SHORT COMMUNICATION

First reports of giant anteater (Myrmecophaga tridactyla) and greater naked-tailed armadillo (Cabassous tatouay) for the Iguaçu National Park, Paraná, Brazil, with notes on all xenarthran occurrences

Anne-Sophie Bertrand\textsuperscript{A,B,1} & Amadeu M.V.M. Soares\textsuperscript{A}

\textsuperscript{A}Universidade de Aveiro, Biology Department and CESAM (Research Center in Marine and Environment), University of Aveiro, Campus de Santiago, Aveiro, 3810-193, Portugal. E-mail: annesophie.bertrand@gmail.com (ASB)

\textsuperscript{B}Iguaçu National Park, Management and Conservation Department – Guest researcher, Avenida das Cataratas, BR-469, KM18, CEP 85857-970, Foz do Iguaçu, Paraná, Brazil

\textsuperscript{1}Corresponding author

Abstract Four Xenarthra species appear on the list of mammals whose presence has been documented in the Iguaçu National Park (INP). We conducted the first long-term camera trap monitoring in the Iguaçu region, encompassing the park and its buffer zone. We confirmed the presence of the four Xenarthra species known to occur in the park, with the first photographic records of giant anteaters (Myrmecophaga tridactyla). We also detected the presence of the greater naked-tailed armadillo (Cabassous tatouay), which had not previously been reported for the park. Giant anteater sightings are described, and habits are discussed. Our data provide important additions to the existing knowledge on giant anteaters inhabiting INP, a key wildlife refuge in southern Brazil.

Keywords: armadillos, Atlantic forest, distribution, habitat preferences, photographic records

Primeiros registros documentados de Myrmecophaga tridactyla e Cabassous tatouay e notas sobre a ocorrência de xenartros do Parque Nacional do Iguaçu, Paraná, Brasil

Resumo Quatro espécies de xenartros constam na lista oficial de mamíferos cuja presença foi documentada no Parque Nacional do Iguaçu (PNI). Realizamos o primeiro monitoramento por armadilhas fotográficas de longo prazo na região Iguaçu, abrangendo o parque e sua zona de amortecimento. Confirmamos a presença das quatro espécies de xenartros que ocorrem no parque, com os primeiros registros fotográficos de tamanduá-bandeira (Myrmecophaga tridactyla). Detectamos também a presença do tatu-de-rabo-mole grande (Cabassous tatouay), que não constava na lista do parque. Os registros obtidos de tamanduá-bandeira são descritos e hábitos são discutidos. Nossos dados fornecem complementos importantes ao conhecimento existente sobre o tamanduá-bandeira ocorrendo no PNI, um importante refúgio silvestre do sudeste do Brasil.

Palavras-chave: distribuição, mata Atlântica, preferências de hábitat, registros fotográficos, tatus

The official list of non-flying mammal species for the Iguaçu National Park (INP) in southwestern Brazil includes 48 species, of which four are xenarthrans: the yellow armadillo (Euphractus sexcinctus), the nine-banded armadillo (Dasypus novemcinctus), the lesser anteater (Tamandua tetradactyla), and the giant anteater (Myrmecophaga tridactyla; Medri & Mourão, 2008). Species presence was confirmed by sightings, road kills, or through trichology (i.e., big cats’ scat content analysis; MMA, 1999). Regarding the latter, in the absence of other forms of evidence, microscopic hair analysis has been used as an identification technique, but its reliability has been questioned many times. Nowadays, microscopic
Hair identification is not considered definitive when compared to DNA or photographic evidence (Foran et al., 1997; Farrel et al., 2000; Sahajpal et al., 2009). Of course, DNA can be extracted from hair material and would help tremendously to turn a microscopic identification into conclusive evidence (Bertrand et al., 2006).

All of the xenarthrans at INP, except the giant anteater, are listed as Least Concern in the IUCN Red List of Threatened Species (IUCN, 2017). However, much remains unknown regarding species dynamics, ecology, distribution, and trends (Abba et al., 2014; Anacleto et al., 2014; Loughry et al., 2014; Miranda et al., 2014a). The giant anteater is listed as Vulnerable based on local extinctions, road kills (Cáceres et al., 2010), and habitat loss due to fire (Prada & Marinho-Filho, 2004) and human-oriented soil use (Miranda et al., 2014b). In fact, it is listed in a threatened category everywhere it is known to occur (Miranda et al., 2014b).

