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Common vampire bats (*Desmodus rotundus*) feeding on the giant anteater (*Myrmecophaga tridactyla*) and the giant armadillo (*Priodontes maximus*)

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ABSTRACT
There has been an increase in the number of studies on the diet of common vampire bats following the widespread use of modern camera traps by field researchers. In this study, we report evidence of common vampire bats feeding on two species of xenarthrans: a juvenile giant anteater (*Myrmecophaga tridactyla* Linnaeus, 1758) being carried on its mother's back in the southern Pantanal, and a giant armadillo (*Priodontes maximus* Kerr, 1792) in the Atlantic rainforest of Minas Gerais state. The variety of species that *Desmodus rotundus* (E. Geoffroy, 1810) feeds on may favor the transmission of microorganisms in populations of wild and domestic mammals.

Keywords: camera-trap, Chiroptera, disease, hematophagy, Xenarthra

RESUMO - Morcego-vampiro (*Desmodus rotundus*) predando tamanduá-bandeira (*Myrmecophaga tridactyla*) e tatu-canastra (*Priodontes maximus*): possíveis implicações epidemiológicas
Há um número crescente de estudos sobre a dieta do morcego-vampiro condizente com o aumento do uso de armadilhas fotográficas por pesquisadores de campo. Neste estudo, relatamos evidências de morcego-vampiro predando duas espécies de Xenarthra: um tamanduá-bandeira (*Myrmecophaga tridactyla* Linnaeus, 1758) juvenil sendo carregado nas costas da mãe no Pantanal Sul, e um tatu-canastra (*Priodontes maximus* Kerr, 1792) na Mata Atlântica de Minas Gerais. A alimentação de diversas espécies por *Desmodus rotundus* (E. Geoffroy, 1810) pode favorecer a transmissão de microorganismos para populações de mamíferos silvestres, bem como para animais domésticos.

Palavras-chave: armadilha-fotográfica, Chiroptera, hematófago, saúde, Xenarthra

Hematophagy is rare among the more than 1,474 species of bats recorded worldwide (Simmons & Cirranello 2024). Of these, only three species are hematophagous and are distributed exclusively on the American continent. The Common Vampire Bat,

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Desmodus rotundus (Geoffroy, 1810) (Chiroptera, Phyllostomidae, Desmodontinae), is endemic to Latin America with a wide distribution, occurring from Mexico to central Argentina and Uruguay (Eisenberg & Redford 1989). It can be found throughout the entirety of Brazil's territory (Reis et al. 2013). In addition to *D. rotundus*, there are *Diaemus youngii* (Jentink 1893) and *Diphylla ecaudata* (Spix, 1823), which are considered rare in the wild and feed mainly on bird blood (Mendoza Sáenz et al. 2023).

Desmodus rotundus occurs at sea level up to an altitude of over 3500 m (Greenhall 1988). It occupies diverse habitats ranging from rainforests to deserts, where it maintains an exclusively hematophagous diet and feeds on the blood of numerous vertebrate species (McNab 1973; Greenhall 1988). A systematic review reported a total of 63 common vampire bat prey species within 5 classes, 21 orders, and 45 families (Brown & Escobar 2023). They have an extremely elongated cecum which allows a considerable amount of blood to be stored (Greenhall 1988). They also have the ability to inhibit hemostasis in the host by producing natural anticoagulants (Gohlke et al. 1996).

Over the past two decades, the use of camera traps has exponentially increased our ability to conduct noninvasive surveys and collect records of behaviors and events that would otherwise be impossible to obtain (Kays 2016). Within the superorder Xenarthra, there are camera trap records of common vampire bats chasing and/or feeding on the giant armadillo (*Priodontes maximus*) in the Atlantic rainforest and the Brazilian Cerrado, respectively (Zórtea et al. 2018; De Oliveira et al. 2022), records of feeding on the nine-banded armadillo (*Dasypus novemcinctus* Linnaeus, 1758) in northern Oaxaca, Mexico (Ríos-Solís et al. 2021), as well as the southern tamandua (*Tamandua tetradactyla* Linnaeus, 1758) (Kays 2016), northern tamandua (*Tamandua mexicana* Saussure, 1860), and giant anteater (*Myrmecophaga tridactyla*) in the Amazon (Brown & Escobar 2023).

