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THE TADPOLE OF *LEPTODACTYLUS NOTOAKTITES* HEYER, 1978 (ANURA, LEPTODACTYLIDAE)

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Abstract. The external morphology and oral disc of the tadpole of *Leptodactylus notoaktites* Heyer, 1978, are described and illustrated for Gosner's stage 33. The internal oral anatomy was analyzed under SEM at Gosner's stage 36 whereas chondrocranial anatomy is reported for Gosner' stage 38. The morphology of this tadpole is compared with those available for other species of the *L. mystaceus* complex. The overall characteristics do not depart from those known for the genus *Leptodactylus* and they particularly agree for those of the *fuscus* species group. The labial tooth row formula is 2(2)/3.

Keywords: *Leptodactylus notoaktites,* tadpole, SEM oral anatomy, chondrocranium.

Introduction

The genus *Leptodactylus* consists of about 82 currently recognized species (Heyer *et al.,* 2005; Frost, 2006) of medium to large size frogs distributed from Central America and throughout South America. Heyer (1978) revised the *fuscus* species group and suggested that *L. mystaceus* (Spix, 1824) – until then considered a taxon of wide distribution from the Amazon Basin to northern Argentina and Southern Brazil – was a species complex. *Leptodactylus notoaktites* was recognized separate from *L. mystaceus* for the populations occurring in the states of Paraná, Santa Catarina, and São Paulo, Brazil (Heyer, 1978). Since then, little is known about the biology of this species and the larval stage of this species is unknown. Herein, we describe and illustrate the tadpole, the internal oral anatomy (using scanning electron microscopy, SEM), and the chondrocranial characteristics of *Leptodactylus notoaktites.*

Material and Methods

A lot of five *Leptodactylus notoaktites* tadpoles was collected by M. Segalla, in October, 1998, at Pousada Itupava, Porto de Cima, Municipality of Morretes, State of Paraná, Brasil (Lat. 25°57'S, Long. 48°53'W). The lot is deposited at the Museu de História Natural Capão da Imbuia, Curitiba, Paraná, Brasil, with number MNHCI 4199. Specimens were fixed in 10% formalin (commercial grade) and staged following Gosner (1960). Tadpoles were preserved during development; for species identification we raised one individual through Gosner's stage 42 (see discussion).

Terminology of oral anatomy follows Altig and McDiarmid (1999). Measurements follow Lavilla and Scrocchi (1986) and Altig and McDiarmid (1999). Measurements were made using a Mitutoyo digital calliper under a binocular microscope with an ocular grid. The description of larval external morphology is based on examination of specimens in Gosner's stages 33, 36, 38, 40 and 42. Tadpole description and illustration is based on a Gosner's stage 33 specimen. A tadpole in Gosner's stage 38 was prepared for chondrocranial analysis; chondrocranial methodology and terminology follows Larson and de Sá (1998). A tadpole in Gosner's stage 36 was dissected for SEM analysis. The specimen was prepared as follows: ultrasonically cleaned for 15 min, fixed in 3-4% solution of glutaraldehyde for 2 h at room temperature (rt), followed by three 15 min washes with 0.1 M phosphate buffer, post fixed for 2 h in a 1% solution of osmium tetroxide rt, three 15 min washes in 0.1 M phosphate buffer were repeated. Subsequently, samples were dehydrated using 15 min changes of the following graded ethanol series: 35%, 50%, 70%, 80%, 95%, and three 100% changes. Specimens were critical point dried in CO_2, mounted on aluminum stubs and sputter coated with gold/palladium, 22 nanometers thick, using a Hummer VII sputtering system. Internal oral anatomy was examined in a Hitachi S-2300 scanning electron microscope at 15 kV, 20 kV and 25 kV and photographed using Polaroid 55 positive/negative film. Morphological features were recorded using the methodology presented by Was-