This short communication presents findings on xenarthrans extracted from a broader mammal inventory conducted in the INP region between September 2012 and October 2014. We used camera-traps to record over 30 different non-flying species of mammals. Here we provide the first photographic evidence confirming the presence of the giant anteater in INP, and also report the first record of the greater naked-tailed armadillo (Cabassous tatouay), which was not previously listed for the park. Finally, we discuss our findings on M. tridactyla and C. tatouay, provide brief notes on other recorded xenarthran species, and mention some important conservation issues.

Sixteen motion-triggered cameras were used to conduct a broad mammal survey in the region of the INP. We randomly placed the cameras within the INP as well as in its 5-km surrounding buffer zone. At each sampling station, we recorded latitude and longitude coordinates, as well as habitat type, microhabitat, canopy closure, and soil type. Habitat type and microhabitat were identified in loco, canopy closure was calculated using a quadrant, and soil type was identified using existing classification map (Ricobom & Skiba, 2001). Rapidfire PC900™ cameras (Reconyx, Holmen, WI, USA) automatically recorded air temperature, date, and time while taking 15 pictures in near-video sequences. Cameras were set in bursting mode, taking one photograph per second until the animal left the detection zone.
Sampling effort consisted of 6,190 sampling days in 193 different locations, covering 80 km² of the westernmost section of the INP (N=84 sampling stations) and its buffer zone (N=109), from São Miguel do Iguaçu to Foz do Iguaçu (Fig. 1). This is the first long-term monitoring in the region, covering 755 consecutive days, and totaling 247,693 photographic records. Each sampling location was monitored for 33 days on average. Three of our 16 cameras were stolen, and possibly destroyed, by fishermen and poachers, who represent one of the main pressures on giant anteater populations (Miranda et al., 2014b; Quiroga et al., 2016).

Of 7,681 individual animal records, 540 (7.0%) were of xenarthrans, accounting for 6.3% of INP records (N=216) and 14.9% in the buffer zone (N=324). With 97.4% of all xenarthran records (N=526), the nine-banded armadillo was the species most commonly observed; it was found equally often inside and outside the INP (Bertrand, 2016). In order to fully characterize the habitat gradient offered by the Iguaçu region, we installed our cameras in the widest variety of natural habitats. Thus, the predominance of the nine-banded armadillo is likely due to the fact that it is the most common armadillo species locally, rather than an artifact of a selective sampling procedure. The lesser anteater (1.1%, N=6) was found more times in unprotected forest remnants than inside the INP (Bertrand, 2016). Our remaining records consisted of four yellow armadillos, three giant anteaters (0.56%; Fig. 2), and one greater naked-tailed armadillo (Fig. 3). These last two species were solely found within the INP boundaries, whereas the yellow armadillo was only found in the forest thickets of the park buffer zone, suggesting that habitat differences may dictate species distribution, which in turn may reflect sensitivity to habitat alterations (Abba & Superina, 2010). Table 1 presents a detailed description, including date, time, weather, soil type, and habitat features, of the records obtained for giant and lesser anteaters, yellow armadillos, and the greater naked-tailed armadillo. The time of day when the three giant anteater photographs were taken is consistent with the timing of activity cycles reported by Shaw et al. (1987).

Confusion over the taxonomic identification of the greater naked-tailed armadillo has made its conservation status and distribution uncertain (González & Abba, 2014). Currently, this species is listed as Least Concern by the IUCN, primarily because it is thought to have a wide distribution and to be relatively tolerant of habitat modification, being found in agricultural lands and secondary forests. In this study, the animal we observed was found on the edge of an illegal salt lick within the park boundary, where human-related pressures abound. Nationally, C. tatouay is known to occur in the southern and eastern portions of Brazil (Abba & Superina, 2010), which includes our study site. As we only collected one record, our intention here is merely to report the presence of the species in one of the most important conservation areas in southwestern Brazil, rather than extrapolate about its potential habitat preferences or distribution. Nonetheless, habitat information is provided for this record in Table 1.

Scientists have shown considerable interest in charismatic giant anteaters; hence, there are more data available on this species as compared with many other xenarthrans (Miranda et al., 2014a). They appear to select different habitat types according to temperature; such thermoregulatory sensitivity may be linked with the fact that they feed exclusively on low-caloric foods (i.e., ants and termites; McNab, 2000). During colder days, giant anteaters can be seen sun bathing in open areas, whereas they rest in forest shade on hotter days (Medri, 2002; Sampaio et al., 2006). They also have...
been observed bathing in ponds in order to regulate their body temperature (and/or avoid bothersome flies) on hot days in Bolivia (Emmons et al., 2004). In one of our three photographic records, the animal was indeed on the edge of a river within the INP early at night on a hot day (Table 1). While this corroborates what Sampaio et al. (2006) found based on the monitoring of 11 individuals in the Brazilian Pantanal, the bathing habits of giant anteaters still puzzle ecologists. For example, Emmons et al. (2004) reported individuals also bathing in the middle of cool nights, and during the dry season, a time when they are unlikely to be bothered by flies. Unfortunately, our data do not allow any insights on the matter.

