Birds in Atlantic Forest fragments in north-east Brazil

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Durante o mês de outubro de 2001 os autores percorreram 15 fragmentos florestais no Estado de Alagoas, Brasil. O objetivo principal foi localizar novas populações e obter mais dados sobre os táxons endêmicos do 'Centro Pernambuco'. Foram realizados censos em cada um dos fragmentos, que também foram analisados quanto ao estado geral de conservação. Discute-se a presença de espécies-chave, como grandes frugívoros ou aquelas sensíveis à fragmentação ou às mudanças na estrutura da vegetação. Os dois fragmentos mais importantes, com relação ao número de espécies encontrado e o número de táxons endêmicos, estão localizados na Usina Serra Grande (Mata do Pinto e Mata do Engenho Coimbra), onde foram registrados 16 táxons endêmicos e/ou ameaçados de extinção. Recomenda-se pesquisa taxonômica urgente, que procure evidenciar os táxons endêmicos do 'Centro Pernambuco', além de uma efetiva proteção aos fragmentos e às aves que ainda os habitam, uma maior vigilância contra a caça, a retirada de madeira e o desmatamento e um programa de reflorestamento que procure conectar os fragmentos mais próximos entre si.

In contrast to the Amazon forest, the Brazilian Atlantic Forest stretches along a broad latitudinal band, with little longitudinal variation. This latitudinal gradient, from c.6ºS to 32 S, is further diversified by the montane ranges born of intense Cenozoic tectonic activity[51] that occur throughout much of the region. It is little wonder that tropical forest in such setting is an important centre of endemism. Over 90% of known frogs and 70% of reptiles recorded in the Atlantic Forest are endemic[26,40]. Among the breeding avifauna, c.200 recognised species are endemic to the Atlantic Forest region[31]. Endemism levels are probably even greater as several taxa currently regarded as subspecies may prove to be biological (BSC) and/or phylogenetic (PSC) species once detailed taxonomic studies are undertaken. Examples of such from north-east Brazil include *Thamnophilus caerulescens pernambucensis*, *T. aethiops distans* and *Iodopleura pipra leucopygia*[55,61].

The 'Serra do Mar' centre of avian endemism[22] covers the Atlantic Forest from Rio Grande do Norte (c.7 S) to Rio Grande do Sul (c.32 S), with two main divisions: the narrow belt of coastal and montane forests, and the *Araucaria* forests of southern Brazil and nearby Argentina and Paraguay. Despite forming a recognisable entity, the Serra do Mar centre can be further divided into several 'subcentres' characterised by assemblages of endemic birds[21,68].

The forested belt north of the rio São Francisco is one such area, generally referred to as the 'Pernambuco centre'[12,57]. It includes both the coastal forests and complex transitional area between them and drier habitats inland. The Pernambuco centre is considered an area of interchange between biota

Figure 1. Extensive areas of forest have been destroyed to make way for sugarcane plantations, leaving the landscape heavily fragmented (Luiz Claudio Marigo)

Figure 2. Usina Serra Grande contains one of the largest and best-preserved remnants of montane forest in Alagoas; it harbours a considerable number of endemic and globally threatened species (Luiz Claudio Marigo)

Table 1. Endemic forest birds of the Pernambuco centre and nearby highland forests of Ceará state, Brazil. Threat categories follow BirdLife International[11]. Nomenclature and status of endemic taxa is based on general catalogues or recent revisions[8,33,49,55,56,70] and specimens housed in the collections of Museu de Zoologia da Universidade de São Paulo and Universidade Federal de Pernambuco.

Taxon	Distribution	Status
Tinamus solitarius pernambucensis Berla, 1946	Alagoas and Pernambuco	Near Threatened
Mitu mitu Linnaeus, 1766	Alagoas	Extinct in the wild
Penelope superciliaris alagoensis Nardelli, 1993	Alagoas	-
Odontophorus capueira plumbeicollis Cory, 1915	Alagoas to Ceará	-
Leptodon forbesi (Swann, 1922)	Alagoas and Pernambuco	Critical
Pyrrhura anaca (Gmelin, 1788)	Ceará, Pernambuco and Alagoas	-
Phaethornis ochraceiventris camargoi Grantsau, 1988	Pernambuco, Alagoas	-
Momotus momota marcgraviana Pinto & Camargo, 1961	Alagoas and Paraíba	-
Picumnus limae Snethlage, 1924	Ceará	-
Picumnus fulvescens Stager, 1961	Pernambuco and Paraíba	-
Picumnus exilis pernambucensis Zimmer, 1947	Alagoas and Pernambuco	-
Dendrocincla fuliginosa taunayi Pinto, 1939	Alagoas to Pernambuco	-
Lepidocolaptes fuscus atlanticus (Cory, 1916)	Pernambuco to Ceará	-
Synallaxis infuscata Pinto, 1950	Pernambuco and Alagoas	Critical
Automolus leucophthalmus lammi Zimmer, 1947	Alagoas and Paraíba	-
Philydor novaesi Teixeira & Gonzaga, 1983	Alagoas	Critical
Xenops minutus alagoanus Pinto, 1954	Alagoas to Paraíba	-
Sclerurus caudacutus caligineus Pinto, 1954	Alagoas	-
Thamnophilus caerulescens pernambucensis Naumburg, 1937	Alagoas and Pernambuco	-
Thamnophilus caerulescens cearensis (Cory, 1919)	Ceará	-
Thamnophilus aethiops distans Pinto, 1954	Alagoas and Pernambuco	-
Myrmotherula snowi Teixeira & Gonzaga, 1985	Alagoas and Pernambuco	Critical
Terenura sicki Teixeira & Gonzaga, 1983	Alagoas and Pernambuco	Endangered
Cercomacra laeta sabinoi Pinto, 1939	Alagoas and Pernambuco	-
Pyriglena leuconota pernambucensis Zimmer, 1931	Pernambuco, Alagoas and (perhaps) Paraíba	-
Myrmeciza ruficauda soror Pinto, 1940	Alagoas to Paraíba	Endangered
Conopophaga melanops nigrifrons Pinto, 1943	Alagoas to Paraíba	-
Iodopleura pipra leucopygia Salvin, 1885	Alagoas, Pernambuco and Paraíba	Endangered
Phylloscartes ceciliae Teixeira, 1987	Alagoas and Pernambuco	Critical
Platyrhynchus mystaceus niveigularis Pinto, 1954	Alagoas to Paraíba	-
Hemitriccus mirandae Snethlage, 1925	Alagoas and Ceará	Vulnerable
Hemitriccus zosterops naumburgae (Zimmer, 1945)	Alagoas to Paraíba	-
Schiffornis turdinus intermedius Pinto, 1954	Alagoas to Paraíba	-
Hemithraupis flavicollis melanoxantha (Lichtenstein, 1823)	Pernambuco, Alagoas	-
Tangara fastuosa Lesson, 1831	Alagoas to Paraíba	Endangered
Tangara cyanocephala corallina (Berlepsch, 1903)	Pernambuco and Alagoas	-
Tangara cyanocephala cearensis Cory, 1916	Ceará	-
Caryothraustes canadensis frontalis Hellmayr, 1905	Ceará, Pernambuco and Alagoas	-

of the Atlantic and Amazon forests[57], with typically Amazonian forms occurring alongside Atlantic Forest taxa[18,54,76]. Birds are the group with the largest number of north-east Brazilian representatives of Amazonian species, most being disjunct, endemic populations currently treated as subspecies (Table 1). Other taxa, such as *Crypturellus strigulosus* and *Pteroglossus inscriptus*, have not diverged morphologically from their Amazonian counterparts. Overall, 38 bird taxa are recognised as endemic to the Pernambuco centre (Table 1).

Compared to other sectors of the Atlantic Forest, the Pernambuco centre is the one that has been most severely impacted by humans, as well as being the least known and protected[18–20,35,37,39]. It is unsurprising that the region harbours the largest number of threatened birds in Brazil, and one area (Murici, Alagoas) supports the most threatened birds in the Americas[77].

Forest destruction in the Pernambuco centre began five centuries ago, driven mostly by sugarcane plantations and mills (*usinas*), and cattle ranching[18]. Aside from forest clearance, extraction and hunting depleted and even extirpated species, e.g. a population of Bare-faced Curassow *Crax fasciolata*[53,69]. Human impact has been sufficiently pervasive that most remaining forest is second growth, occupying formerly cultivated or heavily logged areas[4].

Initially, the *usinas* planted sugarcane in the plains along the main rivers draining to the sea, and consequently riverine forests and wetlands are long gone. The mills used wood for power, thus deforestation increased in the 19th century when steam machinery was introduced. The tablelands

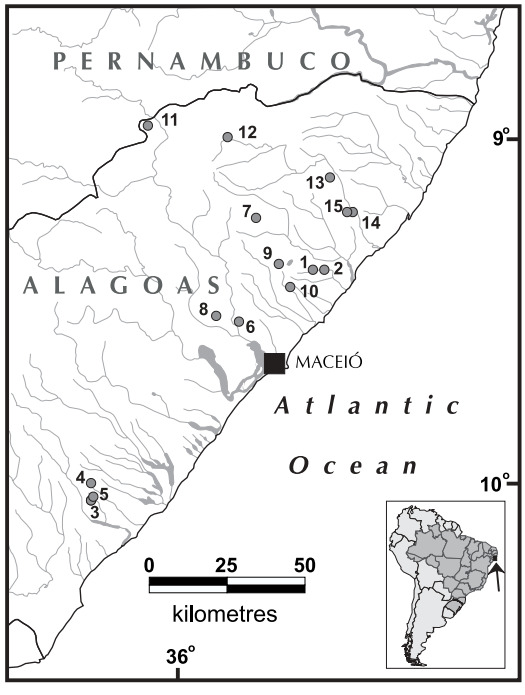

Figure 1. Localities surveyed (see also Table 2): 1. Usina Santo Antonio 1; 2. Usina Santo Antonio 2; 3. Fazenda Riachão, Usina Coruripe; 4. Mata do Capiatã, Usina Coruripe; 5. Mata do Riachão, Usina Coruripe; 6. Mata da Sálvia, Usina Utinga-Leão; 7. Torre da Embratel, Murici Ecological Station; 8. Mata do Cedro, Usina Utinga-Leão; 9. Mata da Sela, Usina Cachoeira; 10. Mata Bamburral II, Usina Cachoeira; 11. Mata do Pinto, Usina Serra Grande; 12. Mata do Engenho Coimbra, Usina Serra Grande; 13. Mata da Encosta do Grotão, Usina Camaragibe; 14. Mata da Santa Justina, Usina Santo Antônio; 15. Grotão do Brás, Mata de Santa Justina, Usina Santo Antônio.

away from the floodplains were largely spared until the 20th century, when demand for wood, and thus clearance, peaked. Deforestation reached its height between the late 1970s and 1988, during the PROALCOOL, an official programme of the Brazilian government that subsidised the owners of *usinas* in order to increase ethanol and sugar production. In order to acquire readily accessible taxpayer money they had little incentive to return, *usina* owners virtually eliminated all accessible forest in order to grow sugarcane[69]. Now, most remnant forests are within steep valleys, where suitable conditions to plant sugarcane do not exist, or near sources of water the *usinas* considered useful to protect. Besides causing habitat loss, sugarcane plantations, until quite recently, also relied heavily on aerial pesticide applications, which reached remnant forests. In addition, few landowners forbade hunting or woodcutting in their forests. These further impacts have greatly affected the local avifauna.

