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Author: DeLuca, John J.

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Research Article

Birds of conservation concern in eastern Acre, Brazil: distributional records, occupancy estimates, human-caused mortality, and opportunities for ecotourism

John J. DeLuca[1]

[1]Conservation Leadership Programme, www.conservationleadershipprogramme.org; Currently at 13 North San Francisco Street, #304, Flagstaff, AZ 86001; (352) 281-8889; delucajj@gmail.com

ABSTRACT

Few ornithologists have conducted research in the southwestern Amazonian state of Acre, Brazil. Threats and opportunities associated with completion of the Brazil-Peru Interoceanic Highway provide impetus to increase understanding of 1) the distribution, status, and natural history of rare and restricted-range birds, 2) human-wildlife conflicts, and 3) interest in ecotourism within Acre. I conducted point-count surveys, recorded opportunistic encounters, and estimated occupancy for the globally threatened, near-threatened, and restricted-range birds of eastern Acre. I also interviewed hunters that inhabit Chico Mendes Extractive Reserve (CMER) about their perception of the relative abundance of the near-threatened Harpy Eagle (*Harpia harpyja*) and Crested Eagle (*Morphnus guianensis*), about conflicts with these species, how conflicts were resolved, and their interest in community-run ecotourism. Results suggest that the vulnerable Blue-headed Macaw (*Primolius couloni*) is uncommon but widely distributed throughout eastern Acre. The vulnerable Rufous Twistwing (*Cnipodectes superrufus*) appears rare; it was detected at only four locations but appears to occur throughout CMER. I present information on the diet of both species. I expand upon and confirm recent findings that extend the distribution of several near-threatened and restricted-range species. Interviews with local hunters suggest that *H. harpyja* and *M. guianensis* are rare to uncommon and widely persecuted throughout CMER, although interest in community-run ecotourism presents opportunities to increase conservation of these and other rare species. Land managers, biologists, and conservation organizations may use these results and recommendations to inform wildlife management decisions, estimates of population trends, and ecotourism ventures.

KEY WORDS: *Primolius couloni*; *Cnipodectes superrufus*; *Harpia harpyja*; ecotourism; Amazon

RESUMO

Poucos ornitólogos têm conduzido pesquisas no estado do Acre, sudoeste da Amazônia, Brasil. As ameaças e as oportunidades associadas com a finalização da Rodovia Interoceânica entre o Brasil e o Peru devem impulsionar o aumento no entendimento sobre 1) a distribuição, a condição e a história natural de aves raras e de distribuição restrita, 2) os conflitos entre pessoas e a fauna silvestre e 3) o interesse em ecoturismo no Acre. Eu conduzi levantamentos com o uso de pontos fixos, registrei encontros oportunistas e estimei a ocupação para aves ameaçadas, quase-ameaçadas e de distribuição restrita na região leste do Acre. Eu também entrevistei caçadores habitantes da Reserva Extrativista Chico Mendes (CMER) sobre a percepção dos mesmos em relação à abundância do gavião real (*Harpia harpyja*) e do uiraçu-falso (*Morphnus guianensis*), os conflitos dessas pessoas com essas espécies, como tais conflitos foram solucionados e qual o interesse dessas pessoas em ecoturismo comunitário. Os resultados sugerem que a maracanã-de-cabeça-azul (*Primolius couloni*), espécie considerada vulnerável, é incomum, mas, distribuída amplamente no leste do Acre. O flautim-rufo (*Cnipodectes superrufus*), espécie considerada vulnerável, parece ser raro; o mesmo foi detectado apenas em quatro locais, mas parece ocorrer em todo o CMER. Eu apresento informações sobre a dieta de ambas as espécies. Os meus registros expandem e confirmam descobertas recentes que ampliam a distribuição de várias espécies quase-ameaçadas e de distribuição restrita. As entrevistas com os caçadores locais sugerem que *H. harpyja* e *M. guianensis* são de raras a incomum e amplamente perseguidas em toda a CMER, embora o interesse em ecoturismo comunitário apresente oportunidades de aumentar a conservação dessas e de outras espécies raras. Gestores, biólogos e organizações de conservação podem usar esses resultados e recomendações para ajudar nas decisões de manejo da fauna silvestre, tendências populacionais e empreendimentos de ecoturismos.

KEY WORDS: *Primolius couloni*; *Cnipodectes superrufus*; *Harpia harpyja*; ecoturismos; Amazônia

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Introduction

The state of Acre, Brazil, lies within southwestern Amazonia. It comprises a large section of the South-east Peruvian Lowlands Endemic Bird Area (EBA) [1]. This EBA has "high biological importance" and is an "area of urgent priority for conservation action" [1], yet the distribution and natural history of many rare and restricted-range species in this EBA are only beginning to be studied [2-10]. Four globally threatened bird species currently or potentially occur in Acre, according to the International Union for the Conservation of Nature (IUCN) and Birdlife International. These include the Blue-headed Macaw (*Primolius couloni*), Rufous Twistwing (*Cnipodectes superrufus*), Selva Cacique (*Cacicus koepckae*), and Wattled Curassow (*Crax globulosa*). The former three species are classified as vulnerable, and the latter species is classified as endangered [11].

Population estimates of *P. couloni* have been made difficult by the species' apparently large territory size and nomadic behavior. Its distribution remains uncertain, although the species appears to inhabit a wide variety of ecosystems, including edge habitat [11-12]. Ornithologists described *C. superrufus* in 2007, and this bamboo-obligate flycatcher has been observed at only 15 locations [3, 6, 11, 13-14]. *C. koepckeae* occurs in "transitional forest that lines narrow, high-gradient rivers" [15]. It has been detected in only five locations [11, 15]. A recent expedition by Dante Buzetti confirmed its presence in east-central Acre [5]. *C. globulosa* is a large game bird of riverine and vàrzea forest that once ranged throughout western Amazonia but now occupies 14 isolated populations that encircle the Acre region, with one site occurring along the border of Acre and Peru. The largest known population is estimated at 250 individuals [11]. Habitat loss (especially that associated with the completion of the Brazil-Peru Interoceanic Highway) and demographic stochasticity threaten the conservation of all of these species. Hunting and wildlife trade additionally threaten the conservation of *P. couloni* and *C. globulosa*. In light of these threats, the distribution, demographics, and natural history of these little-known, globally threatened species merit further research [11].

