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ARTICLE

An avifaunal inventory and conservation prospects for the Gurupi Biological Reserve, Maranhão, Brazil

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ABSTRACT: We carried out an avifaunal inventory of the Gurupi Biological Reserve, Maranhão, municipalities of Bom Jardim and Centro Novo do Maranhão, between December 2009 and December 2013. The main objective was to estimate species richness and identify endemic species. A further objective was to identify vulnerable and endangered species to provide information for the development of conservation strategies. Data were collected using mist-netting and MacKinnon lists, as well as nonsystematic observations. A total of 424 species were recorded from 64 families; 18 of which considered endemic taxa. Seven are threatened nationally: *Psophia obscura, Guaruba guarouba, Pyrrhura lepida lepida, Pteroglossus bitorquatus bitorquatus, Phlegopsis nigromaculata paraensis, Dendrocincla merula badia,* and *Dendrocolaptes medius.* In addition to these, another eight are threatened internationally (IUCN 2014): *Tinamus tao*, *Penelope pileata, Lophornis gouldii*, *Pyrrhura amazonum*, *Touit huetii, Pionites leucogaster, Pyrilia vulturina* and *Lepidothrix iris.* Survey results underscore the extreme importance of the Gurupi Biological Reserve as a strategic site for the conservation and maintenance of endemic and endangered species of the Belém Center of Endemism in Brazilian Amazonia.

KEY-WORDS: Amazon, birds, Belém Center of Endemism, endangered species, inventory.

INTRODUCTION

During the 1980s, a number of scientific expeditions were conducted in the remaining tracts of Amazonian forest in the Brazilian state of Maranhão, many of which involved the ornithological division of the Goeldi Museum, in Belém (IBAMA 1999).

These studies resulted in the production of a number of reports, which were presented in 1984 by the Brazilian Institute for Forestry Development (*Instituto Brasileiro de Desenvolvimeno Florestal* - IBDF), as the federal forestry institute was then known, concerning the Golden Parakeet, *Guaruba guarouba* (IBAMA 1999). These documents recommended the creation of a national park or biological reserve in western Maranhão. This proposal was based on biogeographical analyses of endemism and total species richness (Oren 1988), which focused primarily on the threatened species that occur in the region.

These initiatives led to the creation of the Gurupi Biological Reserve (REBIO Gurupi), through the Federal Decree N° 95614 of January 12, 1988, which had the primary objective of ensuring the conservation of the fauna and flora of one of the last significant remnants of the typical dense alluvial and plateau rainforests of the state of Maranhão (IBAMA 1999).

The REBIO Gurupi is an extremely important area for bird conservation in the Amazon, since it is located in the most threatened endemism center in Brazil, the Belém Center of Endemism (hereafter Belém CE) (Silva *et al.* 2005, De Luca *et al.* 2009). The greatest threats to this center are disorderly occupation, illegal logging and deforestation due to the expansion of agricultural activities (Skole & Tucker 1993, Gascon *et al.* 2001, Valois 2003). The expansion of agriculture and deforestation in the Brazilian Amazon has reached its highest rates in 1970s, with western and southern Maranhão ranking among the most heavily deforested areas. Only a few scattered forest fragments, located primarily within reserves, remained (Aleixo 2009).

These areas are important for studies on historical biogeography, as well as providing data for the testing of hypotheses on the processes that resulted in the formation of the region's biota (Cracraft 1985, 1994, Morrone 1994, Morrone & Crisci 1995). They also contain a number of unique and irreplaceable species (Silva *et al.* 2005).

There have been no comprehensive surveys of the avifauna of the interior of the REBIO Gurupi. The few available studies have been conducted in the areas surrounding the reserve, such as Oren & Roma (2011) and Oren (1992), who described a new subspecies, *Celeus torquatus pieteroyensi* (Pieter Oyen's Ringed Woodpecker), from the region of the Gurupi River in Maranhão, and also the forested districts of Marajo Island. To further illustrate the lack of primary data on the bird fauna of REBIO Gurupi, the appendix VII of the reserve's management plan provides a list of species actually found in a nearby forest reserve belonging to the Vale do Rio Doce mining company, in the municipality of Buriticupu (IBAMA 1999).

Here, we compile a list of bird species for the REBIO of Gurupi, identifying endemic, endangered and vulnerable species to support conservation and protection strategies in the area.

MATERIAL AND METHODS

Study area

The REBIO Gurupi is an integral protection conservation unit, created by decree number 95,614 of January 12th, 1988, which delimits a total area of 341,650 hectares. Subsequently, however, measurements of the area using a Global Positioning System corrected the area to 271,000 ha, partially located within the municipalities of Bom Jardim, Centro Novo do Maranhão, and São João do Carú, all in the state of Maranhão. The reserve is bordered by three indigenous reservations, Alto Turiaçu to the north, and Carú and Awa to the west, and is located within the Belém CE.

The reserve's management plan establishes three zones, that is, areas that present specific characteristics, which require distinct strategies of intervention and protection. During the present study, data were collected at 12 points within two of these zones - the undisturbed zone and the recovery zone (Figure 1). The points were located to best sample the different successional stages and aquatic environments found within each zone (Figure 2). All sampling points were georeferenced using a Garmin Etrex Vista, Datum SAD 69 handheld GPS (Table 1).

Undisturbed zone

The REBIO Gurupi management plan defines this area as the central and best preserved portion of the reserve (IBAMA 1999). The vegetation is dense rainforest with a continuous canopy of approximately 35 m in height, with emergent trees reaching 50 m. The most frequent canopy tree species include *Manilkara huberi* (Ducke) Standl, *Shefflera morototoni* (Aubl.) March., *Hymenaea courbaril* Linnaeus, Cenostigma tocantinum Ducke, and Goupia glabra Aubl., in addition to genera such as Hymenolobium Benth., Eschweilera Mart. ex DC., *Cordia* L., *Inga* Mill., *Jacaranda* Juss., *Simarouba* Aubl., *Spondias* L., and *Vismia* Vand. Below the canopy, the lower strata are formed by a diversity of trees, shrubs, lianas, and herbaceous plants, which formed a well stratified, shady and humid understory, with a thick layer of leaf litter. This zone is dominated by plant species of the families Rubiaceae, Maranthaceae, and Arecaceae. The structure and composition of this forest are characteristic of an advanced stage of maturity (Freitas *et al.* 2005, Prata 2007, Guariguata & Ostertag 2001). However, some areas have suffered the effects of illegal logging, which has resulted in clearings produced by the felling and dragging of trees.

Recovery zone

The REBIO Gurupi management plan defines this area as the portion of the reserve affected by anthropogenic impacts, which will be reclassified as and when it will be completely restored. This zone is characterized by the presence of a number of tracts of degraded primary forest as well as many areas previously deforested for the establishment of pastures and "slash and burn" agriculture, presenting different successional stages. Some of the sampling points were located in areas characterized by widely-spaced emergents of the genera Eschweilera Mart. Ex DC., *Byrsonima* H.B.K., *Ocotea* Aubl., and *Inga* Mill., with an understory dominated by shrubs of the family Piperaceae which are typical of an advanced stage of regeneration (Prata 2007). Other areas of this zone are characterized by the presence of the Jamaican nettletree (*Trema micrantha* (L.) Blume.), a number of different *Cecropia* species, as well as *Tapirira guianensis* Aubl., which are considered to be indicators of early-growth forests (Guariguata & Ostertag 2001). Other records were collected at distinct features of the landscape in the study areas, such as pastures, and small marshes and permanent lakes.

Systematic field work was conducted by D. M. L. and D. S. L. R., beginning in August, 2010, and ending in December, 2012. Nonsystematic observations were carried out by C. M. between December, 2009, and December, 2013. Surveys of the reserve's avifauna also involved the use of complementary qualitative and quantitative methods for the collection of data in the different habitats sampled. Survey data were collected using mist-nets and MacKinnon lists (Anjos *et al.* 2010, Ribon 2010).

The MacKinnon lists method employed (MacKinnon 1991) consisted of the identification of 10 species, which represent a sampling unit, based on the modifications suggested by Herzog *et al.* (2002). This

