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A New Species of *Hylodes* from Southeastern Brazil (Amphibia: Leptodactylidae)

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APPENDIX I

Material Examined

Osornophryne antisana. Ecuador: Napo: Volcán Sumaco, SE of summit, QCAZ 4573, 4574, 4575. Napo:

vía Salcedo-Oriente, 3500–3600 m, eastern slopes, QCAZ 411. Tungurahua: Páramos dellangantes, QCAZ 1648.

Osornophryne bufoniformis. Ecuador: Departamento de Carchí; Santa Barbara, 2650 m, KU 189945; Páramo del Angel, 23 km SW Tulcán, KU 117880. Imbabura: Cordillera de Intag, La Delicia, KU 132126. USNM 322774–5. Provincia Napo; Santa Barbara, USNM 193537–193540. Colombia: Departamento de Cauca: Municipio Paez, carretera al paramo de Santo Domingo, 3200–3300, Pedro M. Ruiz coll. 28.x.1972, MCZ 100559; Paramo Purace, Laguna San Raphael, 3200 m, KU 144113–144114; Purace, 3450 m, KU 145036–45037; 23 km E. of Purace, 3275 m, KU 169134–169135. Departamento de Narino; 12 km E. of Pasto, 3050 m, KU 169137, 169139–169140.

Osornophryne guacamayo. Ecuador: Napo: Volcán Sumaco, SE of summit, QCAZ 4576–4584, AGG (AGG numbers are deposited in QCAZ) 191, 193, 216, 219, 230, 238–240, 242, 247, 250, 253, 256, 257.

Osornophryne percrassa. Colombia: Departamento de Tolima: Herveo, 3100 m Pedro M. Ruiz coll. 28.i.1972. MCZ 100558. USNM 151325, 322776–7. *Osornophryne sumacoensis*. Ecuador: Napo: Volcán Sumaco, SE of summit, 2500 m, QCAZ 4570–4572. *Osornophryne talipes*. Ecuador: Imbabura: north slope of Nudo de Mojanda, 3400 m, KU 131798. Colombia: Departamento de Cauca: 26 km E. of Purace, 3180 m, KU 169136.

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A NEW SPECIES OF *HYLODES* FROM SOUTHEASTERN BRAZIL (AMPHIBIA: LEPTODACTYLIDAE)

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ABSTRACT: A new species of leptodactylid frog is described from the Serra das Cabras in São Paulo, southeastern Brazil. The new species is a member of the *Hylodes lateristrigatus* group and is characterized by its small size and high number of notes per call. Descriptions of the tadpole and advertisement call and information on natural history are provided.

Key words: Anura; Leptodactylidae; Hylodinae; Advertisement call; New species; Southeastern Brazil; Tadpole

THE rheophilic frogs of the genus *Hylodes* are restricted to the Atlantic Forests in Brazil, with the only known exception being *H. otavioi* from the riparian forests in rocky fields at the Serra do Cipó, Minas Gerais, Brazil (Sazima and Bokermann, 1982).

In the genus *Hylodes*, there are 15 species currently recognized in four groups: one in the *H. glaber* group, nine in the *H. lateristrigatus* group, one in the *H. mertensi* group, and four in the *H. nasus* group (Duellman, 1993; Frost, 1985; Izecksohn and Gouvêa, 1983). The *Hylodes lateris-*



FIG. 1.—*Hylodes saximati*, ZUEC 9004 (holotype), an adult male in life.

trigatus group contains small to moderate-sized species characterized by slender bodies, smooth dorsums, and light dorsolateral stripes (Heyer, 1982). The species presently allocated in the *H. lateristrigatus* group are *Hylodes 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, and *H. vanzolinii* Heyer.

During a survey of the anuran fauna of the Serra das Cabras, Atlantic Forest at Campinas, State of São Paulo, southeastern Brazil, we collected specimens of a new species of the *Hylodes lateristrigatus* group described herein.

MATERIAL AND METHODS

Vocalizations were recorded with a Nagra E tape recorder and Sennheiser ME 80 microphone at a tape speed of 19 cm/s. We analyzed the tapes on a Macintosh Classic computer coupled to the MacRecorder Sound System 2.0.5, using 512 points. Specimens used in the description or examined for comparisons are in AL-

MNRJ (Adolpho Lutz collection, Museu Nacional, Rio de Janeiro, Brazil), MNRJ (Museu Nacional, Rio de Janeiro, Brazil), MZUSP (Museu de Zoologia, Universidade de São Paulo, 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). Tooth-row formula notation of the tadpole follows that of Altig (1970).

