

## TWO NEW SPECIES OF TORRENT FROG OF THE GENUS *HYLODES* (ANURA, HYLODIDAE) WITH NUPTIAL THUMB TUBERCLES

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**ABSTRACT:** We analyzed variation among *Hylodes* with nuptial tubercles using morphometrics, vocalization, and external morphology. We identified three species: *Hylodes phyllodes* from the Serra do Mar, State of São Paulo, and southern portion of the State of Rio de Janeiro; a new species from Ilha Grande, municipality of Angra dos Reis; and a new species from the Serra dos Órgãos, municipality of Guapimirim. The new species are both from the state of Rio de Janeiro, southeastern Brazil.

**Key words:** Amphibia; Atlantic Rainforest; *Hylodes fredii*; *Hylodes pipilans*; Hylodinae; Vocalization

SPECIES of *Hylodes* Fitzinger, 1926 occur in southeastern and southern Brazil, associated with rheophilic habitats in the Atlantic rainforest (Haddad and Pombal, 1995; Haddad et al., 1996; Nascimento et al., 2001). *Hylodes phyllodes* Heyer and Cocroft, 1986 was described from Boracéia, São Paulo, and originally placed in the *H. lateristrigatus* species group. This species group contains small to moderate-sized species with slender bodies, smooth dorsum, and light dorsolateral stripes (Heyer, 1982). Actually, it is hard to differentiate between the species groups as the putatively diagnostic characters are continuous and overlap to some extent (Haddad et al., 1996; Pavan et al., 2001). The *H. lateristrigatus* species group is the most diverse in the genus, comprising 15 species: *H. amnicola*, *H. babax*, *H. charadranaetes*, *H. heyeri*, *H. lateristrigatus*, *H. magalhaesi*, *H. meridionalis*, *H. ornatus*, *H. otavioi*, *H. perplicatus*, *H. phyllodes*, *H. regius*, *H. sazimai*, *H. uai*, and *H. vanzolinii*. The other three species groups are composed of one to three species (Pombal et al., 2002).

*Hylodes phyllodes* is characterized mainly by nuptial tubercles on the male thumbs (Heyer and Cocroft, 1986). While examining specimens of *Hylodes* with nuptial tubercles, we identified acoustic and morphological differences among three populations: one from Serra do Mar, distributed from Boracéia to Mangaratiba; one from Ilha Grande, an island off the southern coast of the state of Rio

de Janeiro; and another from Serra dos Órgãos. Detailed morphological and acoustical comparisons among these populations support a new taxonomic arrangement.

### MATERIALS AND METHODS

Institutional abbreviations are those of Leviton et al. (1985) except for CFBH (Célio F. B. Haddad collection, Departamento de Zoologia, I.B., Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil); MCNAM (Museu de Ciências Naturais, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, State of Minas Gerais, Brazil); MZUFV (Museu de Zoologia “João Moojen de Oliveira”, Universidade Federal de Viçosa, Viçosa, State of Minas Gerais, Brazil); and ZUEC (Museu de História Natural, Universidade Estadual de Campinas, Campinas, State of São Paulo, Brazil).

Specimens were split into three different populations for statistical analyses: (1) the population from Serra do Mar, containing the type specimens of *Hylodes phyllodes*, distributed from Boracéia, State of São Paulo, to Mangaratiba, State of Rio de Janeiro; (2) the population formerly referred as *H. phyllodes* (Rocha et al., 1997; Hatano et al., 2002) that occurs in Ilha Grande; and (3) the population from Serra dos Órgãos (Fig. 1).

We measured 80 adult males (55 from the Serra do Mar, 17 from the Ilha Grande, and 8 from the Serra dos Órgãos) for the following characters: SVL (snout–vent length), HL (head length), HW (head width), TD (tympanum diameter), ED (eye diameter), IOD

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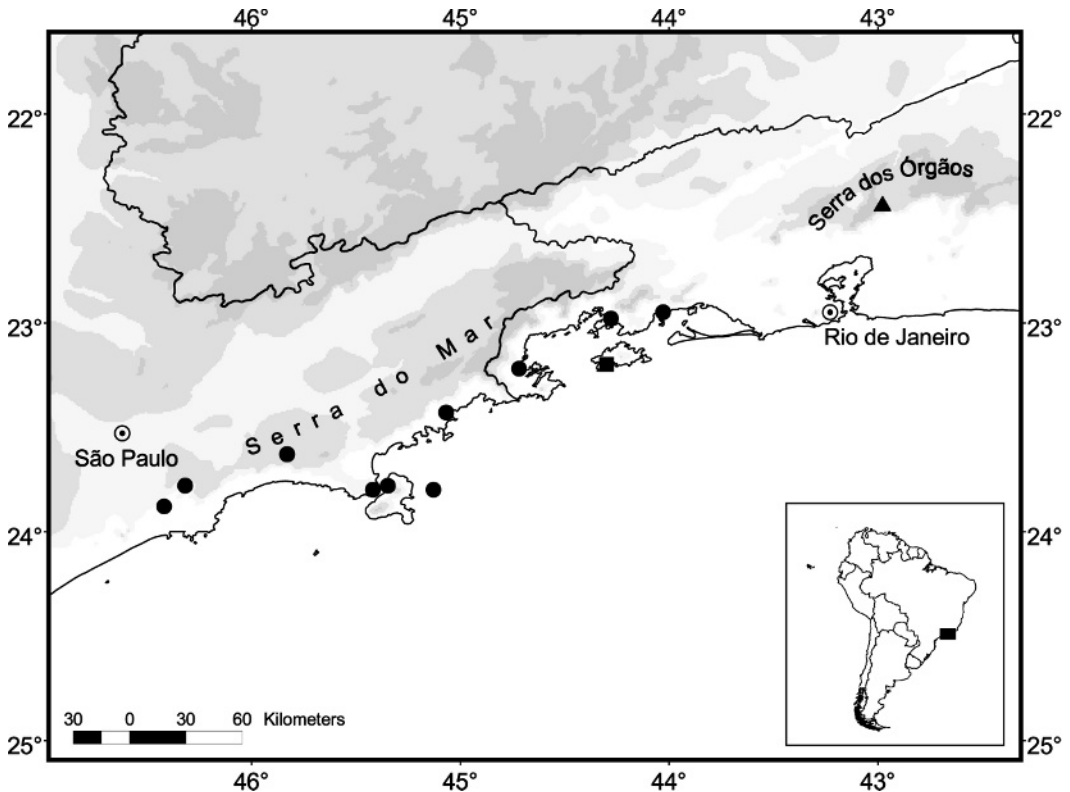


FIG. 1.—Geographical distribution of the examined populations of *Hylodes* with nuptial thumb tubercles: solid circles correspond to specimens from Serra do Mar; square corresponds to specimens from Ilha Grande; triangle corresponds to specimens from Serra dos Órgãos; and open, dotted circles correspond to the largest cities (São Paulo and Rio de Janeiro). Areas above 400, 800 and 1200 m are shaded gray.

