginais do nordeste e ecótonos associados. *Rev. Bras. Biociências* 5: 273–275.
8. Comitê Brasileiro de Registros Ornitológicos (CBRO) 2011. Lista das aves do Brasil. 10ª edição. www.cbro.org.br (accessed 15 March 2011).
9. Cavalcanti, R. B. (1983) Aves do Cerrado. *Rev. Servidor Público* 11: 63–67.
10. Cavalcanti, R. B. (1992) The importance of forest edges in the ecology of open country cerrado birds. In: Furley, P. A., Proctor, J. & Ratter, J. A. (eds.) *Nature and dynamics of forest-savanna boundaries*. London, UK: Chapman & Hall.
11. Cole, M. M. (1986) *The savannas: biogeography and geobotany*. London, UK: Academic Press.
12. Cracraft, J. (1985) Historical biogeography and pattern of differentiation within the South American avifauna: areas of endemism. In: Buckley, P. A., Foster, M. S., Morton, E. S., Ridgely, R. S. & Buckley, F. G. (eds.) *Neotropical ornithology*. *Orn. Monogr*. 36.
13. Farias, G., Silva, B. W. A. G. & Albano, C. A. (2005) Diversidade de aves em áreas prioritárias para conservação da Caatinga. In: Araújo, F. S., Rodal, M. J. & Barbosa, M. R. V. (eds.) *Análise das variações da biodiversidade do bioma caatinga: suporte e estratégias regionais de conservação*. Brasília: Ministério do Meio Ambiente.
14. Hass, A., Paula, W. & Barreto, L. (2007) Caracterização da avifauna da região de Balsas. In: Barreto, L. (ed.) *Cerrado norte do Brasil*.

Pelotas: União Sul-Americana de Estudos da Biodiversidade.
15. Hellmayr, C. E. (1929) A contribution to the ornithology of northeastern Brazil. *Publ. Field Mus. Nat. Hist. Zool. Ser*. 12(18): 235–505.
16. Instituto Brasileiro de Desenvolvimento Florestal (1979) *Plano de manejo: Parque Nacional de Sete Cidades*. Brasília: Fundação Brasileira para a Conservação da Natureza.
17. Kruskal, J. B. & Wish, M. (1978) *Multidimentional scaling*. Newbury Park, CA: Sage Publications.
18. Lopes, F. M. (2008) Análise da composição e riqueza de aves em três fitofisionomias na Fazenda Bonito, Município de Castelo do Piauí. Monografia de conclusão de curso. Teresina: Universidade Federal do Piauí.
19. Nascimento, J. L. X. & Neto, A. S. (1996) *Aves da Estação Ecológica de Aiuaba, Ceará*. Brasília: IBAMA.
20. Nascimento, J. L., Sales-Júnior, S., Sousa, A. & Minns, J. (2005) Avaliação rápida das potencialidades ecológicas e econômicas do Parque Nacional de Ubajara, Ceará, usando aves como indicadores. *Ornithologia* 1: 32–42.
21. Negret, A. J. (1983) Diversidade e abundância da avifauna da reserva Ecológica do IBGE. Dissertação de Mestrado. Brasília: Universidade de Brasília.
22. Oliveira, M. E. A., Martins, F. R., Castro, A. A. J. F. & Santos, J. R. (2007) Classes de cobertura vegetal do Parque Nacional de Sete Cidades (transição campo-floresta) utilizando imagens TM/Landsat, NE do Brasil. *An. XIII Simpósio Bras. Sensoriamento Remoto*. Florianópolis.
23. Olmos, F. (1993) Birds of Serra da Capivara National Park, in the "caatinga" of north-eastern Brazil. *Bird Conserv. Intern*. 3: 21–36.
24. Olmos, F. & Brito, G. R. R. (2007) Aves da região da Barragem de Boa Esperança, médio rio Parnaíba, Brasil. *Rev. Bras. Orn*. 15: 115–131.
25. Pacheco, J. F. (2004) As aves da Caatinga: uma análise histórica do conhecimento. In: Silva, J. M. C., Tabarelli, M., Fonseca, M. T. & Lins, L. V. (eds.) *Biodiversidade da caatinga: áreas e ações prioritárias para conservação*. Brasília: Ministério do Meio Ambiente.
26. Rizzini, C. T. (1979) *Tratado de fitogeografia do Brasil*. São Paulo: Ed. Humanismo, Ciências e Tecnologia Hugitec & Ed. Universidade de São Paulo.
