

SHORT NOTE

Defensive Behavior in *Rhinella bergi* and *Rhinella mirandaribeiroi* (Anura: Bufonidae)

Comportamiento defensivo en *Rhinella bergi* y *Rhinella mirandaribeiroi* (Anura: Bufonidae)

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- Received: 09/Aug/2020
- Accepted: 06/Sep/2021
- Online Publishing: 08/Sep/2021

Citation: Nehemy IKR, Mângia S, Carvalho PS, Santana DJ. 2022. Defensive Behavior in *Rhinella bergi* and *Rhinella mirandaribeiroi* (Anura: Bufonidae). *Caldasia* 44(3):648-652. doi: <https://doi.org/10.15446/caldasia.v44n3.89189>

ABSTRACT

Here we report two cases of defensive behavior known as “stiff-legged”, unprecedented for the species *Rhinella bergi* and *R. mirandaribeiroi*. We registered the behavior at localities in Mato Grosso do Sul and Minas Gerais states, Brazil. With our records, there are now five species from open areas that exhibit this behavior. We assume that the species that inhabit these areas exhibit this avoiding predation behavior simulating a dead body on the ground, behavior known as “death feigning”, unlike forest species, which use this strategy to camouflage themselves between the leaves.

Keywords: Amphibians, defensive strategy, stiff-legged posture.

RESUMEN

Reportamos aquí dos casos de comportamiento defensivo conocido como “stiff-legged”, sin precedentes para las especies *Rhinella bergi* y *R. mirandaribeiroi*. Los registros se realizaron en localidades de los estados de Mato Grosso do Sul y Minas Gerais, Brasil. Con nuestros registros, ahora hay cinco especies de áreas abiertas que exhiben este comportamiento. Asumimos que las especies que habitan estas áreas despliegan este comportamiento que evita la depredación simulando un cadáver en el suelo, comportamiento conocido como “fingir la muerte”, a diferencia de las especies forestales, que utilizan esta estrategia para camuflarse entre las hojas.

Palabras clave: Anfibios, estrategia defensiva, postura “stiff-legged”.

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Anurans exhibit several defensive behaviors, including sound emission (*e.g.* release calls and agonistic calls) and visual displays, such as thanatosis and stiff-legged (Duellman and Trueb 1986, Toledo *et al.* 2011). The last one is characterized by a posture with the legs stiff and back extended, remaining the individual static in this position for a few minutes after the disturbance caused by a potential predator (Sazima 1978, Schlüter and Salas 1991, Bertolucci *et al.* 2007).

This behavior is mainly known for groups that inhabit forests: species of the genera *Proceratophrys*, *Macrogenioglottus*, *Odontophrynus* (Odontophrynidae), *Scythrophrys* (Leptodactylidae), *Arcovomer*, and *Ctenophryne* (Microhylidae) (Toledo and Zina 2004, Menin and Rodrigues 2007, Giaretta and Martins 2009, Maffei and Ubaid 2016, Mira-Mendes *et al.* 2016, Rolim 2017, Borteiro *et al.* 2018). However, the stiff-legged behavior was also recorded for species that are typical of non-forested environments, such as the toads *Rhinella granulosa* (Spix, 1824) and *R. pygmaea* (Myers and Carvalho, 1952) (Mângia and Santana 2013, Figueiredo-de-Andrade and Silveira 2018), both from the *R. granulosa* species group (Narvaes and Rodrigues 2009). In this note, we report two cases of stiff-legged behavior in additional species of the *R. granulosa* species group.

On 23 November 2017, we observed a male individual of *Rhinella bergi* (Céspedes, 2000) in a Chacoan area, in the Porto Murtinho municipality (21°41 South, 57°44 West), Mato Grosso do Sul state, Brazil. When we handled the specimen, at approximately 21:00h, it exhibited the stiff-legged defensive behavior (Fig. 1a). Right after we placed the individual on the floor, it continued exhibiting the behavior, keeping the hind limbs stretched and back extended, with the body flattened dorso-ventrally. The second record was registered on 19 December 2018, in the São Gonçalo do Pará municipality (19°59 South, 44°51 West), Minas Gerais state, Brazil. We collected a male individual of *R. mirandaribeiroi* (Gallardo, 1965), which exhibited the same stiff-legged behavior, while being handled (Fig. 1b). We collected both specimens and housed at the Zoological Collection of the Federal University of Mato Grosso do Sul (ZUFMS-AMP13336; ZUFMS-AMP13283; collection permits: SISBio 45889-1).