Several near-threatened (NT) and/or restricted-range species (according to species lists of Endemic Bird Areas in [1]; approximately <50,000 km^2 in distribution; RR) also currently or potentially occupy Acre: Elusive Antpitta (*Grallaria eludens;* NT; RR), Rufous-fronted Antthrush (*Formicarius rufifrons;* NT; RR), Amazonian Parrotlet (*Nannopsittaca dachilleae*; NT), Harpy Eagle (*Harpia harpyja;* NT), Crested Eagle (*Morphnus guianensis;* NT), Chestnut-throated Spinetail (*Synallaxis cherriei;* NT), Peruvian Recurvebill (*Simoxenops ucayalae;* NT), Scarlet-hooded Barbet (*Eubucco tucinkae;* RR), Semi-collared Puffbird

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(*Malacoptila semicincta;* RR), White-lined Antbird (*Percnostola lophotes;* RR), Goeldi's Antbird (*Myrmeciza goeldii;* RR), Black-faced Cotinga (*Conioptilon mcilhennyi;* RR), and Long-crested Pygmy-Tyrant (*Lophotriccus eulophotes;* RR), Fine-barred Piculet (*Picumnus subtilis*), and White-cheeked Tody-flycatcher (*Poecilotriccus albifacies*). See [11] for more information on the ecology of these species.

Threats and opportunities exist in relation to the conservation of the rare and restricted-range bird species of Acre. The imminent construction of a major highway connecting the Pacific Ocean of Peru to the Atlantic Ocean of Brazil may lead to a drastic increase in deforestation throughout southwestern Amazonia [16-17] and cause a decline in the habitat and populations of species of conservation concern. Easier access to Acre may also increase opportunities for ecotourism, especially birding tours focused on rare and restricted-range species. This, in turn, may raise local interest in habitat conservation and ultimately benefit wildlife. However, ecotourism's benefits to landscape-scale conservation may be limited [18]. It is therefore important to understand the demographics and natural history of the globally threatened, near-threatened, and restricted-range species of Acre, Brazil, in order to: 1) prioritize allocation of habitat conservation funds, law enforcement, environmental education, and other resources for reducing habitat degradation within and around the protected areas of southwestern Amazonia, and 2) inform planning for potential ecotourism operations. In addition, it is important to understand local communities' interest in ecotourism before considering such operations. The specific aims of this study are to improve understanding of the distribution and occupancy of the globally threatened, near-threatened, and restricted-range bird species of eastern Acre, Brazil; to learn if and how local peoples have conflicts with said species; and to learn if local peoples have an interest in community-based ecotourism.

Methods

I conducted 125 point-counts in patches of *Guadua* bamboo and 41 alongside water courses (rivers or perennial streams) within primary, tropical wet forests. I opportunistically recorded observations of focal species outside of point counts. Focal species included all of the aforementioned globally threatened, near-threatened, and restricted range bird species of Acre except for *P. albifacies* and *P. subtilis*. These two species were described as hundreds of kilometers outside of Acre in [1], so I unfortunately did not survey for these species. However, *P. albifacies* and *P. subtilis* have been recently discovered in central and eastern Acre [4, 7].

I conducted surveys in six study sites between May and August, 2008. I spent 12-15 days conducting surveys in three regions ("seringais") of Chico Mendes Extractive Reserve (CMER; 16, 19): Assis Brasil (-10.46740, -69.69060 [latitude, longitude; WGS 1984]), Brasileia (-10.55270, -69.28960), and Xapuri (-10.46740, -68.5990). CMER is approximately 970,570 ha, and approximately 2,000 homesteads (landholder units: "colocações") are distributed throughout the reserve [17, 19]. I conducted more limited surveys in Antimary State Forest (-9.27664, 68.27900), protected forested areas within the Peixoto Settlement Project (-9.77299, -67.22180) and the Parque Zoobotânico at the Universidade Federal do Acre (-9.95569, -67.87080) (Fig. 1). Only surveys from CMER and Antimary State Forest were used to inform occupancy estimates.

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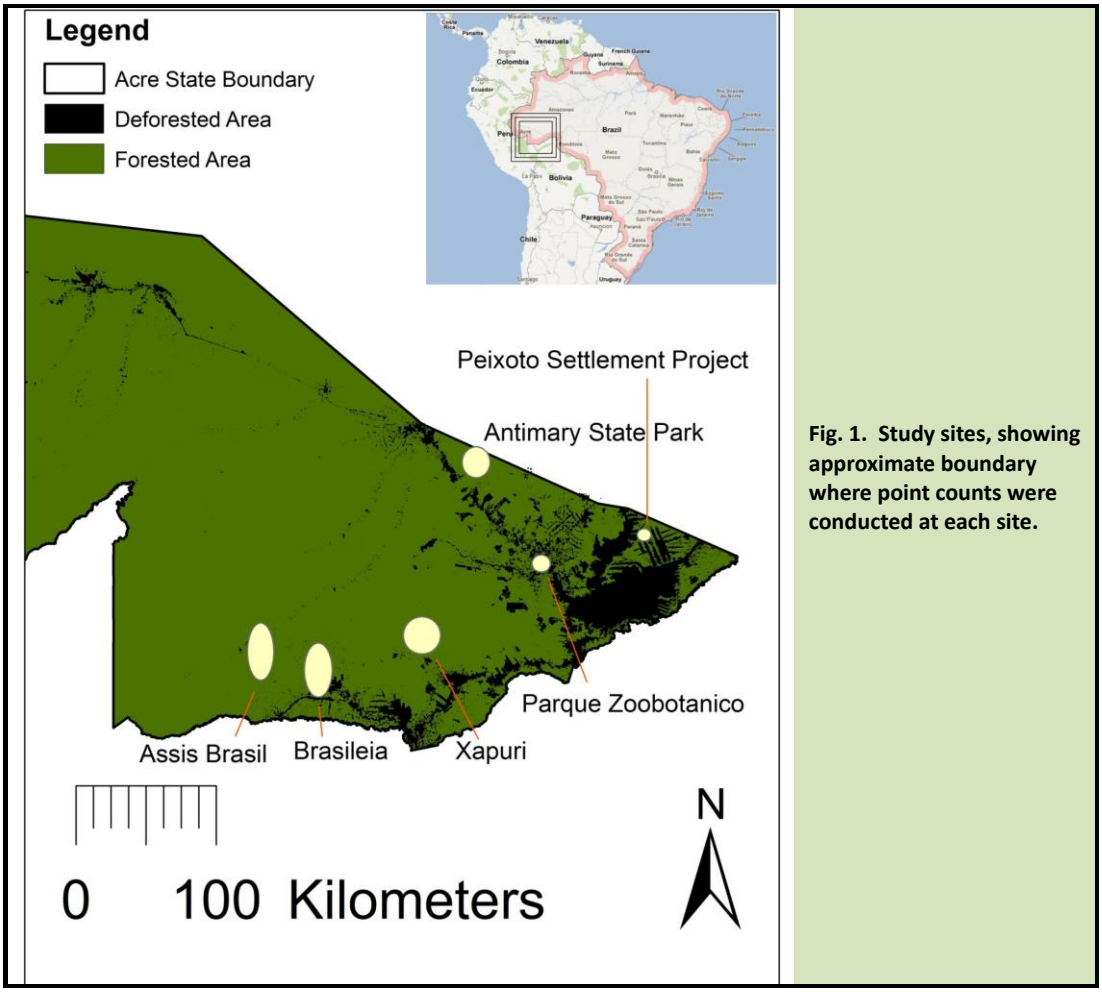


