The avifauna of the Catimbau National Park, an important protected area in the Brazilian semiarid

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ABSTRACT: The Catimbau National Park is a protected area, located within the Caatinga Dry Forest, in the central region of the Brazilian state of Pernambuco. This protected area encompasses ~60,000 ha of an exceptional diversity of habitats, resulting in a high avian diversity, including several rare and endemic species. The park is considered an area of high biological importance and of conservation priority. Despite its relevance for conservation, human degradation due to chronic anthropogenic disturbances (hunting, birds trapping, selective logging, and livestock grazing) has modified the park’s natural environments. In 2014, we initiated avian inventories within the park, as part of a long-term ecological research (LTER). Although the avifauna of the park has been described before, our systematic surveys allowed us to have a better understating of the park’s avifauna and resulted in several additions to the species list. Here, we update and reevaluate the park’s avifauna, discuss the presence of resident and migratory species, and include comments on endemic and rare species that occur within the park’s boundaries. We sampled the avifauna through systematic surveys (point counts) and opportunistic observations between 2014 and 2017, including both dry and rainy seasons. We recorded a total of 192 species, including 25 species new to the park’s list. During our point counts, we detected 117 species in the dry season, whereas 34 were recorded exclusively during the rainy season. Nearly 10% of the park’s avifauna (19 species) is represented by migratory species, such as *Elaenia chilensis* and *Turdus amaurochalinus*. Catimbau National Park is important for the conservation of the Caatinga avifauna, since it harbors endemic, range-restricted, migratory, and globally threatened species. Therefore, we emphasize that environmental education and ecological restoration projects, allied to enforcing environmental laws are urgent for the maintenance of biodiversity and ecosystem services in the Catimbau National Park.

KEY-WORDS: Caatinga, long-term ecological research, migratory birds, Neotropical Dry Forests, ornithological inventory.

INTRODUCTION

The Caatinga Domain (hereafter, Caatinga) represents the largest patch of Seasonally Dry Tropical Forest in the Neotropics (Pennington et al. 2000). Far from representing a single vegetational type, the Caatinga is highly heterogeneous, presenting a wide diversity of ecosystems and habitats. Different combinations of soil, relief, topography and rainfall regimes create a wide variety of habitats (Egler 1951, Sarmiento 1975, Andrade-Lima 1981, Leal et al. 2003). Much of this variation can be found at one particular protected area in the Caatinga: the Catimbau National Park (hereafter, CNP). This exceptional diversity of habitats results in a high diversity of bird species, including several rare and endemic, which is one of the reasons the park is considered an area of high biological importance and of conservation priority (Devenish et al. 2009, Menezes et al. 2012).

Unfortunately, much of the degradation observed within the Caatinga, where over 63% of its area has already been modified by human activities (Pennington et al. 2009, Araújo & Silva 2017, Silva & Barbosa 2017) is also evident at the CNP. The park faces many chronic anthropogenic disturbance pressures as a result of the nearly 300 families that live within the park and depend on livestock grazing and logging to survive (Rito et al. 2017, Arnan et al. 2018). Also, the absence of a well-designed management plan, mandatory by Brazilian law (SNUC 2002), reflects negatively on the overall conservation of the National Park. At present, CNP presents many degraded areas with different histories of human land use (Cruz et al. 2017, MMA 2018a).

Given the remarkable habitat heterogeneity found at the park, the relatively large topographic variation (500–1100 m), and the rainfall gradient within such a small area (650–1100 mm/yr), Catimbau National Park was selected to establish a Long-term Ecological Research (LTER) Program (http://www.peldcatimbau.org). The
main purpose of Catimbau’s LTER site is to evaluate how chronic anthropogenic disturbances and changes in rainfall regime affect the biota. A total of 20 permanent plots were established, covering most of the topographical, environmental, and anthropogenic disturbance gradient, offering a unique opportunity to understand patterns of diversity in many different biological groups (Rito et al. 2017). Each biological group studied relied on a different sample scheme, depending on the spatial scale desired. To study the avifauna, we established 2 km transects around each one of the 20 permanent plots, sampled by 10 point counts, systematically established every 200 m.

The avifauna of the CNP is relatively well known due to past surveys (Farias 2009, Sousa et al. 2012). The first ornithologist to present a species list of the park’s avifauna, based on non-systematic inventories and opportunistic observations, included 139 species (Farias 2009). A few years later, Sousa et al. (2012) presented a more complete list of the park’s avifauna, updating the park’s list to 202 species, including important endemic and threatened species, such as Penelope jacucaca and Spinus yarrellii.

In this study, we present the results of three years (2014–2017) of systematic surveys conducted around 20 sites distributed throughout the park, and opportunistic observations conducted elsewhere within the park. We also present a new updated list of the avifauna of the CNP, with relevant information about the avian community, with important records of threatened, migratory, and endemic species. We also provide ecological aspects of species richness and patterns of species composition, highlighting the potential threats found in this protected area and its importance for the conservation of Caatinga birds.

METHODS

Study area

The Catimbau National Park (~60,000 ha), created by a federal decree on 13 December 2002, is a protected area located within three municipalities (Buíque, Tupanatinga and Ibimirim) in the central region of the Brazilian state of Pernambuco (between 8°24’00’’ and 8°36’35’’S; 37°0’30’’ and 37°1’40’’W) (Fig. 1). Climate is classified as tropical semiarid, according to Koeppen’s classification; showing a mean annual temperature of 23°C, with a great inter-annually irregularity in rainfall regimes, which vary from 650 to 1100 mm/year (SNE 2002).

This protected area is located within the Caatinga Domain, a Seasonally Dry Tropical Forest. Most of the park (70%) is composed of old-growth vegetation in sandy soils, with five main phytosociognomies with distinct vegetation structure and floras, including i) shrubby-arboreal Caatinga generally located on the leeward slopes and at altitudes between 600 and 800 m a.s.l., ii) shrubby Caatinga with Cerrado elements can be found in many sites of the Chapada São José, both in lower and surrounding areas of the hills and slopes, iii) shrubby Caatinga with elements of rocky fields (campos rupestres) occur in the plateaus and mountain ranges (800 and 1100 m a.s.l.), iv) evergreen arboreal vegetation (brejos de altitude) at the foothills, and v) evergreen shrubby Caatinga located on windward slopes between 600 and 800 m a.s.l. (Rodal et al. 1998, SNE 2002). Systematic and opportunistic methodologies were conducted in these phytosociognomies, as well as in aquatic environments (lagoons, ponds and temporary pools) found at the CNP (Fig. 2).

