Herpetological Conservation and Biology 14(2):370–379.
Submitted: 16 August 2017; Accepted: 30 April 2019; Published: 31 August 2019.

A Description of the Tadpoles of *Hylodes pipilans* Canedo and Pombal, 2007: An Endemic Species of the Atlantic Forest of Brazil

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***Abstract*.—*Hylodes pipilans* Canedo and Pombal, 2007 (no common name) is a lotic stream anuran endemic to the Serra dos Órgãos Mountain Range in the Atlantic Forest area of Brazil. We describe the tadpole of this species, including its chondrocranial skeleton and internal oral features. The tadpoles have elliptical bodies in dorsal and lateral views, rounded snouts in dorsal and lateral views, and elliptical nostrils in dorsal view, with a projection covering the entire inner edge of the nostril. The labial tooth row formula is 2(2)/3(1). The external morphology of *H. pipilans* tadpoles is more similar to that of *H. fredi* (no common name) and *H. meridionalis* (Rio Grande Tree Toad) than other *Hylodes* tadpoles. The condrocranial skeleton is very similar to that of *H. ornatus*; however, the *cornua trabeculae* of *H. pipilans* is longer and thinner than those of *H. ornatus*. The internal oral morphology resembles that of other species of *Hylodes* described previously.**

Key Words.—amphibians; condrocranial skeleton; frogs; Hylodidae; internal oral morphology

Introduction

The genus *Hylodes* is distributed in eastern Brazil from Espírito Santo to Rio Grande do Sul States (Lingnau et al. 2008; Frost, D.R. 2017. Amphibian Species of the World: An Online Reference. Version 6.0. American Museum of Natural History, New York, New York, USA. Available from http://research.amnh.org/herpetology/ amphibia/index.php [Accessed 11 July 2017]). The genus currently comprises 26 species (Sá et al. 2015) of small to medium-sized diurnal frogs that only reproduce in forested lotic streams (e.g., Lingnau et al. 2008; Silva and Benmaman 2008). The genus *Hylodes* has traditionally been divided into four groups (Heyer 1982): the *Hylodes glaber* and *Hylodes mertensi* groups, with one species each; the *Hylodes nasus* group, containing *H. asper* (Warty Tree Toad), *H. cardosoi* (no common name), *H. dactylocinus* (no common name), and *H. nasus* (Santa Catarina Tree Toad); and the *Hylodes lateristrigatus* group, which contains 20 species: *H. amnicola* (no common name), *H. babax* (Caparao Mountains Tree Toad), *H. caete* (no common name), *H. charadranaetes* (Rio Tree Toad), *H. fredi* (no common name), *H. heyeri* (no common name), *H. japi* (no common name), *H. lateristrigatus* (Baumann's Tree Toad) , *H. magalhaesi* (Sao Paulo Tree Toad), *H. meridionalis* (Rio Grande Tree Toad), *H. ornatus* (Ornate Tree Toad), *H. otavioi* (Otavio Tree Toad), *H. perere* (no common name), *H. perplicatus* (Humboldt's Tree Toad), *H. phyllodes* (Boraceia Tree Toad), *H. pipilans* Canedo and Pombal, 2007 (no common name), *H. regius* (Royal Tree Toad), *H. sazimai* (no common name), *H. uai* (no common name), and *H. vanzolinii* (Vanzolini's Tree Toad; Pavan et al. 2001; Malagoli et al. 2017). Of the 26 species in the genus *Hylodes,* only 18 have had their larvae described (Table 1) and the chondrocranium of only two species have been described (Bilate et al. 2012; Nogueira-Costa and Wachlevski 2015).

Hylodes pipilans is restricted to the Serra dos Órgãos Mountain Range (Frost, *op. cit*.), an area located in the Atlantic Forest domain, one of the most threatened biodiversity hotspots in the world (Béllard et al. 2014). The Atlantic Forest harbors great diversity and endemism of anuran amphibians (da Silva et al. 2014), and about 80% of them have tadpoles (McDiarmid and Altig 2000). Despite this great diversity, the tadpoles of several Atlantic Forest anuran species are unknown (Laia and Rocha 2012). Tadpoles are an important life stage

Figure 1. Dorsal view of newly metamorphosed individual of *Hylodes pipilans* (no common name) from Soberbo River, Guapimirim, Rio de Janeiro, southeastern Brazil (specimen MNRJ 35055). Scale bar = 10 mm. (Photographed by Paulo Nogueira-Costa).

