

## A New Species of *Proceratophrys* (Anura: Leptodactylidae) from the Amazon Rain Forest

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**ABSTRACT.**—A new *Proceratophrys* from Rondônia, Brazil, is described based on adults and tadpoles. The new form represents a species with eyelids bordered by large, irregularly arranged, warts; postocular swellings absent; snout obtuse with flaring lip in profile; tympanum defined as a depression in the skin; and dorsal surfaces of body and leg bearing high elevated warts. The new species extends the known distribution of the genus to the northwest and represents the first described species of *Proceratophrys* from the Amazon rain forest. We discuss the species group arrangement in *Proceratophrys* based on morphology, geographic distribution, and habitat.

**RESUMO.**—Um novo *Proceratophrys* é descrito de Rondônia, Brasil, com base em adultos e girinos. A nova forma representa uma espécie com as pálpebras bordeadas por verrugas irregularmente arranjadas, entumecimento pós-ocular ausente, focinho obtuso com borda projetada em perfil, tímpano definido como uma depressão na pele e superfícies dorsais do corpo e pernas com verrugas altas. A nova espécie estende a distribuição conhecida do gênero para o noroeste e representa a primeira espécie de *Proceratophrys* da floresta pluvial amazônica. Discutimos o arranjo em grupos de espécies de *Proceratophrys* com base em morfologia, distribuição geográfica e habitat.

The genus *Proceratophrys*, currently composed of 13 species (Frost, 1985; Heyer et al., 1990; Caramaschi and Velosa, 1997; Eterovick and Sazima, 1998), is most diverse in eastern Brazil

within the Atlantic Forest domain (sensu Ab'Saber, 1977). Two species of *Proceratophrys* are known to occur further west in South America, one in central Brazil (*P. goyana*) (Frost, 1985) and the other in northeast Argentina (*P. avelinoi*). Recently, new species of *Proceratophrys* have been described (e.g., Mercadal del Barrio and Barrio, 1993), even from areas with relatively well-known herpetological faunas in southeast

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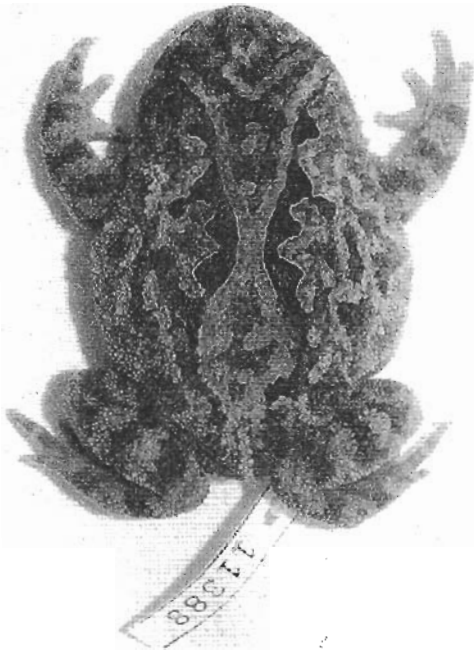


FIG. 1. Photograph of dorsal view of *Proceratophrys concavitympanum* (paratopotype ZUEC 11388; 58.8 mm SVL); photo by AAG.

