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STATUS OF THE GLOBALLY THREATENED FOREST BIRDS OF NORTHEAST BRAZIL

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ABSTRACT

*The Atlantic Forest of northeast Brazil hosts a unique biota which is among the most threatened in the Neotropics. Near-total conversion of forest habitat to sugar cane monocultures has left the region's endemic forest-dependent avifauna marooned in a few highly-fragmented and degraded forest remnants. Here we summarise the current status of 16 globally threatened species based on surveys conducted over the last 11 years. We found a bleak situation for most of these species and consider that three endemics: *Glaucidium mooreorum* (Pernambuco Pygmy-owl), *Cichocolaptes mazarbarnetti* (Cryptic Treehunter) and *Philydor novaesi* (Alagoas Foliage-gleaner) are most likely globally extinct. Some positive news can, however, be reported for both *Leptodon forbesi* (White-collared Kite) and *Synallaxis infuscata* (Pinto's Spinetail)*

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which may warrant re-evaluation of their respective red list statuses. We outline a road map to prioritise conservation interventions in the region directed at preventing the extinction of this suite of threatened bird species and their companion biota.

KEY-WORDS: Fragmentation; Species-area relationship; Conservation intervention; Protected areas.

INTRODUCTION

The Atlantic Forest stretches across eastern Brazil, eastern Paraguay and northeastern Argentina (Rizzini, 1997). It is subdivided into regional biogeographic provinces or centres of endemism with their own unique biotas (Silva & Casteletti, 2003; Silva *et al.*, 2004). The most threatened of these endemic areas is the Pernambuco Centre of Endemism (henceforth PCE) in northeastern Brazil, a strip of Atlantic Forest north of the São Francisco River, encompassing the states of Alagoas, Pernambuco, Paraíba and Rio Grande do Norte (Brown, 1982; Prance, 1982).

This region has suffered from both the first (dating back to the 16th century) and the most severe waves of forest loss observed in any Brazilian ecoregion. Deforestation rates accelerated during the late 1970s and early 1980s (Silveira *et al.*, 2003a) when the last remaining large tracts of lowland forest were lost. This pulse of forest loss was driven by a Brazilian government program (with the support of the World Bank) called PROALCOOL which was launched in 1975 and aimed to increase ethanol production as a substitute for gasoline, helping Brazil to reduce its dependence on oil following the global petroleum crisis of the early 1970s (Teixeira, 1986; Cavalcanti, 1992; Silveira *et al.*, 2003a; Martinelli & Filoso, 2008). This drive for energy independence came at a cost of most remaining forest, leaving the regional landscape dominated by sugar-cane monocultures (Silveira *et al.*, 2003a; Tabarelli *et al.*, 2010). Regional forest cover is now reduced to 12.1% of its original pre-Columbian extent (Ribeiro *et al.*, 2009).

The legacy of this assault on the region's forests is that 48% of the remaining fragments are smaller than 10 ha and very few are larger than 1,000 ha, moreover all are embedded in a hostile matrix of sugar cane plantations (Ranta *et al.*, 1998). Remaining forest patches are threatened by on-going degradation from fire, selective-logging and firewood removal and the large-bodied vertebrate fauna is threatened by hunting (Silveira *et al.*, 2003a).

Of the 434 bird species recorded in the PCE, 65% are strongly associated with forest habitats (Roda, 2003). Fifteen of these are currently listed on the In-

ternational IUCN Red List (IUCN, 2013), making the PCE the Brazilian ecosystem with the highest relative number of threatened birds (Olmos, 2005) and probably one of the most threatened in the world (see the list of endemic and threatened species in Silveira *et al.*, 2003a). Distributional data for these threatened taxa is critical for effective conservation planning, to revise threat assessments and more pessimistically to document the likely imminent extinction of some of these bird species. Here we present new records for globally threatened species, synthesise knowledge on their tolerance to habitat loss and fragmentation, and assess their future conservation prospects.

METHODS

Study area and bird surveys

The PCE is divided into three geographical sub-units: the coastal plain, the São Franciscana depression and the Planalto da Borborema (IBGE, 1985), this last stretching across the entire PCE over 900 m asl (Moreira, 1977). The regional climate is hot and humid (Nimer, 1972), with the rainfall decreasing from the coastal plain to the interior, and increasing again at the highest altitudes (Annel, 1998 *apud* Roda, 2003). On the coast, annual rainfall varies from 1,750 to 2,000 mm, with a dry season lasting from October to January. In the interior annual rainfall varies from 1,250 to 1,750 mm, with a longer dry season extending between October and March (Coutinho *et al.*, 1998; IBGE, 1985). Broadly interpreted, the Atlantic Forest in the PCE includes mangroves, restingas, semideciduous and ombrophilous forests, and their contact zones (IBGE, 2004; Tabarelli *et al.*, 2006). Ombrophilous forests are dominated by trees in the families Leguminosae, Lauraceae, Sapotaceae, Chrysobalanaceae, and Lecythidaceae (Grillo *et al.*, 2006).

We compiled data from both intensive targeted bird surveys and opportunistic observations in the PCE over the course of the last 11 years, accumulating data for many globally-threatened bird species. These surveys were undertaken in Atlantic Forest fragments of varying size, from 6 to 1,200 hectares, all with lit-

TABLE 1: Localities visited in the PCE.