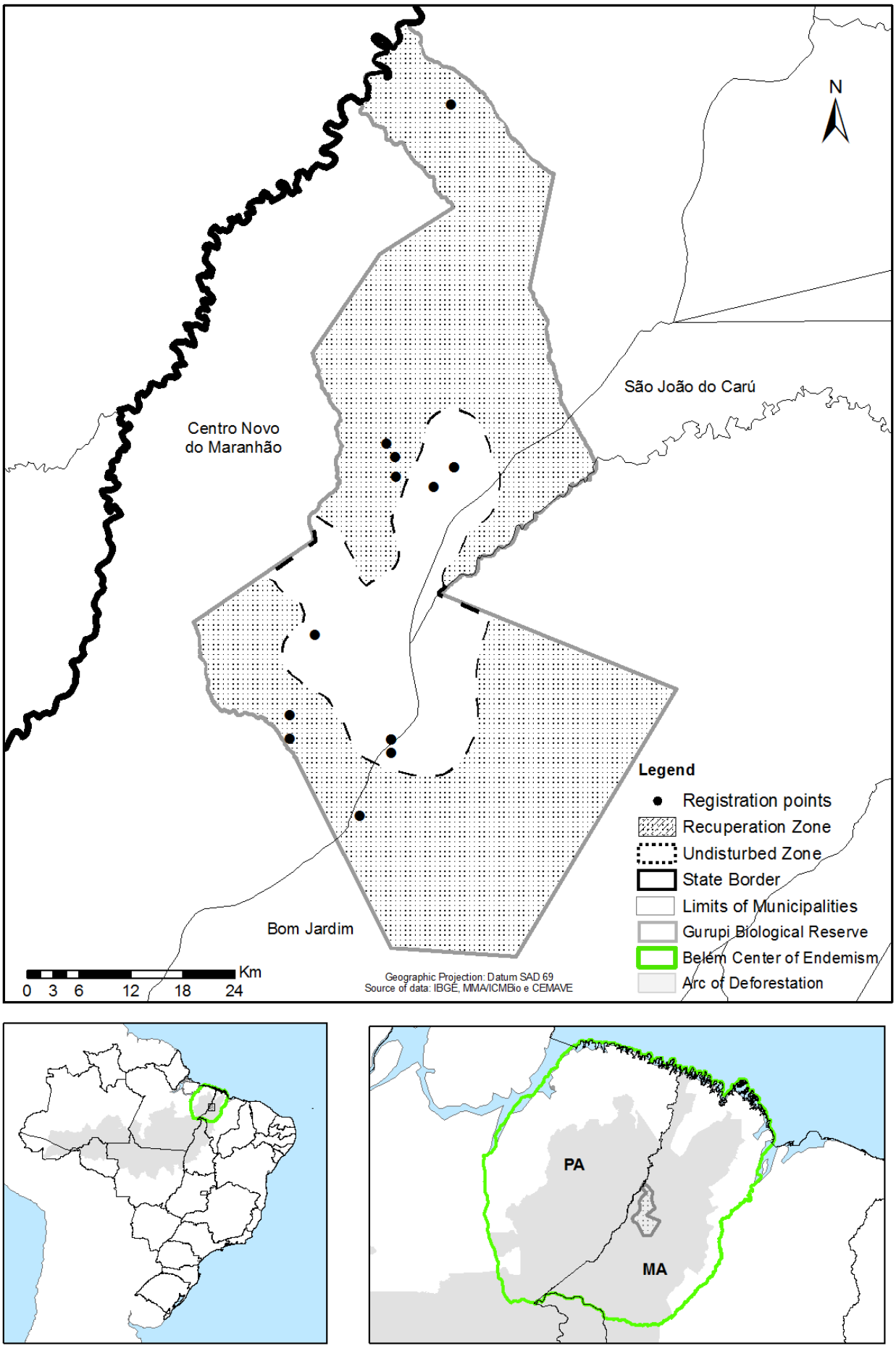

FIGURE 1. Localities surveyed during this study at REBIO Gurupi between December 2009 and December 2012. The figure also shows the location of the reservation with respect to the state of Maranhão, adjacent municipalities, the Belém Center of Endemism, and the arc of deforestation in Brazil.

FIGURE 2. Habitats surveyed in both undisturbed and recovery areas at REBIO Gurupi: (a) primary forest; (b) forest regeneration in advanced stage; (c) small marshes; (d) forest regeneration in early stage; (e) disturbed areas / pastures; (f) temporary lake. Photographs were taken by D. M. L.

procedure was used to survey all different habitat types found within the reserve, and resulted in the collection of a total of 199 lists, in order to obtain a rarefaction curve and quantify the number of species. These records were collected during 30 nonconsecutive days, generally between 06:00 h and 10:00 h in the morning, and 15:00-18:30 h in the afternoon, with a total of 225 hours of sampling time. Complementary data were collected in a nonsystematic manner by C. M. between December, 2009, and December, 2013, during periodic visits to the reserve as part of the eastern Amazonian division of the national Program for Biodiversity Research (PPBio). However, nonsystematic data obtained by C. M. were not used to estimate a rarefaction curve.

Estimates of species richness obtained with the Mackinnon lists were carried out with Bootstrap Mean estimators and CHAO 2 using the statistical program EstimateSWin 8.2 (Colwell 2006).

Additional data were collected using mist nets, with 10 nets (9 m x 2.5 m, with a 25 mm mesh) set up on nonconsecutive days in each sampling area, with five days spent in the recovery Zone, and four days in the undisturbed zone. The nets were open between 05:30 h and 18:00 h, with a total sampling effort of 625 net-hours in the recovery Zone, and 500 net-hours in the undisturbed zone. Following identification and processing, the birds captured were marked with standard CEMAVE/ICMBio metallic bands before released back into the wild.

Species were identified based on the specialized literature (Erize *et al.* 2006, Ridgely & Tudor 1989, 1994, 2009, Sick 1997, Sigrist 2009, van Perlo 2009). Photographic records obtained in the field of considerable biogeographic importance were compared with material available online (www.wikiaves.com.br), and later archived this same database. In the case of threatened species for which no documentation was available, a detailed description was recorded, based on field observations. Species of relevant biogeographical interest, for which we obtained only isolated observations, were listed separately (Appendix 1), following the recommendations in Lees *et al.* (2014).

RESULTS

Altogether 424 species were recorded at the REBIO Gurupi (Table 2). Among the species and subspecies recorded, seven were considered endangered according to the National List of Brazilian Fauna Threatened with Extinction (MMA 2003), as follows: *Psophia obscura* (Endangered - EN; also regarded as threatened globaly, see IUCN 2014), *Guaruba guarouba* (Vulnerable - VU; also threatened globaly according to the IUCN 2014), *Pyrrhura lepida lepida* (Endangered - EN, also threatened globaly according to the IUCN 2014), *Pteroglossus bitorquatus bitorquatus* (Vulnerable - VU), *Phlegopsis nigromaculata paraensis* (Endangered - EN), *Dendrocincla merula badia* (Endangered - EN), and *Dendrocolaptes medius* (Endangered - EN). In addition to these, eight species are threatened globally (IUCN 2014): *Tinamus tao* (Vulnerable - VU), *Penelope pileata* (Vulnerable - VU), *Lophornis gouldii* (Vulnerable - VU), *Pyrrhura amazonum* (Endangered - EN), *Touit huetii* (Vulnerable - VU), *Pionites leucogaster* (Vulnerable - VU), *Pyrilia vulturina* (Vulnerable - VU), and *Lepidothrix iris* (Vulnerable - VU).

We recorded 18 taxa endemic to the Belém CE: *Ortalis superciliaris*, *P. obscura*, *P. lepida lepida*, *P. bitorquatus bitorquatus*, *Celeus torquatus pieteroyensi*, *Thamnophilus aethiops incertus*, *Pyriglena leuconota leuconota*, *Phlegopsis nigromaculata paraensis*, *Dendrocincla merula badia*, *Synallaxis rutilans omissa*, *Todirostrum chrysocrotaphum illigeri*, *Piprites chloris grisescens*, *Manacus manacus purissimus*, *Terenotriccus erythrurus hellmayri*, *Ramphocaenus melanurus austerus*, *Lanio cristatus pallidigula*, *Tangara velia signata* and *Granatellus pelzelni paraensis*.

The data from mist-net captures are included here only for the calculation of species richness. The cumulative species curve based on the 10 species MacKinnon lists accumulated throughout REBIO Gurupi (n = 199) reached a total of 320 species. The CHAO 2 and Boostrap estimators calculated a total species richness of 380 and 364, respectively. Therefore, the estimated values are higher than the species richness recorded empirically (Figure 3).

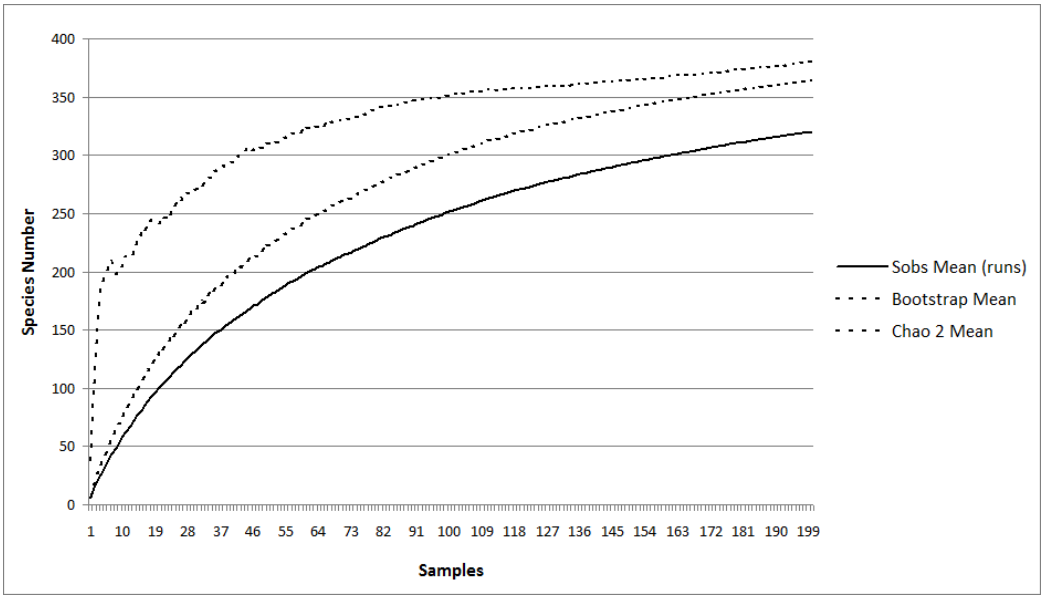

FIGURE 3. Species accumulation curve based on 199 Mackinnon lists obtained between August 2010 and December 2012 at REBIO Gurupi. Values of observed species richness (Sobs) along with those estimated by Bootstrap and CHAO 2 are shown.

TABLE 1. Coordinates (SAD 69 Lat/Lon hddd°mm'ss.s") of sampling points in undisturbed (Zd) and recovery zones (Zr) of REBIO Gurupi.

