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The Tadpole of *Bokermannohyla flavopicta* Leite, Pezzuti and Garcia, 2012 and Oral Cavity Anatomy of the Tadpole of *B. oxente* Lugli and Haddad, 2006 (Anura: Hylidae)

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Abstract. We describe and illustrate the external morphology, oral disc, and oral cavity anatomy (OCA) of the larvae of *Bokermannohyla flavopicta* and the OCA of the tadpole of *B. oxente.* We collected tadpoles of *B. flavopicta* at Serra do Barbado, Abaíra municipality, Chapada Diamantina, Bahia state. At Gosner stage 36, the tadpole of *B. flavopicta* has a depressed body with low tail fins and a broad, ventral oral disc bordered by a single row of marginal papillae, with a narrow gap on the anterior labium; submarginal papillae present in small amounts mostly on the commissure and on the anterior labium of the oral disc. The most common labial tooth row formula is 2(2)/7(1). The overall OCA of both species is similar, but can be distinguished mainly by the number of buccal roof papillae per side, shape of pre-narial arena ridge, and infralabial and lingual papillae morphology. The internal and external morphology of these larvae are compared with available descriptions for larvae of other species placed in the *B. pseudopseudis* group, and we comment on characters that best distinguish species within this group. Finally, the anteroposterior row of papillae in the prenarial arena (proposed as putative synapomorphy for the *B. pseudopseudis* species group) was also observed in *B. flavopicta* and *B. oxente* tadpoles, reinforcing the importance of larval external and internal characters in anuran comparative morphology research.

Keywords. *Bokermannohyla pseudopseudis* species group; Chapada Diamantina ecoregion; Larval morphology; New occurrence record; Systematics; Taxonomy.

INTRODUCTION

Bokermannohyla Faivovich, Haddad, Garcia, Frost, Campbell and Wheeler, 2005 currently comprises 32 species placed in five species group (Faivovich et al., 2005; Brandão et al. 2012). *Bokermannohyla flavopicta* is a recently described species endemic to the southwestern region of Chapada Diamantina, Bahia state, and a member of *B. pseudopseudis* species group (Leite et al. 2012), which currently comprises eight other species [*B. alvarengai* (Bokermann, 1956), *B. ibitiguara* (Cardoso, 1983); *B. itapoty* Lugli and Haddad, 2006a; *B. oxente* Lugli and Haddad, 2006b; *B. pseudopseudis* (Miranda-Ribeiro, 1937); *B. sagarana* Leite, Pezzuti and Drummond, 2011; *B. sapiranga* Brandão, Magalhães, Garda, Campos, Sebben and Maciel, 2012; and *B. saxicola* (Bokermann, 1964)] distributed throughout streams in open fields or savannas on rocky areas of highlands, mainly in the Cerrado biome (Faivovich et al., 2009; Brandão et al., 2012; Leite et al., 2012).

Few aspects of the reproductive biology and natural history of *Bokermannohyla flavopicta* are known and since its description no further data have been published. Moreover, the species is known from only three sites in the highlands of Chapada Diamantina (Serra das Almas and Serra do Itobara, Rio de Contas municipality, and Serra do Bastião, Mucugê municipality) at 1,500 m above sea level (asl) making general information on its distribution and natural history especially important for narrowly distributed and possibly threatened anuran species such as *B. flavopicta* (see Leite et al., 2012).

Larval morphology has been employed as a useful source of comparative data for anuran taxonomy generally (see Provete et al., 2012) and *Bokermannohyla* specifically (Eterovick and Brandão, 2001; Leite and Eterovick, 2010; Pezzuti et al., 2015). For instance, all species in the *B. circumdata* group that have had their larvae described are distinguished from each other based on their external morphology (Magalhães et al., 2012; Pezzuti et al., 2015). Likewise, some larval oral cavity characters have

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been proposed as putative synapomorphies for species included in the *B. pseudopseudis* group (e.g., anteroposterior row of papillae in the prenarial arena) as well as for Cophomantini tribe (e.g., the presence of narial vacuities), although the homology of these characters has not yet been rigorously tested (d'Heursel and Haddad, 2007; Kolenc et al., 2008). Although the larvae of most species of *Bokermannohyla* have been described (24 of 32 species, 75%), OCA descriptions are unavailable for most species (8 of 32 species, 25%; Provete et al., 2012; Pezzuti et al., 2015). Tadpole external morphology has been described for six species of the *B. pseudopseudis* group: *B. alvarengai, B. ibitiguara, B. itapoty, B. oxente, B. pseudopseudis* and *B. saxicola* (Eterovick and Brandão, 2001; Lugli and Haddad, 2006a, b, and references therein), but the OCA has only been reported for *B. alvarengai, B. itapoty,* and *B. saxicola* tadpoles (d'Heursel and Haddad, 2007).

Herein, we describe the external morphology and OCA of the tadpole of *Bokermannohyla flavopicta* and compare it with tadpoles of the species in the *B. pseudopseudis* group described in the literature. We also describe the larval OCA of *B. oxente,* which is also endemic to the Chapada Diamantina ecoregion (Lugli and Haddad, 2006b), and provide a new occurrence for *B. flavopicta* in the southwestern region of Chapada Diamantina.