| Reference | Locality | Municipality | Geographic Coordinates | | | | Area (ha) |
|-----------|--|--------------------------|------------------------|--------------|---------------|---------|-----------|
| | | | State | Latitude (S) | Longitude (W) | | |
| PB-01 | PE Mata do Pau Ferro | Areia | PB | 6° 58' | 35° 42' | 607 | |
| PB-02 | | Serraria | PB | 6° 49' | 35° 37' | c. 25 | |
| PB-03 | RPPN Engenho Gargaú | Santa Rita | PB | 7° 01' | 34° 57' | 1058 | |
| PB-04 | RPPN Fazenda Pacatuba | Sapé | PB | 7° 02' | 35° 09' | 266 | |
| PB-05 | APP Mata do Buraquinho | João Pessoa | PB | 7° 08' | 34° 51' | 471 | |
| PB-06 | Fazenda Cidade Viva | Conde | PB | 7° 01' | 34° 57' | c. 7 | |
| PE-01 | Mata do Estado | São Vicente Férrer | PE | 7° 37' | 35° 30' | 600 | |
| PE-02 | Engenho Água Azul | Timbaúba | PE | 7° 36' | 35° 23' | c. 600 | |
| PE-03 | Mata de Aldeia | Camaragibe/Abreu e Lima | PE | 7° 52' | 35° 04' | c. 1200 | |
| PE-04 | ESEC Caetés | Paulista | PE | 7° 55' | 34° 55' | 157 | |
| PE-05 | PE Dois Irmãos | Recife | PE | 8° 00' | 34° 56' | 387 | |
| PE-06 | RVS Mata do Curado | Recife | PE | 8° 04' | 34° 57' | 102 | |
| PE-07 | Mata do CMNE | Recife | PE | 8° 04' | 34° 58' | c. 52 | |
| PE-08 | Sancho neiborhood | Recife | PE | 8° 05' | 34° 57' | | |
| PE-09 | Campus da UFRPE | Recife | PE | 8° 01' | 34° 56' | c. 8 | |
| PE-10 | Engenho Jussará | Gravatá | PE | 8° 17' | 35° 35' | c. 400 | |
| PE-11 | Sítio Vale Verde | Gravatá | PE | 8° 20' | 35° 32' | c. 430 | |
| PE-12 | Sítio do Contente | Gravatá | PE | 8° 16' | 35° 32' | c. 420 | |
| PE-13 | Sítio Palmeira | Gravatá | PE | 8° 19' | 35° 30' | c. 150 | |
| PE-14 | RPPN Bituri | Brejo da Madre de Deus | PE | 8° 16' | 36° 25' | 110 | |
| PE-15 | Engenho Utinga | Cabo de Santo Agostinho | PE | 8° 20' | 35° 03' | c. 250 | |
| PE-16 | Engenho Bita | Ipojuca | PE | 8° 22' | 35° 03' | c. 69 | |
| PE-17 | Engenho Aparauá | Goiana | PE | 7° 32' | 35° 02' | c. 20 | |
| PE-18 | | Bonito | PE | 8° 35' | 35° 47' | c. 65 | |
| PE-19 | PNM Mucuri-Hymalaia | Bonito | PE | 8° 32' | 35° 43' | 104 | |
| PE-20 | Pedra do Rosário | Bonito | PE | 8° 33' | 35° 43' | | |
| PE-21 | Engenho Brejão | Bonito | PE | 8° 34' | 35° 42' | | |
| PE-22 | Mata da Chuva | Bonito | PE | 8° 32' | 35° 41' | | |
| PE-23 | Bonito Eco Parque | Bonito | PE | 8° 37' | 35° 43' | c. 54 | |
| PE-24 | Mata da Pedra da Pimenta | Bonito | PE | 8° 31' | 35° 42' | | |
| PE-25 | Engenho Opinioso | Amaraji | PE | 8° 22' | 35° 32' | c. 350 | |
| PE-26 | RPPN Eco Fazenda Morim | São José da Coroa Grande | PE | 8° 52' | 35° 12' | 209 | |
| PE-27 | Mata das Cobras (Usina Trapiche) | Sirinhaém | PE | 8° 33' | 08° 10' | c. 43 | |
| PE-28 | Mata do Dêra (Usina Trapiche) | Sirinhaém | PE | 8° 33' | 35° 09' | c. 319 | |
| PE-29 | Mata de Santo Antônio (Usina Trapiche) | Sirinhaém | PE | 8° 33' | 35° 09' | c. 23 | |
| PE-30 | Mata do Franco II (Usina Trapiche) | Sirinhaém | PE | 8° 36' | 35° 08' | c. 6 | |
| PE-31 | Mata do Xanguá (Usina Trapiche) | Rio Formoso | PE | 8° 37' | 35° 11' | c. 570 | |
| PE-32 | | Catende | PE | 8° 36' | 35° 47' | c. 170 | |
| PE-33 | | Escada | PE | 8° 23' | 35° 12' | c. 159 | |
| PE-34 | | Ribeirão | PE | 8° 29' | 35° 16' | c. 16 | |
| PE-35 | Engenho Cachoeira Linda | Barreiros | PE | 8° 49' | 35° 18' | c. 350 | |
| AL-01 | Fazenda Triunfo | São Miguel dos Milagres | AL | 9° 12' | 35° 25' | c. 180 | |
| AL-02 | Fazanda Cachoeira | Pindoba | AL | 9° 28' | 36° 20' | c. 10 | |
| AL-03 | PM de Maceió | Maceió | AL | 9° 36' | 35° 45' | 137 | |
| AL-04 | Farol neiborhood | Maceió | AL | 9° 38' | 36° 16' | | |
| AL-05 | RPPN Madeiras | Junqueiro | AL | 9° 51' | 36° 24' | 224 | |
| AL-06 | Mata do Cedro (Usina Utinga Leão) | Rio Largo | AL | 9° 31' | 35° 54' | c. 1000 | |
| AL-07 | Usina Coruripe | Coruripe | AL | 10° 00' | 36° 16' | c. 660 | |
| SE-01 | Crasto | Santa Luzia do Itanhý | SE | 11° 22' | 37° 25' | c. 900 | |

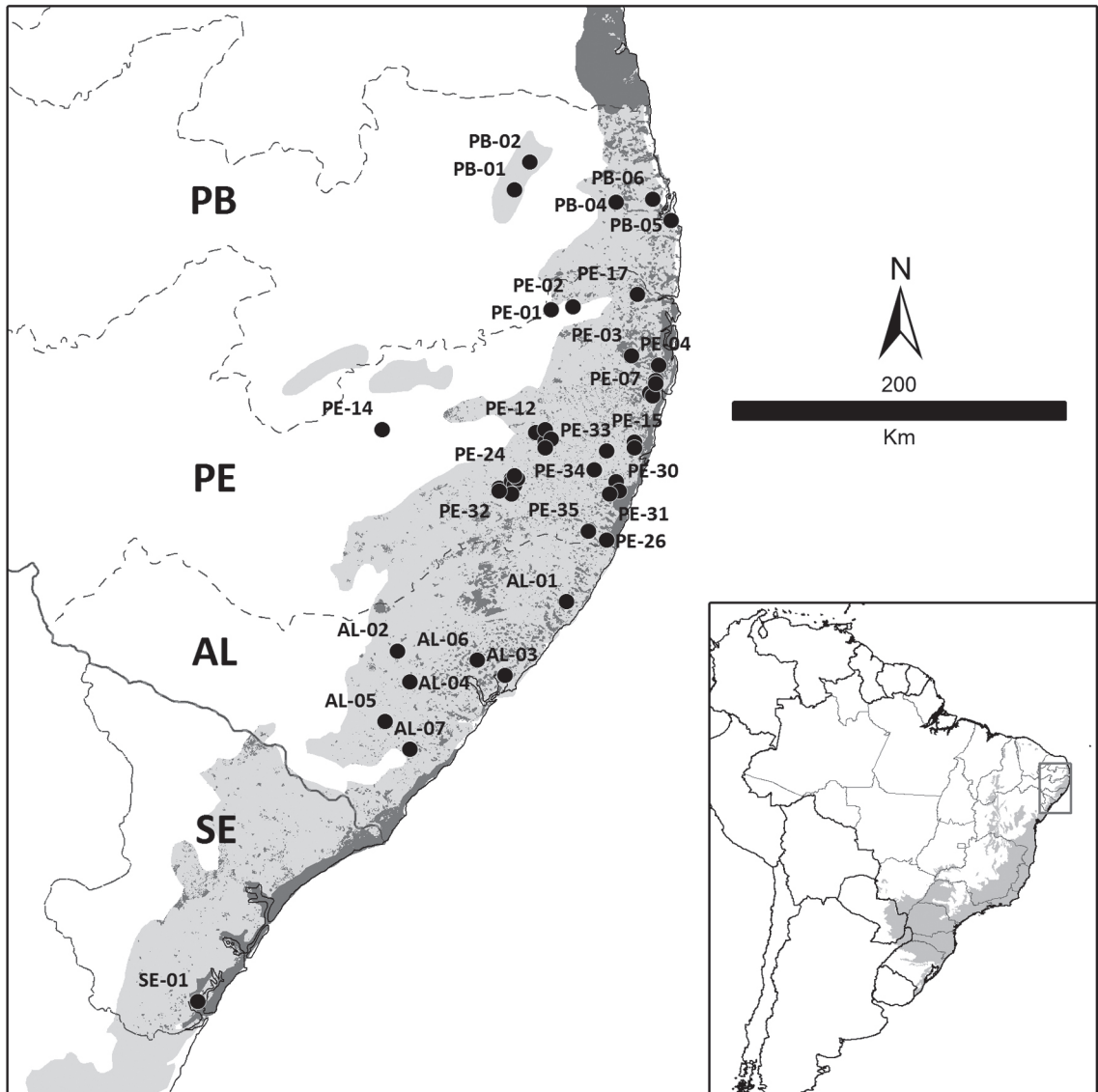


FIGURE 1: Geographical location of survey localities mentioned in the text.

tle, if any, connectivity to other fragments (Table 1). Our surveys took place in six localities in Paraíba, 35 in Pernambuco and seven in Alagoas states. An additional site outside the PCE range (in Sergipe) was included given records of two threatened birds widely regarded as endemic to the PCE *sensu strictu* (Fig. 1).

Species accounts are provided for taxa currently classified as threatened on the IUCN Red List and restricted to the PCE in addition to two recently described or 'upgraded' species and we also indicate the current national threat status as judged by the Brazilian Ministry of the Environment (Ministério do Meio Ambiente: MMA, 2003). Scientific names of the species follow those of the Comitê Brasileiro de Registros Ornitológicos (CBRO, 2014). Geographic coordi-

nates of survey sites, patch area, and habitat type are listed in Table 1. Given the importance of providing objective documentation for rare species (see *e.g.*, Lees *et al.* 2014b), we present links to digital vouchers (sound-recordings or photographs) deposited on the Brazilian avian photo archive *Wikiaves* (www.wikiaves.com.br) and/or the global avian sound library *xeno-canto* (www.xenocanto.org). Recordings on both sites are searchable by the catalogue number provided in the species accounts.