27. Santos, M. P. D. (2001) Composição da avifauna nas Áreas de Proteção Ambiental Serra da Tabatinga e Chapada das Mangabeiras, Brasil. *Bol. Mus. Para. E. Goeldi, Sér. Zool*. 17: 43–67.
28. Santos, M. P. D. (2004) As comunidades de aves em duas fisionomias da vegetação de Caatinga no estado do Piauí, Brasil. *Rev. Bras. Orn*. 12: 113–123.
29. Santos, M. P. D. (2008) Bird community distribution in a Cerrado-Caatinga transition area, Piauí, Brazil. *Rev. Bras. Orn*. 16: 323–338.
30. Sick, H. (1966) A fauna do Cerrado como fauna arborícola. *An. Acad. Bras. Ciênc*. 38: 355–356.
31. Silva, J. M. C. (1995) Birds of the Cerrado region, South America. *Steenstrupia* 21: 69–92.
32. Silva J. M. C. & Santos, M. P. D. (2005) A importância relativa dos processos biogeográficos na formação da avifauna do Cerrado e de outros biomas brasileiros. In: Scariot, A., Souza-Silva, J. C. & Felfili, J. M. (eds.) *Cerrado: ecologia, biodiversidade e conservação*. Brasília: Ministério do Meio Ambiente.
33. Silva, J. M. C., Souza, M. A., Bieber, A. G. D. & Carlos, C. J. (2004) Aves da Caatinga: status, uso do hábitat e sensitividade. In: Leal, I. R., Tabarelli, M. & Silva, J. M. C. (eds.) *Ecologia e conservação da Caatinga*. Recife: CEPAM.
34. Silveira, L. F. & Santos, M. P. D. (in press) Diversity of birds in Serra das Confusões National Park, Brazil: how many species can be found in an undisturbed *Caatinga*? *Rev. Bras. Orn*.
35. Silveira, L. F., Calonge-Mendez, A. & Brito, G. R. R. (2001) Range extensions and new records of birds in Piaui state, Brazil. *Intern. J. Orn*. 4: 219–224.
36. Snethlage, H. (1927) Meine Reise durch Nordostbrasilien. I. Reisebericht. *J. Orn*. 75: 453–484.
37. Snethlage, H. (1928) Meine Reise durch Nordostbrasilien. II. Biologische Beobachtungen. *J. Orn*. 76: 503–581.
38. Stotz, D. F., Fitzpatrick, J. W., Parker, T. A. & Moskovits, D. K. (1996) *Neotropical birds: ecology and conservation*. Chicago: University of Chicago Press.
39. Telino-Júnior, W. R., Neves, R. M. L. & Nascimento, J. L. X. (2005) Biologia e composição da avifauna em uma Reserva Particular de Patrimônio Natural da Caatinga Paraibana. *Ornithologia* 1: 49–57.
40. Tubelis, D. P. & Cavalcanti, R. B. (2001) Community similarity and abundance of bird species in open habitats in a central Brazilian cerrado. *Orn. Neotrop*. 12: 57–73.
41. Vanzolini, P. E. (1981) A quasi-historical approach to the natural history of the differentiation of reptiles in tropial geographic islates. *Pap. Avuls. Zool., São Paulo* 34: 189–204.
42. Zaher, H. (2001) *Diversidade de vertebrados terrestres da Estação Ecológica de Uruçuí-una, Piauí*. Relatório final. São Paulo: Universidade de São Paulo.

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Douglas Danilo dos Santos† (*in memoriam*)

Appendix 1. List of bird species recorded in Sete Cidades National Park, Piauí. Habitat: (Og) open grassland, (Rs) rocky savanna, (Sv) savanna proper, (Sw) Savanna woodland, (Gf) gallery forest, (Df) dry forest and (Sp) seasonal pools. Habitat use: (1) species independent of forest habitats, (2) species semi-dependent on forest habitats and (3) species dependent on forest habitats. Type of record: (Ob) sight, (Vc) vocalisation heard, (Vr) vocalisation recorded, (Cp) mist-netted and (MPEG) specimen (deposited at Museu Paraense Emílio Goeldi).

