SALAMANDRA **58**(1): 71–75
15 February 2022 | ISSN 0036–3375

SALAMANDRA
German Journal of Herpetology

Correspondence

Description of the tadpole of *Phyllodytes amadoi* (Anura: Hylidae) from its type locality in Bahia, Brazil

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Manuscript received: 16 February 2021
Accepted: 5 December 2021 by Arne Schulze

Phyllodytes Wagler, 1830 is a monophyletic genus within the hylid tribe Lophyohylini, endemic to the Atlantic rainforest and adjacent Caatinga areas of eastern Brazil, comprising 15 described species (Dias et al. 2020). Knowledge on diversity within *Phyllodytes* is dynamically growing as new species have been described in the past few years (e.g., Marciano et al. 2017, Vörös et al. 2017, Orrico et al. 2018, Dias et al. 2020), and an increasing number of loci were used for more precise analyses (Blotto et al. 2020). Several undescribed species may further shape the phylogenetic relationships within the genus (Blotto et al. 2020). Besides helping to recognize cryptic amphibian diversity (Grosjean et al. 2015), larval identification provides essential information to the taxonomy of amphibians (Blotto et al. 2020). Within *Phyllodytes*, larvae have been described for 10 species (Magalhães et al. 2015, Santos et al. 2019, Dias et al. 2020), while tadpoles of *P. maculosus*, *P. megatympanum*, *P. kautskyi*, *P. punctatus* and *P. amadoi* remain unknown. For comparison of skeletal morphology of tadpoles within the ten species see Vera Candioti et al. (2016) and Da Mota et al. (2020). In the present paper we describe the external morphology of *Phyllodytes amadoi* Vörös, Dias & Solé, 2017.

We collected six tadpoles of stages ranging between 25–30 (sensu Gosner 1960) at the Private Reserve of Natural Heritage Ararauna in the municipality of Una, State of Bahia, Brazil, which is the type locality of *Phyllodytes amadoi* (15°18'38.3" S, 39°9'55.9" W, WGS84, 96 m a.s.l.) (Vörös et al. 2017), on the 17th October 2019. Adults of *P. amadoi* were spotted in the same bromeliads. Considering that only two *Phyllodytes* species – *P. amadoi* and *P. melanomystax* – inhabit the area and the tadpole of *P. melanomystax* has already been described (Caramaschi et al. 1992), we assumed that the collected tadpoles belong to *P. amadoi*. Furthermore, in the area, *P. melanomystax* occupies tanks of bromeliads located high up on the trunks of large trees, while *P. amadoi* typically breeds in terrestrial or small epiphytic bromeliads in lower parts of the trunks of trees. Specimens were transported to the Tropical Herpetology Lab of the Universidade Estadual de Santa Cruz (UESC), Bahia, Brazil, and were examined and measured. After processing they were deposited at the Collection of Amphibians and Reptiles of the Museu de Zoologia da UESC (MZUESC) (Catalogue numbers: MZUESC 22073–22078). The following parameters were measured using a Leica S9I Stereo Microscope (Leica, Wetzlar, Germany): Total length (TL), Body length (BL), Body width (BW), Width of tail musculature (WTL), Body height (BH), Dorsal fin height (DFH), Height of tail musculature (HTL), Ventral fin height (VFH), Interorbital distance (IOD), Internarial distance (IND), Eye–snout distance (ESD), Nare–snout distance (NSD), Eye diameter (ED) and Nare diameter (ND) following Altig & McDiarmid (1999).