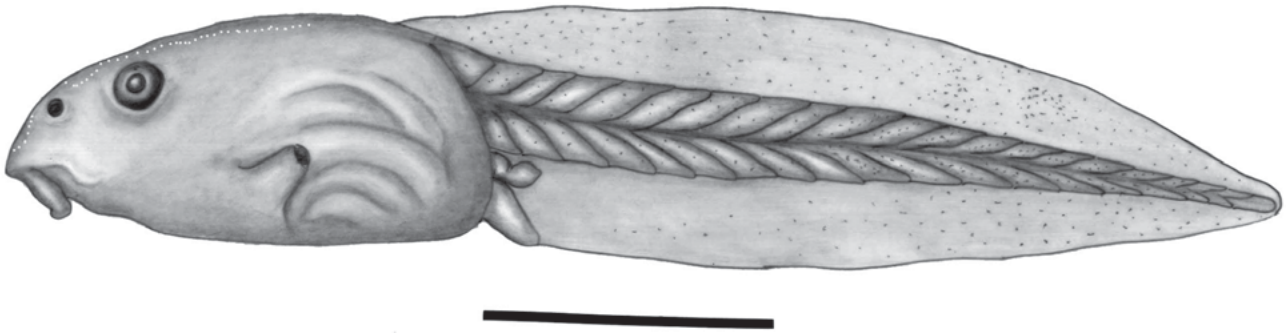

Figure 1: Tadpole of *Leptodactylus notoaktites,* MNHCI 4199, Gosner Stage 33. Bar = 5 mm.

sersug (1976) and Wassersug and Heyer (1988), terminology follows de Sá and Langone (2002).

Results

Tadpole description

External Morphology (Stage 33) – Tadpoles of *Leptodactylus notoaktites* are exotrophic, lotic, and benthic guild members (McDiarmid and Altig 1999, guild IIA1). They have an elliptical and elongated body, which is about 36% of the total length (Fig. 1). The maximum body width is located half way in the body. Dorsally, a slight constriction is visible in the posterior half of the body. In dorsal and lateral views the snout is rounded. The eyes are of medium size and laterally directed; eyes are positioned dorsolaterally on the body and visible in dorsal and lateral view. The external nares are located half way between the eyes and the tip of the snout. Narial openings are small, rounded, and laterodorsally positioned. The lateral line system is distinctly visible. Tail fins are low; dorsal and ventral fins are about equal in height and nearly parallel to the tail musculature. The dorsal fin originates slightly anterior to the tail-body junction and the ventral fin originates at the posterior ventral terminus of the body. Maximum tail height about equal to body height. Tail fins slope to a broadly rounded tail tip. Main tail axis eutiurial. Myotomes of tail musculature defined and extending to the posterior tip of the tail. The spiracle is sinistral, relatively short, and directed dorsolaterally, with a rounded and midlateral opening. The vent tube and vent tube's apertures are medial relatively to the ventral fin.

Measurements in mm – Measurements *sensu* Altig and McDiarmid (1999): body length: 8.0; tail muscle height: 1.5; fin height: 4.3; *sensu* Lavilla and Scrocchi (1986): total length: 22.3; eye diameter: 0.8; interorbital distance: 1.5; body maximum width: 5.5; body width at eyes: 4.6; body width at nostrils: 2.6; body maximum height: 3.9; rostro-spiracular distance: 5.0; frontonasal distance: 1.0; naso-ocular distance: 0.9; nostril diameter: 0.2; internarial distance: 1.2; width of oral disc: 2.0; width of dorsolabial gap: 1.3; body length/total length: 36%; eye diameter/body length: 10%; with of dorsolabial gap/body length: 16.25%.

The oral disc is positioned anteroventrally; it corresponds to about 36.4% of the body width and is not emarginate (Fig. 2). The posterior labium of the oral disc has a single row of large and conical marginal papillae with blunt tips, a large rostral gap occupies most of the upper labium (about 65% of the width of the oral disk); no mental gap is present. No submarginal or intramarginal papillae were found. The labial tooth row formula is 2(2)/(3), all labial tooth rows are sub-equal in length; tooth row A-2 is interrupted by a distinct; labial teeth are serrated. Upper and lower jaw sheaths are wide, pigmented for about 1/3 of their width, and their edge is serrated.

