ocephali, Chimaeridae), from the Eastern North Atlantic, and redescription of *Hydrolagus affinis* (Brito Capello, 1867). Arch. Fisch. Wiss. 40:229–248.

LEVITON, A. E., R. H. GIBBS JR., E. HEAL AND C. E. DAWSON. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985:802–832.

MANILO, A. G., AND Y. V. MOVCHAN. 1989. First record of long-nosed chimaera, *Neoharriotta pinnata*, from the Arabian Sea. J. Ichthyol. 29(7):136–141. [Translation of original publication in Voprosy Ikhtiologii 1989, 29(6):908–913].

NORMAN, J. R. 1939. Fishes. Scientific report of the John Murray Expedition 1933–34. 7:14–15.

POLL, M. 1951. Poissons I. Généralités. II. Sélaciens et chimères. Expéd. Océanogr. Belge Eaux Côt. Afric. Atlant. Sud 4:144–152.

SCHNAKENBECK, W. 1929. über einige Meeresfische aus Südwestafrika. Mitt. Zool. Staatsinst. Zool. Mus. Hamburg 44:23–45.

SEWELL, R. B. S. 1912. Notes on the deep-sea fish obtained by the R.I.M.S.S. "Investigator," during the survey season 1910–11. Rec. Ind. Mus. 7:1.

SILAS, E. G., AND G. S. D. SELVARAJ. 1980. Studies on demersal fishes of the deep neritic waters and the upper continental slope. 3. On *Neoharriotta pinnata* (Schnackenbeck), a potentially important resource. J. Mar. Biol. Ass. India 22:149–158.

THOMAS, K. 1980. A nitrocellulose embedding technique for vertebrate morphologists. Herp. Rev. 14: 80–81.

WOOD-MASON, J., AND A. ALCOCK. 1891.fbNatural history notes from H. M. Indian marine survey steamer "Investigator." On the results of deep-sea dredging during the season 1890–91. Ann. Mag. Nat. Hist. 8:16–34.

(DAD) ACADEMY OF NATURAL SCIENCES, 1900 BENJAMIN FRANKLIN PARKWAY, PHILADELPHIA, PENNSYLVANIA 19103-1195; AND (MS) INSTITUT FÜR SEEFISCHEREI, PALMAILLE 9, D-22767, HAMBURG, FEDERAL REPUBLIC OF GERMANY. Send reprint requests to DAD. Submitted: 14 March 1995. Accepted: 2 Feb. 1996. Section editor: R. Winterbottom.

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New Species of *Hylodes* from the Atlantic Forest of Brazil (Amphibia: Leptodactylidae)

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A new species of leptodactylid frog is described from Eldorado, state of São Paulo, southeastern Brazil. The new species is a member of the *Hylodes lateristrigatus* group and is characterized by its large size, slightly rugose to rugose dorsal skin texture, robust body, and high number of notes per call. Descriptions of the advertisement call and information on natural history are provided.

FROGS of the genus *Hylodes* are restricted to eastern Brazil, mainly associated with the Atlantic forests (Haddad and Pombal, 1995). In this genus, there are 16 species currently recognized in four groups: one in the *H. glaber* group, 10 in the *H. lateristrigatus* group, one in the *H. mertensi* group, and four in the *H. nasus* group (Haddad and Pombal, 1995). The *H. lateristrigatus* group contains small- to moderate-sized species characterized by slender bodies, smooth dorsums, and light dorsolateral stripes (Heyer, 1982). The species presently allocated to the *H. lateristrigatus* group are *H. babax* Heyer, *H. charadranaetes* Heyer and Cocroft, *H. lateristrigatus* (Baumann), *H. magalhaesi* (Bokermann), *H. ornatus* (Bokermann), *H. otavioi* Sazima and Bokermann, *H. phyllodes* Heyer and Cocroft, *H. regius* Gouvêa, *H. sazimai* Haddad and Pombal, and *H. vanzolinii* Heyer. Haddad and Pombal (1995) undertook a general survey in Brazilian museum collections that revealed a large number of unnamed species of this genus, mainly within the *H. lateristrigatus* group. Herein, we describe a new species of the *Hylodes lateristrigatus* group from the surroundings of Caverna do Diabo, Atlantic forest at Eldorado, in the southern part of the state of São Paulo, southeastern Brazil.