In Venezuela and Argentina, giant anteaters were exclusively nocturnal during the hot season (Shaw et al., 1987; Di Blanco et al., 2015). In the Brazilian Cerrado, all xenarthrans except the yellow armadillo usually display nocturnal habits (Zimbres et al., 2013). While nearly all of our records of xenarthrans were indeed made between 19:00 hr and 03:00 hr, two of the three giant anteater records occurred during the day (Table 1). Diurnal activity has been reported by others (Shaw et al., 1987; Sampaio et al., 2006), with activity occurring during the day when temperatures are mild, and later in the evening on hotter days.

Habitat preferences remain unclear as giant anteaters use open and forested lands in unknown proportions (e.g., Medri & Mourão, 2005). Sampaio et al. (2006) demonstrated that, while active, habitat choice by giant anteaters is mainly related to food/prey availability. In a study conducted in Serra da Canastra in the Brazilian Cerrado (Minas Gerais; Shaw et al., 1987), individuals preferred scrublands over other habitat types. However, some individuals had none of this common habitat type in their home range. Giant anteaters also favored riparian forests, which may be rich in termites and ants (Reis & Cancell, 2007; Brown et al., 2009). In our study, all three records were in forest and riparian habitats (Table 1).

The limits of giant anteaters’ distribution range in South America are also periodically altered by

![Figure 3](image-url). Photographic record of a greater naked-tailed armadillo (*Cabassous tatouay*) on 3 May 2014 in the Iguazu National Park, Paraná, Brazil.
sporadic sightings or roadkills. In Honduras, the species was thought to be extirpated in the 1990s but few sightings have recently been reported (McCain, 2001; Reyes et al., 2010). One sighting was also reported in Costa Rica in 1989 (Timm et al., 1989), and another individual was killed by a hunter in Nicaragua (Koster, 2008), all suggesting extension or maintenance of their current distribution.

Much still needs to be understood about the behavior of giant anteaters but recent studies indicate that this species can show a high capacity to respond to habitat disturbance. In the Brazilian state of Paraná they are able to inhabit pine plantations, where they feed on leaf-cutter ants (Braga et al., 2014). In the Cerrado, they have shown resilience to human-caused habitat alterations, such as fire and habitat loss (Shaw et al., 1987), and remained present even when most natural habitat had been converted to soy crops (Klink & Moreira, 2002). Additionally, a high survival rate was observed during a reintroduction project in the Iberá Nature Reserve, Corrientes province, Argentina. Between 2007 and 2013, 31 giant anteaters were released and 18 were radiotracked, providing information on habitat selection and indicating factors that could hamper long-term survival (Di Blanco et al., 2015). The animals preferred forest habitats where they almost exclusively rested. Deforestation and cattle management seemed to be the main threats to their survival. Only time will tell whether human-caused landscape transformation indeed negatively impacts giant anteaters (Superina et al., 2010). Regardless, the species has proved able to cope in unexpected ways with human-imposed pressures and contexts (Young et al., 2003; Braga et al., 2014).

Our photographic confirmation of giant anteaters in the INP is an important addition to the existing knowledge on the species. The INP is the only wildlife refuge in the entire region and is therefore of invaluable worth in terms of biodiversity and conservation (Tabarelli et al., 2005). Considering the conservation significance of the species and the lack of information about it in such an important part of its range, more research would help in piecing together recent occurrence reports and behavioral descriptions from different locations in South and Central America (Koster, 2008; Pérez Jimeno & Amaya, 2009; Hack & Krüger, 2013; Braga et al., 2014). Consequently, the most important goal of this paper is to inform the scientific community.

### Table 1

Detailed description of the photographic records of Xenarthra species obtained at Iguazu National Park and its surrounding buffer zone. **C. t.** *Cabassous tatouay*; **E. s.** *Euphractus sexcinctus*; **M. t.** *Myrmecophaga tridactyla*; **T. t.** *Tamandua tetradactyla*; **R. H.** relative humidity; soil types: **NVef2** rhodic paleudalf; **LVef1** typic hapludox; **GX1** epiaquic haplustult; **Loc** location; **P** park; **B** buffer zone.