Alhough Europeans occupied much of the Brazilian coast within a comparatively short period, it was in the north-east that colonisation had the most damaging impacts on the Atlantic Forest. Over 90% of forests in the Pernambuco centre have been cleared and the remnants are mostly small and isolated[65], a different situation from that in south-east Brazil, where the coastal mountains and poor coastal soils forced large-scale agriculture elsewhere, permitting the survival of relatively large forest areas that may act as sources[13,24,39,59].

The forests of the Pernambuco centre originally covered c.56,000 km^2 or 4.6% of the Atlantic Forest complex. Main forest types were transitional inland forests (34.9%), semideciduous forests (28.4%) and open ombrophyllous forests (20.5%). Data from 1995 satellite images showed only 2,124 km^2 of forests remained or only 3.76% of the Pernambuco centre[45]. The situation has deteriorated since, as forest clearance has continued even in 'protected' areas such as Murici (pers. obs.).

It has been suggested that the Atlantic Forest avifauna is pre-adapted to withstand forest fragmentation because of the persistence of diverse communities in patches of reduced area[7,13,14,58] but the evidence is equivocal[2], and it has been argued that those Atlantic Forest species more sensitive to human impacts became extinct without formal description[46]. Bird guilds differ in their vulnerability to human impacts, some being more susceptible to hunting (large-bodied species such as cracids and other ground frugivores[64]), while others are vulnerable to fragmentation and changes in the physical structure of their habitat, such as understorey insectivores and large arboreal frugivores[1–3,16,28,30,38,78].

Despite being considered a conservation priority, and the long history of human impact making it an ideal area to understand the long-term impact of habitat fragmentation, deforestation, extraction and chronic hunting on Neotropical forests, few recent data concerning forest bird communities in the Atlantic Forest of north-east Brazil exist[6,36,44,54]. Here, we endeavour to plug this gap, describing the results of quantitative bird surveys in 15 forest fragments in Alagoas state, and discussing the impacts of human activities on selected bird guilds.

Methods

We conducted bird surveys in Atlantic Forest fragments in Alagoas during October 2001. Our main goal was to search for unreported populations of the regional endemics[66,67] (see Table 1) and to assess the conservation status of forest fragments on sugar mill land, which harbour most such remnants in north-east Brazil.

Field work was undertaken during the period 6–27 October 2001. We visited 15 previously identified, larger and better-preserved forest fragments

Table 2. Forest fragments surveyed for endemic Atlantic Forest birds in Alagoas, 6–27 October 2001.

Locality	Location	Area (ha)	Field hours	Number of species recorded	Notes
1. Usina Santo Antônio 1	09°23'S 35°37'W; 100 m	c.80	7	89	Ombrophyllous forest within a steep narrow valley with a creek. Few patches of larger trees amid tangled, degraded second growth; some large ground bromeliads, emergent trees (mostly *Parkia pendula*). Intensive on-going selective logging. Several poacher hides.
2. Usina Santo Antônio 2	09°23'S 35°35'W; 30 m	c. 25	4	84	Ombrophyllous forest within a steep narrow valley with creeks. Several large trees and emergents (mostly *Parkia pendula*), open understorey. No evidence of recent logging. Several poacher hides.
3. Fazenda Riachão, Usina Coruripe	10°03'S 36°16'W; 120 m	337	6	38	Drier forest with many *Caesalpina echinata* trees. No perennial creek. Upper canopy 20 m, with emergents over 30 m. No evidence of recent logging. Several poacher hides.
4. Mata do Capiatã, Usina Coruripe	10°00'S 36°16'W; 150 m	458	6	53	Linked to the previous fragment, with similar vegetation in better-drained areas. Three creeks, surrounded by ombrophyllous forest with trees over 40 m, draining a large reservoir surrounded by forest. A village of 400 people by the forest, which is encircled by second growth. Three poachers observed.
5. Mata do Riachão, Usina Coruripe	10°03'S 36°16'W; 100 m	454	2.1	24	Drier forest with many *Caesalpina echinata* trees and very large fig trees. A small perennial creek. Upper canopy at 25 m, with emergents over 40 m. No evidence of recent logging.
6. Mata da Sálvia, Usina Utinga-Leão	09°32'S 35°50'W; 160 m	c.400	4	77	Ombrophyllous forest within a valley with open undergrowth. Many tall emergents (*Parkia pendula*). Forest centre surrounded by a belt of *Cecropia* and other secondary species. Selective logging of poles, poaching and bird catching recorded.
7. Torre da Embratel, Murici Ecological Station	09°14'S 35°47'W; 470 m	c.300	2.5	40	Second-growth montane forest, highly degraded. Most trees have multiple trunks due to re-sprouting from former cutting. Taller trees belong to non-commercial species. Many secondary species like *Cecropia*. Intensive logging.
8. Mata do Cedro, Usina Utinga-Leão	09°31'S 35°54'W; 120 m	c.500	7	78	Ombrophyllous tall forest with many emergents (*Parkia*) and large *Attalea* palms. Connected to other fragments and total area may be 1,000 ha. Slopes possess tall forest with open understorey; level areas selectively logged and have lower trees and tangled understorey. Forest surrounds a large water reservoir. One gunshot heard.
9. Mata da Sela, Usina Cachoeira	09°22'S 35°43'W; 160 m	c.100	2	46	Dry forest on a hillside with many exposed boulders. Highly degraded by selective logging. A few emergents, up to 30 m high, tower above an 8 m-high canopy of second-growth spp. (*Cecropia*, Melastomaceae). Undergrowth with many sedges.
10. Mata Bamburral II, Usina Cachoeira	09°26'S 35°41'W; 150 m	c.500	2.1	69	Ombrophyllous forest within a steep, narrow valley with a creek. Large emergents (*Parkia pendula* and *Aspidosperma* sp.) amid many second-growth spp. (*Inga*, *Cecropia*). An abandoned camp (of poachers?) found.
11. Mata do Pinto, Usina Serra Grande	08°58'S 36°06'W; 160 m	c.300	5.4	103	Ombrophyllous hilltop forest with a 20 m-high canopy; evidence of selective logging long ago. Many fruiting *Didymopanax morototoni* and melastomes, the latter forming a belt around parts of the fragment. Open undergrowth with sedge patches. Creeks and two water reservoirs within the fragment.
12. Mata do Engenho Coimbra, Usina Serra Grande	09°00'S 35°52'W; 590 m	c.800	5.1	103	Tall ombrophyllous forest with a 20–25 m-high canopy and emergents over 30 m. Many palms (*Attalea*, *Euterpe edulis*) and arboreal bromeliads. Many fallen fruits (Sapotaceae and Annonaceae) eaten by parrots. Several creeks. No evidence of selective logging. Eight poachers (plus six hunting dogs) recorded.
13. Mata da Encosta do Grotão, Usina Camaragibe	09°07'S 35°34'W; 160 m	c.100	4	45	Very degraded ombrophyllous forest under severe selective logging. No permanent water. A few emergent *Parkia*.
14. Mata da Santa Justina, Usina Santo Antônio	09°13'S 35°30'W; 30 m	c.80	11	77	Ombrophyllous forest with evidence of past selective logging, within a steep narrow valley. Reasonably conserved, with emergent *Parkia*. Some trails used by poachers and loggers.
15. Grotão do Brás, Mata de Santa Justina, Usina Santo Antônio	09°13'S 35°31'W; 50 m	c.100	7	20	Well-conserved ombrophyllous forest in the narrow steep valley of a small river; 25 m-high canopy. Many emergents (*Parkia pendula* and *Lecythis pisonii*). Many palms, including fruiting *Euterpe edulis*. Open and species-rich undergrowth. An old trail, obstructed at points, leads to the forest.

(Table 2) recording bird species observed, number of individuals, as well as habitat type, group size, food habits and general behaviour, and the conservation status of each area. Field work always commenced at dawn and usually continued until nightfall. Birds were observed using binoculars and vocalisations recorded with a Sony TCM 5000 EV and Sennheiser ME66 microphone. Copies of recordings have been deposited at the Arquivo Sonoro Elias Coelho (ASEC), Universidade Federal do Rio de Janeiro. Coordinates and altitude were taken using a GPS and the staff of the *usinas* furnished additional information such as the size of each area. The number of records of each species was converted to an abundance index (number of individuals/100 field hours[78,79]) to facilitate comparisons between areas. We also recorded mammals we encountered as complementary data.

The 15 fragments were very varied in habitat status and conservation. One important fact that demands emphasis is that in southern, drier fragments, there is a trend for the undergrowth of the more humid parts of such forests to be dominated by *Psychotria* (Rubiaceae) treelets, while *Miconia* and *Leandra* spp. (Melastomataceae) are abundant in the more humid northern fragments and may even form a 'belt' around higher altitude areas such as Murici and Usina Serra Grande[66].