Fig. 1. *Hylodes heyeri*, MNRJ 17090 (holotype), an adult male in life.

Materials and Methods

Vocalizations were recorded with a Nagra E tape recorder and Sennheiser ME 80 microphone at a tape speed of 19 cm/sec. We analyzed the tapes on a Macintosh Classic computer coupled to the MacRecorder Sound System 2.0.5, using 256 points. Institutional abbreviations are as listed in 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), WCAB (Werner C. A. Bokermann collection, São Paulo, Brazil), and ZUEC (Museu de História Natural, Universidade Estadual de Campinas, Campinas, São Paulo, Brazil). Measurements are in millimeters. Abbreviations used in the account are SVL (snout–vent length), HL (head length), HW (head width), ED (eye diameter), END (eye-nostril distance), TD (tympanum diameter), THL (thigh length), TBL (tibia length), and FL (foot length). The measured specimens were fixed and preserved.

Hylodes heyeri sp. nov.

Holotype.—MNRJ 17090 (Fig. 1), adult male, collected next to the Caverna do Diabo, (approximately 24°35'S, 48°35'W; 450 m above sea level), Município de Eldorado, Estado de São Paulo, Brasil, on 4 Nov. 1994 by C. F. B. Haddad, J. P. Pombal Jr., and R. P. Bastos.

Paratopotypes.—CFBH 2465-68, three adult males and one adult female collected with the holotype; MNRJ 17091, an adult male collected with the holotype; ZUEC 8238, 8240, 8242-43, 8249-50, 8253-54, eight males collected on 13 Jan. 1980 by A. J. Cardoso, E. Schechtmann, and E. V. V. Oliveira.

Diagnosis.—The largest and most rugose species in the *H. lateristrigatus* group (Heyer, 1982), characterized by large size (males 36.4–42.6 mm SVL); snout rounded in dorsal view and acuminate-protruding in lateral view; upper surfaces of feet, toes, hand, and fingers, and lateral surface of thumb, with enlarged tubercles; upper surfaces of finger discs with well-developed scutes; and dorsum dark brown.

Comparison with other species.—*Hylodes heyeri* is the largest and most rugose species in the *H. lateristrigatus* group (see Haddad and Pombal, 1995, and references therein). The new species differs from *H. babax*, *H. charadranaetes*, *H. ornatus*, *H. regius*, and *H. vanzolini* by its more acuminate snout; from *H. ornatus*, *H. vanzolinii*, and *H. sazimai* by the presence of well-developed scutes on the upper surfaces of the finger discs. The dorsum of *H. heyeri* lacks the distinct color pattern and the dorsal yellow spots of *H. ornatus*, *H. regius*, and *H. vanzolinii* (Bokermann, 1967; Gouvêa, 1979; Heyer, 1982). The new species can be distinguished from *H. lateristrigatus* by its less distinct dorsolateral stripes, and from *H. magalhaesi* by its less distinct white stripe on the upper lip. From *H. phyllodes*, the new species differs by the lack of nuptial thumb spines in males (see Heyer and Cocroft, 1986); from *H. vanzolinii* by the presence of vocal slits and sacs (see Heyer, 1982); and from *H. otavioi* by the less developed fringes on the fingers and toes.

