

Record of the crabs *Poppiana argentiniana* (Rathbun, 1905) and *Valdivia camerani* (Nobili, 1896) in the diet of *Rhinella diptycha* (Cope, 1862) (Anura: Bufonidae), in the Pantanal Mato-Grossense, Brazil

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Seasonal floods in the Pantanal region of Brazil inundate a large area of lowland floodplains, altering the dynamics of food and shelter resources and, consequently, the structure of animal communities (Martins et al., 2015). This region may have different types of environments with variable conditions for amphibians. Although it is well known that knowledge about the feeding ecology of anurans in different environments is important to understanding feeding adaptations in continuously-changing habitats (Pacheco et al., 2017), ecological adaptations of frogs to environmental changes remain understudied in the Pantanal (Souza et al., 2017).

Rhinella diptycha (Cope, 1862), locally known as *cururu*, is a widely distributed toad in South America, occurring from the Atlantic coast of Brazil to Paraguay, Bolivia, Argentina, and Uruguay (Pramuk, 2006; Frost, 2019). These toads are found in several terrestrial habitat types, including agroecosystems and urban areas, in the *Cerrado*, the Atlantic Forest, and the *Chaco* (Stuart et al., 2008; Duré et al., 2009; Motte et al., 2009; Batista et al., 2011). In the *Chaco*, members of the family Bufonidae feed mainly on ants (Formicidae) and beetles

(Coleoptera), and the latter is the most commonly reported prey item in the diet of *R. diptycha* (Duré et al., 2009). The most important food for *R. diptycha* in the *Cerrado* is the larvae of Coleoptera and Formicidae (Batista et al., 2011).

Consumption of decapod crustaceans, such as crabs, by large frogs has been recorded for *Lithobates catesbeianus* (Vrcibradic et al., 2017), *Leptodactylus latrans* (Oliveira et al., 2009; Pazinato et al., 2011), and *Pipa pipa* (Alves-Pinto et al., 2014) but never for any member of the Bufonidae. Decapods share semi-aquatic habits and habitats with frogs, which may result in interspecific interactions including predation. Crabs, in particular, are commonly found sheltering and foraging in underwater vegetation, including flooded grasslands, during the Pantanal flood pulse (Rosa et al., 2009) and among water macrophytes in perennial ponds and creeks during the dry season (Mansur et al., 2005). Even though these animals often use similar microhabitats, there has hitherto been no record of decapod predation by *R. diptycha*.

Materials and Methods

During biodiversity research conducted in the dry season in the Pantanal (August–November 2017), we collected anurans on the banks of the Paraguay River at three sampling sites (ca. 16.3308°S, 57.7640°W; 16.7008°S, 57.8468°W; 16.8651°S, 57.5534°W) in Cáceres Municipality, Mato Grosso State, Brazil (Fig. 1). These observations were made in an area that includes part of the Taiaimã Ecological Station (TES), where little is known about the local herpetofauna (ICMBio, 2017; Silva-Alves et al., 2019). At each site we installed four sampling points, two on each side of the river, and only in TES all sampling points were installed in a protected