In addition to our own fieldwork we also compiled presence/absence data for all threatened species recorded in the last 11 years from 99 variable-sized forest fragments within the PCE, published both in the primary ornithological literature and in the 'grey'

TABLE 2: New locality data for threatened bird species in the PCE. Locality acronyms: ESEC = Estação Ecológica; RPPN = Reserva Particular do Patrimônio Natural; PE = Parque Estadual; APP = Área de Proteção Permanente; RVS = Refúgio da Vida Silvestre; REBIO = Reserva Biológica. Record: SR = Sound-recorded; Ob = Observed; PH = Photographed; HE = Heard.

| Species | n. ind. | Locality | Municipality/State | Date | Catalogue Number | Record |
|-----------------------------|--------------|--------------------------------------|-----------------------------|--|---------------------------------------|--------|
| <i>Leptodon forbesi</i> | 1 | Engenho Jussará | Gravatá/PE | 11/08/2006 | XC#8560 | SR |
| <i>Leptodon forbesi</i> | 1 | Sítio do Contente | Gravatá/PE | 17/09/2009 | | Ob |
| <i>Leptodon forbesi</i> | 1 | Mata do Xanguá/Usina Trapiche | Rio Formoso/PE | 15/01/2008 | | Ob |
| <i>Leptodon forbesi</i> | 1 | RPPN Eco Fazenda Morim | São José da Coroa Grande/PE | 03/06/2009 | | Ob, He |
| <i>Leptodon forbesi</i> | 2 | Engenho Água Azul | Timbaúba/PE | 24/10/2009 | | Ob, He |
| <i>Leptodon forbesi</i> | 1 | ESEC Caetés | Paulista/PE | 28/10/2012; 03/02/2013 | WA#1018593; WA#1017530 | SR |
| <i>Leptodon forbesi</i> | 1 | Engenho Brejão | Bonito/PE | 15/04/2013 | WA#936441 | SR |
| <i>Leptodon forbesi</i> | 1 | Mata do Estado | São Vicente Férrer/PE | 09/01/2005 | XC#133708 | SR |
| <i>Leptodon forbesi</i> | 1 | Parque Municipal de Maceió | Maceió/AL | 22/02/2011; 22/06/2013 | WA#301593 | PH |
| <i>Leptodon forbesi</i> | 1 (juvenile) | Fazenda Cachoeira | Pindoba/AL | 30/01/2014 | WA1232815 | PH |
| <i>Leptodon forbesi</i> | 1 | RPPN Madeiras | Junqueiro/AL | 15/04/2011; 12/05/2012 | | Ob |
| <i>Leptodon forbesi</i> | 1 | Usina Coruripe | Coruripe/AL | 24/11/2012 | | Ob |
| <i>Leptodon forbesi</i> | 2 | RPPN Engenho Gargaú | Santa Rita/PB | 27/06/2011; 04/12/2012; 15/03/2013 | WA#381963; WA#866473; WA#910806 | PH |
| <i>Leptodon forbesi</i> | 1 | Fazenda Cidade Viva | Conde/PB | 15-16/01/2013 | WA#564946 | PH |
| <i>Leptodon forbesi</i> | 1 | APP Mata do Buraquinho | João Pessoa/PB | 28/10/2011 | WA#488482 | PH |
| <i>Leptodon forbesi</i> | 1 | Craсто | Santa Luzia do Itanh/SE | 05/09/2003 | WA#1074720 | PH |
| <i>Touit surdus</i> | c. 8 | PE Dois Irmãos | Recife/PE | 01/06/2003 | XC#6447 | SR |
| <i>Touit surdus</i> | 2 | Mata do Comando Militar do Nordeste | Recife/PE | 13/01/2007 | | Ob, He |
| <i>Touit surdus</i> | 6 and 9 | Mata das Cobras/Usina Trapiche | Sirinhaém/PE | 24/11/2006; 16/12/2006 | | Ob, He |
| <i>Touit surdus</i> | 1, 2 and 4 | Mata do Xanguá/Usina Trapiche | Rio Formoso/PE | 12/04/2013; 25-26/11/2006 | XC#932659 | Ob, He |
| <i>Touit surdus</i> | 5 | Mata do Dêra/Usina Trapiche | Sirinhaém/PE | 17/12/2006 | | Ob, He |
| <i>Touit surdus</i> | 1 | Mata de Santo Antônio/Usina Trapiche | Sirinhaém/PE | 28/01/2007 | | Ob, He |
| <i>Touit surdus</i> | 4 | Engenho Aparauá | Goiana/PE | 16/10/2004 | | Ob |
| <i>Touit surdus</i> | 7 | RPPN Eco Fazenda Morim | São José da Coroa Grande/PE | 02/06/2009 | | Ob |
| <i>Touit surdus</i> | c. 6 | Mata da Pedra da Pimenta | Bonito/PE | 28/01/2012 | | He |
| <i>Touit surdus</i> | c. 5-6 | Mata de Aldeia | Camaragibe/Abreu e Lima | 2006-2012 | | Ob, He |
| <i>Touit surdus</i> | 4 | Mata do Cedro | Rio Largo/AL | 10/09/2011 | | Ob, He |
| <i>Touit surdus</i> | c. 10 | RPPN Engenho Gargaú | Santa Rita/PB | 20/12/2011; 02/08/2013; 11/01/2013 | WA#1103439 | PH, SR |
| <i>Touit surdus</i> | 2 | RPPN Fazenda Pacatuba | Sapé/PB | 30/11/2011 | | PH |
| <i>Synallaxis infuscata</i> | 4 | RPPN Bituri | Brejo da Madre de Deus/PE | 18/05/2003 | XC#7252 | SR |
| <i>Synallaxis infuscata</i> | 2 | Sítio Palmeiras | Gravatá/PE | 18/09/2004 | | SR |
| <i>Synallaxis infuscata</i> | 3 | Sítio Vale Verde | Gravatá/PE | 04-05/11/2004 | | Ob, He |
| <i>Synallaxis infuscata</i> | 2 | Engenho Jussará | Gravatá/PE | 03/01/2007 | WA#15026 | PH |
| <i>Synallaxis infuscata</i> | 2 | Sítio do Contente | Gravatá/PE | 30/08/2009; 15/09/2009 | XC#38887; XC#38885 | SR |