(interorbital distance), END (eye–nostril distance), IND (internostril distance), THL (thigh length), TBL (tibia length), and FL (foot length). All measurements (in mm) were taken with calipers to the nearest 0.1 mm, following Cei (1980) and Duellman (2001). We used no females in the statistical comparisons because only one adult female from the population of Serra dos Órgãos is available. Statistics are given as  $\bar{x} \pm SD$ .

We verified size difference with an analysis of variance (ANOVA) on SVL. In order to verify multivariate morphometric differences we used multivariate analysis of variance (MANOVA; Zar, 1999), principal components analysis (PCA; Manly, 2000) and size-free discriminant analysis (Reis et al., 1990). These three analysis are partially redundant, but MANOVA provides a statistic and probability whereas PCA and size-free discriminant analysis only provides a graphic representation

of the differences. The PCA evaluates distribution of the specimens in multivariate space without an a priori definition of groups, while the size-free discriminant analysis studies the variation between and within each previously defined population independent of their size differences. We plotted the scores obtained in the PCA and size-free discriminant analysis and defined the main morphometric characters discriminating the populations in both analyses. Assumptions of univariate normality and homoscedasticity were evaluated with the Kolmogorov-Smirnov's and Levene's tests, respectively (Zar, 1999). We performed statistical calculations with MatLab 4.2c1 for Windows (Mathworks, 1994) and Statistica 6.0 for Windows (Statsoft, 2001) software packages.

We analyzed advertisement calls from specimens of the three populations to provide data on call duration, number of notes per call, rate

of notes (notes/second), note intervals, note duration, call frequency and intensity modulation, call structure, and note modulation and frequency (dominant harmonic). We compare calls of the populations from Ilha Grande and Serra dos Órgãos to three of the original recordings used in the description of *Hylodes phyllodes* by Heyer and Cocroft (1986). We analyzed calls from six specimens from Ilha Grande and five specimens from the Serra dos Órgãos, considering five calls per specimen. Additionally, we analyzed data on call duration, number of notes per call, and rate of notes from 361 calls of eight specimens from Ilha Grande and 449 calls of six specimens from Serra dos Órgãos. To confirm that analyzed calls are advertisement calls, we obtained territorial calls through playback. Recordings were made with a professional Marantz cassette tape recorder coupled to a Sennheiser ME66/K6 microphone set. We made sonograms and waveforms using the program Avisoft-SAS Lab Light, with FFT-Length 256, Frame 100%, and Window Flat top.

Snout profile standards in descriptions of holotypes follow Heyer et al. (1990). Drawings were made using a stereomicroscope with a drawing tube.

#### RESULTS

The distribution of nuptial thumb tubercles shows an important difference among the populations examined. Tubercles are distributed in an elliptical area at the base of the thumb in specimens from Serra do Mar and Serra dos Órgãos (Fig. 2A, C). In the specimens from Ilha Grande, tubercles are scattered all over the dorsum of the thumb (Fig. 2B). Nuptial tubercles are also smaller in the specimens from Ilha Grande.

The three populations differ in adult male SVL ( $F_{2,77} = 267.9$ ;  $P < 0.01$ ;  $n = 80$ ). Adult males from Ilha Grande are larger than the others ( $\bar{x} = 34.4 \pm 1.0$ ; range 32.8–36.7;  $n = 17$ ) whereas specimens from Serra dos Órgãos are the smallest ( $\bar{x} = 24.2 \pm 0.8$ ; range = 23.0–25.1;  $n = 8$ ). Adult males from Serra do Mar have intermediate values ( $\bar{x} = 27.8 \pm 1.3$ ; range 25.4–32.2;  $n = 55$ ).

The MANOVA among the three populations demonstrate significant differences

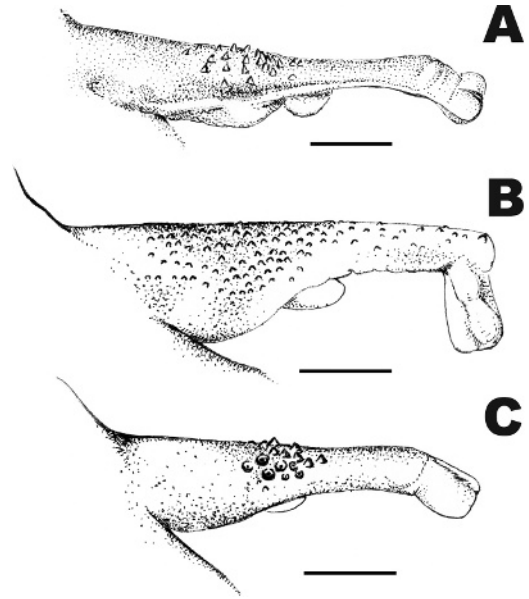


FIG. 2.—Distribution of nuptial tubercles in the thumb of (A) a male from Serra do Mar (MZUSP 1719), (B) a male from Ilha Grande (MNRJ 36077), and (C) a male from Serra dos Órgãos (MNRJ 33765), scale bars 1 mm.

( $R_{22,134} = 28.22$ ;  $P < 0.01$ ;  $n = 80$  adult males). The principle component and size free discriminant function analysis differentiates the three populations mainly by the first principal component and first discriminant function, which represents respectively 94.7% and 93.4% of the entire variation. Each analysis extracted a single function with an eigenvalues greater than 1 heavily weighted by SVL. Other components and functions had eigenvalues less than one and are not judged to be reliable. We were unable to identify morphometric characters other than SVL to distinguish among the species.