MATERIALS AND METHODS

We collected tadpoles of *Bokermannohyla flavopicta* in March 2014 at Serra dos Barbados, district of Catolés de Cima, Abaíra municipality, Bahia state, Brazil (13°17'20"S; 41°54'25"W; approximately at 1,700 m asl), which represents a new occurrence record for this species within the highlands of southwestern Chapada Diamantina (see Fig. 1). Tadpoles were anesthetized in 5% lidocaine, preserved in 5% formalin and housed at Museu de Zoologia da Universidade Estadual de Feira de Santana (MZFS lots 1342, 1343). Three larvae were raised in the laboratory until completion of metamorphosis for species identification (MZFS 1273, Fig. 2). The juvenile specimens were attributed to *B. flavopicta* because of the dorsal pattern of light gray to light brown background with irregularly shaped brown marbled blotches (pattern only known in *B. flavopicta* and *B. itapoty* among species that occur in Chapada Diamantina), head wider than long, and the reticulated iris pattern (not known in *B. itapoty*) (see Fig. 2). Additionally, no other species of *Bokermannohyla* was observed in sympatry with *B. flavopicta,* although *B. oxente* occurs in lower portions of the same mountain where *B. flavopicta* tadpoles were collected, and *B. itapoty* and *B. juiju* are restricted to the northern portion of

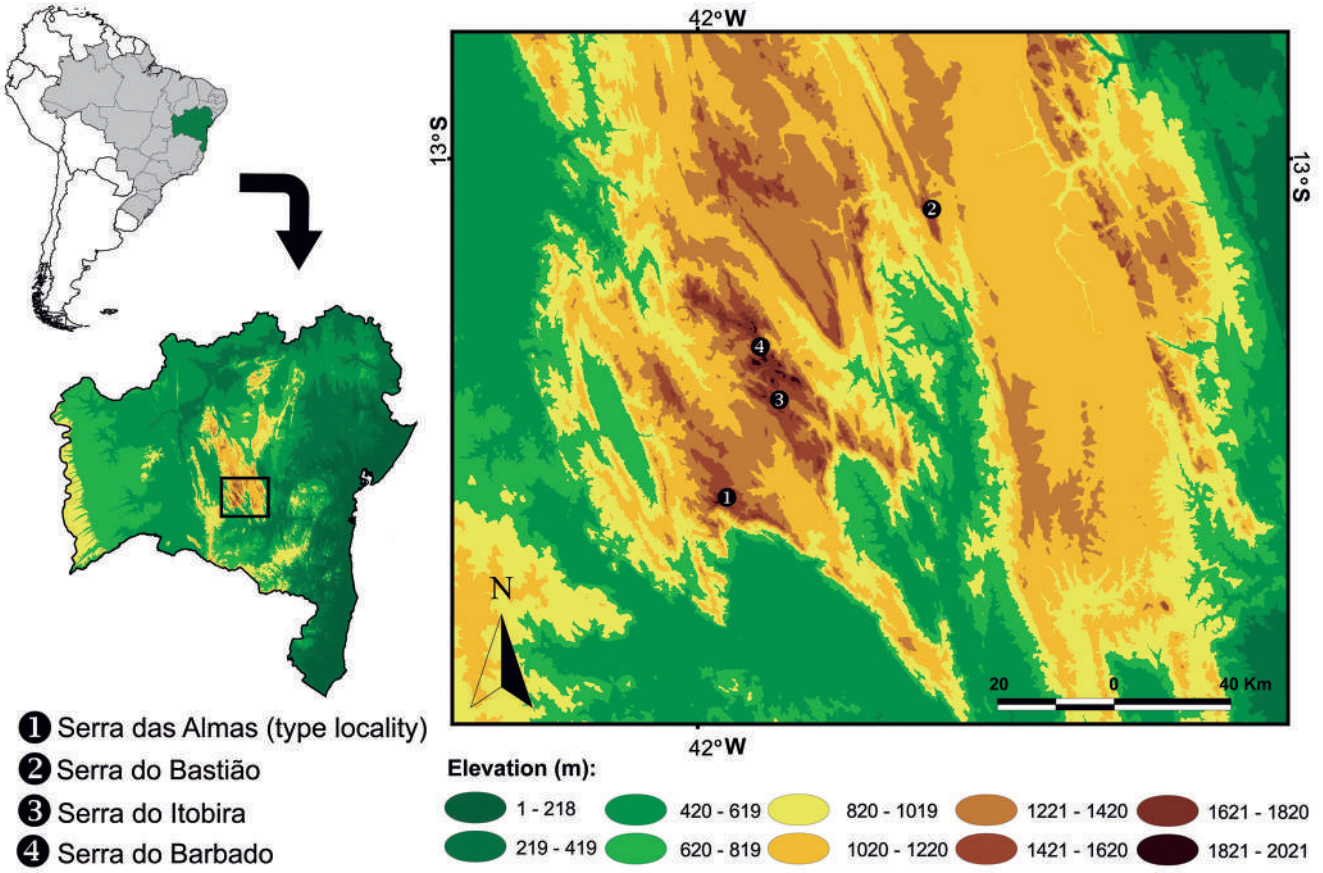

Figure 1. Distribution of *Bokermannohyla flavopicta* in the highlands of southwestern Chapada Diamantina, Bahia state, Brazil.