External morphology (based on one tadpole, TD4, Gosner stage 26, Fig. 1.): The body is oval in dorsal and ventral views (Fig. 1A, C) and depressed (shallow ellipse) in lateral view (Fig. 1B). Snout rounded in dorsal, ventral and lateral views. BL corresponds to the 38% of TL. The eyes are small, positioned dorsally and oriented dorsolaterally. ED corresponds to 15.7% of BW and IOD corresponds to 58.8% of BW. Nares are small (ND/IND = 4.6%), oval, with anterolateral openings, located closer to the snout than to the eyes (NSD > ESD). Short and sinistral spiracle located in the centre of the body, below the midline of the body height. Spiracle is cylindrical, opening is rounded and dorso-posteriorly directed, with its internal wall fused to the body wall. The vent tube opening is dextral, rounded and directed posteriorly with its in-

ner wall being attached to the ventral fin. The dorsal fin is arched and emerges on the body just before the body–tail junction. The ventral fin is lower than dorsal fin and originates at the posterior ventral terminus of the body. The tail tip is rounded. The myotomes of the tail musculature are not strongly marked. Oral disc is ventral, not emarginated, surrounded by a single row of marginal papillae, alternated, with a wide dorsal gap (Fig. 2D). Submarginal and marginal papillae are rounded and interrupted dorsomedially in the anterior labium forming a wide gap. Labial tooth row formula (LTRF): 2(2)/2. Labial tooth row lengths are as follows: A1 = A2 > P1 = P2. Jaw sheaths serrated and completely keratinized; upper jaw sheath arc-shaped and lower jaw sheath U-shaped. For measurements see Table 1.

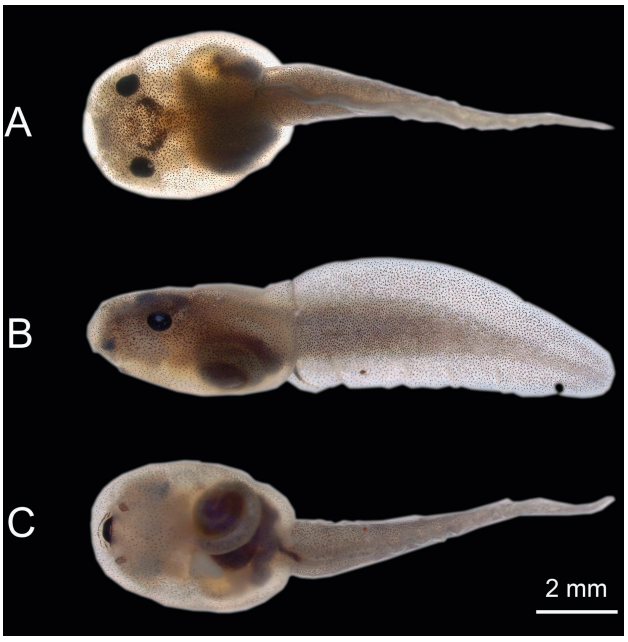

Figure 1. Tadpole of *Phyllodytes amadoi* (MZUESC 22076; Gosner stage 26 in (A) dorsal, (B) lateral and (C) ventral views.

Coloration: In life, tadpoles are greyish with a translucent skin and a darker grey pigmentation on both sides of the tail musculature. Fins are not or slightly pigmented. Dorsally the body is translucent with a grey triangle-shape marking between the eyes. Ventrally the body is translucent with the intestinal coils and two adhesive glands on both sides of the oral disc visible (Figs 2A, B, C.). In preservative the pigmentation of tail musculature fades and small dark spots covering the whole body become visible (Figs 1A, B, C).

Variation: Adhesive glands well visible in younger stages, disappearing at stage 30 (TD6).

Natural History Notes: We found tadpoles in the tanks of middle size terrestrial and small epiphytic bromeliads at 1–1,5 m height on the trunks of large trees in a regenerating forest along a small stream known as Rio Pimenta. One tadpole had eggs in its digestive tract.