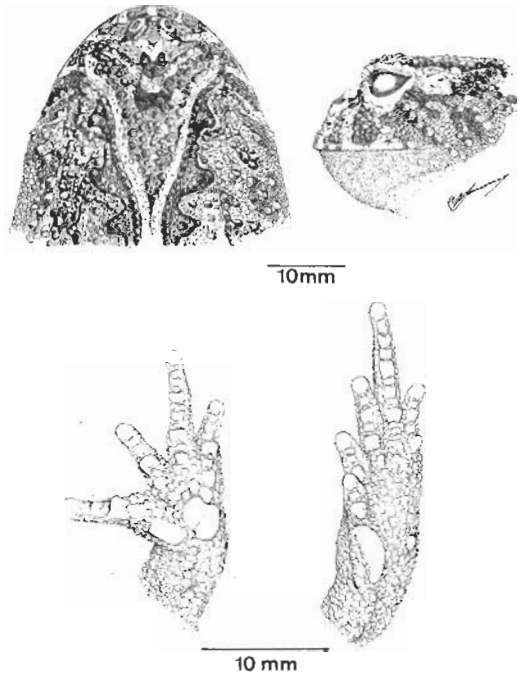


FIG. 2. Holotype *Proceratophrys concavitympanum* ZUEC 11387 (59.8 mm SVL). Dorsal view of head (upper left); head from left side (upper right); palmar view of left hand (lower left); sole of left foot (lower right).

Brazil (Giaretta and Sazima, 1993; Eterovick and Sazima, 1998). The only previously reported occurrence of a *Proceratophrys* species in the Amazonian forest references tadpoles of an unidentified species (Hero, 1990). Herein we describe a new *Proceratophrys* from the State of Rondônia, northern Brazil, which represents the first described species of *Proceratophrys* from the Amazon rain forest.

#### MATERIALS AND METHODS

Detailed comparisons with the new form were restricted to the most similar species of *Proceratophrys*. These include three species without enlarged palpebral appendages and without postocular swelling (see Fig. 2A in Giaretta and Sazima, 1993), namely *Proceratophrys cristiceps* (Müller, 1884), *P. goyana* (Miranda-Ribeiro, 1937), and *P. cururu* (Eterovick and Sazima, 1998).

The holotype and paratopotypes are housed in the Museu de História Natural da Universidade Estadual de Campinas (ZUEC). We examined specimens of *Proceratophrys cristiceps* from northeastern Brazil, *P. goyana* from Goiás and Mato Grosso (Central Brazil), and the types of *P. cururu* (see Appendix); all of which are housed at ZUEC and Museu de Zoologia da Universidade de São Paulo (MZUSP). All measurements were made with calipers to the near-

est 0.1 mm. Head width and length was measured at the corner of the mouth, hand length from the base of the inner metacarpal tubercle; other measurements were taken as in Heyer et al. (1990). The tadpoles of the new species were identified as belonging to a *Proceratophrys* by direct comparison with those of other congeneric species housed at ZUEC (*Proceratophrys appendiculata*, *P. boiei*, *P. cururu*, and *P. palustris*). Only the new species is known to occur at the type locality in Rondônia, so there is little chance of confusing congeneric tadpoles. The tadpole description and measurements follow Altig (1970) and Altig and Johnston (1989). Coloration in life of adults was based on photographs of one living and two freshly killed individuals. Individuals were sexed by dissection. Webbing formulae follow Savage and Heyer (1997). Tadpoles (ZUEC 11544-45) were preserved, and permanently stored, in 5% formalin immediately after capture.

#### *Proceratophrys concavitympanum* sp. n. (Figs. 1–2)

*Holotype*.—ZUEC 11387; an adult female, collected by Paulo S. Bernarde and Marcelo N. de C. Kokubum on 8 January 1997 at Fazenda Jaburi (approximately 60°43'W, 11°37'S), Muni-

TABLE 1. Measurements (mm), and percentages of snout-vent length (parenthesis) of three types of *Proceratophrys concavitympanum*.

Type # (ZUEC)	11387 holotype adult female	11388 paratype adult female	11389 paratype young female
Snout-vent length	59.8	58.8	43.4
Head length	21.4 (35.8)	20.3 (34.6)	14.4 (33.2)
Head width	28.1 (46.9)	26.8 (45.6)	20.0 (46.1)
Eye diameter	5.8 (9.6)	5.4 (9.2)	4.6 (10.6)
Eye-snout distance	11.3 (18.9)	11.7 (19.9)	9.2 (21.2)
Tympanum diameter	3.6 (5.9)	3.1 (5.3)	2.5 (5.7)
Thigh	24.4 (40.8)	24.1 (41.0)	17.1 (39.4)
Shank	21.2 (35.4)	21.2 (36.0)	15.8 (36.4)
Foot	22.1 (37.8)	21.5 (36.6)	16.2 (37.4)
Hand	15.9 (26.6)	15.0 (25.6)	12.1 (27.9)

pality of Espigão D'Oeste, State of Rondônia, Brazil.

