



Defensive behavior of contracting in *Rhaebo guttatus* (Schneider, 1799) (Anura: Bufonidae)

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ABSTRACT

Anurans possess various defense mechanisms, including contracting, which aims to prevent injury during subjugation and hinder predation. Herein, we describe the defensive behavior of contracting in *Rhaebo guttatus* recorded in the Chapada das Mesas National Park, Maranhão, Brazil. On April 19, 2023, a juvenile male *R. guttatus* exhibited contracting behavior for approximately 27 minutes while being handled, before returning to normal activity. This is the first record of contracting behavior for *R. guttatus*. Contracting is distinct from thanatosis and may be an evolutionary strategy that complements other known defenses of the species, such as toxin secretion and defensive postures. Documenting this behavior is relevant for understanding antipredatory strategies in anurans.

KEYWORDS: Antipredatory strategies. Anurans. Toxin secretion. Cerrado. Evolution.

Comportamento defensivo de contração em *Rhaebo guttatus* (Schneider, 1799) (Anura: Bufonidae)

RESUMO

Os anuros possuem diversos mecanismos de defesa, incluindo a contração, que visa evitar lesões durante a subjugação e dificultar a predação. Aqui, descrevemos o comportamento defensivo de contração em *Rhaebo guttatus* registrado no Parque Nacional da Chapada das Mesas, Maranhão, Brasil. Em 19 de abril de 2023, um macho juvenil de *R. guttatus* ao ser manuseado, exibiu o comportamento de contração por aproximadamente 27 minutos antes de retornar à atividade normal. Este é o primeiro registro do comportamento de contração para *R. guttatus*. A contração é diferenciada

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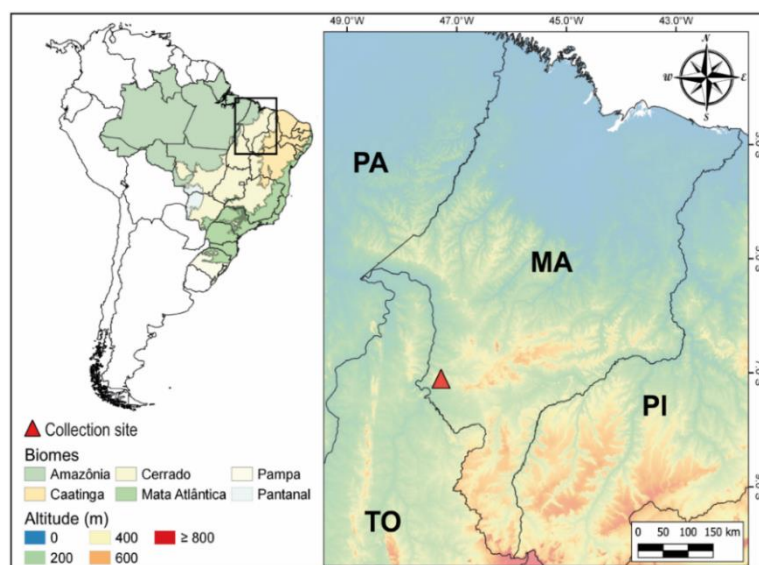
da tanatose e pode ser uma estratégia evolutiva que complementa outras defesas conhecidas da espécie, como a secreção de toxinas e posturas defensivas. A documentação deste comportamento é relevante para a compreensão das estratégias antipredatórias em anuros.

PALAVRAS-CHAVE: Estratégias antipredatórias. Anuros. Secreção de toxinas. Cerrado. Evolução.

The genus *Rhaebo* Cope, 1862, belonging to the family Bufonidae, ranges from eastern Honduras to northern and western Colombia, northwestern Ecuador, and Venezuela, extending through the Amazonian plains of Venezuela, Colombia, Ecuador, Peru, Bolivia, Brazil, and the Guianas (Frost, 2024). This genus includes 14 species, among which *Rhaebo guttatus* (Schneider, 1799) is one of the two species of *Rhaebo* found in Brazil (Mueses-Cisneros; Cisneros-Heredia; McDiarmid, 2012; Frost, 2024). Although *R. guttatus* is considered an Amazonian species, it shows tolerance to transition areas between the Amazon and Cerrado biomes, extending into gallery forests (Azevedo-Ramos *et al.*, 2010; Silva, 2016; Benício; Lima, 2017; Andrade *et al.*, 2020).