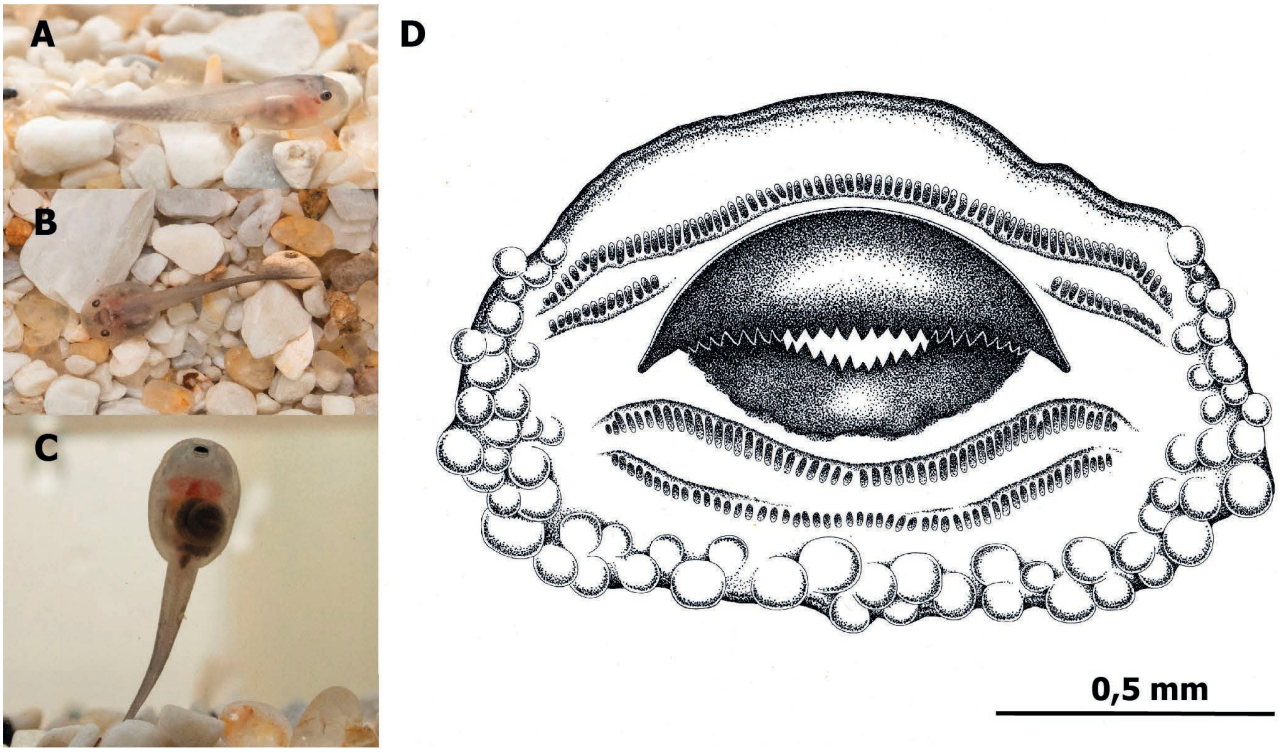

Figure 2. Photographs of a living *Phyllodytes amadoi* tadpole (MZUESC 22078, at Gosner stage 30 – TD1) in (A) lateral, (B) dorsal and (C) ventral views. (D) Drawing of the oral disc of the same specimen.

Table 1. Morphometric measurements (in mm) of six *Phyllodytes amadoi* tadpoles from Private Reserve of Natural Heritage Ararauna, municipality of Una, State of Bahia, Brazil.