Bird survey and analyses

We conducted avian surveys at the CNP between August 2014 and August 2017, including both the dry and the rainy seasons. We surveyed the avifauna using point counts with unlimited detection radius (Ralph et al. 1996, Bibby et al. 2000, Sutherland et al. 2004). CNP hosts 20 LTER permanent sites (plots), spatially established to remain independent from one another and to account for the climatic and land use variation found at the park (Table 1, Fig. 1). Around each of these 20 sites, we established 2 km-long transects, which we sampled conducting point counts, which were systematically distributed every 200 m, totaling 10 point counts per site and 200 in the park. All localities and point-counts were geo-referenced using a Garmin GPS unit (GPSMAP64). We sampled each point count during 10 min, when all birds detected by sight or sound were recorded. Each site was sampled three times, once during the dry season and twice during the rainy season, totaling 600 point counts. Besides our systematic surveys, we conducted opportunistic observations between point counts and throughout the park’s entire area.

Birds were identified by sight and sound by an experienced observer (FMGLC). We used binoculars and digital recorders to observe and document species presence in the area. Taxonomy and nomenclature follow the Brazilian Committee of Ornithological Records (Picentini et al. 2015). Species were classified according to their conservation and distribution status. Patterns of endemism (Caatinga and northeast Brazil endemics) were based on Pacheco (2004) and Aratijú & Silva (2017). Threatened species were defined according to Brazilian (MMA 2018b) and international red lists (IUCN 2019). Migration status follows Somenzari et al. (2018), who revised migratory patterns for Brazilian birds.

For habitat we used the five types as described by

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Table 1. Permanent plots from the Long-Term Ecological Research (LTER) PELD Catimbau, Brazil.

| LTER Sites | Geographic coordinates | Annual mean precipitation (mm) | Altitude (m a.s.l.) |
|------------|------------------------|-------------------------------|-------------------|
| P02        | -37.1968 -8.5313       | 647                           | 703.0             |
| P04        | -37.3551 -8.5072       | 591                           | 692.2             |
| P07        | -37.3973 -8.5554       | 516                           | 559.8             |
| P08        | -37.2993 -8.4496       | 578                           | 665.9             |
| P10        | -37.2301 -8.5354       | 647                           | 705.4             |
| P11        | -37.2248 -8.5167       | 673                           | 719.8             |
| P14        | -37.3046 -8.4278       | 540                           | 623.3             |
| P15        | -37.3174 -8.4133       | 510                           | 577.8             |
| P16        | -37.3259 -8.4658       | 555                           | 650.6             |
| P17        | -37.2329 -8.5581       | 940                           | 836.8             |
| P20        | -37.3222 -8.4854       | 653                           | 733.3             |
| P21        | -37.2963 -8.5209       | 843                           | 876.2             |
| P22        | -37.3428 -8.4831       | 552                           | 660.8             |
| P23        | -37.3118 -8.5178       | 785                           | 842.1             |
| P25        | -37.238 -8.4757        | 588                           | 655.2             |
| P26        | -37.2346 -8.4942       | 645                           | 698.5             |
| P27        | -37.277 -8.5113        | 903                           | 965.5             |
| P28        | -37.3096 -8.5372       | 787                           | 829.4             |
| P29        | -37.2475 -8.5708       | 762                           | 772.6             |
| P30        | -37.2449 -8.5166       | 913                           | 960.6             |

Figure 1. Location of Catimbau National Park, Pernambuco, Brazil. Distribution of the 20 plots used for bird sampling with point counts in PELD Catimbau.
Figure 2. General view of phytosociognomies and landscapes found at Catimbau National Park, Pernambuco, Brazil. (A) shrubby-arboreal Caatinga; (B) shrubby Caatinga with Cerrado elements; (C) shrubby Caatinga with rocky fields elements (Campos Rupestres); (D) evergreen arboreal vegetation; (E) evergreen shrubby Caatinga; (F) aquatic environment available during the rainy season. Photo author: F.M.G. Las-Casas.
Table 2. List of bird species recorded at the Catimbau National Park, Pernambuco, Brazil. Species recorded by Sousa et al. (2012), and not by us (#). New records for the park during the present study (*). Migratory species (MG) and partially migratory (PM). Undefined endemic (End): Caatinga endemic (EC), endemic northeast (EN). Threatened (Thr): “Near Threatened” (NT; IUCN 2019), “Vulnerable” (VU; MMA 2018). Habitat: aquatic environment (AE), shrubby Caatinga (SA), shrubby Caatinga with Cerrado elements (SC), shrubby Caatinga and rocky fields (RC), evergreen arboreal Caatinga (EA), evergreen shrubby Caatinga (ES).