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). Measurements technique for adults follows that of Duellman (1970); the measured specimens were fixed and preserved.

SYSTEMATIC ACCOUNT

Hylodes saximati sp. nov.

Holotype.—ZUEC 9004 (Fig. 1), adult male, collected next to the Observatório de Capricórnio, Joaquim Egídio, Municí-

pio de Campinas (approximately 22°54'S, 46°49'W; approximately 1100 m elevation), Estado de São Paulo, Brasil, on 24 November 1990 by Célio F. B. Haddad, José P. Pombal, Jr., and Ivan Sazima.

Paratopotypes.—MNRJ 15869, an adult male, collected on 1 February 1991 by C. F. B. Haddad and J. P. Pombal, Jr.; MZUSP 69637, adult male, collected on 5 April 1992 by C. F. B. Haddad and J. P. Pombal, Jr.

Diagnosis.—A small, slender species (males 27.1–28.5 mm SVL) belonging to the *H. lateristrigatus* group (sensu Heyer, 1982), characterized by (1) snout rounded in dorsal view, (2) thumb without nuptial asperities or spines, (3) upper surfaces of finger discs without well developed scutes, (4) dorsum dark brown.

Comparison with other species.—*Hylodes sazimai* is smaller than *H. babax*, *H. charadranaetes*, *H. lateristrigatus*, *H. magalhaesi*, *H. otavioi*, and *H. regius*; the latter species range from 30.0–39.2 mm SVL (Bokermann, 1964; Gouvêa, 1979; Heyer, 1982; Heyer and Cocroft, 1986; Sazima and Bokermann, 1982.) The new species also differs from *H. babax* and *H. otavioi* by the absence of well developed scutes on the upper surfaces of finger discs; scutes are well developed in *H. babax* and *H. otavioi*. *Hylodes sazimai* differs from *H. charadranaetes* in having a uniform color on the dorsum, rather than a variegated pattern. It can be distinguished from *H. lateristrigatus* by its less evident dorsolateral stripes, and from *H. magalhaesi* by its light belly [black with white spots in *H. magalhaesi* (Bokermann, 1964)] and larger fringes and discs on the fingers and toes. *Hylodes sazimai* differs from *H. regius* by its dull colors in life, rather than the contrasting colors of *H. regius* (Gouvêa, 1979), and by a more rounded snout. *Hylodes ornatus* is smaller than *H. sazimai* and has a pair of elongate, light dorsal bands. From *H. phyllodes*, the new species differs by its more rounded snout and thumb without nuptial spines. *Hylodes sazimai* is distinguished from *H. vanzolinii* by the truncate snout (in dorsal view) and nostrils closer from the tip of snout than in the latter species.

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

Description of holotype.—Body slender (Fig. 1); head longer than wide, snout round in dorsal view and protruding in lateral view (Fig. 2A,B); nostrils slightly protuberant, directed laterally; canthus rostralis distinct; loreal region weakly concave; tympanum distinct, large, diameter about $\frac{1}{2}$ eye diameter; weak supratympanic fold; well developed lateral vocal sacs; vocal slits present; tongue medium-sized; vomerine teeth in two small series, between and behind choanae; choanae small. Arms robust; thumb without nuptial asperities or spines; subarticular tubercles single, round (Fig. 2C); outer metacarpal tubercle nearly round, inner metacarpal tubercle elliptical; finger discs medium sized, nearly round; finger length I = II < IV < III; fingers laterally fringed; upper surfaces of finger discs without well developed scutes; finger and toe discs of about equal size. Legs moderately robust; foot with an ovoid 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