Defensive behavior in anurans is a broad study area, with various species exhibiting distinct strategies to avoid predation. Within the vast behavioral repertoire of toads, there is a wide range of defensive postures (Toledo; Sazima; Haddad, 2011; Souza *et al.*, 2020; Ramos *et al.*, 2021). Anurans have developed various antipredatory mechanisms, organized into three stages (avoiding detection, preventing attacks, and counterattacking), generally involving aposematic coloration (warning), defensive postures, and toxin production (Toledo; Jared, 1995; Toledo; Haddad, 2009; Toledo; Sazima; Haddad, 2011; Ferreira *et al.*, 2019). Many of these strategies in toads show a complex synergistic coupling between behaviors (Ramos *et al.*, 2021; Tovar *et al.*, 2022), morphophysiological and acoustic mechanisms (Toledo; Haddad, 2009; Toledo; Sazima; Haddad, 2011; Mailho-Fontana *et al.*, 2013). One such mechanism is known as "contracting". Contracting or shrinking involving the body contracting to avoid injury during subjugation and to hinder predation (Toledo; Sazima; Haddad, 2011; Ferreira *et al.*, 2019). In this study, we describe the defensive contracting behavior of *R. guttatus*, observed in the Chapada das Mesas National Park (CMNP), Maranhão state, northeastern Brazil (Figure 1).

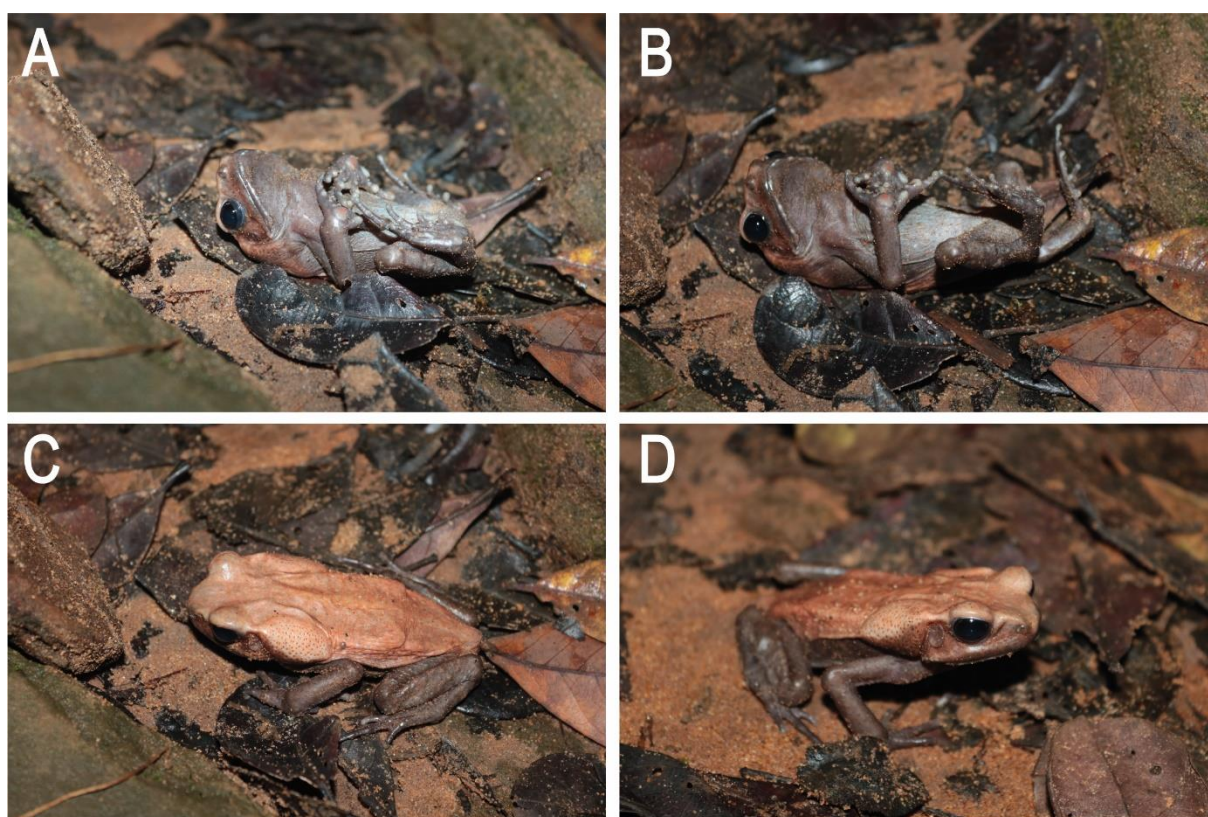
Figure 1: Chapada das Mesas National Park (CMNP), state of Maranhão, northeastern Brazil.