Table 1. Measurements (in mm) of *Bokermannohyla flavopicta* larvae, reported as mean ± SD followed by the minimum and maximum values in parentheses. *n* = number of individuals.

Measurements	Stage 26 (*n* = 6)	Stage 28 (*n* = 4)	Stage 29 (*n* = 2)	Stage 30 (*n* = 1)	Stage 36 (*n* = 1)
Total length	53.0 ± 7.8 (42.4–61.3)	65.4 ± 3.1 (61.4–68.4)	64.3 ± 7.0 (59.3–69.2)	72.7	69.7
Body length	17.6 ± 2.3 (14.6–20)	22.0 ± 0.5 (21.5–22.6)	20.8 ± 2.8 (18.8–22.8)	23.9	22.8
Body height	8.3 ± 1.1 (7.0–9.5)	10.6 ± 0.2 (10.4–10.8)	10.1 ± 1.1 (9.3–10.8)	11.3	11
Body width	9.3 ± 1.4 (7.6–10.7)	10.1 ± 3.4 (5.2–13.1)	11.2 ± 0.8 (10.6–11.7)	12.5	12.3
Tail length	35.4 ± 5.6 (26.9–41.3)	43.4 ± 3.1 (39.2–45.8)	43.5 ± 4.2 (40.5–46.4)	48.8	46.9
Maximum tail height	9.9 ± 1.6 (7.6–11.3)	12.8 ± 0.2 (12.6–13)	13.3 ± 0.5 (12.9–13.6)	14.3	14.5
Dorsal fin height	3.9 ± 0.4 (3.5–4.5)	4.9 ± 0.2 (4.6–5.1)	5.1 ± 0.4 (4.8–5.3)	5.3	5.3
Ventral fin height	2.7 ± 0.5 (2.2–3.4)	3.5 ± 0.3 (3–3.6)	3.5 ± 0.1 (3.4–3.5)	4.1	4.4
Tail muscle height	5.3 ± 1.0 (4.1–6.8)	6.7 ± 0.3 (6.4–7)	6.8 ± 0.1 (6.7–6.8)	7.6	6.8
Tail muscle width	4.1 ± 0.8 (3.2–5.2)	5.6 ± 0.2 (5.3–5.8)	5.3 ± 0.7 (4.8–5.8)	6.2	6.1
Eye diameter	1.9 ± 0.3 (1.5–2.2)	2.5 ± 0.3 (2.2–2.9)	2.4 ± 0.3 (2.2–2.6)	3	3.2
Interorbital distance	5.8 ± 0.8 (4.7–6.6)	7.4 ± 0.1 (7.2–7.5)	7.4 ± 0.6 (6.9–7.8)	9	8.2
Eye snout distance	6.1 ± 0.6 (5.4–6.8)	7.2 ± 0.7 (6.1–7.8)	7.0 ± 0.7 (6.5–7.5)	8.1	8.2
Eye nare distance	2.8 ± 0.2 (2.6–3.2)	3.5 ± 0.2	3.4 ± 0.1 (3.3–3.4)	3.5	4.2
Nare snout distance	3.3 ± 0.5 (3.1–4.2)	3.7 ± 0.8 (2.5–4.5)	3.7 ± 0.6 (3.2–4.1)	4.6	4
Internarial distance	3.7 ± 0.5 (3.1–4.2)	4.5 ± 0.2 (4.3–4.8)	4.4 ± 0.2 (4.2–4.5)	4.7	4.9
Snout spiracle distance	9.9 ± 1.1 (8.6–11.3)	11.0 ± 0.8 (9.8–11.6)	10.8 ± 0.8 (10.2–11.3)	13.4	12.7
Oral disc width	5.5 ± 0.6 (4.7–6.2)	6.5 ± 0.4 (6–6.8)	6.9 ± 0.4 (6.6–7.2)	7.2	6.8

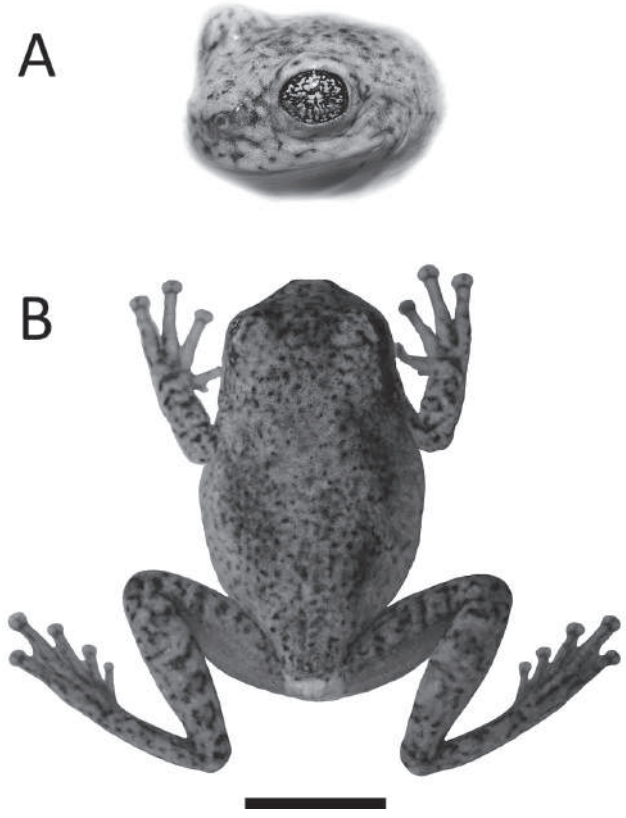

Figure 2. Juvenile *Bokermannohyla flavopicta* (MZFS 1273) metamorphosed in the laboratory. Note the reticulated irises **(A)** and light gray to light brown background with irregularly shaped brown marbled blotches dorsal pattern **(B).** Scale bar = 10 mm.