Points	Lat	Long	Area
1	W 46 42 38.0	S 03 38 33.7	Zd
2	W 46 41 21.5	S 03 37 21.2	Zd
3	W 46 50 03.1	S 03 47 50.0	Zd
4	W 46 45 16.7	S 03 54 21.2	Zd
5	W 46 45 18.0	S 03 55 10.0	Zd
6	W 46 47 15.5	S 03 59 07.4	Zr
7	W 46 51 38.1	S 03 52 48.7	Zr
8	W 46 51 36.3	S 03 54 17.3	Zr
9	W 46 44 57.9	S 03 37 57.1	Zr
10	W 46 45 02.5	S 03 36 41.2	Zr
11	W 46 45 35.2	S 03 35 52.2	Zr
12	W 46 41 34.2	S 03 14 42.5	Zr

DISCUSSION

According to Oren & Roma (2011) 503 species of birds were recorded in the Amazonian sector of Maranhão State. According to our data, REBIO Gurupi holds at least 84% of these species. Compared with the total number of species recorded for the state of Maranhão (640 spp., Oren 1991), REBIO Gurupi harbors about 66% of the bird species recorded in the state. The number of species inventoried by us in the reserve, taking into account the proportions of the sampled area, habitat heterogeneity, and sampling effort, is also significant in comparison to the total number of species recorded for the Belém CE. Roma (1996) lists 529 species for the Belém CE in the eastern part of the state of Pará, while Novaes & Lima (2009) recorded 490 species for the Belém metropolitan area, and Lees *et al*. (2012) listed 440 species for several sites at Paragominas. Only Portes *et al*. (2011) recorded a slightly greater number of species (441 species) than us at nine forest fragments of the Belém CE in the state of Pará, covering the municipalities of Paragominas, Tailândia and Tomé-Açu.

In our study, the cumulative species curve did not stabilize by the end of the sampling (Figure 3), indicating that additional species would probably have been recorded if more MacKinnon lists had been collected. The asymptote may rarely be reached in areas of high diversity (Ribon 2010), and it seems likely that further surveys at REBIO Gurupi will render a more complete picture of the diversity of the reserve's avifauna.

In the present study, the most diverse bird family was Tyrannidae, which is the third richest avian taxon in Brazil (CBRO 2014). Tyrannids are highly versatile ecologically, and are able to live in a wide range of habitats, including primary and secondary forests, as well as more open spaces (Sick 1997, Sigrist 2009). In the present study, species typical of open areas, such as *Pitangus sulphuratus, Tyrannus melancholicus, Machetornis rixosa*, and *Fluvicola nengeta*, were common in the recovery Zone. Early and mid-growth secondary forests also favor the occurrence of more generalist species, tolerant of habitat disturbance, such as *Forpus xanthopterygius, Thamnophilus doliatus, Thamnophilus palliatus, Taraba major, Legatus leucophaius, Cyanocorax cyanopogon, Pheugopedius genibarbis*, and *Ramphocelus carbo*.

The geographical proximity to other, more open biomes, such as the cerrado and dry forests, may account for species from other biomes occurring into the study area following the new open areas created by deforestation (Develey 2009, Sick 1997). Species in this category are, for example, *Bubo virginianus*, *Ara severus*, *Brotogeris chiriri*, *Columbina minuta* and *Polioptila plumbea*.

Army ant swarms, which displace insects such as crickets and cockroaches during their forays, are common in the Amazon basin (Sick 1997). These columns attract birds that habitually exploit the insect prey disturbed by the ants' foraging behavior, including species of the families Thamnophilidae, Dendrocolaptidae, and Furnaridae. This phenomenon was observed frequently during the period of the present study, with the following species commonly attending the army ant swarms: *Pyriglena leuconota, Willisornis vidua, Phlegopsis nigromaculata paraensis*, *Dendrocincla merula badia, Deconychura longicauda* and *Dendrocincla fuliginosa*. The largest numbers of thamnophilid, dendrocolaptid and furnarid species were observed in mixed species flocks in the undergrowth, which normally included *Thamnomanes caesius*, *Xenops minutus, Glyphorynchus spirurus, Deconychura longicauda, Dendrocincla fuliginosa, Dendroplex picus, Xiphorhynchus guttatus, Myrmotherula axillaris, Isleria hauxwelli, Myrmotherula menetriesii, Dysithamnus mentalis*, *Automolus rufipileatus* and *Herpsilochmus rufimarginatus.*

The relatively large number of accipitrid species recorded during the present study, in addition to a number of frugivores that are sensitive to habitat fragmentation, such as *Selenidera gouldii*, *Cotinga cotinga, Cotinga cayana, Xipholena lamellipennis, Iodopleura isabellae, Haematoderus militaris*, and *Aburria cujubi* indicate the presence of good quality habitat, and suggest a relatively well-balanced food web at REBIO Gurupi (Willis 1979, Ricklefs 2001, Noss & Csuti 1997, Lees & Peres 2006). In particular, records of *Harpia harpyja*, *Spizaetus tyrannus*, and *Leucopternis albicollis* indicate good primary forest cover, given that the presence of these raptor species may be dependent on large areas of pristine habitat (Oren & Roma 2011).

The family Psittacidae was one of the five most diverse recorded in the present study, as might be expected, considering that the Amazon region has the highest diversity of parrots (Sick 1997). Two of the taxa recorded - *Guaruba guarouba* and *Pyrrhura lepida lepida* - are listed in Brazil (MMA 2003) as threatened with extinction.

Noteworthy conservation and biogeographic records

Harpy Eagle (*Harpia harpyja*). An individual was observed perched on a maçaranduba tree (*Manilkara huberi*) in the recovery Zone in September, 2011, at around 08:00 h. This relatively robust specimen was presumed to be a female. In the same area in March, 2012, a second individual was sighted flying over an area of late-growth secondary forest. A third photographic record was obtained from a local resident of the sustainable forest management project adjacent to the biological reserve. Prior to the present study, in January, 2000, C. M. observed the species in a peripheral area of the reserve, which has now been deforested. There is evidence of genetic structuring of the *Harpia* populations in the Amazon biome, which are still relatively large, although there is lower variability in the Arc of Deforestation (ICMBio 2008). Given this, the populations located in highly impacted areas may be at increased risk of local extinction, given that this species is sensitive to anthropogenic disturbance, and is among the first to disappear when deforestation accelerates (Trinca *et al*. 2008, ICMBio 2008). The species is included in Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) and is also listed as near-threatened by the IUCN (2014).

Black-and-white Hawk-Eagle (*Spizaetus melanoleucus*). D. M. L. recorded an individual flying over the margin of the primary forest in the northern extreme of the reserve, at 03°14'42.56"S, 46°41'34.22"W (Lima 2010). In December, 2013, C. M. recorded another individual in the south of the reserve. These appear to be the first published records of the species in the Amazon sector of Maranhão, given that it is not cited in Oren & Roma (2011), although C. M. observed the species previously at a different locality (unpublished data). According to Sick (1997) the species occurs from Mexico to Argentina, and in Brazil its presence is characterized by scattered occurrences.

Orange-breasted Falcon (*Falco deiroleucus*). C. M. observed one individual on 4th March 2010 a few km south of the ICMBio station, not strictly inside the Reserve, but in the buffer zone. As far as we know, this is the first report for this species in Maranhão. The observation took place at around 07:00 hs, during a walk in the area, and the bird was perched, eating an individual of *Eupsittula aurea* (Psittacidae). The falcon showed a less compact appearence than the similar and far more common *Falco rufigularis*. It seemed to be longer-tailed than the latter species, and showed a rufous color in the upper breast. Further and most importantly, the falcon was around twice the size of the parakeet it had captured, eliminating any possible misidentification.

Dark-winged Trumpeter (*Psophia obscura*). This species was recorded on 20 occasions during the present study. Two records were obtained in December, 2009, three in June, 2010, three in August, 2010 (Lima & Raíces 2012), two in December, 2010, two in September, 2011, and six in December, 2013, all in the recovery Zone (Figure 4, C. M. photographed), with a further two records obtained in the undisturbed zone in November, 2011 (D.M. L. and D. S. L. R.). The species was observed at several locations in primary forest, but sometimes also in disturbed areas affected by illegal deforestation. While most of the sightings were recorded in the recovery zone, the vast majority of these observations coincided with the areas of pristine forest within this zone. While the species may occur throughout the Belém CE (Oren & Roma 2011), it is dependent on well-preserved habitats, and may thus be vulnerable to disturbance, which may often lead to local extinction. The species is considered to be endangered, both in Brazil (MMA 2003) and within its geographic range in general (IUCN 2014), as well as in the state of Pará (COEMA 2007). The species is rare and difficult to observe in most other forest remnants located within the Belém CE (A. Aleixo *pers. comm*.).

Golden Parakeet (*Guaruba guarouba*). This species was recorded in both recovery and undisturbed zones. On October, 2010, D. M. L. and D. S. L. R observed an active *G. guarouba* nest containing two nestlings in an angelim tree (*Hymenolobium* sp.) of approximately 40 m in height in an area of secondary forest at the edge of an access road close to the sustainable forest management project (Lima 2012a). Laranjeiras (2011) also observed Golden Parakeet nests in open areas adjacent to the continuous forest, which were exposed to potential disturbance such as nest robbery for the illegal wild bird trade. During observations of this nest, a group of three individuals were observed feeding the nestlings. Similar cooperative infant care involving family members has been observed in this species by Silveira & Belmonte (2005). During the present study, a total of approximately 145 individuals were observed during 19 encounters with the species, although it seems likely that many of these parakeets were recorded more than once, given that it was not possible to identify the animals individually. The maximum number of individuals observed during a single encounter was 34.

Pearly Parakeet (*Pyrrhura lepida lepida*) – C. M. observed four individuals flying over an area of the recovery zone in December 2009 and two other individuals were seen, also in flight, on September, 2011. Four individuals were sighted resting in the subdossel of a forest in an

advanced state of regeneration, connected by continuous primary forest in December 2011 (registration by D. M. L). In December 2012 a flock of about 8-10 individuals was sighted consuming the inflorescence of *Parkia decussata* Ducke (Fabaceae) (Lima 2012b). This species was sighted at least four times in December, 2013, in flocks of up to six individuals (registration by C. M.). Once again, it is not possible to confirm whether these encounters involved the same or different groups. Silveira (2008a) indicated that recent records of the subspecies are scarce and poorly documented, but that it probably occurred in the REBIO Gurupi. Thus, this is the first documented record of this species for the REBIO Gurupi (Table 2). The nominate subspecies distribution is in upland forest of northern and eastern Pará, between the Tocantins and Gurupi Rivers and western Maranhão, being endemic to the Belém CE (Oren & Roma 2011, Silveira 2008a). It is categorized as endangered (MMA 2003). The main threats are habitat loss and, in recent years, capture to the illegal trade of wild birds (Silveira 2008b).

