Death of *Bothrops* cf. *mattogrossensis* (Serpentes: Viperidae) after an unsuccessful predation event on *Apostolepis* sp. (Serpentes: Dipsadidae)

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Snakes are important elements of terrestrial ecosystems due to their predator-prey interactions, influencing population dynamics (Strüssmann & Sazima, 1993; Greene, 1997). They have a wide variety of feeding habits and use different prey-capture methods, ranging from swallowing live prey to envenomation or constriction (Bernarde, 2012). Their diet represents an axis of their ecological niche and can be influenced by habitat use, feeding behavior, and prey variation (Toft, 1985). Unsuccessful predation events occur mainly because of morphological incompatibility between prey and predator (Nogueira et al., 2013; Azevedo et al., 2018). In the case of juvenile specimens, unsuccessful predation can also occur due to the lack of experience in dealing with prey, particularly large or dangerous ones (Sazima & Martins, 1990). Additionally, the amount of toxin in the prey as well as the body region attacked by the predator can also interfere with the

success of predation (Costa & Trevelin, 2020). Unsuccessful attempts can generate a series of consequences, from energy exhaustion to the death of both individuals by suffocation or the action of the poison of the species involved (Cavalcanti et al., 2012; Caramaschi & Niemeyer, 2012).

Bothrops mattogrossensis Amaral, 1925 is one of the species belonging to the complex *Bothrops neuwiedi* group and occurs from Peru to Argentina (Silva & Rodrigues, 2008; Nogueira et al., 2019). In Brazil, it is found in the states of Amazonas, Tocantins, Rondônia, Mato Grosso, Mato Grosso do Sul, Goiás, and São Paulo (Nogueira et al., 2019). However, it is possible that the populations from the northwest of Mato Grosso and Rondônia belong to the newly described *B. sonene* (Costa et al., 2022). *Bothrops mattogrossensis* inhabits low-elevation areas in the Cerrado, Pantanal, Chaco, and Amazonian savannas (Bernarde et al., 2012; Nogueira et al., 2019). Like most species in the *B. neuwiedi* group, *B. mattogrossensis* is a generalist species and does not show ontogenetic diet variation, feeding on ectothermic and endothermic prey (Martins et al., 2002; Monteiro et al., 2006). Herein we report the death of an individual of *B.* cf. *mattogrossensis* after an attempted predation on *Apostolepis* sp. (Dipsadidae). We also provide a dietary review of *B. mattogrossensis*.

Residents of the municipality of Vilhena, state of Rondônia, northern Brazil, found two dead snakes on 20 April 2020: one juvenile *B. mattogrossensis* ingesting head-first one adult *Apostolepis* sp. in a forested area (12°28′20.0″ S, 60°10′10.0″ W). This region comprises a transition area between Amazonia and Cerrado biomes (IBGE, 2019). The body of the specimen of *B.* cf. *mattogrossensis* presented several lesions (Fig. 1). The individuals were photographed by the residents and the images were sent via WhatsApp to the authors with a request to identify the species. According to the residents, sightings of *Bothrops* spp. individuals are relatively common in the locality, but this is the first record of predation on the property.

The predator was identified as *Bothrops* cf. *mattogrossensis* based on the pattern of dorsal blotches. In the location, two morphologically similar species of *Bothrops* are likely to occur: *Bothrops mattogrossensis* and *Bothrops atrox* (Nogueira et al., 2019). The general pattern of rounded-shaped blotches closely resembles the characteristic C-shaped blotches found in the *Bothrops neuwiedi* species group, to which *B. mattogrossensis* belongs (Carrasco et al., 2019). In turn, the prey was identified as *Apostolepis* sp. based on the combination of external morphological traits, such as the presence of a black caudal spot and dorsal dark stripes

(Ferrarezzi et al., 2005; França et al., 2018).

