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Elementary survival strategy: first record of death-feigning behavior in *Atractus pantostictus* (Colubridae, Dipsadinae)

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Resumo

Este estudo apresenta o primeiro registro da adoção de estratégias defensivas primárias (criptismo) e secundárias (comportamentos) em uma serpente do gênero *Atractus*. Durante um trabalho de campo em Santana da Vargem, Minas Gerais, foi observada a atividade de *death-feigning* (tanatose) em um indivíduo de *Atractus pantostictus*. O evento permitiu documentar uma sequência de respostas defensivas exibidas pelo animal. Ao ser tocado suavemente, o indivíduo inicialmente permaneceu imóvel, passando em seguida a realizar contorções corporais e, por fim, o enrolamento do tronco, simulando morte. Todo o repertório comportamental teve duração aproximada de vinte segundos, sendo sucedido por fuga. Este registro amplia o conhecimento sobre os mecanismos de defesa em espécies fossoriais, como *A. pantostictus*, e contribui para a compreensão dos comportamentos antipredatórios no gênero *Atractus*, cuja história natural ainda é pouco conhecida.

Palavras-chave: comportamento antipredatório; defesa primária; tanatose; defesa secundária.

Abstract

This study reports the first record of primary (crypsis) and secondary (behavioral) defensive strategies in a snake of the genus *Atractus*. During fieldwork conducted in Santana da Vargem, Minas Gerais, southeastern Brazil, a *death-feigning* (thanatosis) behavior was observed in an individual of *Atractus pantostictus*. The event allowed the documentation of a sequence of defensive responses exhibited by the snake. When gently touched, the individual initially remained motionless, then performed body contortions, and finally coiled its trunk while simulating death. The entire behavioral sequence lasted approximately twenty seconds and was followed by escape. This record expands the knowledge of defense mechanisms in fossorial species such as *A. pantostictus*. It contributes to the understanding of antipredator behaviors in the genus *Atractus*, whose natural history remains poorly known.

Keywords: antipredator behavior; primary defense, thanatosis; secondary defense.

The evolutionary arms race drives the continuous diversification of behavioral and morphological traits, shaping both predatory and defensive adaptations (Dawkins & Krebs, 1979; Abrams, 1986). These interactions are illustrated by empirical observations of natural history, particularly within predator-prey interaction, which are essential for understanding the adaptive value of defensive traits (Bates, 1862; Greene, 2005). Defense mechanisms are remarkably widespread across all classes of living organisms, highlighting their evolutionary importance (Skelhorn, 2018; Carli & Farabollini, 2022). Among terrestrial tetrapods, selective pressures have favored an extensive defensive repertoire (Caro, 2014), organized into two key strategies: primary defense, which prevents detection (e.g., camouflage, cryptic behavior), and secondary defense, deployed after detection (e.g., escape, thanatosis) (Edmunds, 1974; Greene, 1988; Kumar *et al.,* 2019).

One widely documented defensive behavior against predators is death-feigning behavior (Honma *et al*., 2006), also known as thanatosis (Humphreys & Ruxton, 2018). This behavior is normally interpreted as an anti-predatory strategy aimed at disrupting the predator's behavior, particularly those predators that rely on movement to detect or subdue prey (Miyatake *et al*., 2004; Humphreys & Ruxton, 2018).

Many squamates are bottom-level consumers in food chains, making them vulnerable to predation. Therefore, death-feigning plays a fundamental role in the survival of individuals of this group (Martins, 1996; Fuentes *et al.,* 2021; Miranda *et al.,* 2023). Snakes are prey to a variety of predators, both vertebrates and invertebrates (Voris & Murphy, 2002; Maitland, 2003; Nyffeler & Gibbons, 2021). The genus *Atractus* is extremely diverse, with approximately 180 species distributed exclusively in the Americas (Passos *et al.,* 2024; Uetz *et al.,* 2025). *Atractus* species are typically burrowers, (Ferreira-Silva *et al.,* 2019) and have been recorded as prey for a wide variety of animals such as other species of snakes (Da Silva *et al.,* 2015; Souza *et al.* 2011; Rojas-Morales, 2013), and even fish (Snyder, 2016). Nonetheless, little is known about the behavior of *Atractus* species (Oliveira *et al.,* 2008; Passos *et al.,* 2010).

Among snakes, the repertoire of primary defenses is vast, including camouflage, disruptive coloration, and aposematism (Sazima & Abe, 1991; Valkonen *et al*., 2011; Muscat et al., 2024). They also exhibit a variety of secondary defenses, such as head triangulation, neck flattening, balling, and death-feigning (Bustard, 1969; Tozetti *et al*., 2009; Muscat & Entiauspe-Neto, 2016; Fuentes *et al.,* 2021). Some species have been shown to enhance death-feigning behavior with odors released through cloacal discharge (Gehlbach, 1970; Menezes *et al*., 2017; Golubović *et al*., 2021).

