

- SHINE, R., P. S. HARLOW, W. R. BRANCH, AND J. K. WEBB. 1996. Life on the lowest branch: sexual dimorphism, diet and reproductive biology of an African Twig Snake, *Thelotornis capensis* (Serpentes, Colubridae). *Copeia* 1996:290–299.
- SOKAL, R. R., AND F. J. ROHLF. 1981. *Statistical Tables*. 2nd ed. Freeman and Co., San Francisco, CA.
- VAN WYK, J. H. 1984. Ovarian morphological changes during the annual breeding cycle of the Rock Lizard *Agama atra* (Sauria: Agamidae). *Navorsing van die Nasionale Museum, Bloemfontein* 4: Part 11.
- . 1989. The female reproductive cycle of the lizard, *Cordylus polyzonus polyzonus* (Sauria: Cordylidae) in the Orange Free State. *South African Journal of Zoology* 24:263–269.
- . 1991. Biennial reproduction in the female viviparous lizard *Cordylus giganteus*. *Amphibia-Reptilia* 12:329–342.
- . 1995. The male reproductive cycle of the lizard, *Cordylus giganteus* (Sauria: Cordylidae). *Journal of Herpetology* 29:522–535.
- VAN WYK, J. H., AND P. LE F. N. MOUTON. 1998. Reproduction and sexual dimorphism in the montane viviparous lizard, *Pseudocordylus capensis* (Sauria: Cordylidae). *South African Journal of Zoology* 33:156–165.
- VITT, L. J., AND W. E. COOPER. 1985. The evolution of sexual dimorphism in the skink *Eumeces laticeps*: an example of sexual selection. *Canadian Journal of Zoology* 63:995–1002.

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## New Species of *Physalaemus* Fitzinger, 1826 from Southern Bahia, Brazil (Anura, Leptodactylidae)

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**ABSTRACT.**—A new species of *Physalaemus* belonging to the *Physalaemus cuvieri* species group is described from southern Bahia, Brazil. It inhabits the borders of Atlantic Rain Forest fragments, natural forest clearings, and cacao plantations. The new species is characterized by its medium size, robust body, warty skin, presence of inguinal glands, one pair of dorsal tubercles on the sacral region, and an interorbital black transversal stripe generally covering a pair of tubercles.

**RESUMEN.**—Uma nova espécie de *Physalaemus* pertencente ao grupo de *Physalaemus cuvieri*, é descrita do sul da Bahia, Brasil. A espécie é encontrada nas bordas de fragmentos de Mata Atlântica, clareiras naturais e plantações de cacau. A espécie nova é caracterizada pelo seu tamanho médio, corpo robusto, pele verrucosa e presença de glândulas inguinais, de um par de tubérculos dorsais na região sacral e de uma faixa preta transversal na região interorbital, geralmente cobrindo um par de tubérculos.

The Neotropical frog genus *Physalaemus* Fitzinger, 1826, currently contains 41 valid species (Frost, 2002; Caramaschi et al., 2003). Lynch (1970) recognized and diagnosed four species groups in the genus: *Physalaemus biligonigerus* group, *Physalaemus pustulosus* group, *Physalaemus signifer* group, and *Physalaemus cuvieri*

group. Two species, *Physalaemus deimaticus* and *Physalaemus rupestris*, are not assigned to any of these species groups (Sazima and Caramaschi, 1986; Caramaschi et al., 1991). The *Physalaemus cuvieri* group is the most diverse, including 20 species distributed throughout South America (Frost, 2002). The *P. cuvieri* group is characterized by small to moderate size (14–39 mm SVL), slender to stocky build, smooth to warty skin, first finger not longer than the second, presence of an inner tarsal tubercle, presence of small,

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noncompressed metatarsal tubercles (except *Physalaemus albifrons*), absence or presence of small inguinal glands (large in *Physalaemus aguirrei*), absence of parotoid glands, and presence of maxillary and premaxillary teeth (Lynch, 1970). In the coastal region of eastern Brazil, this group is represented by eight species: *Physalaemus aguirrei*, *Physalaemus albifrons*, *Physalaemus barrioi*, *Physalaemus cicada*, *Physalaemus cuvieri*, *Physalaemus jordanensis*, *Physalaemus kroyeri*, and *Physalaemus soaresi* (Frost, 2002). Feio et al. (1999) pointed out that *P. aguirrei*, *Physalaemus maximus*, *Physalaemus olfersii*, and *P. soaresi* should compose a new species group, but they lacked supporting evidence.