| Family and species | English names                  | End/Thr | Habitats                  | Documentation |
|--------------------|--------------------------------|---------|---------------------------|---------------|
| **TINAMIDAE**      |                                |         |                           |               |
| Crypturellus noctivagus zabele# | Yellow-legged Tinamou         | EN/VU, NT |                           |               |
| Crypturellus parvirostris | Small-billed Tinamou         |         | SA/SC/EA/ES               |               |
| Crypturellus tataupa | Tataupa Tinamou              |         | SA/SC/EA/ES               |               |
| Nothura boraquira  | White-bellied Norhura         |         | SA/ES                     |               |
| Nothura maculosa   | Spotted Norhura               |         | SA                        |               |
| Rhynchotus rufescens# | Red-winged Tinamou         |         |                           |               |
| **ANATIDAE**       |                                |         |                           |               |
| Dendrocygna viduata | White-faced Whistling-Duck    |         | AE                        | WA2919491     |
| Cairina moschata#  | Muscovy Duck                  |         |                           |               |
| Amazonetta brasiensis# | Brazilian Teal            |         |                           |               |
| **CRACIDAE**       |                                |         |                           |               |
| Penelope superciliaris ochromitra* | Rusty-margined Guan     | EN       | EA/ES                     |               |
| Penelope jacucaca# | White-browed Guan            |         | EC/VU                     |               |
| Ortalis arauacan   | East Brazilian Chachalaca     |         | AE                        |               |
| **PODICIPEDIDAE**  |                                |         |                           |               |
| Tachybaptus dominicus* | Least Grebe                  |         | AE                        |               |
| Podilymbus podiceps# | Pied-billed Grebe           |         |                           |               |
| **PHALACROCORACIDAE** |                            |         |                           |               |
| Nannopterus Brasilianus# | Neotropic Cormorant       |         |                           |               |
| **ARDEIDAE**       |                                |         |                           |               |
| Tigrisoma lineatum# | Rufescent Tiger-Heron         |         |                           |               |
| Nycticorax nycticorax# | Black-crowned Night-Heron  |         |                           |               |
| Butorides striata# | Striated Heron               |         |                           |               |
| Bubulcus ibis      | Cattle Egret                 |         | SA                        |               |
| Ardea alba         | Great Egret                  |         | AE                        |               |
| Egretta thula      | Snowy Egret                  |         | AE                        |               |
| **CATHARTIDAE**    |                                |         |                           |               |
| Cathartes aura     | Turkey Vulture               |         | SA/SC/RC/EA/ES            | WA2104773     |
| Cathartes burrovianus | Lesser Yellow-headed Vulture |         | SA/SC/RC/EA/ES            | WA2104774     |
| Coragyps atratus   | Black Vulture                |         | SA/SC/RC/EA/ES            |               |
| Sarcoramphus papa* | King Vulture                 |         | SA/SC/RC/EA/ES            | WA1467218     |
| **ACCIPITRIDAE**   |                                |         |                           |               |
| Gampsonyx swainsonii | Pearl Kite                 |         | SA/ES                     | WA1874623     |
| Elanus leucurus    | White-tailed Kite            |         | SA                        |               |
| Ictinia plumbea#   | Plumbeous Kite               |         |                           |               |
| Geranospiza caerulescens | Crane Hawk              |         | SA                        |               |
| Family and species          | English names             | End/Thr | Habitats | Documentation |
|----------------------------|---------------------------|---------|----------|---------------|
| Heterospizias meridionalis* | Savanna Hawk              | SA      |          |               |
| Urubitinga urubitinga*     | Great Black Hawk          | SA      |          |               |
| Rupornis magnirostris      | Roadside Hawk             | SA/SC/RC/EA/ES | WA2427047 |
| Parabuteo unicinctus*      | Harris’s Hawk             | SA      |          | WA2560060     |
| Geranoaetus albicaudatus    | White-tailed Hawk         | SA      |          |               |
| Geranoaetus melanoleucus    | Black-chested Buzzard-Eagle| SA/RC   |          | WA2101247     |
| Buteo nitidus              | Gray-lined Hawk           | SA      |          |               |
| Buteo brachyurus           | Short-tailed Hawk         | SA/EA   |          |               |
| Buteo albonotatus*         | Zone-tailed Hawk          | SA      |          |               |
| **RALLIDAE**               |                           |         |          |               |
| Aramides mangle*           | Little Wood-Rail          |         |          |               |
| Aramides cajaneus*         | Gray-necked Wood-Rail     |         |          |               |
| Pardirallus nigricans*     | Blackish Rail             |         |          |               |
| Gallinula galeata          | Common Gallinule          | AE      |          |               |
| Porphyriops melanops       | Spot-flanked Gallinule    | AE      |          |               |
| Porphyrio martinicus*      | Purple Gallinule          | AE      |          | WA2951832     |
| **CHARADRIIDAE**           |                           |         |          |               |
| Vanellus chilensis         | Southern Lapwing          | SA      |          |               |
| **RECURVIROSTRIDAE**       |                           |         |          |               |
| Himantopus mexicanus*      | Black-necked Stilt        |         |          | WA2490975     |
| **JACANIDAE**              |                           |         |          |               |
| Jacana jacana              | Wattled Jacana            | AE      |          |               |
| **COLUMBIDAE**             |                           |         |          |               |
| Columbina minuta           | Plain-breasted Ground-Dove| SA/EA/ES/SC |          |               |
| Columbina talpacoti        | Ruddy Ground-Dove         | EA/ES   |          |               |
| Columbina squammata        | Scaled Dove               | SA/EA/ES/SC |          |               |
| Columbina picui            | Picui Ground-Dove         | SA/EA/ES/SC |          | WA1471673     |
| Claravis pretiosa*         | Blue Ground-Dove          | SA      |          |               |
| Columba livia*             | Rock Pigeon               |         |          |               |
| Patagioenas picazuro       | Picazuro Pigeon           | SA/EA/ES |          |               |
| Zenaida auriculata         | Eared Dove                | SA      |          | WA2723505     |
| Leptotila verreauxi        | White-tipped Dove         | SA/EA/ES/SC |          |               |
| Leptotila rufascilla       | Gray-fronted Dove         | EA      |          |               |
| **CUCULIDAE**              |                           |         |          |               |
| Micrococos cinereus*       | Ash-colored Cuckoo        | SA      |          |               |
| Piaya cayana               | Squirrel Cuckoo           | SA/EA/ES/SC |          | WA2106950     |
| Coccyzus melacoryphus*     | Dark-billed Cuckoo        | SA/EA/ES/SC |          | WA2850701     |
| Crotophaga major*          | Greater Ani               |         |          |               |
| Crotophaga ani             | Smooth-billed Ani         | SA      |          |               |
| Guira guira                | Guira Cuckoo              | SA      |          | WA2049012     |
| Tapera naevia              | Striped Cuckoo            | SA      |          |               |
| **TYTONIDAE**              |                           |         |          |               |
| Tyto furcata               | American Barn Owl         | SA      |          |               |
| Family and species       | English names             | End/Thr | Habitats | Documentation |
|-------------------------|---------------------------|---------|----------|---------------|
| **STRIGIDAE**           |                           |         |          |               |
| *Megascops choliba*     | Tropical Screech-Owl      |         | SA       |               |
| *Glaucidium brasilianum*| Ferruginous Pygmy-Owl     | SA/EA/ES| WA2677373|               |
| *Athene cunicularia*    | Burrowing Owl             |         | SA       | WA2290250     |
| **NYCTIBIIDAE**         |                           |         |          |               |
| *Nyctibius griseus*     | Common Potoo              |         | SA       |               |
| **CAPRIMULGIDAE**       |                           |         |          |               |
| *Antrostomus rufus*     | Rufous Nightjar           |         |          |               |
| *Nyctidromus albicollis*| Common Pauraque           |         | SA       |               |
| *Nyctidromus hirundinaceus*|                       | Pygmy Nightjar |         | SA          |
| *Hydropsalis parvula*   | Little Nightjar           |         | SA       | WA2723643     |
| *Hydropsalis longirostris*| Band-winged Nightjar     |         | SA       |               |
| *Hydropsalis torquata*  | Scissor-tailed Nightjar   |         | SA       |               |
| *Nannochordeiles pusillus novaesi*|               | Least Nighthawk |         | EN          |
| *Chordeiles acutipennis*| Lesser Nighthawk          |         |          |               |
| **APODIDAE**            |                           |         |          |               |
| *Tachornis squamata*    | Fork-tailed Palm-Swift    |         | SA/EA    |               |
| **TROCHILIDAE**         |                           |         |          |               |
| *Anopetia gounellei*    | Broad-tipped Hermit       |         | EC       | SA/ES         |
| *Phaethornis pretrei*   | Planalto Hermit           |         | SA/EA/ES |               |
| *Eupetomena macroura*   | Swallow-tailed Hummingbird|         |          | WA1989371     |
| *Anthracothorax nigricollis*| Black-throated Mango  |         |          |               |
| *Chrysolampis mosquitus*| Ruby-topaz Hummingbird   |         |          | WA1874630     |
| *Chlorostilbon lucidus* | Glittering-bellied Emerald|         |          | WA2918587     |
| *Polytmus guainumbi*    | White-tailed Goldenthroat|         |          |               |
| *Amazilia fimbriata*    | Glittering-throated Emerald|               |         | WA2490872     |
| *Amazilia lactea*       | Sapphire-spangled Emerald |         |          |               |
| *Heliomaster squamosus* | Stripe-breasted Starthroat|         |          | WA2918598     |
| **TROGONIDAE**          |                           |         |          |               |
| *Trogon curucui*        | Blue-crowned Trogon       |         | SA/EA/ES | WA3273333     |
| **ALCEDINIDAE**         |                           |         |          |               |
| *Chloroceryle americana*| Green Kingfisher          |         |          |               |
| **BUCCONIDAE**          |                           |         |          |               |
| *Nystalus maculatus*    | Spot-backed Puffbird      |         |          | WA2346838     |
| **PICIDAE**             |                           |         |          |               |
| *Picumnus fulvescens*   | Tawny Piculet             | EN/NT   |          | WA2687064     |
| *Veniliornis passerinus*| Little Woodpecker         |         |          |               |
| *Piculus chrysocloros*  | Golden-green Woodpecker   |         |          |               |
| *Colaptes melanochloros*| Green-barred Woodpecker   |         |          |               |
| **CARIAMIDAE**          |                           |         |          |               |
| *Cariama cristata*      | Red-legged Seriema        |         |          |               |
| **FALCONIDAE**          |                           |         |          |               |
| *Caracara plancus*      | Southern Caracara         |         | SA/SC    |               |
| *Milvago chimachima*    | Yellow-headed Caracara    |         | SA/SC    |               |

