The Tadpole of *Physalaemus albifrons* (Spix, 1824) (Anura, Leiuperidae)

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**Abstract.** The tadpoles of *Physalaemus albifrons* used in this description were obtained from a pair collected in a permanent pond in Brotas de Macaúbas, state of Bahia, Brazil. The external morphological features are similar to those of other members of the *P. albifrons* species group, differing by the presence of interruptions in the row of the marginal papillae of the lower lip. Labial tooth row formula is 2(2)/3(1, 2). The internal oral morphology of *P. albifrons* differed from those of *P. marmoratus*, *P. santafecinus* and *P. biligonigerus* by the presence of three lingual papillae.

**Keywords.** Taxonomy, internal oral morphology, description.

**Introduction**

The genus *Physalaemus* Fitzinger, 1826, is currently composed of 42 species distributed from northern to central Argentina, eastern Bolivia, Paraguay, Uruguay, Brazil, the Guianas, lowlands of southern Venezuela, southeastern Colombia, and western Ecuador (Frost, 2010).

Recently, Nascimento et al. (2005) revised the genus and proposed seven species groups: *Physalaemus albifrons* sp. gr., *P. cuvieri* sp. gr., *P. deimaticus* sp. gr., *P. gracilis* sp. gr., *P. henselii* sp. gr., *P. oflersii* sp. gr. and *P. signifer* sp. gr. According to this taxonomic review, *P. albifrons* species group comprises of four species: *P. albifrons* Spix, 1824, *P. biligonigerus* Cope, 1861, *P. marmoratus* (Reinhardt and Lütken, 1862) (= *P. fuscomaculatus*, see Nascimento et al., 2006), and *P. santafecinus* Bario, 1965, all occurring in South America, from Argentina, Uruguay, and Paraguay, to central, southeastern, and northeastern Brazil, associated with open formations of the Chaco, Cerrado, and Caatinga Domains (Frost, 2010; IUCN, 2010).

Except for the *Physalaemus albifrons* tadpole, the larvae of all other members of the *P. albifrons* species group have been described, including external and internal oral morphologies (Perotti and Céspedes, 1999; Nomura et al., 2003). Herein, we describe the external and internal oral features of the tadpole of *P. albifrons* and we compare them with the larval traits described for tadpoles belonging to this species group.

**Materials and Methods**

Eggs were obtained from a pair of *Physalaemus albifrons* collected in January 2010, in a permanent pond (12°00′24″S, 42°37′35″W) in the municipality of Brotas de Macaúbas, Chapada Diamantina, Bahia state, Brazil. The Chapada Diamantina is covered mainly by open formations of the Caatinga Domain, with dry semi-arid to humid climate, mean temperature 20.6°C and mean altitude 814 m. Rainy season comprises the months from November to March (CNM, 2010).

Tadpoles were fixed in 8% formalin and the stages of development were defined according to Gosner (1960). The description of the external morphology was based on twenty specimens at stages 36-39 and terminology and measurements follow Altig and McDiarmid (1999). Teeth row formula follows Altig (1970). The external and internal oral morphology was based on five specimens at stages 36-38, stained with 3% Methylene Blue solution and terminology follows Wassersug (1976). Measurements and observation of morphological features were made using an ocular micrometer under a stereoscopic microscope (Olympus SZ40). Drawings are based on specimens at stage 38. The tadpoles are deposited at the Museu de Zoologia da Universidade Federal da Bahia (MZUFBA 010375).