We here present the first record of death-feigning behavior in a snake of the genus *Atractus*. On November 19, 2024, in Santana da Vargem, Minas Gerais (21°14′56″S, 45°30′41″W), during fieldwork, an individual *A. pantosticus* was spotted moving along the side of a trail. The behaviors of the observed snake were analyzed through *ad libitum* sampling (Altmann, 1974). When the researcher (AS) approached the individual, it remained motionless. When carefully touched with the tip of a pen, the snake exhibited death-feigning behavior, remaining motionless (Fig 1A). When further disturbed by touch, the snake contorted its body into irregular bends and flexures (Fig. 1B) and coiled tightly (Fig. 1C), corresponding to Behaviors 53 and 58 described by Carpenter & Ferguson (1977). The entire death-feigning sequence lasted approximately 20 seconds, after which the snake moved away rapidly. These behaviors were recorded on video; the recording was deposited in the Coleção Audiovisual do Museu de Zoologia Adão José Cardoso, at Universidade Estadual de Campinas, under catalogue number ZUEC-PIC1199 ZUEC-VID 1342).

Death-feigning is an important defensive behavior as some predators may refuse to ingest previously dead prey (Francq, 1968; Barnard, 1983). Furthermore, temporary immobility may allow for an escape attempt if the predator becomes distracted (Caro, 2014). *Atractus pantostictus* appears to employ camouflage as primary defense mechanism, as its brown coloration makes it difficult to be visually detected (Stevens & Merilaita, 2011). However, when a potential predator is detected, it may display death-feigning (Honma *et al.,* 2006; Tan *et al.,*2024). The observations and records presented here expand the behavioral knowledge of the defensive repertoire of *Atractus pantostictus.* this fascinating group of snakes.

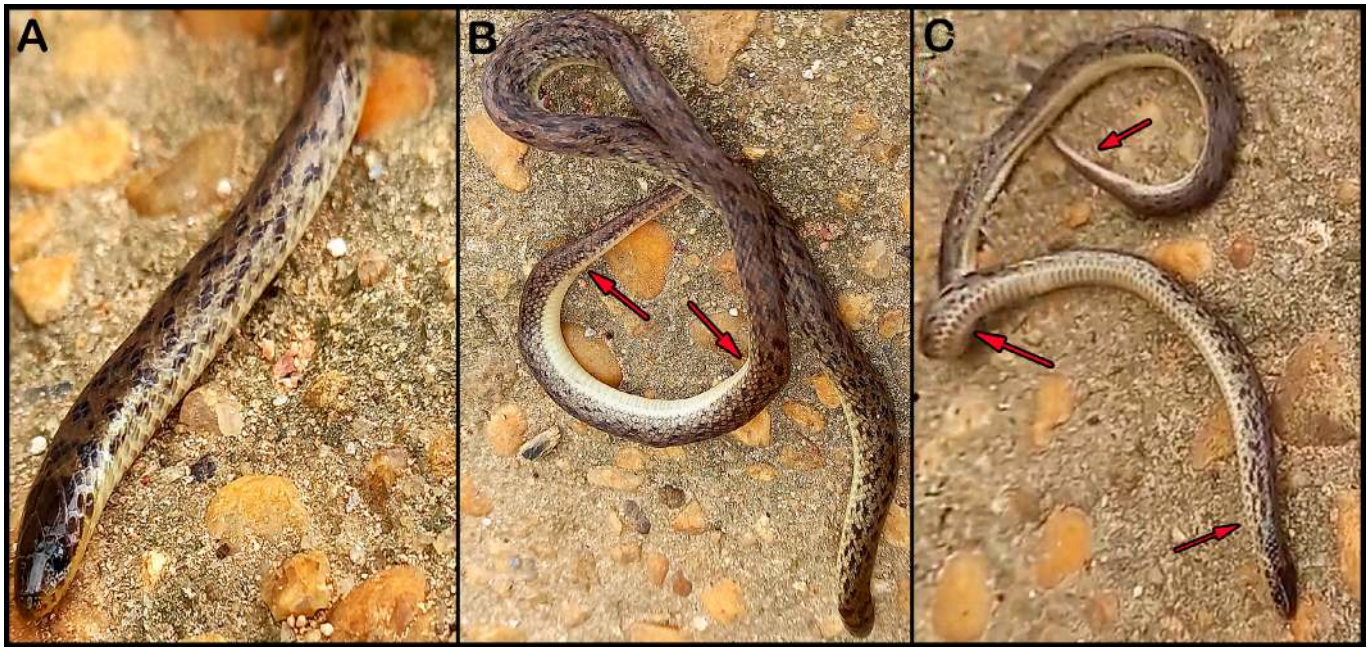

Figura 1. Different stages of death-feigning behavior in *Atractus pantostictus*. When the individual is stressed, it remains static (**A**); contorts the body with irregular flexures (**B**); and coils the body (**C**). Red arrows indicate points of exposure of the belly caused by contractions.

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