Fig. 1. Study sites, showing approximate boundary where point counts were conducted at each site.

I conducted 8-min. point-count surveys of variable radius [20] from May-August, 2008, with a minimum distance of 300 m between each count location. To create detection histories for estimation of species occupancy, I subdivided the 8 min. count into four 2-min. periods, recording the period in which I saw or heard an individual for the first time. I performed these surveys within four hours of dawn and three hours of dusk (06:00-10:00 and 15:00 to 18:00, local time).

In CMER, I met with leaders of the three "seringais" to select appropriate "colocações" for conducting this research. "Colocações" needed to be managed by community members who would welcome my presence, and they needed to contain trails for harvesting Brazil nuts or rubber. I conducted bird surveys along these trails (which were less than one meter in width), and I interviewed local hunters in and around selected "colocações." Although a random, stratified sampling design for bird surveys and interviews with local hunters (see below) would have been ideal, logistical considerations required this more opportunistic design.

I used program PRESENCE to estimate occupancy, according to the methods outlined by Mackenzie et al. [21]. I attempted occupancy estimation only for species that I detected more than three times during point counts. When estimating occupancy for avian species of conservation concern, I used data only from the 125 surveys that we conducted in bamboo habitat; most species that I detected often enough

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to estimate occupancy are considered bamboo-obligate, and including riverine counts in occupancy estimation added another independent variable to the analysis of an already small dataset and therefore compromised occupancy estimates.

I interviewed 21 hunters in CMER to ask about their perceptions of the relative abundance of and their interactions with over 40 wildlife species of conservation concern. In this article, I analyze results only regarding *C. globulosa*, *H. harpyja*, and *M. guianensis*. I informed each potential interviewee of the aims, methods, and anticipated benefits of the interview. I informed them that they were at liberty to abstain from participation in the interview and that they were free to withdraw their consent to participation at any time. I began interviews by assuring interviewees that individual responses would remain confidential. I then outlined an (albeit subjective) scale of relative abundance: Rare ("raro"; "quase nunca vejo ou muito muito pouco"), uncommon ("pouco comum"), common ("comum"), very common ("muito comum, bastante"), does not occur ("não acontece e nunca vi"), or extirpated ("ja vi no pasado, mas agora não existe"). Next, I showed interviewees an image of a species and asked them to provide a relative rating of abundance using the aforementioned scale. Then, I asked interviewees if a species caused any conflicts with their livestock production (virtually all landholders within CMER produce limited numbers of livestock) or other aspects of their life. I followed up by asking them if they killed the species to reduce any perceived conflicts or for any other purpose. Last, I explained the concept of community-run ecotourism and asked interviewees if they had an interest in the concept.

Results

Blue-headed Macaw (Primolius couloni)

I was unable to estimate occupancy for *P. couloni* (Fig. 2) as I only once detected it in a stationary position during point-count surveys. I encountered *P. couloni* in CMER (in all three regions/sites), Antimary State Forest, and Peixoto Settlement Project (Fig. 1; Appendices 1-2 and 5) at 35 locations. Assuming that unique groups exist at least 10 km apart from one another (following Tobias and Brightsmith [12]), I encountered unique groups in all but one study site (Appendix 1-2 and 5). Without correcting for detectability, and only counting the maximum group size for each study site (because multiple encounters per site could be the same family group flying over), I encountered at least 27 individuals.

In CMER, I observed *P. couloni* on multiple occasions in Assis Brasil, Brasileia, and Xapuri. I encountered the species in groups of 2-6. In relative comparison to the largest *Ara spp*. of eastern Acre, *P. couloni* appeared to be uncommon but not as rare or limited in distribution: I encountered Scarlet Macaws (*Ara macao*) and Red-and-Green Macaws (*Ara chloropterus*) only along the Icuriã River in the region of Assis Brasil, and I encountered the Blue-and-Yellow Macaw (*Ara ararauna*) only once, in Antimary State Forest. The only location where I did not detect *P. couloni* was at the Parque Zoobotânico of the Universidade Federal de Acre, an isolated patch of forest within the city of Rio Branco (see [9] for information on avifauna of this location).