Advertisement calls also distinguish the three populations. According to Heyer and Cocroft (1986) and confirmed by our analysis, the advertisement call of *Hylodes phyllodes* (also shown in Heyer et al., 1990) has a duration of 1.05–2.10 s and 12–20 notes per call given at a rate of 8–11 per second; notes emitted at regular intervals at the beginning of the call and usually paired at the end of the call; note duration 0.05–0.06 s; individual notes not pulsed, ascendant frequency modulated; calls slightly frequency modulated, beginning higher, ending lower;

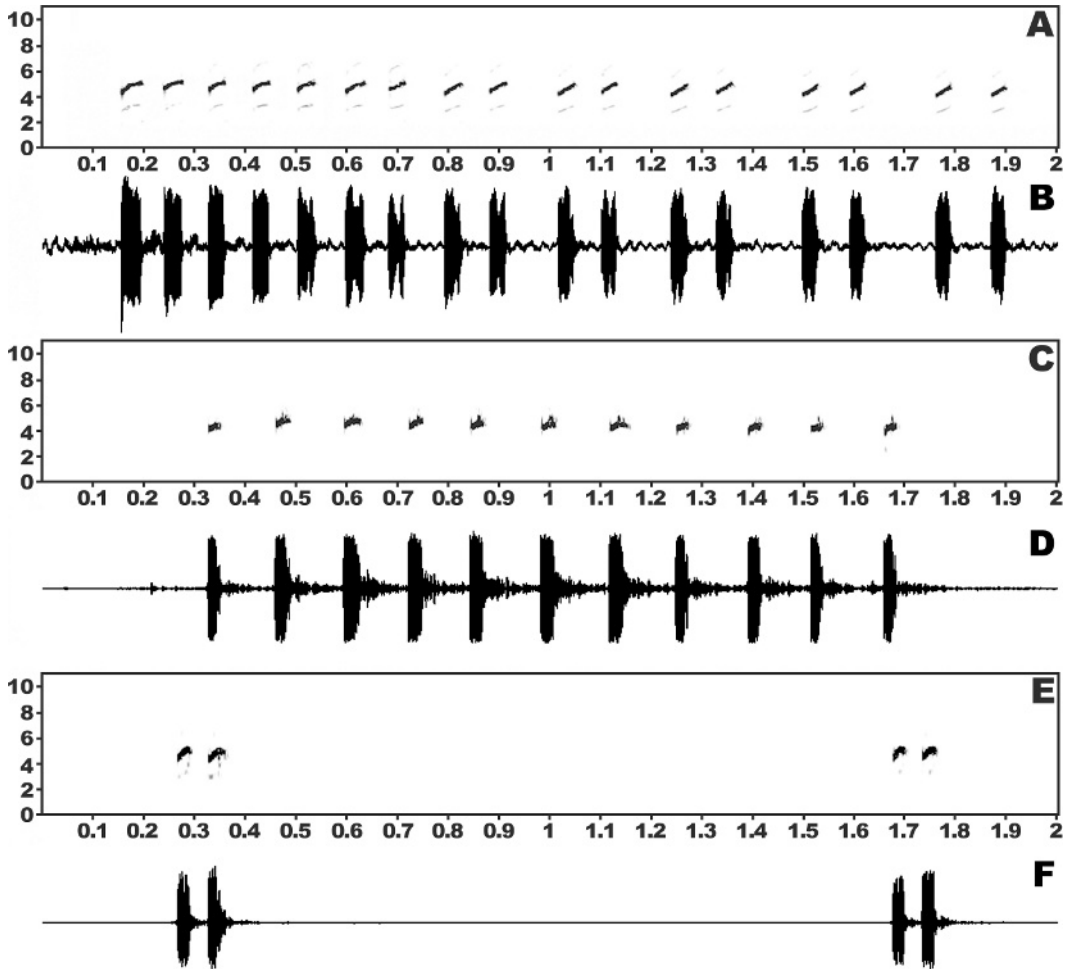


FIG. 3.—Sonograms and waveforms of advertisement calls of (A, B) *Hylodes phyllodes* (MZUSP 59934, holotype), recorded on December 1976, air temperature 20°C; (C, D) a male from Ilha Grande (MNRJ 36077, holotype), recorded on April 2004, air temperature 25°C; and (E, F) a male from Serra dos Órgãos (MNRJ 33765), recorded on October 2002, air temperature 22°C.

call with harmonic structure, fundamental frequency about 1500–2200 Hz; dominant frequency (= third harmonic) at the beginning of the call 4300–5700 Hz, at the end of the call 4100–5300 Hz (Fig. 3A, B).

The population from Ilha Grande (Fig. 3C, D) has an advertisement call duration of 0.59–3.36 s ( $\bar{x} = 1.35 \pm 0.16$  s) and 5–23 notes per call ( $\bar{x} = 10.49 \pm 1.13$ ) at a mean rate of 6.06–9.50 notes per second ( $\bar{x} = 7.85 \pm 0.60$ ). The call consists of two distinct parts: the first has smaller and regular note intervals; the second part is extremely variable, occasionally absent, and with larger and irregular note intervals.

Analysis considering both parts shows note intervals of about 0.06–0.16 s ( $\bar{x} = 0.10 \pm 0.01$  s); note duration of about 0.02–0.04 s ( $\bar{x} = 0.03 \pm 0.01$  s); notes with harmonic structure and ascendant frequency modulation; very weak fundamental and second harmonics; third harmonic dominant (one male emitted one lower frequency note with similar energy both in fundamental and third harmonics at a random position in the sequence of notes, comparing different calls); call modulation slightly ascendant from the first to the second–third notes and descendant to the end; mean dominant frequency of the

first note 3800–4400 Hz, in the second and third notes 3800–4500 Hz; and at the end of the call 3600–4100 Hz; call intensity descendant modulation (first 3–5 notes stronger, the subsequent notes weaker).