Results

A list of bird species recorded in our survey is presented in Table 3. The areas that harboured the most species were Mata do Engenho Coimbra and Mata do Pinto, both with 103 species recorded after slightly more than five field hours in each fragment. Both belong to Usina Serra Grande and are relatively close (c.30 km by car) to each other, though situated at different altitudes.

Indicator species

Tinamous and cracids

The larger cracids and tinamous are classic examples of birds vulnerable to hunting[50,64]; indeed Alagoas Curassow *Mitu mitu* is considered extinct in the wild[11,66]. We found no evidence for the continued existence of *Tinamus solitarius pernambucensis*, now thought to be restricted to Murici (F. Pinto pers. comm.), at any of our survey sites. None of the people we interviewed was aware of recent records of the *macuca*, as local people commonly refer to it. The form was rarely heard in Murici during the 1991 breeding season (J. F. Pacheco *in litt*.) and recent visits there by birdwatching groups have also failed to detect it; thus the taxon, if valid, is evidently Critically Endangered.

Even where present, forest tinamous were scarce in all areas, with only 1–2 records/area, while *Crypturellus parvirostris* was common in nearby sugarcane plantations and other man-made habitats. *C. soui* was the most widespread species, recorded in six areas, an expected result, as the species prefers dense secondary vegetation at edges and clearings, and will use bushy areas and cocoa plantations[15]. It is probably well able to withstand selective logging and forest fragmentation, and its small size and cryptic habits mean that hunters do not favour the species. *C. strigulosus*, on the other hand, is restricted to lowland humid forests and was found only at Grotão do Brás, near sea level, where a single record was made. At Usina Uruba and Coruripe we were shown three captive *C. noctivagus* caught in scrubby coastal forest (restinga) near the mouth of the rio São Francisco, at *usinas* Coruripe and Marituba. They exhibited the dark coloration characteristic of the threatened nominate (Atlantic Forest) subspecies and thus represent either a significant northward range extension for this taxon or a population intermediate between *C. n. noctivagus* and the caatinga *C. n. zabele*. The species appears to be as locally scarce as Solitary Tinamou and is Critically Endangered at a regional level.

Ortalis araucuan is apparently a habitat generalist easily recognised by its vocalisation and gregarious habits that make its detection simple for biologists and poachers alike. This species was considered common throughout north-east Brazil[71] but we recorded it only once (a pair duetting at site 2). Despite chachalacas being the cracids best able to cope with hunting and deforestation, it was absent from 14 fragments surveyed and its status does not appear as safe as formerly considered.

Penelope superciliaris is another generalist able to cope with deforestation and even comparatively high levels of poaching, and was found in five fragments varying from well conserved to heavily degraded forest. The population in Alagoas belongs to the recently described *P. s. alagoensis*, which appears quite distinctive in plumage[43].

Birds of prey

While open-country species such as *Buteo* spp. are common, larger forest raptors and owls (*Spizaetus* spp., *Spizastur melanoleucus* and *Pulsatrix perspicillata*) appeared scarce or absent from our survey sites. The continued survival of *Spizaetus tyrannus* in the region is attested by recent records at Usina Serra Grande (S. A. Roda *in litt*.) and one was seen in June 2002 near the Pernambuco/Alagoas border stalking marmosets (F. Melo *in litt*.). The largest hawk species we recorded were the medium-sized and adaptable *Leptodon cayanensis* (two sites), *Geranospiza caerulescens* (two sites) and *Micrastur semitorquatus* (only in Mata da Sálvia). All *Leptodan* recorded by us exhibited the typical characters of *L.cayanensis*, and the validity of White-collared Kite *L.forbesi* is currently being studied by LFS.

Table 3. Bird taxa recorded in 15 forest fragments in Alagoas, north-east Brazil, and their relative abundances (individuals/100 hours; for a fuller explanation of such methodology see Willis[78] and Willis & Onki[99]). See Table 2 for the code of localities (1–15). Question marks refer to observations in which the species identity was uncertain.

English name Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Little Tinamou *Crypturellus soui*	14	50	-	-	-	-	-	-	100	-	-	59	-	18	29
Tataupa Tinamou *Crypturellus tataupa*	14?	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brazilian Tinamou *Crypturellus strigulosus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57
Striated Heron *Butorides striatus*	-	-	-	-	-	-	-	29	-	-	19	-	-	-	-
Rufescent Tiger-heron *Tigrisoma lineatum*	-	-	-	17	-	-	-	-	-	-	37	-	-	-	-
Black Vulture *Coragyps atratus*	14	50	67	-	-	100	320	14	150	-	56	118	50	64	14
Turkey Vulture *Cathartes aura*	14	-	-	-	-	-	80	29	-	-	-	20	75	36	-
Lesser Yellow-headed Vulture *Cathartes burrovianus*	14	-	-	33	-	-	120	57	-	-	19	20	-	18	-
Bicoloured Hawk *Accipiter bicolor*	-	-	-	17?	-	-	-	-	-	-	-	-	-	-	-
Grey-headed Kite *Leptodon cayanensis*	-	-	-	-	-	-	-	-	-	-	-	59	-	-	-
Crane Hawk *Geranospiza caerulescens*	-	-	-	-	-	-	-	14	-	-	-	-	25	-	-
Grey Hawk *Asturina nitida*	-	-	-	-	-	25	40	29	-	95	19	-	-	-	-
Roadside Hawk *Rupornis magnirostris*	14	25	-	33	-	-	-	-	-	95	-	-	50	27	-
Short-tailed Hawk *Buteo brachyurus*	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-
Zone-tailed Hawk *Buteo albonotatus*	14	-	-	17	-	-	-	-	-	-	-	59	-	-	-
Crested Caracara *Caracara plancus*	14	-	-	17	-	50	-	-	-	48	19	20	25	18	-
Yellow-headed Caracara *Milvago chimachima*	-	-	-	-	-	75	-	-	-	-	37	-	-	-	-
Laughing Falcon *Herpetotheres cachinnans*	-	-	-	-	-	25	-	29	50	-	-	-	-	9	-
Barred Forest-falcon *Micrastur ruficollis*	14	25	-	-	-	-	-	-	-	-	19	20	-	9	14
Collared Forest-falcon *Micrastur semitorquatus*	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-
Speckled Chachalaca *Ortalis araucuan*	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-
Rusty-margined Guan *Penelope superciliaris alagoensis*	-	-	33	-	-	-	-	29	50	48	19	-	-	-	-
Spot-winged Wood-quail *Odontophorus capueira plumbeicollis*	-	-	-	-	-	-	-	29	-	-	-	-	-	-	-
Limpkin *Aramus guarauna*	-	-	-	-	-	-	-	43	-	-	-	-	-	-	-
Rufous-sided Crake *Laterallus melanophaius*	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-
Russet-crowned Crake *Laterallus viridis*	-	-	-	-	-	-	-	-	-	48	-	-	-	-	-
Grey-necked Wood-rail *Aramides cajanea*	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-
Ash-throated Crake *Porzana albicollis*	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-
Blackish Rail *Pardirallus nigricans*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Purple Gallinule *Porphyrula martinica*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Common Moorhen *Gallinula chloropus*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Wattled Jacana *Jacana jacana*	-	-	-	-	-	-	-	71	-	-	37	-	-	-	-
Scaled Pigeon *Columba speciosa*	29	-	-	-	-	-	-	29	100	95	19	20	-	-	-
Plain-breasted Ground-dove *Columbina minuta*	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ruddy Ground-dove *Columbina talpacoti*	-	-	-	-	-	300	-	57	-	-	-	-	-	-	29
White-tipped Dove *Leptotila verreauxi*	14	25	-	17	-	50	-	71	-	-	19	20	25	18	-
Grey-fronted Dove *Leptotila rufaxilla*	-	-	-	-	-	-	-	14	-	-	19	20	-	9	-
Ruddy Quail-dove *Geotrygon montana*	-	-	-	-	-	25	-	29	-	-	-	-	-	-	-
Red-shouldered Macaw *Diopsittaca nobilis*	71	100	-	-	-	450	2560	57	-	-	-	235	100	91	57
Jandaya Parakeet *Aratinga jandaya*	-	25	-	-	-	-	-	-	100	-	-	-	100	27	-
Peach-fronted Parakeet *Aratinga aurea*	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-
Blue-winged Parrotlet *Forpus xanthopterygius*	-	-	-	-	-	-	-	-	-	-	37	39	-	-	-
Plain Parakeet *Brotogeris tirica*	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-
Golden-tailed Parrotlet *Touit surda*	14	-	-	-	-	150	480	-	-	95	-	235	-	-	-
Blue-headed Parrot *Pionus menstruus*	29	-	-	-	-	-	-	-	100	-	-	98	-	91	-
Dark-billed Cuckoo *Coccyzus melacoryphus*	-	-	-	-	-	-	-	57	-	-	-	-	-	-	-
Squirrel Cuckoo *Piaya cayana*	14	50	-	17	48	50	40	43	-	95	74	39	-	27	14
Smooth-billed Ani *Crotophaga ani*	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-
Guira Cuckoo *Guira guira*	57	50	-	-	-	-	-	-	-	-	-	-	-	-	-
Striped Cuckoo *Tapera naevia*	14	25	-	-	-	25	40	-	-	95	-	39	25	18	-
Tropical Screech-owl *Otus choliba*	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-
Spectacled Owl *Pulsatrix perspicillata*	-	-	-	-	95	-	-	-	-	-	-	-	-	-	-
Ferruginous Pygmy-owl *Glaucidium brasilianum*	-	-	-	33	-	-	-	-	-	-	-	-	25	-	-
Common Potoo *Nyctibius griseus*	-	-	17	17	-	-	-	-	-	-	-	-	-	-	-
Short-tailed Nighthawk *Lurocalis semitorquatus*	-	-	17	33	48	-	-	-	-	-	19	137	-	36	-
Pauraque *Nyctidromus albicollis*	-	50	33	50	286	-	-	-	-	-	19	118	50	18	-
Ocellated Poorwill *Nyctiphrynus ocellatus*	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
Rufous Nightjar *Caprimulgus rufus*	-	25	-	33	-	-	-	-	-	-	-	-	-	9	-
Scissor-tailed Nightjar *Hydropsalis torquata*	-	25	-	-	-	-	-	-	-	-	-	-	25	-	-
Lesser Swallow-tailed Swift *Panyptila cayennensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-
Grey-rumped Swift *Chaetura spinicauda*	-	75	-	-	-	-	-	-	50	-	-	20	-	-	-
Rufous-breasted Hermit *Glaucis hirsuta*	14	-	-	-	-	25	-	29	-	-	19	-	-	-	-
Buff-bellied Hermit *Phaethornis ochraceiventris camargoi*	-	-	-	-	-	-	-	-	-	48?	19?	59?	-	-	-
Reddish Hermit *Phaethornis ruber*	29	25	50	83	48	25	40	57	-	48	-	78	-	-	-
Swallow-tailed Hummingbird *Eupetomena macroura*	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-