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| Family and species | English names | End/Thr | Habitats | Documentation |
|--------------------|--------------|---------|----------|---------------|
| Herpetotheres cachinnans | Laughing Falcon | SA/SC/EA/ES | | WA1635330 |
| Micrastur ruficollis | Barred Forest-Falcon | SA/SC/EA/ES | | |
| Falco sparverius | American Kestrel | SA/SC/EA/ES | | |
| Falco rustigulus | Bat Falcon | RC | | |
| Falco femoralis | Aplomado Falcon | SA/SC/EA/ES | | |
| Falco peregrinus* | Peregrine Falcon | SA/ES | | |
| PSITTACIDAE | | | | |
| Primolius manacana* | Blue-winged Macaw | | | |
| Thoecocerus acuticaudatus haemorrhous | Blue-crowned Parakeet | EN | SA/ES | |
| Eupsittula cactorum | Cactus Parakeet | EC | SA/SC/RC/EA/ES | WA2106953 |
| Forpus xanthopterygius | Blue-winged Parrotlet | SA/SC/EA/ES | | WA1989370 |
| Amazona aestiva | Turquoise-fronted Parrot | SA/EA/ES | | |
| THAMNOPHILIDAE | | | | |
| Myrmochilus strigalis | Stripe-backed Antbird | EN | SA/SC/RC | |
| Formicivora melanogaster bahiae | Black-bellied Antwren | EN | SA/SC/RC/EA/ES | WA1467784 |
| Herpsilochmus sellowii* | Caatinga Antwren | EN | SA/RC | WA2113554 |
| Herpsilochmus atricapillus* | Black-capped Antwren | | | |
| Sakesphorus cristatus | Silvery-cheeked Antshrike | EC | SA/SC/RC | WA2850912 |
| Thamnophilus capistratus | Caatinga Antshrike | EC | SA/SC/RC | WA2851005 |
| Thamnophilus torquatus | Rufous-winged Antshrike | | | |
| Thamnophilus pelzelni | Planalto Slaty-Antshrike | SA/SC/EA/ES | | |
| Taraba major | Great Antshrike | SA/SC/RC/ES | | |
| GRALLARIIDAE | | | | |
| Hyllopezus ochroleucus | White-browed Antpitta | EC/NT | SA/SC/RC/EA/ES | WA2308551 |
| DENDROCOLAPTIONIDAE | | | | |
| Sittasomus griseicapillus* | Olivaceous Woodcreeper | | | |
| Campylorhampus trochilorostris | Red-billed Serythbill | | SA | |
| Dendroplex picus* | Straight-billed Woodcreeper | | SA | |
| Lepidocolaptes angustirostris | Narrow-billed Woodcreeper | SA/SC/RC/EA/ES | | WA2490963 |
| FURNARIIDAE | | | | |
| Furnarius figulus | Wing-banded Hornero | SA | | |
| Furnarius leucopus | Pale-legged Hornero | SA/ES | | |
| Pseudoseisura cristata | Caatinga Cacholote | EN | SA | |
| Phacellodomus rufifrons rufifrons/ specularis | Rufous-fronted Thornbird | EN | SA/SC/EA/ES | |
| Certhiaxis cinnamomeus | Yellow-chinned Spinetail | | SA/SC/RC | |
| Synallaxis bellmayri | Red-shouldered Spinetail | EC | SA/SC/RC | |
| Synallaxis frontalis | Sooty-fronted Spinetail | SA/SC/RC | | |
| Synallaxis albecens | Pale-breasted Spinetail | SA | | |
| Synallaxis hypsopodia* | Cinereous-breasted Spinetail | | | |
| Synallaxis scutata* | Ochre-checkered Spinetail | | | |
| Cranioleuca semicinerea | Gray-headed Spinetail | SA/EA/ES | | |
| Family and species | English names | End/Thr | Habitats | Documentation |
|--------------------|---------------|---------|----------|---------------|
| **TITYRIDAE**      |               |         |          |               |
| Pachyramphus viridis | Green-backed Becard | SA/SC |         |               |
| Pachyramphus polychropterus<sup>PM</sup> | White-winged Becard | SA/SC/ES |         | WA2918602     |
| Pachyramphus validus<sup>PM</sup> | Crested Becard |         |         |               |
| Xenopsarci albinucha | White-naped Xenopsaris | SA |         | WA2491020     |
| **RHYNCHOCYCLIDAE** |               |         |          |               |
| Tolmomyias flaviventris | Yellow-breasted Flycatcher | SA/SC/EA/ES |         |               |
| Todirostrum cinereum | Common Tody-Flycatcher | SA/SC/RC/ES |         |               |
| Hemitriccus margaritaceiventer | Pearly-vented Tody-tyrant | SA/SC/RC |         | WA2101248     |
| **TYRANNIDAE**     |               |         |          |               |
| Hirundinea ferruginea | Cliff Flycatcher | SA/RC |         | WA2288299     |
| Stigmatura napensis bahiae | Lesser Wagtail-Tyrant | EN | SA/SC | WA2678822     |
| Eucarthus melopyrus | Tawny-crowned Pygmy-Tyrant | SA/SC/RC |         |               |
| Camptostoma obsoletum | Southern Bearded-Tyrannulet | SA/SC/RC/EA/ES |         | WA2347009     |
| Elaenia flavogaster | Yellow-naped Elaenia | EA/ES |         |               |
| Elaenia spectabilis<sup>PM</sup> | Large Elaenia | SA/SC/RC/ES |         |               |
| Elaenia chilensis<sup>MC</sup> | Chilean Elaenia | SA/SC/RC/ES |         | WA2677969     |
| Suiriri suiriri bahiae* | Suiriri Flycatcher | EN | SA | WA1874629     |
| Myiopagis viridicata<sup>PM</sup> | Greenish Elaenia | SA/SC/ES |         |               |
| Phaeomyias murina<sup>ND</sup> | Mouse-colored Tyrannulet | SA/SC/RC/ES |         | WA2850711     |
| Phyllomyias fasciatus cearensis | Planalto Tyrannulet | EN | SA/SC/ES |               |
| Serpophaga subcrisata* | White-crested Tyrannulet | SA/ES |         | WA2678868     |
| Myiarchus swainsoni<sup>PM</sup> | Swainson's Flycatcher | SA |         |               |
| Myiarchus ferox | Short-crested Flycatcher | EA/ES |         |               |
| Myiarchus tyrannulus | Brown-crested Flycatcher | SA/SC/RC/EA/ES |         | WA1989368     |
| Casiornis fuscus<sup>PM</sup> | Ash-throated Casiornis | SA/ES |         | WA2490796     |
| Pitangus sulphuratus | Great Kiskadee | SA/SC/ES |         |               |