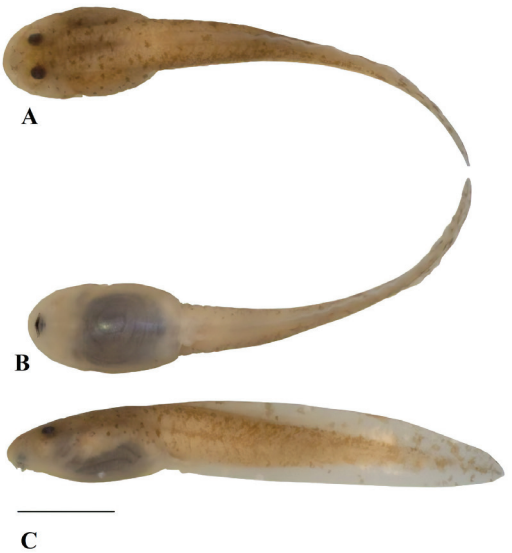

Figure 2. Tadpole of *Hylodes pipilans* (no common name), stage 34, from Soberbo River, Guapimirim, Rio de Janeiro, Southeastern Brazil (specimen MNRJ 35055). (A) dorsal, (B) ventral, and (C) lateral views. Scale bar = 10 mm. (Photographed by Paulo Nogueira-Costa).

of most anurans, and the lack of tadpole descriptions for some species confounds the understanding of several ecological processes for these species (McDiarmid and Altig 2000). In addition, the use of larvae in phylogenetic studies has become increasingly widespread (Haas 2003; Faivovich et al. 2005). Therefore, studies addressing the description of tadpoles are necessary to facilitate understanding of the ecology, evolution, and natural history of amphibians. Herein, we describe the tadpole of *H. pipilans,* including its chondrocranial skeleton and internal oral morphology.

Materials and Methods

We collected 13 tadpoles of *Hylodes pipilans* and housed all specimens at the amphibian collection of the Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ), Brazil. We collected the tadpoles with a hand dip net at its type locality, Soberbo River, Guapimirim, Rio de Janeiro, southeastern Brazil in July 2002 (specimen MNRJ 35043, one tadpole), January 2003 (MNRJ 35045, two tadpoles), March 2003 (MNRJ 35046, five tadpoles), and April 2003 (MNRJ 35055, five tadpoles). We anesthetized tadpoles with 5% lidocaine and then fixed and preserved them in 5% formalin. To confirm species identification, we kept some individuals until metamorphosis (Fig. 1) in a 50-L aquarium with a hang-on external filter operating at 240 L/h. Tadpoles used for measurements and descriptions were in stages 25, 26, 29, 34, and 35 (Gosner 1960).

We measured tadpoles with a digital caliper to the nearest 0.1 mm. External morphology terminology and measurements follow Altig and McDiarmid (1999). We dissected and stained two specimens (stages 26 and 27, MNRJ 35046) with a 1% methylene blue solution for description of internal oral features. Terminology follows Wassersug (1976). We cleared and stained one individual (stage 32) to describe the chondrocranium. Terminology follows Sokol (1981) and Haas (1995).

Results

External morphology—Descriptions below are based in one individual in stage 34 (MNRJ 35055; Table 2; Fig. 2); the range is based on all sampled tadpoles (n = 13; Table 2). The body is elliptical in dorsal and lateral views. Body length corresponds to 33.5% (range, 30.6–36.1%) of the total length, and body height corresponds to 91.9% (85.3–108.5%) of the tail height. The snout is rounded in dorsal and lateral views. Eyes are dorsolaterally located and oriented. The nostril is elliptical in dorsal view with a marginal projection covering the entire inner edge of nostril. This projection is triangular and positioned at the medial region of the inner wall of the nostril (Fig. 3A). Nostril is elliptical in lateral view, dorsolaterally oriented (Fig. 3C), with diameter averaging 9.6% (6.8–11.2%) of the body length. Nine individuals (69.3% of the 13 examined) had a little-developed projection in the nostril (Fig. 3A). The nostril aperture of four individuals (30.8%) cannot be distinguished dorsally, and the projection is well developed (Fig. 3B).

Distance between the eye and nostril is 45.2% (28.7–59.3%) of the distance between the eye and snout; interorbital distance is 92.8% (84.5–112.6%) of the internostril distance; and distance between nostril and