Recent surveys in the Atlantic Rain Forest of southern Bahia, Brazil, resulted in the collection of a new species of this group. Herein, we present the description of this new species, the sonogram of the advertisement call, and some notes on natural history and distribution.

#### MATERIALS AND METHODS

Comparisons with the new species were restricted to the forms of the *P. cuvieri* group inhabiting the eastern coastal region of Brazil, as based on the authors' examination of specimens and on information given by Izecksohn (1965), Bokermann (1966a,b, 1967), Lynch (1970), and Heyer et al. (1990). Specimens used in the description or examined for comparisons are deposited in EI (Eugenio Izecksohn collection, deposited in Universidade Federal Rural do Rio de Janeiro, Seropédica, RJ, Brazil), MCN (Museu de Ciências Naturais PUC Minas, Belo Horizonte, MG, Brazil), MNRJ (Museu Nacional, Rio de Janeiro, RJ, Brazil), and MZUSP (Museu de Zoologia, Universidade de São Paulo, SP, Brazil). Specimens examined are listed in Appendix 1.

Abbreviations used in the measurements of specimens are SVL (snout-vent length), HL (head length), HW (head width), ED (eye diameter), TD (tympanum diameter), UEW (upper eyelid width), IOD (interorbital distance), IND (internostril distance), END (eye-nostril distance), THL (thigh length), TBL (tibia length), and FL (foot length, including tarsus). All measurements are in millimeters, and SVL, HL, HW, THL, TBL, and FL were measured with calipers, whereas the other measurements were made with an ocular micrometer. Specimens were sexed by the presence or absence of vocal sac.

Vocalizations were recorded with a Sony DAT TCD-D8 digital tape recorder with a Sennheiser K6/ME66 microphone set. Sonograms were produced by the software Avisoft-SASLab Light for Windows, version 3.74, using 16 bit resolution, 22 kHz sampling frequency, FFT with 256 points, FlatTop window, 50% overlap, and 100% frame.



FIG. 1. *Physalaemus erikae* sp. n., holotype (MNRJ 30349), dorsal view.

#### *Physalaemus erikae* sp. n.

Figures 1–2

*Holotype*.—MNRJ 30349, adult male (Fig. 1), collected at Fazenda Vista Bela (16°36'S, 39°55'W), Municipality of Guaratinga, State of Bahia, Brazil, by B. V. S. Pimenta, R. T. Moura, A. Paglia, and R. V. Lopes on 14 September, 2000.

*Paratypes*.—MNRJ 28981, adult female, collected by B. V. S. Pimenta on 13 March 2001, MNRJ 28982, adult female, collected by B. V. S. Pimenta on 21 June 2001, MNRJ 28983, adult male, collected by B. V. S. Pimenta on 12 July 2001, and MNRJ 28985, adult female, collected by B. V. S. Pimenta on 20 March 2002, at Reserva Particular do Patrimônio Natural (RPPN) Estação Veracruz (16°23'S, 39°10'W), Municipality of Porto Seguro, State of Bahia, Brazil; MNRJ 28984, adult female, collected by R. V. Lopes on November, 2001 at Fazenda Princesa do Pajaú (17°10'S, 39°50'W), Municipality of Itamaraju, State of Bahia, Brazil; MNRJ 30028–29, MNRJ 30348, three adult females, collected by B. V. S. Pimenta and R. V. Lopes on 18 July 2000, MNRJ 30347, MCN 2198–99, MCN 2203, four adult females, collected by B. V. S. Pimenta and P. H. C. Cordeiro on 30 April 2000, at RPPN Serra do Teimoso (15°09'S, 39°31'W), Municipality of Jussari, State of Bahia, Brazil; MNRJ 30343–46,