In addition to the event described above, we conducted a literature review on the diet of *B. mattogrossensis* in the Google Scholar database using the keywords in Portuguese, English, and Spanish on 04 April 2023: predação OR presa OR predador OR depredacíon OR predacíon OR depredador OR predation OR prey OR predator OR diet OR dieta AND "*Bothrops mattogrossensis*" AND "*Bothrops neuwiedi*". For *Bothrops neuwiedi*, we only considered works published up to 2008 and within the geographic range of *B. mattogrossensis*, due to the taxonomic revision of the *B. neuwiedi* complex proposed by Silva & Rodrigues (2008) which resulted in the revalidation of *B. mattogrossensis*. We also searched for records in databases (Schalk & Cove, 2018; Grundler, 2020). Overall, we found five studies that described predation events by *B. mattogrossensis* (Table 1) consuming five different animal groups: two records with mammals, three with amphibians, one snake, one lizard, and one centipede. Previous predation records involving *B. mattogrossensis* are all from the state of Mato Grosso do Sul, Pantanal biome (Fig. 2). Our literature review indicates that this is the first report of unsuccessful predation by *B. mattogrossensis*. Monteiro et al. (2006) also reported snake predation by *B. mattogrossensis* in the Pantanal, but details and species identification were not provided.

Failed predation events are scarce and sporadic, which makes it difficult to analyze these phenomena (Costa & Travellin, 2020). In some cases, as reported here, the prey may be too large and cause suffocation during swallowing, leading to the death of both individuals (*e.g.*, Nogueira et al., 2013; Carilo Filho et al., 2017). The *Apostolepis* did not resist due to the toxic effects of the *Bothrops* venom (Sazima & Martins, 1990). However, the death of *B. mattogrossensis* may have been caused by internal injuries, asphyxia during ingestion, or by envenomation by the rear-fanged *Apostolepis*, whose venom may cause local hemorrhage and other effects (Salomão et al., 2003). It is important to point out that *Apostolepis* species have fossorial habits (see Harvey, 1999) and despite being recorded in the diet of *B.* gr. *neuwiedi* (Valdujo et al., 2002), these events are probably opportunistic since the two species do not share the same habitat.

We found little information on the diet of *B. mattogrossensis* and no record of unsuccessful predation, indicating a gap in ecological knowledge of the species. Most of the predation records come from the analyses of stomach content from specimens deposited in scientific collections (Monteiro et al., 2006). In this sense, citizen science can

be an important ally, aiming to leverage the knowledge of natural history, solve inconsistent problems in the literature, and promote engagement in conservation actions for biodiversity (Souza et al., 2022). Given the difficulty of recording predation events, especially those involving fossorial species, our results provide information on the natural history of snakes, which may be useful to guide future studies.

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Table 1. Species reported as prey of *Bothrops mattogrossensis*. We indicate the prey group, family, identification, geographic location, and bibliographic references. All records are from Brazil. MT: Mato Grosso; MS: Mato Grosso do Sul; RO: Rondônia.

Prey group	Family	Species	Location	State	Reference
Anura	Leptodactylidae	*Leptodactylus chaquensis* (Cei, 1950)	Aquidauna	MS	Costa-Pereira et al. (2016)
Anura	Leptodactylidae	*Leptodactylus latrans* (Steffen, 1815)	Miranda	MS	Pereira et al. (2013)
Anura	Unidentified	Unidentified	Unidentified	MT/ MS	Monteiro et al. (2006)
Centipedes	Unidentified	Unidentified	Unidentified	MT/ MS	Monteiro et al. (2006)
Lizard	Unidentified	Unidentified	Unidentified	MT/ MS	Monteiro et al. (2006)
Mammal	Echimyidae	*Thrichomys pachyurus* (Wagner, 1845)	Corumbá	MS	Benício et al. (2018)
Mammal	Unidentified	Unidentified	Unidentified	MT/ MS	Monteiro et al. (2006)
Snake	Unidentified	Unidentified	Unidentified	MT/ MS	Monteiro et al. (2006)
Centipedes	Unidentified	Unidentified	Unidentified	MT/ MS	Monteiro et al. (2006)
Snake	Dipsadidae	*Apostolepis assimilis*	PN das Emas	GO	Valdujo et al. (2002)
Snake	Dipsadidae	*Apostolepis* sp.	Vilhena	RO	This study