FIGURE 4. Flock of Dark-winged trumpeters (*Psophia obscura*). Photograph taken on December, 2013 by C. M.

TABLE 2. List of the 424 bird species recorded in the Gurupi Biological Reserve (MA, Brazil), from December 2010 to December 2012 and (*) complementary data collected in a nonsystematic manner by C. M. between December, 2009, and December, 2013. Zoning: Zd = undisturbed zone; Zr = recovery zone. Habitat: P = primary forest; S = forest regeneration in advanced stage; Cp = forest regeneration in early stage; B = small marshes; L = lakes; aa = disturbed areas / pasture. Type of record: A = Auditory, V = Visual, Ca = capture in mist nets; F = Photographed. Photo reference numbers are searchable in the online databases of www.wikiaves.com.br (WA). Taxon/species names followed by the acronym (Tn) indicate those regarded as threatened according to the National List of Brazilian Fauna Species Threatened with Extinction (MMA 2003). Taxon/species names followed by the acronym (Ti) indicate those regarded as threatened globally according to IUCN (2014). EN = Endemic species / subspecies to the Belém Center of Endemism according to Oren & Roma (2011). Taxonomy and nomenclature follows CBRO (2014).

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Tinamidae Gray, 1840					
Tinamus major (Gmelin, 1789)*		x	P	A	
Tinamus tao Temminck, 1815 [Ti]	x	x	P, S	A	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Crypturellus cinereus (Gmelin, 1789)		x	Cp	A	
Crypturellus soui (Hermann, 1783)	x		S	A	
Crypturellus strigulosus (Temminck, 1815)		x	Cp	A	
Crypturellus variegatus (Gmelin, 1789)	x	x	P, Cp	A	
Crypturellus parvirostris (Wagler, 1827)	x	x	P, S	V, A	
Anhimidae Stejneger, 1885					
Anhima cornuta (Linnaeus, 1766)	x	x	Cp, B	F,V	1037719
Anatidae Leach, 1820					
Dendrocygna viduata (Linnaeus, 1766)	x		B, L	F	
Dendrocygna autumnalis (Linnaeus, 1758)	x		B, L	V	
Cairina moschata (Linnaeus, 1758)	x		B, L	F	
Amazonetta brasiliensis (Gmelin, 1789)	x		B, L	F	1064152
Cracidae Rafinesque, 1815					
Ortalis superciliaris (Gray, 1867) [EN]	x	x	P, Cp, S, B	V	
Penelope superciliaris Temminck, 1815	x	x	Cp, S	V	
Penelope pileata Wagler, 1830 [Ti]	x		P, S	F,V	1036681
Aburria cujubi (Pelzeln, 1858)	x	x	P, Cp	V	
Pauxi tuberosa (Spix, 1825)		x	P, Cp	F	1029277
Odontophoridae Gould, 1844					
Odontophorus gujanensis (Gmelin, 1789)*		x	P	A	
Podicipedidae Bonaparte, 1831					
Tachybaptus dominicus (Linnaeus, 1766)*		x	B	V	
Podilymbus podiceps (Linnaeus, 1758)	x		B, L	V	
Ciconiidae Sundevall, 1836					
Mycteria americana Linnaeus, 1758	x		B	F	1065020
Anhingidae Reichenbach, 1849					
Anhinga anhinga (Linnaeus, 1766)	x		B, L	F	1041429
Ardeidae Leach, 1820					
Tigrisoma lineatum (Boddaert, 1783)	x		B, L	V	
Cochlearius cochlearius (Linnaeus, 1766)	x		B	V	
Nycticorax nycticorax (Linnaeus, 1758)	x		B	V	
Butorides striata (Linnaeus, 1758)	x		B, L	V	
Bubulcus ibis (Linnaeus, 1758)	x	x	B	V	
Ardea cocoi Linnaeus, 1766	x		L	V	
Ardea alba Linnaeus, 1758	x		B, L	V	
Pilherodius pileatus (Boddaert, 1783)	x		B	V	
Egretta thula (Molina, 1782)	x		B, L	V	
Threskiornithidae Poche, 1904					
Mesembrinibis cayennensis (Gmelin, 1789)*	x		B	V	
Theristicus caudatus (Boddaert, 1783)	x		B	V	
Cathartidae Lafresnaye, 1839					
Cathartes aura (Linnaeus, 1758)	x	x	P, S, Cp, B, C	V	
Cathartes burrovianus Cassin, 1845	x	x	P, Cp, B, C	V	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Cathartes melambrotus Wetmore, 1964		x	Cp	F	1064209
Coragyps atratus (Bechstein, 1793)	x	x	P, Cp, aa	V	
Sarcoramphus papa (Linnaeus, 1758)	x	x	P, Cp	V	
Accipitridae Vigors, 1824					
Leptodon cayanensis (Latham, 1790)	x	x	P, S	F	1065446
Chondrohierax uncinatus (Temminck, 1822)		x	S	V	
Elanoides forficatus (Linnaeus, 1758)	x	x	P, Cp, B	F	1036637
Gampsonyx swainsonii Vigors, 1825		x	Cp	V	
Elanus leucurus (Vieillot, 1818)	x	x	aa	V	
Harpagus bidentatus (Latham, 1790)		x	Cp	V, F	1180188
Harpagus diodon (Temminck, 1823)	x		S	V	
Ictinia plumbea (Gmelin, 1788)		x	Cp	V	
Accipiter superciliosus (Linnaeus, 1766)*		x	P	V	
Accipiter bicolor (Vieillot, 1817)*		x	P	V	
Busarellus nigricollis (Latham, 1790)	x	x	P, Cp	V	
Rostrhamus sociabilis (Vieillot, 1817)*		x	B	V	
Geranospiza caerulescens (Vieillot, 1817)		x	S	V	
Heterospizias meridionalis (Latham, 1790)	x	x	P	V	
Urubitinga urubitinga (Gmelin, 1788)	x		B	F	1180181
Rupornis magnirostris (Gmelin, 1788)	x	x	Cp, S	V	
Geranoaetus albicaudatus (Vieillot, 1816)	x	x	aa	V	
Pseudastur albicollis (Latham, 1790)	x	x	P, S	F	1030148
Leucopternis kuhli Bonaparte, 1850*		x	P	V	
Buteo nitidus (Latham, 1790)		x	Cp	V, F	1238809
Buteo brachyurus Vieillot, 1816	x		Cp, S	V, F	1194316
Buteo albonotatus Kaup, 1847	x		P	V, F	1238793
Harpia harpyja (Linnaeus, 1758)		x	P	V	
Spizaetus tyrannus (Wied, 1820)	x	x	P	V	
Spizaetus melanoleucus (Vieillot, 1816)	x	x	P	F	1065501
Aramidae Bonaparte, 1852					
Aramus guarauna (Linnaeus, 1766)		x	B	V	
Psophiidae Bonaparte, 1831					
Psophia obscura Pelzeln [Tn; Ti; EN]	x	x	P, Cp	V, A, F	C. M. R.
Rallidae Rafinesque, 1815					
Aramides cajaneus (Statius Muller, 1776)	x		B	A	
Laterallus viridis (Statius Muller, 1776)	x		B	A	
Laterallus melanophaius (Vieillot, 1819)	x		B, L	V	
Porzana flaviventer (Boddaert, 1783)	x		B	V	
Gallinula galeata (Lichtenstein,1818)	x		B, L	V	
Porphyrio martinicus (Linnaeus, 1766)	x		B, L	V	
Charadriidae Leach, 1820					
Vanellus chilensis (Molina, 1782)	x	x	B, aa	V	
Scolopacidae Rafinesque, 1815					