I encountered *P. couloni* in a diversity of habitats, including primary and secondary forest, vàrzea/floodplain and terra firme, and interior and forest-edge. Most encounters were from flyovers, but I opportunistically saw or heard stationary individuals in both interior forest and forest edge bordering livestock pastures. I encountered the species in roosting trees (i.e., trees where a group arrived at dusk, rested, and departed at dawn) on two occasions, each time in the same species and size of palm (Fig. 2; most likely *Iriartea deltoidea*; a palm of 20-30 cm diameter at breast height (DBH) and 20-30 m tall, with a bulge toward the center; locally named "paxiúba barriguda"). Both roosting observations were on the

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interface of pasture and lowland forest, but this may have been due to detectability more than habitat preference. One encounter was in the Peixoto Settlement Project (in a standing dead palm), and the other in the Xapuri region of CMER (in a live palm with cavities at its center; Fig. 2). In Peixoto, I watched a roosting family group with a high-powered spotting scope (see Fig. 2 for a digiscoped image); this group was of mixed ages, with two adults (identified by white irises) and two immature individuals (identified by dusky grey irises; presumably offspring). This group returned to the same roosting tree several nights in a row and was within 300 m of a roosting pair of Red-bellied Macaws (*Orthopsittaca manilata*). I did not have a spotting scope in Xapuri, so I was unable to age the four roosting individuals that I encountered there. I encountered only one clay lick during this study, in the region of Assis Brasil. Here, I opportunistically encountered six *P. couloni* in association with approximately 20 Mealy Parrots (*Amazona farinosa*); 15 Yellow-crowned Parrots (*Amazona ocrocephala*); 400 Blue-headed Parrots (*Pionus menstruus*); and 15 Red-and-Green Macaws (*Ara chloropterus*).



FIG. 2. Blue-headed Macaws (*P. couloni*; top left) and their roost sites in Peixoto Settlement Project (top left) and Xapuri region (top right). The Icuriã River (bottom left) and local clay licks (bottom right) host a diversity of globally threatened and charismatic wildlife species in Assis Brasil: This biodiverse region of Chico Mendes Extractive Reserve may be ideal for community-run ecotourism. Copyright John J. DeLuca.

In CMER, I encountered *P. couloni* spending time in actively fruiting trees on the interface of lowland forest and small (<20 ha) pasture on several occasions: I saw the species in *Dipteryx micrantha* ("cumaru ferro"), *Cecropia spp.* ("imbauba"), and large woody vines ("lianas"). I also saw *P. couloni* in a fruiting "anjico" tree (scientific name unknown; a common name for many species). I assume that as *P. couloni* was seen actively and acrobatically moving throughout the fruiting parts of these plants for minutes at a time, and that since these plants bore fruit at the time of observation, *P. couloni* was likely eating the fruit of these plants.

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In the Xapuri region of CMER, one of my guides stated that many people take hatchlings from the nests of “maracanas” (local name used for *P. couloni, O. manilata*, and Chestnut-fronted Macaws [*Ara severus*]) and “araras” (local named used for large *Ara spp*). This guide claimed that *P. couloni* only lays 2 eggs. I clarified that he indeed could distinguish between *P. couloni* and other “maracana” species by asking him open-ended questions about differences in their appearance. This guide was a resident of CMER, and he believed that nest-robbing has declined since the creation of the reserve because people are afraid to illegally sell, although he stated that some people probably still sell in secret. He stated that he has seen *P. couloni* nestlings between August and September in "paxiúbao" (literally, “big belly”; possibly the old-growth form of “paxiúba barriguda” [*Iriartea deltoidea*] or a large [upwards of 1.5 m DBH] hardwood with flaky, reddish bark which was referred to as “paxiúbao” by another guide).

Rufous Twistwing (Cnipodectes superrufus)

All individuals were encountered in *Guadua* bamboo. I never detected the species during point-count surveys, which made it impossible to estimate occupancy. I encountered only four individuals in four different locations (Appendices 1-2 and 5). Three of these records were in new locations (i.e, outside the 15 previously known occurrences of the species [9, 13-14]).

I observed *C. superrufus* once in a bamboo patch within vàrzea in the Parque Zoobotânico at the Universidade Federal de Acre (confirming a previous record [13-14]), within 30 m of an edge between forest and the campus green. I observed the species twice in the region of Assis Brasil in CMER – once in upland terra firme and once in streamside “baixo de terra firme” (seasonally flooded, streamside microhabitat within terra firme). I observed *C. superrufus* once in the region of Xapuri in CMER, in upland terra firme habitat. These records of *C. superrufus* greatly expand on the one known location of the species in CMER [3]. It constitutes the first record within seasonally flooded bamboo habitat, which conflicts with the hypothesis that the species may prefer upland bamboo habitat [13-14].

On one occasion, in the Assis Brasil region of CMER, I recorded behavioral data of *C. superrufus*, including vocal recordings and feeding behavior (data to be available online at the Macaulay Library). The individual responded to playback by making counter-vocalizations, producing sound from its modified primary feathers, flying in dashed circles around the playback source, and flicking its tail and wings.

I observed the consumption of four food items by this individual. Three food items were Coleoptera or Lepidoptera larvae of approximately 1.5-2 times bill length. One prey item was round and approximately 0.6 times bill length. This food item and at least one of the three larvae were repeatedly smacked on a branch before being eaten. Others species detected within 50 m of this encounter included Greenish Elaenia (*Myiopagis viridicata*), Manu Antbird (*Cercomacra manu*), Sulphur-bellied Tyrant-Manakin (*Neopelma sulphureiventer*), Peruvian Recurvebill (*Simoxenops ucayalae*), and Rufous-capped Nunlet (*Nonnula ruficapilla*).

Significant records

- I detected the near-threatened species, *S. ucayalae,* throughout CMER and Antimary State Park and approximately 50 km north of the historic northeastern edge of its global distribution [3, 5-6, 22]. This also confirms recent findings of the species in CMER [3].
- I made one distributional record for the near-threatened, restricted-range *N. dachilleae.* This

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expands the northeastern extent of its global distribution by approximately 40 km to the north and 100 km to the east [5].

- I detected the near-threatened, patchily distributed *S. cherriei* in the regions of Assis Brasil and Brasileia, CMER. Combined with other recent detections [5-6, 2-3], these records substantially increase the species' global distribution [22] and demonstrate that it likely occurs throughout most of Acre, from approximately 9 degrees south of the equator and southward.
- I detected the near-threatened and restricted-range *F. rufifrons* several times in the region of Assis Brasil, CMER. The species was previously only encountered in Brazil directly on the border of Peru and Acre [2]. Observations from this study expanded the species' range approximately 75 km north 100 km east of its historic eastern range in Brazil.
- I detected the restricted-range *E. tucinkae* approximately 75 km north and 100 km east of the previously most eastern distributional record in Brazil, along the Icuriã River in CMER [2-3].
- I made several new distributional records for the restricted-range *P. lophotes.* This confirms other recent records of the species in eastern Acre [2-3] and increases the global distribution of the species approximately 50 km to the north [1-3, 22].
- Although Southern Caracara (*Caracara plancus*) was not a focal species in this study, I saw this species once in the Brasileia region of CMER; this confirms other recent, new records of this open-land species expanding into Brazil [2].