Giant anteaters can reach over two meters in length, can weigh up to 50 kg (McNab 1984), and are distributed from Belize and Guatemala to the north, going south throughout South America, excluding the Andes region, to northern Argentina (Wetzel 1985). This species displays both nocturnal and diurnal activity as part of a thermoregulatory behavior to avoid exposure during the hottest or coldest hours of the day (Giroux et al. 2023). Giant anteater pups remain with their mother for about a year, increasing their exploratory behavior and distance from the mother as the months go by (Jerez & Halloy 2003).

The giant armadillo is by far the largest species of extant armadillos (Emmons & Feer 1997) with a body mass generally between 28 and 50 kg and a total length that can reach up to 150 cm (Emmons & Feer 1997; Desbiez et al. 2019). This species spends 75–80% of its time underground. Accelerometer data shows that armadillos are not active and do not feed while underground, pointing to a fossorial behavior for the species (Desbiez et al. 2021).

The present study discusses camera trap records of common vampire bats feeding on (a) a juvenile giant anteater being carried on its mother's back, in the southern Pantanal wetlands of Mato Grosso do Sul, Brazil; and (b) a giant armadillo in the Rio Doce State Park, a protected area located in the Atlantic rainforest of Minas Gerais state in southeastern Brazil. These records are the first documented attacks of *D. rotundus* on a

giant armadillo in the Brazilian Atlantic Forest and on a giant anteater in the Pantanal wetlands. We discuss the possible epidemiological implications associated with this contact between vampire bats and xenarthrans.

The first record comes from a study carried out between 2020 and 2023 on private cattle ranches (latitude -19.256802; longitude -55.786773) in the Brazilian Pantanal (Nhecolândia subregion) and described in detail by Desbiez et al. (2020). We established a camera trap array (n=75 camera sites) in an area where a cluster of twelve known individual *P. maximus* had been captured and monitored over the course of eight years. To build the trap array, first we defined camera locations using ArcGIS, predefining their locations throughout the area occupied by the 12 animals and applying 1 km spacing between them. Then, we applied a 250 m buffer around the predefined point locations to search for evidence of *P. maximus*, optimizing the placement of the camera traps. Evidence included sleeping burrows, feeding excavations or even termite mounds with recent signs of predation as described in Massocato & Desbiez (2019). A total of 109,500 trap-nights of sampling effort was expended over the course of 48 months.

The second record comes from a study carried out between 2020 and 2023 in the buffer zone of the Rio Doce State Park (latitude -19.756012; longitude -42.635965). This park was created in 1944 with approximately 36,000 ha, covering portions of Timóteo, Marliéria and Dionísio municipalities (IEF 2023). The Rio Doce State Park is the largest remnant of the Atlantic Forest in the state of Minas Gerais (IEF 2023). A systematic random grid comprised of 56 cameras was used to identify and estimate the population of giant armadillos in the park. Camera traps were placed within 1 km of each other. Once again, at each installation point an active search was carried out for burrows, feeding holes, broken termite mounds or any other evidence of giant armadillos at the site within a radius of up to 300 meters. A total of 81,760 trap-nights of sampling effort was expended over the course of 48 months.

All records are from Reconyx camera traps (HyperFire 2 security covert IR camera; Reconyx, Holmen, USA) set to rapid-fire mode, recording five consecutive photos without any intervals. The sampling effort was defined by: [number of camera traps x number of sampling days], where each day corresponds to a period of 24 hours (Srbek-Araújo & Chiarello 2005)

On October 4th, 2021, a camera trap image showing a common vampire bat feeding on a juvenile giant anteater was obtained in forested habitat in the Nhecolândia region of the Brazilian Pantanal (latitude -19.214477; longitude -55.812852) (Fig. 1). The bat was pictured potentially feeding close to the left ear of a juvenile giant anteater being transported on its mother's back (Fig. 2).