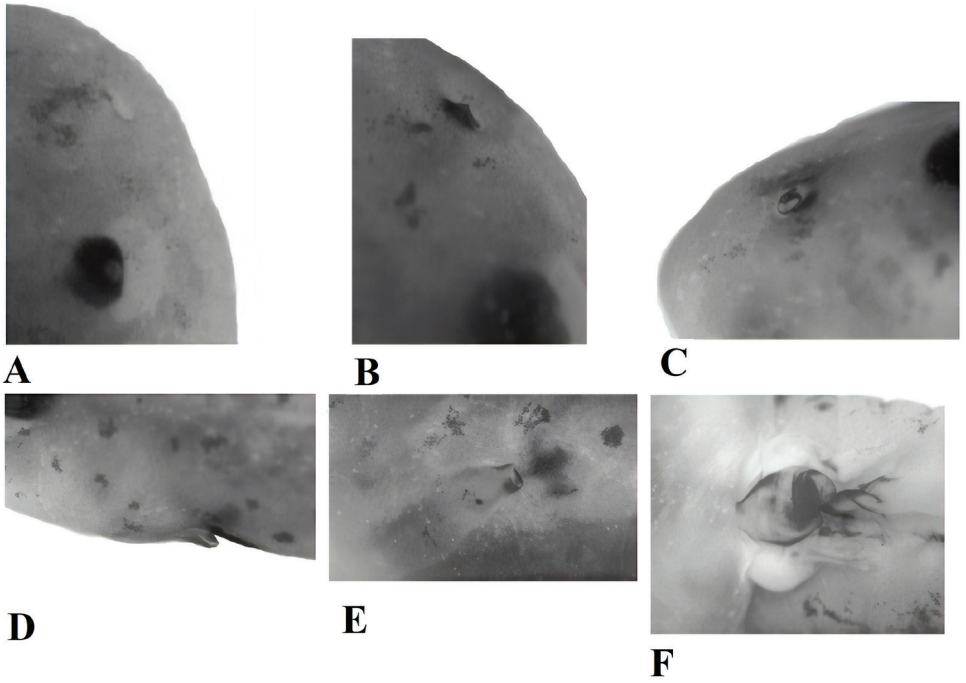

Figure 3. Dorsal view of newly metamorphosed individual of *Hylodes pipilans* (no common name) from Soberbo River, Guapimirim, Rio de Janeiro, southeastern Brazil (specimen MNRJ 35055). Scale bar = 10 mm. (Photographed by Paulo Nogueira-Costa).

snout is 13.2% (9.1–14.6%) of the body length. The spiracle is sinistral, with inner wall free from body, posterodorsally oriented, and tapering towards the aperture, which is elliptical (Fig. 3D and E). The distance between spiracle and snout is 18.5% (16.4–21.1%) of the total length. The anal tube is longer than wide (Fig. 3F), dextral, and attached to the ventral fin with right wall displaced dorsally. The dorsal fin originates at the first third of the caudal musculature; dorsal fin is arched and slightly higher than the ventral fin, which is relatively straight and slightly arched. The tail is higher than the body height (body height corresponds to 81.1% of tail height); tail height represents approximately 67% (62.8–70.6%) of the total length and ends in a pointed tip. The body has a ventral depression anterior to the intestines.

The oral disc is ventral (Fig. 4), bordered by one row of conical marginal papillae (each papilla approximately

Table 1. Species of the genus *Hylodes* and the respective reference for the description of their tadpoles.

Scientific Name	Common Name	Reference
H. amnicola	no common name	Pombal et al. (2002)
H. asper	Warty Tree Toad	Bokermann (1963); Costa et al. (2010)
H. babax	Caparao Mountains Tree Toad	Pirani et al. (2011)
H. charadranaetes	Rio Tree Toad	Costa et al. (2010)
H. dactylocinus	no common name	Pavan et al. (2001)
H. fredi	no common name	Laia et al. (2010)
H. heyeri	no common name	Costa et al. (2009)
H. japi	no common name	Sá et al. (2015)
H. lateristrigatus	Baumann's Tree Toad	Lutz (1930)
H. magalhaesi	Sao Paulo Tree Toad	Gomes et al. (2012)
H. meridionalis	Rio Grande Tree Toad	Nogueira-Costa and Wachlevski (2015)
H. nasus	Santa Catarina Tree Toad	Wogel et al. (2004)
H. ornatus	Ornate Tree Toad	Bilate et al. (2012)
H. otavioi	Otavio Tree Toad	Sazima and Bokermann (1982)
H. perplicatus	Humboldt's Tree Toad	Haddad et al. (2003)
H. phyllodes	Boraceia Tree Toad	Heyer et al. (1990)
H. pipilans	no common name	Present study
H. sazimai	no common name	Haddad and Pombal (1995)
H. uai	no common name	Nascimento et al. (2001)