| Species | n. ind. | Locality | Municipality/State | Date | Catalogue Number | Record |
|-------------------------------|---------|--------------------------------|-----------------------------|--|-------------------------|--------|
| <i>Synallaxis infuscata</i> | c. 8 | Engenho OpiniOSO | Amaraji/PE | 15-16/04/2005 | XC#5630; XC#4308; | SR |
| <i>Synallaxis infuscata</i> | 1 | | Bonito/PE | 24/03/2011 | | SR |
| <i>Synallaxis infuscata</i> | 1 | | Catende/PE | 29/03/2011 | | SR |
| <i>Synallaxis infuscata</i> | c. 8 | Mata do Xanguá/Usina Trapiche | Rio Formoso/PE | 25-26/11/2006; 16/12/2006; 16/01/2007; 13/11/2010 | WA#239839 | PH, SR |
| <i>Synallaxis infuscata</i> | 1 | | Ribeirão/PE | 19/06/2013 | | PH, SR |
| <i>Synallaxis infuscata</i> | 1 | PE Mata do Pau Ferro | Areia/PB | 09/09/2011 | WA#442343; WA#650002 | PH |
| <i>Automolus lammi</i> | 1 | PE Dois Irmãos | Recife/PE | 03/06/2005 | | HE |
| <i>Automolus lammi</i> | 2 | Engenho Jussará | Gravatá/PE | 22/10/2006; 04/01/2007 | | Ob |
| <i>Automolus lammi</i> | 3 | Mata de Aldeia | Camaragibe/Abreu e Lima | 05/04/2007 | | Ob, He |
| <i>Automolus lammi</i> | 2 | RPPN Engenho Gargaú | Santa Rita/PB | 27/06/2011; 01/07/2011 | WA#382246; WA#403857 | PH |
| <i>Automolus lammi</i> | 1 | Crasto | Santa Luzia do Itanh/SE | 18/03/2004 | WA#90429; XC#80772 | PH, SR |
| <i>Myrmeciza ruficauda</i> | 1 | Mata de Aldeia | Camaragibe/Abreu e Lima | 15/06/2009 | | SR |
| <i>Myrmeciza ruficauda</i> | c. 9-10 | Engenho Cachoeira Linda | Barreiros/PE | 2006-2011 | | Ob, He |
| <i>Myrmeciza ruficauda</i> | 2? | Engenho Brejão | Bonito/PE | 15/04/2013 | | HE |
| <i>Myrmeciza ruficauda</i> | 2? | Mata da Chuva | Bonito/PE | ?/11/2011 | | HE |
| <i>Terenura sicki</i> | 2 | PNM Matas do Mucuri-Himalaya | Bonito/PE | 05/07/2011 | | Ob |
| <i>Terenura sicki</i> | c. 5 | Engenho Brejão | Bonito/PE | 15/04/2013 | | Ob |
| <i>Xipholena atropurpurea</i> | 1 | Mata do Dêra/Usina Trapiche | Sirinhaém/PE | 17/11/2006 | XC #8950 | SR |
| <i>Xipholena atropurpurea</i> | 2 | Mata do Xanguá/Usina Trapiche | Rio Formoso/PE | 17/11/2006 | | Ob |
| <i>Xipholena atropurpurea</i> | 2 and 3 | Engenho Cachoeira Linda | Barreiros/PE | 12/03/2006; 29/01/2009 | | Ob, He |
| <i>Xipholena atropurpurea</i> | 2 | RPPN Eco Fazenda Morim | São José da Coroa Grande/PE | 02/06/2009 | | Ob, He |
| <i>Phylloscartes ceciliae</i> | 4 | Engenho Jussará | Gravatá/PE | 22/10/2006 | XC#7916 | SR |
| <i>Phylloscartes ceciliae</i> | 2 | PNM Matas do Mucuri-Himalaya | Bonito/PE | 05/07/2011 | | Ob, He |
| <i>Phylloscartes ceciliae</i> | 2 | Engenho Brejão | Bonito/PE | 14/04/2013 | XC#7916 | SR |
| <i>Phylloscartes ceciliae</i> | 2 | Pedra do Rosário | Bonito/PE | 13/04/2013 | | Ob, He |
| <i>Tangara fastuosa</i> | 3 | RVS Mata do Curado | Recife/PE | 15/04/2003; 30/11/2003 | | Ob |
| <i>Tangara fastuosa</i> | 4 | RPPN Bituri | Brejo da Madre de Deus/PE | 18/05/2003 | | Ob |
| <i>Tangara fastuosa</i> | 4 | Bonito Ecoparque | Bonito/PE | 04/04/2004 | | Ob |
| <i>Tangara fastuosa</i> | 6 | Sítio Vale Verde | Gravatá/PE | 05/11/2004 | | Ob |
| <i>Tangara fastuosa</i> | 3 | Engenho Jussará | Gravatá/PE | 24/04/2005 | | Ob |
| <i>Tangara fastuosa</i> | 7 | Engenho OpiniOSO | Amaraji/PE | 15/04/2005 | | Ob |
| <i>Tangara fastuosa</i> | 4 | Mata das Cobras/Usina Trapiche | Sirinhaém/PE | 25/11/2006 | | Ob |
| <i>Tangara fastuosa</i> | 3 and 5 | Mata do Xanguá/Usina Trapiche | Rio Formoso/PE | 26/11/2006; 16/12/2006 | XC#8945 | SR |
| <i>Tangara fastuosa</i> | 2 and 6 | Mata do Dêra/Usina Trapiche | Sirinhaém/PE | 17/12/2006; 27/01/2007 | | Ob |
| <i>Tangara fastuosa</i> | 6 | RPPN Eco Fazenda Morim | São José da Coroa Grande/PE | 04/06/2009 | | Ob |

| Species | n. ind. | Locality | Municipality/State | Date | Catalogue Number | Record |
|--------------------------|-------------|--------------------------------------|-----------------------------|--|------------------|--------|
| <i>Tangara fastuosa</i> | 3 | Engenho Utinga | Cabo de Santo Agostinho/PE | 03/03/2012 | | Ob, He |
| <i>Tangara fastuosa</i> | 2 | Engenho Bita | Ipojuca/PE | 04/03/2012 | | Ob, He |
| <i>Tangara fastuosa</i> | 2 | | Ribeirão/PE | 19/06/2013 | | Ob |
| <i>Tangara fastuosa</i> | 4 | | Serraria/PB | 31/12/2006 | XC#9411 | SR |
| <i>Tangara fastuosa</i> | 1 | Fazenda Cachoeira | Pindoba/AL | 02/02/2011 | WA#301686 | PH |
| <i>Tangara fastuosa</i> | 1 | Fazenda Triunfo | São Miguel dos Milagres/AL | 17/11/2011 | WA#281101 | PH |
| <i>Tangara fastuosa</i> | 2 | RPPN Madeiras | Junqueiro/AL | 14/06/2012 | | Ob |
| <i>Tangara fastuosa</i> | 1 | Farol neighborhood | Maceió/AL | 04/01/2013 | | Ob |
| <i>Curaeus forbesi</i> | 7 | Sítio Palmeiras | Gravatá/PE | 18/09/2004 | XC#7272 | SR |
| <i>Curaeus forbesi</i> | 3 | Sítio Vale Verde | Gravatá/PE | 05/11/2004 | | Ob, He |
| <i>Curaeus forbesi</i> | c. 15 | Engenho Opinioso | Amaraji/PE | 15/04/2005 | | Ob, He |
| <i>Curaeus forbesi</i> | c. 30 | RPPN Eco Fazenda Morim | São José da Coroa Grande/PE | 02-03/06/2009 | | SR |
| <i>Curaeus forbesi</i> | c. 20 | Engenho Utinga | Cabo de Santo Agostinho/PE | 03/03/2012 | | Ob, He |
| <i>Curaeus forbesi</i> | c. 15 to 20 | Engenho Bita | Ipojuca/PE | 04/03/2012 | | Ob, He |
| <i>Curaeus forbesi</i> | 5 to 20 | Engenho Cachoeira Linda | Barreiros/PE | 2003-2011 | | Ob, He |
| <i>Curaeus forbesi</i> | c. 7 to 11 | Mata das Cobras/Usina Trapiche | Sirinhaém/PE | 24-25/11/2006; 16 and 28/01/2007 | XC#10211 | SR |
| <i>Curaeus forbesi</i> | c. 15 | Mata do Xanguá/Usina Trapiche | Rio Formoso/PE | 26/11/2006; 16/12/2006 | XC#8944 | SR |
| <i>Curaeus forbesi</i> | 6 | Mata de Santo Antônio/Usina Trapiche | Sirinhaém/PE | 27-28/01/2007 | | Ob, He |
| <i>Curaeus forbesi</i> | c. 9 or 11 | Mata do Franco II/Usina Trapiche | Sirinhaém/PE | 25/02/2007 | | Ob, He |
| <i>Curaeus forbesi</i> | 6 | | Escada/PE | 31/03/2011; 01/04/2011 | | PH |
| <i>Curaeus forbesi</i> | 1 | | Ribeirão/PE | 18/06/2013 | | PH |
| <i>Sporagra yarellii</i> | 2 | RVS Mata do Curado | Recife/PE | 30/11/2003 | | Ob, He |
| <i>Sporagra yarellii</i> | 6 and 8 | Sancho neighborhood | Recife/PE | 22/04/2004; 15/05/2004 | | Ob, He |
| <i>Sporagra yarellii</i> | 2 | Campus da UFRPE | Recife/PE | 20/09/2011 | | Ob, He |
| <i>Sporagra yarellii</i> | 2 | RPPN Bituri | Brejo da Madre de Deus/PE | 18/05/2003 | | Ob, He |
| <i>Sporagra yarellii</i> | c. 4 | Mata de Aldeia | Camargibe/Abreu e Lima | 12/03/2005 | | Ob, He |
| <i>Sporagra yarellii</i> | 1 | Engenho Utinga | Cabo de Santo Agostinho/PE | 03/03/2012 | | Ob, He |
| <i>Sporagra yarellii</i> | 2 | | Bonito/PE | 18/12/2010 | | Ob |

literature – e.g., unpublished consultancy reports (for additional data sources see Appendix). With this information we created a species-by-site matrix with binary presence/absence data. Using this matrix we assessed the species-area relationship between forest fragment area (\log_{10} ha) and number of threatened bird species, performing a linear regression model considering all 99 forest fragments for which we could find bird data. The R^2 value that we report is the adjusted R^2 . We also constructed a horizontal point plot illustrating species presence/absence in all forest fragments.