English name Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Black Jacobin *Melanotrochilus fuscus*	-	-	-	-	-	-	-	-	-	-	-	78	-	-	-
Sombre Hummingbird *Aphantochroa cirrochloris*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Black-throated Mango *Anthracothorax nigricollis*	-	-	-	-	-	50	-	29	-	48	19	-	-	-	-
Ruby-topaz Hummingbird *Chrysolampis mosquitus*	-	-	-	-	-	50	-	-	-	-	-	20	25	9	-
Blue-chinned Sapphire *Chlorestes notatus*	29	25	33	50	-	25	40	43	100	-	-	-	25	-	-
Glittering-bellied Emerald *Chlorostilbon aureoventris*	-	-	-	-	-	-	-	-	-	95	-	-	-	-	-
Long-tailed Woodnymph *Thalurania watertonii*	29	25	-	33	-	-	-	-	-	143	-	20	-	-	-
Rufous-throated Sapphire *Hylocharis sapphirina*	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White-chinned Sapphire *Hylocharis cyanus*	-	25	17	17	-	-	-	14	-	-	-	78	-	-	-
Versicoloured Emerald *Agyrtria versicolor*	14	-	-	-	-	-	-	-	-	48	-	-	-	-	-
Glittering-throated Emerald *Amazilia fimbriata*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Black-eared Fairy *Heliothryx aurita*	-	25	-	-	-	-	-	-	-	-	37	-	-	-	-
Blue-crowned Trogon *Trogon curucui*	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-
White-tailed Trogon *Trogon viridis*	43	50	-	33	-	25	-	-	-	95	-	-	-	9	14
Green Kingfisher *Chloroceryle americana*	14	-	-	-	-	-	-	29	-	48	-	-	-	-	-
Blue-crowned Motmot *Momotus momota marcgraviana*	14	-	-	-	-	-	-	71	-	95	-	59	-	82	-
Rufous-tailed Jacamar *Galbula ruficauda*	29	50	50	17	-	25	40	100	100	48	93	20	-	9	-
Lettered Aracari *Pteroglossus inscriptus*	-	-	-	-	-	-	-	43	-	-	37	-	-	18	-
Black-necked Aracari *Pteroglossus aracari*	-	25	-	-	-	-	240	29	-	-	-	-	-	127	43
Channel-billed Toucan *Ramphastos vitellinus*	14	-	-	-	-	-	-	-	-	-	-	78	-	-	-
Golden-spangled Piculet *Picumnus exilis pernambucensis*	-	-	-	17	-	75	80	43	100	48	19	157	-	36	-
Fulvous Piculet *Picumnus fulvescens*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Little Woodpecker *Veniliornis passerinus*	-	-	-	-	-	-	-	-	-	95	-	-	-	-	-
Red-stained Woodpecker *Veniliornis affinis*	43	-	-	-	-	-	160	-	-	-	19	39	-	18	-
Yellow-throated Woodpecker *Piculus flavigula*	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
Golden-green Woodpecker *Piculus chrysochloros*	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-
Blond-crested Woodpecker *Celeus flavescens*	29	-	-	-	-	-	-	-	-	48	19	-	-	-	-
Lineated Woodpecker *Dryocopus lineatus*	14	25	-	-	-	-	-	-	-	-	19	20	-	-	-
Sooty-fronted Spinetail *Synallaxis frontalis*	-	-	-	-	-	25	-	-	-	-	19	-	50	-	-
Pinto's Spinetail *Synallaxis infuscata*	-	-	-	-	-	25	-	-	-	-	74	-	-	-	-
Grey-headed Spinetail *Cranioleuca semicinerea*	-	-	-	-	-	-	-	-	-	-	74	20	-	-	-
Yellow-chinned Spinetail *Certhiaxis cinnamomea*	-	-	-	-	-	-	-	-	-	-	37	20	-	-	-
Common Thornbird *Phacellodomus rufifrons*	-	-	-	-	-	-	-	-	-	-	19	20	-	-	-
Plain Xenops *Xenops minutus alagoanus*	57	25	-	-	-	-	40	29	-	48	19	20	-	9	-
White-eyed Foliage-gleaner *Automolus leucophthalmus lammi*	-	-	-	-	-	-	-	-	-	-	-	137	-	-	-
Plain-brown Woodcreeper *Dendrocincla fuliginosa taunay*	-	-	-	-	-	-	-	29	-	-	-	78	-	18	-
Olivaceous Woodcreeper *Sittasomus griseicapillus*	43	25	-	17	-	100	-	43	50	95	37	59	-	45	-
Straight-billed Woodcreeper *Xiphorhynchus picus*	14	50	-	-	-	-	-	-	-	-	19	20	25	-	-
Buff-throated Woodcreeper *Xiphorhynchus guttatus*	14	-	17	100	95	50	-	100	-	-	37	-	-	55	29
Lesser Woodcreeper *Lepidocolaptes fuscus atlanticus*	-	-	-	-	-	25	-	-	-	-	-	20	-	-	-
Great Antshrike *Taraba major*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Barred Antshrike *Thamnophilus doliatus*	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
White-shouldered Antshrike *Thamnophilus aethiops distans*	-	-	-	-	-	-	80	29	-	-	-	78	-	-	-
Variable Antshrike *Thamnophilus caerulescens pernambucensis*	86	25	-	-	95	25	-	-	50	-	74	39	100	27	14
Rufous-winged Antshrike *Thamnophilus torquatus*	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-
Plain Antvireo *Dysithamnus mentalis*	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-
White-flanked Antwren *Myrmotherula axillaris*	29	50	33	17	-	-	40	86	100	-	-	78	-	18	57
Black-capped Antwren *Herpsilochmus atricapillus*	57	50	-	33	-	-	-	-	-	-	56	-	-	-	-
Rufous-winged Antwren *Herpsilochmus rufimarginatus*	86	50	100	133	95	275	80	143	250	95	37	490	-	27	-
White-fringed Antwren *Formicivora grisea*	114	50	33	33	95	25	40	114	100	-	-	-	-	-	-
Orange-bellied Antwren *Terenura sicki*	-	-	-	-	-	-	-	-	-	-	-	98	-	-	-
Willis' Antbird *Cercomacra laeta sabinoi*	14	-	-	-	-	-	-	-	-	-	-	39	-	-	-
White-backed Fire-eye *Pyriglena leuconota pernambucensis*	29	50	33	-	-	50	80	43	100	48	-	118	-	-	14
Scalloped Antbird *Myrmeciza ruficauda soror*	-	-	-	-	-	-	-	-	-	-	-	235	-	-	29
Rufous-capped Antthrush *Formicarius colma*	-	-	-	33	-	-	-	14	-	-	-	20	-	-	-
Rufous Gnateater *Conopophaga lineata cearae*	14	25	-	-	-	25	-	-	-	-	-	-	-	-	-
Black-cheeked Gnateater *Conopophaga melanops nigrifrons*	-	50	33	33	48	25	-	14	-	-	-	157	-	55	14
Screaming Piha *Lipaugus vociferans*	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-
Bearded Bellbird *Procnias averano*	43	-	-	-	-	-	80	86	-	-	-	-	-	-	-
White-bearded Manakin *Manacus manacus*	114	100	-	-	-	75	40	-	100	95	204	59	-	55	-
Blue-backed Manakin *Chiroxiphia pareola*	171	100	67	200	190	25	120	257	200	190	93	588	-	73	14
Red-headed Manakin *Pipra rubrocapilla*	86	100	33	50	48	100	120	100	-	48	130	510	-	55	-
Pale-bellied Tyrant-manakin *Neopelma pallescens*	86	100	17	17	-	-	-	29	-	-	19	39	-	-	-
Slender-footed Tyrannulet *Zimmerius gracilipes*	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
White-lored Tyrannulet *Ornithion inerme*	-	-	-	-	-	-	80	-	100	48	19	-	-	36	-
Southern Beardless-tyrannulet *Camptostoma obsoletum*	29	100	17	33	48	125	-	43	50	48	-	20	25	18	-
Yellow Tyrannulet *Capsiempis flaveola*	57	100	-	-	-	175	-	-	-	95	19	39	-	-	-
Forest Elaenia *Myiopagis gaimardii*	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-