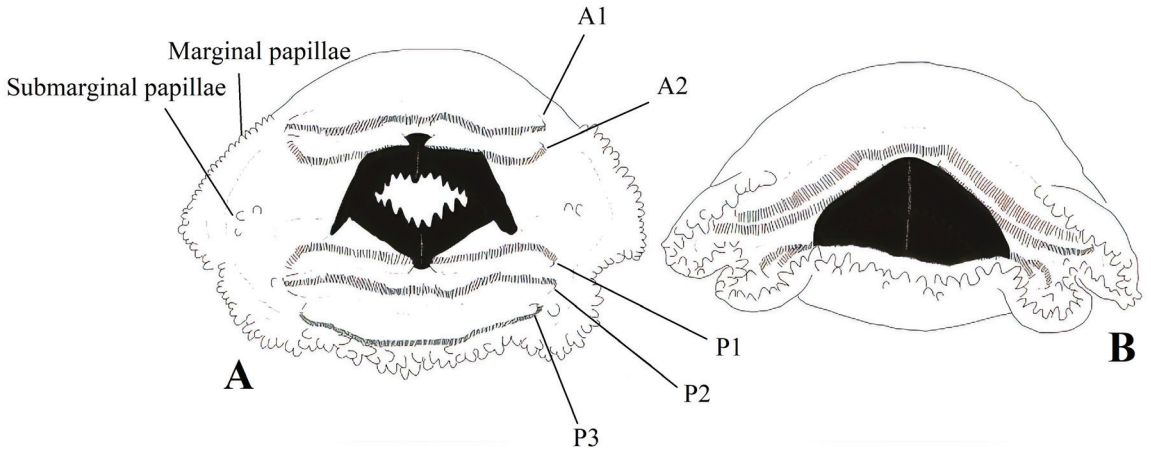

Figure 4. Oral disc of *Hylodes pipilans* (no common name), stage 34 from Soberbo River, Guapimirim, Rio de Janeiro, southeastern Brazil (specimen MNRJ 35055). Oral disc (A) open, and (B) in rest. First (A1) and second (A2) anterior tooth row. First (P1), second (P2), and third (P3) posterior tooth rows.

0.1 mm long), with an anterior interruption in the anterior labium, equivalent to A1 in length. The submarginal conical papillae (approximately 0.1 mm long) are present as a group of three papillae right of the mandible, a group of two papillae left of the mandible, one papilla beside P2 on the right side, and one next to P3 on the left side. The formula of the labial tooth row is 2(2)/3(1): that is, there are two anterior tooth rows (A1 and A2) with the second (A2) interrupted, and three posterior tooth rows (P1, P2, and P3) with the first (P1) interrupted. Tooth row A2 is longer than A1, P2 is longer than P1, and P1 is longer than P3. The jaw sheaths are broad and serrated, with the lower one V-shaped with a medial projection and the upper one U-shaped. The number of labial teeth in A1 are approximately 38/mm.

Coloration.—In life, dorsal and lateral surfaces of the body are brown; the spiracle is transparent; the ventral surface of body is transparent; the tail musculature is light brown with patches scattered throughout the musculature; fins are transparent with brown punctuations; and the tail has golden stripes along the musculature, interrupted or not by transverse dark brown stripes. In preserved specimens, the brown color is less bright than the coloration in life.

Internal oral features.—The buccal floor is triangular, as long as wide with two pairs of infralabial papillae, close to one another (Fig. 5A). The outer pair has a complex structure and is longer than wide, with five finger-shaped projections of irregular margins that

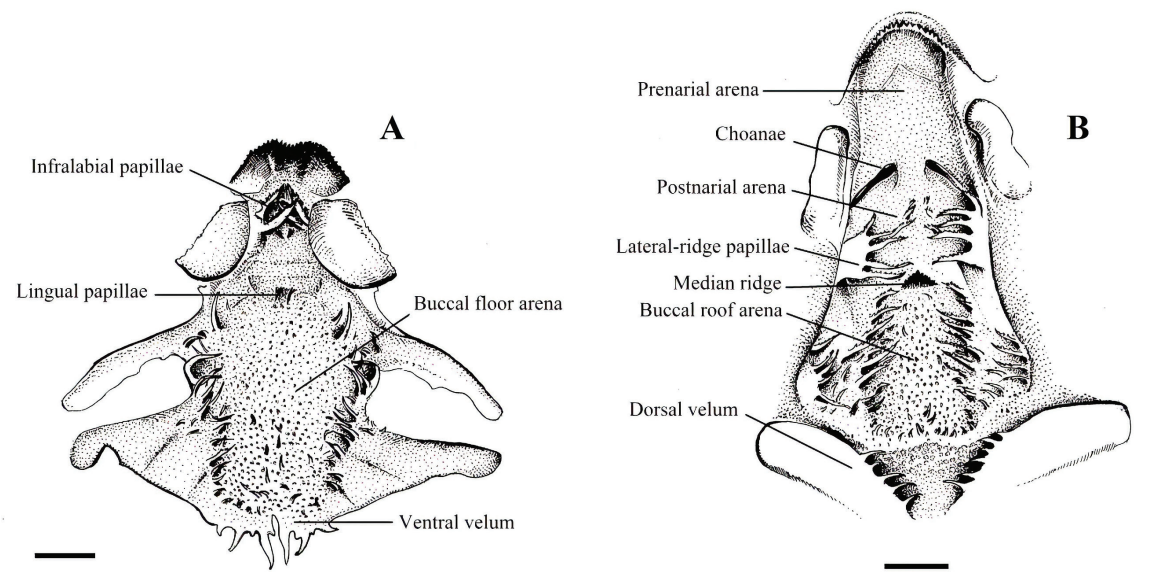

Figure 5. Internal oral features of *Hylodes pipilans* (no common name), stage 27, from Soberbo River, Guapimirim, Rio de Janeiro, southeastern Brazil (specimen MNRJ 35046). (A) Buccal floor, and (B) buccal roof. Scale bars = 1.0 mm.