The advertisement call of *H. heyeri* differs from those of all other known species in the *H. lateristrigatus* group by the high number of notes per second. The call duration of the new species is longer than that of *H. babax* and shorter than those of *H. otavioi*, *H. regius*, and *H. sazimai*. The note duration of the new species is shorter than those of *H. charadranaetes*, *H. lateristrigatus*, *H. otavioi*, and *H. phyllodes*. The number of notes per call of the new species is higher than those of *H. babax*, *H. charadranaetes*, *H. lateristrigatus*, *H. otavioi*, and *H. phyllodes*. The dominant frequency of the call of *H. heyeri* is higher than that of *H. magalhaesi* and lower than those of *H. babax*, *H. charadranaetes*, and *H. regius*; the advertisement call of the new species is distinguished from that of *H. phyllodes* also by the absence of notes given in pairs at the end of the call and from that of *H. charadranaetes* also by the absence of descending frequency modulation (for comparative data, see Heyer and Cocroft, 1986).

Description of holotype.—Body robust (Fig. 1); head longer than wide, snout round in dorsal view and acuminate-protruding in lateral view (Fig. 2A–B); nostrils slightly protuberant, directed laterally; canthus rostralis distinct; loreal region concave; tympanum distinct, large, diameter about three-fourths eye diameter; weak supratympanic fold extending from the back of the eye to the groin; well-developed lateral vocal sacs; vocal slits present; tongue medium-sized; vomerine teeth in two small series, between choanae; choanae small, round. Arms robust; thumb with nuptial asperities and without spines; subarticular tubercles single, round (Fig. 2C); outer metacarpal tubercle nearly round, inner metacarpal tubercle elliptical; finger lengths II < I < IV < III; fingers laterally fringed; finger discs medium-sized, nearly triangular; upper surfaces of finger discs with well-developed scutes; finger and toe discs of about equal size. Legs robust; foot with an elliptical inner metatarsal tubercle (Fig. 2D) and a protruding round outer metatarsal tubercle; subarticular tubercles single, round; toes extensively fringed laterally; extensive tarsal fold-flap continuous distally with toe fringe on outer side of first toe; upper surfaces of feet, toes, hand, and fingers, and lateral surface of thumb, with enlarged tubercles; toe discs nearly triangular; upper surfaces of toes discs with well-developed scutes. Dorsal skin texture slightly rugose; posterior region of the body and flanks dorsally rugose; undersurfaces smooth; rugose texture near the vent and on the ventral surfaces of the thighs.

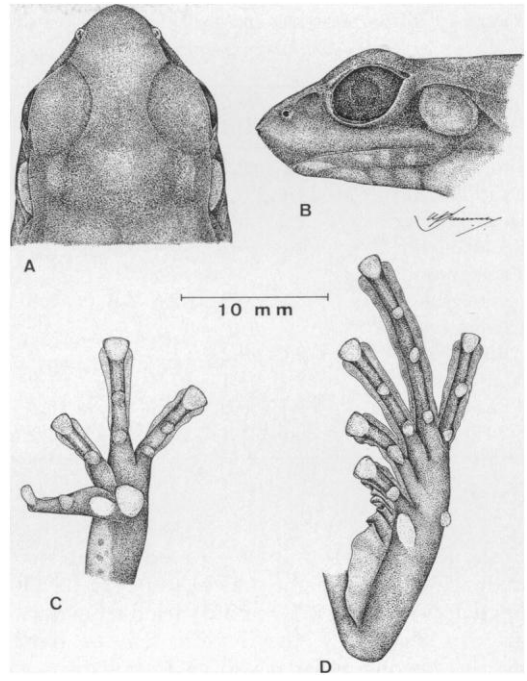

Fig. 2. *Hylodes heyeri*, MNRJ 17090 (holotype). (A) Dorsal and (B) lateral views of head; ventral views of (C) hand and (D) foot.

Color in life of the holotype.—Dorsum dark brown; upper surfaces of forelimbs, tibia, and foot brown with dark irregular spots; upper surface of thigh and groin greenish brown with dark irregular spots; brownish white line extending from the shoulder to the groin; a whitish lateral stripe extending from tip of snout to the arm insertion; throat silver-gray; belly dark gray with cream marbling; lower surfaces of hindlimbs brown with dark brown marbling; iris cupreous.