English name Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Large Elaenia *Elaenia spectabilis*	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yellow-bellied Elaenia *Elaenia flavogaster*	29	25	17	17	-	125	120	14	-	190	74	118	75	36	-
White-crested Tyrannulet *Contopus cinereus*	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-
Sepia-capped Flycatcher *Leptopogon amaurocephalus*	14	25	17	17	48	125	-	43	50	48	19	39	-	73	-
Alagoas Tyrannulet *Phylloscartes ceciliae*	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
White-eyed Tody-tyrant *Hemitriccus zosterops naumburgae*	43	50	67	83	95	50	120	100	100	95	19	216	-	91	-
Common Tody-flycatcher *Todirostrum cinereum*	14	25	-	-	-	150	-	43	-	-	111	-	75	18	-
White-throated Spadebill *Platyrinchus mystaceus*	-	-	-	-	143	-	-	29	-	48	-	20	-	-	-
Olivaceous Flatbill *Rhynchocyclus olivaceus*	-	-	17	-	-	-	-	-	-	-	-	59	-	-	-
Yellow-olive Flycatcher *Tolmomyias poliocephalum*	-	-	17?	-	-	-	-	57?	-	-	19?	-	-	-	-
Yellow-breasted Flycatcher *Tolmomyias flaviventris*	57	100	67	67	143	150	-	114	50	143	19	98	25	27	-
Bran-coloured Flycatcher *Myiophobus fasciatus*	-	-	-	-	-	-	-	14	-	-	19	-	25	-	-
Euler's Flycatcher *Lathrotriccus euleri*	-	50	33	33	48	-	-	14	-	48	74	39	-	27	-
Masked Water-tyrant *Fluvicola nengeta*	-	-	-	-	-	25	-	86	-	-	74	-	-	-	-
Bright-rumped Attila *Attila spadiceus*	-	-	17	17	48	25	-	71	-	48	37	98	-	36	14
Greyish Mourner *Rhytipterna simplex*	14	25	17	17	48	25	-	29	50	95	-	157	-	27	14
Dusky-capped Flycatcher *Myiarchus tuberculifer*	-	-	-	-	-	-	-	-	-	48	-	-	-	-	-
Swainson's Flycatcher *Myiarchus swainsoni*	29	-	-	50	-	-	-	-	100	95	-	20	-	-	-
Short-crested Flycatcher *Myiarchus ferox*	-	-	-	-	-	-	-	29	-	-	-	-	25	-	-
Great Kiskadee *Pitangus sulphuratus*	29	25	-	-	-	25	-	43	-	48	130	-	25	18	-
Boat-billed Flycatcher *Megarynchus pitangua*	57	50	-	-	-	25	-	-	100	95	111	59	25	18	-
Social Flycatcher *Myiozetetes similis*	29	50	-	-	-	100	-	143	-	95	37	78	-	18	-
Streaked Flycatcher *Myiodynastes maculatus*	-	-	17	-	48	-	-	-	-	-	-	-	-	-	-
Variegated Flycatcher *Empidonomus varius*	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-
Tropical Kingbird *Tyrannus melancholicus*	14	25	17	17	-	225	-	29	-	95	56	137	-	36	-
Thrush-like Schiffornis *Schiffornis turdinus intermedius*	14	-	17	33	48	-	-	57	50	48	-	-	-	18	-
Green-backed Becard *Pachyramphus viridis*	-	-	-	-	-	25	-	14	50	48	-	-	-	-	-
White-winged Becard *Pachyramphus polychopterus*	14	25	-	-	-	-	-	-	50	95	37	20	-	-	-
Grey-breasted Martin *Progne chalybea*	-	-	-	-	-	-	-	-	-	190	37	-	-	-	-
White-rumped Swallow *Tachycineta leucorrhoa*	-	-	-	-	-	-	-	57	-	-	-	-	-	-	-
Blue-and-white Swallow *Notiochelidon cyanoleuca*	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Southern Rough-winged Swallow *Stelgidopteryx ruficollis*	29	-	-	-	-	75	-	43	100	381	19	-	-	127	-
Black-capped Donacobius *Donacobius atricapillus*	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Moustached Wren *Thryothorus genibarbis*	86	50	33	33	95	200	80	143	300	48	-	59	100	36	-
House Wren *Troglodytes aedon*	-	25	-	-	-	100	40	-	-	-	19	20	25	18	-
Rufous-bellied Thrush *Turdus rufiventris*	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-
Pale-breasted Thrush *Turdus leucomelas*	43	100	-	-	-	200	40	43	50	48	278	137	50	55	57
Cocoa Thrush *Turdus albicollis*	-	-	-	-	-	-	-	-	-	-	19	39	-	-	-
Long-billed Gnatwren *Ramphocaenus melanurus*	86	25	-	-	-	-	-	-	50	48	19	373	-	45	-
Tropical Gnatcatcher *Polioptila plumbea*	-	75	-	-	-	25	-	-	-	95	37	-	-	-	-
Red-eyed Vireo *Vireo olivaceus*	143	100	100	317	333	125	-	271	100	190	93	294	150	91	29
Rufous-browed Peppershrike *Cyclarhis gujanensis*	114	25	17	17	-	75	40	-	50	95	130	176	25	9	-
Tropical Parula *Parula pitiayumi*	57	50	-	-	-	-	40	-	-	-	-	20	-	-	-
Golden-crowned Warbler *Basileuterus culicivorus*	57	25	-	17	-	100	-	14	-	95	74	20	50	36	-
Flavescent Warbler *Basileuterus flaveolus*	29	25	-	-	-	-	-	-	-	48	74	-	50	-	-
Bananaquit *Coereba flaveola*	86	100	117	67	-	250	-	100	50	190	93	314	75	55	-
Brazilian Tanager *Ramphocelus bresilius bresilius*	-	-	-	-	-	50	-	-	-	-	93	20	-	-	-
Cinnamon Tanager *Schistochlamys ruficapillus*	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-
Orange-headed Tanager *Thlypopsis sordida*	-	-	-	-	-	-	-	-	-	-	56	-	50	-	-
Guira Tanager *Hemithraupis guira*	57	50	67	-	-	50	120	-	-	-	111	118	-	-	-
Yellow-backed Tanager *Hemithraupis flavicollis melanoxantha*	43	50	167	33	-	-	-	-	100	-	37	529	-	36	-
Hooded Tanager *Nemosia pileata*	-	50	33	33	-	150	-	100	-	48	37	-	50	-	-
Flame-crested Tanager *Tachyphonus cristatus*	86	75	-	50	-	-	80	-	50	-	37	294	-	36	-
White-lined Tanager *Tachyphonus rufus*	114	50	33	-	-	175	-	-	50	190	37	98	100	55	-
Sayaca Tanager *Thraupis sayaca*	-	-	-	-	-	75	-	14	-	-	56	59	50	36	-
Palm Tanager *Thraupis palmarum*	29	50	-	-	-	225	-	100	100	-	204	157	150	73	-
Purple-throated Euphonia *Euphonia chlorotica*	-	-	-	-	-	-	-	-	-	-	19	20	25	18	-
Violaceous Euphonia *Euphonia violacea*	-	50	-	-	-	150	80	29	50	-	111	39	-	18	-
Chestnut-bellied Euphonia *Euphonia pectoralis*	-	-	-	-	-	-	-	-	-	-	-	98	-	-	-
Seven-coloured Tanager *Tangara fastuosa*	171	150	-	-	-	75	-	-	-	95	148	-	-	-	-
Red-necked Tanager *Tangara cyanocephala corallina*	-	-	-	-	-	-	-	-	-	-	444	78	200	-	-
Burnished-buff Tanager *Tangara cayana*	114	100	-	-	-	275	-	-	-	143	204	39	-	73	-
Opal-rumped Tanager *Tangara velia cyanomelaena*	57	-	-	-	-	-	280	-	-	-	-	-	-	-	-
Blue Dacnis *Dacnis cayana*	114	50	-	-	-	100	-	57	150	48	56	137	-	18	-
Green Honeycreeper *Chlorophanes spiza*	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-
Red-legged Honeycreeper *Cyanerpes cyaneus*	-	50	-	-	-	-	80	-	100	48	-	-	-	-	-
Blue-black Grassquit *Volatinia jacarina*	-	25	-	-	-	-	-	-	-	-	-	20	-	-	-
White-bellied Seedeater *Sporophila leucoptera*	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-

English name Scientific name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sooty Grassquit *Tiaris fuliginosa*	29	-	-	-	-	-	-	-	-	-	37	-	-	-	-
Pectoral Sparrow *Arremon taciturnus*	-	25	-	33	-	175	40	14	-	95	167	39	-	-	-
Rufous-collared Sparrow *Zonotrichia capensis*	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-
Buff-throated Saltator *Saltator maximus*	86	25	-	-	-	75	40	29	-	95	19	78	25	55	-
Black-throated Grosbeak *Saltator fuliginosus*	-	50	-	-	-	75	-	-	-	-	37	20	-	-	-
Yellow-green Grosbeak *Caryothraustes canadensis frontalis*	57	-	-	33	-	-	-	-	100	-	-	39	-	36	-
Epaulet Oriole *Icterus cayanensis*	-	-	-	-	-	50	-	-	-	95	37	-	25	-	-

Large canopy frugivores and omnivores

Some canopy frugivores require large territories, while all rely on limited resources such as tree hollows and adequate fruit crops. Many are targeted by poachers for meat or to supply the cagebird market. Nevertheless, most are able to cover long distances in search of fruiting trees (some even performing migrations[63]) and may be pre-adapted to fragmented landscapes provided key food resources and nest sites remain.

The most widespread parrots were the adaptable, forest-edge and cerrado *Diopsittaca nobilis* and *Aratinga jandaya*, found in nine and five sites respectively. Their comparative abundance is surprising as both are targets of illegal cagebird commerce (*D. nobilis* being made up to look like Amazon parrots) and rely on fairly large cavities for nesting, available only in older trees. *D. nobilis* is quite common in coconut groves in northern Alagoas and its ability to utilise open habitats presumably include unappreciated strategies that permit the species to survive in Alagoas.

No *Amazona* parrots were recorded, and the threatened *Amazona rhodocorytha* may be extinct in Alagoas. We also failed to record *Pyrrhura anaca*, which is apparently restricted to the montane forests of Murici[73]. *Brotogeris tirica* was found only at Mata da Sela, where a pair was observed. Its rarity is surprising as it was described as common by Teixeira *et al*.[72] and the species is widespread in south-east Brazil from sea-level (where it is very common) to over 1,000 m, and it even occurs in downtown São Paulo (pers. obs.).

Pionus menstruus reichenowi is a quite distinctive form of a widespread Amazonian species, which occurs from Alagoas south to northern Espírito Santo (records from Rio de Janeiro are uncertain: J. F. Pacheco pers. comm.). Habitat destruction has been severe within its range and the race has been heavily trapped to supply the cagebird market, although it persists in a few protected areas, principally in Espírito Santo[41,48]. This taxon deserves Vulnerable status. We found *P. m. reichenowi* in four areas (Table 2), including the large Mata do Engenho Coimbra. However, the most significant population was at site 14, where we recorded at least three different small groups. In other areas, despite the presence of apparently suitable habitat, none was recorded. In the southern Atlantic Forest, the related *P. maximiliani* is more abundant in some fragmented or logged forests[1,78], so the genus may be better able to cope with human impacts than *Amazona* species.