The defensive stiff-legged behavior is usually combined with the anuran cryptic coloration resembling dead leaves (Toledo *et al.* 2011). Nevertheless, both species recorded in the present study have terrestrial habits and inhabit open areas (Narvaes and Rodrigues 2009). *Rhinella bergi* occurs in Chaco regions of Paraguay, northwestern Argentina and Mato Grosso do Sul in Brazil (Céspedes 2000), while *R. mirandaribeiroi* occurs in Cerrado areas

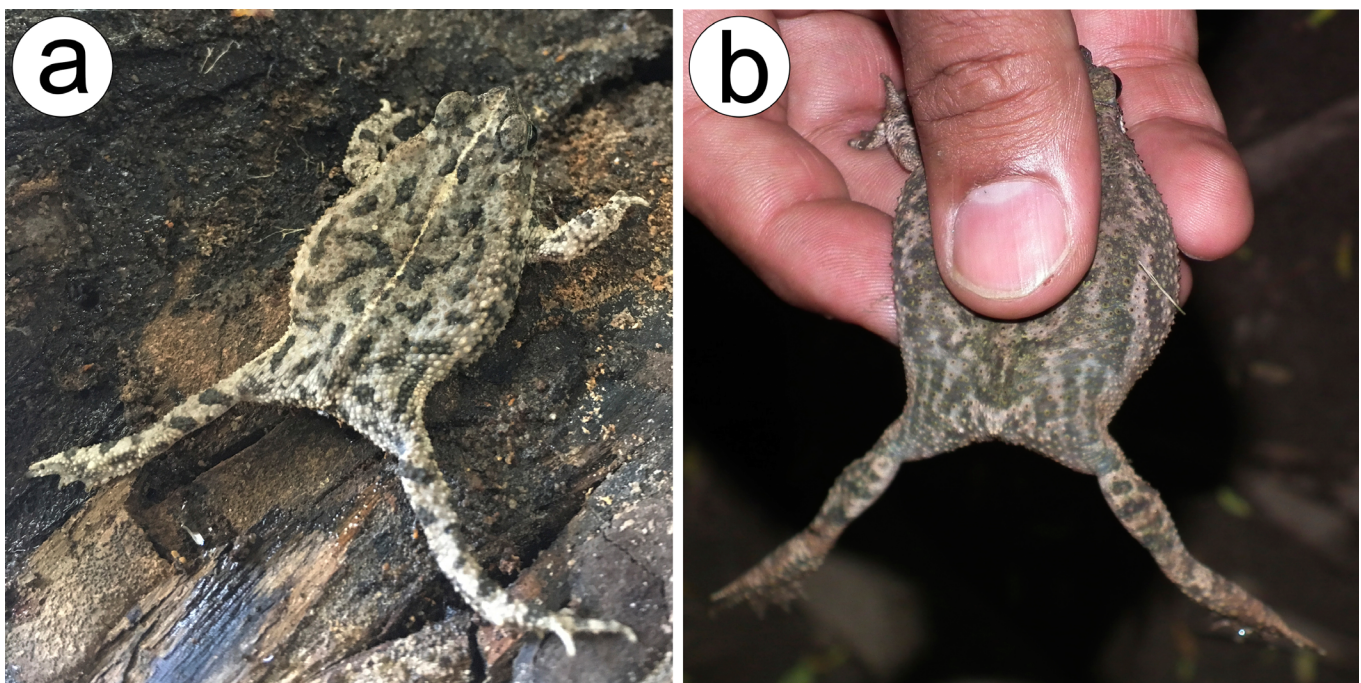


Figure 1. Specimens of *Rhinella* displaying stiff-legged behavior. **a** Adult male of *Rhinella bergi* (MAP4018), captured in Porto Murtinho municipality, Mato Grosso do Sul state, Brazil. **b** Adult male of *Rhinella mirandaribeiroi* (MAP5768), captured in São Gonçalo do Pará municipality, Minas Gerais state, Brazil.

Table 1. Records of stiff-legged behavior for Brazilian anuran species from forest environments and open areas.