Scientific name	English name	Habitat	Habitat use	Type of record
TINAMIDAE (4)				
Crypturellus parvirostris	Small-billed Tinamou	Og, Rs, Sv	1	Ob, Vc, Vr
Crypturellus tataupa	Tataupa Tinamou	Gf, Df	3	Ob, Vc, Vr
Rhynchotus rufescens	Red-winged Tinamou	Og, Rs, Sv	1	Ob, Vc
Nothura boraquira	White-bellied Nothura	Og, Rs, Sv	2	Ob, Vc, Vr
ANATIDAE (4)				
Dendrocygna viduata	White-faced Whistling Duck	Sp	1	Ob, Vc
Dendrocygna autumnalis	Black-bellied Whistling Duck	Sp	1	Ob
Sarkidiornis sylvicola	Comb Duck	Sp	1	Ob
Amazonetta brasiliensis	Brazilian Teal	Sp	1	Ob
CRACIDAE (2)				
Ortalis superciliaris	Buff-browed Chachalaca	Sv, Sw, Gf, Df	2	Ob, Vc, Vr
Penelope superciliaris	Rusty-margined Guan	Sw, Gf, Df	3	Ob, Vc, Vr
PODICIPEDIDAE (1)				
Tachybaptus dominicus	Least Grebe	Sp	1	Ob
ARDEIDAE (5)				
Tigrisoma lineatum	Rufescent Tiger Heron	Sp	1	Ob
Butorides striata	Striated Heron	Sp	1	Ob
Bubulcus ibis	Cattle Egret	Sp	1	Ob
Ardea alba	Great Egret	Sp	1	Ob
Egretta thula	Snowy Egret	Sp	1	Ob
THRESKIORNITHIDAE (1)				
Theristicus caudatus	Buff-necked Ibis	Og, Sp	1	Ob, Vc, Vr
CATHARTIDAE (4)				
Cathartes aura	Turkey Vulture	Sw	1	Ob
Cathartes burrovianus	Lesser Yellow-headed Vulture	Rs, Sv	1	Ob
Coragyps atratus	Black Vulture	Og, Rs, Sv	1	Ob
Sarcoramphus papa	King Vulture	Sw	2	Ob
ACCIPITRIDAE (10)				
Leptodon cayanensis	Grey-headed Kite	Sw, Gf, Df	3	Ob, Vr
Elanoides forficatus	Swallow-tailed Kite	Og, Rs, Sv	1	Ob
Gampsonyx swainsonii	Pearl Kite	Sw	1	Ob, Cp, MPEG
Elanus leucurus	White-tailed Kite	Og, Sv	1	Ob
Ictinia plumbea	Plumbeous Kite	Og, Sv, Df	2	Ob
Rostrhamus sociabilis	Snail Kite	Og, Gf	1	Ob
Geranospiza caerulescens	Crane Hawk	Sv, Sw	2	Ob
Heterospizias meridionalis	Savanna Hawk	Og, Rs, Sv	1	Ob
Rupornis magnirostris	Roadside Hawk	Rs, Sv, Sw	1	Ob, Vc, Vr, Cp

Scientific name	English name	Habitat	Habitat use	Type of record
Geranoaetus albicaudatus	White-tailed Hawk	Rs, Sv, Sw	1	Ob
FALCONIDAE (8)				
Caracara plancus	Southern Caracara	Rs, Og, Sv	1	Ob
Milvago chimachima	Yellow-headed Caracara	Rs, Og, Sv	1	Ob, Vc, Vr
Herpetotheres cachinnans	Laughing Falcon	Sv, Sw, Gf, Df	2	Ob, Vc, Vr
Micrastur ruficollis	Barred Forest Falcon	Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
Micrastur semitorquatus	Collared Forest Falcon	Sw, Gf, Df	2	Ob, Vc, Vr
Falco sparverius	American Kestrel	Rs, Og, Sv	1	Ob
Falco rufigularis	Bat Falcon	Sw, Df	3	Ob
Falco femoralis	Aplomado Falcon	Og, Sv, Sw	1	Ob
ARAMIDAE (1)				
Aramus guarauna	Limpkin	Sp	1	Ob
RALLIDAE (3)				
Aramides cajanea	Grey-necked Wood Rail	Gf	2	Ob, Vc, Vr
Gallinula galeata	Common Moorhen	Sp	1	Ob
Porphyrio martinicus	Purple Gallinule	Sp	1	Ob
CARIAMIDAE (1)				
Cariama cristata	Red-legged Seriema	Og, Rs, Sv	1	Ob, Vc, Vr
CHARADRIIDAE (1)				