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Actitis macularius (Linnaeus, 1766)	x	x	B, L	V	
Tringa solitaria Wilson, 1813		x	B, L	F	1038987
Jacanidae Chenu & Des Murs, 1854					
Jacana jacana (Linnaeus, 1766)	x	x	B, L	V	
Columbidae Leach, 1820					
Columbina passerina (Linnaeus, 1758)	x		Cp, aa, S	V	
Columbina minuta (Linnaeus, 1766)*		x	Cp	V	
Columbina talpacoti (Temminck, 1811)	x	x	Cp, aa, B	V	
Columbina squammata (Lesson, 1831)	x		Cp, aa	V,A	
Columbina picui (Temminck, 1813)*		x	Cp	V	
Claravis pretiosa (Ferrari-Perez, 1886)	x	x	Cp, S	V, A, Ca	
Patagioenas speciosa (Gmelin, 1789)		x	P, Cp	V	
Patagioenas cayennensis (Bonnaterre, 1792)*		x	P, S, Cp	V	
Patagioenas plumbea (Vieillot, 1818)		x	P, Cp	V	
Patagioenas subvinacea (Lawrence, 1868)*		x	P	V	
Zenaida auriculata (Des Murs, 1847)		x	Cp	V	
Leptotila verreauxi Bonaparte, 1855	x	x	Cp	A	
Leptotila rufaxilla (Richard & Bernard, 1792)	x	x	Cp	V, A, Ca	
Geotrygon montana (Linnaeus, 1758)	x	x	Cp, S	A, Ca	
Cuculidae Leach, 1820					
Coccycua minuta (Vieillot, 1817)	x	x	P	V,F	
Piaya cayana (Linnaeus, 1766)	x	x	P, Cp	V	
Coccyzus melacoryphus Vieillot, 1817	x		S	V	
Coccyzus americanus (Linnaeus, 1758)*		x	S	V	
Coccyzus euleri Cabanis, 1873	x		P, S	A	
Crotophaga major Gmelin, 1788	x	x	Cp, B, aa	V	
Crotophaga ani Gmelin, 1788		x	B, aa	V	
Guira guira (Gmelin, 1788)	x	x	Cp, B, aa	V	
Tapera naevia (Linnaeus, 1766)	x		aa	V	
Dromococcyx phasianellus (Spix, 1824)*		x	Cp	V	
Tytonidae Mathews, 1912					
Tyto furcata (Temminck, 1827)*		x	Cp, aa	V	
Strigidae Leach, 1820					
Megascops choliba (Vieillot, 1817)		x	Cp	A	
Megascops usta (Sclater, 1858)		x	Cp	Ca	
Lophostrix cristata (Daudin, 1800)	x		P	A	
Pulsatrix perspicillata (Latham, 1790)		x	P, Cp	A	
Bubo virginianus (Gmelin, 1788)*		x	S	V, A	
Strix virgata (Cassin, 1849)*		x	P, S	V, A	
Strix huhula Daudin, 1800	x	x	P, Cp	A	
Glaucidium hardyi Vielliard, 1990*		x	P	A	
Glaucidium brasilianum (Gmelin, 1788)		x	Cp	A, Ca	
Athene cunicularia (Molina, 1782)	x		aa	V	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Nyctibiidae Chenu & Des Murs, 1851					
Nyctibius grandis (Gmelin, 1789)		x	P, Cp	A	
Nyctibius griseus (Gmelin, 1789)	x	x	Cp	V, A	
Nyctibius leucopterus (Wied, 1821)*		x	P	V	
Caprimulgidae Vigors, 1825					
Nyctiphrynus ocellatus (Tschudi, 1844)*		x	P, S	V	
Antrostomus rufus (Boddaert, 1783)*		x	P, S	V, A	
Antrostomus sericocaudatus Cassin, 1849*		x	P	V	
Hydropsalis leucopyga (Spix, 1825)*		x	P, S	V	
Hydropsalis nigrescens (Cabanis, 1848)	x	x	P, Cp	V	
Hydropsalis albicollis (Gmelin, 1789)	x	x	P, Cp	V, A, Ca	
Hydropsalis parvula (Gould, 1837)*		x	P, S	V, A	
Chordeiles acutipennis (Hermann, 1783)	x		Cp	V	
Apodidae Olphe-Galliard, 1887					
Chaetura spinicaudus (Temminck, 1839)	x	x	Cp, aa	V	
Chaetura chapmani Hellmayr, 1907*		x	S	V	
Chaetura brachyura (Jardine, 1846)	x	x	Cp, aa, S	V	
Tachornis squamata (Cassin, 1853)	x	x	Cp	V	
Panyptila cayennensis (Gmelin, 1789)	x	x	Cp	V	
Trochilidae Vigors, 1825					
Glaucis hirsutus (Gmelin, 1788)		x	Cp	V, Ca	
Phaethornis ruber (Linnaeus, 1758)	x	x	P, Cp, S	V, Ca	
Phaethornis superciliosus (Linnaeus, 1766)	x	x	P, Cp, S	V, Ca	
Campylopterus largipennis obscurus Gould, 1848[EN]*		x	P, S	V, Ca	
Eupetomena macroura (Gmelin, 1788)		x	Cp	V	
Florisuga mellivora (Linnaeus, 1758)*		x	P	V	
Anthracothorax nigricollis (Vieillot, 1817)		x	Cp	V	
Topaza pella (Linnaeus, 1758)	x	x	P, Cp, S	V	
Chrysolampis mosquitus (Linnaeus, 1758)	x	x	P, Cp, S	V, Ca	
Lophornis gouldii (Lesson, 1832)[Ti]*	x	x	S	V	
Chlorostilbon notatus (Reich, 1793)*		x	P,S	V, Ca	
Thalurania furcata (Gmelin, 1788)	x	x	P, Cp	V, Ca	
Amazilia versicolor (Vieillot, 1818)*		x	S	V	
Amazilia fimbriata (Gmelin, 1788)	x	x	Cp, S	V	
Heliothryx auritus (Gmelin, 1788)	x	x	P, Cp	V	
Heliomaster longirostris (Audebert & Vieillot, 1801)*		x	S	V	
Calliphlox amethystina (Boddaert, 1783)*		x	S	V	
Trogonidae Lesson, 1828					
Trogon melanurus Swainson, 1838	x	x	P	V	
Trogon viridis Linnaeus, 1766		x	Cp	V, A	
Trogon ramonianus Deville & DesMurs, 1849	x	x	P, S	V, A	
Trogon curucui Linnaeus, 1766	x		P	V, A	
Trogon rufus Gmelin, 1788	x		P	Ca	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Alcedinidae Rafinesque, 1815					
Megaceryle torquata (Linnaeus, 1766)	x	x	B	V	
Chloroceryle amazona (Latham, 1790)	x	x	B	V	
Chloroceryle americana (Gmelin, 1788)	x		L	V	
Chloroceryle inda (Linnaeus, 1766)	x		L	V	
Momotidae Gray, 1840					
Momotus momota (Linnaeus, 1766)		x	P, S	V, A	
Galbulidae Vigors, 1825					
Brachygalba lugubris (Swainson, 1838)	x		B	F	1041472
Galbula cyanicollis Cassin, 1851	x	x	P, Cp	V, Ca	
Galbula ruficauda Cuvier, 1816	x	x	P, Cp, S	V, F	
Galbula dea (Linnaeus, 1758)	x		B	V	
Jacamerops aureus (Statius Muller, 1776)*		x	P	V	
Bucconidae Horsfield, 1821					
Notharchus hyperrhynchus (Sclater, 1856)	x	x	P	F	1073816
Notharchus tectus (Boddaert, 1783)	x	x	P, Cp, S	V, F	1081976
Bucco tamatia Gmelin, 1788	x		S	V	
Bucco capensis Linnaeus, 1766	x	x	P, Cp	A	
Nystalus torridus Bond & Meyer de Schauensee, 1940	x	x	P, Cp, S	A, F	1073824
Nystalus maculatus (Gmelin, 1788)	x	x	Cp	A	
Monasa nigrifrons (Spix, 1824)	x	x	P, Cp	V, A	
Monasa morphoeus (Hahn & Küster, 1823)	x	x	P, Cp, S	V, F,A	1030081
Chelidoptera tenebrosa (Pallas, 1782)	x	x	Aa	F	1029232
Ramphastidae Vigors, 1825					
Ramphastos tucanus Linnaeus, 1758	x	x	P, Cp, S	V, A, F	1180193
Ramphastos vitellinus Lichtenstein, 1823	x	x	P, Cp, S	V, A, F	1036649
Selenidera gouldii (Natterer, 1837)	x		P	A,F	1238732
Pteroglossus inscriptus Swainson, 1822	x	x	P, Cp	V, A, F	1031536
Pteroglossus bitorquatus bitorquatus Vigors, 1826 Tn; Ti; EN	x	x	P, Cp, S	V, F	1029361
Pteroglossus aracari (Linnaeus, 1758)	x	x	S, Cp	V	
Picidae Leach, 1820					
Picumnus exilis (Lichtenstein, 1823)*	z		P, Cp	V	
Melanerpes candidus (Otto, 1796)		x	Cp	V	
Melanerpes cruentatus (Boddaert, 1783)		x	Cp	V, F	1032436
Veniliornis affinis (Swainson, 1821)*		x	P, S	V	
Piculus flavigula (Boddaert, 1783)*		x	P, S	V	
Piculus paraensis (Snethlage, 1907) EN*		x	P	V	
Colaptes melanochloros (Gmelin, 1788)		x	Cp	V	
Celeus elegans (Statius Muller, 1776)	x	x	S	V, A	
Celeus ochraceus (Spix, 1824)*		x	P	V	
Celeus flavus (Statius Muller, 1776)*		x	P	V	
Celeus torquatus pieteroyensi Oren, 1992 EN	x	x	P	V, A	
Dryocopus lineatus (Linnaeus, 1766)	x	x	P, Cp, S	V, F	1041940