The population from Serra dos Órgãos (Fig. 3E, F) has an advertisement call duration of 0.06–0.10 s ( $\bar{x} = 0.08 \pm 0.01$  s) and two notes per call at a rate of 20.58–32.79 notes per second ( $\bar{x} = 26.64 \pm 3.67$ ); note intervals 0.02–0.04 s ( $\bar{x} = 0.03 \pm 0.005$  s); note duration 0.02–0.03 s ( $\bar{x} = 0.02 \pm 0.01$  s); notes with harmonic structure and ascendant frequency modulation; very weak fundamental and second harmonics; third harmonic dominant; calls usually with no noticeable frequency modulation; dominant frequency about 4600–5400 Hz in the first note and 4700–5400 Hz in the second note; males calling in duet may emit calls with descendant frequency modulation (second note with lower frequency).

The territorial calls of *Hylodes phyllodes* have an increase in the number of paired notes (J. P. Pombal Jr., personal observation). The territorial calls of males from Ilha Grande also show an increase in the number of notes. After playback, one male from Ilha Grande emitted longer calls ( $n = 11$ ) with call duration of 4.29–17.92 s ( $\bar{x} = 7.61 \pm 4.23$  s), and 30 to 127 notes ( $\bar{x} = 55.45 \pm 30.54$ ) emitted at a rate of 6.93–8.29 notes per second ( $\bar{x} = 7.28 \pm 0.37$ ). This call is similar to the advertisement call, except for an extended second part. After playback, one male from Serra dos Órgãos emitted calls with more notes (3, 4, and 6) that we consider a territorial call. Calls with three notes ( $n = 3$ ) have descendant frequency; calls with four notes ( $n = 3$ ) have ascendant frequency in the first and second notes and descendant in the others; calls with six notes ( $n = 2$ ) have ascendant frequency from first to fourth notes, descendant in the others, and one (fourth) or two notes (second and third) with lower energy. Another sequence of territorial calls was obtained from two individuals calling in duet, without human interference. One individual emitted three note territorial calls.

On the basis of morphological and acoustical differences among the three populations, we concluded that they represent different

species. The name *Hylodes phyllodes* Heyer and Cocroft, 1986 is applied to the population from Serra do Mar. The other two populations are described herein.

*Hylodes fredii* sp. nov.

Fig. 4 and 5; Table 1

*Hylodes phyllodes*: Rocha et al., 1997:208 (Ilha Grande). Hatano et al., 2002:314 (Ilha Grande).

*Holotype*.—MNRJ 36077, adult male (Fig. 4), collected at Ilha Grande (23°09'S, 44°30'W), Municipality of Angra dos Reis, State of Rio de Janeiro, Brazil, on 3 April 2004, by C. Canedo and F. H. Hatano.

*Paratopotypes*.—MNRJ 10895, adult male, collected on 24 September 1944, by H. Sick; MNRJ 18809, adult male, collected on 26 February 1997 by C. F. D. Rocha; MNRJ 38936, adult male, collected on 17 January 2004 by F. H. Hatano; MNRJ 35191, cleared and stained, adult male, collected on 6 January 1997; MNRJ 35192, adult male, collected on 20 January 1997; MNRJ 35193–95, adult males, collected on 8–9 November 1997; MNRJ 35196–98, adult males, collected on 13 December 1997; MNRJ 35199–203, adult males, collected on 6–7 January 1998; MNRJ 35204, 35206–08, 35210–11, adult males, MNRJ 35205, young female, and MNRJ 35209, adult female, collected on 1–3 February 1998; MNRJ 35214, adult male, and MNRJ 35215, young female, collected on 6 May 1998; MNRJ 35216, 35218, young males, and MNRJ 35217, adult female (no date); MNRJ 35219, young male, collected on 13 April 1996; MNRJ 35220, cleared and stained, adult male, collected on 12 October 1997; MNRJ 35221, adult female, collected on 03 November 1997; MNRJ 35222, adult male, collected on 05 November 1997; MNRJ 35244, young male, collected on 6 May 1998; MNRJ 35245, young female, collected on 29 February 2000; MNRJ 35246, adult female, collected on 27 April 2003; MNRJ 35247, adult male, collected on 09 November 2002; MNRJ 35248, adult male, collected on 16 January 2001; MNRJ 35249, unsexed young, collected on 13 December 2000; MNRJ 35250–54, adult males (no date); MNRJ 35255, young female, and MNRJ 35256–57, cleared and stained, adult female,



FIG. 4.—*Hylodes fredei*, MNRJ 36077 (holotype, SVL 34.8 mm).

collected on 10 April 1999; and MNRJ 35258–62, adult males, collected on 23 March 2000; all collected by F. H. Hatano.

**Diagnosis.**—This new species is diagnosed by following combination of characters: (1) small nuptial tubercles scattered all over the dorsal surface of male thumbs; (2) larger size, compared to the other species of the genus with thumb tubercles (SVL 32.8–36.7 mm in adult males); and (3) advertisement call

composed of two distinct parts: the first with regular note intervals and the second with irregular note intervals.

**Comparison with others species.**—*Hylodes fredei* differs from all congeners, except *H. phyllodes*, by the presence of nuptial tubercles on the male thumbs. *H. fredei* differs from *H. phyllodes* by its larger size (adult male SVL of *H. phyllodes* 25.4–32.2 mm) and the distribution of nuptial tubercles, scattered all over the dorsal surface of the male thumbs (distributed in an elliptical area on the dorsum of thumbs in *H. phyllodes*). Besides these morphological differences, *H. fredei* differs from *H. phyllodes* by the advertisement call without paired notes in the second part (paired notes present in *H. phyllodes*).

**Description of holotype.**—Body slender; head longer than wide; snout nearly rounded to subovoid in dorsal view and protruding in lateral view (Fig. 5); nostrils slightly protuberant, directed laterally; canthus rostralis distinct, straight; loreal region concave; small light tubercles uniformly distributed along margin of upper lip; tympanum rounded, its diameter larger than half of eye diameter; supratympanic fold developed, extending from eye to shoulder, slightly overlapping the dorsal tympanic annulus; weak lateral fold extending from eye, above supratympanic fold, to inguinal region; lateral vocal sacs paired; tongue large, ovoid; vomerine teeth in two small series between choanae; choanae

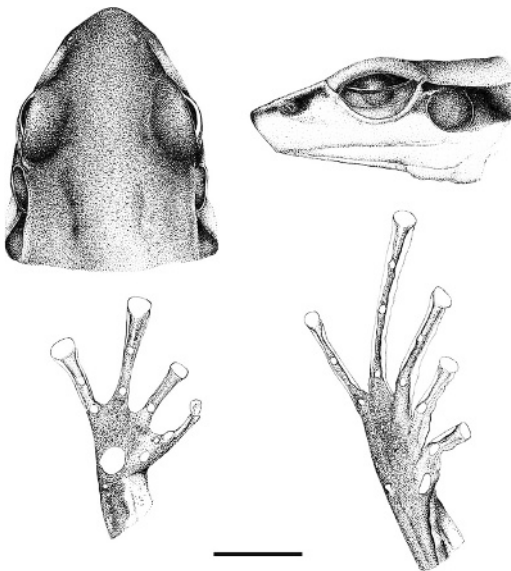


FIG. 5.—Head, hand and foot of *Hylodes fredei*, MNRJ 36077 (holotype, scale bar 5 mm).