Vanellus chilensis	Southern Lapwing	Og, Sp	1	Ob, Vc, Vr
SCOLOPACIDAE (3)				
Gallinago paraguaiae	South American Snipe	Sp	1	Ob, Vc, Vr
Actitis macularius	Spotted Sandpiper	Sp	1	Ob
Tringa solitaria	Solitary Sandpiper	Sp	1	Ob
JACANIDAE (1)				
Jacana jacana	Wattled Jacana	Sp	1	Ob
COLUMBIDAE (9)				
Columbina minuta	Plain-breasted Ground Dove	Og, Rs, Sv	1	Ob, Vc, Vr, Cp
Columbina talpacoti	Ruddy Ground Dove	Og, Rs, Sv, Sw	1	Ob, Vc, Vr, Cp, MPEG
Columbina squammata	Scaled Dove	Og, Rs, Sv	1	Ob, Vc, Vr, Cp, MPEG
Columbina picui	Picui Ground Dove	Og, Rs, Sv	1	Ob, Vc, Vr, Cp
Claravis pretiosa	Blue Ground Dove	Og, Rs, Sv, Sw	2	Ob, Vc
Patagioenas picazuro	Picazuro Pigeon	Sv	2	Ob, Vc
Zenaida auriculata	Eared Dove	Og, Rs, Sv	1	Ob
Leptotila verreauxi	White-tipped Dove	Sv, Sw	2	Ob, Vc, Vr, Cp
Leptotila rufaxilla	Grey-fronted Dove	Sw, Gf, Df	3	Ob, Vc, Vr, Cp
PSITTACIDAE (6)				
Primolius maracana	Blue-winged Macaw	Sv, Sw	2	Ob, Vc, Vr
Aratinga leucophthalma	White-eyed Parakeet	Sw, Gf	2	Ob, Vc, Vr
Aratinga aurea	Peach-fronted Parakeet	Rs, Sw, Gf	1	Ob, Vc, Vr
Forpus xanthopterygius	Blue-winged Parrotlet	Og, Sv	1	Ob, Vc, Vr, Cp
Pionus maximiliani	Scaly-headed Parrot	Og, Sv	2	Ob, Vc, Vr
Amazona aestiva	Blue-fronted Parrot	Sw, Gf, Df	3	Ob, Vc, Vr
CUCULIDAE (8)				
Piaya cayana	Squirrel Cuckoo	Sw, Gf	2	Ob, Vc
Coccyzus melacoryphus	Dark-billed Cuckoo	Sv, Sw	2	Ob
Coccyzus euleri	Pearly-breasted Cuckoo	Sv, Sw	2	Cp, MPEG
Crotophaga major	Greater Ani	Sv, Sw	2	Ob, Vc, Vr
Crotophaga ani	Smooth-billed Ani	Og, Rs, Sv	1	Ob, Vc
Guira guira	Guira Cuckoo	Og, Sv	1	Ob, Vc
Tapera naevia	Striped Cuckoo	Og, Rs, Sv	1	Ob, Vc, Vr, Cp
Dromococcyx phasianellus	Pheasant Cuckoo	Sw, Df	3	Ob, Vc, Vr
TYTONIDAE (1)				
Tyto alba	Barn Owl	Sv, Sw	1	Ob, Vc

Scientific name	English name	Habitat	Habitat use	Type of record
STRIGIDAE (3)				
Megascops choliba	Tropical Screech Owl	Og, Sv	2	Ob, Vc, Vr
Glaucidium brasilianum	Ferruginous Pygmy Owl	Og, Sv, Sw	2	Ob, Vc, Vr
Athene cunicularia	Burrowing Owl	Og, Sv, Sw	1	Ob, Vc, Vr
NYCTIBIIDAE (1)				
Nyctibius griseus	Common Potoo	Sw	2	Ob, Vc, Vr
CAPRIMULGIDAE (3)				
Hydropsalis albicollis	Pauraque	Og, Rs, Sv	2	Ob, Vc, Vr
Hydropsalis parvula	Little Nightjar	Og, Rs, Sv	1	Ob, Vc
Hydropsalis torquata	Scissor-tailed Nightjar	Rs, Sv	1	Ob, Vc, Vr, MPEG
APODIDAE (3)				
Cypseloides senex	Great Dusky Swift	Gf	1	Ob, MPEG
Chaetura brachyura	Short-tailed Swift	Sv, Sw	2	Ob
Tachornis squamata	Fork-tailed Palm Swift	Sw, Gf	1	Ob
TROCHILIDAE (10)				
Phaethornis ruber	Cinnamon-throated Hermit	Sv, Sw, Gf, Df	2	Ob, Cp
Phaethornis pretrei	Planalto Hermit	Sv, Sw, Gf	2	Ob, Cp
Eupetomena macroura	Swallow-tailed Hummingbird	Rs, Sv	1	Ob, Cp
Anthracothorax nigricollis	Black-throated Mango	Rs, Sv, Sw	2	Ob