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Campephilus rubricollis (Boddaert, 1783)	x	x	P, Cp, S	V, F	1083897
Campephilus melanoleucos (Gmelin, 1788)	x	x	P	V	
Falconidae Leach, 1820					
Ibycter americanus (Boddaert, 1783)	x	x	P, Cp, S	F	1180215
Caracara plancus (Miller, 1777)	x	x	B, aa	F	
Milvago chimachima (Vieillot, 1816)		x	aa	V	
Herpetotheres cachinnans (Linnaeus, 1758)	x	x	Cp	F	1031555
Micrastur ruficollis (Vieillot, 1817)*		x	P	V	
Micrastur mintoni Whittaker, 2002	x	x	P	V	
Micrastur semitorquatus (Vieillot, 1817)	x		P	V	
Falco sparverius Linnaeus, 1758		x	Cp, aa	V	
Falco rufigularis Daudin, 1800	x	x	Cp	F	1083881
Falco deiroleucus Temminck, 1825*	x		Cp	V	
Psittacidae Rafinesque, 1815					
Ara macao (Linnaeus, 1758)	x	x	P, Cp, S	F	1036661
Ara chloropterus Gray, 1859	x		P, S	F	1030079
Ara severus (Linnaeus, 1758)*		x	P, S, Cp	V	
Orthopsittaca manilatus (Boddaert, 1783)		x	P, Cp	V	
Diopsittaca nobilis (Linnaeus, 1758)		x	S, Cp	V	
Guaruba guarouba (Gmelin, 1788) [Tn; Ti]	x	x	P, Cp, S	F	1029265
Psittacara leucophthalmus (Statius Muller, 1776)	x	x	Cp, S	F	1185791
Aratinga jandaya (Gmelin, 1788)	x	x	P, Cp, S	V,F	
Eupsittula aurea (Gmelin, 1788)*		x	S, Cp	V	
Pyrrhura lepida lepida (Wagler, 1832) [Tn; Ti; EN]	x	x	P, S	F	1027814
Pyrrhura amazonum Hellmayr, 1906 [Ti] *		x	P, S	V	
Forpus xanthopterygius (Spix, 1824)	x	x	Cp	V	
Brotogeris chiriri (Vieillot, 1818)*	x	x	Cp, S	V	
Brotogeris chrysoptera (Linnaeus, 1766)	x	x	P	V	
Touit huetii (Temminck, 1830) [Ti] *		x	P	V	
Pionites leucogaster (Kuhl, 1820) [Ti]	x	x	P, Cp, S	V	
Pyrilia vulturina (Kuhl, 1820) [Ti]	x		P	F	1238382
Pionus menstruus (Linnaeus, 1766)	x	x	P, Cp, S	F	1038941
Pionus fuscus (Statius Muller, 1776)	x	x	P, Cp	F	1029310
Amazona farinosa (Boddaert, 1783)	x	x	Cp, S	V	
Amazona amazonica (Linnaeus, 1766)	x	x	P	V	
Amazona ochrocephala (Gmelin, 1788)*		x	P	V,F	1083958
Deroptyus accipitrinus (Linnaeus, 1758)	x	x	P, S	F	1180250
Thamnophilidae Swainson, 1824					
Pygiptila stellaris (Spix, 1825)	x	x	P, Cp	A	
Myrmotherula multostriata Sclater, 1858	x	x	P	V, A	
Myrmotherula longipennis Pelzeln, 1868*		x	P	V	
Myrmotherula axillaris (Vieillot, 1817)	x	x	P, Cp	A, Ca	
Myrmotherula menetriesii (d'Orbigny, 1837)	x	x	P, Cp	V, Ca	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Formicivora grisea (Boddaert, 1783)	x	x	P, Cp	A, Ca	
Isleria hauxwelli (Sclater, 1857)	x		P, S	A, Ca	
Thamnomanes caesius (Temminck, 1820)	x	x	P, Cp	A, Ca	
Dysithamnus mentalis (Temminck, 1823)	x	x	P, Cp	A, P, Ca	
Herpsilochmus rufimarginatus (Temminck, 1822)	x	x	P, Cp, S	A	
Sakesphorus luctuosus (Lichtenstein, 1823)	x		P	A	
Thamnophilus doliatus (Linnaeus, 1764)*		x	Cp	V	
Thamnophilus palliatus (Lichtenstein, 1823)	x		Cp, S, B	F	1041503
Thamnophilus pelzelni Hellmayr, 1924	x		P	A	
Thamnophilus aethiops incertus Pelzeln, 1869 EN	x	x	P, Cp	A, Ca	
Thamnophilus amazonicus Sclater, 1858	x	x	P, Cp, S	A, Ca	
Taraba major (Vieillot, 1816)	x		Cp, S	V, A, F	1036704
Hypocnemoides maculicauda (Pelzeln, 1868)	x		S	A	
Pyriglena leuconota leuconota (Spix, 1824) EN	x	x	P, Cp	V, A, Ca	
Cercomacra cinerascens (Sclater, 1857)*	x	x	P, Cp	A	
Cercomacra laeta Todd, 1920*		x	P, S, Cp	V, A, Ca	
Willisornis vidua (Hellmayr, 1905)	x	x	P, Cp	A, Ca	
Phlegopsis nigromaculata paraensis Hellmayr, 1904 Tn; EN	x	x	P, Cp	V	
Conopophagidae Sclater & Salvin, 1873					
Conopophaga roberti Hellmayr, 1905EN		x	Cp	V, A, Ca	
Grallariidae Sclater & Salvin, 1873					
Hylopezus paraensis Snethlage, 1910	x	x	P, Cp	A	
Formicariidae Gray, 1840					
Formicarius colma Boddaert, 1783		x	Cp	A, Ca	
Formicarius analis (d'Orbigny & Lafresnaye, 1837)*		x	P, S	V, A	
Scleruridae Swainson, 1827					
Sclerurus macconnelli Chubb, 1919	x		P	A	
Sclerurus rufigularis Pelzeln, 1868		x	P	V, A	
Sclerurus caudacutus (Vieillot, 1816)	x	x	P, Cp, S	V, A	
Dendrocolaptidae Gray, 1840					
Dendrocincla fuliginosa (Vieillot, 1818)	x	x	P, Cp	A,Ca	
Dendrocincla merula badia (Zimmer, 1934) Tn; EN	x		P	A, Ca	
Deconychura longicauda (Pelzeln, 1868) *		x	P	Ca	
Certhiasomus stictolaemus (Pelzeln, 1868)		x	Cp	A	
Glyphorynchus spirurus (Vieillot, 1819)	x	x	P, Cp	V,Ca	
Xiphorhynchus spixii (Lesson, 1830)	x	x	S	A	
Xiphorhynchus obsoletus (Lichtenstein, 1820)		x	S	A, Ca	
Xiphorhynchus guttatus (Lichtenstein, 1820)	x	x	P, S	A, F	1038873
Dendroplex picus (Gmelin, 1788)	x	x	P, Cp, S	A, Ca	
Lepidocolaptes layardi (Sclater, 1873)*		x	P, S	V, A	
Dendrocolaptes medius Todd, 1920 Tn; EN	x	x	P, Cp, S	V, A	
Xenopidae Bonaparte, 1854					
Xenops minutus (Sparrman, 1788)	x	x	P, Cp	Ca	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Furnariidae Gray, 1840					
Berlepschia rikeri (Ridgway, 1886)	x	x	P, Cp	A	
Automolus paraensis Hartert, 1902*		x	P	V, A	
Automolus rufipileatus (Pelzeln, 1859)*	x		P, S	V, A, Ca	
Anabacerthia ruficaudata (d'Orbigny & Lafresnaye, 1838) *		x	P	V	
Philydor erythrocercum (Pelzeln, 1859)*		x	P	V, Ca	
Philydor pyrrhodes (Cabanis, 1848)	x		P	A	
Certhiaxis cinnamomeus (Gmelin, 1788)	x		B	A	
Synallaxis albescens Temminck, 1823	x		Cp, B	A	
Synallaxis rutilans omissa (Hartert, 1901) [EN]	x	x	P, Cp	A	
Synallaxis gujanensis (Gmelin, 1789)*		x	S	V	
Pipridae Rafinesque, 1815					
Tyranneutes stolzmanni (Hellmayr, 1906)*		x	P	V, A	
Ceratopipra rubrocapilla Temminck, 1821*		x	P	V, A	
Lepidothrix iris (Schinz, 1851) [Ti]		x	P	A	
Manacus manacus purissimus Todd, 1928 [EN]	x	x	Cp	V, Ca	
Chiroxiphia pareola (Linnaeus, 1766)	x	x	Cp, S	V, Ca	
Dixiphia pipra (Linnaeus, 1758)		x	P	V, A	
Onychorhynchidae Tello, Moyle, Marchese & Cracraft, 2009					
Onychorhynchus coronatus (Statius Muller, 1776)	x	x	P, Cp	V, Ca	
Terenotriccus erythrurus hellmayri (E. Snethlage, 1907) [EN]	x	x	P, Cp, S	V, Ca	
Myiobius atricaudus Lawrence, 1863	x	x	Cp, S	V, Ca	
Tityridae Gray, 1840					
Schiffornis turdina (Wied, 1831)*		x	P	A, Ca	
Iodopleura isabellae Parzudaki, 1847*		x	P	V	
Tityra inquisitor (Lichtenstein, 1823)	x	x	P, S	V	
Tityra cayana (Linnaeus, 1766)	x	x	P, S	F	1194380
Tityra semifasciata (Spix, 1825)	x	x	P, Cp	V	
Pachyramphus castaneus (Jardine & Selby, 1827)*		x	S	V	
Pachyramphus polychopterus (Vieillot, 1818)	x	x	P, Cp	A	
Pachyramphus marginatus (Lichtenstein, 1823)	x		P, S	V	
Pachyramphus minor (Lesson, 1830)		x	S	V, A	
Pachyramphus validus (Lichtenstein, 1823)	x	x	P	V, A	
Cotingidae Bonaparte, 1849					
Lipaugus vociferans (Wied, 1820)	x	x	P, Cp, S	A	
Gymnoderus foetidus (Linnaeus, 1758)*		x	P	V	
Xipholena lamellipennis (Lafresnaye, 1839)	x	x	P	F	1180204
Cotinga cotinga (Linnaeus, 1766)	x	x	P, S	F	1422358
Cotinga cayana (Linnaeus, 1766)*		x	P	V	
Haematoderus militaris (Shaw, 1792)	x		P	F	1080430
Querula purpurata (Statius Muller, 1776)		x	Cp	F	1081252
Pipritidae Ohlson, Irestedt, Ericson & Fjeldså, 2013					
Piprites chloris grisescens (Novaes, 1964) [EN]	x	x	P, Cp, S	V, A	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Platyrinchidae Bonaparte, 1854					
Platyrinchus saturatus Salvin & Godman, 1882*		x	P	V	
Platyrinchus platyrhynchos (Gmelin, 1788)*		x	P	V	
Rhynchocyclidae Berlepsch, 1907					
Taeniotriccus andrei (Berlepsch & Hartert, 1902)*		x	P	A	
Mionectes oleagineus (Lichtenstein, 1823)	x	x	P, Cp	A, Ca	
Mionectes macconnelli (Chubb, 1919)	x	x	P	Ca	
Tolmomyias sulphurescens Zimmer, 1939	x	x	P	V	
Tolmomyias flaviventris (Wied, 1831)	x	x	P, S	V	
Todirostrum maculatum (Desmarest, 1806)		x	P	V	
Todirostrum cinereum (Linnaeus, 1766)	x	x	P, Cp	V	
Todirostrum chrysocrotaphum illigeri (Cabanis & Heine, 1859) EN *	x	x	P, Cp	V, A	
Poecilotriccus fumifrons (Hartlaub, 1853)*		x	P	V	
Poecilotriccus sylvia (Desmarest, 1806)*		x	P	V	
Myiornis ecaudatus (d'Orbigny & Lafresnaye, 1837)*		x	P	V	
Hemitriccus striaticollis (Lafresnaye, 1853)	x		S	V	
Lophotriccus galeatus (Boddaert, 1783)	x	x	P, Cp	V, Ca	
Tyrannidae Vigors, 1825					
Zimmerius acer (Salvin & Godman, 1883)*		x	P, S, Cp	V, A,	
Ornithion inerme Hartlaub, 1853*		x	P	V	
Camptostoma obsoletum (Temminck, 1824)	x	x	Cp, S, B	A	
Elaenia flavogaster (Thunberg, 1822)		x	Cp	A	
Elaenia cristata Pelzeln, 1868*		x	Cp	A	
Myiopagis gaimardii (d'Orbigny, 1839)*		x	P, S	V,A	
Myiopagis viridicata (Vieillot, 1817)		x	Cp	A	
Tyrannulus elatus (Latham, 1790)*		x	S	V, A	
Phaeomyias murina (Spix, 1825)	x	x	P, S	A	
Attila spadiceus (Gmelin, 1789)	x	x	P	V, A	
Legatus leucophaius (Vieillot, 1818)	x	x	P, Cp, aa, B, S	A, F, V	1038926
Ramphotrigon ruficauda (Spix, 1825)*		x	P	V	
Myiarchus tuberculifer (d'Orbigny & Lafresnaye, 1837)*		x	P, S, Cp	V	
Myiarchus swainsoni Cabanis & Heine, 1859	x		S	A	
Myiarchus ferox (Gmelin, 1789)	x	x	P, Cp, S	A	
Myiarchus tyrannulus (Statius Muller, 1776)*		x	S	V, A	
Casiornis fuscus Sclater & Salvin, 1873	x		P	V	
Pitangus sulphuratus (Linnaeus, 1766)	x	x	Cp, aa, S	V, A	
Machetornis rixosa (Vieillot, 1819)*		x	aa	V	
Myiodynastes maculatus (Statius Muller, 1776)	x	x	Cp, aa	F	1030139
Tyrannopsis sulphurea (Spix, 1825)*		x	S,B	V, A	
Megarynchus pitangua (Linnaeus, 1766)	x	x	Cp, aa	A	
Myiozetetes cayanensis (Linnaeus, 1766)	x	x	Cp, B, aa	V, A	
Myiozetetes similis (Spix, 1825)	x	x	Cp	V, A	
Tyrannus melancholicus Vieillot, 1819	x	x	Cp, aa, B,S	V, A	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Tyrannus savana Vieillot, 1808*		x	S, Cp	V	
Empidonomus varius (Vieillot, 1818)		x	Cp	V	
Colonia colonus (Vieillot, 1818)*		x	P	V	
Myiophobus fasciatus (Statius Muller, 1776)*		x	S	V	
Fluvicola nengeta (Linnaeus, 1766)	x	x	Cp, B, aa	V	
Arundinicola leucocephala (Linnaeus, 1764)	x		B	V	
Lathrotriccus euleri (Cabanis, 1868)*		x	P, S	V	
Cnemotriccus fuscatus (Wied, 1831)*		x	S	V	
Contopus nigrescens (Sclater & Salvin, 1880)	x	x	P, S	F	1151531
Vireonidae Swainson, 1837					
Cyclarhis gujanensis (Gmelin, 1789)	x	x	Cp, aa, S	V, A	
Vireo chivi (Vieillot, 1817)	x	x	P, S	A	
Hylophilus semicinereus Sclater & Salvin, 1867	x	x	P, Cp, S	V, A	
Hylophilus pectoralis Sclater, 1866		x	Cp	A	
Corvidae Leach, 1820					
Cyanocorax cyanopogon (Wied, 1821)*		x	S, Cp	V	
Hirundinidae Rafinesque, 1815					
Stelgidopteryx ruficollis (Vieillot, 1817)	x	x	B, aa	V	
Progne tapera (Vieillot, 1817)	x	x	Cp, aa, B	V	
Progne chalybea (Gmelin, 1789)	x	x	aa	V	
Tachycineta albiventer (Boddaert, 1783)	x	x	B	V	
Troglodytidae Swainson, 1831					
Microcerculus marginatus (Sclater, 1855)*		x	S	Ca	
Troglodytes musculus Naumann, 1823	x		aa	V	
Campylorhynchus turdinus (Wied, 1831)		x	Cp	V	
Pheugopedius genibarbis (Swainson, 1838)	x	x	P, Cp, S	A, Ca	
Cantorchilus leucotis (Lafresnaye, 1845)		x	P	A	
Donacobiidae Aleixo & Pacheco, 2006					
Donacobius atricapilla (Linnaeus, 1766)	x		B	V	
Polioptilidae Baird, 1858					
Ramphocaenus melanurus austerus Zimmer, 1937 EN*		x	P, S, Cp	V	
Polioptila plumbea (Gmelin, 1788)	x	x	Cp	V	
Polioptila paraensis Todd, 1937*		x	S	V	
Turdidae Rafinesque, 1815					
Turdus nudigenis Lafresnaye, 1848*		x	P, S	V	
Turdus fumigatus Lichtenstein, 1823*		x	P, S	V	
Turdus leucomelas Vieillot, 1818		x	S	V, A	
Turdus amaurochalinus Cabanis, 1850	x	x	P, Cp	A	
Turdus albicollis Vieillot, 1818	x	x	P	A	
Passerellidae Cabanis & Heine, 1850					
Ammodramus humeralis (Bosc, 1792)	x	x	aa	V	
Arremon taciturnus (Hermann, 1783)	x	x	Cp, S	A, Ca	
Parulidae Wetmore & Zimmer 1947					