Chapada Diamantina (see Faivovich et al., 2009; Leite et al., 2012).

We describe external morphology based on a tadpole in stage 36 (lot 1342) and obtained measurements from 14 specimens in stages 26–36 (MZFS lots 1342, 1343; Table 1). Terminology for external morphology and oral anatomy follows Altig and McDiarmid (1999) and larval stages follow Gosner (1960). Terminology for the lateral line system follows Lannoo (1999). We measured 18 morphometric variables with a Mitutoyo® digital caliper (0.01 mm precision) and an ocular micrometer in a Leica-EZ4D stereomicroscope. Eight of the variables follow Altig and McDiarmid (1999): total length, body length, tail length, maximum tail height, tail muscle height, tail muscle width, interorbital distance, internarial distance; the remaining variables were measured following Magalhães et al. (2013), except for spiracle-snout distance, which was taken from the distal margin of the spiracle to the tip of snout. Measurements are provided in Table 1 and were rounded to the nearest 0.1 mm.

For the OCA description, three tadpoles (Gosner stages 29–30) were dissected, their oral structures stained using methylene blue solution, and analyzed with an ocular micrometer in a Leica-EZ4D stereomicroscope. Internal morphological features were recorded adopting the methodology and terminology presented by Wassersug (1976).

Additionally, four tadpoles of *Bokermannohyla oxente* (two in Gosner stage 30 and two in stage 39) collected at

Chapada Diamantina National Park, Palmeiras Municipality (12°32'18"S, 41°29'9"W; approximately 900 m asl) were dissected for OCA description and are housed in the Coleção do Laboratório de Anfíbios e Répteis-UFRN (AAGARDA 6578). For additional comparisons with *B. flavopicta* tadpole, we also analyzed tadpole of *B. itapoty* (MZFS lot 99) and *B. oxente* (MZFS lot 708), collected at Mucugê Municipality (12°59'55"S, 41°23'26"W; 1000 m asl) and Palmeiras Municipality (12°32'10"S, 41°34'34"W; 850 m asl), Chapada Diamantina region, Bahia state, respectively.

RESULTS

Bokermannohyla flavopicta tadpole description (Stage 36, Fig. 3A–D)

External morphology

The body is overall depressed (wider than tall), oval in both dorsal and ventral views (Fig. 3B, C) and elliptical in lateral view (Fig. 3A, Table 1). The body is slightly wider and higher (but not distinctly) behind the eyes at the level of the spiracle. The snout is rounded in dorsal view and slightly truncate in lateral view. The eyes are large and positioned dorsally. The nares are small, oval, and located midway between eyes and snout; narial opening with a distinctively white rim and without internal projections. A short, sinistral spiracle is located at about half the body's length at the body's middle line; the spiracular opening is rounded and dorso-posteriorly oriented with the centripetal wall partially fused to the body (free distal margin). The vent tube is dextral, directed posteriorly, almost as long as wide, fused to the ventral fin and positioned at its ventral margin. The dorsal fin is slightly higher than the ventral fin, but lower than the musculature height. The dorsal fin originates at the body-tail junction, slightly arches and slopes gradually to the tail tip; the ventral fin originates at the posterior ventral terminus of the body and is parallel to the longitudinal axis of the tail musculature. The tail tip is pointed. Myotomes of the tail musculature are distinct, but not strongly marked, most visible along the anterior half of the tail. The 10 lines observed in the tadpoles of *B. flavopicta* are similar to those described by Lannoo (1999), except for the last part of M, which turns up reaching the upper part of the tail musculature; M is not visible on the last quarter of the tail musculature and V is interrupted above the spiracle (Fig. 3A, B).

