

Predation of *Proceratophrys boiei* (Anura, Odontophrynidae) upon *Ololygon luizotavioi* (Anura, Hylidae)

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DOI: [10.5281/zenodo.13308220](https://doi.org/10.5281/zenodo.13308220)

Anurans are generalist predators that feed on small organisms, including invertebrates such as arthropods (Forti et al., 2011), and small vertebrates like fish (Solé et al., 2009), or even other anurans (Cuestas-Carrillo et al., 2019), a behavior known as batracophagy (Santos et al., 2004). Batracophagy in anurans is a common but understudied behavior (Toledo et al., 2007). In a recent survey on batracophagy by anurans, 67 records of this behavior were found in 18 Brazilian anuran species, distributed among the families Bufonidae, Ceratophryidae, Dendrobatidae, Hylidae, Leptodactylidae, and Ranidae (Benício, 2021).

The horned frog, *Proceratophrys boiei*, a species of the Odontophrynidae family, is widely distributed in Brazil, occurring in the states of Espírito Santo, Minas Gerais, Rio de Janeiro, São Pau-

lo, Paraná, and Santa Catarina (Prado & Pombal, 2008; Frost, 2024). It inhabits the interior or edge of forests, streams, and lentic environments (Forti, 2009). This frog is considered a large species of *Proceratophrys*, with males measuring 39.8–61.9 mm SVL and females measuring 40.0–74.3 mm SVL (Prado and Pombal-Jr., 2008).

Species of the genus *Proceratophrys* are considered predators, with their diet consisting mainly of invertebrates (Teixeira & Coutinho, 2002; Brito et al., 2012; Almeida-Santos et al., 2017). They are also opportunistic animals that exhibit a sit-and-wait behavior, which contributes to their success in capturing and feeding on prey (Brito et al., 2012). The few studies addressing the feeding habits of *P. boiei* showed that its diet mainly consists of invertebrates, especially arthropods, some plant remains, nematodes, and a few vertebrates (Gi-

aretta et al., 1998; Klaion et al., 2011). Among the vertebrates, there is only a single record of batracophagy by *P. boiei*, in which it fed on two adult individuals of *Ischnocnema parva* (Girard, 1853) (Giaretta et al., 1998), a species of the family Brachycephalidae. Considering that information regarding the trophic ecology of a species is important to understand organism interactions (Ceron et al., 2019), in this note we present a second record of batracophagy by *P. boiei*.

During a field expedition to Serra do Brigadeiro (20°42'55"S; 42°26'51"W, WGS84 datum, approximately 1300 m a.s.l.), in the municipality of Ervália, state of Minas Gerais, on November 4th, 2021, we collected a male individual of *Proceratophrys boiei* (Figure 1A). The specimen is deposited in the Coleção Zoológica da Universidade Federal do Mato Grosso do Sul (ZUFMS-AMP 15673; SVL = 46.56 mm). While preparing this specimen for diaphanization, we opened the ventral region to remove the viscera (Figure 2). The stomach was opened to analyze its content due to its large volume.

Among the stomach contents, we found two *Ololygon luizotavioi* Caramaschi and Kisteumacher, 1989 (Hylidae) (Figure 1B). We were able to identify these specimens based on the smaller size of the female (20.0 mm) in comparison to its sympatric congeners, such as *Ololy-*

gon tripui (37.0–39.2 mm) and *Ololygon flavoguttata* (40.0–45.4 mm) (Lourenço et al., 2009). Additionally, the distinct stripe pattern on the thighs and dorsum was diagnostic, and not present in *Ololygon* aff. *rizibilis* (see figure 5F in Moura et al., 2012). The ovigerous female had a ruptured belly, which caused the release of the oocytes. Besides the two *O. luizotavioi*, we also identified other food items in the stomach of *P. boiei*: orthoptera legs and an unidentified Coleopteran.

There is one record of batracophagy in the genus *Proceratophrys*; *P. appendiculata* (Günther, 1873), which contained an adult *Ischnocnema* sp. Reinhardt & Lütken, 1862 (Boquimpiani-Freitas et al., 2002). It is important to note that our record of batracophagy by *P. boiei* involves the ingestion of an arboreal anuran species. Previous records were of *Ischnocnema* that inhabit the forest litter, the same habitat as *Proceratophrys* species (Haddad et al., 2013).

