ZOOLOGIA 28 (1): 142–144, February, 2011
doi: 10.1590/S1984-46702011000100021

SHORT COMMUNICATION

An unusual reproductive mode in *Hypsiboas* (Anura: Hylidae)

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ABSTRACT. We report an unusual reproductive behavior of *Hypsiboas pardalis* (Spix, 1824). Species belonging to this genus usually are known to reproduce in lentic water bodies, with the development of exotrophic tadpoles. Herein, the bromeligenous behavior is reported for the first time in *Hypsiboas* Wagler, 1830. Although this reproductive behavior has been observed more than once here, we believe that it is not typical of *Hypsiboas*, being better characterized as an unusual reproductive mode for *Hypsiboas*, indicating the presence of plasticity in the reproductive modes of *H. pardalis*.

KEY WORDS. Amphibians; behavior; bromeliads; reproductive mode.

The concept of reproductive mode in amphibians can be defined as a combination of traits that include oviposition site, ovum and clutch characteristics, rate and duration of development, stage and size of hatchling, and type of parental care, if it occurs (Salthe & Duellman 1973). Some reproductive modes in anurans are associated with tree holes or aerial plants as bromeliads (Haddad & Prado 2005). The bromeliads are considered a relatively safe habitat for tadpoles and spawns, compared to puddles and streams, where competitors and predators are more abundant (Lehtinen *et al*. 2004). Brazilian species of at least eight anuran genera are known to breed in bromeliads: C*rossodactylodes*, *Dendrophryniscus*, *Flectonotus*, *Gastrotheca*, *Melanophryniscus*, *Phyllodytes*, *Physalaemus* and *Scinax* (Cruz & Peixoto 1985, Peixoto 1995, Haddad & Pombal 1998, Langone *et al*. 2008).

In *Hypsiboas* Wagler, 1830 (Hylidae) two reproductive modes are known: mode 1, in which the eggs are deposited in lentic water, with exotrophic tadpoles; and mode 4, characterized by the deposition of eggs in natural or constructed basins, with subsequent flooding and the release of exotrophic tadpoles into ponds or streams (sensu Haddad & Prado 2005). *Hypsiboas pardalis* (Spix, 1824) is a large sized treefrog included in the *H. faber* group (Faivovich *et al*. 2005). This species inhabits water bodies in forested and open habitats in the Atlantic Forest of southeastern Brazil, in the states of Minas Gerais, Espírito Santo, Rio de Janeiro, and São Paulo (Caramaschi & Napoli 2004). It is relatively common at the Serra do Brigadeiro State Park, municipality of Araponga, state of Minas Gerais, Brazil, and frequently observed calling on tree trunks, next to ponds and swamps (Feio *et al*. 2008).

On 8 November 2009, during an anuran survey at the Serra do Brigadeiro State Park (20º43'19"S, 42º28'43"W, datum SAD1969, 1320 m above sea level), at around 21:00 h, we observed an adult male of *H. pardalis* calling inside an *Alcantarea extensa* (L.B. Smith) J.R. Grant, a giant tank bromeliad (Pertel *et al*. 2006), located approximately one meter away from a stream in an open field. These terrestrial bromeliads are frequently found on the ground throughout the Serra do Brigadeiro State Park. *Alcantarea extensa* occurs naturally at the Serra do Brigadeiro, being more common at rocky outcrops, where it can be found at high densities (tens to hundreds of individuals), as well as on the banks of streams and along margins of temporary ponds, although at lower densities. This species is also used for ornamental purposes, found near the park's administrative buildings (Lacerda *et al*. 2009). A month later, on 7 December 2009, we observed approximately 40 tadpoles in the same plant, living inside two leaf-tanks located at the base of the bromeliad (Fig. 1). On this occasion, we tried to collect some tadpoles by bending down the leaf of the bromeliad to pour the water of the leaf-tank inside a plastic bag. As a result, most of the tadpoles swam down to the base of the leaf-tank and we collected only four tadpoles, which were in stage 26 of Gosner (1960). Three of them were reared in an aquarium (30x15x20 cm) until they completed metamorphosis, 50-53 days later (Fig. 2). One of the tadpoles collected and the other three which completed metamorphosis were deposited in the herpetological collection of the Museu de Zoologia João Moojen, Universidade Federal de Viçosa, municipality of Viçosa, state of Minas Gerais, Brazil (*H. pardalis*, MZUFV 167). Between January 15 and 19, 2010, we did not find the remaining tadpoles inside that bromeliad at the Serra do Brigadeiro State Park. But on 21 February 2010, we found one stage 40 *H. pardalis* tadpole (MZUFV 191) occupying the same leaf-tank of the same bromeliad, 76 days after the first observation. Most likley, the

tadpoles' behavior, of remaining hidden in the leaf-tank, prevented us from observing them. Still in February and also in March 2010, we observed many *H. pardalis* tadpoles (MZUFV 215) at the stream next to the bromeliad, living in low water flow areas, indicating that this species also uses lotic water environments for reproduction. Another group of about 15 tadpoles was found on 20 April 2010, living in a nearby bromeliad, distant about two meters away from the first. Seven tadpoles were collected, apparently in earlier stages of development, and were also reared in an aquarium until they completed metamorphosis, 90-95 days later (MZUFV 219). Additionally, it is possible that water storage capacity in the bromeliads does not support the development of many *H. pardalis* tadpoles. Therefore, we believe that few tadpoles could complete metamorphosis, but at a lower development rate.