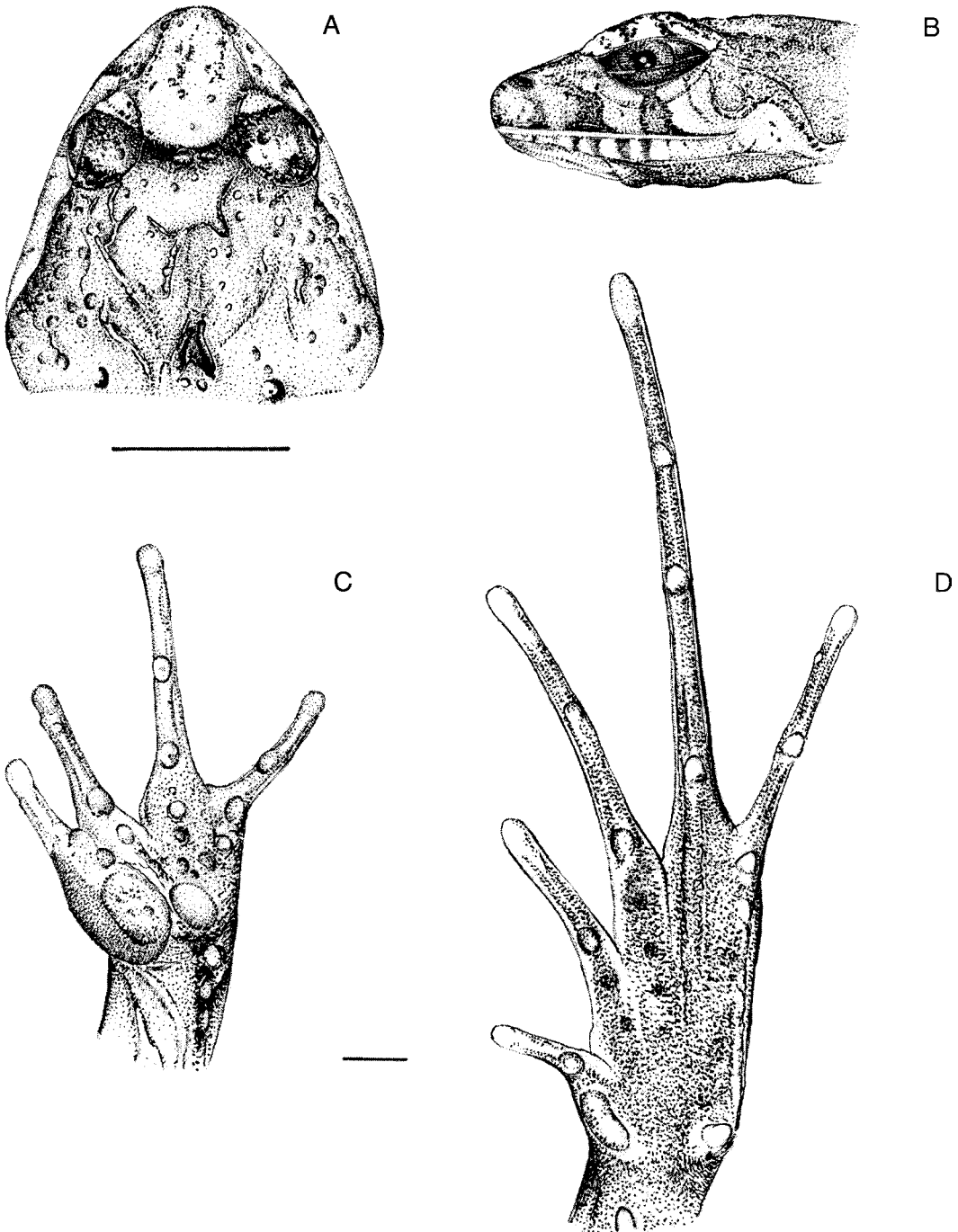


FIG. 2. *Physalaemus erikae* sp. n., holotype (MNRJ 30349). (A) Dorsal and (B) lateral views of head (scale = 5 mm); ventral views of (C) hand and (D) foot (scale = 1 mm).

two adult males and two adult females, collected on 12 and 14 September 2000, at the same locality of the holotype.