| Machetornis rixosa | Cattle Tyrant | SA/ES |         |               |
| Myiodynastes maculatus<sup>PM</sup> | Streaked Flycatcher | SA/ES |         | WA2490928     |
| Megarynchus pitangus | Boat-billed Flycatcher | SC/EA/ES |         |               |
| Myiozetetes similis | Social Flycatcher | SA/SC/EA |         |               |
| Tyrannus melancholicus | Tropical Kingbird | SA/SC/RC/EA/ES |         |               |
| Tyrannus savana<sup>PM</sup> | Fork-tailed Flycatcher | SA |         |               |
| Empidonomas varius<sup>PM</sup> | Variegated Flycatcher | SA/SC/RC/EA/ES |         | WA2851003     |
| Myiophobus fasciatus<sup>PM</sup> | colored Flycatcher | SA/SC/RC/ES |         |               |
| Sublegatus modestus<sup>PM</sup> | Southern Scrub-Flycatcher | SA/ES |         |               |
| Fluvicola albiventris | Black-backed Water-Tyrant | AE |         | WA2918597     |
| Fluvicola nengeta | Masked Water-Tyrant | SA/ES |         | WA2288334     |
| Arundinaria leucocephala | White-headed Marsh Tyrant | AE |         | WA1635342     |
| Cnemotrichus fuscatus | Fuscosus Flycatcher | SA/SC/EA/ES |         |               |
| Knipeleus nigerrimus hoflingi | Velvety Black-Tyrant | EN | SA/RC | WA2918592     |
| Xolmis irupero niveus | White Monjita | EN | SA |               |
| Family and species | English names | End/Thr | Habitats | Documentation |
|--------------------|---------------|---------|----------|---------------|
| **VIREONIDAE**     |               |         |          |               |
| *Cyclarhis gujanensis* | Rufous-browed Peppershrike | SA/SC/RC/ES |          |               |
| *Hylophilus amaurocephalus* | Gray-eyed Greenlet | SA/SC/RC/ES |          |               |
| *Vireo chivi*<sup>PM</sup> | Chivi Vireo | SA/SC/RC/ES |          |               |
| **CORVIDAE**       |               |         |          |               |
| *Cyanocorax cyanopogon* | White-naped Jay | SA/SC/RC/ES |          |               |
| **HIRUNDINIDAE**   |               |         |          |               |
| *Stelgidopteryx ruficollis*<sup>PM</sup> | Southern Rough-winged Swallow | SA/SC/RC/ES |          |               |
| *Progne chalybea*<sup>PM</sup> | Gray-breasted Martin | SA |          |               |
| **TROGLODYTIDAE**  |               |         |          |               |
| *Trogodytes musculus* | Southern House Wren | SA/SC/RC/EA/ES | WA2683268 |               |
| *Pheugopedius genibarbis* | Moustached Wren | SA/SC/RC/ES |          |               |
| *Cantorchilus longirostris bahiae* | Long-billed Wren | EN | SA/SC/RC |               |
| **POLIOPTILIDAE**  |               |         |          |               |
| *Polioptila plumbea* | Tropical Gnatcatcher | SA/SC/RC/EA/ES | WA2101250 |               |
| **TURDIDAE**       |               |         |          |               |
| *Turdus leucomelas* | Pale-breasted Thrush | EA/ES |          |               |
| *Turdus rufiventris* | Rufous-bellied Thrush | SA/SC/RC/EA/ES |          |               |
| *Turdus amaurochalinus*<sup>PM</sup> | Creamy-bellied Thrush | SA/SC |          |               |
| **MIMIDAE**        |               |         |          |               |
| *Mimus saturninus arenaceus* | Chalk-browed Mockingbird | EN | SA/SC/RC/ES | WA2723585 |
| **MOTACILLIDAE**   |               |         |          |               |
| *Anthus lutescens* | Yellowish Pipit | ES |          |               |
| **PASERELLIDAE**   |               |         |          |               |
| *Zonotrichia capensis* | Rufous-collared Sparrow | SA/SC/RC | WA1467779 |               |
| *Ammodramus humeralis* | Grassland Sparrow | SA |          |               |
| **PARULIDAE**      |               |         |          |               |
| *Setophaga pitisayumi* | Tropical Parula | SA/ES |          |               |
| *Myioborus flavivora* | Flavescent Warbler | SA/EA/ES |          |               |
| **ICTERIDAE**      |               |         |          |               |
| *Icterus pyrrhopterus* | Variable Oriole | SA/SC/RC | WA2918615 |               |
| *Icterus jamacaii* | Campo Troupial | EN | SA/SC/RC | WA2106592 |
| *Chrysomus ruficapillus* | Chestnut-capped Blackbird | SA |          |               |
| *Agelaioides fringillarius* | Pale Baywing | EN | SA |          |
| *Molothrus bonariensis* | Shiny Cowbird | SA |          |               |
| *Sturnella superciliaris* | White-browed Meadowlark | SA |          |               |
| **THRAUPIDAE**     |               |         |          |               |
| *Schistochlamys ruficapillus*<sup>*</sup> | Cinnamon Tanager | RC |          | WA2113557 |
| *Paroaria dominicana* | Red-cowled Cardinal | EC | SA/SC | WA2918606 |
| *Tangara sayaca* | Sayaca Tanager | SA/SC/RC/EA/ES |          |               |
| *Tangara palmarum* | Palm Tanager | EA/ES |          |               |
| *Tangara cayana*<sup>*</sup> | Burnished-buff Tanager | SA/SC/RC/EA/ES |          |               |
| *Nemosia pileata* | Hooded Tanager | SA/SC/RC/EA/ES |          |               |
sites was fairly complete. Based on our point counts, estimated species richness was 158 (Chao 1) and 167 species (Jackknife 1). Thus, observed richness by point counts corresponds to 95.6% and 90.4%, respectively, of the estimated richness (Fig. 3).

