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First record of ophiophagy by *Clelia clelia* (Squamata: Dipsadidae) upon *Bothrops taeniatus* (Squamata: Viperidae) in western Pará

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Resumo

As serpentes exibem uma ampla diversidade trófica, sustentada por adaptações morfológicas e comportamentais que lhes permitem subjugar e ingerir presas inteiras. A ofiofagia é bem documentada na região Neotropical, com registros em diversos gêneros, como *Bothrops, Clelia* e *Micrurus*. Em 3 de maio de 2023, um adulto de *Clelia clelia*, uma Dipsadidae opistóglifa, foi observado consumindo um adulto de *Bothrops taeniatus*, uma víbora venenosa característica de habitats florestais amazônicos. A observação ocorreu às 15h30, no solo, ao lado de um cupinzeiro, em uma área rural do município de Juruti, estado do Pará, Brasil. Embora a predação de serpentes por *Clelia clelia* seja bem documentada, este é o primeiro caso conhecido de *Bothrops taeniatus* como sua presa. Além disso, constitui o primeiro registro de *C. clelia* neste município do Pará. Em suma, essa observação amplia o conhecimento sobre as interações tróficas envolvendo serpentes dipsadídeas e fornece novas informações sobre a dinâmica predador-presa em comunidades de serpentes da Amazônia.

Palavras-chave

Amazônia, Juruti, Ofiofagia, Pará, predação.

Abstract

Snakes exhibit a broad trophic diversity, supported by morphological and behavioral adaptations that enable them to subdue and ingest whole prey. Ophiophagy is well documented in the Neotropical region, with records from several genera such as *Bothrops, Clelia*, and *Micrurus*. On 03 May 2023, an adult *Clelia clelia*, an opisthoglyphous Dipsadidae, was observed consuming an adult *Bothrops taeniatus*, a venomous pit viper characteristic of Amazonian forested habitats. The observation was at 3:30 pm on the ground beside a termite mound, in a rural area of Juruti municipality, state of Pará, Brazil. Although snake predation by *Clelia clelia* is well documented, this represents the first known instance of *Bothrops taeniatus* as its prey. Moreover, it constitutes the first record of C. clelia for this municipality in Pará. Altogether, this observation expands the known trophic interactions involving dipsadid snakes and provides new insights into predator-prey dynamics within Amazonian snake assemblages.

Keywords

Amazon, Juruti, Ophiophagy, Pará, predation.

Snakes are widely distributed worldwide and may be classified as generalists or specialists, preying on a wide range of prey, from eggs to large vertebrates (Gaiarsa et al., 2013). Diet is considered a central factor in the evolution of snakes (Greene, 2001), as they have evolved a suite of morphological and behavioral adaptations for killing and ingesting prey whole (Colston et al., 2010). Ophiophagy is widespread and relatively well documented. Among Brazilian snakes, some taxa stand out as predominantly ophiophagous, such as *Boiruna* spp., *Clelia* spp., *Mussurana montana* (Alencar et al., 2013), *Erythrolamprus aesculapii* (Marques & Puorto, 1994; Da Silva & Costa-Campos, 2016), and *Micrurus* spp. (Banci et al., 2017).

To provide new data on ophiophagy and the natural history of snakes, we report a new predation event, the record of a dipsadid snake feeding on a viperid snake in eastern Amazonia, Brazil. On May 3, 2023, an adult Black Muçurana, *Clelia clelia* (Daudin 1803), approximately 150 cm in total length, was observed preying on an adult Speckled Forest Pit Viper, *Bothrops taeniatus* Wagler 1824, with an estimated total length of 90 cm, on private property in the rural area of the municipality of Juruti, western state of Pará, central Brazilian Amazon (2°20′44.70″S, 56°02′4.97″W, WGS84, 84 m elevation, Fig. 1). The predation event occurred on the forest floor at 3:30 pm.

A movement beneath a termite mound drew attention (Fig. 1). Upon approaching the site, a snake was observed preying upon another snake. Due to the high incidence of venomous species in rural Amazonia, the lack of proper handling training, and the considerable number of snakebite cases in remote areas (Souza et al., 2020), rural workers commonly kill snakes as a preventive measure. This occurred in the present case: after detecting the individuals, the workers killed both snakes. Only then was it clearly observed that an adult *C. clelia* was consuming an adult *B. taeniatus.* More than half of the viper's body had already been ingested (Fig. 2), indicating that the predation event was well advanced and likely successful if uninterrupted.



Figure 1. *Clelia clelia* (Daudin 1803) below the termite mound moving, in the rural area of the municipality of Juruti, in western Pará State, Brazil. Photo by Rafael Printes.

Essentially a generalist (Alencar et al., 2013), the diet of *C. clelia* includes lizards, small mammals, occasionally birds, and snakes (Rivas et al., 2023), including venomous species (Solórzano & Sasa, 2022). This observation is ecologically relevant because it documents active predation by an opisthoglyphous dipsadid species on a venomous pit viper. This interaction suggests broader trophic plasticity and may represent an instance of intraguild predation within Amazonian snake assemblages. Furthermore, predation on a viperid implies the use of specific behavioral strategies and a notable degree of physiological tolerance to venom. This species has already been observed to have tolerance, with documented predation events on species from various viperid genera including *Bothrops asper*, *Bothrops atrox, Bothrocophias andianus,* and *Bothriechis schlegelii* (Chavarría & Barrio-Amorós, 2014; Quinteros-Muñoz & Aguayo, 2021; Solórzano & Sasa, 2022).