*Paratopotypes*.—ZUEC 11388, an adult female; ZUEC 11389, a juvenile female; ZUEC 11390, a juvenile of unknown sex. All individuals were collected at the same place and on the same date as the holotype.

*Diagnosis*.—A formal, synapomorphy based, definition of the genus *Proceratophrys* is lacking. The new form closely resembles other *Proceratophrys* in general aspect, especially *Proceratophrys cristiceps* and *P. goyana*. *Proceratophrys concavitympanum* differs from all other *Proceratophrys* by the following combination of characters: eyelids bordered by irregularly arranged warts; no postocular swellings; tympanum well defined as a depression in the skin; snout obtuse with flaring lip in profile; and dorsal surfaces of body and legs with high elevated warts.

*Proceratophrys cristiceps*, *P. goyana*, and *P. cururu* lack prominent palpebral appendages and postocular swellings. Only *P. concavitympanum* has the tympanum defined as a depression in the skin. Unlike *P. concavitympanum*, *P. cristiceps* and *P. goyana* have vertical snouts in profile, narrow heads, dorsal crests well defined beyond the sacral region, strongly (yellow or black) keratinized inner metacarpal tubercles, and less elevated dorsal warts. The new species can be distinguished from *P. cururu* by having larger and fewer eyelid warts, better defined dorsal crests, higher elevated dorsal warts, and darker dorsal coloration in preservative.

*Description of the holotype* (Fig. 2, Table 1).—Head 31.3% wider than long; snout outline nearly round, almost semicircular in dorsal view, obtuse with flaring lip in profile; nares and eyelid not projecting beyond head contour viewed from above; tympanum defined as a depression

in skin; canthal crests distinct; no interocular crest; loreal region concave; lateral margin of upper eyelid with large, irregularly arranged warts, medial warts slightly prominent; face with few large warts; row of five enlarged warts on each side of head from bellow eye to angle of jaw; one enlarged yellowish wart below angle of jaw; nares elliptical and valvular, diverging posteriorly; tongue cordiform, free posteriorly; vomerine teeth in two short transverse series, lying between choanae, separated by about one-half length of single vomerine tooth row; mandibular symphysis with round pin-like process, with a corresponding cavity in upper jaw; finger lengths  $IV < II < I < III$ ; inner carpal tubercle oval; outer carpal tubercle obliquely divided in equal oval halves; subarticular finger tubercles large, squared with rounded corners; supernumerary tubercles well defined, rounded; sides of fingers and toes with distinct wart ridges; no web between fingers; outer margin of forearm with two parallel rows of 4-7 enlarged warts running two-thirds length of forearm; patagium to mid-length of upperarm; symmetrical crests of warts from posterior eyelid to sacral region; crests initially narrowing to mid-body, then diverging until sacral region, beyond sacral region low to vent; dorsal warts in two size classes, the large one are few in number and regularly scattered, also on flanks and dorsum of legs; warts inside dorsal crests equal in aspect to those outside; under magnification, skin and warts of dorsal parts covered by many small circular keratinized spots; dorsal warts of arms more uniform in size than that of dorsum; toe lengths  $I < II \cong V < III < IV$ ; inner metatarsal tubercle very large, sickle shaped, not black or yellow keratinized; outer metatarsal tubercle small but discernible, rounded; no distinctive heel decoration; ridge of warts along inner side of tarsus, 4-5 enlarged warts beyond inner metatarsal tubercle, those proximal same size as outer metatarsal tubercle; sole of foot warty; toes webbed at base; webbing formulae  $I1^+ - 2^- II1^{2-} - 3^- III2^{2-} - 4^- IV4^- - 2V$ ; dorsal skin covering first phalange of fingers and toes smooth, defined proximally by a dermal fold; belly bearing equal sized warts; ventral warts covered with circular spots, but not keratinized as on dorsum; distal ventral surface of thigh with larger warts than belly, a medial circular region with smooth skin; dermal groove from vent to ventral surface of thigh; one or two enlarged yellowish warts below and to each side of vent.