See Appendices 1-7 for occupancy estimates and details on where focal species occurred. For specific geographic coordinates of individual detections and comments on observations, see https://sites.google.com/site/delucajj/.

Interviews about Wattled Curassow (Crax globulosa), Harpy Eagle (Harpia harpyja), Crested Eagle (Morphnus guianensis), and Interest in Ecotourism

I did not detect *C. globulosa, H. harpyja* or *M. guianensis* during this study. Based on interviews in CMER, however, the latter two species apparently occur throughout Brasileia, Xapuri, and Assis Brasil. One hunter whom I interviewed in the Xapuri region claimed that he has seen *C. globulosa* in recent years and in remote vàrzea forest, even after being shown an image of the potentially confounding Razor-billed Curassow (*Mitu tuberosa*). It is important to note that no other hunters recognized this species during interviews, so this information may be suspect. In general, hunters observed that *H. harpyja* was rare and *M. guianensis* was uncommon. Depending on the region of CMER, 40-60% of hunters kill or have killed *H. harpyja*, and 80-100% of hunters kill or killed *M. guianensis.* Although *H. harpyja* and *M. guianensis* are very similar in appearance, most hunters indicated that they knew the difference between the two species, often pointing to the difference in chest pattern. Even if hunters did confuse the two species, the combined results indicate that these species are rare to uncommon and highly persecuted. The prevailing reason for killing these species was to reduce a perceived threat of these species to livestock (Appendix 4). Conversations with interviewees revealed that *H. harpyja* was perceived to prey upon chickens, sheep, and small cattle, whereas *M. guianensis* was perceived to only prey upon chickens.

All but one of the 21 hunters who answered questions about these species expressed interest in community-run ecotourism. Two expressed some interest but were not sure. All others welcomed the concept.

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Focal species not detected

I did not encounter *C. koepckeae, G. eludens,* or *M. semicincta*. The latter two species are notoriously quiet and difficult to detect, so more intensive survey effort may reveal their presence, especially in the Assis Brasil region of CMER. Recent expeditions by Dante Buzetti have confirmed the presence of *C. koepckeae* in east-central Acre [2], indicating that the species possibly occurs along rivers such as the Icuriã River (the river that serves as the northern border of CMER). With more intense survey effort, new populations of *C. globulosa* and *C. koepckeae* could very well be discovered along the Icuriã River and other prominent rivers of Acre.

Discussion

Although *P. couloni* was widely distributed (Fig. 2; Appendix 5), I was not able to estimate occupancy or abundance using detectability-based methods. Based on my observation of the relative abundance of this species in comparison to other psitaccids (see Results for details), *P. couloni* appears uncommon or rare, highly vocal, and highly nomadic or widely distributed. There remains a need to develop an efficient yet defensible method for estimating the abundance of *P. couloni* and other rare psittacids, as current methods (e.g., distance sampling, point counts) are costly to the point of impractical with such wide-ranging, rare species [23].

Results (Appendices 1-2 and 5) confirm that *C. superrufus* is one of the rarest, if not the rarest, bamboo-obligate species in Amazonia [3, 13-14]. I support its recent listing as a vulnerable species. Along with *M. semicincta, F. rufifrons,* and *N. dachilleae*, it was one of the least-detected species in this study (Appendices 1-2 and 5). I estimated that *S. ucayalae* occurs in only 5% of bamboo patches (Appendix 3). The species seems to merit its near-threatened IUCN status, if not revision to vulnerable status. These observations, combined with recent research [3, 5-6], suggest that the species occurs throughout CMER and its distribution is fairly contiguous across eastern Acre and into southwestern Peru and northwestern Bolivia.

Based on interviews with local hunters, *H. harpyja* and *M. guianensis* occur throughout CMER but appear to be rare to uncommon. Most hunters kill or killed *H. harpyja* and *M. guianensis,* primarily to reduce the perceived threat of these species to livestock (Appendix 4). Persecution of *H. harpyja, M. guianensis*, and other large raptors in Brazil [24] and likely elsewhere may threaten the conservation of these species. Conservation organizations could employ a variety of solutions to reduce persecution of these species, including: 1) developing a program to provide funds, materials, and/or training for landholders to build structures that would protect chickens from predators, 2) compensating people who identify and protect the nests of these and other rare bird species; or 3) using environmental education and public relations campaigns to increase pride for the conservation of these charismatic raptors. Furthermore, empirical research into livestock depredation by wild predators may determine the actual impact of these species on livestock numbers. It is important to note that there is no peer-reviewed, first-hand documentation of either species killing livestock; these perceptions may be based more on rumor than on reality [24].

I did not detect *C. koepckeae* or *C. globulosa* during this study. Based on unpublished data from hunters' use of other game birds (JJD unpublished data), *C. globulosa* would very likely be threatened by hunting pressure if it exists in Acre. I recommend extensive downriver surveys by canoe on medium and large rivers in the region (e.g., Icuriã River) to efficiently survey for and inform management of potential new populations of these and other globally threatened, riverine species (e.g., yellow-spotted river turtle [*Podocnemis unifilis*]; giant otter [*Pteronura brasiliensis*]).

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Several interviewees in CMER complained about the lack of protection from the Instituto Brasileio do Meio Ambiente e dos Recursos Renovaveis (IBAMA) and Instituto Chico Mendes da Biodiversidade. They stated that a lack of environmental law enforcement officers on weekends allows bandits to illegally log the reserve and cause other damage to natural resources. Habitat degradation, hunting, and poaching are likely to accelerate with the completion of the Brazil-Peru Interoceanic Highway. Populations of many species of conservation concern in southwestern Amazonia (especially psittacids, cracids, and large raptors that are hunted, traded, or persecuted) may therefore decrease as a result of this highway construction. Increasing law enforcement (including weekends) would help keep protected areas from being degraded. As CMER is known for its community pride and ownership in conservation [17, 19], it may be useful to establish a community-elected, community-run law enforcement program in the Reserve. As the community members who proposed this concept suggested, it would probably be necessary for community members to be compensated for time that would otherwise be spent hunting or farming. Establishing more protected areas – with proper enforcement – along the Interoceanic Highway may create a buffer against habitat degradation.