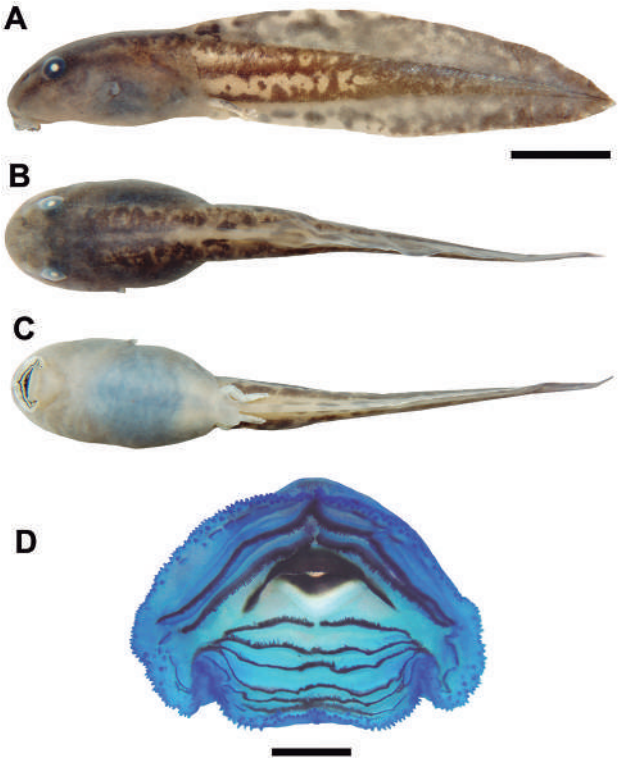

Figure 3. Tadpole of *Bokermannohyla flavopicta* (MZFS lot 1342), stage 36. **(A)** Lateral, **(B)** dorsal, and **(C)** ventral views (Scale bar = 10 mm). **(D)** Oral disc (Scale bar = 1 mm).

The oral disc is broad and positioned ventrally, with two folds on the posterior labium (Fig. 3D); it is bordered by a single row of conical marginal papillae, with a narrow gap on the anterior labium. Papillae are longer than wide with rounded tips. Rounded submarginal papillae are present in small amounts mostly on the commissure and on the anterior labium of the oral disc. Labial tooth row formula (LTRF): 2(2)/7(1); anterior and posterior labial tooth rows about the same length, but P-6 and P-7 are shorter and more fragile than others. Small fragments of tooth row located at the anterior most portion of the superior labium (above A-1) were not considered as a complete row. Also, lateral tooth rows are present on each side of the disc commissure (accessory rows). Tooth row interruption in A-2 wider than in P-1. Jaw sheaths are pigmented and have a serrated edge; upper jaw sheath arc-shaped with long lateral process and lower jaw sheath V-shaped.

Coloration

In life, the dorsal surface of the body is black with light cream blotches near the snout and along the posterior region of the dorsum. Overall, the body's ventral surface is light gray (intestinal coils not visible) without pigmentation. The tail musculature possesses a light cream background coloration covered by irregular dark brown blotches along its length. Both fins have an opaque (not translucent) light brown background coloration covered by irregular black blotches. The posterior portion of the tail has a denser and homogenously dark brown pigmentation. Coloration of preserved specimens