	TD1 MZUESC 22073	TD6 MZUESC 22078	TD2 MZUESC 22074	TD4* MZUESC 22076	TD3 MZUESC 22075	TD5 MZUESC 22077	Mean (±SD)
Gosner stage	30	30	28	26	25	25	
Total length (TL)	19.29	17.25	16.63	13.66	10.92	9.10	13.92 (4.13)
Body length (BL)	6.48	5.78	5.69	5.19	3.70	2.89	4.95 (1.37)
Body width (BW)	4.09	5.04	4.28	3.73	3.22	2.44	3.80 (0.90)
Width of tail musculature (WTL)	1.16	1.76	1.55	1.30	0.89	0.61	1.21 (0.42)
Body height (BH)	2.78	3.03	3.19	2.80	2.47	1.77	2.67 (0.50)
Dorsal fin height (DFH)	0.20	1.25	0.81	1.04	0.80	0.68	0.79 (0.35)
Height of tail musculature (HTL)	1.79	1.79	1.91	1.32	0.95	0.89	1.44 (0.45)
Ventral fin height (VFH)	0.27	0.97	0.79	0.81	0.75	0.65	0.71 (0.23)
Interorbital distance (IOD)	2.31	2.34	2.06	2.19	1.41	1.25	1.93 (0.47)
Internasal distance (IND)	1.23	1.26	1.33	1.21	1.02	0.67	1.12 (0.24)
Eye–snout distance (ESD)	1.36	1.60	1.28	0.89	1.20	0.42	1.12 (0.41)
Nare–snout distance (NSD)	0.33	0.41	0.24	0.26	0.29	0.34	0.31 (0.06)
Eye diameter (ED)	0.87	0.82	0.62	0.58	0.45	0.38	0.62 (0.19)
Nare diameter (ND)	0.08	0.09	0.06	0.05	0.06	0.04	0.06 (0.01)

Comparison with tadpoles of other *Phyllodytes* species: *Phyllodytes amadoi* tadpole is the only among the known species of the genus with the labial tooth row formula 2(2)/2. However, we have to note here that in Santos et al. (2019), the presence of a second, probably a vestigial anterior labial tooth row of *P. praeceptor* tadpole is visible on Figure 2. If this applies to other *P. praeceptor* specimens, it would make this species similar to *P. amadoi*. Tail length (TL) of *P. amadoi* is the smallest among the *Phyllodytes* species, but older Gosner stage specimens may alter this pattern. Size (BL/TL) of *P. amadoi* is smaller than that of *P. acuminatus,* larger than that of *P. edelmoi*, *P. gyrinaethes, P. magnus*, *P. melanomystax and P. praeceptor*, and overlaps with *P. brevirostris* and *P. wuchereri*. Single row of marginal papillae (MP) distinguishes *P. amadoi* from *P. acuminatus*, *P. brevirostris, P. edelmoi and P. praeceptor*. Similarly to most species body constriction (BC) is absent on *P. amadoi*, but differing from *P. gyrinaethes*, *P. luteolus*, *P. melanomystax, P. praeceptor* and *P. tuberculosus* with BC present. Having both dorsal and ventral fin origins on body, *P. amadoi* differs from all species except for *P. magnus*. Spiracle position distinguishes *P. amadoi* from *P. brevirostris*, *P. edelmoi* and *P. gyrinaethes*, while eye position (dorsal) distinguishes *P. amadoi* from *P. edelmoi* and *P. melanomystax* (dorsolateral). The main differences between the tadpoles of described *Phyllodytes* species can be seen in Table 2.

There were several attempts to cluster *Phyllodytes* species into specific groups according to their dorsal color pattern (Caramaschi et al. 2004, Peixoto et al. 2003), structure of advertisement calls (Roberto & Ávila 2013), or skeletal morphology of tadpoles (Da Mota et al. 2020). In a recent work Blotto et al. (2020) used fragments of up to 11 mitochondrial and nuclear genes to reconstruct the phylogeny of Lophyohylini including *Phyllodytes*. Their results indicated that none of the previously proposed groups are monophyletic. Instead they found a clear geographical pattern clustering species from the northern part of the distribution (Pernambuco, Alagoas and Sergipe states of Brazil) (single exception is *P. megatympanum* which occurs in Southern Bahia) and the species distributing in Atlantic forest along the coastline (Bahia, Espírito Santo) and interior areas (Minas Gerais), where *P. amadoi* belongs to. All *Phyllodytes* from both groups share similar characters with *P. amadoi* like body with or without constriction, eyes positioned dorsally, vent tube positioned centrally, being the differences based on number of rows of marginal papillae and a LTRF with two rows on the posterior labium (Magalhães et al. 2015, Dias et al. 2020). Of all the tadpoles described of this genus, eggs were found in the digestive system of only two species while another species has been reported as feeding on eggs opportunistically (Weygoldt 1981, Peixoto et al. 2003, Santos et al. 2019). Because one of the tadpoles of *P. amadoi* had visible eggs in its digestive tract similarly to other members of this genus like *P. praeceptor* and *P. luteolus* (Santos et al. 2019), we suggest that the tadpoles of *P. amadoi* should also be considered as potentially oophagous. Egg consumption could be more widespread than actually recognized for *Phyllodytes* species whose tadpoles develop in small terrestrial bromeliads on the ground of forests.