The completion of the Interoceanic Highway will increase access to Acre and may increase opportunities for local people to develop and benefit from ecotourism operations, including birding tours focused on rare and restricted-range species. The widespread interest of local hunters in ecotourism, along with the prevalence of rare and restricted-range bird species and other wildlife, provides an excellent opportunity for local communities to benefit from wildlife conservation. The region of Assis Brasil in CMER seems most appropriate for ecotourism operations: It hosts a large clay lick with a variety of psitaccid species, the highest number of rare and restricted-range bird species, the highest abundance and diversity of other rare and charismatic wildlife of the three regions of CMER (e.g., *M. tuberosa*, Brazilian tapir [*Tapirus terrestris*], giant otter [*Pteronura brasiliensis*], jaguar [*Panthera onca*], and at least nine species of primates [JJD, unpublished data]); and access to a sizeable and biodiverse river (Fig. 2). Development of community-run ecotourism may increase local support for wildlife conservation and result in less consumption or persecution of rare birds (e.g., *P. couloni*, *H. harpyja*, and *M. guianensis*) and other wildlife of conservation concern.

Implications for conservation

This study helps inform avian conservation in the portion of the South-east Peruvian Lowlands Endemic Bird Area that encompasses eastern Acre, Brazil. It illustrates that the IUCN-Vulnerable *P. couloni* (Fig. 2) occurs throughout CMER and other protected areas of eastern Acre. This study indicates that the recently described, IUCN-Vulnerable *C. superrufus* occurs throughout CMER and confirms recent research [3, 12-13] that *C. superrufus* is likely the rarest bamboo-obligate bird species in southwestern Amazonia. It expands the known distribution of several avian species of conservation concern in southwestern Amazonia, including *S. ucayalae, N. dachilleae*, *S. cherriei*, *F. rufifrons*, *E. tucinkae,* and *P. lophotes*. This study indicates that *H. harpyja* and *M. guianensis* are perceived by hunters as uncommon-rare and are broadly persecuted across CMER. However, it also suggests that human-caused loss of these and other species of conservation concern may be reduced if local communities are provided the resources to turn their general interest in community-run ecotourism into a reality.

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Appendix 1. Detections of avian species of conservation concern by study site.

Region	Species	*Primolius couloni*	*Cnipodectes superrufus*	*Formicarius rufifrons*	*Synallaxis cherriei*	*Simoxenops ucayalae*	*Nannopsittaca dachilleae*	*Eubucco tucinkae*	*Percnostola lophotes*	*Myrmeciza goeldii*	*Lophotriccus eulophotes*	*Conioptilon mcilhennyi*
Assis Brasil (CMER)		x	x	x	x	x	x	x	x	x	x	x
Brasileia, (CMER)		x			x	x	x			x	x	x
Xapuri (CMER)		x	x			x			x	x	x	x
Antimary State Park		x				x			x	x	x	x
PZ UFAC			x									
Peixoto Settlement		x									x	

Data from Antimary State Forest and the Parque Zoobotânico at the Universidad Federal do Acre (PZ UFAC) should not be compared to data from CMER (see section on methods for details).

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Appendix 2. Number of times focal species were detected during point counts and opportunistic encounters.

Species	*Cnipodectes superrufus**	*Formicarius rufifrons**	*Nannopsittaca dachilleae**	*Simoxenops ucayalae**	*Percnostola lophotes**	*Lophotriccus eulophotes**	*Myrmeciza goeldii**	*Primolius couloni*	*Synallaxis cherriei*	*Eubucco tucinkae*	*Conioptilon mcilhennyi*
Bamboo Point-Counts (n=125)											
# Points Detected	1	1	1	6	10	21	19	1	0	0	14
% Points Detected	0.8	0.8	0.8	4.8	8	16.8	15.2	0.8	0	0	11.2
# Individuals Detected	0	1	4	6	12	22	27	2	0	0	20
Riverine Point-Counts (n=41)											
# Points Detected	0	2	0	1	2	0	8	0	1	2	2
% Points Detected	0	4.9	0	2.4	4.9	0	19.5	0	2.4	4.9	4.9
# Individuals Detected	0	2	0	1	3	0	11	0	1	2	2
Opportunistic Detections (approximately 50 days in the field)	3	0	0	3	5	#	#	32	2	0	11
Grand Total (Point-Count + Opportunistic Detections)	3	3	1	10	17	#	#	33	3	2	27

*Indicates bamboo-obligate species; #*L. eulophotes* and *M. goeldii* were so prevalent that it was not practical to record every point where they were opportunistically detected.

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Appendix 3. Estimates of occupancy and detectability.

Species	psi (occupancy estimate)	Std. Err. psi	p (detectability estimate)	Std. Err p
Conioptilon mcilhennyi	0.1852	0.1267	0.2071	0.1931
Percnostola lophotes	0.0984	0.0405	0.3427	0.1998
Lophotriccus eulophotes	0.185	0.0369	0.5299	0.1113
Myrmeciza goeldii	0.1552	0.033	0.6208	0.1088
Synallaxis ucayalae	0.0532	0.0232	0.4418	0.2333

Only those species which I detected in more than three point counts were analyzed for occupancy estimation.