**Results**

Description of tadpole – (Figs. 1A, B, C): Body oval in ventral and dorsal views, and elliptic in lateral view.
Body height is 57% of body length, and body width is 65% of body length. Snout rounded in dorsal and lateral views. Nostrils large, ovoid with a small rounded fleshy projection in internal margin, dorsally oriented, closer to the eyes than to the tip of snout. Inter-nostril distance about 15% of body width. Eyes dorsolaterally positioned, and with a diameter corresponding to 14% of body length. Spiracle sinistral, narrow, short, located at the middle third of the body, directed upward, centripetal wall fused to the body wall, opening laterally directed, with opening diameter smaller than the diameter of the spiracle tube. Spiracle-snout distance about 80% of body length. Vent tube short, large, medial, attached to ventral fin with dextral opening. Tail length is 64% of total length. Origin of dorsal fin at the posterior third of the body. Dorsal fin higher than ventral fin, 38% of total tail height, and ventral fin about 20% of total tail height. Tail musculature well developed with height representing 44% of body height and 45% of total tail height (Table 1).

*Oral Disc* – Ventral, about 35% of body width. Tooth row formula $2(2)/3(1, 2)$, with P-3 about half length of P-2. Single row of marginal papillae, with an extensive gap in the median upper lip and a short gap in the median lower lip. Presence of two ventrolateral

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**Figure 1.** The tadpole of *Physalaemus albifrons*, stage 38 of Gosner (1960): (A) dorsal view; (B) ventral view; (C) lateral view (scale = 2 mm); (D) Oral disc (scale = 1 mm).
gaps in the lower lip. Jaw sheaths dark, finely serrated. Upper jaw sheath convex, arch-shaped, and lower jaw sheath V-shaped (Fig. 1D).

**Coloration in vivo** — The tadpole has a golden iris, translucent body walls with light brown coloration; in dorsal view it has dispersed dark blotches and dots, with a concentration of golden dots in the midline; two black blotches between the nostrils, the eyes, and posterior to the eyes. In lateral view it has dark and gilded spots concentrated below the eye and near to the mouth, gold spots concentrated above the eye, and black spots concentrated between the eye and mouth that extend to the ventrolateral portion; spiracle translucent, with some golden spots located near to the opening; lateroposterior region of body dark brown with dispersed golden spots. Vent transparent, golden on the intestine. There is a descending sequence of blotches over the region of the tail insertion, which extends dorsally along the tail musculature (Fig. 1A). Dorsal and ventral fins translucent, with dispersed black points, also present on the tail musculature.

**Coloration in formalin** — Translucent body, grey colored, with black spots along the dorsal part of the body. Two black blotches between the nostrils, the eyes, and posterior to the eyes. There is a descending sequence of blotches over the region of of the tail insertion, which extends dorsally along the tail musculature (Fig. 1A). Lateral region of body with many dark and brown spots, from the eyes to the laterally-posterior portion of the body. Ventral region grey translucent. Some white dots extending laterally from the ventral part of the body to the oral disc region, together with many dark dots. Tail grey with transparent dorsal and ventral fins, with few dark dots along them, also present on the tail musculature.

Internal Oral Features

**Buccal floor** — (Fig. 2A): Trapezoidal, as long as wide. Presence of two pairs of infralabial papillae, the anterior pair much smaller than the posterior, with smooth surface and irregular apices. The posterior pair showing discrete branches, much larger than the first, with smooth surface and irregular margins and apices. The posterior pair of papillae is easily discernible from the first. Presence of three lingual papillae on the same transverse plane; the median papillae is slightly larger than the lateral ones, which are tapered, have equivalent sizes, smooth surfaces and rounded apices, closer to the posterior pair of infralabial papillae than to the first arena papillae. There are four papillae on each side delimiting the arena floor, the most anterior papillae smaller than the others, rounded and with an irregular surface. The other arena papillae have similar sizes and shapes, with smooth surface, and a tapered apex oriented to the center of the arena. Pustules distributed irregularly on the buccal floor arena (BFA). Ventral velum with irregular margin and presence of small projections of equivalent sizes.