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Myiothlypis mesoleuca (Sclater, 1866)	x	x	P, Cp	A	
Icteridae Vigors, 1825					
Psarocolius viridis (Statius Muller, 1776)		x	S	V, F	1031543
Psarocolius decumanus (Pallas, 1769)		x	S, Cp	V	
Psarocolius bifasciatus (Spix, 1824)	x	x	P, S	V, A	
Procacicus solitarius (Vieillot, 1816)*		x	P, S	V	
Cacicus haemorrhous (Linnaeus, 1766)	x	x	P, Cp, S	V	
Cacicus cela (Linnaeus, 1758)	x	x	P, Cp	V, F	1037714
Icterus cayanensis (Linnaeus, 1766)	x	x	P, Cp	V	
Icterus jamacaii (Gmelin, 1788)		x	Cp	V	
Molothrus oryzivorus (Gmelin, 1788)		x	Cp, S	V	
Molothrus bonariensis (Gmelin, 1789)		x	B,aa	V	
Sturnella militaris (Linnaeus, 1758)	x	x	Cp, aa	V,F	1030127
Mitrospingidae Barker, Burns, Klicka, Lanyon & Lovette, 2013					
Lamprospiza melanoleuca (Vieillot, 1817)	x	x	P, S	F	1081284
Thraupidae Cabanis, 1847					
Coereba flaveola (Linnaeus, 1758)	x	x	Cp, S	V	
Saltator grossus (Linnaeus, 1766)*		x	P, S	V, A	
Saltator coerulescens Vieillot, 1817*		x	S, Cp	V	
Saltator maximus (Statius Muller, 1776)	x	x	Cp, S	V,A	
Parkerthraustes humeralis (Lawrence, 1867)*		x	P	V	
Nemosia pileata (Boddaert, 1783)	x		S	V	
Tachyphonus rufus (Boddaert, 1783)	x	x	P, Cp, S, B	V	
Ramphocelus carbo (Pallas, 1764)	x	x	P, Cp, S	V	
Lanio luctuosus (d'Orbigny & Lafresnaye, 1837)		x	Cp	V	
Lanio cristatus pallidigula Zimmer, 1945 EN		x	Ca	V	
Tangara mexicana (Linnaeus, 1766)	x		P	V	
Tangara velia signata (Hellmayr, 1905)* EN		x	P	V	
Tangara punctata (Linnaeus, 1766)	x		S	V	
Tangara episcopus (Linnaeus, 1766)	x	x	P, Cp, B, S	V	
Tangara palmarum (Wied, 1823)	x	x	P, Cp, S	V,F	1041465
Tangara cayana (Linnaeus, 1766)	x		Cp	V	
Cissopis leverianus (Gmelin, 1788)		x	Cp	V	
Dacnis lineata (Gmelin, 1789)*		x	P	V	
Dacnis cayana (Linnaeus, 1766)	x	x	P, Cp, S	V	
Cyanerpes caeruleus (Linnaeus, 1758)*		x	P, S		
Cyanerpes cyaneus (Linnaeus, 1766)	x	x	P, Cp,S	V	
Chlorophanes spiza (Linnaeus, 1758)		x	P, S, Cp	V	
Hemithraupis guira (Linnaeus, 1766)	x	x	P, Cp, S	V	
Conirostrum speciosum (Temminck, 1824)		x	P, S	V	
Emberizoides herbicola (Vieillot, 1817)	x	x	aa	V	
Volatinia jacarina (Linnaeus, 1766)	x	x	aa, B, Cp	V	
Sicalis columbiana Cabanis, 1851*		x	Cp, aa	V	

Taxon	Zoning		Habitats	Type of record	Photo Ref. WA:
	Zd	Zr			
Sporophila lineola (Linnaeus, 1758)	x	x	aa	V	
Sporophila nigricollis (Vieillot, 1823)	x	x	aa, B	V	
Sporophila bouvreuil (Statius Muller, 1776)	x		aa	V	
Sporophila minuta (Linnaeus, 1758)	x		B	F	1027698
Sporophila angolensis (Linnaeus, 1766)	x	x	Cp, aa, B	V	
Cardinalidae Ridgway, 1901					
Granatellus pelzelni paraensis Rothschild, 1906 [EN]	x	x	P, Cp, S	A, Ca	
Caryothraustes canadensis (Linnaeus, 1766)	x	x	P, Cp, S	F	1043126
Cyanoloxia rothschildii (Lafresnaye, 1847)*		x	S, Cp	V	
Fringillidae Leach, 1820				V	
Euphonia chlorotica (Linnaeus, 1766)	x	x	P, Cp, S	V	
Euphonia violacea (Linnaeus, 1758)	x	x	P, Cp	A	
Euphonia cayennensis (Gmelin, 1789)*		x	P	V	

Vulturine Parrot (*Pyrilia vulturina*). An individual was photographed in November 2011 by D. M. L. (Lima 2011a). The species was recorded in an area of continuous primary forest. *Pyrilia vulturina* is endemic to eastern Amazon (lower Amazon), with other recent records in the Belém CE by Portes *et al.* (2011) and Oren & Roma (2011). Due to habitat loss the species was assessed globally by the IUCN (2014) as vulnerable of extinction.