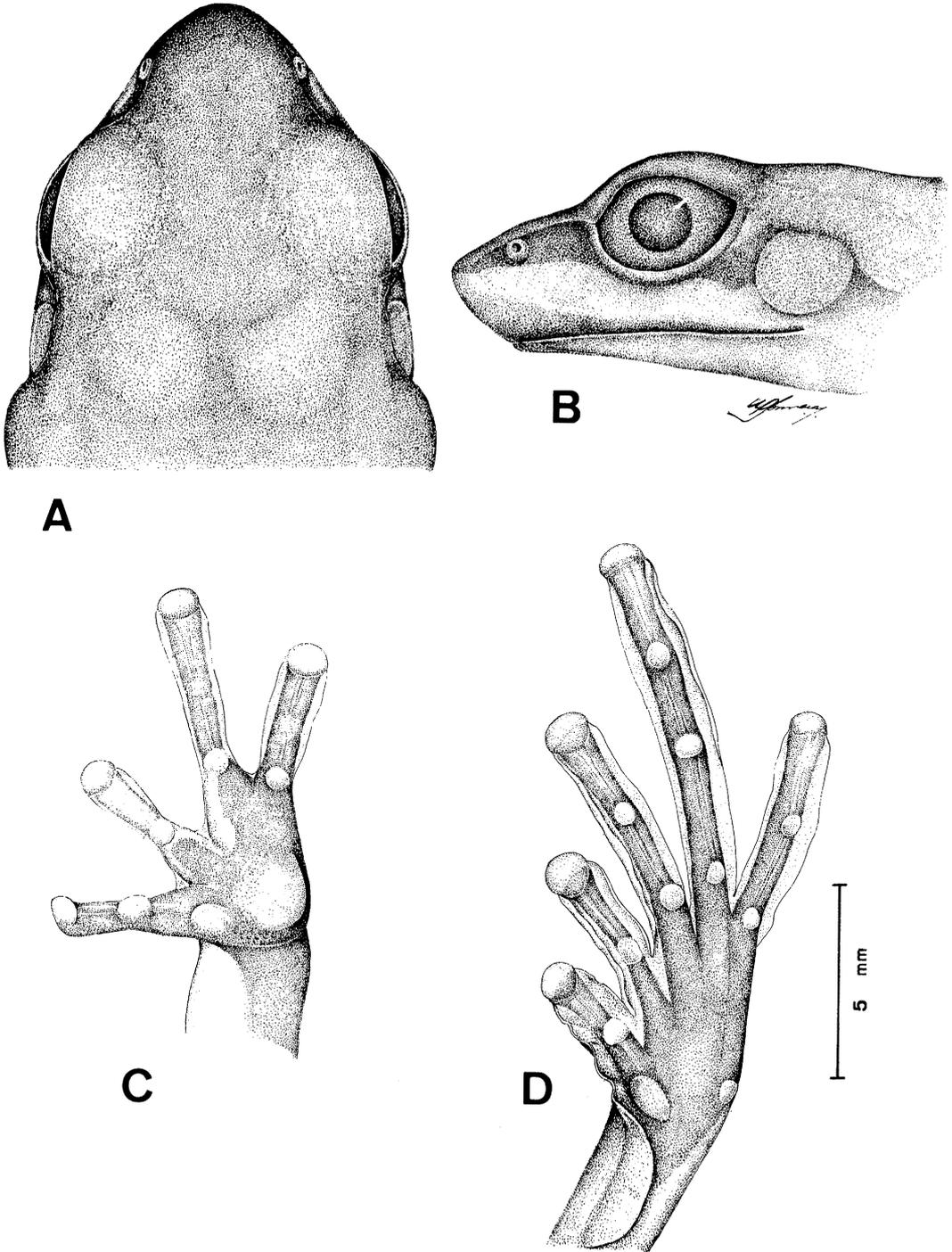


FIG. 2.—*Hylodes sazimai*, ZUEC 9004 (holotype). (A) Dorsal and (B) lateral views of head; ventral views of (C) hand and (D) foot.