Table 2. Measurements of the tadpoles of *Hylodes pipilans* (no common name) from Soberbo River, Guapimirim, Rio de Janeiro, southeastern Brazil, for several developmental stages. Data are in millimeters and presented as means ± standard deviation (range). Variables are: total length (TOL), body length (BL), body width (BW), body height (BH), tail length (TL), tail height (TH), dorsal fin height (DFH), ventral fin height (VFH), internostril distance (IND), interorbital distance (IOD), eye diameter (ED), nostril diameter (ND), eye-nostril distance (END), nostril-snout distance (NSD), eye-snout distance (ESD), snout-spiracle distance (SSD), spiracle-vent tube distance (SVD), and oral disc width (OW).

	Stage (n)				
Variable	25 (5)	26 (5)	29 (1)	35 (1)	34 (1)
TOL	41.44 ± 8.94 (28.6–49.3)	46.72 ± 3.09 (42.1–49.6)	50.1	57.7	56.9
BL	13.20 ± 2.15 (10.1–15.4)	14.38 ± 0.89 (13.3–15.4)	15.7	17.4	17.9
BW	5.62 ± 1.48 (3.5–7.1)	7.32 ± 1.09 (6.5–9.2)	8.0	9.4	9.1
BH	4.80 ± 0.74 (3.7–5.5)	5.78 ± 0.82 (5.0–7.0)	6.5	7.0	7.3
TL	28.74 ± 6.33 (19.8–34.7)	32.00 ± 2.42 (28.2–34.7)	34.5	40.8	38.6
TH	5.84 ± 0.97 (4.4–6.7)	7.04 ± 0.53 (6.3–7.8)	8.3	9.6	7.8
DFH	1.66 ± 0.35 (1.0–2.0)	2.00 ± 0.12 (1.9–2.2)	2.4	2.1	2.3
VFH	1.36 ± 0.47 (0.9–2.1)	1.44 ± 0.21 (1.2–1.7)	1.7	1.4	2.2
IND	2.50 ± 0.60 (1.8–3.1)	2.88 ± 0.13 (2.7–3)	3.1	3.6	3.2
IOD	2.64 ± 0.60 (1.7–3.1)	3.12 ± 0.16 (3.0–3.4)	3.7	4.1	3.7
ED	0.72 ± 0.15 (0.5–0.9)	0.76 ± 0.15 (0.6–0.9)	1.0	1.4	1.0
ND	0.34 ± 0.09 (0.2–0.4)	0.4 ± 0.10 (0.3–0.5)	0.6	0.6	0.4
END	1.42 ± 0.41 (0.8–1.8)	1.56 ± 0.11 (1.4–1.7)	1.7	1.9	2.4
NSD	1.44 ± 0.35 (1.1–1.8)	1.82 ± 0.15 (1.6–2.0)	2.2	2.4	2.1
ESD	3.00 ± 0.60 (2.1–3.6)	3.64 ± 0.30 (3.2–4.0)	3.9	4.6	4.4
SSD	6.50 ± 3.04 (1.3–8.8)	8.18 ± 0.54 (7.7–9.0)	8.6	9.0	9.9
SVD	8.90 ± 2.07 (5.6–10.8)	10.10 ± 0.57 (9.4–10.7)	13.0	12.6	12.6
OW	2.42 ± 0.66 (1.6–2.9)	3.04 ± 0.30 (2.7–3.4)	3.4	4.0	3.9

touch each other; the most posterior projection of the outer pair is smaller than other projections and close to the inner pair of infralabial papillae (Fig. 5A). The inner pair is approximately equivalent to half the length of the lingual papilla, tapered, and with a smooth surface. Two filiform lingual papillae are present, positioned side by side, and tapered. The lingual papillae are closer to the first papilla of the buccal floor arena than to the infralabial papilla; approximately 28–30 papillae are on each side, enclosing the buccal floor arena and extending from the region near the tongue rudiments almost to the ventral velum (Fig. 5A). Papillae directed to the arena center are finger-shaped and curved with smooth surface; the larger papilla of the floor arena is bifurcated and chela-shaped, located in the middle portion of the arena. Arena papillae are grouped in two nearly parallel rows. There are approximately 20 minor papillae, filiform in shape. Approximately four pre-pocket papillae are present, similar to those from the buccal floor arena. Pustules are present on the arena surface, concentrated at the posterior portion or arena. The ventral velum has a pronounced median notch, undulated margin, and six finger-shaped projections (Fig. 5A).