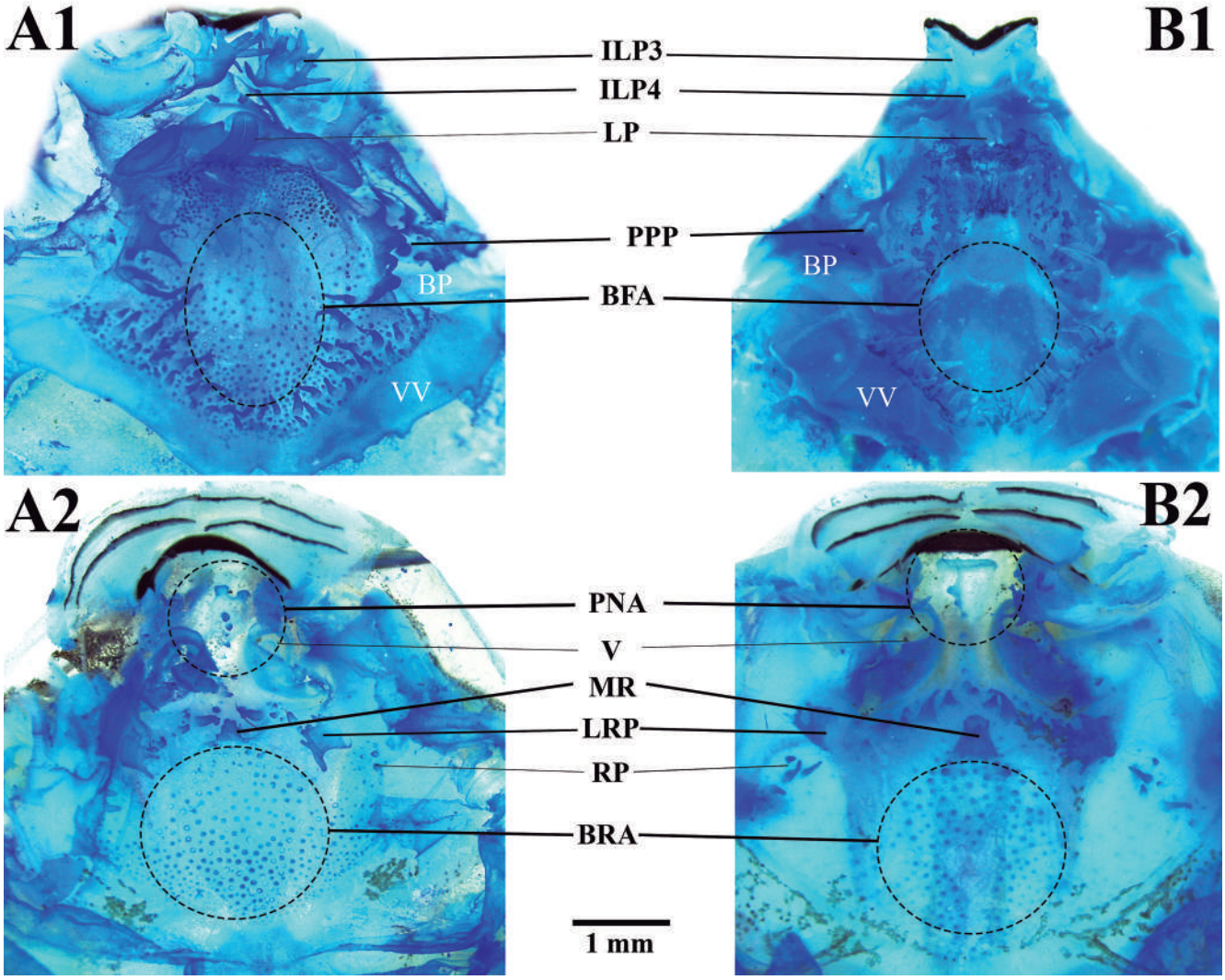

Figure 4. Photographs of oral cavity anatomy: **(A1)** buccal floor and **(A2)** buccal roof of *Bokermannohyla flavopicta,* stage 30. **(B1)** Buccal floor and **(B2)** buccal roof of *Bokermannohyla oxente,* stage 39. Note the presence of the anteroposterior row of papillae in the prenarial arena of both tadpoles (within the PNA circle), a putative synapomorphy of the *B. pseudopseudis* species group. BFA = buccal floor arena; BP = buccal pocket; BRA = buccal roof arena; ILP3 = third infralabial papillae pair; ILP4 = fourth infralabial papillae pair; LP = lingual papillae; LRP = lateral ridge papillae; MR = mediam ridge; PNA = pre-narial arena; PPP = pre-pocket papillae; RP = lateral roof papillae; V = nare vacuity; VV = ventral vellum.

(5% formalin) follows the same pattern as in life, but with a paler aspect and less evident light blotches around the snout (Fig. 3).

Morphological variation

The labial tooth row formula (LTRF) of four tadpoles in stages 26 and 29 (30% of the lot) is 2(2)/6(1). The oral disc of three tadpoles in stages 26 and 28 (21% of the lot) is completely bordered by marginal papillae (gap absent). Only two tadpoles in stage 26 (14% of the lot) did not exhibit fragments of tooth row on the anteriormost portion of the anterior labium. When present, the length and density of such rows vary among individuals. Accordingly, the marginal papillae also vary in density (marginal papillae almost absent in stages 26 and 29; 14% of the lot), and neither character shows any pattern of variation related to developmental stages.

Oral cavity anatomy of *Bokermannohyla flavopicta* and *B. oxente*

Below we described the oral cavity anatomy of *Bokermannohyla flavopicta* and *B. oxente* (*B. oxente* characters in parentheses when different). Buccal floor overall triangular and distinctly broad posteriorly (Fig. 4A1, B1). Four pairs of infralabial papillae oriented transversely: two short and conical pairs present on anteriormost portion; a third complex and large pair (ILP3) with secondary digitiform projections covers most of buccal opening, the last pair (ILP4) also short, attenuated, projecting posteriorly from base of major pair (in *B. oxente,* third

pair shorter and less complex with smaller secondary projections; Fig. 4B1). Two long, attenuated lingual papillae present (shorter in *B. oxente*). Buccal floor arena (BFA) U-shaped and bounded by about 25–30 pairs of BFA papillae (15–20 pairs in *B. oxente*); anteriormost papillae that border the BFA larger and bifid. Anterior half of BFA mostly devoid of pustulations; pustulations evenly scattered over posterior half of BFA. Pustulations and 3–4 pre-pocket papilla present on each side of BFA and anterior to buccal pockets. Buccal pockets about 1/3 of buccal floor total width. Velar surface free, long, possessing small projections on posterior margin; median notch present. Oral roof overall rectangular with broad prenarial arena (Fig. 4A2, B2). Bilobed ridge and 3–4 prenarial papillae present and forming anteroposterior row on midline of prenarial arena (ridge not divided in *B. oxente*). Internal narial openings elongate, elliptical, oriented obliquely, placed about one-third distance back on buccal roof; anterior and posterior narial walls thick, smooth, forming large, rounded vacuity attached to internal nare. Postnarial arena with 4–6 papillae on each side and arranged in inverted "V" pattern with medial papillae larger than others. A few pustulations present on postnarial arena between postnarial papillae and median ridge. A pair of lateral ridge papillae projects medially and exhibit 4–5 digitiform secondary projections. Median ridge overall broader than tall, slightly rectangular, bearing small secondary projections on edge. Buccal roof arena (BRA) broad, devoid of papillae, rectangular overall. BRA field covered by evenly and densely distributed pustulations (less dense in *B. oxente*). Lateral roof papillae present (longer in *B. oxente*). Dorsal velum broad, interrupted medially, curving gradually towards midline; margin of velum mostly smooth. A glandular zone present on posterior half of dorsal velum.