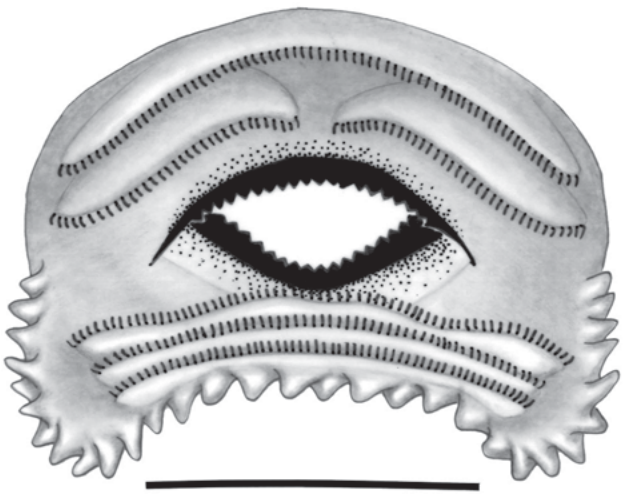

Figure 2: Oral disc of *Leptodactylus notoaktites,* MNHCI 4199, Gosner Stage 33. Bar = 1 mm.

Coloration of Fixed Specimens – Specimens in 10% formalin are overall light brown, with intestinal coils visible through the ventrolateral skin of the body. The dorsal and dorsolateral surfaces of the body are homogeneously brown, grading continuously to a light brown and almost translucent ventral surface. The myotomes of the caudal musculature are well marked. The tail fins and tail musculature are finely speckled with dark melanophores; melanophores are more abundant throughout the dorsal fin and on the posterior half of the ventral fin.

Internal Oral Anatomy – Oral roof overall semicircular, with a broad prenarial arena. A broad rectangular ridge (width about 4X its height) is present in the prenarial arena, immediately in front of the internal nares. Nares are narrow, elliptical, perpendicularly oriented, and placed about one-third way back on buccal roof (Fig. 3A). Narial walls are thick and the anterior edge of each naris bears pustulations; whereas the posterior edge is smooth; no narial valve was observed. Postnarial arena complex. A pair of well-developed, large, and elongated postnarial papillae is found immediately posterior to the naris. The anterior edge of these papillae are serrated and their attenuated tips lie behind and between the internal nares. A few postulations are found on the postnarial arena between the postnarial papillae and the median ridge. The median ridge is overall semicircular with an irregular edge. A pair of simple, large, and conical lateral ridge papillae is oriented transversely on each side of the median ridge; they project medially and their tips lie immediately posterior to the postnarial papillae. Buccal roof arena (BRA) oval-shaped bounded anteriorly by the median ridge and laterally by four pairs of elongated and pointed papillae, with posterior papillae slightly shorter than anterior ones. BRA field evenly scattered with pustulations. Dorsal velum long, curving gradually towards the midline, margin of velum bears papillae and has a distinct medial gap. Glandular zone