The buccal roof is triangular (Fig. 5B). The prenarial arena is without crests or papillae. The internal nares are elliptical, oriented at an angle of 45° in relation to the transverse plane. The distance between choanae is equivalent to the width of the median ridge. The prechoanal papillae are not discernible (Fig. 5B). The postnarial arena has seven to eight papillae that are finger-shaped and arranged on each side in a separate row. The cluster of papillae in postnarial arena form an inverted V, and the largest papillae are finger-shaped with irregular margin, located close to the lateral ridge papillae. There are two conical papillae, ahead of the median ridge (Fig. 5B). The complex lateral ridge papillae are hand-shaped with five ramifications of the anterior margin finely serrated and directed to the center. The median ridge is triangular-shaped with irregular margin. The buccal roof arena is bordered by approximately 15 papillae on each side, finger-shaped, tapered, and with anterior margin low and irregular, directed to the arena center (Fig. 5B). Approximately 10 conical papillae are located at the base of the buccal roof arena. A bifurcate chela-shaped papilla in the arena is absent. The pustules are present and evenly distributed on the arena surface. There is a row of approximately 8–10 lateral papillae on each side of the roof arena; the finger shape of the papillae is distinct. The glandular area is conspicuous. The dorsal velum is medially interrupted, having about five to seven projections (Fig. 5B).

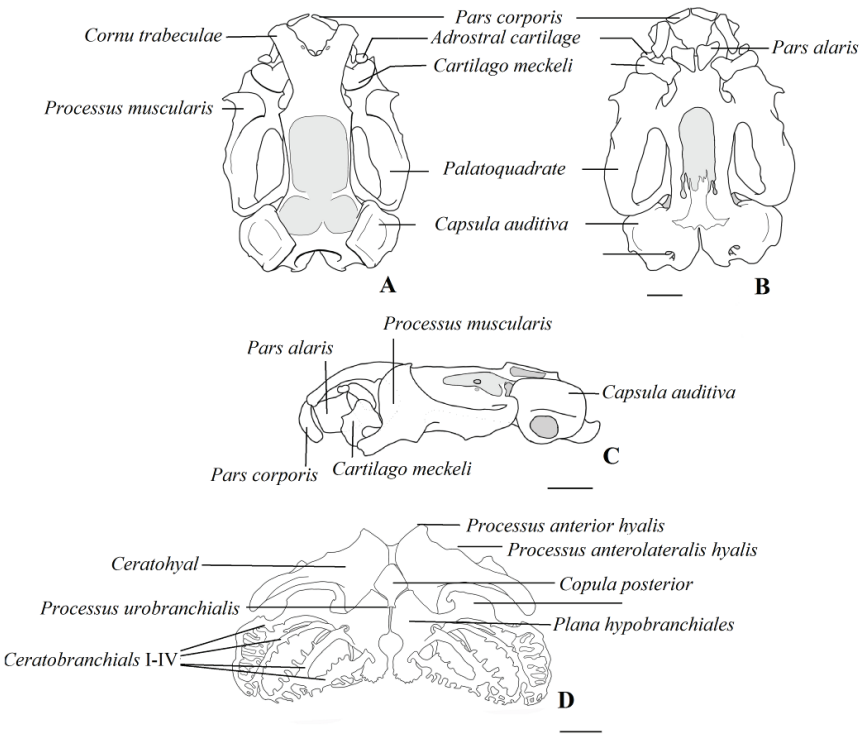

Figure 6. Chondrocranium and hyobranchial apparatus of *Hylodes pipilans* (no common name) tadpoles, stage 32, from Soberbo River, Guapimirim, Rio de Janeiro, southeastern Brazil (specimen MNRJ 35045). (A) Dorsal, (B) ventral, and (C) lateral views of chondrocranium. (D) ventral view of hyobranchial apparatus. Scale bars = 1.0 mm.

Neurocranium.—The *chondrocranium* is longer than wide (Fig. 6). The *cornua trabeculae* is V-shaped, dorsoventrally broad, and flattened. The *processus lateralis trabeculae* is rounded and is present on the ventral posterior margin of the *trabeculae*. The *cartilago suprarostralis* is composed of two squared-shaped elements: the *pars alaris* and *pars corporis*. The ventral edge of the *pars alaris* is rounded and bears a *processus posterior dorsalis,* which articulates with the *cartilago meckeli*. The *adrostral cartilage* is present as a rounded element above the *cartilago meckeli* (Fig. 6).

The *fenestra basicranialis* is absent at the stages analyzed. The *cartilago orbitalis* closes the braincase laterally; this cartilage is attached at the base of the *pila antotica*. The *pila metoptica* separates the *foramen opticum* from the *foramen oculomotorium;* the *foramen opticum* is located anteriorly and smaller than the *foramen oculomotorium*. The *capsula auditiva* is completely separated from the orbital cartilage by the *fissura prootica* (Fig. 6).