Chrysolampis mosquitus	Ruby-topaz Hummingbird	Rs, Sv, Sw	1	Ob
Chlorostilbon lucidus	Glittering-bellied Emerald	Og, Rs, Sv	2	Ob, Cp, MPEG
Thalurania furcata	Fork-tailed Woodnymph	Sv, Sw, Gf	2	Ob, Cp
Polytmus guainumbi	White-tailed Goldenthroat	Rs, Sv	1	Ob
Amazilia fimbriata	Glittering-throated Emerald	Sv, Sw	2	Ob, Cp
Heliothryx auritus	Black-eared Fairy	Og, Sv, Sw	3	Ob
TROGONIDAE (1)				
Trogon curucui	Blue-crowned Trogon	Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
ALCEDINIDAE (2)				
Chloroceryle amazona	Amazon Kingfisher	Og, Gf	2	Ob
Chloroceryle americana	Green Kingfisher	Og, Gf	2	Ob
GALBULIDAE (1)				
Galbula ruficauda	Rufous-tailed Jacamar	Sw, Gf	2	Ob, Vc, Vr, Cp, MPEG
BUCCONIDAE (2)				
Nystalus maculatus	Spot-backed Puffbird	Rs, Sv, Sw, Gf	1	Ob, Vc, Vr, Cp, MPEG
Chelidoptera tenebrosa	Swallow-wing	Sv, Sw, Gf	2	Ob, Vc
RAMPHASTIDAE (2)				
Ramphastos toco	Toco Toucan	Sv, Sw, Df	2	Ob, Vc
Pteroglossus inscriptus	Lettered Aracari	Sw, Gf, Df	3	Ob, Vc
PICIDAE (8)				
Picumnus pygmaeus	Spotted Piculet	Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
Melanerpes candidus	White Woodpecker	Og, Rs, Sv	2	Ob, Vc, Vr
Veniliornis passerinus	Little Woodpecker	Sv, Gf	2	Ob, Vc, Vr, Cp, MPEG
Piculus chrysochloros	Golden-green Woodpecker	Sw, Gf, Df	3	Ob, Vc, Vr
Colaptes melanochloros	Green-barred Woodpecker	Sv, Sw, Gf, Df	2	Ob, Vc
Celeus flavescens	Blond-crested Woodpecker	Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
Dryocopus lineatus	Lineated Woodpecker	Sv, Sw, Gf, Df	2	Ob, Vc, Vr
Campephilus melanoleucos	Crimson-crested Woodpecker	Gf, Df	3	Ob, Vc, Vr
THAMNOPHILIDAE (9)				
Formicivora grisea	White-fringed Antwren	Sw	2	Ob, Vc, Vr
Formicivora melanogaster	Black-bellied Antwren	Rs, Sv, Sw	2	Ob, Vc, Vr, Cp, MPEG
Formicivora rufa	Rusty-backed Antwren	Og, Rs	1	Ob, Vc, Vr, Cp, MPEG
Herpsilochmus sellowi	Caatinga Antwren	Sw, Gf, Df	2	Ob, Vc, Vr, Cp, MPEG
Herpsilochmus atricapillus	Black-capped Antwren	Sv, Sw, Gf	3	Ob, Vc, Vr, Cp
Thamnophilus capistratus	Caatinga Antshrike	Rs, Sv, Sw	2	Ob, Vc, Vr, Cp

Scientific name	English name	Habitat	Habitat use	Type of record
Thamnophilus torquatus	Rufous-winged Antshrike	Rs, Sw, Gf	1	Ob, Vc, Vr
Thamnophilus pelzelni	Planalto Slaty Antshrike	Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
Taraba major	Great Antshrike	Sw, Gf	2	Ob, Vc, Vr, Cp
CONOPOPHAGIDAE (1)				
Conopophaga roberti	Hooded Gnateater	Df	3	Ob, Vc, Vr
DENDROCOLAPTIDAE (5)				
Sittasomus griseicapillus	Olivaceous Woodcreeper	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Campylorhamphus trochilirostris	Red-billed Scythebill	Sw, Gf, Df	3	Ob, Vc, Vr
Dendroplex picus	Straight-billed Woodcreeper	Sv, Sw, Gf	2	Ob, Vc, Vr, Cp, MPEG
Lepidocolaptes angustirostris	Narrow-billed Woodcreeper	Og, Rs, Sv, Sw	1	Ob, Vc, Vr, Cp, MPEG