RESULTS

Our surveys amassed 97 new records of 11 threatened bird species (see Table 2). Richness of threatened species per fragment increased over the range of observed fragment sizes in the PCE (mean: 3.22 threatened species per fragment, SD: 2.72 range 1-14), generating a significant semi-log species-area relationship ($r^2 = 0.236$, $P < 0.001$, $N = 99$, Fig. 2). Threatened species varied in their responses to habitat fragmentation even among respective IUCN threat classes (Fig. 3) in a highly species-specific manner.

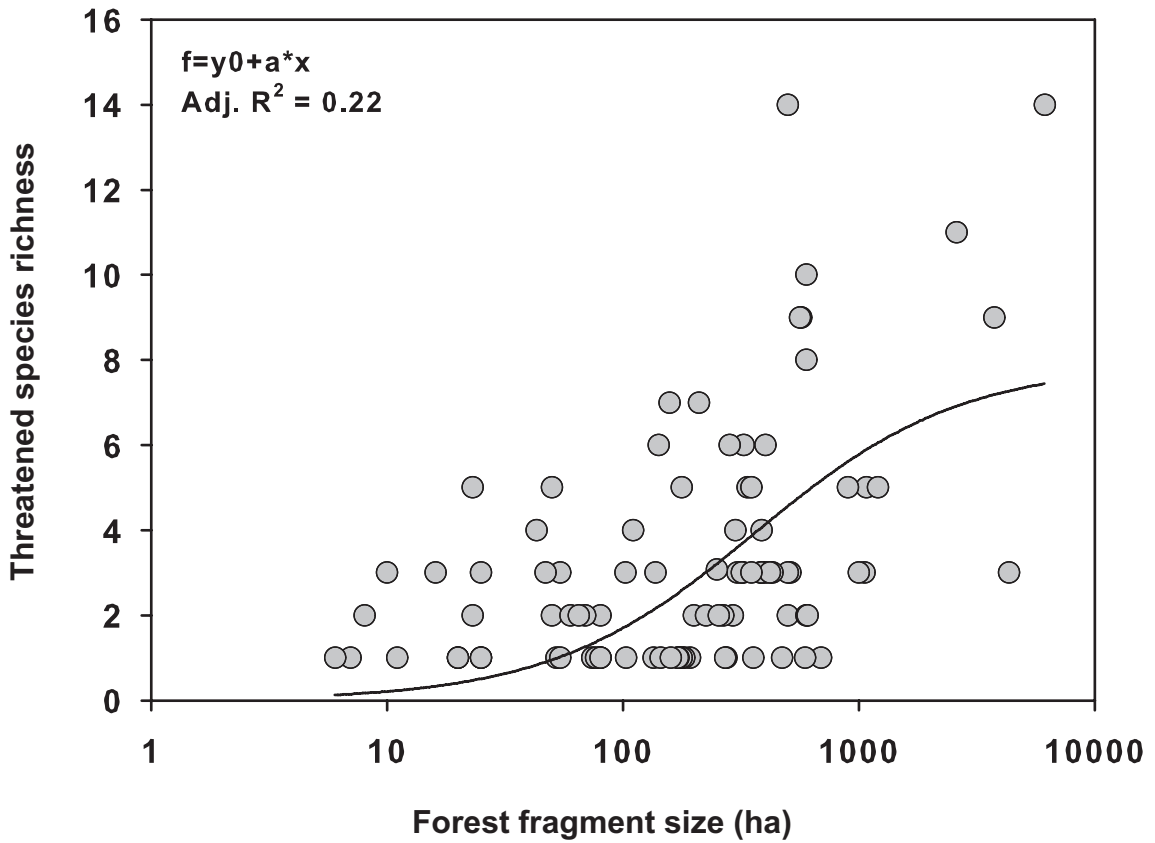


FIGURE 2: Species-area relationship for threatened birds species (n = 13) in variable-sized forest fragments in the PCE.

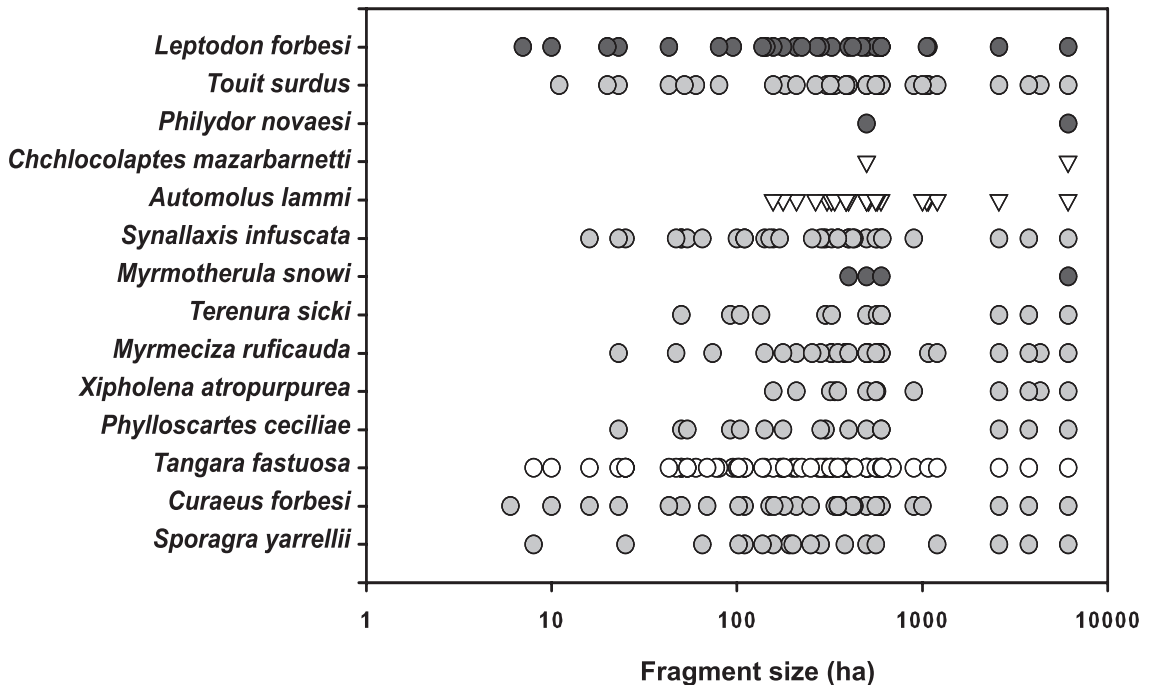


FIGURE 3: Patch occupancy for 13 threatened species of the PCE between 2003-2014, dark grey circles denote critically endangered (CR) species, light grey circles endangered (EN) species and white circles vulnerable (VU) species. The white triangles are used for two species – *Cichlocolaptes mazarbanetti* and *Automolus lammi* which have yet to be evaluated by the IUCN.

Both the well-inventoried 6,116 ha Estação Ecológica de Murici (ESEC Murici) and the 500 ha Mata do Quengo (RPPN Frei Caneca) held all the threatened species at least up until 2007 (see accounts for *Phylodor novaesi* and *Myrmotherula snowi*) but extinctions of these species have been subsequently documented at these sites. Some globally threatened species were not encountered despite our searches, and these negative results are also presented to highlight the critical situation of some threatened birds in the PCE.

