Predation of *Rhinella granulosa* by another bufonid, *Rhinella jimi* (Amphibia: Bufonidae) in Northeastern Brazil

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The family Bufonidae is composed by over 600 species, of which 84 have already been reported from Brazil (Segalla *et al.,* 2016; Frost, 2018). In the municipality of Picos in the Northeast region of Brazil, three representatives of this family can be found: *Rhinella jimi* (Stevaux, 2012), *R. granulosa* (Spix, 1824), and *R. mirandaribeiroi* (Gallardo, 1965) (Benicio & Fonseca, 2014).

Rhinella jimi has an average snout-vent length (SVL) of 103 mm and is well adapted to anthropic environments (Borges-Nojosa & Santos, 2005). The dorsal coloration ranges from brown to beige backgrounds with black spots, and the parotoid glands are well-developed (Roberto *et al.,* 2013). *Rhinella jimi* is found during the day hidden in shelters and at night during the rainy season in both paved and grassy areas in the Picos University Campus.

Rhinella granulosa is smaller (mean SVL = 46 mm, Narvaes & Rodrigues, 2009) than *R. jimi* and generally found in the rainy season in temporary pools and runoff channels. The dorsum is brown with irregular dark spots, and the belly is whitish or cream-colored with black spots, the parotid glands are barely visible (Narvaes & Rodrigues, 2009). This species can be seen on the ground in paved or grassy areas. Pairs in amplexus are commonly seen in or near water, and males can be heard vocalizing near the edges of temporary pools. Additionally, during the day, individuals can be seen in shelters, which they leave at night to reproduce or forage (Pina *et al.,* 2015).

Rhinella mirandaribeiroi is a species similar to *R. granulosa* showing a little darker coloration and a dorsal clearly defined line reaching from the snout to the vent. *Rhinella mirandaribeiroi* is rarely found in the Picos region, however the species is widely distributed in other Brazilian states (Pina *et al.,* 2015).

On November 25, 2016, from 09:37 p.m. until 10:19 p.m., a male individual of *Rhinella jimi* and a female of *R. granulosa* were observed in an anthropic area on the Campus of the Federal University of Piauí, municipality of Picos, located in southeastern Piauí state (07°5'15.88"S, 41°24'1.67"W), northeastern Brazil. The toads were found on a concrete surface and were engaged in intense predator-prey activity (Figure 1). During this activity, the individual of *R. jimi* made successive attempts to prey on the individual of *R. granulosa*. The movements of *R. granulosa* was followed by *R. jimi*. At one point, *R. granulosa* adopted a defensive posture by inflating its lungs and remaining in this position until the end of the event. The predator (*R. jimi*) charged the prey from behind and attempted to ingest its left foot. However, the attempt was unsuccessful because the prey remained in a constant defensive posture. As the prey (*R. granulosa*) attempted to escape, it was blocked by a wall enclosing the space. Then, the prey immediately moved away from the predator. At this time, a significant injury to the left foot and sides of the body were observed. In particular, a large hematoma lesion was visible on the left side, and together with the inflated lung, this lesion made it difficult for the toad to hop. The prey disengaged from the predator and moved toward a shelter containing several other individuals of *R. jimi*. Subsequently, the individual of *R. granulosa* was found dead at the location one day after the attack. The video of the event can be watched here (https://youtu.be/tGaFiVa40iE). This individual was fixed, preserved, and deposited in the Herpetological Collection Junco Campus of the Federal University of Piauí (CHCJ 0666, License SISBIO 22508-1).