This finding represents the second record of batracophagy by *P. boiei* (Giaretta et al., 1998), and the third within the *Proceratophrys* genus (Boquimpiani-Freitas et al., 2002), suggesting that such behavior might be relatively uncommon among this genus (43 species; Frost, 2024). A factor that might contribute to this behavior is that the individual was collected during the breed-

ing season, a period when anurans congregate in large groups for reproduction (Giaretta & Facure, 2006). In temporary ponds along the trail where the *P. boiei* individual was collected we observed many anurans in reproductive activities, including many *O. luzotavioi*: males were calling, and several couples were in amplexus (Figure 1B). It is likely that the couple found in the stomach of *P. boiei* was in amplexus at the time of predation. The gathering of a substantial number of anurans in a single location could lead to unusual behaviors due to the intense activities of the species, such as interspecific amplexus (*e.g.*, Pedro and Nali, 2020), amplexus with inanimate objects (*e.g.*, Mollov et al., 2010), and male-to-male or even female aggression (Pombal-Jr. & Haddad, 2005).

During the breeding season, anurans are exposed, and the male's call may reveal their location, which may lead to predation (Hinshaw & Sullivan, 1990; Giaretta and Menin, 2004). During amplexus, the female's locomotion decreases, and they have difficulty moving (Bowcock et al., 2009; Gray & Mackenzie, 2016), which can also make the couple more susceptible to predation. We believe that the risk of predation might increase when anurans are engaged in amplexus.

Records like the one presented here are important to understand the dietary

habits of anurans, including the preference and availability of food resources in natural environments, as well as predator-prey dynamics (França et al., 2004; Santos et al., 2004; Forti et al., 2011).

ACKNOWLEDGEMENTS

L.C. thanks to Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for his scholarship, and Programa de Pós-Graduação em Biologia Animal da Universidade Federal de Mato Grosso do Sul and Andressa Figueiredo de Oliveira for identifying the arthropods. DJS thanks CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for his research fellowship (309420/2020-2). SM thanks to CNPq for her research fellowship. Specimens were collected under permit number 81643-2 issued by SISBio.

REFERENCES

Almeida-Santos M., Siqueira C.C., Anjos L.A., Van Sluys M., Rocha C.F.D. 2017. Ecological aspects of the horned leaf-frog *Proceratophrys mantiqueira* (Odontophrynidae) in an Atlantic Rainforest area of southeastern Brazil. *Salamandra* 53:413–22.

Benício R.A. 2021. Predation attempt on Miranda Ribeiro's Toad, *Rhinella*

mirandaribeiroi (Anura: Bufonidae) by Cope's Toad *Rhinella diptycha* (Anura: Bufonidae), and a review of batrachophagy in Brazil. *Reptiles & Amphibians* 28:191–196.

Boquimpani-Freitas L., Rocha C.F.D., Van Sluys M. 2002. Ecology of the horned leaf-frog, *Proceratophrys appendiculata* (Leptodactylidae), in an insular Atlantic rain-forest area of southeastern Brazil. *Journal of Herpetology* 36:318–322.

Bowcock H., Brown G.P., Shine R. 2009. Beastly bondage: the costs of amplexus in cane toads (*Bufo marinus*). *Copeia* 2009:29–36.

Brito L., Telles F., Roberto I., Ribeiro S., Cascon P. 2012. Different foraging strategies within congenics? The diet of *Proceratophrys cristiceps* (Müller, 1883) from a dry forest in northeast Brazil. *Herpetology Notes* 5:85–89.

Caramaschi, U., Kisteumacher, G. 1989. Duas novas espécies de *Ololygon* Fitzinger, 1843, do sudeste do Brasil (amphibia, Anura, Hylidae). *Boletim do Museu Nacional. Nova Serie, Zoologia*. 327:1–15.

Ceron, K., Oliveira-Santos, L.G., Souza, C.S., Mesquita, D.O., Caldas, F.L., Araújo, A.C., Santana, D.J. 2019. Global patterns in anuran-prey networks:

structure mediated by latitude. *Oikos* 128:1537–1548.