That the commonest forest parrot (and one of the most frequent birds in Mata do Engenho Coimbra) during our surveys was the globally threatened *Touit surda* points to the cause of the demise of the *Amazona* spp. *T. surda* is not sought as a cagebird because of its poor survival in captivity, and, not being wholly dependent on tree hollows, it is able to nest in arboreal termitaria in relatively young forest[74]. Termitaria and other alternative nest sites probably also account for the continued survival of *Diopsittaca nobilis* and *Aratinga jandaya*[27]. *D. nobilis* has successfully established feral populations in southern Brazilian cities such as São Paulo and Rio de Janeiro, nesting in buildings and other human structures[63] (pers. obs.).

Like parrots, toucans are locally sought by cagebird traffickers and are dependent on tree hollows for nesting and roosting. Toucans also feed heavily on large fruits produced by commercial timber species, e.g. *Virola*, *Ocotea* and *Copaifera* spp., and palms such as *Euterpe edulis*[28,29]. Therefore, they are almost certainly affected by selective logging and palm-heart extraction. The largest toucan in Alagoas, *Ramphastos vitellinus*, was found in only two fragments (Usina Santo Antonio 1 and Mata do Engenho Coimbra), being commonest at the latter. Its rarity is unsurprising as it requires more mature forest with larger hollowed trees and is a more desired target among poachers than the smaller species. It should be noted that the species is quite common in old second-growth forest in the southern Atlantic Forest, being easily found in isolated (but protected) forests of a few hundred hectares close to urban areas (e.g. around São Paulo and Rio de Janeiro, and in northern Santo Amaro Island) but also near large areas of continuous forest that act as sources.

Pteroglossus inscriptus is a widespread Amazonian species known from Pernambuco[52] and three localities in Alagoas[47]. We found it in another three forest fragments (Mata do Cedro, Mata do Pinto and Mata da Santa Justina), being sympatric with *P. aracari* at the first-named locality. The latter occurred in five fragments, all lowland forests, and its relatively greater abundance is consistent with its ability to persist in Atlantic Forest fragments

elsewhere[5].

Two cotingas were found during the surveys: *Lipaugus vociferans* (only at Mata da Encosta do Grotão, near sea level) and *Procnias averano* (at sites 1, 7 and 8). *Xipholena atropurpurea* has been recorded from Mata do Engenho Coimbra (two specimens in the collection of the Universidade Federal de Pernambuco[11]) but was not observed by us. *L. vociferans* is restricted to lowlands, while *P. averano* occurs to at least to 500 m. *Lipaugus* can persist in mosaics of logged forest in the Amazon (pers. obs.) and the closely related *L. unirufus* has survived, albeit in greatly reduced numbers, on Barro Colorado Island after 85 years of isolation from the mainland[62]. A similar pattern appears evident in Alagoas. Bellbirds undertake fairly extensive migrations and this ability probably assists individuals explore widely dispersed forest fragments[63]. *P. averano* has been subject to heavy trapping in Alagoas to supply bird fanciers (one specialised trapper until recently worked in the Camaragipe area: F. Pinto pers. comm.) and this pressure, combined with habitat destruction, explains the species' comparative rarity.

Trunk and twig insectivores

Only two large woodpeckers were found (*Celeus flavescens* and *Dryocopus lineatus*), both at just 3–4 sites. The lack of these otherwise common and conspicuous species able to utilise fragmented forests was striking in apparently suitable habitat such as at Usina Coruripe and Utinga-Leão. The scarcity of large woodpeckers probably affects cavity nesters such as parrots, trogons and toucans, which take advantage of the holes created by woodpeckers.

Six woodcreeper species were found. *Sittasomus griseicapillus*, *Xiphorhynchus picus* and *X. guttatus* appeared widespread and occurred even in degraded fragments, which is unsurprising given that they occupy a broad range of habitats, including woodland with sparse trees[61].

The two forest-dependent woodcreepers, the local forms of *Dendrocincla fuliginosa* and *Lepidocolaptes fuscus*, were found only in the few fragments of more humid forest with the best habitat and/or largest area. Some specialised woodcreepers, e.g. *Dendrocolaptes certhia* and *Campylorhamphus trochilirostris*, whose geographic range includes this region, were not recorded during the surveys. The rarity/absence of woodcreeper species may be linked to the observed scarcity of mixed-species flocks and army ant swarms (see below).

Understorey and ground insectivores

This group comprises forest-dependent species with limited dispersal ability that are known to be adversely affected by habitat fragmentation, changes in vegetation structure associated with logging and extraction, and loss of associated organisms such as army ants, especially if no 'source' areas of undisturbed habitat exist nearby[1,3,9,16,42,78]. Representative taxa are antbirds, e.g. *Thamnophilus aethiops*, *T. caerulescens*, *Dysithamnus mentalis*, *Myrmotherula axillaris*, *Cercomacra laeta*, *Myrmeciza ruficauda*, *Pyriglena leuconota*, *Formicarius colma*, gnateaters (*Conopophaga lineata* and *C. melanops*), some furnariids (*Synallaxis infuscata*, *Automolus leucophthalmus*) and tyrant-flycatchers (*Zimmerius gracilipes*, *Rhynchocyclus olivaceus*).

A few species, at least, appear fairly widespread and able to withstand habitat disturbance (*Thamnophilus caerulescens*, *Myrmotherula axillaris*, *Pyriglena leuconota*, *Conopophaga melanops*). *Pyriglena leuconota*, *T. caerulescens* and, especially, *Hemitriccus zosterops* are the most widespread of the endemic Pernambuco centre taxa, occurring in at least ten of the 15 surveyed sites. On the other hand, the rarity of the conspicuous *Dysithamnus mentalis*, recorded in only one area, was unexpected as the species is usually adaptable and able to maintain healthy populations in forest fragments. The apparent lack of the forest-edge *Synallaxis infuscata* and *Cercomacra laeta*[10] from most fragments was unexpected and, in the latter's case, may partially be a sampling artefact caused by lack of familiarity with the species' vocal repertoire.

Other species, found in only 1–3 areas, which appeared genuinely rare were: *Thamnophilus aethiops*, *Myrmeciza ruficauda*, *Conopophaga lineata*, *Formicarius colma*, *Automolus leucophthalmus* and *Rhynchocyclus olivaceus*. All were present (and some found only) at Mata do Engenho Coimbra and this group probably includes those species most sensitive to habitat disturbance and fragmentation. The presence of some appeared linked to specific microhabitats not found in disturbed fragments. For example, we found *Myrmeciza ruficauda* and *Automolus leucophthalmus* only in open shaded undergrowth dominated by broad-leaved Marantaceae under tall forest by creeks.

One striking observation was the rarity of this guild in apparently suitable habitat at Usina Coruripe and Mata do Cedro, and the generally low species richness and number of records of all guilds there. One explanation may be the recent widespread use of aerially dispersed chemical pesticides, which have certainly reached the isolated forests amid the plantations.

The scarcity of mixed-species flocks comprising understorey and mid-level species was also notable. Although canopy flocks of tanagers and some insectivores such as antwrens (*Herpsilochmus* spp.) were common, flocks of ground and mid-level insectivores were not observed. Also, some key (and

conspicuous) species in this group, e.g. *Sclerurus mexicanus*, *S. caudacutus*, *Dendrocolaptes certhia*, *Thamnomanes caesius*, *Thamnophilus pelzelni*, etc were completely absent, suggesting an important rupture in the bird community. This may be linked to the absence of army ant swarms, none of which was recorded by us.

Important areas

The most important areas in terms of habitat extent, quality of remaining forest and number of threatened and/or endemic bird taxa were those at Usina Serra Grande (16 species in Mata do Engenho Coimbra and eight at Mata do Pinto), Usina Utinga-Leão (11 species at Mata do Cedro), Usina Cachoeira (nine species at Bamburral) and Usina Santo Antônio (nine species at Santo Antonio 1) and, of course, the uplands of Murici. The latter is one of the most important sites for conservation in Neotropics[11,77].

The forests owned by Usina Serra Grande comprise one the most continuous and best-preserved fragments in north-east Brazil, and Mata do Engenho Coimbra may be the largest remnant in the entire region, given the continuing deforestation at Murici. Mata do Engenho Coimbra, despite the activities of poachers, holds most of the endemics described from Murici except, apparently, the local race of Solitary Tinamou, *Tinamus solitarius pernambucensis*, and Alagoas Foliage-gleaner *Philydor novaesi*.

Mata do Cedro may be the largest remnant midway between the sea and the Serra de Borborema highlands, and holds very good habitat. The area is interesting because of the presence of bellbirds and other large frugivores such as toucans and guans, and was one the few fragments where *Thamnophilus aethiops* and *Dendrocincla fuliginosa* were found. The area certainly warrants further research.

The small fragments at Usina Santo Antônio are restricted to the valleys and slopes of low hills. However, the presence of tinamous (*Crypturellus strigulosus*), hawks (*Leptodon cayanensis*), parrots (*Pionus menstruus reichenowi*) and the report of a probably undescribed form of capuchin monkey, *Cebus* sp. (which is rare, but still present) place this forest as a priority for future research. The true extent of the forest belonging to the *usina* is unknown and should be investigated using up-to-date satellite images.

The forests at Usina Coruripe, especially Capiatã, are important due their extent, numbers of mature *Caesalpina echinata* trees and the apparent vegetation difference between the forests north and south of Maceió. Despite its comparatively impoverished avifauna, the Fazenda Riachão/Capiatã fragment could be used for reintroduction and/or translocation experiments of endemics.

Conservation issues

All surveyed fragments were isolated from other forest patches by sugarcane plantations, pastures and other inhospitable habitats for forest birds, effectively making them ecological islands. Though it is possible for canopy frugivores, tanagers and other groups to move between fragments, the same is not true for undergrowth and forest-floor species. Much of the observed species loss can be attributed to the isolation of forest fragments too small to harbour viable populations[25]. Clearly there is an urgent need to create forested corridors between fragments both to increase available habitat and to provide connectivity between otherwise isolated populations[34]. Forest corridors could be planted along watercourses and steep slopes, as dictated by Brazilian law, putting to better use areas that are currently under-utilised[75].