**Buccal roof** — (Fig. 2B): Prenarial arena with three small papillae arranged in semicircle on the transverse plane. Elliptical choanae, separated and oriented on the transverse plane, with a slight tilt to the sides and anterior margin with small irregularities. Distance between the choanae about three times smaller than the width of the median ridge. Postnarial arena with dispersed pustulations; presence of two pairs of postnarial papillae, one pair much larger, curved and more discernible, with minor irregularities and directed to the center of the arena, somehow touching each other. The second pair is smaller, tapered and arranged on

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<th>Table 1. Range, mean and standard deviation (SD) of measurements (mm) of <em>Physalaemus albifrons</em> tadpoles (n = 20 stage 36-39), municipality of Brotas de Macaúbas, Bahia, Brazil. TL = Total Length; BL = Body Length; BW = Body Width; BH = Body Height; Tail L = Tail Length; TH = Tail Height; HTM = Height of the Tail Musculature; DFH = Dorsal Fin Height; VFH = Ventral Fin Height; lnD = Interorbital Distance; ED = Eye Diameter; ND = Nostri Diameter; NSD = Nostri-Snout Distance; ESD = Eye-Snout Distance; SSD = Snout-Spiracle Distance; ODW = Oral Disc Width.</th>
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Oliveira, M. I. R. R. *et al.*
the side of the major papilla of the postnarial arena. Lateral ridge papillae bifid, with tapered apex, smooth, anterior margin with slight irregularities and directed upwards. Median ridge slightly wider than long, forming a semicircle in most specimens. Presence of small irregularities in the margin of the median ridge and four pustulations on the surface. Buccal roof arena (BRA) with three or four finger-like papillae on each side, curved to the center, with similar sizes, tapered apices and smooth surfaces. Presence of pustules dispersed in small amounts distributed on the surface of the BRA. Glandular zone little differentiated. Dorsal velum with wavy margin, with two small median projections of equivalent sizes.

**Discussion**

*External morphology* – The tadpole of *Physalaemus albifrons* presents features that are similar to those of other members of the *P. albifrons* species group, like total body length, ovoid body in dorsal and ventral views, eyes dorsolaterally positioned, spiracle single, sinistral and fused to the body wall (Perotti and Céspedes, 1999; Nomura *et al.*, 2003; Borteiro and Kolenc, 2007). It differs from *P. marmoratus* because it has rounded nostrils (Nomura *et al.*, 2003) and from *P. santafecinus* because of the spiral opening, which is located in the posterior portion of the tube (Perotti and Céspedes, 1999).

Regarding the oral disc, the tadpole of *P. albifrons* is similar to the tadpoles of *P. biligonigerus*, *P. marmoratus* and *P. santafecinus*, by the presence of a single row of marginal papillae with a large rostral gap, but differs from *P. biligonigerus* and *P. santafecinus*, getting close to *P. marmoratus* (Nomura *et al.*, 2003) by the presence of ventrolateral gaps in the lower lip. *Physalaemus albonotatus*, like *P. cuqui* and *P. cuvieri*, presents a median ventral gap, ventrolateral gaps and P3 is usually shorter than the other rows. *Physalaemus fernandezae* and *P. henselli* share the referred features as well (Kolenc *et al.*, 2006). The tadpole of *P. albifrons* presents labial tooth formula 2(2)/3(1, 2), like *P. rupestris* (Nascimento *et al.*, 2001). *Physalaemus albifrons*, *P. marmoratus* and *P. santafecinus* have a V-shaped lower jaw sheath, differing from *P. biligonigerus*, *P. cicada* and *P. cuvieri*, which present a U-shaped one (Cei, 1980; Heyer *et al.*, 1990; Borteiro and Kolenc, 2007; Vieira and Arzabe, 2008).

In all tadpoles of the *Physalaemus albifrons* species group, the vent tube configuration is dextral, a feature shared with other species in the genus, like *P. cuqui* and *P. cuvieri* (Heyer *et al.*, 1990; Perotti, 1997), *P. erythros* (Baêta *et al.*, 2007) and *P. jordanensis* (Gomes *et al.*, 2010). Although in *P. marmoratus*,

![Figure 2. The tadpole of Physalaemus albifrons, stage 38 of Gosner (1960): (A) buccal floor and (B) buccal roof (scale = 1 mm).](image)
P. biligonigerus and P. albifrons, the dextral configuration is only related to its opening, it originates medially and is partially fused to the ventral fin (Nomura et al., 2003; Borteiro and Kolenc, 2007).