Species accounts

Pauxi mitu (Linnaeus, 1766), Alagoas Curassow (IUCN and MMA: EW; Fig. 4)

The last observations of this species from the wild were made in lowland forest fragments at Ro-teiro, Barra de São Miguel, Pilar, and Marechal Deodoro in the mid 1980s (Teixeira, 1986; Silveira *et al.*, 2004). There have been no subsequent sightings by ornithologists in the region and semi-structured interviews with local people living around suitable forest fragments failed to indicate any recent sightings (Silveira *et al.*, 2004, GAP unpublished data). However, prior to this species' extinction in the wild, a few individuals were captured and a captive breeding program was launched. This program is now composed of both hybrids (with Razor-billed Curassow *Pauxi tuberosa*) and pure-bred individuals, and is currently run by two aviculturists in Minas Gerais, Brazil (see Silveira *et al.*, 2004). This captive population, now numbering over 100 pure-bred individuals, is subject to genetic management (Francisco *et al.*, in prep.) with a reintroduction program scheduled to start in 2015 in Alagoas.



FIGURE 4: *Pauxi mitu* (Linnaeus, 1766), Alagoas Curassow, Captive bird, Poços de Caldas, Minas Gerais, June 2008 (Luís Fábio Silveira).

Leptodon forbesi (Swann, 1922), White-collared Kite (IUCN: CR)

Considered one of the world's most threatened raptors, this species was recently "rediscovered" (Pereira *et al.*, 2006; Dénes *et al.*, 2011), when recorded from 12 localities in the states of Alagoas and Pernambuco (Seipke *et al.*, 2011). This species was considered a PCE endemic, but there is now a single recent record south of the São Francisco river in Sergipe outside of the PCE which may be a vagrant individual – perhaps unsurprising as a river is unlikely to form a major barrier for a large soaring forest raptor. We recorded this species from another 16 sites in Pernambuco, Alagoas and Paraíba states (Table 2). This series of new records (including the first for the state of Paraíba) suggests that this species is more widespread in the PCE than formerly thought. The persistence of some individuals in small and degraded forest fragments (and likely an ability to move between different forest patches) coupled with an apparent absence of hunting pressure, suggest a degree of resilience to land-use change in the region, although quantitative studies should be undertaken to assess this assumption. Nevertheless, we suggest that this species also ought to be the target of a captive breeding program given the relative ease at which raptors can be maintained and bred in captivity.

Touit surdus (Kuhl, 1820), Golden-tailed Parrotlet (IUCN: VU)

Despite its relatively ample distribution in the Atlantic Forest – stretching from Paraíba to São Paulo (Collar, 1997; Forshaw, 2010), this species is only known from only 12 localities in the PCE (Roda, 2003) with Silveira *et al.* (2003a) finding this parrotlet in 5 of 15 surveyed forest fragments (Fig. 3). Our fieldwork produced additional records from 13 localities in Pernambuco, Paraíba and Alagoas (Table 2). As with the preceding species, this parrotlet may be preadapted to life in fragmented landscapes as these and other psittacids have to track spatio-temporally variable fruit resources (*e.g.*, Lees & Peres, 2009). Parrotlets in the genus *Touit* have very poor survivorship in captivity and are thus not highly sought after by bird traffickers (Collar, 2000). A pair was observed attending a nest in an arboreal termitarium in the RPPN Fazenda Pacatuba, municipality of Sapé, Paraíba. The preference for nesting in arboreal termitaria frees members of this genus from dependence on tree hollows, required by many parrot species. These may be a population-limiting factor in degraded and regenerating forests with few large old trees (*e.g.*, Cockle *et al.*, 2010).

Glaucidium mooreorum
Silva, Coelho & Gonzaga, 2002,
Pernambuco Pygmy-owl (IUCN: CR)

Documented records of this enigmatic species include just the type series of two individuals collected in November 1980 and a single sound-recording obtained in October 1990 from the Reserva Biológica (REBIO) de Saltinho, Pernambuco. Since its description, the species has been extensively sought-after by many different fieldworkers in forest fragments across the PCE using playback of the single vocal sample available (see Roda & Pereira, 2006; Roda *et al.*, 2011). These searches have resulted in just one subsequent undocumented sight record of a single bird observed at Usina Trapiche in November 2001 (Silva *et al.*, 2002). Our own playbacks elicited a mobbing response in small passerines (*e.g.*, Red-headed Manakin *Ceratopipra rubrocapilla*, Olivaceous Woodcreeper *Sittasomus griseicapillus*, Variable Oriole *Icterus pyrrhopterus*) at Engenho Cachoeira Linda, Mata do Roncadorzinho, and other fragments *e.g.*, the Usina Trapiche (Mata do Dêra, Mata do Sá and Engenho Jaguaré) which we may interpret as evidence of the historic occurrence of *G. mooreorum* in these localities. Given the absence of records for a minimum period of 12 years, we consider that this species may be potentially extinct. Galileu Coelho (*pers. comm.*) regularly heard one or more individuals of this species singing near the main house of the Saltinho research station until the start of the 1990's. Pygmy-owls belonging to the *Glaucidium minutissimum* species complex (which also includes *G. hardyi*) (Marks *et al.*, 1999) occur at low densities in well-preserved forest physiognomies, so there is now very little suitable habitat left for this species in the PCE. However, there are several precedents for the rediscovery of cryptic night birds (*e.g.*, Halleux & Goodman, 1994; King & Rasmussen, 1998) and we encourage observers to keep looking, just in case.

***Philydor novaesi* Teixeira & Gonzaga, 1983,**
Alagoas Foliage-gleaner (IUCN and MMA: CR)

Discovered at Murici, Alagoas in 1979 (Teixeira & Gonzaga, 1983), this species has only ever been found at this type locality and the RPPN Frei Caneca, Pernambuco (Roda, 2008; Roda *et al.*, 2011, Fig. 5). This is one of the most highly sought-after species (by both visiting birders and professional ornithologists alike), and ourselves and others have searched extensively for this species in forest fragments across the PCE (even in forest patches outside of the 'known' altitudinal range) but with no

success. Playback of vocalisations of the Alagoas Foliage-gleaner – a nuclear species in mixed-species flocks (acting to aggregate, and orientate other flock members), attracted facultative flock-following heterospecifics (Mazar-Barnett *et al.*, 2005; Roda, 2008; Roda *et al.*, 2011), such as the Long-billed Gnatwren *Ramphocaenus melanurus* (at Murici and Bonito), Rufous-winged Antwren *Herpsilochmus rufimarginatus* and White-flanked Antwren *Myrmotherula axillaris* (at Mata do Estado). We interpret the reaction of these flock-following species as expressing interest in joining a flock and evidence for the historic occurrence of this species at Mata do Estado, Engenho Água Azul, Bonito and Gravatá. This species was last recorded from Murici in 2007 (sound-recording in Minns *et al.*, 2009 and image here: <http://ibc.lynxeds.com/photo/alagoas-foilage-gleaner-philydor-novaesi/perched-adult>) and last recorded from Frei Caneca in September 2011 (CA, video-recording) despite subsequent intensive searches at both these localities. Along with Pernambuco Pygmy-owl, we consider the Alagoas Foliage-gleaner likely extinct following forest loss, fragmentation and degradation. The disappearance of these species represent the first evidence for extinctions of endemic Brazilian birds in modern times (see Lees *et al.*, 2014a).

Cichlocolaptes mazarbarnettii
Barnett & Buzzetti, 2014,
Cryptic Treehunter (Not Evaluated)

This recently-described taxon (Mazar-Barnett & Buzzetti, 2014), was formerly confused with the preceding species with which it is cryptically similar but differs subtly in morphology, plumage, behaviour and vocalizations (see also Claramunt, 2014). Like *Philydor novaesi* it is only known from Murici and RPPN



FIGURE 5: *Philydor novaesi* Teixeira & Gonzaga, 1983, Alagoas Foliage-gleaner, Frei Caneca, PE, November 2007 (Ciro Albano).

Frei Caneca and was apparently a specialist in foraging in arboreal bromeliads. Mazar-Barnett & Buzzetti (2014) suggest that it should be listed as Critically Endangered both nationally and internationally. Realistically however this species is also likely extinct, there have been no records from other sites in the region and the last records from Frei Caneca were obtained in February 2005 (D. Buzzetti: XC#180936) and the last records from Murici was in April 2007 (D. Buzzetti: XC#180893). The disappearance of these two Furnarids and the *Glaucidium* pygmy-owl represent the first evidence for extinctions of endemic Brazilian birds in modern times.