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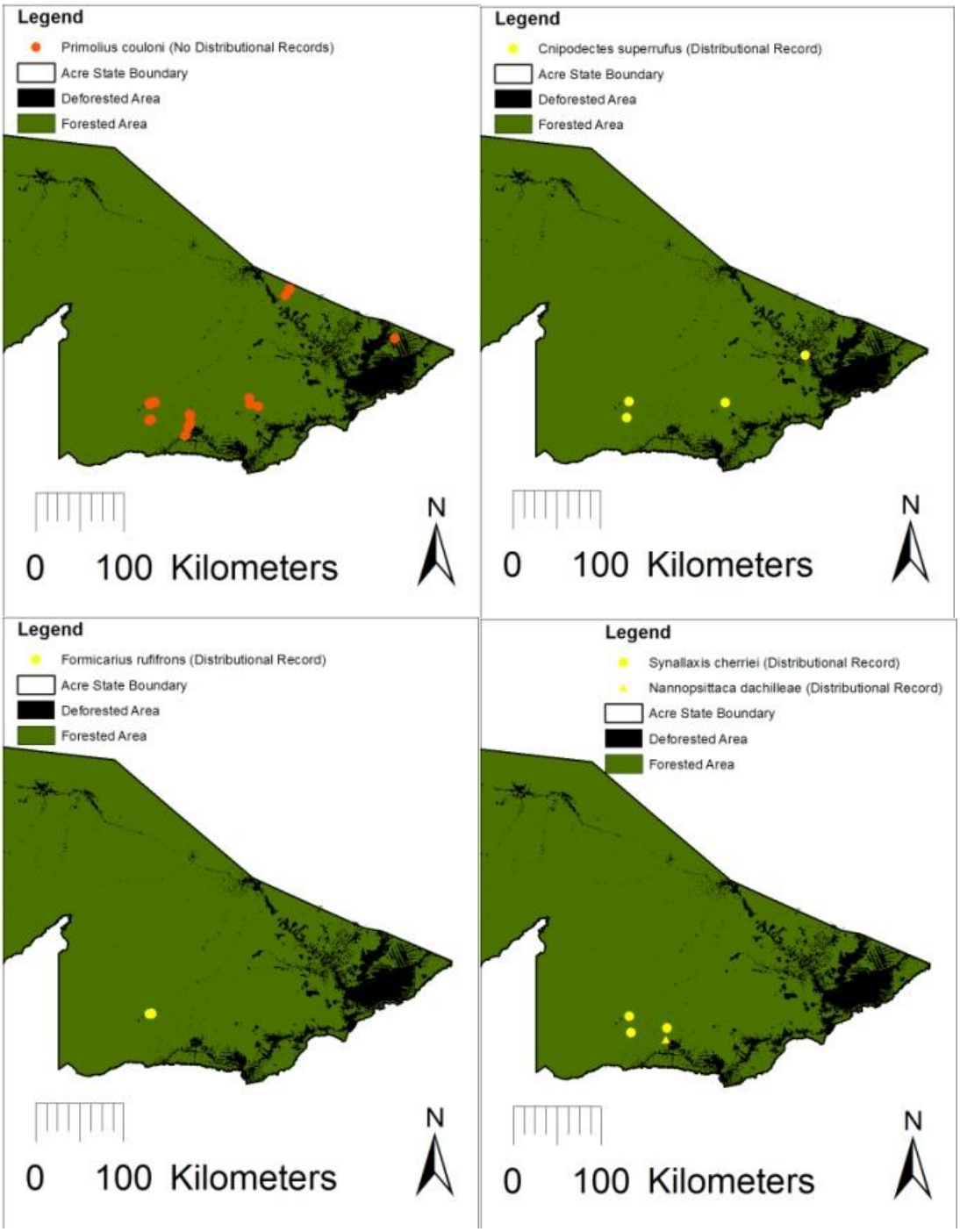
Appendix 4. Results of interviews with hunters from Chico Mendes Extractive Reserve (CMER)

CMER Region	Hunter ID	Relative Abundance *Harpia harpyja**	Relative Abundance *Morphnus guianensis**	Kills/Killed *Harpia harpyja***	Kills/Killed *Morphnus guianensis***
Brasileia	1	1	1	0	1
Brasileia	2	1	1	0	1
Brasileia	3	1	1	0	0
Brasileia	4	1	2	2	1
Brasileia	5	3	3	1	1
		Median RA	***Median RA***	***% Who Kill/Killed****	***% Who Kill/Killed****
		1	*1*	*40*	*80*
Assis Brasil	6	0	0	0	0
Assis Brasil	7	1	0	0	0
Assis Brasil	8	1	1	1	1
Assis Brasil	9	2	2	1	1
Assis Brasil	10	2	2	1	1
Assis Brasil	11	2	0	0	0
		Median RA	***Median RA***	***% Who Kill/Killed****	***% Who Kill/Killed****
		1.5	*1*	*60*	*100*
Xapuri	12	0	2	0	1
Xapuri	13	1	1	3	1
Xapuri	14	1	2	0	1
Xapuri	15	1	2	0	0
Xapuri	16	1	2	0	1
Xapuri	17	1	2	0	1
Xapuri	18	1	3	1	1
Xapuri	19	2	2	1	1
Xapuri	20	3	3	1	1
Xapuri	21	3	3	0	0
		Median RA	***Median RA***	***% Who Kill/Killed****	***% Who Kill/Killed****
		1	*2*	*44*	*80*

*0=Does not occur; 1=Rare; 2=Uncommon; 3=Common; 4=Abundant; **0=Does not kill; 1=Kills to reduce perceived livestock predation; 2=Hunts for food; 3=Killed once out of curiosity; ***Denominator used to calculate percentage excluded interviewees that stated that the species does not occur in the region.