On March 29, 2017, from 7:35 p.m. until 7:40 p.m., another event of predation of *R. granulosa* by *R. jimi* was observed. During this event, an individual of *R. jimi,* with the aid of its front limbs, ingested and swallowed a individual of *R. granulosa*. The video of the predation can be watched here: https://youtu.be/AjkUPskJlY8. The prey ingestion began with the right side of the prey's body so that its mouth and left limbs were exposed. After prey ingestion, the female predator was taken to the herpetology laboratory for morphometric analysis and necropsy (SVL = 214 mm; weight = 1.488 kg). The female was sacrificed by inoculation with 20 ml of lidocaine in the ventral portion



Figure 1: Predation of an individual of *Rhinella granulosa* by *Rhinella jimi*.

of the body near the ventricle. Necropsy was performed by a postero-anterior medial incision. After the viscera had been exposed, the distended stomach was removed, and the ingested *R. granulosa* individual was observed inside, along with other food items, mainly Arthropoda and Coleoptera (Figure 2). The ingested individual of *R. granulosa* had a SVL = 59 mm, and its external appearance was intact. Both individuals were fixed, preserved, and deposited in the Herpetological Collection Junco Campus of the Federal University of Piauí (CHCJ 0667 and 0668).

Amphibians have a diet consisting primarily of invertebrates, but some species can feed on small vertebrates (Duellman, & Trueb, 1994). Batrachophagy occurs sporadically in amphibians (Toledo *et al.,* 2007). Cannibalism is common in tadpoles (McDiarmid & Altig, 1999) but rare in adults; when it does happen, it usually involves predation on young (Wiseman & Bettaso, 2007; Hobel, 2011; Struijk *et al.,* 2014; Maffei *et al.,* 2014) and tends to occur most frequently in nonarboreal species (Toledo *et al.,* 2007; Wells, 2007). This behavior is considered an opportunistic form of predation (Duellman & Trueb, 1994).

The diet of *Rhinella* spp. consists of invertebrates: Coleoptera, Hymenoptera, Odonata, Opiliones, and Araneae (Sabagh *et al.,* 2012). Ants are the most representative items (Toft, 1980; Teixeira *et al.,* 1999; Sabagh & Carvalho-e-Silva, 2008; Maragno & Souza, 2011; Sabagh *et al.,* 2012). However, for some species of *Rhinella,* beetles are the most important items in the diet (Lajmanovich, 1994; Grant, 1996; Duré *et al.,* 2009; Isaacs & Hoyos, 2010; Batista *et al.,* 2011).

Amphibians usually ingest their prey whole, and as result, mouth dimensions tend to restrict the upper size limit of the prey they consume (Blackburn & Moreau, 2006). This relation is generally reflected in many *Rhinella* species by a positive relation between the mouth size and prey dimensions (Duré *et al.,* 2009; Quiroga *et al.,* 2009; Batista *et al.,* 2011; Maragno & Souza, 2011). Both of our observations of *R. jimi* agree with the observation of these authors. In the first attempt, the male was smaller, and the prey's defensive behavior turned swallowing into a difficult task. In the second observation, the *R. jimi* female was much bigger than the prey, enabling ingestion.



Figure 2: Indivudual of *Rhinella granulosa* observed inside stomach contents of *Rhinella jimi,* with other food items, mainly Arthropoda and Coleoptera.

Anurophagy was too observed with *Boana albomarginata* feeding on *Dendropsophus meridianus* in the Southeast of Brazil (Figueiredo-de-Andrade *et al.,* 2012). For Leptodactylidae, anurophagy has been recorded in *Leptodactylus labyrinticus* (= *L. vastus*), which was observed preying on *Stereocyclops parkeri* and *L. latrans* preying on several other amphibian species. The same is valid for *Boana faber, Ceratophrys* and several other large species of anurans (Figueiredo-de-Andrade *et al.,* 2012).

In adult bufonids, anurophagy has already been observed in *Rhinella marina* in Colombia by Issacs & Hoyos (2010) on both tadpoles and adults. On the other hand, specimens of *R. marina* introduced in Australia, studied by Heise-Pavlov and Longway (2011), consumed a diet consisting predominantly of Arthropods, mainly Araneae.

Another record was provided by Guix (1993), with *Bufo paracnemis* (= *R. jimi,* actually) in Ouricuri, Pernambuco state, Southeastern Brazil, but no more details about this event are available. We emphasize that while all cited examples of anurophagy have been documented in natural environments (forest), in this report from the Caatinga region, we observed anurophagy by *R. jimi* in an anthropic environment on a concrete substrate. We observed different results for the attempted predation – one of defense and the other of predation.

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