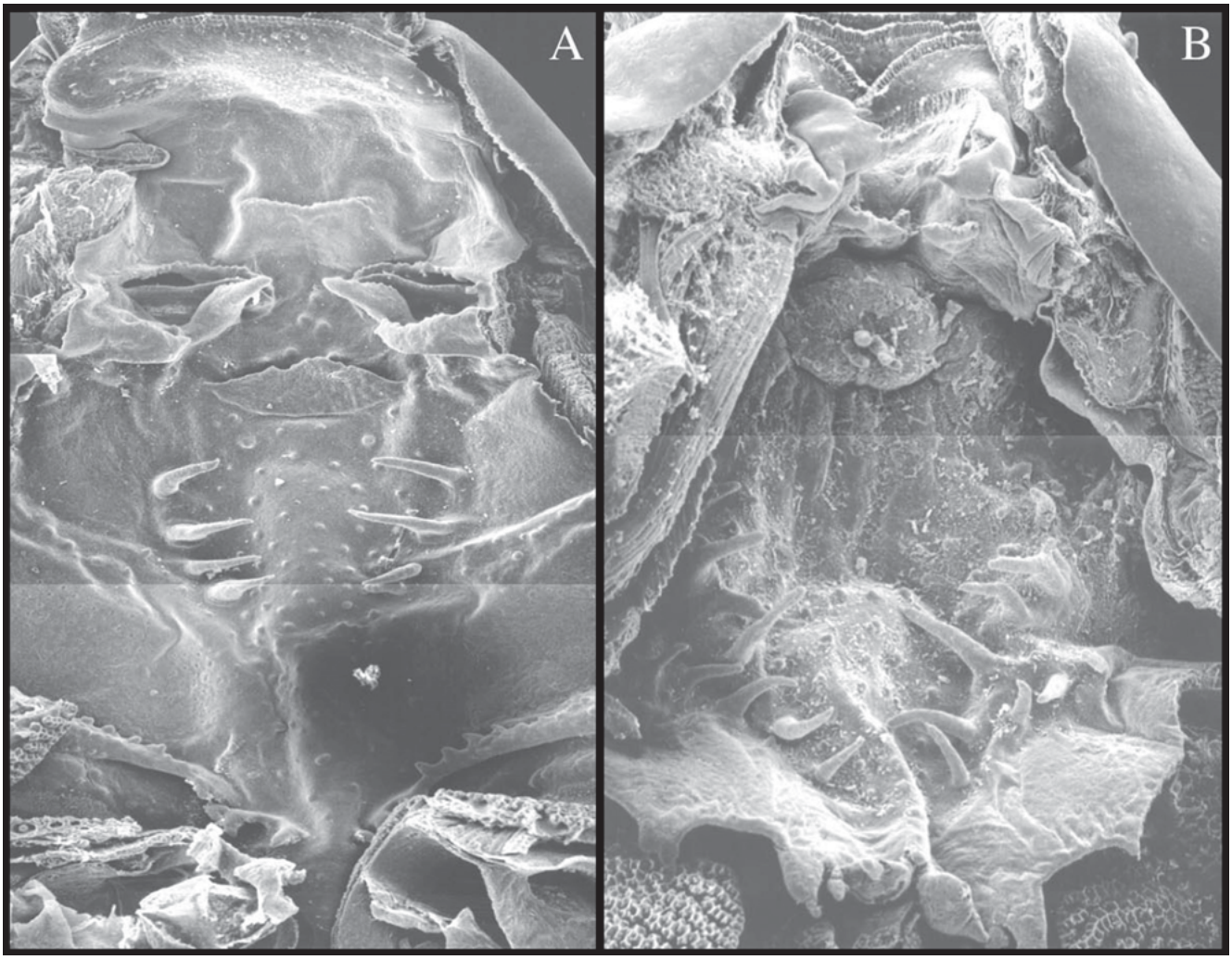

Figure 3: Scanning electron microsopy of the oral anatomy of *Leptodactylus notoaktites,* Gosner Stage 36. A. Oral roof, B. Oral floor.

of velum wide and well defined. Buccal floor overall triangular and broad (Fig. 3B). Two pairs of infralabial papillae present, the most anterior pair is slightly smaller than the transversely oriented second pair. Three long and attenuate lingual papillae are present. Buccal floor arena (BFA) is U-shaped and bounded by about 6-7 pairs of long, attenuate, papillae. A few pustulations are homogenously scattered within the BFA. Velar surface free, long, and with continuous slightly jagged posterior margin. Median notch and secretory pits are absent. Gill filters of moderate size with an average filter mesh.

Chondrocranial Anatomy – The chondrocranium of *L. notoaktites* is slightly longer than wider (Fig. 4A-C). The suprarostral consist of wide corpora, ventrally fused at the midline and forming a U-shaped space between them. The corpora are continuous dorsolaterally with the suprarostral alae. The cornua trabeculae are broad and their length is about 20% of the total chondrocranial length. Both the processus (p.) lateralis trabeculae of the cornua trabeculae and the p. quadratoethmoidalis of the commissura quadratocranialis anterior are distinctly visible. At stage 38, the basicranial fenestra is closed and the cranial floor has completed chondrification; two pairs of foramina, f. craniopalatina and f. carotica primaria, are clearly visible. The orbital cartilages are well developed, and confluent with the otic capsules, forming the lateral wall of the braincase, where the foramen opticum, oculomotorium, and prooticum are visible. Dorsally, a frontal and a parietal fontanellae of about equal size