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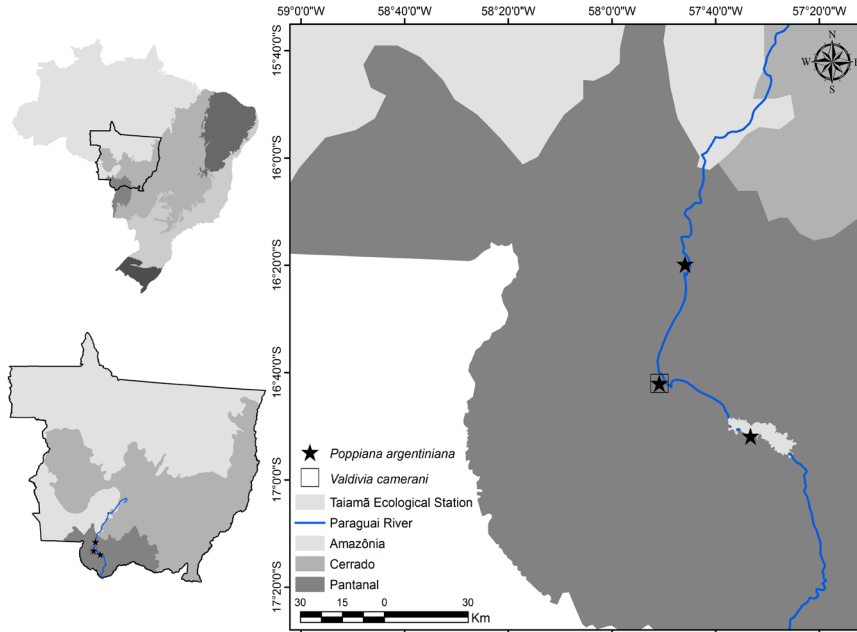


Figure 1. Study area and localities where *Poppiana argentiniana* and *Valdivia camerani* were consumed by *Rhinella diptycha* in the Pantanal ecoregion of Mato Grosso State, Brazil.

area. At each sampling point, three sets of pitfall traps were installed in seasonally flooded riparian forests along the river's margins. The traps were checked daily in the morning for ten consecutive days.

We euthanised trapped animals using an injection of 2% lidocaine hydrochloride (Xylestesin®) and fixed them in 10% formalin. Specimens were preserved in 70% ethanol and deposited in the collection of the Centro de Pesquisa de Limnologia, Biodiversidade, Etnobiologia do Pantanal (CELBE-A), at the Universidade do Estado de Mato Grosso (UNEMAT). We measured snout–vent lengths (SVL) using digital callipers (Digimess 100, 174BL). We removed the stomach of specimens through a ventral incision to analyse the stomach content, and we examined specimens' gonads to determine sex. We sorted food items using a stereomicroscope and then stored the prey separately in tubes containing 70% ethanol. Crabs were identified following the identification manual of Magalhães (2003).

Results and Discussion

The sampling effort totalled 1440 bucket-nights, during which we captured 65 individuals of *R. diptycha*. A total of 12 identifiable crabs were found in the

stomachs of nine adult *R. diptycha*. Crabs at advanced stages of digestion were not identifiable and not counted. Parts of one individual of *Valdivia camerani* were found in one adult male *R. diptycha* (SVL 132 mm) and individuals of *Poppiana argentiniana* were found in the stomachs of five females (mean SVL 165.6 ± 6.9 mm) and three adult males (mean SVL 134.7 ± 2.0 mm) (Figs. 1, 2).

Given that there had not been any records of crabs in the diet of *R. diptycha* hitherto, we consider an incidence of 9 out of 65 (14%) a relatively high frequency, indicating that this observation is not merely coincidental or unique to a single individual. The presence of crabs may be instead reflect opportunistic feeding related to the high abundance of crabs in flooded environments in the study region (Rosa *et al.*, 2009). Other studies on the diet of *R. diptycha* (Duré *et al.*, 2009; Batista *et al.*, 2011; Gavira *et al.*, 2013) crustaceans were not reported. We observed that among females only individuals ready to reproduce (i.e., with high numbers of oocytes) consumed crabs, and feeding on crabs in that situation may be related to the physiological need for a greater energy requirement. This relationship of reproductive females consuming larger prey was also observed in *Ameerega flavopicta* (Biavati *et al.*, 2004).