*Diagnosis.*—A species belonging to the *P. cuvieri* group, characterized by (1) medium size

(males 21.6–26.6 mm SVL, females 19.2–27.1 mm SVL); (2) body robust; (3) tympanum weakly distinct; (4) presence of inguinal glands; (5) dorsal skin texture warty or with longitudinal ridges; (6) presence of one pair of dorsal tubercles

on the sacral region; (7) presence of an interorbital black transversal stripe, generally covering a pair of tubercles; and (8) presence of a dorso-lateral dermal fold beginning at the posterior corner of the eye, ending near the inguinal region.

*Physalaemus erikae* has a smaller size (SVL for males 21.6–26.6 mm) than *P. albifrons*, *P. barrioi*, *P. cuvieri*, and *P. kroyeri* (combined SVL for males 25.9–35.0 mm), warty skin (with longitudinal glandular lines in *P. albifrons* and *P. barrioi*, smooth or finely granular in *P. cuvieri*), and presence of inguinal glands (absent in these species). *Physalaemus erikae* is distinguished from *P. aguirrei*, *P. cicada*, *P. jordanensis*, and *P. soaresi* by its stocky build and warty skin (smooth in *P. aguirrei*, *P. cicada*, and *P. soaresi*; with longitudinal glandular lines in *P. jordanensis*). By its weakly distinct tympanum, *P. erikae* differs from *P. barrioi*, *P. cicada*, and *P. cuvieri*, which have indistinct tympanums. *Physalaemus erikae* is distinguished from *P. aguirrei*, *P. barrioi*, *P. cicada*, *P. jordanensis*, and *P. soaresi* by the absence of a black or dark-brown stripe covering the loreal region and flanks and differs from *P. jordanensis* and *P. barrioi* by the lack of pigmentation on inguinal glands.

*Description of Holotype*.—Body robust; head wider than long; snout rounded in dorsal and lateral views (Fig. 2A–B); nostrils ovoid, non-protuberant, directed laterally; canthus rostralis distinct, straight; loreal region concave; eyes slightly protuberant; tympanum weakly distinct; supratympanic fold from posterior corner of eye to shoulder (Fig. 2B); a weakly marked dorsolateral fold beginning at posterior corner of eye, immediately above the supratympanic fold, ending near inguinal region; vocal sac subgular, large, expanded externally; choanae large, nearly round; tongue narrow, long; maxillary and premaxillary teeth visible under magnification. Arms slender, upper-arms shorter and moderately more robust than forearms; fingers slender, long; finger lengths  $I < II \cong IV < III$ ; brown nuptial asperities on thumbs; subarticular tubercles single, round; outer metacarpal tubercle medium, ovoid; inner metacarpal tubercle large, ovoid; few small supranumerary tubercles; fingers tip not expanded (Fig. 2C). Legs moderately robust; tibia longer than thigh; sum of tibia and thigh lengths smaller than SVL; presence of a discrete tarsal fold; toes slender, long, toe lengths  $I < II < V < III < IV$ ; subarticular tubercles single, conical, protruding; foot with an elliptical inner metatarsal tubercle, small; outer metatarsal tubercle small, conical, protruding; few supranumerary tubercles, small; toes tip not expanded (Fig. 2D); tarsal tubercle on the distal third, round. Inguinal glands small, not pigmented; dorsal surfaces warty with scattered, weakly developed, short ridges; presence of one

conspicuous pair of dorsal black tubercles on the sacral region, and another pair between the eyes. Undersurfaces smooth, except for the thighs, which are finely areolate.

*Color in Preservative of Holotype*.—The general pattern is brown with small black blotches on dorsum and an interorbital black transversal stripe, covering a pair of tubercles. Dorsal surfaces of arms are light brown with a transverse black blotch; legs are light brown with dark brown transverse stripes and small black granules. Flanks are grayish-brown. Ventral surfaces have a cream background with chest and part of the belly gray marbled. Hands and feet are grayish-brown. Gular and cloacal regions are black.