TABLE 1.—Snout–vent length and ratios of measurements of *Hylodes pipilans* and *Hylodes fredii* type specimens:  $\bar{x} \pm$  SD (range).

	<i>Hylodes pipilans</i> Males (n = 9)	<i>Hylodes pipilans</i> Female (n = 1)	<i>Hylodes fredii</i> Males (n = 19)	<i>Hylodes fredii</i> Females (n = 9)
Snout–vent Length	24.1 $\pm$ 0.8 (23.0–25.1)	27.7	34.4 $\pm$ 1.0 (32.8–36.7)	35.4 $\pm$ 1.9 (31.7–37.5)
Head Length / Head Width	1.2 $\pm$ 0.1 (1.2–1.3)	1.2	1.2 $\pm$ 0.0 (1.2–1.3)	1.2 $\pm$ 0.0 (1.2–1.3)
Eye Diameter / Tympanum Diameter	1.7 $\pm$ 0.2 (1.5–2.0)	1.9	1.8 $\pm$ 0.1 (1.6–2.0)	1.9 $\pm$ 0.1 (1.7–2.1)
Internostril Distance / Interorbital Distance	1.0 $\pm$ 0.1 (0.9–1.2)	1.1	1.3 $\pm$ 0.1 (1.1–1.4)	1.3 $\pm$ 0.1 (1.2–1.5)
Eye Diameter / Eye–nostril Distance	1.7 $\pm$ 0.2 (1.5–2.2)	1.9	1.8 $\pm$ 0.2 (1.5–2.0)	1.9 $\pm$ 0.2 (1.6–2.2)
Tibia Length / Snout–vent Length	0.5 $\pm$ 0.0 (0.5–0.5)	0.5	0.5 $\pm$ 0.0 (0.5–0.6)	0.5 $\pm$ 0.0 (0.5–0.6)
Foot Length / Thigh Length	1.0 $\pm$ 0.1 (0.9–1.1)	1.0	1.1 $\pm$ 0.0 (1.0–1.1)	1.1 $\pm$ 0.0 (1.0–1.1)
Tibia Length / Thigh Length	1.1 $\pm$ 0.0 (1.0–1.1)	1.0	1.1 $\pm$ 0.0 (1.0–1.2)	1.1 $\pm$ 0.0 (1.1–1.1)

round, small, reaching the lingual shelf of maxilla; maxillary teeth not visible but discernible by probe. Arms and forearms moderately slender; subarticular tubercles single, round; outer metacarpal tubercle large, nearly round; inner metacarpal tubercle small, elliptical; supernumerary tubercles absent in hands; finger lengths II < I = IV < III; thumb with small nuptial tubercles scattered all over dorsal surface (Fig. 2B); thumb almost not fringed along inner margin and slightly fringed along outer margin; other fingers fringed laterally from distal edge of proximal subarticular tubercle to disc, except in outer margin of finger III, where fringe does not reach proximal tubercle; finger tips dilated; discs nearly triangular or elliptical in ventral view, with no marginal grooves; discs of fingers I and II smaller (Fig. 5); upper surfaces of finger discs with well developed scutes. Legs slender; tibia slightly larger than thigh; foot with elongate, ovoid inner metatarsal tubercle and a protruding, round outer metatarsal tubercle; subarticular tubercles single, nearly round, protruding on toes III, IV, and V; supernumerary tubercles absent in feet; toe lengths I < II < V < III < IV; toes extensively fringed laterally; in outer margin of toe V, fringe extends to middle of proximal subarticular tubercle; extensive fold-flap in inner margin of tarsus, continuous distally with fringe on inner side of toe I, almost reaching heel; toe tips dilated; discs nearly elliptical in ventral view, with no marginal grooves; discs of toes I and V smaller (Fig. 5); upper surfaces of toe discs with well-de-

veloped scutes; finger and toe discs similar in size. Dorsal skin texture almost smooth; posterior region of body and proximal portion of thighs with few tubercles; undersurfaces smooth; granular texture near vent and on ventral surface of thighs.

*Measurements of holotype.*—SVL 34.8; HL 12.2; HW 10.5; TD 2.5; ED 4.4; IOD 3.3; END 2.3; IND 4.1; THL 17.0; TBL 17.8; FL 16.1.

*Color of holotype in alcohol.*—Dorsum brown; dorsal surface of legs brown with few conspicuous dark brown bars (one in the middle of thighs, one in the knees, two in the shanks and feet), hidden surfaces of thighs predominantly brown with light blotches. Upper lip whitish below of dark brown stripe, extending from tip of snout to near insertion of arm; whitish dorsolateral line from shoulder to inguinal region; medial, longitudinal brown line in gular region; belly cream with irregular brown blotches; ventral surfaces of thighs and upper arms cream with light-brown blotches; ventral surfaces of forearms, hands, shanks, and feet with small light blotches. Anterior surfaces of arms brown below and cream above.

*Variation.*—Measurements (mean, standard deviation, and range) of paratopotypes are presented in Table 1. Most males have small tubercles on the second finger: 50% ( $n = 19$ ) have 1–12 small tubercles near the disc of the second finger, at least on one hand; 10.5% ( $n = 4$ ) have small tubercles on the middorsal surface of the distal half of the second finger, at least on one hand; 2.5% ( $n = 1$ ) have small tubercles all over the middorsal

surface of the second finger. Females are larger than males and lack vocal sacs, vocal slits, nuptial thumb tubercles, and tubercles along the margin of the upper lip. In females, fingers and toes are less fringed and the tarsal fold is narrower.