Dendrocolaptes platyrostris	Planalto Woodcreeper	Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
FURNARIIDAE (10)				
Xenops rutilans	Streaked Xenops	Sw, Gf, Df	3	Ob, Vc
Furnarius figulus	Wing-banded Hornero	Rs, Sv	1	Ob, Vc, Vr
Furnarius leucopus	Pale-legged Hornero	Sw, Gf	2	Ob, Vc, Vr
Pseudoseisura cristata	Caatinga Cacholote	Sv, Sw	2	Ob, Vc, Vr
Phacellodomus rufifrons	Rufous-fronted Thornbird	Rs, Sv	2	Ob, Vc, Vr
Certhiaxis cinnamomeus	Yellow-chinned Spinetail	Sv, Sw	1	Ob, Vc
Synallaxis frontalis	Sooty-fronted Spinetail	Gf, Df	3	Ob, Vc, Cp, MPEG
Synallaxis albescens	Pale-breasted Spinetail	Rs, Sv	1	Ob, Vc, Vr
Synallaxis scutata	Ochre-cheeked Spinetail	Sw, Gf	2	Ob, Vc, Cp, MPEG
Cranioleuca vulpina	Rusty-backed Spinetail	Sv, Sw, Gf	1	Ob, Vc
PIPRIDAE (2)				
Neopelma pallescens	Pale-bellied Tyrant-Manakin	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Chiroxiphia pareola	Blue-backed Manakin	Gf, Df	3	Ob, Vc, Vr
TITYRIDAE (6)				
Myiobius atricaudus	Black-tailed Flycatcher	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Tityra inquisitor	Black-crowned Tityra	Gf, Df	3	Ob, Vc
Tityra cayana	Black-tailed Tityra	Sv, Sw, Gf, Df	3	Ob, Vc, Vr
Pachyramphus viridis	Green-backed Becard	Sv, Sw	2	Ob, Vc, Cp, MPEG
Pachyramphus polychopterus	White-winged Becard	Sv, Sw	2	Ob, Vc, Vr
Pachyramphus validus	Crested Becard	Sv, Sw, Df	3	Ob, Vc
COTINGIDAE (1)				
Procnias averano	Bearded Bellbird	Gf, Df	3	Vc
INCERTAE SEDIS (1)				
Platyrinchus mystaceus	White-throated Spadebill	Sw, Df	3	Ob, Vc
RHYNCHOCYCLIDAE (5)				
Leptopogon amaurocephalus	Sepia-capped Flycatcher	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Tolmomyias flaviventris	Yellow-breasted Flycatcher	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Todirostrum cinereum	Common Tody-Flycatcher	Og, Rs, Sv	2	Ob, Vc, Vr
Hemitriccus striaticollis	Stripe-necked Tody-Tyrant	Sv, Sw	2	Ob, Vc, Vr
Hemitriccus margaritaceiventer	Pearly-vented Tody-Tyrant	Og, Sv, Sw, Gf, Df	2	Ob, Vc, Cp, MPEG
TYRANNIDAE (31)				
Hirundinea ferruginea	Cliff Flycatcher	Og, Rs, Sv	2	Ob, Vc
Euscarthmus meloryphus	Tawny-crowned Pygmy Tyrant	Sv, Sw	2	Ob, Vc
Camptostoma obsoletum	Southern Beardless Tyrannulet	Rs, Sv, Sw	1	Ob, Vc, Vr
Elaenia flavogaster	Yellow-bellied Elaenia	Og, Rs, Sv	2	Ob, Vc, Cp, MPEG
Elaenia parvirostris	Small-billed Elaenia	Og, Rs, Sv	1	Ob, Vc, Cp, MPEG
Elaenia cristata	Plain-crested Elaenia	Og, Rs, Sv	1	Ob, Vc, Cp, MPEG
Elaenia chiriquensis	Lesser Elaenia	Og, Rs, Sv	1	Ob, Vc, Cp, MPEG
Suiriri suiriri	Suiriri Flycatcher	Og, Rs, Sv	1	Ob, Vc
Myiopagis viridicata	Greenish Elaenia	Sw, Gf, Df	3	Ob, Vc
Phaeomyias murina	Mouse-coloured Tyrannulet	Sv, Sw	1	Ob, Vc, Cp, MPEG
Myiarchus swainsoni	Swainson's Flycatcher	Og, Rs, Sv	1	Ob, Vc, Cp, MPEG