*Measurements of Holotype*.—SVL 24.8; HL 7.2; HW 8.8; ED 2.6; TD 1.0; UEW 1.9; IOD 1.8; IND 1.7; END 2.7; THL 10.9; TBL 12.3; FL 13.9.

*Variation*.—In some specimens, the dorsolateral dermal fold is more evident. Arms in females are slender and the inner metacarpal tubercle is smaller than in males. Some specimens have a higher number of small supranumerary tubercles on hands. Instead of a warty skin with discrete, short ridges, females MCN 2198–2199, MNRJ 28982, and MNRJ 30348, and male MNRJ 30344 possess a pair of well-developed longitudinal ridges from upper eyelids to sacral region and another short pair between the eyes, and many longitudinal rows of small granules. A few specimens possess a less evident interorbital black transversal stripe or it is absent. Tarsal fold is not present in some specimens. Coloration pattern varies substantially among specimens. Gular region is cream with light-brown small blotches in females. Specimens MNRJ 30344–30345 have a cream and light-brown general color pattern. Some specimens present a white or light-brown line on the urostylum. Females MNRJ 30347 and MCN 2198–2199 have yellowish-brown flanks, and female MNRJ 28982 has a white vertebral line from snout to vent, interrupting the interorbital black transversal stripe. Variations on measurements are in Table 1.

*Vocalization*.—On 25 October 2001, two male *P. erikae* calling alternately were recorded emitting calls with one note consisting of eight harmonics between approximately 0.34 and 4.8 kHz, with descendent frequency modulation (Fig. 3A). The mean duration of the call was 0.56 sec (SD = 0.01, range = 0.53–0.57,  $N = 16$  vocalizations of two males), and the mean intercall interval (defined here as the time from the end of one call to the beginning of the next call) was 13.42 sec (SD = 8.87, range = 4.85–35.92,  $N = 16$  vocalizations of two males). The fundamental harmonic was about 0.34 and 0.78 kHz; dominant frequency was 3.22 kHz, corresponding to the seventh

TABLE 1. Mean ( $\bar{x}$ ), standard deviation (SD), and range of the measurements (in millimeters) of males and females of *Physalaemus erikae* sp. n.

	Males (N = 5)			Females (N = 13)		
	$\bar{x}$	SD	Range	$\bar{x}$	SD	Range
SVL	23.7	2.1	21.6–26.6	23.1	2.3	19.2–27.1
HL	7.0	0.8	6.0–7.8	6.9	0.7	5.7–7.7
HW	7.6	1.0	6.8–8.8	7.4	0.8	6.0–8.3
ED	2.4	0.1	2.2–2.6	2.4	0.2	2.0–2.9
TD	1.0	0	1.0–1.0	0.9	0.2	0.6–1.2
UEW	2.0	0.1	1.9–2.2	2.0	0.2	1.6–2.3
IOD	2.4	0.3	2.0–2.7	2.5	0.3	2.0–3.0
IND	1.7	0.1	1.6–1.8	1.7	0.1	1.6–1.8
END	1.7	0.2	1.3–1.8	1.7	0.2	1.4–1.9
THL	10.2	0.8	9.2–10.9	9.9	0.9	7.9–11.2
TBL	11.7	0.9	10.4–12.7	11.6	1.0	9.1–12.8
FL	12.7	1.0	11.3–13.9	12.7	0.8	10.7–13.6

harmonic. The eighth harmonic ranged from 3.2–4.8 kHz.

*Physalaemus erikae* call has a shorter duration than the calls of *P. barrioi* (1.2–1.4 sec; Bokermann, 1967), *P. jordanensis* (1.4–1.6 sec; Bokermann, 1967) and *P. kroyeri* (0.7–0.9 sec; Bokermann, 1966b), a higher dominant frequency

range than the calls of *P. aguirrei* (2.0–3.0 kHz; Bokermann, 1966a), *P. albifrons* (1.0–2.0 kHz; Bokermann, 1966b), *P. cicada* (2.0–3.0 kHz; Bokermann, 1966b), and *P. cuvieri* (0.58–0.8 kHz; Heyer et al., 1990). Information on the call of *P. soaresi* is not available.