<table>
<thead>
<tr>
<th>Species</th>
<th>Coordinates</th>
<th>Date</th>
<th>Time</th>
<th>Habitat</th>
<th>Microhabitat</th>
<th>Canopy (%)</th>
<th>Soil type</th>
<th>Precipitation (mm)</th>
<th>Temperature (°C)</th>
<th>R. H.</th>
<th>Loc</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. t.</td>
<td>25°34′11″S, 54°25′11″W</td>
<td>03/05/2014</td>
<td>02:08</td>
<td>Subtropical rainforest</td>
<td>Alluvial</td>
<td>80</td>
<td>NVef2</td>
<td>0.0</td>
<td>26.3</td>
<td>74.6</td>
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</tr>
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<td>M. t.</td>
<td>25°33′08″S, 54°19′49″W</td>
<td>04/06/2013</td>
<td>16:22</td>
<td>Subtropical rainforest</td>
<td>Palm trees</td>
<td>80</td>
<td>NVef2</td>
<td>0.0</td>
<td>17.4</td>
<td>90.5</td>
<td>P</td>
</tr>
<tr>
<td>M. t.</td>
<td>25°34′02″S, 54°23′21″W</td>
<td>31/03/2014</td>
<td>18:50</td>
<td>Tropical rainforest</td>
<td>Riparian</td>
<td>95</td>
<td>LVef1</td>
<td>29.6</td>
<td>23.8</td>
<td>87.6</td>
<td>P</td>
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<tr>
<td>M. t.</td>
<td>25°34′08″S, 54°24′10″W</td>
<td>24/04/2014</td>
<td>11:20</td>
<td>Tropical rainforest</td>
<td>Palm trees</td>
<td>90</td>
<td>LVef1</td>
<td>0.0</td>
<td>19.5</td>
<td>85.0</td>
<td>P</td>
</tr>
<tr>
<td>T. t.</td>
<td>25°37′09″S, 54°29′18″W</td>
<td>07/06/2013</td>
<td>05:56</td>
<td>Subtropical rainforest</td>
<td>Alluvial</td>
<td>90</td>
<td>NVef2</td>
<td>0.0</td>
<td>18.3</td>
<td>91.8</td>
<td>B</td>
</tr>
<tr>
<td>T. t.</td>
<td>25°31′35″S, 54°20′03″W</td>
<td>03/07/2013</td>
<td>1:29</td>
<td>Subtropical rainforest</td>
<td>Alluvial</td>
<td>95</td>
<td>GX1</td>
<td>0.0</td>
<td>18.6</td>
<td>82.8</td>
<td>B</td>
</tr>
<tr>
<td>T. t.</td>
<td>25°29′25″S, 54°21′26″W</td>
<td>01/11/2013</td>
<td>0:44</td>
<td>Subtropical rainforest</td>
<td>Bamboo</td>
<td>100</td>
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<td>26.9</td>
<td>64.9</td>
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<tr>
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<td>24/01/2014</td>
<td>0:31</td>
<td>Subtropical rainforest</td>
<td>Riparian</td>
<td>90</td>
<td>NVef2</td>
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<td>70.4</td>
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<tr>
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<td>10/06/2014</td>
<td>2:58</td>
<td>Tropical rainforest</td>
<td>Palm trees</td>
<td>85</td>
<td>LVef1</td>
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<td>17.7</td>
<td>89.0</td>
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</tr>
<tr>
<td>T. t.</td>
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<td>03/09/2014</td>
<td>23:23</td>
<td>Tropical rainforest</td>
<td>Alluvial</td>
<td>100</td>
<td>LVef1</td>
<td>0.0</td>
<td>25.4</td>
<td>71.9</td>
<td>P</td>
</tr>
<tr>
<td>E. s.</td>
<td>25°31′32″S, 54°20′01″W</td>
<td>06/06/2013</td>
<td>22:29</td>
<td>Subtropical rainforest</td>
<td>Alluvial</td>
<td>95</td>
<td>GX1</td>
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<td>18.7</td>
<td>82.9</td>
<td>B</td>
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<tr>
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<td>29/06/2013</td>
<td>1:41</td>
<td>Subtropical rainforest</td>
<td>Alluvial</td>
<td>95</td>
<td>GX1</td>
<td>8.2</td>
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<td>91.2</td>
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<td>Subtropical rainforest</td>
<td>Dicksonia ferns</td>
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<td>NVef2</td>
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<td>18.2</td>
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<td>Subtropical rainforest</td>
<td>Alluvial</td>
<td>70</td>
<td>NVef2</td>
<td>65.4</td>
<td>23.5</td>
<td>91.2</td>
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</tbody>
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about the presence of both the giant anteater and the greater naked-tailed armadillo in this part of their range, and thus serve as an invitation for further research.

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**References**


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