Predation attempt on *Dermatonotus muelleri* (Boettger, 1885) (Anura: Microhylidae) by *Caracara plancus* (Miller, 1777) (Aves: Falconidae) with a new defensive behavior reported

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Amphibians are important components of the trophic networks in many ecosystems, in different life stages, as prey for both vertebrates and invertebrates (Toledo 2005, Toledo et al. 2007, Haddad et al. 2013). Although some animals eat frogs opportunistically (e.g. Delaix-Zaqueo et al. 2017, Cavalcante et al. 2019, Güell et al. 2019), anurans represent a significant part of the diet of many species (e.g. Menin et al. 2005, Toledo 2005, Toledo et al. 2007, Costa et al. 2012, Jones et al. 2021). For this reason amphibians exhibit numerous strategies to avoid predators, including stiff-legged behavior, puffing up the body, and production of harmful secretions (Toledo et al. 2011).

At 10:15h on 24 November 2020, during a wildlife rescue in São Gonçalo do Gurguéia municipality (10.115°S, 45.285°W), state of Piauí, northeastern Brazil, we observed an adult Southern Caracara, *Caracara plancus* (Falco-

nidae) manipulating an object on the ground with its foot. The action was recorded using a video camera and the video is deposited in Fonoteca Neotropical Jacques Vielliard – under the voucher ZUEC-VID 952. We identified the potential prey as a Müller's termite frog, *Dermatonotus muelleri*, a burrowing species from the diagonal belt of open formations in Paraguay, Bolivia, Argentina, and Brazil (Oliveira et al. 2018). While the Caracara attacked the frog, the frog puffed up the body (Fig. 1A). After using its foot 14 times, the Caracara pecked once (Fig. 1B) and immediately shook its head (Fig. 1C). Fifteen seconds later, the bird moved away from the prey and, one minute later, flew away. After two minutes, one of us (DSB) approached and handled the frog, which remained puffed up and appeared to have an injury on its back (Fig. 1D). Slimy glandular secretion by the skin is a mechanism of defense of amphibians, usually activated by stress or injury, and the secretions vary from odoriferous to extraordinarily toxic (Toledo & Jared 1995, Gomes et al. 2007; Vitt & Caldwell 2013). After external examination, DSB released the frog in a safe location.

The Southern Caracara is a bird of prey with a generalist diet, feeding on insects, fish, mammals, birds, reptiles, and amphibians (Vargas et al. 2007, Idoeta & Roesler 2012). Although amphibians are included in its diet (Crozariol & Gomes 2009), they appear to be an occasional prey item (Vargas et al. 2007). This species is known to follow agricultural machinery to eat unearthed animals (see Sazima & Augusto 1991; Zamprogno & Sazima 1993, Assis & Costa 2020). The reaction of the Caracara of shaking its head immediately after pecking the frog was probably due to the secretions from the *D. muelleri*'s skin (see Cavalcante et al. 2017). The behavior was similar to the reaction of chickens after attempting to prey on *Brachycephalus ephippium* (see supplementary videos of Rebouças et al. 2019), another toxic anuran.

This is also the first report of the defensive behavior of puffing up the body in *D. muelleri*. This behavior consists of filling the lungs with air to increase the size of the frog, discouraging the predator (Toledo et al. 2011). The association of this defensive behavior and skin secretion has been documented for other amphibians (Toledo et al. 2011, Meneses & Corrêa 2020). Combining defensive behaviors results in a higher chance of escape from potential predators that are discouraged only when multiple signals are displayed (Toledo et al. 2011). While some anurans produce skin secretion at the same time as puffing up the body (e.g. *Physalaemus nattereri*, Lenzi-Mattos et al. 2005, *Odontophrynus* spp. Borteiro et al. 2018), others use this strategy only after physical contact (e.g. *Centrolene savagei*, Esco-

bar-Lasso & Rojas-Morales 2012). For *D. muelleri*, the synergistic behavior of puffing up the body and the skin secretion was effective in repelling the Crested Caracara. Despite some records of predation on *D. muelleri* (Wild 2001, Gavira et al. 2008, Stănescu et al. 2014, Caldas et al. 2017, Leal et al. 2018, Andrade et al. 2020) little is known about how its defensive strategies act against possible predators.

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Figure 1. Sequence of events during a predation attempt on *Dermatonotus muelleri* by *Caracara plancus*. A) an adult *C. plancus* manipulating the frog (indicated with a red arrow) with its foot; B) the *C. plancus* pecking the *D. muelleri*; C) *C. plancus* shaking its head and moving away from the frog; D) an injury on the dorsum of the *D. muelleri*, indicated by a red arrow.