**Habitat and Distribution.**—Specimens of *P. erikae* were found in temporary ponds in cow pastures at the borders of Atlantic Rain Forest remnants, natural clearings inside the forest, and cacao plantations. Males call from the edges of ponds or floating on shallow water. Females were found near ponds or dwelling on forest floor litter. Males also call during the day after heavy rains. This species was also registered by vocalization, with no specimens captured, at Fazenda Taquara (15°58'S, 39°22'W), Municipality of Belmonte, Fazenda Palmeira (15°56'S, 39°38'W), Municipality of Itapebi, Mata Cara Branca (16°17'S, 39°25'W), Municipality of Santa Cruz de Cabrália, and Fazenda Alcoprado (17°17'S, 39°40'W), Municipality of Teixeira de Freitas. All these localities are also situated in southern Bahia, Brazil (Fig. 4). It is also expected to occur in northeastern Minas Gerais and northern Espírito Santo, because of the proximity and similarity of vegetation types between south Bahia and these regions.

**Etymology.**—The specific epithet "*erikae*" honors the second author's wife, Érika Costa Elias, in gratitude for her friendship and assistance.

## DISCUSSION

The *P. cuvieri* species group, as proposed by Lynch (1970), shows a wide diversity of forms and life histories. The validity of this group as a natural group was questioned by Feio et al. (1999) when they suggested that *P. aguirrei*, *P. maximus*, *P. olfersii*, and *P. soaresi* could compose

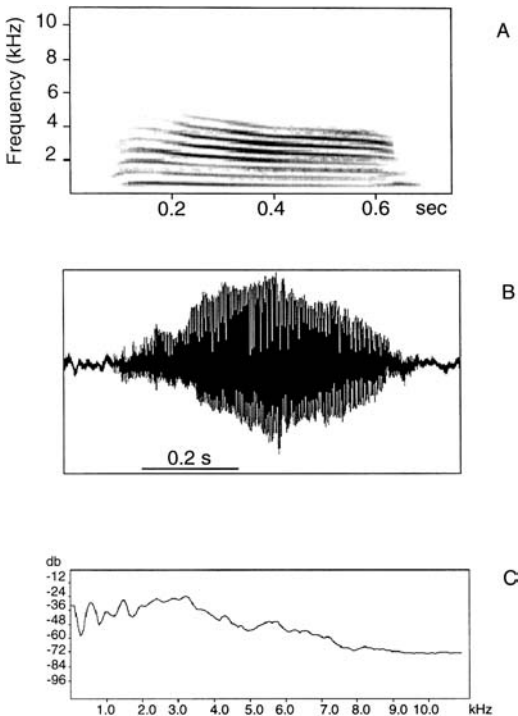


FIG. 3. (A) Sonogram, (B) oscillogram, and (C) power spectrum of the advertisement call of *Physalaemus erikae* sp. n.; recorded at RPPN Estação Veracruz, Porto Seguro, Bahia, Brazil, on 25 October 2001, 2100 h. Air temperature = 24.4°C. Specimen not collected.