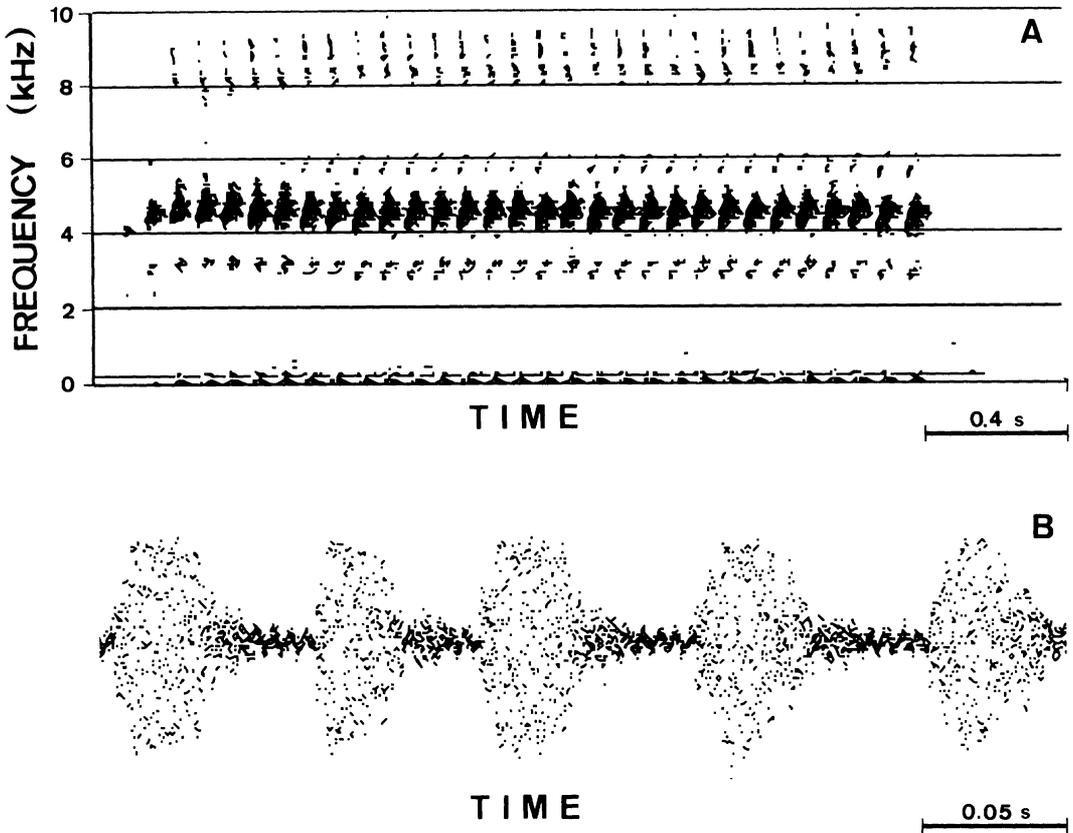


FIG. 3.—(A) Sonagram and (B) wave form of the advertisement call of *Hylodes sazimai*, recorded on 24 November 1990 at 1530 h; air temperature 20 C. The wave form corresponds to the last five notes in the sonagram.

fringe on outer side of first toe. Dorsal skin texture slightly rugged; undersurfaces smooth; rugged texture near the vent.

Color in life of the holotype: Dorsum dark brown; upper surfaces of thigh, tibia, and foot reddish brown with dark transverse bars; forearm reddish brown with dark spots; light line extending from the eye to the groin; dark brown lateral stripe extending from tip of snout, through nostril, eye, and tympanum to near arm insertion; a whitish lateral stripe below the dark brown stripe extending from tip of snout to the arm insertion; lips dark; throat and belly whitish with dark brown marbling; iris cupreous.

Color in preservative of the holotype: In preservative (alcohol 70%), the colors are similar to those in life, except for the red-

dish-brown areas and iris that become brown.

Measurements of the holotype: SVL 27.1; HL 10.9; HW 9.1; ED 3.8; END 1.6; TD 2.1; THL 14.0; TBL 14.3; FL 14.4.

Variation.—In life, the whitish lateral stripe may be yellowish. Measurements (mean, range) of three males: SVL 27.6, 27.1–28.5; HL 10.8, 10.7–10.9; HW 9.2, 9.1–9.3; ED 3.8, 3.8; END 1.7, 1.6–1.8; TD 2.3, 2.1–2.6; THL 14.0, 13.8–14.3; TBL 14.4, 14.3–14.5; FL 14.2, 14.1–14.4.

Advertisement call.—Calls given sporadically; three neighboring males about 10 m apart emitted advertisement calls at intervals of 9.90 ± 1.27 s ($\bar{x} \pm SD$) at an air temperature of 22 C; call duration about 2.0 s; 28–35 notes per call (31.72 ± 2.15 , $n = 11$) given at a rate of 14.5/s; notes