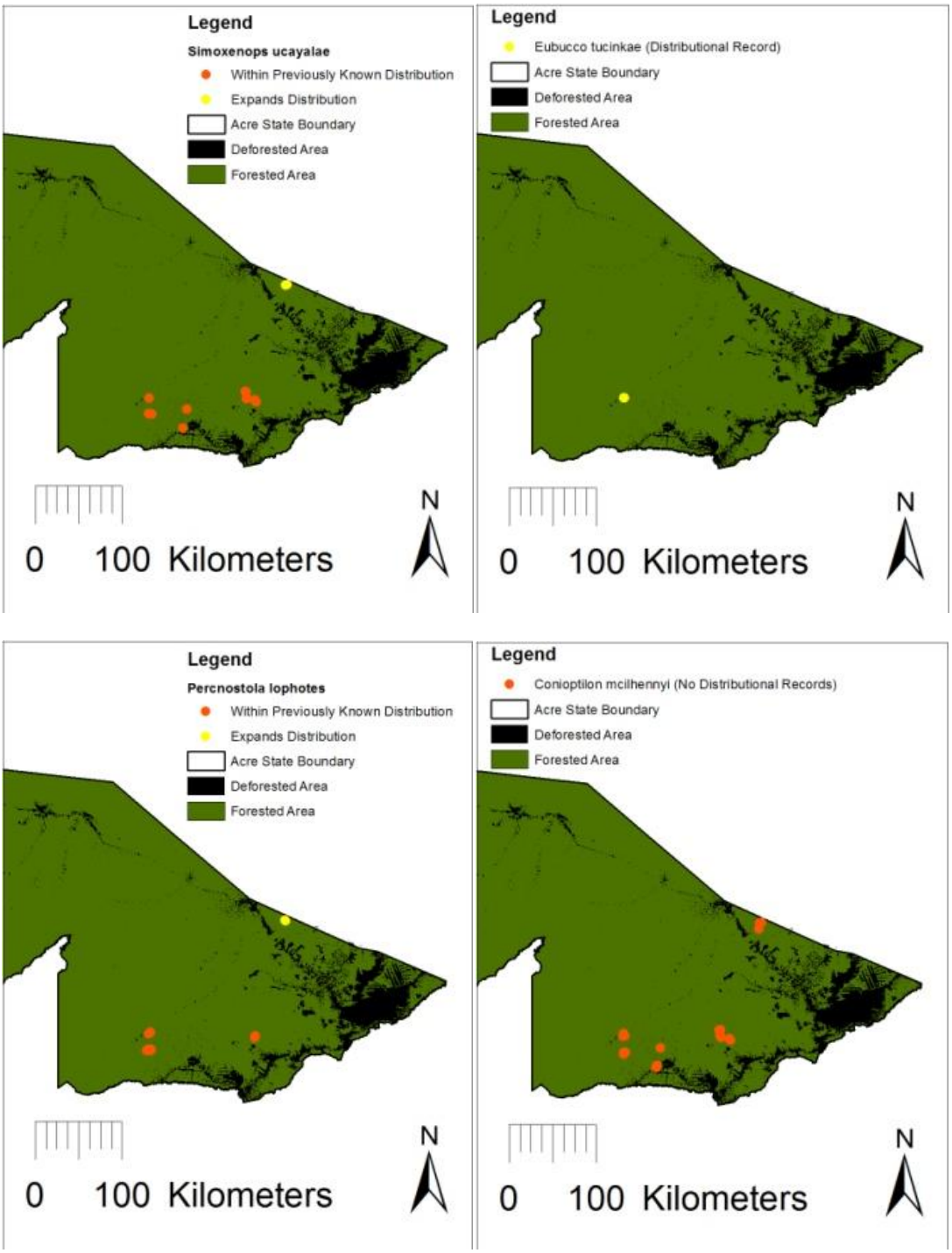
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Appendix 5. Detections of *Primolius couloni*, *Cnipodectes superrufus*, *Formicarius rufifrons*, *Synallaxis cherriei*, and *Nannopsittaca dachilleae.* Yellow circles and triangles indicate distributional or other significant records. Red circles indicate detections within previously known ranges. See online appendix for GIS coordinates of individual observations.



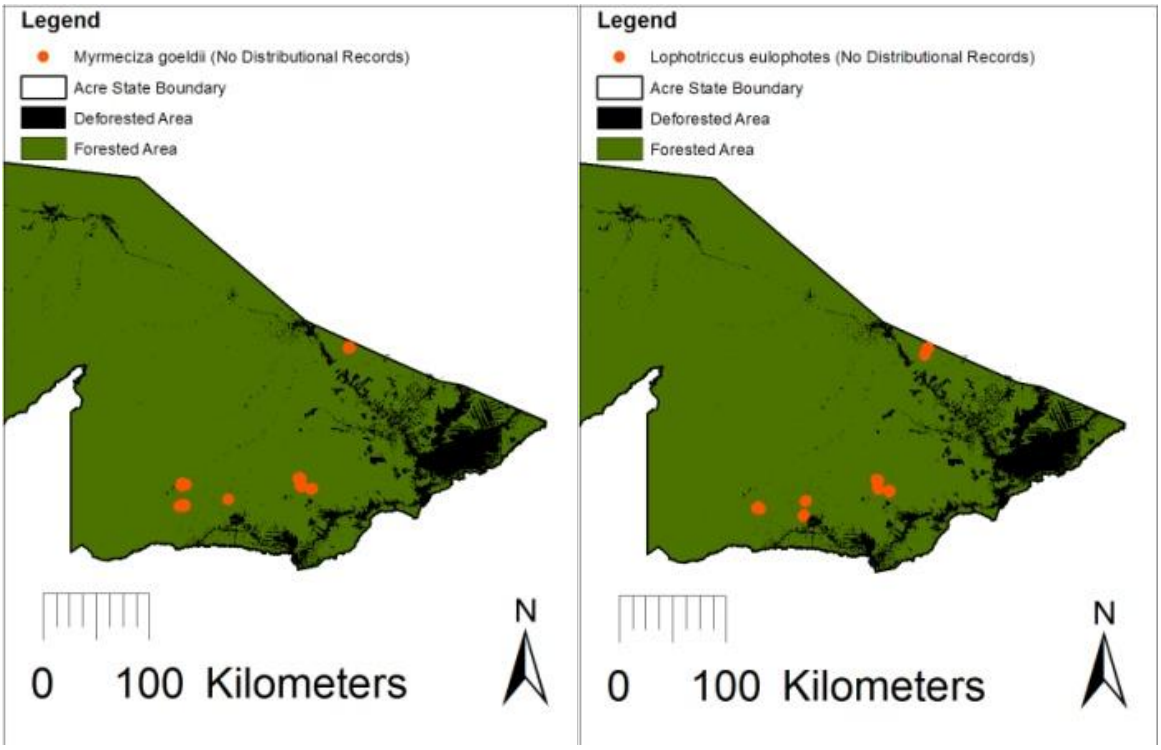
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Appendix 6. Detections of *Synallaxis ucayalae*, *Eubucco tucinkae*, *Percnostola lophotes*, and *Conioptilon mcilhennyi*. Yellow circles indicate distributional or other significant records. Red circles indicate detections within previously known ranges. See online appendix for GIS coordinates of individual observations.



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Appendix 7. Detections of *Myrmeciza goeldii* and *Lophotriccus eulophotes*. Red circles indicate detections within previously known ranges. See online appendix for GIS coordinates of individual observations.



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