*Distribution.*—The new species is known only from Ilha Grande, an island belonging to the Municipality of Angra dos Reis, southern coast of the State of Rio de Janeiro, South-eastern Brazil.

*Etymology.*—The name of the new species honors our friend Carlos Frederico Duarte da Rocha, for his contribution to the knowledge of the ecology of Brazilian amphibians and reptiles and his conservation efforts, especially on Ilha Grande.

*Hylodes pipilans* sp. nov.

Fig. 6 and 7; Table 1

*Holotype.*—MNRJ 33765, adult male (Fig. 6), collected near to the Soberbo River at Serra dos Órgãos (22°22'S, 42°45'W), Municipality of Guapimirim, State of Rio de Janeiro, Brazil on 19 October 2002 by P. A. Abrunhosa, L. N. Weber, and H. Wogel.

*Paratopotypes.*—MNRJ 31928–31, adult males, collected on 1 November 1987 by M. Soares and L. C. Pantoja; MNRJ 33742, cleared and stained, adult male, collected on 12 April 2003 by L. N. Weber; MNRJ 33764, adult male, and MNRJ 33766, cleared and stained adult male, collected with the holotype; MNRJ 35989, adult male, and MNRJ 35990, adult female, collected on 22 March 2004, by P. A. Abrunhosa, L. N. Weber, and H. Wogel; MNRJ 37306, adult male, MNRJ 37307, cleared and stained adult male, and MNRJ 37308, unsexed young, collected on 21 October 2004, by L. N. Weber; MNRJ 39371, adult male, collected on 31 May 2005 by C. Canedo and B. V. S. Pimenta; MNRJ 39374, adult male, collected on 1 April 2005 by C. Canedo and B. V. S. Pimenta.

*Diagnosis.*—This new species is diagnosed by the following combination of characters: (1) pointed nuptial tubercles distributed in an elliptical area at the base of the dorsal surface of male thumbs; (2) small size (SVL about 23.0–25.1 mm in adult males); and (3) advertisement call composed of only two notes.

*Comparison with others species.*—*Hylodes pipilans* differs from all congeners except *H.*

*phyllodes* and *H. fredei* by the presence of nuptial tubercles on the male thumbs. *Hylodes pipilans* differs from *H. phyllodes* and *H. fredei* by its smaller size (combined adult male SVL of *H. phyllodes* and *H. fredei* 25.4–36.7 mm) and the advertisement call with only two notes (12–20 notes per call in *H. phyllodes*; 5–23 in *H. fredei*). Further, *H. pipilans* differs from *H. fredei* by the distribution of nuptial tubercles in an elliptical area at the base of thumb (distributed all over the dorsum of thumbs in *H. fredei*).

*Description of holotype.*—Body moderately slender; head longer than wide; snout round in dorsal view and protruding in lateral view (Fig. 7); nostrils slightly protuberant, directed laterally; canthus rostralis distinct, slightly curved; loreal region concave; small light tubercles uniformly distributed along margin of upper lip; tympanum rounded, its diameter larger than half of eye diameter; supratympanic fold developed, extending from the posterior corner of eye to shoulder, reaching the dorsal tympanic annulus; weak lateral fold extending from the eye, above the supratympanic fold, to inguinal region; lateral vocal sacs paired, with small tubercles; tongue large, rounded; vomerine teeth in two small series between choanae; choanae elliptical, reaching the lingual shelf of maxilla; maxillary and premaxillary teeth not visible but discernible by probe. Arms slender, forearms moderately robust; subarticular tubercles single, rounded; outer metacarpal tubercle large, nearly round; inner metacarpal tubercle small, elliptical, weakly developed; supernumerary tubercles absent in hands; finger lengths  $II < I = IV < III$ ; corneous, pointed nuptial tubercles in an elliptical area at the base of dorsal surface of thumbs (Fig. 2C); inner margin of thumb not fringed, outer margin weakly fringed; other fingers fringed laterally from distal edge of proximal subarticular tubercle to disc; finger tips dilated; discs nearly triangular in ventral view, with no marginal grooves; disc of finger I smaller, nearly rounded (Fig. 7); upper surfaces of finger discs with well developed scutes. Legs slender, tibia slightly larger than thigh; foot with elongate inner metatarsal tubercle and small, protruding, round outer metatarsal tubercle; subarticular tubercles slightly protruding, larger, slightly elliptical



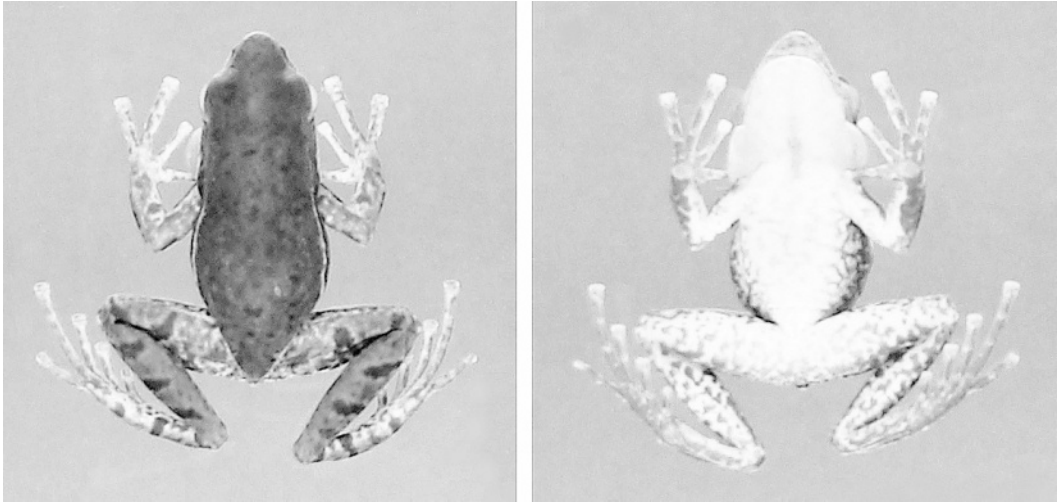


FIG. 6.—*Hylodes pipilans*, MNRJ 33765 (holotype, SVL 25.1 mm).

on toes I and II, smaller and round on toes III, IV, and V; supernumerary tubercles absent in feet; toe lengths  $I < II < V < III < IV$ ; toes extensively fringed laterally; in outer margin of toe V, fringe extends to the level of distal edge of proximal subarticular tubercle; extensive fold-flap in inner margin of tarsus, continuous distally with fringe on inner side of toe I, almost reaching heel; toe tips dilated; discs

nearly triangular in ventral view, with no marginal grooves; discs of toes I and V smaller, nearly rounded (Fig. 7); upper surfaces of toe discs with well developed scutes. Dorsal skin texture almost smooth with few small tubercles scattered, texture slightly rugose in dorsal surfaces of legs; posterior region of the body and flanks with a few tubercles; undersurfaces smooth; granular texture near vent and on ventral surface of thighs.

