

Predation behaviour of *Leptodeira annulata* Linnaeus, 1758 (Serpentes: Dipsadidae) on *Physalaemus cuvieri* Fitzinger, 1826 (Anura, Leptodactylidae)

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Snakes and anurans are important components of natural trophic systems, often interacting as predator and prey (Camargo Filho et al., 2008; Bernardes and Abe, 2010; Silva et al., 2010; Fonseca et al., 2012). Typically, snakes prey on anurans (Vitt, 1983; Toledo et al., 2007; Bernardes and Abe, 2010; Silva et al., 2010; Siqueira et al., 2012; Falkenberg et al., 2014; Oliveira et al., 2017) although, occasionally, the roles are reversed, and anurans can also prey on snakes (Silva et al., 2007; Camargo Filho et al., 2008; Fonseca et al., 2012).

One prominent predator of anurans is the banded cat-eyed snake, *Leptodeira annulata* Linnaeus, 1758, which exploits anurans at all stages of their life cycle, including the eggs, tadpoles, and adults (Ávila and Morais, 2007; Bernarde and Abe, 2010; Santos-Silva et al., 2014; Falkenberg et al., 2014). *Leptodeira annulata* is found throughout most of the Neotropical region, between Mexico and Argentina (Carvalho et al., 2005). This snake is nocturnal and semi-arboreal, and is typically found near the edge of water bodies in humid environments (Martins and Oliveira, 1998; Carvalho et al., 2005; Bernarde and Abe, 2010; Sales et al., 2013).

The preference of *L. annulata* for anuran prey is related to its nocturnal habits, which coincide with the activity pattern of most anuran species (Vitt, 1996; Ávila and Moraes, 2007). Predation events have rarely been observed (Matthews et al., 2000; Lima and Colombo,

2008); there is only one study that reported the predation of a *Physalaemus* species by *L. annulata* (Santos-Silva et al., 2014). However, Borges et al. (2014) have found remains of a specimen of *Physalaemus cuvieri* Fitzinger, 1826 in the stomach contents of a *L. annulata* individual. The present study describes the behaviour of *L. annulata* during the predation of *Physalaemus cuvieri* Fitzinger, 1826.

The events reported here were recorded on 4 November 2016, in Palmeiras de Goiás, in the state of Goiás, Brazil (16°43'37.64" S, 49°48'16.18" W, 595 m a.s.l.) between 20:29 h and 21:05 h. The frog was initially captured when the snake seized the frog by the middle of its right thigh (Fig. 1A). We then monitored the animals continuously as the frog attempted to escape and the snake ingested its prey. Despite its concerted efforts to escape, the frog was unable to free itself, while the snake remained motionless, waiting for the frog to stop moving.

Initially, the frog tilted its body forward, although this resulting in it losing its footing at approximately 7 minutes, leaving it belly up (Fig. 1B). This position facilitated the ingestion of the anuran by the snake. The snake began to ingest its prey by the right leg, followed by the left leg, stopping when it reached the pelvic girdle (Fig. 1C). In the meantime, the frog had inflated its body, while otherwise remaining motionless. The frog did not emit distress calls at any time, although it did maintain its body inflated. The snake paused briefly until the frog allowed its body to deflate, and then swallowed its prey completely through rhythmic movements of its mandible. The whole process up to the complete ingestion of the prey lasted approximately 20 minutes. Once it had ingested its prey, the snake adjusted its mandible to a normal position and moved away (Fig. 1D).