Taxon	Habitat	References
Bufonidae		
<i>Dendrophryniscus berthaltutzae</i> Izecksohn, 1994	Forest-floor	Toledo et al. 2011
<i>Dendrophryniscus brevipollicatus</i> Jiménez de la Espada, 1870	Forest-floor	Bertoluci et al. 2007
<i>Dendrophryniscus carvalhoi</i> Izecksohn, 1994	Forest-floor	Cassimiro et al. 2010
<i>Dendrophryniscus leucomystax</i> Izecksohn, 1968	Forest-floor	Bertoluci et al. 2007
<i>Rhinella bergi</i> (Céspedes, 2000)	Open areas	Present study
<i>Rhinella granulosa</i> (Spix, 1824)	Forest-floor	Mângia and Santana 2013
<i>Rhinella marina</i> (Linnaeus, 1758)	Open areas	Ferrante et al. 2020
<i>Rhinella mirandaribeiroi</i> (Gallardo, 1965)	Open areas	Present study
<i>Rhinella pygmaea</i> (Myers and Carvalho, 1952)	Open areas	Figueiredo-de-Andrade and Silveira 2018
Craugastoridae		
<i>Euparkerella cochranae</i> Izecksohn, 1988	Forest-floor	Toledo et al. 2011
Cycloramphidae		
<i>Cycloramphus parvulus</i> (Girard, 1853)	Forest-floor	Rocha et al. 1998
Leptodactylidae		
<i>Paratelmatoobius poecilogaster</i> Giaretta and Castanho, 1990	Forest-floor	Toledo et al. 2011
<i>Physalaemus gracilis</i> (Boulenger, 1883)	Forest-floor	Rocha and Martins 2013
<i>Pleurodema bibroni</i> Tschudi, 1838	Forest-floor	Kolenc et al. 2009
<i>Scythrophrys sawayae</i> (Cochran, 1953)	Forest-floor	Garcia 1999
Microhylidae		
<i>Arcovomer passarellii</i> Carvalho, 1954	Forest-floor	Giaretta and Martins 2009
<i>Chiasmocleis ventrimaculata</i> (Andersson, 1945)	Forest-floor	Schlüter and Salas 1991
<i>Ctenophryne geayi</i> Mocquard, 1904	Forest-floor	Schlüter and Salas 1991, Menin and Rodrigues 2007
<i>Microhyla berdmorei</i> (Blyth, 1856)	Forest-floor	Shahrudin 2014
<i>Stereocyclops incassatus</i> Cope, 1870	Forest-floor	Tonini et al. 2011
<i>Stereocyclops parkeri</i> (Wettstein, 1934)	Forest floor	Sazima 1978
Odontophrynidae		
<i>Macrogenioglottus alipioi</i> Carvalho, 1946	Forest floor	Mira-Mendes et al. 2016
<i>Odontophrynus americanus</i> (Duméril and Bibron, 1841)	Open areas	Maffei and Ubaid 2016, Rolim 2017, Borteiro et al. 2018
<i>Proceratophrys appendiculata</i> (Günther, 1873)	Forest floor	Sazima 1978
<i>Proceratophrys boiei</i> (Wied-Neuwied, 1824)	Forest-floor	Toledo and Zina 2004, Costa et al. 2009
<i>Proceratophrys mantiqueira</i> Mângia, Santana, Cruz and Feio, 2014	Forest-floor	Moura et al. 2010 (cited as <i>P. melanopogon</i>)
<i>Proceratophrys melanopogon</i> (Miranda-Ribeiro, 1926)	Forest-floor	Toledo et al. 2011
<i>Proceratophrys moehringi</i> Weygoldt and Peixoto, 1985	Forest-floor	Weygoldt 1986
<i>Proceratophrys renalis</i> (Miranda-Ribeiro, 1920)	Forest-floor	de Amorim Peixoto-M et al. 2013, Peixoto et al. 2013

of Brazil, in the Noel Kempff National Park, Bolivia, and in Cerrado enclaves within the Amazon Forest (Narvaes and Rodrigues 2009, Melo *et al.* 2013).

Our records add up to five species of open areas exhibiting this defensive strategy (Maffei and Ubaid 2016, Rolim 2017, Borteiro *et al.* 2018, Figueiredo-de-Andrade and Silveira 2018, Ferrante *et al.* 2020) (Table 1). Mira-Mendes *et al.* (2016) demonstrated the occurrence of this behavior for 23 forest-floor species. Although *Pleurodema bibroni* Tschudi, 1838 is categorized as a species from the forest-floor in the Mira-Mendes *et al.* (2016) study, Kolenc *et al.* (2009) showed that this species also inhabits non-forested environments, suggesting that *P. bibroni* exhibit the stiff-legged behavior as death feigning function, rather than camouflage.

In total, 29 anuran species from six families show the stiff-legged behavior, with the family Bufonidae having the largest number of species that exhibit this defensive strategy (n=9), from which four species are from open areas (Table 1). Forest species that exhibit the stiff-legged behavior use this strategy to camouflage themselves among the leaves, once they present cryptic coloration, thus avoiding predation (Sazima 1978). With this, we can assume that the species of open areas perform stiff-legged behavior to look like dead body on the ground (death feigning).

AUTHOR'S CONTRIBUTION

IKRN and PSC design and writing; SM and DJS obtaining data, descriptions and photographs. All authors reviewed drafts of the paper and approved the final draft.

ACKNOWLEDGMENTS

We are grateful to the reviewers of the manuscript, who made detailed observations that contributed to the improvement of the grade. IKRN thanks Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPQ) for his scholarship (CNPq 133940/2020-9). DJS thanks Conselho Nacional de Desenvolvimento Científico e Tecnológico for his research fellowship (CNPq 309420/2020-2). PSC thanks Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES Finance Code 001)

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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