Source: Research data, 2024.

During fieldwork conducted on April 19, 2023, in the CMNP, Maranhão state, northeastern Brazil (6°59'38.3"S 47°09'52.1"W; datum WGS84, ca. 227 m a.s.l), a juvenile male *R. guttatus* was found on the leaf litter around 17:30 h, in the Prata Waterfall, near the course of the Farinha River, in a humid Cerrado area. The individual was carefully handled to avoid additional stress and physical damage. During handling, it was observed that the toad remained motionless for a prolonged period after being returned to the ground, keeping its anterior and posterior limbs folded close to its body, initially with its eyes closed but later opened, and with its body arched. The defensive contracting behavior lasted approximately 27 minutes (Figure 2). Subsequently, the individual gradually recovered, initially opening eyes, stretching legs, and finally returning to its normal position and activities. After recording the behavior, the specimen was released.

Figure 2: Specimen of *Rhaebo guttatus* exhibiting defensive behavior of contracting recorded in the Chapada das Mesas National Park (CMNP), state of Maranhão, northeastern Brazil.



Source: Research data, 2024.

Contracting is known to be a widespread behavior in Hylidae, Bufonidae, and Leptodactylidae (Toledo; Sazima; Haddad, 2010; Ferreira *et al.*, 2019; Pedroso-Santos; Sanches; Costa-Campos, 2022), as observed in *Pithecopus azureus* (Cope, 1862) (Borteiro *et al.*, 2014), *Bokermannohyla luctuosa* (Pombal & Haddad, 1993) (Moroti *et al.*, 2018), and *Nymphargus pijao* Montilla, Arcila-Pérez, Toro-Gómez, Vargas-Salinas & Rada, 2023 (López-Molina *et al.*, 2023). Despite some similarities, contracting behavior differs from thanatosis (playing dead) as a response to a threat (Toledo; Sazima; Haddad, 2010). In thanatosis, individuals remain motionless, with the ventral side facing up and limbs close to or relaxed from the body (Toledo; Sazima; Haddad, 2010; Ferreira *et al.*, 2019; Ramalho *et al.*, 2019). In contracting, individuals remain motionless with the ventral side facing up, limbs close to the body, usually with eyes closed, and body arched (Toledo; Sazima; Haddad, 2010; Ferreira *et al.*, 2019).

The present record is consistent with the findings of Toledo, Sazima, and Haddad (2010), who relate defensive contracting behavior primarily to anuran groups possessing toxic secretions, such as in *R. guttatus*. Thus, contracting appears to be a possible evolution of thanatosis due to its level of complexity, as ingested in a contracted posture, the individual may produce harmful secretions aiming at regurgitation (Sazima, 1974; Toledo; Sazima; Haddad, 2010).

In general, defensive strategies for *R. guttatus* are well-documented, such as toxin secretion from skin glands (Mailho-Fontana *et al.*, 2013), release call (Marinho *et al.*, 2019), body elevation posture (Ferreira *et al.*, 2019), and thanatosis (Pedroso-Santos; Sanches; Costa-Campos, 2022). It is noteworthy that only individuals of this species can voluntarily release secretion from their parotoid glands as a defensive strategy (Jared *et al.*, 2011; Mailho-Fontana *et al.*, 2014). Despite the variety of studies, we describe here the first record of defensive contracting behavior for the genus. Overall, different defensive strategies related to predator-prey interactions aim to deter, avoid, or confuse predators, utilizing morphological, physiological, and behavioral responses selected by natural selection (Duellman; Trueb, 1994; Wells, 2007). Documenting such strategies is crucial for understanding the ecology and evolution of antipredatory responses in amphibians.

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CONFLICT OF INTEREST. The authors declare that they have no commercial or associative interest that represents a conflict of interest in relation to the manuscript.

ETHICAL APPROVAL. Not applicable.

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