The *H. pardalis* tadpole is characterized by having an oval body (in dorsal view), dorsal and laterally directed eyes, a row of uniseriate marginal papillae, 2(2)/3(1) tooth row formula, brown body and tail musculature, with transverse darker brown bands on dorsum of the tail musculature. These traits were observed in the tadpole specimens which were fixed before metamorphosis. After metamorphosis, the juvenile is easily distinguished by its general pale-yellow color with several brown-red dots on dorsal surfaces of body and limbs (Bokermann 1968) (Fig. 2).

The egg deposition in the water of tree holes or aerial plants and with the development of exotrophic tadpoles is known as reproductive mode 6 (Haddad & Prado 2005). However, the reproductive mode reported herein for *H. pardalis* presents differences related to location of the bromeliad, since it is terrestrial. Another similar reproductive mode associated with terrestrial bromeliads has been reported for some leiuperid species of *Physalaemus*, which deposit foam nests on water accumulated inside leaf-axils of the bromeliads (mode 14) (Cruz & Peixoto 1985, Haddad & Pombal 1998). In this case, the differences between this mode and the mode reported here is related to the clutch features, since in *Physalaemus* the eggs are deposited in foam nests (Haddad & Pombal 1998) while in *H. pardalis* the eggs are deposited as films directly on the water surface (Lutz 1960, Bokermann 1968). This type of reproductive association between anurans and terrestrial bromeliads (i.e. calling and oviposition inside bromeliads) has already been reported for some anuran species – e.g. *Scinax arduous* Peixoto, 2002, *Crossodactylodes izecksohni* Peixoto, 1983, *Flectonotus fissilis* (Miranda Ribeiro, 1920), *Scinax* sp. *perpusillus* group) – (Peixoto 2002, Pertel *et al.* 2006, Feio *et al.* 2008, Lacerda *et al.* 2009), even though it is not listed among the thirty nine modes reported in the last revision of anuran reproductive modes (Haddad & Prado 2005).

Natural variation in oviposition sites may reflect plasticity in the behavioral response of anurans to different environment conditions (Wells 2007, Touchon & Warkentin 2008). The plasticity of reproductive modes is rarely reported, perhaps because it has been considered a fixed behavior (Touchon & Warkentin 2008). For example, species that construct basins in which eggs are laid (mode 4), essentially do not differ in any way in their egg and larval development from many anurans with mode 1. Consequently, they sometimes will place eggs in natural rock pools or streams (Wells 2007). This was already verified for the nest-building gladiator frog *H. faber* by Haddad & Prado (2005). According to these authors, when the water level rises so that muddy banks are not available for males to construct their nests (mode 4), the eggs are deposited as a surface film in ponds (mode 1). A similar plasticity in the reproductive

Figures 1-2. (1) Tadpoles of *H. pardalis* living inside a leaf-tank of a bromeliad at Serra do Brigadeiro State Park, municipality of Araponga, state of Minas Gerais, Brazil. (2) A froglet of *H. pardalis*, from a tadpole which metamorphosed 50 days after being collected (MZUFV 167).

mode behavior can be observed for *H. pardalis*. Although its reproductive mode is defined as mode 4 (sensu Haddad & Prado 2005), Lutz (1960) pointed as unknown whether building nests has become an obligatory feature for the oviposition in this species. The non-mandatory building of nests has already been reported for *H. pardalis* by other authors (e.g. Bokermann 1968, Feio *et al*. 2008). According to Wells (2007), some anuran species that usually are pond-breeders may eventually place their eggs in quiet stream pools. In fact, this was observed herein for *H. pardalis*. Therefore, we believe that the reproductive mode reported herein is better characterized as an unusual reproductive mode for the genus *Hypsiboas*, indicating the presence of plasticity in the reproductive mode of *H. pardalis*.

ACKNOWLEDGMENTS

We thank the two anonymous referees for the valuable comments on this manuscript. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) and Instituto Estadual de Florestas (IEF) for collection permits (IBAMA 20857-1, IEF 071/09). Universidade Federal de Viçosa for logistical support. Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for financial support. Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for fellowships granted to MRM and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for fellowships granted to APM.

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Submitted: 10.III.2010; Accepted: 26.XI.2010.
Editorial responsibility: Mauricio O. Moura