Scientific name	English name	Habitat	Habitat use	Type of record
Myiarchus ferox	Short-crested Flycatcher	Sw	2	Ob, Vc
Myiarchus tyrannulus	Brown-crested Flycatcher	Og, Rs, Sv	2	Ob, Vc, Cp, MPEG
Casiornis fuscus	Ash-throated Casiornis	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Pitangus sulphuratus	Great Kiskadee	Og, Sv, Sw	1	Ob, Vc, Vr
Machetornis rixosa	Cattle Tyrant	Og, Sv	1	Ob, Vc
Myiodynastes maculatus	Streaked Flycatcher	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Megarynchus pitangua	Boat-billed Flycatcher	Sw, Gf	2	Ob, Vc, Vr
Myiozetetes cayanensis	Rusty-margined Flycatcher	Sw, Gf, Df	3	Ob, Vc, Vr
Myiozetetes similis	Social Flycatcher	Sv, Sw	2	Ob, Vc, Vr
Tyrannus melancholicus	Tropical Kingbird	Og, Sv, Sw	1	Ob, Vc
Tyrannus savana	Fork-tailed Flycatcher	Og, Rs, Sv	1	Ob, Vc
Griseotyrannus aurantioatrocristatus	Crowned Slaty Flycatcher	Sv, Sw	2	Ob, Vc
Empidonomus varius	Variegated Flycatcher	Og, Rs, Sv, Sw	2	Ob, Vc, Cp, MPEG
Myiophobus fasciatus	Bran-coloured Flycatcher	Sw, Gf	1	Ob, Vc
Sublegatus modestus	Southern Scrub Flycatcher	Sv, Sw	2	Ob, Vc
Fluvicola albiventer	Black-backed Water Tyrant	Gf	1	Ob, Vc
Fluvicola nengeta	Masked Water Tyrant	Sp, Gf	1	Ob, Vc
Cnemotriccus fuscatus	Fuscous Flycatcher	Sw, Gf, Df	3	Ob, Vc, Cp, MPEG
Xolmis cinereus	Grey Monjita	Og, Rs, Sv	1	Ob, Vc
Xolmis irupero	White Monjita	Og, Sv	1	Ob, Vc
VIREONIDAE (3)				
Cyclarhis gujanensis	Rufous-browed Peppershrike	Rs, Sv, Sw	2	Ob, Vc, Vr
Vireo olivaceus	Red-eyed Vireo	Sv, Sw, Gf, Df	3	Ob, Vc, Vr
Hylophilus poicilotis	Rufous-crowned Greenlet	Gf, Df	3	Ob, Vc, Vr
CORVIDAE (2)				
Cyanocorax cristatellus	Curl-crested Jay	Rs, Sv	1	Ob, Vc, Vr
Cyanocorax cyanopogon	White-naped Jay	Sv, Sw, Gf, Df	2	Ob, Vc, Vr
HIRUNDINIDAE (2)				
Stelgidopteryx ruficollis	Southern Rough-winged Swallow	Rs, Sv	1	Ob, Vc
Progne chalybea	Grey-breasted Martin	Og, Sv	1	Ob, Vc
TROGLODYTIDAE (3)				
Troglodytes musculus	Southern House Wren	Sv, Sw	1	Ob, Vc, Vr
Pheugopedius genibarbis	Moustached Wren	Gf, Df	3	Ob, Vc, Vr
Cantorchilus longirostris	Long-billed Wren	Sv, Sw, Gf	3	Ob, Vc, Vr
DONACOBIIDAE (1)				
Donacobius atricapilla	Black-capped Donacobius	Sp	1	Ob, Vc
POLIOPTILIDAE (1)				
Polioptila plumbea	Tropical Gnatcatcher	Sv, Sw	2	Ob, Vc, Vr
TURDIDAE (3)				
Turdus rufiventris	Rufous-bellied Thrush	Sw, Gf	1	Ob, Vc, Vr
Turdus leucomelas	Pale-breasted Thrush	Sw, Gf	2	Ob, Vc, Vr, Cp, MPEG
Turdus amaurochalinus	Creamy-bellied Thrush	Sv, Sw	2	Ob, Vc, Vr
MIMIDAE (1)				
Mimus saturninus	Chalk-browed Mockingbird	Og, Rs, Sv	1	Ob, Vc, Vr
MOTACILLIDAE (1)				
Anthus lutescens	Yellowish Pipit	Og, Rs	1	Ob, Vc
COEREBIDAE (1)				
Coereba flaveola	Bananaquit	Rs, Sv, Sw	2	Ob, Vc, Vr, Cp, MPEG