Color in preservative of the holotype.—In preservative (70% alcohol), the colors are similar to those in life, except for the greenish-brown areas and iris which become brown. All the brown tones became dark brown and the dark brown tones became black.

Measurements of the holotype.—SVL 41.3; HL 16.0; HW 12.6; ED 4.7; END 2.3; TD 3.6; THL 20.7; TBL 22.1; FL 21.8.

Variation.—Dorsal skin texture varied from slightly rugose to rugose; the enlarged tubercles on the upper surfaces of feet, toes, hand, and fingers, and lateral surface of thumb are lacking

TABLE 1. MEASUREMENTS OF MALES AND FEMALE OF *Hylodes heyeri* IN mm.

	Males (n = 13)			Female (n = 1)
	$\bar{X}$	SD	Range	
Snout–vent length	39.3	2.1	36.4–42.6	45.0
Head length	15.0	0.7	14.2–16.0	16.6
Head Width	12.7	0.6	11.5–13.7	13.5
Eye diameter	4.6	0.3	4.1–5.0	5.3
Tympanum diameter	3.0	0.3	2.6–3.6	2.8
Eye–nostril distance	2.2	0.2	1.7–2.6	1.9
Thigh length	20.1	1.1	17.9–21.9	21.8
Tibia length	21.7	0.9	20.5–23.1	23.4
Foot length	20.6	1.1	18.8–21.9	23.1

in the female and in one male, reduced in two males, evident in eight males, and very developed in two males. Belly in life varied from dark gray to silver-gray; the dorsum may be dark brown or brown with dark brown irregular spots. Measurements of 13 males and one female are presented in Table 1.

Vocalizations.—Advertisement calls given sporadically; at an air temperature of 21–23 C the call durations are 0.72–1.53 sec (1.05 ± 0.24, n = 32); 21–37 notes per call (27.63 ± 4.76, n = 32) given at a rate of 23.4–29.9/sec (26.72 ± 2.23, n = 32); notes given at regular intervals; note duration 0.03–0.04 sec; each note is a rising frequency-modulated whistle with a dominant frequency (= third harmonic) range of 3.7–4.3 kHz; call with harmonic structure (Fig. 3, upper). Encounter calls with 1–4 frequency-modulated notes (2.09 ± 0.89, n = 55); note duration and dominant frequency similar to those of the advertisement call (Fig. 3, lower).

The streams inhabited by the new species have waterfalls that produce high noise; the dominant frequency in the third harmonic apparently allows for a communication channel free from the frequencies of the waterfall noise (Bastos and Pombal, 1995).

Natural history.—Males of *H. heyeri* were observed calling in Nov. and Jan. (wet season). Males are diurnal and call from shaded places on rocks and in rock crevices of small- to medium-sized streams; some males were observed calling near a stream inside a cave (Caverna do Diabo). The frogs are wary, hiding in rock crevices or plunging into the water when disturbed. Females were observed in the same environment occupied by males; oviposition and tadpoles are unknown.

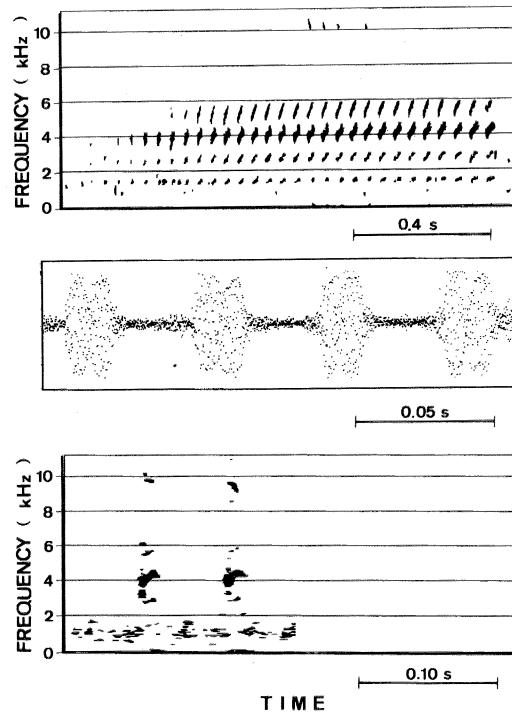

Fig. 3. Sonagram (upper) and wave form (middle) of the advertisement call of *Hylodes heyeri*; the wave form corresponds to the last four notes in the sonagram. Sonagram (lower) of the encounter call of *H. heyeri*. Both vocalizations were recorded on 5 Nov. 1994; air temperature 21 C.