*Variation*.—The other adult female (paratopotype ZUEC 11388) differs from the holotype mainly by the belly bearing unequally sized warts; an interocular row of 12 warts from the margin of one eyelid to the other; and 1-2 dor-

solateral rows, of warts on each side of the body, running antero-posteriorly.

*Color.*—In life the dorsal pattern is complex and resembles a dead leaf. The dorsum is predominantly pale yellow with the crests of warts bordered peripherally by a symmetrical and irregular wide gray lacework. Two gray mottled areas on the top of head are separated from each other by a narrow pale yellow stripe between the eyes. Four dark brown mottled areas are present on each side of face, each one separated by narrow stripes of pale brown. Dorsolateral crests are gray. There are 2–3 transverse gray bars on forearms, thighs, and shanks. The belly and throat are pale pink or with fine gray reticulations. In preservative, the pale yellow dorsal pattern becomes pale brown; the darker gray portions remain unchanged. The venter becomes pale gray with reticulations or homogeneously pale yellow.

*Tadpoles.*—The description is based in two similar sized (50.1 mm) tadpoles at Stage 36 (Gosner, 1960; Fig. 3). Body oval in dorsal view, depressed oval in lateral view; eyes and nares dorsal; nares rounded; oral disc positioned anteroventrally; spiracle sinistral, with aperture at mid-distance between snout and posterior end of body; spiracular aperture oval, directed posterodorsally; spiracle with short distal free border; lateral line system in three discrete branch pairs; first branch long, from internal border of nares to posterior end of body, passing just medial to dorsal borders of eyes; second branch short, on muscular portion of dorsum; third branch short, at lateral midheight of body, bordering spiracle dorsally; anal tube short and broad, with dextral aperture, entirely fused to ventral fin by slender, folded membrane; tail musculature strong; myosepts not very evident; dorsal fin deeper than ventral, arched, originating at body-tail junction, maximal height in anterior-most quarter; ventral fin straight; tip of tail pointed. Oral disc surrounded by papillae (Fig. 3), except for a broad anterior gap; marginal papillae in single row laterally; submarginal papillae present posterolateral and posteriorly; oral disc emarginated laterally; tooth row formula 2(2)/3(1); A2 and P1 divided medially by short gaps; jaw sheaths strongly keratinized and blunt; body wall almost entirely transparent on flanks and venter; pale brown blotches on dorsum of body; tail fins translucent with many small pale gray flecks; tail musculature mottled with gray. Measurements (Means in mm; N = 2) as follow: body length = 16.9, body width = 12.0, body depth = 9.8, tail length = 30.6, fin maximal height = 9.5, tail muscle height = 5.0, eye-snout distance = 4.6, oral disc width = 9.0, eye diameter, interorbital distance, and inter-narial distance = 2.1.

*Habitat and distribution.*—At Fazenda Jaburi, the predominant vegetation is Open Rain Forest (IBGE, 1992). The frogs were collected at night inside the forest along the margin of the permanent pond where the tadpoles were collected. The new species is known only from the type locality.

*Etymology.*—The specific epithet "*concauitympanum*" is a composed name from the Latin words "*concauum*", meaning concave, incavate, and "*tympanum*", meaning eardrum and is used as a noun in apposition. The name refers to the depression on each side of the head at the location of the tympanum.

#### DISCUSSION

The encounter of *Proceratophrys concauitympanum* in the state of Rondônia expands the known distribution of the genus to the northwest and represents the first described *Proceratophrys* from the Amazon rain forest. The taxonomic status of some populations of *Proceratophrys* from the Amazon basin remains unresolved. The tadpole of *P. concauitympanum* differs from the tadpole of *Proceratophrys* described by Hero (1990) from Manaus (Central Amazon) by being 43% larger in total length, even in earlier developmental stage. One of us (AAG) has examined adults of another undescribed *Proceratophrys* species from the State of Pará (Brazil), collected by M. Gordo and C. F. B. Haddad. It is unknown if the Pará species is conspecific with the tadpoles described by Hero (1990). Thus, besides *P. concauitympanum*, at least one more new species of *Proceratophrys* is known from the Amazon Forest.