The two *capsula auditiva* are connected dorsally by the *tectum synoticum*. The *larval crista parotica* bears a triangular and little-developed *processus posterolateralis*. The *processus oticus* is absent. The *arcus occipitalis* connects the *capsula auditiva* with the *planum basale*. The *arcus occipitalis* is a curved cartilage at an angle of 90° that connects the posterior region of the *planum basale* to the ventral posterior region of the *capsula auditiva*, forming the *foramen magnum* (Fig. 6).

The palatoquadrate is broad, slightly curved, attached to the neurocranium anteriorly by the *commissura quadratocranialis* and posteriorly by the *processus ascendens*. The *commissura quadratocranialis* is a square-shaped cartilage, dorsoventrally oriented, and connecting to the palatoquadrate in the region of the *processus muscularis*. A little-developed *processus antorbitalis* is present in the medial portion of the commissure. The *processus pseudopterygoideus* and the *processus quadratoethmoidalis* are absent at the stages analyzed (Fig. 6).

Anteriorly, the subocular bar of the palatoquadrate curves to form the *processus muscularis*. The *processus muscularis* is dorsally rounded, with two triangular projections, one anterolaterally at its junction with the *pars articularis quadrati* and the other posterodorsally. The *pars articularis quadrati* forms the anterior portion of the palatoquadrate, which is a squared cartilage that articulates the palatoquadrate with the *cartilago meckeli*. The *processus muscularis* curves medially but does not connect with the *processus antorbitalis*. The *facies articularis hyalis* is rounded and articulates the ceratohyal with the palatoquadrate. The *processus ascendens* is an elongated and slightly flattened cartilage

that connects the posterior region of the palatoquadrate to the braincase. The *processus ascendes* is attached to the base of the *pila antotica,* forming a low suspensorium (Fig. 6).

The *cartilago meckeli* is curved and transversely oriented, articulated with the *pars articularis quadrati* anteriorly and with the *cartilago infrarostralis* posteriorly. The *processus dorsomedialis* is rounded and bigger than the *processus ventromedialis,* which is a small triangular element. The *processus retroarticularis* of the *cartilago meckeli* has a ventral curvature around the *pars articularis quadrati* (Fig. 6). The *cartilago infrarostralis* is rectangular, the two elements are in contact medially forming a V-shaped structure. The anterior margin of the structure has a slight concavity that articulates with the *cartilago meckeli* (Fig. 6).

Hyobranchial apparatus.—The *ceratohyal* is elongated perpendicularly to the body axis (Fig. 6D). Each *ceratohyal* has four processes anteriorly: two *processus anterior hyalis* and the two *processus anterolateralis hyalis*. The *processus anterior hyalis* is triangular, with the apex truncate and oriented slightly laterally. The *processus anterolateralis hyalis* is present. The *processus posterior hyalis* is triangular, with the apex directed laterally. The *copula anterior* is absent (Fig. 6D).

The copula posterior is in contact with the *plana hypobranchiales* posteriorly and is a trapezoidal cartilage with a *processus urobranchialis* in the medioposterior region. The *plana hypobranchiales* is a broad and flattened cartilage with a prolongation posteriorly; the *plana hypobranchiales* articulates with the branchial baskets. The *condylus* is triangular shaped with a rounded tip. The branchial baskets are composed of four *ceratobranchials*; the *ceratobranchial* I is the smallest and has a *processus anterior branchialis* that projects into the anterior region of the *processus branchialis* (Fig. 6D). The anterior portions of the *plana hypobranchiales* are confluent with the *ceratobranchial* I; *ceratobranchial* II, III, and IV are articulated with the plana hypobranchiales. The *commissura terminalis* joins the *ceratobranchial* I to II, II to III, and III to IV. Dorsally, the *plana hypobranchiales* has three spiculae, two in the region of the insertion of *ceratobranchial* II and one near the insertion of *cerabranchial* III (Fig. 6D).

Discussion

Hylodes pipilans, *H. fredi,* and *H. meridionalis* are the only species with described tadpoles in *Hylodes* that have dorsal fins that originate before the body-tail junction (Laia et al. 2010). This differentiates these three species from the other *Hylodes*. The tadpoles of *H. fredi* have a larger eye diameter (mean = 1.2 mm; range, 0.8–1.7 mm) and higher tail (mean = 10.1 mm; range, 8.9–11.8 mm) than *H. pipilans* (see *H. pilians* measurements in Table 2).