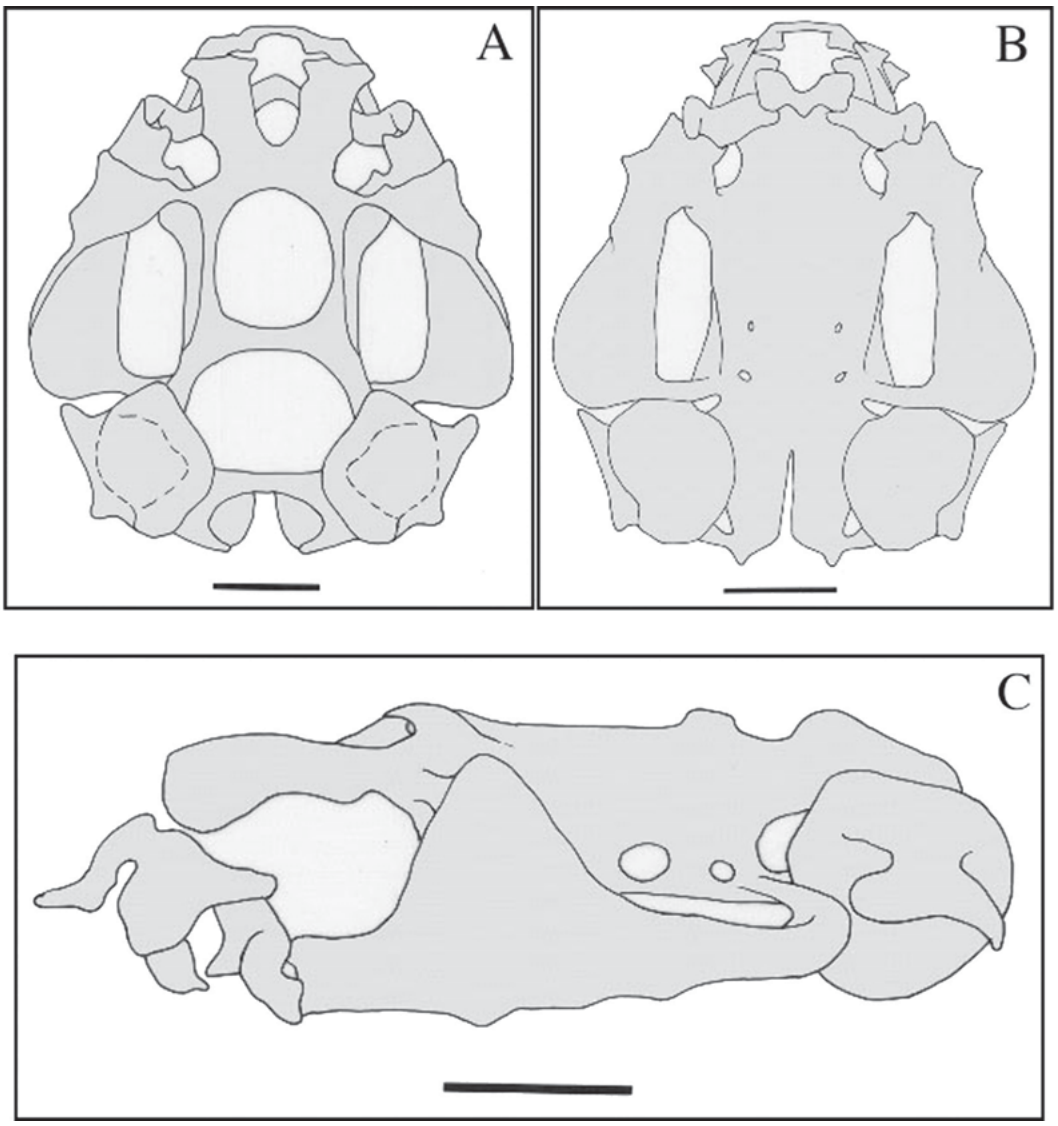

FIGURE 4: Chondrocraneal anatomy of *Leptodactylus notoaktites,* MNHCI 4199, Gosner stage 38. Bar = 1 mm. A. Dorsal, B. Ventral, and C. Lateral views.