***Synallaxis infuscata* Pinto, 1950,
Pinto's Spinetail (IUCN and MMA: EN)**

This PCE endemic is inferred to be in decline due to forest loss and fragmentation (Remsen, 2003) although we found it to be locally common, occupying edge habitats and exhibiting a greater tolerance to habitat fragmentation than other endemic birds in the PCE, potentially warranting a re-evaluation of its status (Fig. 3). Roda *et al.* (2011) were able to compile records in 53 localities in the PCE. We recorded this species from nine sites in Pernambuco and Paraíba states (Table 2, Fig. 6).



FIGURE 6: *Synallaxis infuscata* Pinto, 1950, Pinto's Spinetail, Sirinhaém, PE, November 2010 (Ciro Albano).

***Automolus lammi* Zimmer, 1947,
Pernambuco Foliage-gleaner (Not Evaluated)**

Zimmer (2008) advocated splitting this taxon from its putative sister-species, the White-eyed Foliage-gleaner (*Automolus leucophthalmus*) a change subsequently adopted by the South American Classification Committee (Remsen *et al.*, 2013) which means a formal conservation assessment by the IUCN is due.

We consider this species to be globally threatened given that it is only known from 16 localities in Pernambuco, Paraíba and Alagoas (Roda, 2003; Silveira *et al.*, 2003a; Farias *et al.*, 2007) and we present records from five new sites (Table 2). This species was also found south of the São Francisco river, in Sergipe (beyond the PCE as usually delimited) at the Mata do Crasto, in the municipality of Santa Luzia do Itanhhy by A. Grosset & J. Minns. It is hoped that the belated recognition of species status for this distinctive taxon may afford it a higher conservation profile (*e.g.*, Mace, 2004).

***Myrmotherula snowi* Teixeira & Gonzaga, 1985,
Alagoas Antwren (IUCN and MMA: CR)**

This species is known from just four disjunct localities: ESEC Murici (Alagoas), RPPN Frei Caneca, Mata do Estado and Engenho Jussará (Pernambuco) (Mazar-Barnett *et al.*, 2005; Roda *et al.*, 2011). There have been no recent records from RPPN Frei Caneca, where the last report concerns a single female photographed in 2007 (WA#92572; 13/12/2007). Despite extensive searching using playback (*e.g.*, at Engenho Jussará, Bonito, Gravatá, Maraial and Brejo dos Cavalos), we were unable to find any additional sites for this species. This species requires urgent conservation intervention to prevent its imminent extinction; less than 30 individuals are thought to survive and the species shares life history traits (such as area sensitivity and obligatory flock-following behaviour) with the Alagoas Foliage-gleaner (see Lees *et al.*, 2014a).

***Myrmoderus ruficaudus soror* (Pinto, 1940),
Scalloped Antbird (IUCN and MMA: EN)**

This species is represented in the PCE by the endemic subspecies *M. r. soror*, which is confined to humid forests in the states of Paraíba, Pernambuco and Alagoas (Zimmer & Isler, 2003; Grantsau, 2010). This taxon is known in the PCE from 29 localities (Farias *et al.*, 2002; Roda, 2003; Silveira *et al.*, 2003a; Farias *et al.*, 2007, 2010) and currently persists in forest fragments of varying sizes and in varying states of degradation. We recorded this species from an additional four sites in Pernambuco (Table 2).

***Terenura sicki* Teixeira & Gonzaga, 1983,
Orange-bellied Antwren (IUCN and MMA: EN)**

Roda *et al.* (2011) reported this PCE endemic in 14 forest fragments in upland forest (between 300 and 700 m asl) in the states of Pernambuco and Alagoas. Albano (2009) also reported this species in lowland

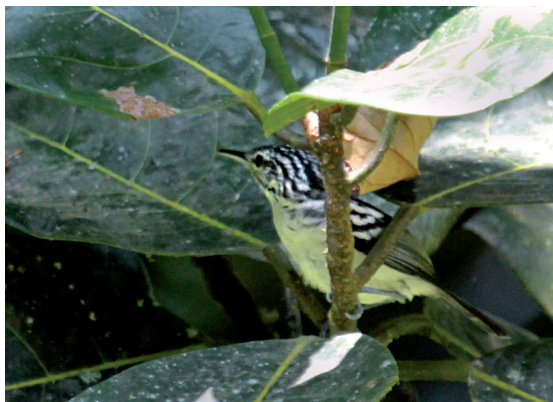


FIGURE 7: *Terenura sicki* Teixeira & Gonzaga, 1983, Orange-bellied Antwren, Frei Caneca, PE, November 2012 (Alexander Lees).



FIGURE 8: *Xipholena atropurpurea* (Wied, 1820), White-winged Cotinga, Porto Seguro, BA, November 2008 (Ciro Albano).

forest (c. 80 m asl) at Usina Trapiche. We add two new localities in Pernambuco (Table 2, Fig. 7). This species is typically seen accompanying mixed-species flocks: at the Parque Natural Municipal Mucuri-Himalaya it was observed foraging with *Veniliornis* sp., *Sittasomus griseicapillus*, *Herpsilochmus atricapillus*, *Phylloscartes ceciliae*, *Basileuterus culicivorus* and *Lanio cristatus*, and at the Engenho Brejão was observed in a mixed species flock including *Myrmotherula axillaris*, *Herpsilochmus atricapillus* and *Phylloscartes ceciliae*. This species is still recorded with some frequency at the Mata do Estado and Engenho Água Azul (GAP), and six territories were located at the 630 ha RPPN Frei Caneca in November 2012 (ACL: WA#814109, XC#113530; November/2012). It has apparently declined to a handful of pairs (perhaps now a single pair) at the ESEC Murici, Alagoas (Albano 2009, A. Whittaker *pers. comm.*). The causes of this near-extinction at the latter site are unknown, but given that the ESEC Murici is the largest remaining forest patch in the PCE this is a very worrying trend, and we consider that this species now qualifies for Critically Endangered status based on a total population now estimated at fewer than 250 mature individuals in a few disparate forest fragments.

***Xipholena atropurpurea* (Wied, 1820),
White-winged Cotinga (IUCN and MMA: EN)**

Restricted to primary lowland and adjacent foothill Atlantic forest (up to 900 m asl), between Paraíba and Rio de Janeiro (Snow, 2004), it has been reported from 13 protected areas (BirdLife International, 2013). This species has been recorded from 25 localities in the PCE between 1961 and 2003 (Roda, 2003). Our fieldwork produced records from an additional four sites in Pernambuco (Table 2, Fig. 8).

***Phylloscartes ceciliae* Teixeira, 1987,
Alagoas Tyrannulet (IUCN and MMA: EN)**

This PCE endemic is known from 17 localities in the states of Pernambuco and Alagoas (Roda *et al.*, 2011) and was found in just one of 15 fragments inventoried by Silveira *et al.* (2003a). We found this species in another four sites in Pernambuco (Table 2, Fig. 9). Although still highly imperilled, this species' conservation prospects are slightly brighter than those of the other four 'Murici endemics' – *Philydor novaesi*, *Cichlocolaptes mazarbarnetti*, *Myrmotherula snowi* and *Terenura sicki*, occurring in more forest patches albeit always at low densities (Fig. 3).



FIGURE 9: *Phylloscartes ceciliae* Teixeira, 1987, Alagoas Tyrannulet, Frei Caneca, PE, December 2007 (Ciro Albano).

***Tangara fastuosa* (Lesson, 1831),
Seven-colored Tanager (IUCN and MMA: VU)**

Silveira *et al.* (2003b) summarized the conservation status and distribution of this species. Here, we report 18 additional records across three states (Ta-



FIGURE 10: *Tangara fastuosa* (Lesson, 1831), Seven-colored Tanager, Tamandaré, PE, March 2008 (Ciro Albano).

ble 2, Fig. 10). Of the endemic and threatened birds of the PCE, this tanager is among the most tolerant to habitat disturbance, occupying forest edges and orchards where breeding behaviour has been observed (Fig. 3, Silveira *et al.*, 2003b). Capture for the illegal bird trade remains a threat, with individuals traded in illegal street markets around Recife, Pernambuco between June 2000 and June 2005, and between August 2010 and April 2011 (Pereira & Brito, 2005; Regueira & Bernard, 2012).