Coco L., Borges Junior V.N., Fusinato L.A., Kiefer M.C., Oliveira J.C., Araújo P. G. ... Rocha C.F. 2014. Feeding habits of the leaf litter frog *Haddadus binotatus* (Anura, Craugastoridae) from two Atlantic Forest areas in southeastern Brazil. *Anais da Academia Brasileira de Ciências* 86:239–249.

Cuestas-Carrillo J.F., Ferreira V.G., Santana D.J. 2019. Batrachophagy by *Leptodactylus chaquensis* (Anura: Leptodactylidae) in the Brazilian Cerrado and Pantanal. *Herpetology Notes* 12:261–263.

Forti L.R., Tissiani A.S.O., Mott T., Strüssmann C. 2011. Diet of *Ameerega braccata* (Steindachner, 1864) (Anura: Dendrobatidae) from Chapada dos Guimarães and Cuiabá, Mato Grosso State, Brazil. *Brazilian Journal of Biology* 71:189–196.

Forti L.R. 2009. Temporada reprodutiva, micro-habitat e turno de vocalização de anfíbios anuros em lagoa de Floresta Atlântica, no sudeste do Brasil. *Revista Brasileira de Zoociências* 11: 89–98

França L., Facure K., Giaretta A. 2004. Trophic and spatial niches of two large-sized species of *Leptodactylus* (Anura) in southeastern Brazil. *Studies*

on Neotropical Fauna and Environment 39:243–248.

Frost D.R. 2024. Amphibian Species of the World: an Online Reference. Version 6.2 (16 January 2024). Electronic Database accessible at <https://amphibiansoftheworld.amnh.org/index.php>. American Museum of Natural History, New York, USA. doi.org/10.5531/db.vz.0001

Giaretta A.A., Araújo M.S., Medeiros H.F.D., Facure K.G. 1998. Food habits and ontogenetic diet shifts of the litter dwelling frog *Proceratophrys boiei* (Wied). *Revista Brasileira de Zoologia* 15:385–388.

Giaretta A.A., Facure K.G. 2006. Terrestrial and communal nesting in *Eupemphix nattereri* (Anura, Leiuperidae): interactions with predators and pond structure. *Journal of Natural History* 40:2577–2587.

Giaretta A.A., Menin M. 2004. Reproduction, phenology and mortality sources of a species of *Physalaemus* (Anura: Leptodactylidae). *Journal of Natural History* 38:1711–1722.

Girard C. 1853. Descriptions of new species of reptiles, collected by the U.S. Exploring Expedition, under the command of Capt. Charles Wilkes, U.S.N. Second part—including the species of

batrachians, exotic to North America. *Proceedings of the Academy of Natural Sciences of Philadelphia* 6:420–424.

Gray H.M., MacKenzie T.R. 2016. Extreme tactics used by cane toads, *Rhinella marina* (Linnaeus, 1758) (Anura: Bufonidae), to disrupt amplexant pairs and to avoid persistent satellite males. *Herpetology Notes* 9:233–235.

Günther A.C.L.G. 1873. Contribution to our knowledge of *Ceratophrys* and *Megalophrys*. *Annals and Magazine of Natural History* 11:417–419.

Haddad C.F., Toledo L.F., Prado C.P., Loebmann D., Gasparini J.L., Sazima I. 2013. *Guia dos anfíbios da Mata Atlântica: diversidade e biologia*. Anolis Books, São Paulo..

Hinshaw S.H., Sullivan B.K. 1990. Predation on *Hyla versicolor* and *Pseudacris crucifer* during reproduction. *Journal of Herpetology* 24:196–197.

Klaion T., Almeida-Gomes M., Tavares L.E., Rocha C.F., Sluys M.V. 2011. Diet and nematode infection in *Proceratophrys boiei* (Anura: Cycloramphidae) from two Atlantic rainforest remnants in Southeastern Brazil. *Anais da Academia Brasileira de Ciências* 83:1303–1312.