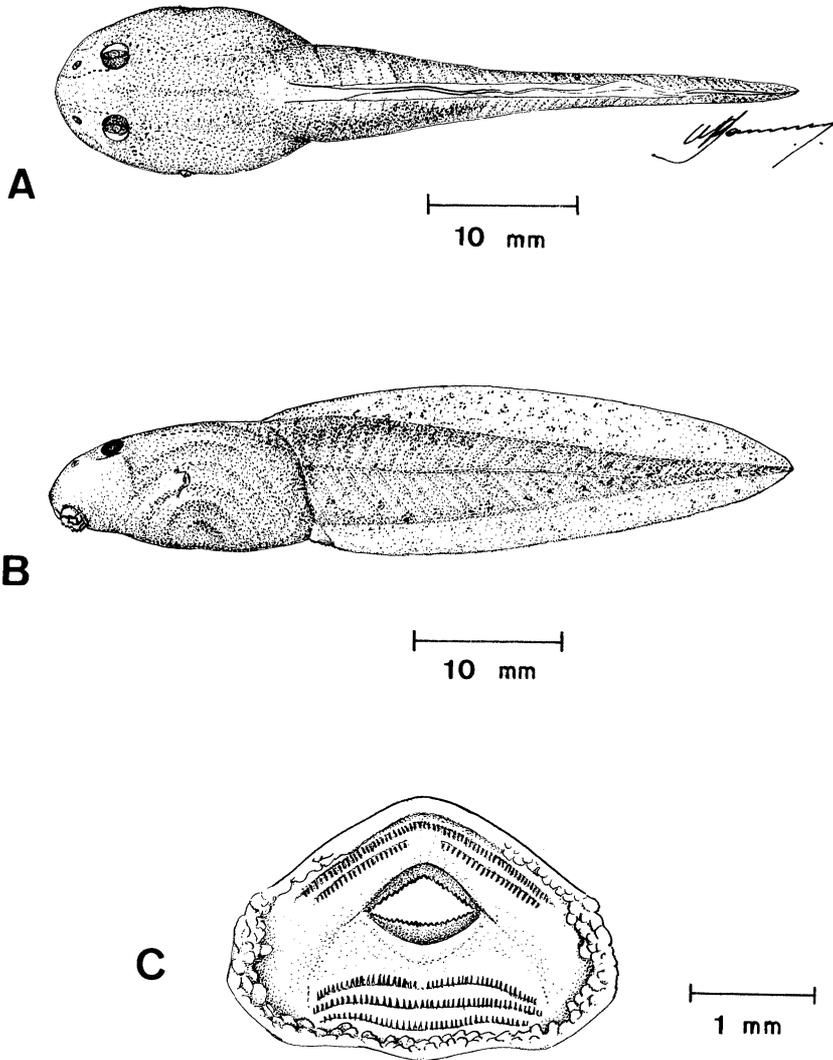


FIG. 4.—Tadpole of *Hylodes sazimai*, stage 25; (A) dorsal and (B) lateral views; (C) oral disc.

given at regular intervals; note duration 0.04–0.05 s; each note is a rising frequency modulated whistle with a dominant frequency (=third harmonic) range of 4.0–5.5 kHz; call with harmonic structure (Fig. 3). Encounter calls were heard but not recorded.

Tadpoles.—Larvae were obtained from the rivulet at the type locality. The following description is based on a tadpole in developmental stage 25 (Gosner, 1960). Total length 47.5 mm; body length 16.8 mm; body elliptical in dorsal view; ovoid

in lateral view, widest posteriorly (Fig. 4A,B); body wider than high; snout rounded; eyes small, dorsolateral; nostrils about midway between the eyes and the tip of snout, directed laterally; spiracle sinistral, its opening at the middle of the body; cloacal tube short, conical, opening dextral; caudal musculature robust, gradually tapering to pointed tip; dorsal fin originating on body; dorsal fin higher than the ventral. Lateral line system composed of 12 lateral lines, six on each side of the body and tail. Body with a ventral depression anterior to

the region of the coiled intestine; two lateral lines, one on each side of the body, converge on the ventral depression.

Oral disc (Fig. 4C) directed ventrally and bordered by two or three rows of small papillae interrupted on a large area on the anterior labium; tooth row formula 2(2)/3(1); jaw sheaths strongly developed and serrate; posterior jaw sheath V-shaped.

In life, dorsum brown with small dark brown, black, and reddish spots; ventral and lateral surfaces of body pale brown with whitish punctations; tail brown, with large pale brown blotches anterodorsally; lateral and ventral surfaces of tail brown with whitish punctations. Fins translucent with brown punctations. Iris yellowish. In preservative dorsum brown; throat and belly transparent; caudal musculature with scattered brown pigmentation more concentrated on the upper first third; fins translucent with scattered brown pigmentation more concentrated on the dorsal fin.