Of the 26 species of *Hylodes,* 12 have information available on the oral anatomy of their tadpoles: *Hylodes nasus* (Wassersug and Heyer 1988; treated as *Hylodes* cf. *asperus* in error according to Costa et al. 2010a), *H. asper* (Costa et al. 2010a), *H. charadranaetes* (Costa et al. 2010b), *H. ornatus* (Bilate et al. 2012), *H. magalhaesi* (Gomes et al. 2012; Weber and Caramaschi 2013), and *H. dactylocinus*, *H. heyeri*, *H.* aff. *lateristrigatus*, *H. meridionalis*, *H. phyllodes, H. sazimai*, and *H. uai* (Weber and Caramaschi 2013). The larval internal oral morphology of *H. pipilans* resembles that of other species described previously. The internal oral morphology of the 12 species are very similar to each other (Costa et al. 2012; Weber and Caramaschi 2013), differing in the number of papillae and structures such as projections or pustules. The largest infralabial papillae pair is discernible and has five finger projections in *H. pipilans* (four to eight in other species previously studied; Weber and Caramaschi 2013). The presence of the papillae from the ventral arena surface, bifurcate/chela-shaped, and pustules in the surface of the arena, posterior concentrated, are common among the all species studied, included *H. pipilans*. Well-developed projections of the velum above the glottis are also seen in *H. charadranaetes*, *H. heyeri*, *H. magalhaesi*, *H. phyllodes*, and *H. uai* (Weber and Caramaschi 2013).

The presence of a cluster of postnarial papillae arranged like an inverted V in *H. pipilans* is common in other species studied (Weber and Caramaschi 2013). The presence of complex lateral-ridge papillae, hand-shaped, occurs in all species, with five ramifications in *H. pipilans* and four to eight in other species previously studied (Weber and Caramaschi 2013). The triangular-shaped median ridge is present in *H. pipilans* and is the most common form, represented in *H. asper*, *H. charadranaetes*, *H. dactylocinus*, *H. aff. lateristrigatus*, *H. meridionalis*, *H. phyllodes*, and *H. uai* (Weber and Caramaschi 2013). The large number of pustules on the buccal roof arena in *H. pipilans* is also present in *H. charadranaetes*, *H. heyeri*, *H. aff. lateristrigatus*, *H. magalhaesi*, *H. ornatus*, *H. phyllodes*, *H. sazimai*, and *H. uai* (Weber and Caramaschi 2013). The distinct glandular area in *H. pipilans* is present but not so discernible in *H. asper*, *H. dactylocinus, H. heyeri*, *H. meridionalis*, and *H. nasus* (Weber and Caramaschi 2013). Bilate et al. (2012) distinguish between two patterns on the buccal floor and buccal roof arena in the arrangement of the papillae: a V or U arrangement versus two almost parallel lines. We observed the two almost parallel lines in the *H. pipilans* tadpoles. The larval chondrocranial skeleton of *Hylodes pipilans* is very similar to that of *H. ornatus* and *H. meridionalis*. However, the *cornua trabeculae* of *H. pipilans* is longer and thinner than that of *H. ornatus* and shorter and

thicker than that of *H. meridionalis*.

The monophyly of Hylodidae has been corroborated by several works (Nuin and Val 2005; Frost et al. 2006; Grant et al. 2006; Pyron and Wiens 2011); however, the position of this family within the Hyloidea is uncertain. The chondrocranium of *H. pipilans, H. ornatus* (Bilate et al. 2012), and *H. meridionalis* (Haas 2003; Nogueira-Costa and Wachlevski 2015) are similar to that of Dendrobatoidea (*sensu* Grant et. al. 2006). For example, the *processus muscularis* lacks the chondrified *commissura quadratoorbitalis*; the *cartilago suprarostralis* is composed of four elements; the *pars alaris* and *pars corporis* are both separate and articulate distally with the *cornua trabeculae,* which is short; the *processus anterolateralis* is present; the *larval processus oticus* is absent; the *commissural quadratoorbitalis* is absent; *processus anterior branchialis* is present; and the *processus antorbitalis* is conspicuous (Haas 1995, 2003). These similarities suggest a close relationship between *Hylodes* and Dendrobatoidea, as indicated by Grant et al. (2006) and Haas (2003). The verification of these larval characters, however, as putative synapomorphies for the Dendrobatoidea + Hylodidae clade (Grant et. al. 2006) should be tested in a phylogenetic context.

Acknowledgments.—We thank J.P. Pombal, Jr. and U. Caramaschi from Museu Nacional, Universidade Federal do Rio de Janeiro, Brazil (MNRJ); H. Zaher from Museu de Zoologia, Universidade de São Paulo, Brazil (MZUSP); D. Rossa Feres from Departamento de Zoologia, Universidade Estadual Paulista, São José do Rio Preto, Brazil (DZSJRP); L.B. Nascimento from Museu de Ciências Naturais, Pontificia Universidade Católica de Minas Gerais, Brazil (MCNAM); C. Haddad from Coleção Célio F. B. Haddad, Departamento de Zoologia, Universidade Estadual Paulista, Rio Claro, Brazil (CFBH); and A.M.P.T. Carvalho e Silva from Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro, Brazil (UNIRIO) for allowing us to examine specimens under their care. The Museu Nacional, Universidade Federal do Rio de Janeiro provided logistic support. Paulo Nogueira-Costa and M. Bilates received doctoral fellowships from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), and P. Nogueira-Costa was supported by a post-doctoral fellowship from Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ, E-26/201.760/2015, E-26/201.829/2015).

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