***Curaeus forbesi* (Sclater, 1886),
Forbes Blackbird (IUCN and MMA: EN)**

This cryptic and thus often overlooked species has two disjunct populations, one found in the PCE and the other in the state of Minas Gerais, south-east Brazil (Jaramillo & Burke, 1999; Fraga, 2011; Mazzoni *et al.*, 2012). Here, we report records from a further 13 sites in Pernambuco (Table 2, Fig. 11). The observation in Escada, Pernambuco involved a flock forag-



FIGURE 11: *Curaeus forbesi* (Sclater, 1886), Forbes Blackbird, Tamandaré, PE, October 2008 (Ciro Albano).

ing in association with *Molothrus bonariensis*. Nests of *Curaeus forbesi* are parasitised by *Molothrus bonariensis* which may represent cause declines in anthropogenic landscapes with elevated cowbird densities (Jaramillo & Burke, 1999; Fraga, 2011) but this behaviour has yet to be recorded in the PCE. The pre-Columbian habitat of Forbes's Blackbird in PCE is not known. Most of our records came from forest edges associated with sugar cane plantations, with many nests were found in mango trees, near houses. Autecological studies are needed to understand the ecology of this species in anthropogenic landscapes.

***Sporagra yarrellii* (Audubon, 1839),
Yellow-faced Siskin (IUCN and MMA: EN)**

Formerly widespread in north-eastern Brazil, now all populations are very reduced and fragmented following decades of intense illegal trapping (Fernandes-Ferreira *et al.*, 2012). Here, we found this species in seven new sites in Pernambuco (Table 2). This species is still often encountered for sale in some places in north-east Brazil.

DISCUSSION

Our surveys produced many additional records of globally threatened bird species. We reveal that the conservation situation for some poorly known species such as *Leptodon forbesi* and *Synallaxis infuscata* is more positive than previously thought, given their apparent higher tolerance to habitat loss and disturbance (Fig. 3). However, the situation for most threatened species is very bleak; for example, we failed to find new records or localities for *Philydor novaesi*, *Cichocolaptes mazarbarnetti* and *Glauucidium mooreorum*, which may be globally extinct. Many other species such as the Alagoas Antwren *Myrmotherula snowi* are in precipitous decline and their continued survival is dependent on immediate conservation intervention, if is not already too late. Fragment size (Fig. 2) was a strong predictor of threatened species richness in forest fragments of the PCE (even considering variable survey effort between fragments), reinforcing the need to protect all large forest remnants. This species-area relationship was likely mediated by significant unmeasured variation in habitat quality, with logged, burned and secondary forest patches likely harbouring fewer threatened species (*e.g.*, Moura *et al.*, 2013). However, it is also likely that variation in occupancy in some of the larger forest patches with low threatened

species richness may reflect Pre-Columbian differences in distribution patterns; for which several of the patches in the north of the region may lie outside of their respective bioclimatic distributional envelopes.

Declines and local extinctions of many guilds (Silveira *et al.*, 2003a) even in protected areas (*e.g.*, ESEC Murici) indicate that these remaining forest fragments may now be suboptimal for these species following changes to the biophysical characteristics of the fragments themselves. Small forest patches are especially vulnerable to fire, especially after selective logging events and this sensitivity is exacerbated by climatic edge effects such as exposure to drying winds, which may result in tree and bromeliad mortality (Siqueira-Filho & Tabarelli, 2006; Loarie *et al.*, 2011).

Proposed conservation actions

1) Consolidate existing fragments into larger blocks

The largest remaining forest patches as ESEC Murici are likely too small to hold viable populations of many species in the long-term, and even fragments as large as 10,000 ha are expected to owe extinction debts in the long-term (*e.g.*, Ferraz *et al.*, 2003; Lees & Peres, 2008b). Land purchases for afforestation with native tree communities (by governments or major NGOs) should be directed at areas buffering existing large fragments, perhaps within the remit of the Project for the Conservation and Sustainable Use of Brazilian Biological Diversity (PROBIO, see Tabarelli *et al.*, 2005). The resultant secondary forests will dampen edge effects on existing primary forest remnants and eventually facilitate inter-patch movements for species (such as small insectivorous passerines) behaviourally reticent or physically incapable of crossing extensive sugar cane plantations (Moore *et al.*, 2008; Lees & Peres 2009).

2) Conferral of legal protection on existing large unprotected forest fragments

Many of the largest fragments in the region (*e.g.*, around Bonito, Pernambuco) have no legal protection and efforts should be maintained to at least achieve private legal reserve (RPPN: Reserva Particular do Patrimônio Natural) status for these areas. Landowner benefits could also include additional income from responsible ecotourism (Şekercioglu, 2002) or participation in REDD+ carbon-trading schemes prioritising biodiversity (Gardner *et al.*, 2011).

3) Ensuring private landholder compliance with the Brazilian Forest Code

Fulfilment of existing *Brazilian Forest Code* requirements, which will require effective law enforcement, is needed to ensure that streams are buffered by the requisite minimum amount of riparian forest (APPs) and that existing legal reserve (RL) requirements are met. This would increase the size of and connectivity between existing forest patches and facilitate rescue effects in small patches (Alger & Lima, 2003; Lees & Peres, 2008a).

4) Consider captive breeding programs for critically endangered species

For species such as *Myrmotherula snowi*, extreme *ex-situ* conservation measures such as captive breeding may have to be considered (see *e.g.*, Groombridge *et al.*, 2004; Lees *et al.*, 2014a). Existing populations may become extinct with one or two decades without intervention and are unlikely to persist long-enough to benefit from the effects of any (hypothetical) reforestation plans. However, there are few precedents for the animal husbandry and captive breeding of subsocial passerines (although see Touchton *et al.*, 2014), so appropriate 'practice' species (*e.g.*, *Myrmotherula axillaris* as a surrogate for *M. snowi*) should be selected first to assess the viability of such an approach before the lives of individuals of the rarer species are risked.

5) Survey any remaining un-surveyed forest patches and consider the merit of translocation of 'stranded' individuals of rare species to larger patches

Not all patches within the PCE have been surveyed, and their remains the chance that individuals of species of high conservation priority may still be found in relatively small forest patches for which long term population survival is inviable. If this is the case then translocation of individuals to larger forest patches may be desirable to maintain genetic diversity of such populations (*e.g.*, VanderWerf *et al.*, 2006).

CONCLUSION

Without significant, government and NGO action, we anticipate imminent extinctions of more threatened endemic birds from the PCE and the reduction of the regional forest avifaunal poor to a handful of disturbance and fragmentation-tolerant species. These extinctions will also likely include a number of PCE endemic subspecies, many of which may be the subject of future taxonomic upgrades *e.g.*, *Xiphorhynchus (fuscus) atlanticus* (already split by the CBRO, 2011).

RESUMO

A Floresta Atlântica do Nordeste do Brasil abriga uma biota única que está entre as mais ameaçadas na região Neotropical. A quase total conversão dos habitats florestais em áreas de plantação de cana-de-açúcar deixou a avifauna florestal endêmica da região isolada em poucos remanescentes florestais altamente fragmentados e degradados. Aqui, resumimos o status atual de 16 espécies globalmente ameaçadas baseado em pesquisas conduzidas nos últimos 11 anos. Encontramos uma situação desanimadora para a maioria dessas espécies e consideramos que três espécies endêmicas: *Glauclidium mooreorum* (caturé-de-pernambuco), *Cichlocolaptes mazarbarnetti* (gritador-do-nordeste) e *Philydor novaesi* (limpa-folha-do-nordeste) estejam provavelmente extintas. Algumas notícias positivas podem, no entanto, ser reportadas para *Leptodon forbesi* (gavião-de-pescoço-branco) e *Synallaxis infuscata* (tatac), do qual necessitam de uma reavaliação de seus respectivos status na lista vermelha. Descrevemos em linhas gerais um planejamento para priorizar as intervenções conservacionistas na região direcionadas na prevenção da extinção do conjunto das espécies de aves ameaçadas e sua biota associada.

PALAVRAS-CHAVE: Fragmentação; Relação espécie-área; Intervenção conservacionista; Áreas protegidas.

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APPENDIX

Additional references used to construct species by site matrix.

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