Natural history.—Males of *Hylodes sazimai* were observed calling from October through April (wet season). Males are diurnal and frequent shaded places on rocks, in rock crevices, and on the banks of a small stream running amidst and under large granitic boulders. The frogs are wary, hiding in rock crevices or plunging into the water when disturbed. Females and ovipositions are unknown.

Distribution.—The new species is known only from the type locality in the Serra das Cabras, Campinas, State of São Paulo, southeastern Brazil.

Etymology.—The specific name is in honor to our friend Ivan Sazima for his contribution to the knowledge of the Brazilian vertebrate fauna.

Remarks.—In his diagnostic definition of the genus *Hylodes*, Lynch (1971) stated that larvae have dextral vents. However, in the subfamily Hylodinae, this character is not exclusive for the genus *Hylodes* because it is present also in *Megaelosia* (Lynch, 1971). As an addition to the diagnostic definition of *Hylodes*, we record that in the subfamily Hylodinae, only the tadpoles of *Hylodes* have a ventral depression. We found this depression in large tadpoles (stage 25 of Gosner, 1960) of three

species of *Hylodes* that we analyzed (*Hylodes asper*, *H. otavioi*, and *H. sazimai*). We did not observe this ventral depression in tadpoles of the other two genera within the subfamily Hylodinae. We analyzed *Crossodactylus dispar*, *Megaelosia goeldi*, *M. lutzae*, and *M. massarti*.

Heyer and Cocroft (1986) suggested that more information is needed to clarify the specific status of *Hylodes otavioi* relative to *H. lateristrigatus*. We compared both species and concluded that they are distinct. *Hylodes otavioi* is smaller than *H. lateristrigatus*, and it has more extensively fringed toes, a more arcuate canthus rostralis, and a different color pattern.

The studies of Heyer (1982), Izecksohn and Gouvêa (1983), and Heyer and Cocroft (1986) made possible the use of proper names for the genus *Hylodes*. However, a general survey that we made in Brazilian museum collections revealed a large number of unnamed species of this genus, mainly within the *H. lateristrigatus* group.

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PRIMITIVE, HELODERMATID-LIKE PLATYNOTAN FROM THE EARLY CRETACEOUS OF UTAH

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ABSTRACT: We describe an advanced anguimorph lizard from the Albian (Early Cretaceous) of Utah. The taxon lacks at least one important feature (retracted nares) of Varanoidea, and for this reason is referred to the Necrosauridae, a fossil group characterized by a combination of anguoid and varanoid characters. Nonetheless, the fossil bears several advanced characters (such as widely-spaced, trenchant, plicidentine, marginal teeth lacking replacement pits) suggesting relationship to Varanoidea, and others (form of the maxilla, suggesting a blunt, rounded snout; osteoderm pattern and ornamentation) reminiscent of Helodermatidae; the closest comparison is with Late Cretaceous *Paraderma*, which represents the first record of that family. Regardless of specific affinities, the unnamed taxon represents the earliest occurrence of terrestrial Platynota, partly occluding a major gap in the fossil record of lizards, and documents the presence of this group of highly predaceous squamates in the Early Cretaceous of North America. Like living varanoids, especially helodermatids, the taxon from Utah may have included relatively large prey in its diet.

Key words: Varanoidea; Necrosauridae; Helodermatidae; Cretaceous

VARANOID lizards and suspected fossil allies are of special interest in that they are evidently related to some of the major radiations of squamates, including mosasaurs (and related aquatic taxa) and, pos-

sibly, snakes (Camp, 1923; Carroll, 1988). Varanoids are also of interest because they were relatively larger and more highly predaceous than other anguimorphs, and they preyed more heavily on vertebrates

APPENDIX I

Additional Specimens Examined

Hylodes babax MZUSP 57949 (holotype); *H. charadranaetes* MZUSP 60648 (holotype), MZUSP 60656–59 (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. phylloides* MZUSP 59934 (holotype), 37712–17 (paratypes), ZUEC 2615, 6365–66, ZUEC 6411 (topotype), 6797, 6987–89, 8420; *H. regius* MNRJ 4110 (holotype), 4106, 4108–09, 4111 (paratypes).