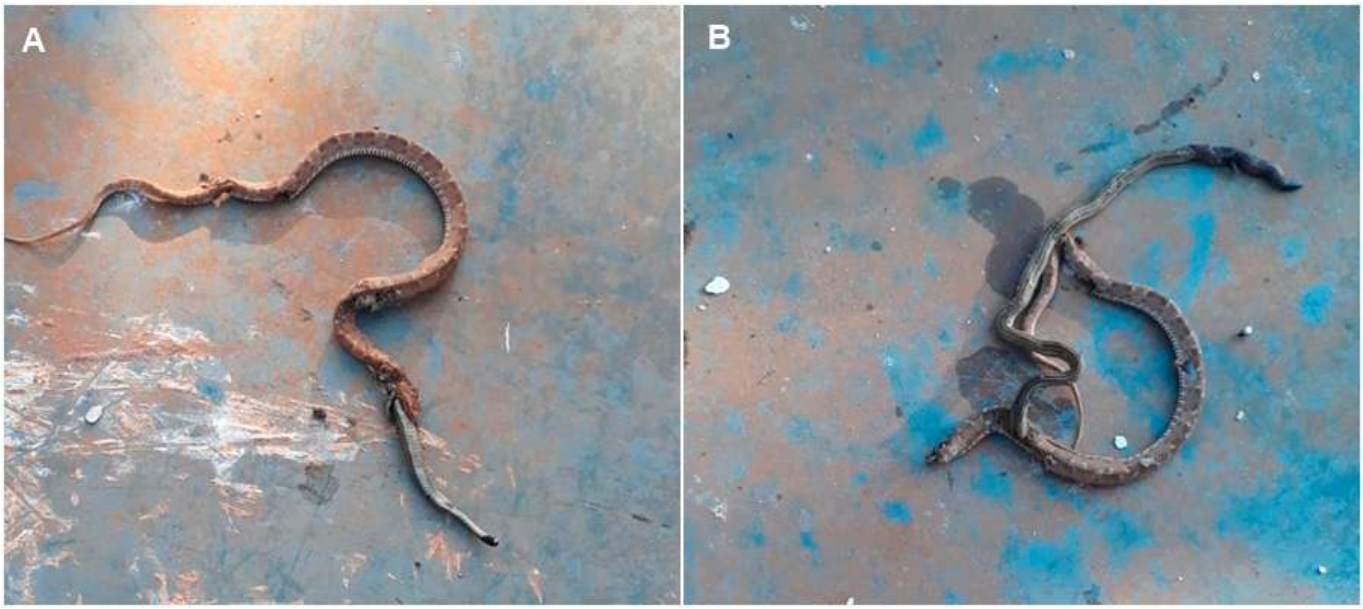

Figure 1. Unsuccessful predation of *Apostolepis* sp. by *Bothrops* cf. *mattogrossensis*: (A) Position of individuals found by the local resident; note the tail tip of *Apostolepis* sp. protruding from the pitviper's mouth, suggesting it was swallowed head-first. (B) The *Apostolepis* after removal from the stomach of *B.* cf. *mattogrossensis* by the residents; the head of the *Apostolepis* is at top right. The head of the *Bothrops* was apparently chopped off, together with the posterior portion of the *Apostolepis* body. Photos provided by the local residents.