Two species groups have been recognized in *Proceratophrys*; the *P. bigibbosa* and *P. boiei* species groups (Lynch, 1971; Caramaschi, 1996). However, considering the recently described species, this arrangement appears unsatisfactory. The presence of a postocular swelling suggests a monophyletic group relating *Proceratophrys bigibbosa* to two other species from the *P. bigibbosa* species group we consider valid: *P. aelinoi* and *P. palustris*. The presence of a prominent medial palpebral appendage suggests another group related to *P. boiei*, which also includes *P. appendiculata*, *P. fryi*, *P. laticeps*, *P. melanopogon*, *P. moehring*, and *P. schirchi*. Shared derived characters are not evident between *P. concauitympanum*, *P. cristiceps*, *P. cururu*, *P. goyana*, and the undescribed species from Pará. Some zoogeographic agreement exist in this group arrangement. The *P. bigibbosa* clade are present in southern Brazil and adjacent countries; *P. palustris* may represent a relictual species in the Poços de Caldas plateau, of the interior of southeastern Brazil (Giaretta and Sazima, 1993). The *P. boiei* species group is related to eastern Atlantic forest, and

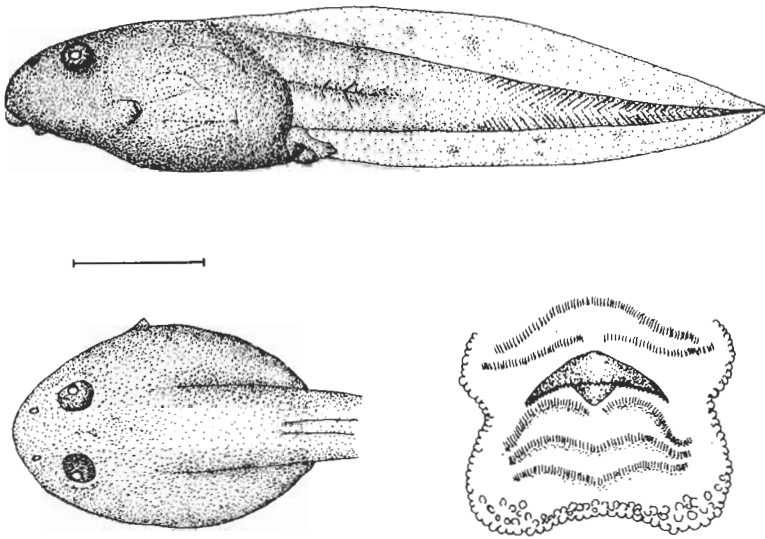


FIG. 3. Tadpole of *Proceratophrys concavitympanum* (ZUEC 11544). Lateral view (above); dorsal view of the anterior portion of body (below left); oral disc (below right). Scale = 8 mm for lateral and dorsal view and 1.5 mm for the oral disc.

the species of the "cristiceps group" are more richly represented in open, seasonally dry, environments (e.g., *cristiceps*, *cururu*, and *goyana*). *Proceratophrys concavitympanum* and the undescribed species from Pará may represent species that have invaded the amazon forest from southern drier cerrado/caatinga vegetational formations.

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#### APPENDIX

*Specimens examined.*—*Proceratophrys cururu*, ZUEC 9557 (holotype) and two paratopotypes (ZUEC 4113 and 9559), Serra do Cipó (Minas Gerais). *P. cristiceps*, ZUEC 8765, 8767-68, Teixeira (Paraíba); 4110 Picos (Piauí); 4125 Santana do Cariri (Ceará). *P. goyana*, MZUSP 71648, 71840, 71844, 71852, 71854, 71849, 72349, 72611-12, Serra da Mesa (Goiás); 66688, Santa Rita do Araguaia (Goiás); 66758, Alto Araguaia (Mato Grosso).

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