During point counts, we made 18,272 avian contacts. The 10 most detected species during these censuses were Zonotrichia capensis ($n = 926$), Eupsittula cactorum ($n = 850$), Zenaida auriculata ($n = 675$), Sakesphorus cristatus ($n = 626$), Stigmatura napensis ($n = 620$), Hemitriccus margaritaceiventer ($n = 592$), Columbina picui ($n = 559$), Poliopitla plumbea ($n = 547$), Coryphospingus pileatus ($n = 545$), and Thamnophilus capistratus ($n = 539$). On the other hand, 26 species were only recorded once (singletons) or twice (doubletons).

During the dry season we detected 117 species and 4,521 individuals. During the wet season (which we sampled twice) we detected 146 species and had a mean abundance of 6,875.2 individuals ($n = 13,751$). The five most abundant species during the dry season were Eupsittula cactorum ($n = 283$ individuals detected), Chlorostilbon lucidus ($n = 276$), H. margaritaceiventer ($n = 239$), P. plumbea ($n = 212$), and Formicivora melanogaster ($n = 174$). Whereas, during the wet season the five most abundant species were Z. capensis ($n = 394$), Z. auriculata ($n = 337$), E. cactorum ($n = 283$), S. cristatus ($n = 243$), and S. napensis ($n = 223$).