Acknowledgements:

We thank Marcos Vinícius dos Santos da Anunciação Vieira for helping in the field and Caio Vinícius de Mira Mendes for taking photographs of the live tadpoles. We are grateful to Viktória

Table 2. Comparison of external morphological characters of described tadpoles of *Phyllodytes* species. This table is an updated version of Table 2. in Magalhães et al. (2015), complemented with characters of *P. praeceptor* (Santos et al. 2019), *P. magnus* (Dias et al. 2020) and *P. amadoi* (this study). * Character states based on illustrations provided in the original tadpole description.

Species	Gosner stage	Total length	Body length relative to total length	Labial tooth row formula	Rows of marginal papillae	Body constriction	Dorsal fin origin	Ventral fin origin	Spiracle position	Eye position	Reference
P. acuminatus	38	26.0	41	2(2)/4	two	absent	body–tail junction	on body	at midbody, in lower half	dorsal	Campos et al. 2014
P. amadoi	26	13.6	38	2(2)/2	one	absent	on body	on body	at midbody, in lower half	dorsal	Present study
P. brevirostris	35	17.3–32.7	38	2(2)/5	one anteriorly and two posteriorly	absent	on body	on body	at midbody, at midline	dorsal	Vieira et al. 2009
P. edelmoi	28	27.1	36	2(2)/5–6	two anteriorly and three posteriorly	absent	on body	on body	in body's last third, in lower half	dorsolateral	Peixoto et al. 2003
P. gyrinaethes	34	30.0	35	1(1)/5	one	anteriorly and laterally	body–tail junction	on body	in body's last third, in lower half	lateral	Peixoto et al. 2003
P. luteolus	36	29.0	–	2(2)/4	one	laterally	at tail musculature*	on body*	at midbody, at midline	dorsal*	Bokermann 1966
P. magnus	35	28.8	36	2(2)/5–6	one	absent	on body	on body	at the middle third of body, in lower half	dorsal	Dias et al. 2020
P. melanomystax	36	34.6	32	2(2)/3	one	laterally	on tail musculature*	on tail musculature*	at midbody, at midline	dorsolateral	Caramaschi et al. 1992
P. praeceptor	38	25.1	33.5	1/2	two	at midbody	body–tail junction	on body–tail junction	at the middle third of the body, in lower half	dorsal	Santos et al. 2019
P. tuberculosus	35	31.0	–	2(2)/4	one	laterally	on tail musculature*	on body*	at midbody, at midline	dorsal*	Bokermann 1966
P. wuchereri	36	31.5	38	2(2)/4	one	absent	body–tail junction	on body	at midbody, in lower half	dorsal	Magalhaes et al. 2015

Szőke (HNHM) for the excellent drawing of the oral disc and Tamás Németh (SZIE) for technical help with Figure 1. Project no. [KH130360] has been implemented with the support provided from the National Research, Development and Innovation Fund of Hungary, financed under the [KH_18] funding scheme to JV. MS acknowledges funding by Alexander von Humboldt-Stiftung/Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (BEX 0585/16-5) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNpq) for a Research Productivity Grant (309365/2019-8) and, jointly with Fundação de Amparo à Pesquisa do Estado da Bahia (FAPESB) for funding through a "PROTAX" Project. IRD thanks Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for fellowship (process 151218/2021-8). Tadpoles were collected under license 13708-2 issued by Instituto Chico Mendes de Conservação da Biodiversidade—ICMBio.

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