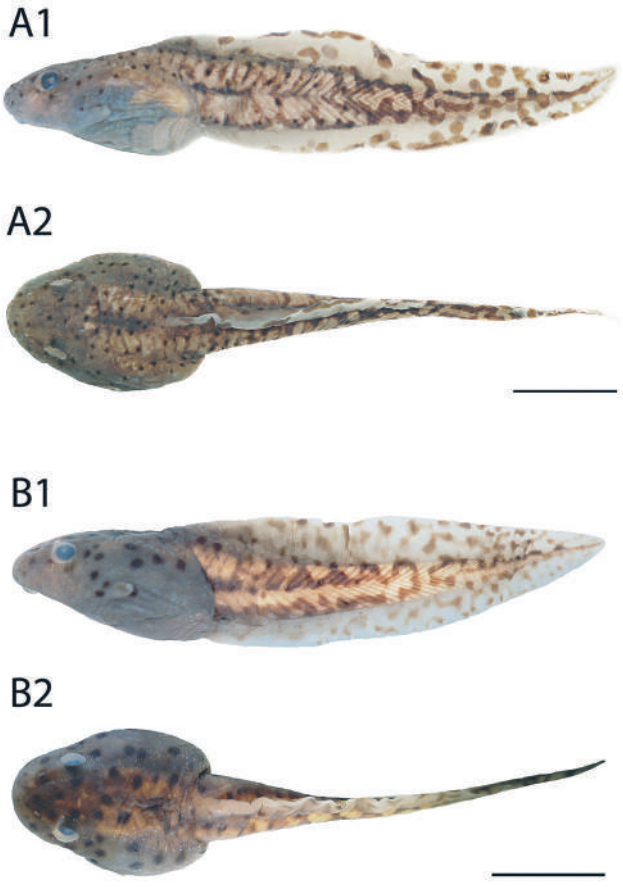

Figure 5. Lateral and dorsal views of the tadpoles of **(A1–A2)** *Bokermannohyla itapoty* (stage 28, MZFS 99) and **(B1–B2)** *Bokermannohyla oxente* (stage 28, MZFS 708) from Chapada Diamantina ecoregion, Bahia, Brazil. Scale bars = 10 mm.

Natural history

Tadpoles of *Bokermannohyla flavopicta* were observed in a permanent rocky bottom mountain stream located at 1,500–1,700 m asl in the beginning of the dry season. Most collected tadpoles are in early development stages (90% between 26–30). The tadpoles usually remain in low current portions of the stream (about 20–30 cm depth). We observed them to be active during day and found them to be mostly associated with the rocky substrate where they conceal themselves when disturbed. Only tadpoles of *Scinax* sp. (gr. *catharinae*) were collected syntopically with those of *B. flavopicta*.

Tadpoles of *B. oxente* also occur in this area, but only at lower elevations portions of the same mountain stream (below 1,400 m asl). For species identification, post-metamorphic and juvenile individuals were raised in aquaria for 3 weeks, consumed termites, and survived for about more 2 weeks after metamorphosis.

DISCUSSION

In addition to *Bokermannohyla flavopicta,* four more species of *Bokermannohyla* are endemic to the Chapada Diamantina ecoregion: *B. diamantina* Napoli and Juncá, 2006, *B. oxente, B. itapoty,* and *B. juiju* Faivovich, Lugli, Lourenço and Haddad 2009. Among these, only the tadpole of *B. juiju* is not described. Although *B. flavopicta* occurs sympatrically with *B. oxente,* their tadpoles were not collected in syntopy and are easily distinguished from each other (see below). Additionally, *B. diamantina* is also restricted to the southwestern region of Chapada Diamantina but the lower number of tooth rows [LTRF 2(2)/3(1)] and presence of fleshy projections on the nostril margins promptly distinguishes *B. diamantina* tadpoles from those of *B. flavopicta* (see Pezzuti et al., 2015).

The external morphology of *Bokermannohyla flavopicta* tadpoles is similar to other tadpoles of *B. pseudopseudis* species group (Sazima and Bokermann, 1977; Cardoso, 1983; Eterovick and Brandão, 2001; Lugli and

Haddad, 2006a, b). They all develop in streams located in open fields or savannas and running on rocky areas of highlands, have a depressed body with low fins, a ventral oral disc almost or completely bordered by papillae, and exhibit 6–10 tooth rows on the entire oral disc (always exhibiting two well-defined rows on the anterior labium) with ventral folds. However, the larvae of these species differ in body shape, oral disc features, and color patterns.

The presence of at least six well-defined tooth rows on the posterior labium distinguishes *Bokermannohyla flavopicta* tadpoles from *B. alvarengai, B. oxente* and *B. ibitiguara* tadpoles, which exhibit from 4–5 (Sazima and Bokermann, 1977; Cardoso, 1983; Lugli and Haddad, 2006b). Conversely, *B. saxicola* can exhibit up to eight rows on the posterior labium (Eterovick and Brandão, 2001), which does not occur in *B. flavopicta* tadpoles. Additionally, the presence of a fragmented anteriormost row of teeth (above A1) on the anterior labium was not reported for tadpoles of *B. alvarengai* and *B. ibitiguara* tadpoles, even in advanced development stages (present in *B. flavopicta* and also reported for the remaining species). The narrow gap on the anterior labium of the oral disc is observed in most tadpoles of the *B. pseudopseudis* group, except *B. saxicola,* in which the oral disc is completely bordered by papillae in all stages of development (Eterovick and Brandão, 2001). Nevertheless, we observed that some *B. flavopicta* tadpoles in earlier stages exhibited a complete row of papillae; hence, this character should be carefully evaluated in combination with other characters when comparing these tadpoles.