THRAUPIDAE (15)				
Saltatricula atricollis	Black-throated Saltator	Sv, Sw	1	Ob, Vc, Vr
Compsothraupis loricata	Scarlet-throated Tanager	Sv, Sw	2	Ob, Vc, Vr, Cp, MPEG
Nemosia pileata	Hooded Tanager	Sv, Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
Thlypopsis sordida	Orange-headed Tanager	Sv, Sw	2	Ob, Vc
Cypsnagra hirundinacea	White-rumped Tanager	Rs, Sv	1	Ob, Vc, Vr

Scientific name	English name	Habitat	Habitat use	Type of record
Tachyphonus rufus	White-lined Tanager	Sv, Sw, Gf	3	Ob, Vc, Vr, Cp, MPEG
Ramphocelus carbo	Silver-beaked Tanager	Sv, Sw	2	Ob, Vc
Lanio pileatus	Pileated Finch	Og, Rs, Sv	2	Ob, Vc, Vr, Cp, MPEG
Tangara sayaca	Sayaca Tanager	Sw, Gf	2	Ob, Vc
Tangara palmarum	Palm Tanager	Sw, Gf	2	Ob, Vc
Tangara cayana	Burnished-buff Tanager	Sv, Sw	1	Ob, Vc
Schistochlamys ruficapillus	Cinnamon Tanager	Og, Rs, Sv	1	Ob, Vc, Vr
Paroaria dominicana	Red-cowled Cardinal	Og, Rs, Sv	1	Ob, Vc, Vr
Dacnis cayana	Blue Dacnis	Sw, Gf	2	Ob, Vc
Hemithraupis guira	Guira Tanager	Sv, Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
Conirostrum speciosum	Chestnut-vented Conebill	Sw, Gf, Df	3	Ob, Vc
EMBERIZIDAE (10)				
Zonotrichia capensis	Rufous-collared Sparrow	Og, Rs, Sv	1	Ob, Vc, Vr
Ammodramus humeralis	Grassland Sparrow	Og, Rs, Sv	1	Ob, Vc, Vr
Sicalis flaveola	Saffron Finch	Og, Rs, Sv	1	Ob, Vc, Vr
Emberizoides herbicola	Wedge-tailed Grass Finch	Og	1	Ob, Vc, Vr
Volatinia jacarina	Blue-black Grassquit	Og, Rs, Sv	1	Ob, Vc
Sporophila plumbea	Plumbeous Seedeater	Og, Rs, Sv	1	Ob, Vc
Sporophila albogularis	White-throated Seedeater	Og, Rs, Sv	1	Ob, Vc, Vr
Sporophila angolensis	Chestnut-bellied Seed Finch	Og, Rs, Sv	1	Ob, Vc, Vr
Tiaris fuliginosus	Sooty Grassquit	Df	3	Ob, MPEG
Arremon taciturnus	Pectoral Sparrow	Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
CARDINALIDAE (2)				
Piranga flava	Hepatic Tanager	Sv, Rs, Sw	1	Ob, Vc, Vr
Cyanoloxia brissonii	Ultramarine Grosbeak	Gf, Df	3	Ob, Vc, Vr
PARULIDAE (2)				
Basileuterus culicivorus	Golden-crowned Warbler	Sw, Gf	3	Ob, Vc, Vr
Basileuterus flaveolus	Flavescent Warbler	Sw, Gf, Df	3	Ob, Vc, Vr, Cp, MPEG
ICTERIDAE (8)				
Psarocolius decumanus	Crested Oropendola	Sw, Gf, Df	3	Ob, Vc, Vr
Cacicus cela	Yellow-rumped Cacique	Sw, Gf, Df	3	Ob, Vc, Vr, MPEG
Icterus cayanensis	Epaulet Oriole	Sv, Sw, Gf	2	Ob, Vc, Vr
Icterus jamacaii	Campo Troupial	Sv, Sw, Gf	2	Ob, Vc, Vr
Gnorimopsar chopi	Chopi Blackbird	Sw	1	Ob, Vc, Vr
Chrysomus ruficapillus	Chestnut-capped Blackbird	Og, Sv	1	Ob, Vc
Agelaioides badius	Bay-winged Cowbird	Rs, Sv	1	Ob, Vc
Molothrus bonariensis	Shiny Cowbird	Og, Rs, Sv, Sw	1	Ob, Vc
FRINGILLIDAE (1)				
Euphonia chlorotica	Purple-throated Euphonia	Sw, Gf	2	Ob, Vc, Vr, Cp, MPEG
PASSERIDAE (1)				
Passer domesticus	House Sparrow	Sv	1	Ob, Vc