**Internal Oral Features** – The tadpole of Physalaemus albifrons is similar to *P. marmoratus* and *P. santafeecinus*, regarding the number of infralabial papillae (Nomura et al., 2003; Perotti and Céspedez, 1999). This feature is shared with some species in the *P. cuvieri* group, such as *P. albonotatus*, *P. centralis* and *P. cuvieri* (Miranda and Ferreira, 2009), differing from *P. albifrons*, *P. santafeecinus* and *P. marmoratus* by the length of those papillae, which are bigger in species from the *P. albifrons* group (Perotti and Céspedez, 1999; Nomura et al., 2003). *Physalaemus albifrons*, on the other hand, presents three independent lingual papillae, similar to some species of the *P. cuvieri* species group (Miranda and Ferreira, 2009).

*Physalaemus albifrons, P. santafeecinus* and *P. marmoratus* present pustulations in the anterior region of the buccal floor (Perotti and Céspedez, 1999, Nomura et al., 2003), which are more dispersed and fewer in number in *P. albifrons*. The BFA in *P. albifrons* and in *P. santafeecinus* are similar in number, location and shape of the papillae (Perotti and Céspedez, 1999), but differ in number of pustulations in the region. Three small papillae that occur in the prenarial area in *P. albifrons* can be misinterpreted as pustulations; they are oriented in a semicircle on the transverse plane of the area. *Physalaemus marmoratus* and *P. santafeecinus* do not present papillae in this area, but they do present pustulations oriented in a semicircle (Perotti and Céspedez, 1999; Nomura et al., 2003).

The position and shape of the internal nares are similar in all four species of the *P. albifrons* species group. The presence of four prenarial papillae is shared by *P. albifrons*, *P. marmoratus* and *P. santafeecinus* (Perotti and Céspedez, 1999; Nomura et al., 2003). The lateral ridge papilla is bifurcated in *P. albifrons* and in *P. marmoratus* (Nomura et al., 2003) and the median ridge presents pustulations in the upper margin in *P. albifrons, P. marmoratus, P. santafeecinus* and *P. biligonigerus*, differing in its shape, which is a semicircle in all species except *P. biligonigerus* (Perotti and Céspedez, 1999; Nomura et al., 2003; Borteiro and Kolenc, 2007). The number of papillae in the roof arena may vary from three to four in *P. albifrons* and *P. marmoratus* (Nomura et al., 2003) and from five to six in *P. santafeecinus* (Perotti and Céspedez, 1999).

To conclude, the following features can distinguish *Physalaemus albifrons* from other tadpoles of *Physalaemus*: single row of marginal papillae with a large rostral gap, two short gaps in the lower lip in the infra angular region and one gap in the median region; labial tooth row formula 2(2)/3(1, 2); median vent tube, partially fused to the tip of ventral fin, and with dextral opening; three lingual papillae oriented in the transverse plane from the floor arena of the oral cavity.

**RESUMO**

Os girinos de *Physalaemus albifrons* utilizados nesta descrição foram obtidos de um casal coletado em uma lagoa permanente em Brotas de Macaúbas, Estado da Bahia, Brasil. As características da morfologia externa são semelhantes aos demais membros do grupo de espécies de *P. albifrons*, diferindo quanto a presença de interrupções na fileira de papilas marginais do lâbio inferior. Fórmula dentária 2(2)/3(1, 2). A morfologia oral interna difere dos girinos de *P. marmoratus, P. santafeecinus* e *P. biligonigerus* pela presença de três papilas linguais, como ocorre no grupo de espécies de *P. cuvieri*.

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