From our inventory (systematic and opportunistic) most of the species detected are considered residents. Nineteen species recorded at the CNP are considered migratory or partially migratory (Table 2). For example, Elaenia chilensis is an austral migrant, Tyrannus savana and Turdus amaurochalinus are considered partial austral migrants. We observed a single individual of T. savana flying over a disturbed open area in the CNP on March 2017. Elaenia chilensis and T. amaurochalinus were commonly recorded only during the rainy season. Similarly, two species of migratory cuckoos (Coccyzus melacoryphus and Micrococcus cinereus) were only recorded during the rainy season. Whereas C. melacoryphus was

| Family and species     | English names   | End/Thr | Habitats            | Documentation |
|------------------------|----------------|---------|---------------------|---------------|
| Compsothraupis loricata| Scarlet-throated Tanager | EN      | SA/SC/RC            | WA1635323     |
| Conirostrum speciosum | Chestnut-vented Conebill | SC/EA/ES |          |               |
| Sicalis flaveola       | Saffron Finch   |         | SA                  |               |
| Sicalis luteola        | Grassland Yellow-Finch | SA      |          |               |
| Volatinia jacarina     | Blue-black Grassquit | SA      |          | WA2105977     |
| Coryphospingus pileatus| Pileated Finch | SA/SC/RC |          | WA2850094     |
| Tachyphonus rufus      | White-lined Tanager | SA/SC/RC/ES |          | WA2105976     |
| Dacnis cayana*         | Blue Dacnis     |         | ES                  |               |
| Coereba flaveola       | Bananaquit      |         | SA/SC/RC/EA/ES      |               |
| Sporophila lineola*PM  | Lined Seedeater |         |          |               |
| Sporophila nigrisellis | Yellow-bellied Seedeater | SA      |          |               |
| Sporophila leucopetera | White-bellied Seedeater  |         |          |               |
| Sporophila bouvreui*PM | Copper Seedeater |         |          |               |
| Sporophila albogularis | White-throated Seedeater | EC      | SA/SC/RC            | WA2918631     |
| Saltator similis       | Green-winged Saltator | SA      |          |               |
| Thlypopsis sordida     | Orange-headed Tanager | SA      |          | WA2687083     |
| **CARDINALIDAE**       |                |         |          |               |
| Piranga flava*         | Hepatic Tanager |         | EA/ES               |               |
| Cyanoloxia brissonii   | Ultramarine Grosbeak | SA      | SC/RC               |               |
| **FRINGILLIDAE**       |                |         |          |               |
| Spinus yarrellii*      | Yellow-faced Siskin | VU      |          |               |
| Euphonia chlorotica    | Purple-throated Euphonia | SA      | SC/RC/EA/ES        |               |
| **ESTRILDIDAE**        |                |         |          |               |
| Estrilda astrild*      | Common Waxbill  |         | SA                  |               |
| **PASSERIDAE**         |                |         |          |               |
| Paser domesticus       | House Sparrow   |         | SA                  |               |
relatively common, *M. cinereus* was recorded once on June 2017, during an opportunistic observation in a disturbed area. Some partial migrant species (*Myiophobus fasciatus*, *Casiornis fuscus*, *Myiiodinastes maculatus*, *Empidonax varius*, *Hydropsalis parvula*, *Vireo chivi*, *Pachyramphus polychoterus*, *Elatenia spectabilis*, *Myiarchus swainsoni* and *Progne chalybea*) were regularly detected during the rainy season in the park. Finally, species like *Bubulcus ibis*, *Xenopsaris albinucha*, *Columbina minuta*, *Columbina talpacoti*, *Patagioenas picazuro*, *Z. auriculata*, *Chrysomus ruficapillus*, *Agelaioides fringillarius*, *Molothrus bonariensis*, *Sicalis luteola*, *Volatinia jacarina*, and aquatic species such as *Dendrocygna viduata*, *Himantopus mexicanus*, as well as species from the families Podicipedidae, Ardeidae and Rallidae (Table 2) were recorded exclusively during the rainy season and are likely to carry out seasonal displacements within the Caatinga.

During our surveys most species were detected in more than one habitat. Most of the species recorded during our studies were detected in shrubby-arboreal Caatinga (162 species), followed by shrubby Caatinga with Cerrado elements (*n* = 85 spp.), shrubby Caatinga with elements of rocky fields (*n* = 59 spp.), evergreen arboreal vegetation (*n* = 56 spp.), evergreen shrubby Caatinga (*n* = 89), and 12 species related to aquatic environments.

A total of 28 taxa detected in our surveys are considered range-restricted. Nine species are endemic to the Caatinga, whereas 19 taxa are restricted to the Brazilian northeast (Table 2). *Picumnus fulvescens* a northeastern endemic and *Hylopezus ochroleucus* a Caatinga endemic are considered “Near Threatened”, with decreasing trends in their populations (IUCN 2019). None of the species is considered threatened by extinction according to the Brazilian MMA (2018b). Three exotic species were recorded (*Columba livia*, *Estrilda astrild* and *Passer domesticus*), mostly in urban and peri-urban areas, but there is no evidence that they represent any threat to autoctonous species.

**DISCUSSION**

In this study we presented newly quantitative data on the avian assemblage found at the Catimbau National Park. During our quantitave surveys, restricted to 20 sites, we detected ~70% (155 species) of the 192 species. In addition, opportunistic observations included another 37 species of birds, mostly waterbirds that do not occur at or near our sampled sites. In fact, according to species richness estimators, our quantitative surveys detected the vast majority of the species present in our sites, showing the importance of conducting systematic surveys. The CNP avian assemblage (192 species) represented ~35% of bird species registered for the Caatinga Domain (*sensu* Araújo & Silva 2017; *n* = 548) and 35.8% of the 535 bird species recorded for the state of Pernambuco (Farias & Pereira 2009).

Despite our systematic surveys, we failed to find 34 bird species previously reported for the CNP by Sousa *et al.* (2012). Among the species we failed to record, 11 are linked to aquatic environments, including three species of herons (*Tigrisoma lineatum*, *Nycticorax nycticorax*, and *Butorides striata*), two of ducks (*Cairina moschata* and *Amazonetta brasiliensis*), two common inhabitants of ponds and pools (*Podilymbus podiceps* and *Nannopterum brasilianum*), two species of raptors likely occurring in low densities (*Buteo nitidus* and *Buteo albonotatus*), two species
of hummingbirds (Anthracothorax nigricollis and Polytomus guainumbi), two species of nightbirds (Antrostomus rufus and Chordeiles acutipennis), four species of birds often linked to more humid forests (Hersiliochmus atricapillus, Sittaosmus griseicapillus, Synallaxis hypospodia, and Pheugopedius genibarbis), and three species of seedeaters known to have erratic populations elsewhere in the Caatinga (Sporophila lineola, Sporophila leucoptera, and Sporophila bouvreuil).