Distribution.—The new species is known only from the type locality in the vicinity of Caverna do Diabo, Eldorado, State of São Paulo, southeastern Brazil.

Etymology.—The name of the new species honors Ron Heyer for his contribution to the knowledge of Brazilian anurans.

Remarks.—Heyer (1982) proposed four species groups for *Hylodes* based on external morphology; such groups, including the *lateristrigatus*, were recognized by Heyer and Cocroft (1986) as not necessarily monophyletic convenience groupings. Although *H. heyeri* is presently considered in the *H. lateristrigatus* group, because individuals show the diagnostic light dorsolateral stripes (Fig. 1), this species has some morphological features suggesting relationship with the *H. asper* group, such as large size, robust body form, and granular dorsal surfaces (Fig. 1). Detailed morphological and genetic studies are necessary to formulate an adequate phylogenetic hypothesis for the species of the genus *Hylodes*.

Additional Specimens Examined

Hylodes babax MZUSP 57949 (holotype); *H. charadranaetes* MZUSP 60648 (holotype), MZUSP 60649-59 (paratypes), ZUEC 8091-92, 8094-98, 8326-27 (topotypes); *H. lateristrigatus* AL-MNRJ 2364 (topotype), MZUSP 53259-61 (topotypes); *H. magalhaesi* WCAB 34318-19, 34322, 34327, 34334, 37681, 37683-84, 45342, 45345 (topotypes); *H. ornatus* MZUSP 60682-83, 60843-45 (topotypes), ZUEC 737-38, 4087 (topotypes); *H. otavioi* ZUEC 3351-53, 5022 (paratypes); *H. phyllodes* MZUSP 59934 (holotype), 1716-1721 (paratypes), ZUEC 2615, 6365-66, ZUEC 6411 (topotype), 6797, 6987-89, 8420; *H. regius* MNRJ 4110 (holotype), 4106, 4108-09, 4111-12 (paratypes); *H. sazimai* MNRJ 15869 (paratype), MZUSP 69637 (paratype), ZUEC 9004 (holotype).

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Literature Cited

Bokermann, W. C. A. 1967. Una nueva especie de *Elosia* de Itatiaia, Brasil (Amphibia, Leptodactylidae). Neotropica 13:135–137.

Bastos, J. P., And J. P. Pombal Jr. 1995. New species of *Crossodactylus* (Anura: Leptodactylidae) from the Atlantic rain forest of southeastern Brazil. Copeia 1995:436–439.

Gouvêa, E. 1979. Uma nova espécie de elosiineo da Serra do Itatiaia (Amphibia, Anura, Leptodactylidae). Rev. Brasil. Biol. 39:855–859.

Haddad, C. F. B., and J. P. Pombal Jr. 1995. A new species of *Hylodes* from southeastern Brazil (Amphibia: Leptodactylidae). Herpetologica 51:279–286.

Heyer, W. R. 1982. Two new species of the frog genus *Hylodes* from Caparaó, Minas Gerais, Brasil (Amphibia: Leptodactylidae). Proc. Biol. Soc. Washington 95:377–385.

———, and R. B. Cocroft. 1986. Descriptions of two new species of *Hylodes* from the Atlantic forests of Brazil (Amphibia: Leptodactylidae). *Ibid.* 99:100–109.

Leviton, A. E., R. H. Gibbs Jr., E. Heal, and C. E. Dawson. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985:802–832.

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