*Measurements of holotype.*—SVL 25.1; HL 9.8; HW 7.8; TD 1.8; ED 3.1; IOD 3.3; END 2.0; IND 3.6; THL 12.8; TBL 13.8; FL 12.7.

*Color of holotype in alcohol.*—Dorsum brown with darker brown blotches; dorsal surface of legs brown with anteriorly incomplete, dark brown bars (one in the middle of thighs, one in the knees, three in the shanks and feet), hidden surfaces of thighs marbled with brown and light blotches. Upper lip whitish below of dark brown stripe, extending from the tip of snout to near insertion of arm, with brown blotches anteriorly; light dorsolateral line from shoulder to inguinal region; medial, longitudinal brown line in posterior portion of gular region; belly cream with irregular, small brown blotches; ventral surfaces of thighs and upper arms cream with brown blotches; ventral surfaces of forearms, hands, shanks, and feet brown with darker blotches; anterior surface of arms with a cream

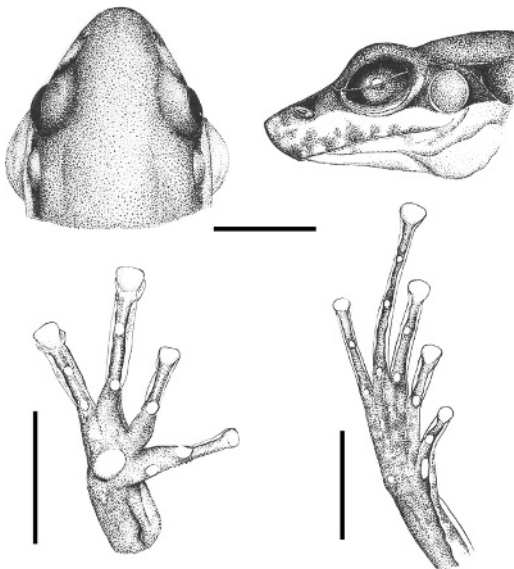


FIG. 7.—Head, hand and foot of *Hylodes pipilans*, MNRJ 33765 (holotype, scale bars 5 mm).

longitudinal line, continuous to the line of the lateral surface of head, margined on both sides by a brown area.

*Color in life*.—(MNRJ 39371, paratype) Dorsum dark brown and slightly greenish; dorsal surface of legs greenish brown, with three dark brown bars in the thighs, shanks, and feet, and one dark brown bar in the knees. A well defined silver line on the lateral area of head, bordering the upper lip; a copper line anterior to the eye; white dorsolateral line from the shoulder to the inguinal region; flank dark brown. Belly silver with irregular brown blotches; a medial, longitudinal brown line on the gular region; vocal sacs brown; ventral surface of thighs and upper arms reddish brown; ventral surfaces of forearms, hands, shanks, and feet brown, with darker blotches. Anterior surface of arms with a longitudinal cream line, continuous to the line of the lateral surface of head, edged on both sides by a brown area; proximal region of forearm with a longitudinal cream line. Iris brown.

*Variation*.—Measurements (mean, standard deviation, and range) of paratopotypes are given in Table 1. Half of the males (50%,  $n = 5$ ) lack the corneous cover of the tubercles, probably lost after collection, since four of them are preserved for more than 18 yr. The female is larger than males and lacks vocal sacs, vocal slits, nuptial thumb tubercles, and tubercles along the margin of the upper lip. In the female, fingers and toes are less fringed and the tarsal fold is narrower.

*Distribution*.—*Hylodes pipilans* is known only from Serra dos Órgãos, in the Municipality of Guapimirim, State of Rio de Janeiro, Southeastern Brazil.

*Etymology*.—The species name, *pipilans*, is a Latin word that means “who sings like a bird”, referring to the advertisement call of this species.

#### DISCUSSION

Our analysis of morphometric parameters, external morphology, and vocalization differentiates three species: *Hylodes phyllodes*, as formerly recognized, was a species complex. This result reflects a need for more studies of *Hylodes* as well as most anuran genera from Brazilian Atlantic rainforest.

There is no recent taxonomic revision of *Hylodes*, although at least two studies include deeper discussion of the genus: Heyer (1982) and Heyer and Cocroft (1986) recognized eleven species, described four others including *H. phyllodes*, and proposed the species groups. Since those papers, seven new species of *Hylodes* have been described (Haddad and Pombal, 1995; Haddad et al., 1996; Nascimento et al., 2001; Pavan et al., 2001; Pombal et al., 2002; this paper). This genus occurs mainly in the Atlantic rainforest, in southern and southeastern Brazil, including the best studied regions in terms of herpetology of that country (i.e., those surrounding the large cities of São Paulo and Rio de Janeiro). Still, recent descriptions of anuran species from the Brazilian Atlantic rainforest are not uncommon, e.g., *Brachycephalus brunneus* (Ribeiro et al., 2005), and *Aplastodiscus eugenioi* (Carvalho-e-Silva and Carvalho-e-Silva, 2005). One of the new species described here occurs in a mountain area near Rio de Janeiro, a very well studied place and type locality of many anuran species described in the 19th and early 20th centuries (e.g., Miranda-Ribeiro, 1926; Lutz, 1930).

The Atlantic rainforest is the biome with the greatest endemism and richness of anurans in the world (Duellman, 1999). The description of two species in the vicinities of large cities shows that the Brazilian Atlantic rainforest anurans are still insufficiently known.