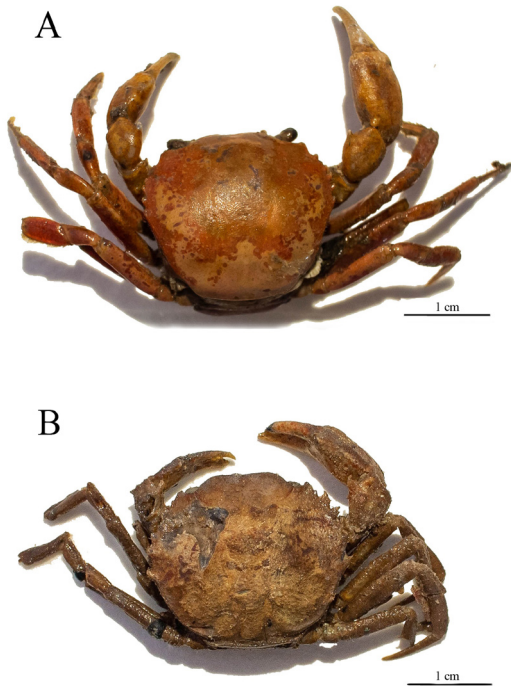


Figure 2. Crabs found in stomachs of *Rhinella diptycha* in the region of Cáceres, Pantanal Mato-Grossense. (A) *Poppiana argentiniana* and (B) *Valdivia camerani*. Photos by Derick Victor de Souza Campos.

Rhinella diptycha is a terrestrial anuran with opportunistic and generalist feeding behaviour (Duré et al., 2009; Batista et al., 2011). Our observations may point to additional, hitherto unknown, trophic interactions, possibly affected by the flooding of the Pantanal. These findings may also be important to the management plan of Taiaimã Ecological Station, and are relevant to the monitoring of Pantanal's fauna.

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References

- Alves-Pinto, H.N., Verdade, V.K., Rodrigues, M.T. (2014): Morphometric variation of *Pipa pipa* (Linnaeus, 1758) (Anura: Pipidae) with notes on diet and gonad development. *Herpetology Notes* 7: 347–353.
- Batista, R.C., Brito-De-Carvalho, C., Freitas, E.B., Franco, S.C., Batista, C.C., Coelho, W.A., Faria, R.G. (2011): Diet of *Rhinella schneideri* (Werner, 1894) (Anura: Bufonidae) in the Cerrado, Central Brazil. *Herpetology Notes* 4: 17–21.
- Biavati, G.M., Wiederhecker, H.C., Colli, G.R. (2004): Diet of *Epipedobates flavopictus* (Anura: Dendrobatidae) in a Neotropical savanna. *Journal of Herpetology* 38: 510–518.
- Duré, M.I., Kehr, A.I., Schaefer, E.F. (2009): Niche overlap and resource partitioning among five sympatric bufonids (Anura, Bufonidae) from northeastern Argentina. *Phyllomedusa* 8: 27–39.
- Frost, D.R. (2019): *Amphibian Species of the World*. American Museum of Natural History, New York, USA. Version 6.0. Available at: <http://research.amnh.org/herpetology/amphibia/index.html>. Accessed on 22 July 2019.
- Gavira, R.S.B., Bovo, R.P., Andrade, D.V. (2013): Natural history notes. *Rhinella schneideri* (Cururu toad). Diet. *Herpetological Review* 44: 657.
- Instituto Chico Mendes de Conservação da Biodiversidade – ICMBio (2017): Plano De Manejo da Estação Ecológica de Taiaimã. Ministério de Meio Ambiente, BRASÍLIA. Available at: http://www.icmbio.gov.br/portal/images/stories/plano-de-manejo/plano_de_manejo_esc_taiaima_vs_070617.pdf. Accessed on 10 May 2018.
- Magalhães, C. (2003): Família: Pseudothelphusidae e Trichodactylidae. In: Manual de Identificação dos Crustáceos Decápodos de Água Doce Brasileiros, p. 143–297. Melo, G.A.S., Ed., São Paulo, Brazil, Edições Loyola.
- Mansur, C.B., Hebling, N.J., Souza, J.A. (2005): Crescimento relativo de *Dilocarcinus pagei* Stimpson, 1861 e *Sylviocarcinus australis* Magalhães & Türkay, 1996 (Decapoda: Trichodactylidae) no Pantanal do Rio Paraguai, Porto Murtinho, Mato Grosso do Sul. *Boletim do Instituto de Pesca* 31(2): 103–107.
- Martins, C.A., Roque, F.O., Santos, B.A., Ferreira, V.L., Strüßmann, C., Tomas, W.M. (2015): What shapes the phylogenetic structure of anuran communities in a seasonal environment? The influence of determinism at regional scale to stochasticity or antagonistic forces at local scale. *PLoS ONE* 10(6): e0130075.
- Motte, M., Núñez, K., Cacciali, P., Brusquetti, F., Scott, N., Aída Luz Aquino, L.A. (2009): Categorización del estado de conservación de los anfibios y reptiles de Paraguay. *Cuadernos de Herpetología* 23(1): 5–18.
- Oliveira, S.V., Trindade, A.O., Pazinato, D., Ribeiro, L., Cappellari, L.H. (2009): Registro de *Trichodactylus panoplus* (Crustacea, Decapoda) na dieta de *Leptodactylus latrans* (Anura, Leptodactylidae), no sul do Brasil. *Biodiversidade Pampeana* 7(1): 44–46.
- Pacheco, E.O., Ferreira, V.G., Carvalho, R.M.H. (2017): Diet of *Boana albopunctata* (Anura: Hylidae) in an Atlantic Forest fragment of southeastern Brazil. *Phyllomedusa* 16(1): 57–62.