Despite most *usinas* nominally protecting their forests, woodcutting (mainly for poles and firewood) was detected in many surveyed areas. Such activity is deleterious as most forests have been selectively logged and continue to lose trees as they become adult. Planting of fast-growing species could provide an alternative source of poles, and coupled with better enforcement would help prevent further degradation. Also, forest enrichment by planting timber species important in shaping forest structure, and other species offering resources such fruits and nectar to the fauna, would assist in making better habitats of many remaining forests.

An important issue is poaching, which is undertaken using shotguns and dogs, and accounts for the general scarcity of larger birds and mammals. Among the latter, only the marmoset *Callithrix jacchus* was common and widespread (recorded in nine areas). We also recorded lone raccoons *Procyon cancrivorus* (area 12), foxes *Cerdocyon thous* (areas 6 and 12) and tayras *Eira barbara* (sites 1 and 12) and a group of c.6 coatis *Nasua nasua* (area 5). Agoutis *Dasyprocta prymnolopha* and squirrels *Sciurus alphonsei* attain high densities in isolated forest fragments in south-east Brazil[17,23] but were observed only once in areas 8 and 4, respectively, and armadillo burrows, often comparatively ubiquitous in Neotropical forests, were absent from all but areas 8 and 12. Hunting with firearms is traditional in regional culture, but is not related to the poverty of the rural population. Rather, it is a weekend activity undertaken by urbanites and country people alike, and more a pastime than for survival. According to the owners of Usina Utinga-Leão, many poachers caught red-handed in their forests are off-duty policemen enjoying target practice and leisure time with like-minded friends.

Enquiries in Maceió and Murici revealed the cost of .12 and .28 cartridges (which are favoured)

to be R$2.00–2.50 (c.US$1) apiece, while 1 kg of frozen chicken cost R$1.7 (c.US$0.68). Given other costs involved in hunting, such as transportation (there is no sizeable forest within a 10 km-radius of urban areas) and food for the hunter and his dogs, it is clear that hunting is not being driven by hunger. The common excuse that hunger causes poaching is not supported by the facts, and the activity is the most likely cause for the obvious absence or rarity of medium and large vertebrates in all surveyed forests. Only if this threat can be removed will it be possible to advance plans to reintroduce locally extinct species such as *Tinamus solitarius* and *Mitu mitu* into the larger fragments.

Research recommendations

The taxonomic status of several subspecies endemic to north-east Brazilian deserves further and urgent attention. Several taxa were originally described as species and subsequently demoted to subspecies during the 'lumping era' of the mid-20th century without detailed work to support such decisions, or relegated to synonyms by reviewers who failed to examine appropriate specimen material. The 'lower' taxonomic treatment afforded to several endemic (and certainly threatened) taxa has certainly been responsible for their conservation not being considered a priority[60,79]. Though the status of some taxa is doubtful (e.g. *Tinamus solitarius pernambucensis*), other subspecies are clearly species under either the PSC or BSC, which will dramatically increase the number of endemics and/or threatened species-level taxa in this region of Brazil. A more critical and scientific approach to taxonomic research is needed to support conservation efforts.

Local NGOs and authorities must undertake the implementation of multiple-use forested corridors between small forest fragments. Such projects are relatively inexpensive to finance and possess an obvious social component given the locally high demand for firewood, with results being apparent in the short term. This is an essential mechanism for forest birds that cannot cross the 'sea of sugarcane' that isolates forest fragments. The best tree associations for creating new habitats and their permeability by forest birds are interesting, and necessary, topics for future research.

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References

1. Aleixo, A. (1999) Effects of selective logging on a bird community in the Brazilian Atlantic Forest. *Condor* 101: 537–548.
2. Aleixo, A. (2001) Conservação da avifauna da Floresta Atlântica: efeitos da fragmentação e a importância de florestas secundárias. In: Albuquerque, J., Cândido, J. F., Straube, F. C. & Roos, A. (eds.) *Ornitologia e conservação: da ciência às estratégias*. Tubarão: Sociedade Brasileira de Ornitologia, UNISUL/CNPq.
3. Aleixo, A. & Vielliard, J. M. E. (1995) Composição e dinâmica da avifauna da Mata Santa Genebra, Campinas, São Paulo, Brasil. *Rev. Bras. Zool*. 12: 493–511.
4. Andrade-Lima, D. (1970) Recursos vegetais de Pernambuco. *Boletim do IPA* 41: 1–32.
5. Anjos, L. dos (2001) Bird communities in five Atlantic Forest fragments in southern Brazil. *Orn. Neotrop*. 12: 11–27.
6. Azevedo, S. M., Coelho, A. G. M., Larrazabal, M. E., Neves, R. M. L. & Telino, W. R. (1998) Conservação e diversidade das aves da Reserva Ecológica Dois Irmãos. In: Machado, I. C., Lopes, A. V. & Porto, K. C. (eds.) *Reserva Ecológica Dois Irmãos: estudos em um remanescente de Mata Atlântica em área urbana (Recife - Pernambuco, Brasil)*. Recife: Ed. Universidade Federal de Pernambuco.
7. Bencke, G. A. & Kindel, A. (1999) Bird counts along an altitudinal gradient of Atlantic Forest in northeastern Rio Grande do Sul, Brazil. *Ararajuba* 8: 17–23.
8. Berla, H. F. (1946) Lista de aves colecionadas em Pernambuco, com descrição de uma subespécie n., de um alótipo e notas de campo. *Bol. Museu Nac*. 65: 1–35.
9. Bierregaard, R. O. & Stouffer, P. C. (1997) Understory birds and dynamic habitat mosaics in Amazonian rainforests. In: Laurance, W. F. & Bierregaard, R. O. (eds.) *Tropical forest remnants: ecology, management and conservation of fragmented communities*. Chicago: The University of Chicago Press.
10. Bierregaard, R. O., Cohn-Haft, M. & Stotz, D. F. (1997) Cryptic biodiversity: an overlooked species and new subspecies of antbirds (Aves: Formicariidae) with a revision of *Cercomacra*

tyrannina in north-eastern South America. *Orn. Monogr*. 48: 111–128.
11. BirdLife International (2000) *Threatened birds of the world*. Cambridge, UK: BirdLife International & Barcelona: Lynx Edicions.
12. Brown, K. S. (1982) Historical and ecological factors in the biogeography of aposematic Neotropical butterflies. *Amer. Naturalist* 22: 453–471.
13. Brown, K. S. & Brown, G. G. (1992) Habitat alteration and species loss in Brazilian forests. In: Whitmore, T. C. & Sayer, J. A. (eds.) *Tropical deforestation and species extinction*. London, UK: Chapman & Hall.
14. Budiansky, S. (1994) Extinction or miscalculation? *Nature* 370: 105.
15. Cabot, J. (1992) Family Tinamidae (tinamous). In: del Hoyo, J., Elliott, A. & Sargatal, J. (eds.) *Handbook of the birds of the world*, 1. Barcelona, Lynx Edicions.
16. Christiansen, M. B. & Pitter, E. (1997) Species loss in a forest bird community near Lagoa Santa in southeastern Brazil. *Biol. Conserv*. 80: 23–32.
17. Chiarello, A. G. (1999) Effects of fragmentation of the Atlantic forest on mammal communities in south-eastern Brazil. *Biol. Conserv*. 89: 71–82.
18. Coimbra-Filho, A. F. & Câmara, I. G. (1996) *Os limites originais do Bioma Mata Atlântica na região nordeste do Brasil*. Rio de Janeiro: RCBN.
19. Collar, N. J., Gonzaga, L. P., Krabbe, N., Madroño Nieto, A., Naranjo, L. G., Parker, T. A. & Wege, D. C. (1992) *Threatened birds of the Americas: the ICBP/IUCN Red Data Book*. Cambridge, UK: International Council for Bird Preservation.
20. Collar, N. J., Crosby, M. J. & Stattersfield, A. J. (1994. *Birds to watch 2: the world list of threatened birds*. Cambridge, UK: BirdLife International (Conservation Series 4).
21. Cordeiro, P. H. C. (2001) Areografia dos Passeriformes endêmicos da Mata Atlântica. *Ararajuba* 9: 125–137.
22. Cracraft, J. (1985) Historical biogeography and patterns within the South American avifauna: areas of endemism. *Orn. Monogr*. 36: 49–84.
23. Cullen, L., Bodmer, R. E. & Padua, C. V. (2000) Effects of hunting in habitat fragments of the Atlantic forests, Brazil. *Biol. Conserv*. 95: 49–56.
24. Dean, W. (1995) *With broadax and firebrand: the destruction of the Brazilian Atlantic Forest*. Berkeley: University of California Press.
25. Diamond, J. M. (1984) "Normal" extinctions of isolated populations. In: Nitecki, M. H. (ed.) *Extinctions*. Chicago: University of Chicago Press.
26. Dixon, J. R. (1979) Origin and distribution of reptiles in lowland tropical rainforest of South America. In: Duellman, W. E. (ed.) *The South America herpetofauna: its origin, evolution and dispersal*. Lawrence: Museum of Natural History of Kansas.
27. Forshaw, J. M. (1977) *Parrots of the world*. Willughby, Australia: Lansdowne Editions.
28. Galetti, M. A. & Aleixo, A. (1998) Effects of palm harvesting on avian frugivores in the Atlantic rain Forest of Brazil. *J. Appl. Ecol*. 35: 286–293.
29. Galetti, M., Laps, R. & Pizo, M. A. (2000) Frugivory by toucans (Ramphastidae) at two altitudes in the Atlantic Forest of Brazil. *Biotropica* 32: 842–850.
30. Galetti, M. & Pizo, M. A. (1996) Fruit-eating by birds in a forest fragment in southeastern Brazil. *Ararajuba* 4: 71–79.
31. Goerck, J. (1997) Patterns of rarity in the birds of the Atlantic Forest of Brazil. *Conserv. Biol*. 11: 112–118.
32. Goerck, J. M. (1999) Distribution of birds along an elevational gradient in the Atlantic Forest of Brazil: implications for the conservation of endemic and endangered species. *Bird Conserv. Intern*. 9: 235–253.
33. Grantsau, R. (1988) *Os beija-flores do Brasil*. Rio de Janeiro: Expressão e Cultura.
34. Harris, L. D. & Silva-Lopez, G. (1992) Forest fragmentation and the conservation of biological diversity. In: Fielder, P. L. & Jain, S. K. (eds.) *Conservation biology: the theory and practice of nature conservation and management*. London, UK: Chapman & Hall.
35. Heyer, W. R. (1988) On frog distribution patterns east of the Andes. In: Vanzolini, P. E. & Heyer, W. R. (eds.) *Proceedings of a workshop on Neotropical distribution patterns*. Rio de Janeiro: Academia Brasileira de Ciências.
36. IBAMA (1998) *Reserva Biológica Guaribas: plano de ação emergencial*. Brasília: IBAMA.
37. INPE, Fundação SOS Mata Atlântica & Instituto Socioambiental (1998) *Atlas dos remanescentes florestais do domínio Mata Atlântica 1990–1995*. São Paulo: Fundação SOS Mata Atlântica/Instituto Socioambiental.
38. Janzen, D. H. (1986) The eternal external threat. In: Soulé, M. E. (ed.) *Conservation biology: the science of scarcity and diversity*. Sunderland: Sinauer.
39. Lima, A. R. & Capobianco, J. P. R. (1997) *Mata Atlântica: avanços legais e institucionais para a sua conservação*. São Paulo: Instituto Ambiental (Documentos ISA 4).
40. Lynch, J. D. (1979) The amphibians of lowland tropical forests. In: Duellman, W. E. (ed.). *The*

South America herpetofauna: its origin, evolution and dispersal. Lawrence: Museum of Natural History of Kansas.