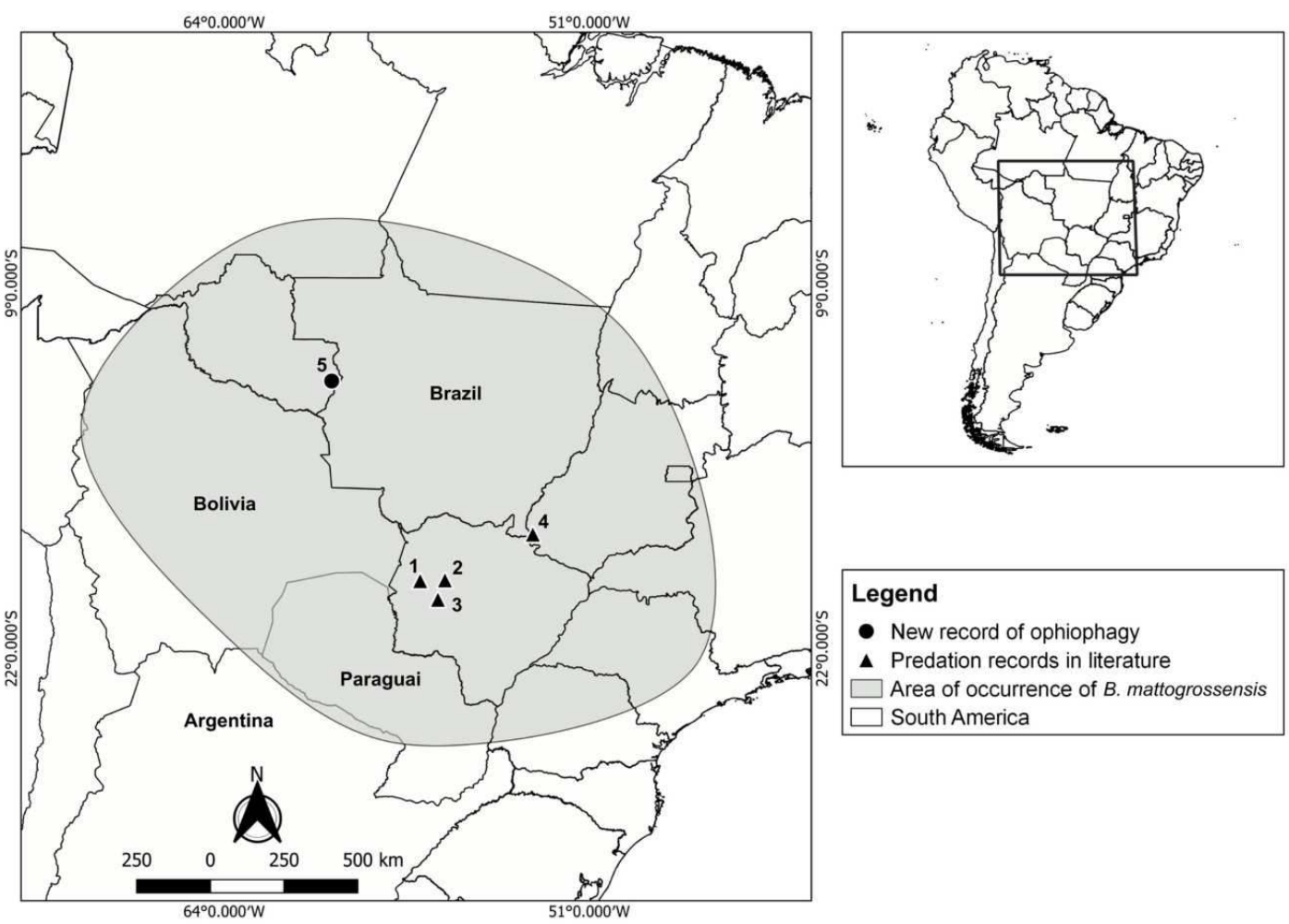

Figure 2. Known range of *Bothrops mattogrossensis* (Cacciali et al. 2021) with triangles indicating the locations of predation records in the literature. The circle indicates the location of the new record. 1) Corumbá, state of Mato Grosso do Sul (MS); 2) Aquidauana, MS; 3) Miranda, MS; 4) Parque Nacional das Emas, state of Goiás; 5) Vilhena, state of Rondônia.