White-winged Potoo (*Nyctibius leucopterus*). C.M. held a single sighting, from December 10th, 2010. The bird was found around 1 km NW from the ICMBio station, in the southern border of the Reserve. As far as we know, this is the first report for this species in Maranhão. The observation took place at around 20:00 hs, during a nocturnal spot lighting, and the bird was perched in the usual attitude for the species of *Nyctibius*, in a primary *terra firme* forest. The bird remained perched, and could be observed for several minutes, under the spot-light, and using binoculars. The diagnostic large white patch on wing coverts could be observed under optimal conditions.

Red-necked Aracari (*Pteroglossus bitorquatus bitorquatus*). The species was recorded at base camp of the Gurupi REBIO consuming papaya (registration by D. M. L). This is a disturbed area with forest regeneration in advanced stage. It was also recorded in the recovery zone with predominant secondary vegetation and plenty of *Cecropia* spp. (Lima 2012c), as well as in the undisturbed zone where it was sighted consuming the fruits of a Sapotaceae of the genus *Pouteria* sp. The species is common in the reserve area and its surroundings. The species is distributed in lowland forests from the right bank of the Tocantins River through northern Maranhão, and according to Silveira (2008b) it would likely occur in the Gurupi REBIO. This is the first documented record of the species inside the reserve. However, it is relatively common in the whole area and in preserved forest remnants in neighboring localities.

White-chinned Woodcreeper (*Dendrocincla merula badia*). The first record of this species at REBIO Gurupi was documented by Lima & Raíces (2012). During the survey the species was recorded only in the undisturbed zone of the protected area, where the vegetation is characterized as dense rainforest, with a continuous canopy (D. M. L). The species was sighted foraging alongside army ants in the undersrtorey. This subspecies is endemic to the Belém CE, occurring east of the Tocantins river into Amazonian Maranhão (Aleixo 2008a). The species is considered endangered at both national (MMA 2003) and state (Pará) levels (COEMA 2007).

Todd's Woodcreeper (*Dendrocolaptes medius*). This species was recorded both in primary forest and *capoeira* (secondary forest) inside the reserve (registration by D. M. L). According to Aleixo (2008b) the species can often be found in upland forests, floodplains and forest in an advanced stage of succession. According to the list of species of Brazilian fauna threatened with extinction (MMA 2003), the species is endangered under the same category of threat as in the state of Pará (COEMA 2007).

Black-spotted Bare-eye (*Phlegopsis nigromaculata paraensis*). The species was recorded foraging solitarily in primary forest and forest in advanced stage of succession inside the reserve (D. M. L). Aleixo (2008c) reports that this species may forage alone, in pairs, or family groups. Apparently, the species is more tolerant to fragmentation and degradation of forest structure than other species associated with army ants (Aleixo 2008c). This explains the presence of the species in forest at advanced stages of regeneration, which suffered from selective logging.

Blackish Pewee (*Contopus nigrescens*). D.M.L. and C. M. observed this species on five occasions during the present study in an area of primary forest in the recovery zone, and in the undisturbed zone. On all occasions, a solitary individual was observed perched in the middle stratum of the forest, engaging in flying forays during which it captured insects on the wing, a typical behavior of this genus. D. M. L. photographed the species in December 2011 (Lima 2011b) where the diagnostic overall uniform dark sooty-gray plumage, dark head, neck and upper parts, blackish-brown wings, blackish tail (sooty gray below) and slightly paler throat could be easily noticed. Sick (1997) reports that the species is rare, with a patchy distribution in the eastern Andes, and in the Acary Mountains of Guyana, for example. In Brazil, the species is known from specimens collected at Itupiranga, Pará (specimens housed at *Museu de Zoologia da Universidade de São Paulo* – MZUSP number 64232), and from observations in the Serra dos Carajás, and one sighting in the area of the Pindaré River, Maranhão, in November, 1977 (Ridgely & Tudor 1994). The species was recently recorded in the Carajás National Forest by Aleixo *et al.* (2012), but was not registered by Oren & Roma (2011), Portes *et al.* (2011) or Lees *et al.* (2012) for the Belém CE. C. M. has also recorded the species several times from a site near Açailândia.

Crimson Fruitcrow (*Haematoderus militaris*). D.M.L. recorded this species on August, 2012. A male perched on a tree was photographed from a distance (Lima 2012d) in an area of primary forest surrounded by secondary growth. This species is considered to be rare, and is probably sensitive to habitat fragmentation and disturbance (Lees *et al.* 2012).

Actions for conservation

The REBIO Gurupi is the only integral protection conservation unit located within the Belém CE, which encompasses the most impacted region of the Brazilian Amazon basin, located between eastern Pará and western Maranhão. This reserve is even more significant in the local context of the Amazon sector of Maranhão, where forest cover has been reduced to less than 25% of the original area (Martins 2011). This whole region, including the REBIO Gurupi, is suffering from the ongoing expansion of the Arc of Deforestation, which is converting forest into pasture at an alarming rate, reducing the once continuous forest to a series of fragments.

One of the major bottlenecks hindering the conservation unit from fully realizing its goal of preserving the flora and fauna within its limits is non-sustainable illegal occupation. For decades REBIO Gurupi has been occupied by irregular settlements approved by government agencies and by squatters (Lima & Raíces 2012); this occupation has resulted in the raising of livestock and has stimulated illegal logging. According to the latest land survey of the reserve, there are roughly 6,306 people living within REBIO Gurupi (ESTRUTURAL 2007).

Actions that can minimize the loss of habitat and hunting of the local avifauna have been performed, for example: demarcation of the unit, judicial direction to begin proceedings for land compensation, creation of an advisory board, and drafting terms of commitment for settlers. Furthermore, an institutional presence has been established in the form of two operational field bases with full-time policing, as well as instruction in administrative processes for the removal of cattle from inside the reserve. At the time of the study, approximately 3,500 heads of cattle were removed from inside the reserve (E.A. Lisboa *pers. comm.*).

Given that much of the Gurupi reserve has been impacted by illegal logging, in addition to the areas cleared for pastures and other land use, there is an urgent need for the development of a reforestation project, which will guarantee the connectivity of habitats, especially for those species that require large tracts of continuous forest for their survival. These species include the members of the Cracidae, in particular *Crax fasciolata pinima*, which was reported by local residents to still occur in the region, and may in fact be held in captivity in some households.

The presence in the reserve of seven endangered species, and two others (*Harpia harpyja* and *Pyrilia vulturina*) that are likely to be included in the Brazilian list of threatened species in the near future, reinforce the need for the establishment of a continuous research program for the REBIO Gurupi, with the aim of providing effective conservation measures that can be implemented by the unit's administrators and partner institutions. In particular, the confirmation of the occurrence of *Crax fasciolata pinima* in the reserve and adjoining indigenous reservations, is a major research priority.

Surrounding the unit grows the demand for permits to implement plans for selective logging and vegetation removal. Therefore, it is important that the National Action Plan for the Conservation of Endangered Species of the Amazon is enforced since it contains the regulatory instructions and resolutions governing the environmental licensing procedures. As such, environmental agencies are legally required to heed protocols that establish conditions and procedures for protection, for example, of trees that present nests of *Harpya harpyja* and *Guaruba guarouba*; as well as to promote the recovery of degraded areas.

New formats for the planning and execution of inspection activities have been carried out, providing an intelligence service aimed at disrupting illegal logging. Another aspect strengthening enforcement actions is the publication of the term of reciprocity between the

Public Security Bureau of Maranhão and the Chico Mendes Institute for Biodiversity Conservation, since the agreement fosters the training of law enforcement agents and police support staff in the field to identify any species that are targeted for trafficking or hunting, as well as the development of allocation protocols for *Crax fasciolata pinima*, *Pteroglossus bitorquatus bitorquatus*, *Psophia obscura*, *Guaruba guarouba*, *Pyrrhura lepida lepida* and *Harpya harpyja*.

Public policy actions, along with the participation of civil entities, in the commitment to protect and conserve the Amazonian forest fragments existing in the REBIO Gurupi and indigenous lands with their surrounding areas have strengthened the implementation and consolidation of the conservation unit. The high number of endemic and endangered species identified in the reserve reinforces its importance for conservation. It is essential to continue all efforts by the federal government to implement these actions specific to the unit, established as effective and efficient tools for the full compliance of the conservation unit's original mission.

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APPENDIX

Species of relevant biogeographical interest, for which we obtained only isolated and undocumented records. We recommend that they are added to the REBIO Gurupi checklist whenever material evidence such as digital or specimen vouchers are obtained.

Species
Tinamus guttatus
Porzana flaviventer
Phaethornis maranhaoensis
Chlorostilbon mellisugus
Myrmornis torquata
Synallaxis frontalis
Myiobius barbatus
Elaenia chiriquensis