On February 2nd, 2023, we obtained camera trap records of a common vampire bat potentially feeding on a giant armadillo in an area of primary forest with a well-established understory (latitude -19.5475674; longitude -42.5265669) in the Rio Doce State Park (Fig. 1). The bat was pictured on the thoracodorsal region of the giant armadillo. In the first picture, the bat is not yet feeding; however, soon after, it begins to feed, using the flexible area between one band and another to bite (Fig 3).

The activity pattern of *D. rotundus* is more intense in the early night hours (Marinho-Filho & Sazima 1989). This coincides with the moment of both of our records (9:37

pm and 9:38 pm). While giant armadillos have strictly nocturnal activity patterns (Desbiez et al. 2021), giant anteaters can vary their activity period, from nocturnal on warm and mild days to diurnal on cold days (Giroux et al. 2023).

The long lifespan of bats and their ability to inhabit diverse ecological niches make this group of animals among the most successful species on Earth. However, this has also increased the global interest in bats as potential reservoir hosts and vectors of zoonotic pathogens (Calisher et al. 2006; Wong et al. 2007; Kuzmin et al. 2011; Wang et al. 2011). Their role in disease epidemiology is even more significant as bats are susceptible to different microorganisms that include viruses, bacteria, fungi and parasites (Whitaker et al. 2009; Wibbelt et al. 2009), however is important to clarify that most of this microorganisms do not represent any threat for human health, and that bats play important ecological roles as prey and predator, arthropod suppression, seed dispersal, pollination, material and nutrient distribution, and recycle.

Recent metagenomic sequencing of *D. rotundus* fecal and saliva samples identified over 58 viral families, 17 of which are known to infect mammalian species (Bergner et al. 2019). The common vampire bat is a known host for many viral pathogens, most notably as the primary rabies virus reservoir in Latin America (Benavides et al. 2020). Although the low basal body temperature of xenarthrans was believed to contribute to decreased susceptibility to rabies virus infection (Grome et al. 2022), there are case reports of free-ranging nine-banded armadillos with naturally acquired rabies infections in the USA (Leffingwell & Neill 1989), as well as a southern tamandua infected with rabies in a North American zoo (Grome et al. 2022).

Various trypanosomatids, including *Trypanosoma cruzi*, have also been found in *D. rotundus* tissue, perianal swabs, and feces samples (Quiroga et al. 2022). Armadillos, sloths, and anteaters have a long coevolutionary history with trypanosomatids (Jansen et al. 2017). In 1912, Carlos Chagas identified the nine-banded armadillo as one of the reservoirs for *Trypanosoma cruzi*, the parasite that causes Chagas disease (Chagas 1912). *Trypanosoma. cruzi* and *T. rangeli* are multi-host wild parasite species transmitted by contaminated feces of triatomine bugs and between mammals through predation (Jansen et al. 2015). Several studies have demonstrated *T. cruzi* and/or *T. rangeli* in armadillos and anteaters (Yaeger 1988; Cardona-Castro et al. 2009; De Araujo et al. 2013; Kluyber et al. 2020). The epidemiological importance of these mammalian species is enhanced as sloths, anteaters, and armadillos are hunted and eaten in some areas of South America, such as the Amazon region (Jansen et al. 2017).

Records of vampire bat predation on species of xenarthrans are still uncommon but are increasing following the growing use of camera traps by field researchers. Reports of ecological interactions between vampire bats and a high number of animal species are critical considering the significant potential for the transmission of infectious agents.

LICENSE AND AUTHORIZATION

The research was performed under licenses #27587 and #53798 (SISBio) from the Chico Mendes Institute for Biodiversity Conservation (ICMBio), granting permission

to capture, immobilize, and manipulate armadillos, as well as collect and store biological samples.