- Pazinato, D.M.M., Trindade, A.O., Oliveira S.V., Cappellari, L.H. (2011): Dieta de *Leptodactylus latrans* (Steffen, 1815) na Serra do Sudeste, Rio Grande do Sul, Brasil. *Biotemas* **24**(4): 147–151.
- Pramuk, J.B. (2006): Phylogeny of South American *Bufo* (Anura: Bufonidae) inferred from combined evidence. *Zoological Journal of the Linnean Society* **146**(3): 407–452.
- Rosa, F.R., Lopes, I.R., Sanches, V.Q.A., Rezende, E.K. (2009): Distribuição de caranguejos Trichodactylidae (Crustacea, Brachyura) em alagados do Pantanal Mato-Grossense (Brasil) e sua correlação com a proximidade do rio Cuiabá e cobertura vegetal. *Papéis Avulsos de Zoologia* **49**(24): 311–317.
- Silva-Alves, V.D., D'Ávila, R.S., Costa, T.M., Barbosa, A.P.D., Brum, B.R., Silva, C.P.A., et al. (2019): Geographic range extension of *Elachistocleis corumbaensis* Piva, Caramaschi & Albuquerque, 2017 (Anura, Microhylidae) with new records in ecotonal zones in the state of Mato Grosso, Brazil. *Check List* **15**(1): 17–20.
- Souza, F.L., Prado, C.P.A., Sugai, J.L.M.M., Ferreira, V.L., Aoki, C., Landgraf-Filho, P., et al. (2017): Diversidade de anfíbios do Estado de Mato Grosso do Sul, Brasil. *Iheringia, Série Zoologia* **107** (Supplement): e2017152.
- Stuart, S., Hoffmann, M., Chanson, J., Cox, N., Berridge, R., Ramani, P., Young, B. (Eds.) (2008): *Threatened Amphibians of the World*. IUCN, Gland, Switzerland, Lynx Edicions.
- Vrcibradic, D., Diaz, A., Cosendey, B.N., Nascimento, B.B., Borges-Júnior, V.N.T. (2017): *Trichodactylus dentatus* (Crustacea, Decapoda, Trichodactylidae) and other prey of a large adult of the exotic American bullfrog, *Lithobates catesbeianus* (Ranidae), caught in a disturbed habitat in southeastern Brazil. *Herpetology Notes* **10**: 375–378.