More important, however, were the apparent absences of three species of conservation concern, including three endemic and threatened species (Crypturellus noctivagus zabele, P. jacucaca, and S. yarrellii) previously reported by Sousa et al. (2012). These species are known to be widely hunted by poachers and for the illegal trade, and their absences may indicate local extinctions. The CNP suffers strong pressure from hunting and illegal trade, particularly for birds. During the study period hunters and local residents were observed trapping birds within the CNP boundaries, an illegal activity outside and even inside the protected area. We found many endemic avian taxa in captivity, including E. cactorum, Paroaria dominicana, Sporophila albogularis and Icterus jamacaii, but also more widespread species, such as Amazona aestiva and Gymnoloxia brissonii, widely appreciated by the illegal trade. We are afraid that if the scenario of hunting activities, illegal logging, overgrazing by goats and cattle, hunting of wild animals (mainly mammals and birds), and bird trapping continue to occur within the park, other species may also become locally extinct. Species whose populations are locally and regionally small are more susceptible to local extinction (e.g., Pereira & Brito 2005, Pereira & Azevedo-Jr. 2011, Fernandes-Ferreira et al. 2012, Las-Casas et al. 2012, Albuquerque et al. 2005, Pereira & Azevedo-Jr. 2011, Fernandes-Ferreira et al. 2012, Lyra-Neves 2011, Las-Casas et al. 2012, Lyra-Neves et al. 2012, Araújo et al. 2017).

On the other hand, we recorded 25 species that were not previously recorded at the CNP (Table 2), including two aquatic species (Tachybaptus dominicus and Himantopus mexicanus), three species of raptores (Heterospizias meridionalis, Urubitinga urubitinga, Parabuteo unicinctus); some aural and intratropical migrants (M. cinereus, Seropphaga subvistata, T. tavisana, and Piranga flavia), whose movements are poorly known; a boreal unreported from the park; migrant (Falco peregrinus); two species of exotic birds (Colombia livia and Estrilda astrild), previously unreported from the park; and one endemicity that likely went undersampled in the past (Hersiliochmus sellowi). These results suggest that the core avian assemblage of the CNP is likely very well established by now, and that future records will likely result from more nomadic aquatic species, aural and northern migrants, and possibly some widespread species that have not yet been recorded in the park. Species richness and avian composition may also vary according to differences in the methods applied, sampling effort, nocturnal observations (Vizentin-Bugoni et al. 2015), as well as the conservation status of the areas (Sayer et al. 2017, Bovo et al. 2018).

These results also suggest that the Caatinga bird assemblage composition presents some clear interannual variation, particularly for aquatic and low density species (Araújo & Silva 2017). During the rainy season at the CNP, there was an increment in bird species richness, with the presence of migratory birds, including both long-distance and intratropical migrants (e.g., Ruiz-Esparza et al. 2011, Las-Casas et al. 2012, Lyra-Neves et al. 2012, Araújo et al. 2017).

Most of the bird species found at the CNP occurred in shrubby arboreal Caatinga, which is the main phytothesiognomy found within the park boundaries. On the other hand, many species of birds can be found in more than one habitat (Table 2), a pattern that is common among birds in the Caatinga. Most of the species included in the park’s list are not forest dependent, being able to explore different habitats (Araújo & Silva 2017). However, some species may be considered forest specialists. In the CNP species such as Leptotila rufa and Ortilis araucana were restricted to more humid habitats such as evergreen forests, a type of vegetation nowadays very uncommon within the park. This type of vegetation was transformed in areas of plantations and pastures (e.g., Pedra do Cachorro) and the remaining tracts of evergreen forests is very fragmented and present different levels of disturbances.

We also noticed that some bird species at the CNP prefer well-conserved and/or forested habitats and rarely occur in disturbed environments (Pereira & Azevedo-Jr. 2011, Las-Casas et al. 2012, Lyra-Neves et al. 2012). This was the case of P. supercilialis, Trogon curucui, Piculus chrysclorhous, Micrastur ruficolis, H. sellowi, H. ochroleucus, C. trochilorostris, Deudreplex picus and S. ruicpicillus. In contrast, other species were only observed in disturbed and open areas, such as Athene cunicularia, Swiriri suiriris, and Xolmis irupero niveus. Species such as Sarcoramphus papa, Geranotaetus melanoleucus, Hydropsalis longirostris, Hirundinea ferruginea and Knipoleus nigerrimus were associated to the CNP’s rocky walls. Some of those rare species were those more dependent on forested habitats and more sensitive to disturbance, preferring isolated sites with very low human interference such as P. supercilialis, Clavis pretiosa, M. ruficolis, C. trochilorostris and S. ruicpicillus.

The Caatinga is the largest block of tropical Dry forests found within South America (Silva & Souza 2018) and is one of the most threatened in the Neotropics, with less than 10% of its original extent (Banda et al. 2016). In Brazil, habitat conservation is uneven among biomes (Jenkins & Joppa 2009, Oliveira & Bernard 2017) and the Caatinga represents the least protected one, with only
1.3% of the total area officially included in protected areas that receive full protection (MMA 2017).

Besides the anthropogenic pressures found within this protected area, such as bird hunting, trapping and cattle grazing, our results demonstrate that the CNP still harbors a valuable Caatinga avian diversity with the presence of range-restricted, endemic, threatened, and migratory species, highlighting its importance for bird conservation. But we emphasize the need of effective management inside and outside the park’s boundaries, since pressures inside the reserve may usually reflect those occurring around (Laurance et al. 2012). Despite being fragmented, patches of Caatinga remain well-connected, which may facilitate recolonizations and community regeneration (Antongiovanni et al. 2018). Thus, the maintenance, management and expansion of protected area networks continue to be one of the most important tools for biodiversity conservation (Las-Casas et al. 2012, Oliveira & Bernard 2017, Antongiovanni et al. 2018).

The exceptional natural features of the park, allied to a rich avifauna could provide an economic opportunity through the development of birdwatching, offering new job opportunities. We emphasize that actions such as environmental education and ecological restoration projects, allied to inspection are urgent for the maintenance of the biodiversity and ecosystem services at the CNP.

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