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#### APPENDIX I

##### Additional Specimens Examined

*Hylodes amnicola*: State of Minas Gerais: Aiuruoca MNRJ 3953; Lima Duarte, Parque Estadual do Ibitipoca MNRJ 24859 (holotype), CFBH 3719–21, MNRJ 24846–47, 24860–61, 25650–55, 26309, 26856–58, MZUFV 4117–19 (paratypes). *Hylodes asper*: State of Rio de Janeiro: Duque de Caxias, Barro Branco MNRJ 666, 1276, 1517, 1554, 1980, 2008, 8116, 8187, 8189, 10472–73; Duque de Caxias MNRJ 2316; Mangaratiba MNRJ 33090; Parati MNRJ 1375, 1631, 7568–72, 32859; Teresópolis MNRJ 31106–08, 33476, MZUSP 2038, 53426. State of São Paulo: Apiaí MZUSP 21882, 21886, 21888; Salesópolis, Boracéia MZUSP 1753, 1761, 1766, 1768, 4033, 4035, 4037, 4039, 23755, 23759, 23761, 23764, 23563–64, 37586–87, 37661–63, 37665–66, 37711, 37764; Santo André, Paranapiacaba MZUSP 8852–54; Ubatuba, Picinguaba MZUSP 130196–97; Paranapiacaba, Caminho do Mar MZUSP 23551, 23554–55, 10236, 10238, 97601. *Hylodes babax*: State of Minas Gerais: Parque Nacional do Caparaó MZUSP 57949 (holotype). *Hylodes charadraetaes*: State of Rio de Janeiro: Nova Friburgo MNRJ 27074; Teresópolis, Serra dos Órgãos MZUSP 60663–66 (paratopotypes), MNRJ 31175–76, 31841–47, 33771. *Hylodes dactylocinus*: State of São Paulo: Peruíbe, Estação Ecológica Juréia-Itatins MZUSP 89901, 89903–04, 89906, 89909–14, MNRJ 31199–200 (paratopotypes). *Hylodes glaber*: State of Rio de Janeiro: Itatiaia MNRJ 3486, 3564, 3900, 14517, 15238–40, 31105, 31118–20, 31122–25, 31178–79, 31181–84, 31186–88, 31818–19, MZUSP 12732–33, 12735–36, 58994, 60827–28, 60830–38, 60841. *Hylodes heyeri*: State of São Paulo: Eldorado, near to Caverna do Diabo MNRJ 17090 (holotype), CFBH 2465–68, MNRJ 17091, ZUEC 8238, 8240, 8242–43, 8249–50, 8253–54 (paratopotype). *Hylodes lateristrigatus*: State of Rio de Janeiro: Nova Friburgo MNRJ 23625–27, 33739; Teresópolis MNRJ 2007, 5055, 10467, 23628, 31833–35, 31839, MZUSP 53259–61. *Hylodes magalhaesi*: State of São Paulo: Campos de Jordão MZUSP 73676 (holotype), MZUSP 73622–29, 73677, 73705, 74439, MNRJ 3973, 14219

(paratopotypes), MZUSP 112658, 112661–62, 112664–65. *Hylodes meridionalis*: State of Rio Grande do Sul: São Francisco de Paula MZUSP 112851, 112853–55. *Hylodes mertensi*: State of São Paulo: Paranapiacaba, Caminho do Mar (old highway São Paulo-Santos) MZUSP 74171 (holotype), MZUSP 10017. *Hylodes nasus*: State of Rio de Janeiro: Rio de Janeiro MNRJ 87–88, 1445, 1856, 1860, 1864, 1866, 1869, 2671, 3089, 10192–93, 10195, 10200, 10204, 10207, 10212–14, 12492, 13698–99, 18478–79, 18481–82, 26894, 26896, 29210–12, 31853–62, 31875–81, 31884, 31894–908, 31932–36, 31938–40, 32075–84, 33398, 33743–44, 34198, 34200–02, 34205, 35113. *Hylodes ornatus*: State of Rio de Janeiro: Itatiaia MZUSP 73679 (holotype), MZUSP 73682–83, 73871–81, 74433 (paratopotypes), MNRJ 3550, 14521–22, 14544–45, 31112–13, 31115, 32069–70, 33405, MZUSP 60683, 60843–45, 96195, 130384–86. *Hylodes otavioi*: State of Minas Gerais: Jaboticatubas, Serra do Cipó MNRJ 4163 (holotype), MZUSP 73575–77. *Hylodes perplicatus*: State of Santa Catarina: Humboldt MNRJ 89 (lectotype), MNRJ 545, 5589, 5595 (paralectotypes); Jardim MZUSP 60697; São Bento do Sul CFBH 3570, 3572–74, MNRJ 30587; Timbé do Sul MZUSP 60698, 60700. *Hylodes phyllodes*: State of Rio de Janeiro: Parati MNRJ 1256, 31849–52, 33393; Angra dos Reis 30933; Mangaratiba MNRJ 37900–01. State of São Paulo: Salesópolis, Boracéia MZUSP 59934 (holotype); MZUSP 1700–02, 1704–06, 1708–11, 3308, 23681–91, 23693–97, 36874, 37702–03 (paratopotypes); Cubatão MZUSP 64747; Paranapiacaba, Caminho do Mar MZUSP 10216; São Sebastião, Ilha Bela MNRJ 24303–04, Ilha dos Búzios MNRJ 23952, 23954; Ubatuba MNRJ 34479–83, MZUSP 84582. *Hylodes regius*: State of Minas Gerais: Itamonte, Vargem Grande MNRJ 4110 (holotype); MNRJ 4109, 4111–12 (paratopotypes). *Hylodes sazimai*: State of São Paulo: Campinas, Joaquim Egídio ZUEC 9004 (holotype), MNRJ 15869, MZUSP 69637 (paratopotypes); Campinas, Sousas MNRJ 34697. *Hylodes uai*: State of Minas Gerais: Belo Horizonte, Mangabeiras MNRJ 23771 (holotype), CFBH 2984–85, MNRJ 23772–75, 23777, MCNAM 1333, 1763 (paratopotypes). *Hylodes vanzolinii*: State of Minas Gerais: Parque Nacional do Caparaó MZUSP 57950 (holotype), MZUSP 52923 (paratopotype).