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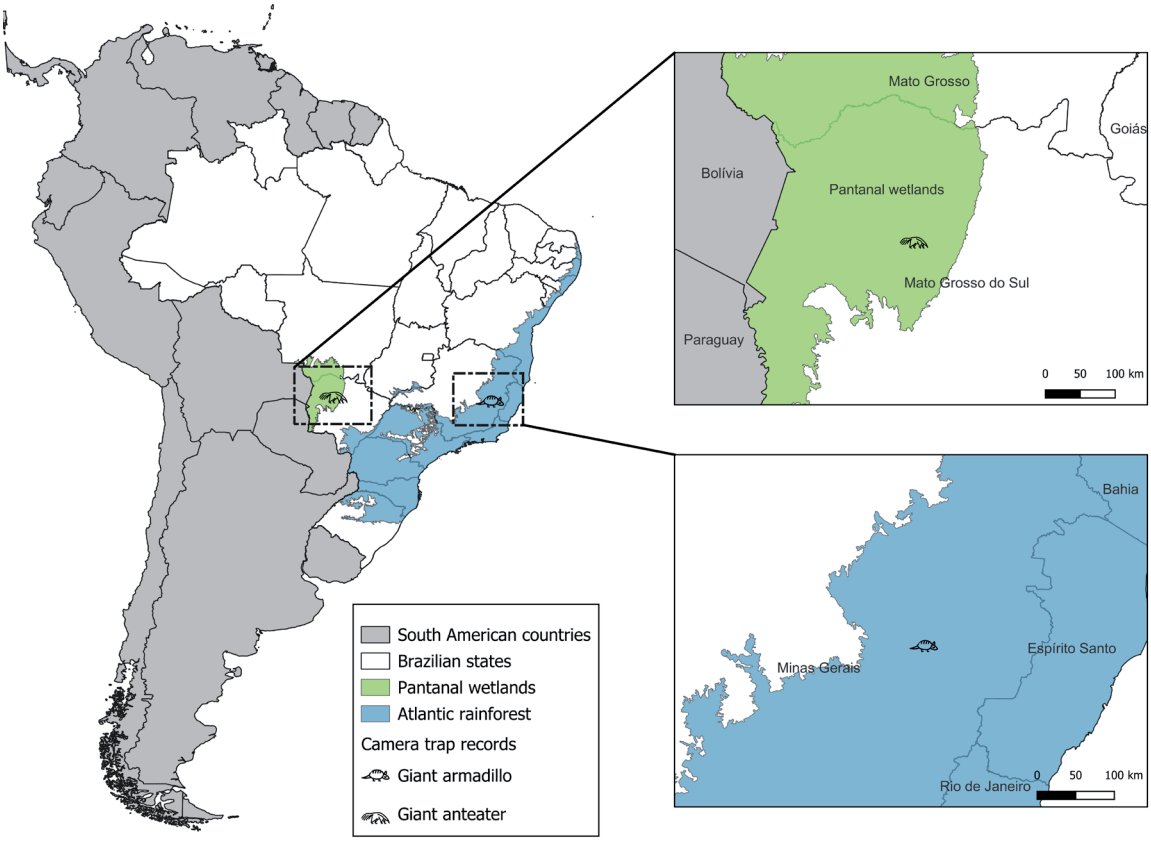

Figure 1. Map showing the locations of the Pantanal wetlands (green), where *Myrmecophaga tridactyla* and *Desmodus rotundus* were recorded, and the Atlantic Forest biome (blue), where *Priodontes maximus* and *D. rotundus* were recorded.

Figure 2. Camera trap record of the common vampire bat (*Desmodus rotundus*) potentially feeding on a juvenile giant anteater (*Myrmecophaga tridactyla*) in the Pantanal wetlands of Mato Grosso do Sul state, Brazil, recorded by a camera trap.

Figure 3. The moment before and during the time the common vampire bat (*Desmodus rotundus*) is pictured feeding on the giant armadillo (*Priodontes maximus*) in the Rio Doce State Park, in the Atlantic rainforest of Minas Gerais state, Brazil, recorded by a camera trap.

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