Clelia clelia is a large-bodied snake with a broad distribution across lowland tropical forests, occurring from Argentina to Venezuela, with records from Bolivia, Brazil, Colombia, Ecuador, the Guianas, Paraguay, Peru, and Trinidad (Nogueira et al., 2019). It is especially widespread throughout Amazonia, with additional occurrences in the Atlantic Forest of the Paraná River basin

in Brazil and marginally in the Pantanal (Nogueira et al., 2019). Although primarily nocturnal, *Clelia clelia* may also be active during the day, foraging on the ground and occasionally within low vegetation (Timofeevski et al., 2017).



Figure 2. *Clelia clelia* (Daudin 1803) with partially swallowed *Bothrops taeniatus* Wagler 1824, in western Pará State, Brazil. Photo by Rafael Printes.

As reported by Solórzano & Sasa (2022), *C. clelia* subdues prey with powerful muscular constriction while simultaneously delivering venom through its rear fangs (Solórzano, 2004), subsequently ingesting the prey head-first. Even when attacking venomous snakes, the numerous defensive bites inflicted by the prey usually result in only mild and transient inflammation, as *C. clelia* possesses physiological tolerance, often described as "immunity", to viperid venoms (Lomonte et al., 1989).

Bothrops taeniatus is a venomous, predominantly nocturnal pit viper widely distributed throughout the Brazilian Amazon (Cunha & Nascimento, 1993; Campbell & Lamar, 2004), typically found in forested habitats where it feeds on small vertebrates (Campbell & Lamar, 2004). Although *Bothrops taeniatus* is often described as a semi-arboreal species, natural history studies show that it can use the forest floor for movement, thermoregulation, shelter, and occasionally foraging (Bernarde 2014). This use of the terrestrial stratum makes encounters with *C. clelia*, a typically terrestrial species active in the understory, ecologically plausible. The predation event reported here is therefore consistent with the known behavioral repertoire of both species. Personal field observations in western Pará corroborate this pattern: individuals of the species were found both on the ground and at low heights in the vegetation (Fig. 3). These observations indicate that *B. taeniatus* is not strictly arboreal but instead occupies a vertical gradient that includes meaningful use of the forest floor.



Figure 3. A juvenile *Bothrops taeniatus* resting above the ground near the city of Santarém, Pará, Brazil. Photo by Ana Maria Coelho.

Furthermore, although *C. clelia* is generally described as primarily nocturnal, the observation occurred at 3:30 pm. This timing suggests either opportunistic diurnal activity, potentially facilitated by shaded microhabitats such as termite mounds, or that the predation event began earlier and extended into the afternoon. Such temporal flexibility is consistent with the species' known opportunistic foraging behavior. The interaction took place in a rural landscape, a setting that promotes habitat overlap between species typically associated with both open areas and forested environments (Nogueira et al., 2019; Campbell & Lamar, 2004), which may increase the likelihood of atypical trophic encounters.

Necrophagy is an unlikely explanation. Rural areas around Juruti host a dense assemblage of scavenging birds, including vultures and caracaras (*Coragyps atratus*, *Cathartes aura*, *C. melambrotus*, *C. burrovianus*, *Sarcoramphus papa*, and *Caracara plancus*), among others. In open forest patches or along

clearing edges, carcasses of small- to medium-sized vertebrates are typically removed or consumed within minutes. According to local residents, the interaction was observed while both snakes were still engaged, and *C. clelia* was killed shortly afterward. Although it is not possible to retrospectively confirm that both individuals were alive at the moment of the photograph, the combination of (i) community reports, (ii) the low probability that a *Bothrops* carcass would remain available without being scavenged, and (iii) the well-documented ophiophagous habits of *C. clelia* makes it ecologically more plausible to interpret the event as active predation rather than opportunistic scavenging. In addition, predation by *Clelia* sp. on arboreal species is known (Guedes, 2021).

The viperid was identified as *Bothrops taeniatus* primarily based on its moss-green dorsal coloration combined with burnt-yellow spots, a diagnostic and unique pattern for the species in the region, hence the common name Speckled Forest Pit Viper. No other *Bothrops* species in eastern Amazonian *terra-firme* forests exhibits this chromatic combination. Regarding the predator, identification as *Pseudoboa nigra* was ruled out because the species is a dietary specialist that predominantly preys on lizards (Orofino et al., 2010; Alencar et al., 2013; Rodrigues et al., 2016). Additionally, Juruti lies hundreds of kilometers from the nearest known records of *P. nigra* in Pará (Nogueira et al., 2019). The same reasoning excludes *Oxyrhopus petolarius*, whose diet is also largely restricted to lizards (Costa, Provete & Feio, 2014). The white gular region visible in the photographs is a distinctive feature of *Clelia clelia*, and the robust body further supports this identification, contrasting sharply with the more slender morphology typical of *Pseudoboa* and *Oxyrhopus* species. The locality of the event falls within the known distribution of *C. clelia*; however, no previous records exist for the species in the municipality of Juruti (Nogueira et al., 2019). Thus, this observation represents both a novel behavioral record and an extension of the known geographic range of *C. clelia*. Taken together, the species' known distribution and its well-established ophiophagous habits provide unequivocal support for the identification as *Clelia clelia*.

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