- Lourenço A.C.C., Nascimento L.B., Pires M.R.S. 2009. A new species of the *Scinax catharinae* species group (Anura: Hylidae) from Minas Gerais, southeastern Brazil. *Herpetologica* 65:468–479.
- Maia-Carneiro T., Kiefer M.C., Van Sluys M., Rocha C.F. 2013. Feeding habits, microhabitat use, and daily activity period of *Rhinella ornata* (Anura, Bufonidae) from three Atlantic rainforest remnants in southeastern Brazil. *North-Western Journal of Zoology* 9:157–165.
- Mollov I.A., Popgeorgiev G.S., Naumov B.Y., Tzankov N.D., Stoyanov A.Y. 2010. Cases of abnormal amplexus in anurans (Amphibia: Anura) from Bulgaria and Greece. *Biharean Biologist* 4:121–125.
- Moura M.R., Motta A.P., Fernandes V.D., Feio R.N., 2012. Herpetofauna da Serra do Brigadeiro, um remanescente de Mata Atlântica em Minas Gerais, sudeste do Brasil. *Biota Neotropica* 12:209–235.
- Napoli M.F., Cruz C.A.G., Abreu R.O., Del Grande M.L. 2011. A new species of *Proceratophrys* Miranda-Ribeiro (Amphibia: Anura: Cycloramphidae) from the Chapada Diamantina, State of Bahia, northeastern Brazil. *Zootaxa* 3133:37–49.
- Pedro F.M.S.R., Nali R.C. 2020. Interspecific amplexus of *Dendropsophus elegans* with a newly metamorphosed individual from the known predator *Boana semilineata* (Anura: Hylidae). *Herpetology Notes* 13:791–793.
- Pombal-Jr J.P., Haddad C.F. 2005. Strategies and reproductive modes of anurans (Amphibia) in a permanent pond in Serra de Paranapiacaba, southeastern Brazil. *Papéis Avulsos de Zoologia* 45:215–229.
- Prado G.M., Pombal-Jr J.P. 2008. Espécies de *Proceratophrys* Miranda-Ribeiro, 1920 com apêndices palpebrais (Anura; Cycloramphidae). *Arquivos de Zoologia* 39:1–85.
- Santos E.M., Almeida A.V., Vasconcelos S.D. 2004. Feeding habits of six anuran (Amphibia: Anura) species in a rainforest fragment in Northeastern Brazil. *Iheringia. Série Zoologia* 94:433–438.
- Solé M., Dias I.R., Rodrigues E.A., Marciano-Jr E., Branco S.M., Cavalcante K.P., Rödder D. 2009. Diet of *Leptodactylus ocellatus* (Anura: Leptodactylidae) from a cacao plantation in southern Bahia, Brazil. *Herpetology Notes* 2:9–15.
- Teixeira R.L., Coutinho E.S. 2002. Hábito alimentar de *Proceratophrys boiei*

(Wied) (Amphibia, Anura, Leptodactylidae) em Santa Teresa, Espírito Santo, sudeste do Brasil. *Boletim do Museu de Biologia Mello Leitão* 14:13–20.

Toledo L.F., Ribeiro R.S., Haddad C.F. 2007. Anurans as prey: an exploratory analysis and size relationships between predators and their prey. *Journal of Zoology* 271:170–177.

Wachlevski M., De Souza P.H., Kopp K., Eterovick P.C. 2008. Microhabitat use and feeding habits of *Crossodactylus bokermanni* Caramaschi and Sazima, 1985 (Anura, Hylodidae) at a site in south-eastern Brazil. *Journal of Natural History* 42:1421–1434.

Editor: Ariadne F. Sabbag



Figure 1. A) *Proceratophrys boiei* (voucher ZUFMS-AMP 15673), and B) amplexing couple of *Ololygon luizotavioi* at the Serra do Brigadeiro, in the municipality of Ervália, state of Minas Gerais (not collected).



Figure 2. A) Skinless individual of *Proceratophrys boiei* in preparation for diaphanization (voucher ZUFMS-AMP 15673, SVL 46.56 mm), B) couple of *Ololygon luizotavioi* found in the stomach of *P. boiei*, C) other stomach contents.