41. Marsden, S. J., Whiffin, M. & Galetti, M. (2001) Bird diversity and abundance in forest fragments and *Eucalyptus* plantations around a Brazilian Atlantic Forest reserve. *Biodiv. Conserv*. 10: 737–751.
42. Mason, D. (1996) Responses of Venezuelan understory birds to selective logging, enrichment strips and vine cutting. *Biotropica* 28: 296–309.
43. Nardelli, P. M. (1993) *A preservação do mutum-de-Alagoas, Mitu mitu*. Queimados, RJ: Semana Ilustrada Editorial.
44. Neves, M. L. & Telino, W. R. (2000) *Caracterização e avaliação da população avifaunística (viabilização do plano de gestão e desenvolvimento de projetos para Áreas de Vulnerabilidade na APA de Guadalupe—PRODETUR/PE)*. Recife: Companhia Pernambucana do Meio Ambiente.
45. Núcleo de Biodiversidade da Universidade Federal de Pernambuco (2000) Análise de prioridades para a conservação das ecorregiões florestais costeiras de Pernambuco e florestas do interior de Pernambuco. Report to WWF Brasil.
46. Olmos, F., Albuquerque, J. L. B., Galetti, M., Milano, M., Câmara, I. G., Coimbra-Filho, A. F., Pacheco, J. F., Bauer, C., Pena, C. G., Freitas, T. R. O., Pizo, M. A. & Aleixo, A. (2001) Correção política e biodiversidade: a crescente ameaça das "populações tradicionais" à Mata Atlântica. In: Albuquerque, J., Cândido, J. F., Straube, F. C. & Roos, A. (eds.) *Ornitologia e conservação: da ciência às estratégias*. Tubarão: Sociedade Brasileira de Ornitologia, UNISUL/CNPq.
47. Pacheco, J. F. & Whitney, B. M. (1995) Range extensions for some birds in northeastern Brazil. *Bull. Brit. Orn. Club* 115: 157–163.
48. Parker, T. A. & Goerck, J. M. (1997) The importance of national parks and biological reserves to bird conservation in the Atlantic Forest region of Brazil. *Orn. Monogr*. 48: 527–541.
49. Parker, T. A., Stotz, D. F. & Fitzpatrick, J. W. (1996) Ecological and distributional databases. In: Stotz, D. F., Fitzpatrick, J. W., Parker, T. A. & Moskovits, D. K. *Neotropical birds: ecology and conservation*. Chicago: University of Chicago Press.
50. Peres, C. (2000) Evaluating the impact and sustainability of subsistence hunting at multiple Amazonian forest sites. In: Robinson, J. G. & Bennett, E. L. (eds.) *Hunting for sustainability in tropical forests*. New York: Columbia University Press.
51. Petri, S. & Fúlfaro, V. J. (1983) *Geologia do Brasil (Fanerozóico)*. São Paulo: T. A. Queiroz & Ed. Universidade de São Paulo.
52. Pinto, O. M. O. (1940) Aves de Pernambuco. *Arq. Zool., São Paulo* 1: 219–282.
53. Pinto, O. M. O. (1952) Redescobrimento de *Mitu mitu* (Linné) no nordeste do Brasil (est. de Alagoas)—provada a independência de *Mitu tuberosus* (Spix) como espécie àparte (sic). *Pap. Avulsos Zool., São Paulo* 10: 325–334.
54. Pinto, O. M. O. (1954) Resultados ornitológicos de duas viagens científicas ao estado de Alagoas. *Pap. Avulsos Zool., São Paulo* 12: 1–98.
55. Pinto, O. M. O. (1978) *Novo catálogo das aves do Brasil*, 1. São Paulo: Revista dos Tribunais.
56. Pinto, O. M. O & Camargo, E. A. de (1961) Resultados ornitológicos de quatro recentes expedições do Departamento de Zoologia ao nordeste do Brasil, com a descrição de seis novas subespécies. *Pap. Avulsos Zool., São Paulo* 13: 51–69.
57. Prance, G. T. (1982) Forest refuges: evidence from woody angiosperms. In: Prance, G. T. (ed.) *Biological diversification in the tropics*. New York: Columbia University Press.
58. Protomastro, J. J. (2001) A test for preadaptation to human disturbances in the bird community of the Atlantic Forest. In: Albuquerque, J., Cândido, J. F., Straube, F. C. & Roos, A. (eds.) *Ornitologia e conservação: da ciência às estratégias*. Tubarão: Sociedade Brasileira de Ornitologia, UNISUL/CNPq.
59. Redford, K. H. (1992) The empty forest. *Bioscience* 42: 412–422.
60. Raposo, M. A. (2001) Taxonomia alfa de aves neotropicais. In: Albuquerque, J., Cândido, J. F., Straube, F. C. & Roos, A. (eds.) *Ornitologia e conservação: da ciência às estratégias*. Tubarão: Sociedade Brasileira de Ornitologia, UNISUL/CNPq.
61. Ridgely, R. S. & Tudor, G. (1994) *The birds of South America*, 2. Austin: University of Texas Press.
62. Robinson, W. D. (1999) Long-term changes in the avifauna of Barro Colorado island, Panama, a tropical forest isolate. *Conserv. Biol*. 13: 85–97.
63. Sick, H. (1997) *Ornitologia brasileira*. Rio de Janeiro: Ed. Nova Fronteira.
64. Silva, J. L. & Strahl, S. D. (1991) Human impact on populations of chachalacas, guans and curassows (Galliformes: Cracidae) in Venezuela. In: Robinson, J. G. & Redford, K. H. (eds.) *Neotropical wildlife use and conservation*. Chicago: University of Chicago Press.
65. Silva, J. M. C. & Tabarelli, M. (2000) Tree species

impoverishment and the future flora of the Atlantic Forest of northeast Brazil. *Nature* 404: 72–74.
66. Silveira, L. F., Olmos, F. & Long, A. (submitted) History, taxonomy and status of Alagoas Curassow *Mitu mitu* (Linnaeus, 1766), the world's most threatened cracid. *Bird Conserv. Intern*.
67. Silveira, L. F., Olmos, F., Roda, S. A. & Long, A. (2003) Notes on the Seven-coloured Tanager *Tangara fastuosa* in north-eastern Brazil. *Cotinga* 20: 82–88.
68. Stattersfield, A.J., Crosby, M. J., Long, A. J. & Wege, D. C. (1998) *Endemic Bird Areas of the world: priorities for biodiversity conservation*. Cambridge, UK: BirdLife International (Conservation Series 9).
69. Teixeira, D. M. (1986) The avifauna of the north-eastern Brazilian Atlantic Forest: a case of mass extinction? *Ibis* 128: 167–168.
70. Teixeira, D. M. (1991) Revalidação de *Pyrrhura anaca* (Gmelin, 1788) do nordeste do Brasil (Psittaciformes: Psittacidae). *Ararajuba* 2: 103–104.
71. Teixeira, D. M. (1997) A conservação dos Cracidae no nordeste extremo do Brasil. In: Strahl, S. D., Beaujon, S., Brooks, D. M., Begazo, A. J., Sedaghatkish, G. & Olmos, F. (eds.) *The Cracidae: their biology and conservation*. Blaine, WA: Hancock House Publishers.
72. Teixeira, D. M., Nacinovic, J. B. & Tavares, M. S. (1986) Notes on some birds from northeastern Brazil. *Bull. Brit. Orn. Club* 106: 70–74.
73. Teixeira, D. M., Nacinovic, J. B. & Luigi, G. (1988) Notes on some birds from northeastern Brazil (3). *Bull. Brit. Orn. Club* 108: 75–79.
74. Telino Junior, W. R., Neves, R. M. L. & Carneiro, R. S. (2000) Observações de *Touit surda* (Psittacideae) em fragmentos florestais de Pernambuco, Brasil. *Melopsittacus* 3: 159–165.
75. Viana, V. M., Tabanez, A. J. & Batista, J. L. (1997) Dynamics and restoration of forest fragments in the Brazilian Atlantic Forest. In: Laurance, W. F. & Bierregaard, R. O. (eds.) *Tropical forest remnants: ecology, management and conservation of fragmented communities*. Chicago: University of Chicago Press.
76. Vivo, M. de (1997) Mammalian evidence of historical ecological change in the Caatinga semiarid vegetation of northeastern Brazil. *J. Comp. Biol*. 2: 65–73.
77. Wege, D. C. & Long, A. J. (1995) *Key Areas for threatened birds in the Neotropics*. Cambridge, UK: BirdLife International (Conservation Series 5).
78. Willis, E. O. (1979) The composition of avian communities in remanescent woodlots in southern Brazil. *Pap. Avulsos Zool., São Paulo* 33: 1–25.
79. Willis, E. O. & Oniki, Y. (1981) Levantamento preliminar de aves em treze áreas do Estado de São Paulo. *Rev. Brasil. Biol*. 41: 121–135.

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