The difficulty of monitoring snakes and frogs systematically in the wild means that detailed

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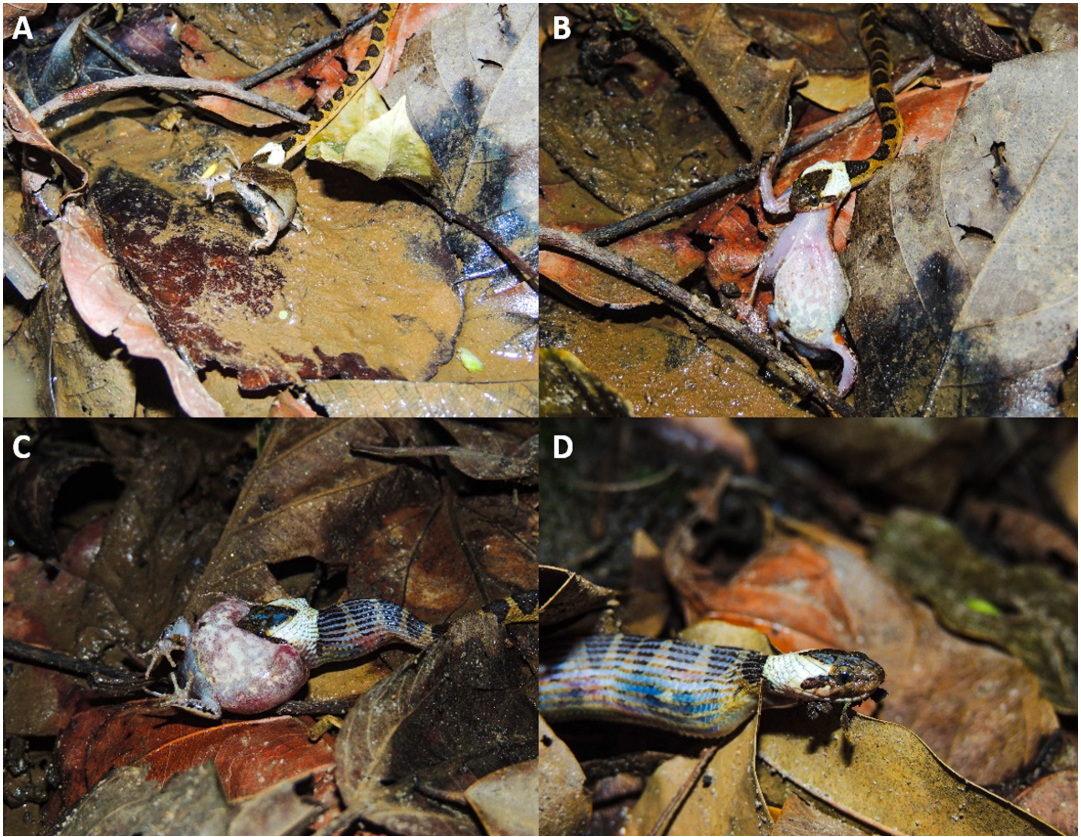


Figure 1. The predation of *Physalaemus cuvieri* by *Leptodeira annulata* in Palmeiras de Goiás, Goiás state, Brazil, in November 2016: (A) the frog is captured by the snake, which seizes its right thigh; (B) when attempting to escape, the frog goes belly up; (C) the frog inflates its body; (D) the snake has ingested the frog completely.

observations of predation events are rare (Malkmus, 2000; Lima and Colombo, 2008). However, despite this difficulty, an apparently relevant aspect that may have an influence on the effectiveness of the predation event was the region of the body where the prey was attacked. In predation events recorded for *L. annulata*, there is a predominance of strike initiated by the head (see Carvalho et al., 2007; Falkenberg et al., 2013; Santos-Silva et al., 2014; Silva-Neta et al., 2015; Aguilar-López et al., 2019), followed by attacks in the flank or hindlimbs (Hagman and Schuller, 2007; Nascimento et al., 2013; Sales et al., 2013; Santos-Silva et al., 2014). In the specific case of *L. annulata* and *P. cuvieri*, while both species are considered to be common, this is the first record of a predation event involving the two species together, under natural conditions. A number of predation events involving *L. annulata* and other anuran species have nevertheless been reported (Vrcibradic et

al., 2007; Sales et al., 2013; Thomassen et al., 2013; Falkenberg et al., 2013; Nascimento et al., 2013; Santos-Silva et al., 2014; Silva-Neta et al., 2015), and the event documented here provides important new insights into the foraging strategies of *L. annulata*, and in particular, its capacity to subjugate a given type of prey.

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