The oral disc of *Bokermannohyla alvarengai, B. oxente,* and *B. saxicola* tadpoles is bordered by two rows of marginal papillae, distinguishing it from those of *B. flavopicta* (oral disc bordered by a single row). Likewise, the oral disc width/body width ratio of *B. flavopicta* tadpoles (ODW/BW = 55%, stage 36) is greater than in all other species of the *B. pseudopseudis* group in similar development stage (BW/ODW ratio about 35% in *B. ibitiguara,* 54% in *B. itapoty,* 47% in *B. oxente,* 47% in *B. pseudopseudis,* and 48% in *B. saxicola*). Sazima and Bokermann (1977) did not provide the BW/ODW ratio for *B. alvarengai* tadpoles, but mentioned that the oral disc is small, and it is possible that such ratio is lower than that of *B. flavopicta* tadpole.

The total length (TL) of *Bokermannohyla flavopicta* tadpoles (TL = 72.7 mm, stage 36) is longer than that of *B. alvarengai* (TL = 53 mm, stage 40), *B. oxente* (TL = 60 mm, stage 37), and *B. ibitiguara* (TL = 62 mm, stage 35) in similar development stages. The spiracle positioned on the body midline distinguishes the tadpole of *B. flavopicta* from those of *B. alvarengai, B. itapoty,* and *B. oxente,* whose spiracle is located below body midline (Sazima and Bokermann, 1977; see Fig. 5A1, B1).

Some color patterns may be used as possible diagnostic characters for tadpoles of the *Bokermannohyla pseudopseudis* group. Although coloration can vary according to pond conditions, predator density, and ontogeny (Thibaudeau and Altig, 2012), we observed that living and fixed *B. flavopicta* tadpoles in all development stages do not exhibit black dots (melanophores) distributed along the body surface, as observed in most tadpoles in the *B. pseudopseudis* group (see Fig. 5 for *B. itapoty* and *B. oxente* tadpoles) except *B. ibitiguara* and *B. saxicola* (Cardoso, 1983; Eterovick and Brandão, 2001). The fin color pattern (black blotches with an opaque light brown background and a denser dark brown coloration on posterior third of tail) also distinguishes *B. flavopicta* tadpoles from those of *B. alvarengai, B. itapoty, B. oxente,* and *B. saxicola,* which exhibit light brown blotches with a slightly grayish translucent background coloration pattern (see *B. itapoty* and *B. oxente* tadpoles in Fig. 5).

Overall, the OCA of *Bokermannohyla flavopicta* and *B. oxente* agrees with previous descriptions for the genus and particularly with the available descriptions for the *B. pseudopseudis* species group (*B. alvarengai, B. itapoty* and *B. saxicola;* d'Heursel and Haddad, 2007). Generally, in this species group, the buccal floor is triangular, both lingual papillae and a pair of infralabial papillae with secondary projections are long (the last covering the oral cavity entrance), the BFA is U-shaped and limited by a high number (20–40) of BFA papillae, the prenarial arena exhibits an anteroposterior row or ridge of papillae, a large rounded vacuity that is attached to the anterior portion of internal nares, the postnarial arena is arranged in an inverted "V" pattern becoming progressively larger from the lateral to the medial region, lateral ridge papillae possess digitiform secondary projections, and the BRA is devoid of papillae. Nevertheless, the species in the *B. pseudopseudis* group differ mostly in size of the larger pair of infralabial papillae (similar in *B. alvarengai, B. flavopicta, B. itapoty,* and *B. saxicola,* shorter in *B. oxente*), length of lingual papillae (shorter in *B. itapoty* and *B. oxente,* similar in the remaining species), number of BFA papillae (15–20 in *B. oxente,* 20–25 in *B. saxicola,* 25–30 in *B. flavopicta,* ~30 in *B. alvarengai,* 30–40 in *B. itapoty*), and shape of the ridge in the prenarial arena (divided in *B. flavopicta,* undivided in the remaining species).

Moreover, the presence of an anteroposterior ridge or row of papillae in the prenarial arena has only been reported for tadpoles belonging to the *Bokermannohyla pseudopseudis* group within Cophomantini (d'Heursel and Haddad, 2007; Kolenc et al., 2008), a feature also observed in *B. flavopicta* and *B. oxente* tadpoles (Fig. 4). Such characteristic was proposed as a putative synapomorphy for this species group (d'Heursel and Haddad, 2007). However, careful comparative analysis of *B. pseudopseudis, B. sagarana,* and *B. sapiranga* tadpoles along with other congeners is still needed to conclude that this characteristic is a synapomorphy for the *B. pseudopseudis* group, considering that the tadpole OCA has been described for only 25% of *Bokermannohyla* species (Provete et al., 2012).

Additionally, the vacuities in the internal nares (proposed as a putative synapomorphy of Cophomantini; Faivovich et al., 2005) have also been observed in *B. flavopicta* and *B. oxente* tadpoles. Internal larval characters (e.g., OCA and chondrocranium) have been shown to be especially important in comparative studies (Faivovich et al., 2005; d'Heursel and Haddad, 2007; Kolenc et al., 2008), deserving more attention in future systematics analyses in anuran species, especially because adult and tadpole external morphology have not provided informative sources for diagnosing species group in this genus (Faivovich et al., 2005; Leite and Eterovick, 2010).

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