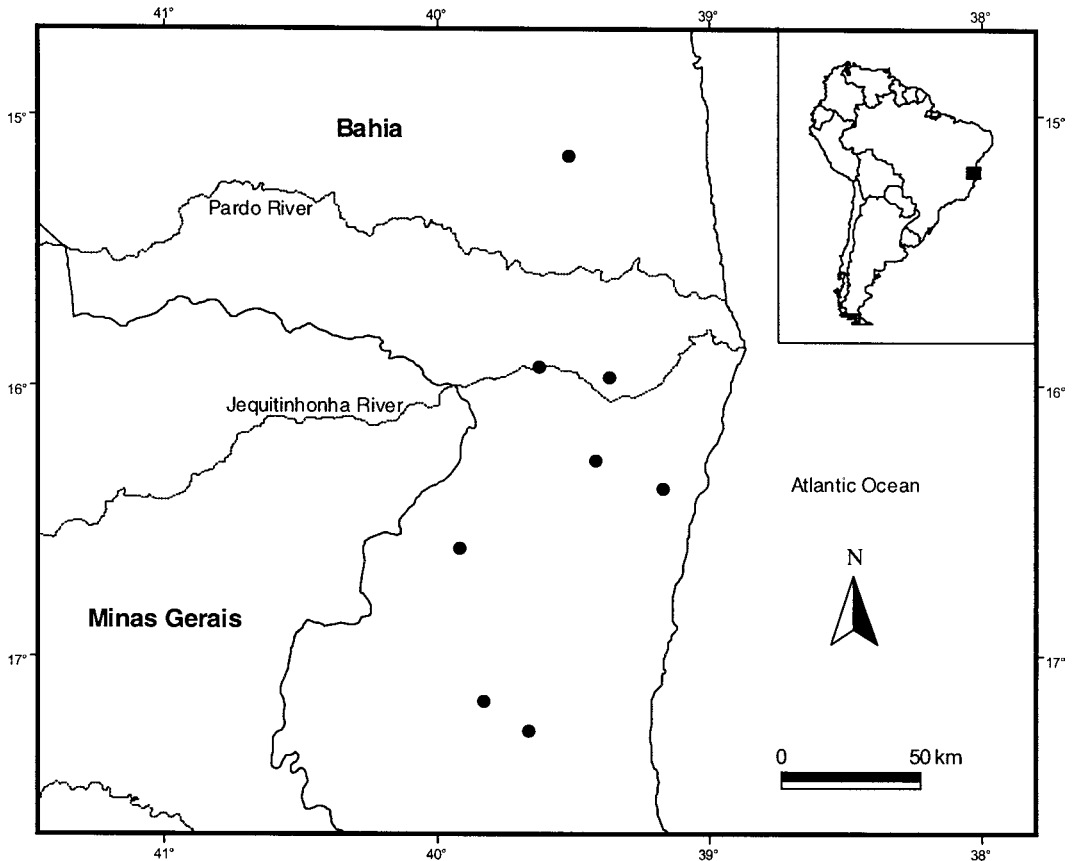


FIG. 4. Distribution of *Physalaemus erikae* sp. n. (dots) in southern Bahia, Brazil.

a separate species group, because of morphological similarities and the habit of reproducing on forested areas. It is possible that as the knowledge of the relationships between the *Physalaemus* species grows other groups will be proposed.

The discovery of a new species of *Physalaemus* occurring over a relatively broad area demonstrates the current poor knowledge about taxonomy and composition of species in large regions of the Atlantic Rain Forest in Brazil. The last species of the *P. cuvieri* group described from Brazil was *P. lisei*, which occurs in the Atlantic Rain Forest of southern Brazil (Braun and Braun, 1977). Because of the high level of anthropogenic pressure that the Atlantic Rain Forest experiences, field studies on distribution and composition of herpetological communities are vital. These studies might reveal other new species and identify centers of endemism, population fluctuations, and other important data regarding the taxonomy, conservation, and management of lowland tropical forest anurans.

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## LITERATURE CITED

- BOKERMANN, W. C. A. 1966a. Dos nuevas especies de *Physalaemus* de Espirito Santo, Brasil *Physis* 26:193–202.
- . 1966b. Notas sobre três espécies de *Physalaemus* de Maracás, Bahia (Amphibia, Leptodactylidae). *Revista Brasileira de Biologia* 26:253–259.
- . 1967. Três novas espécies de *Physalaemus* do sudeste brasileiro (Amphibia, Leptodactylidae). *Revista Brasileira de Biologia* 27:135–143.
- BRAUN, P. C., AND C. A. S. BRAUN. 1977. Nova espécie de *Physalaemus* do Rio Grande do Sul (Anura, Leptodactylidae). *Revista Brasileira de Biologia* 37:867–71.
- CARAMASCHI, U., L. C. CARCERELLI, AND R. N. FEIO. 1991. A new species of *Physalaemus* (Anura: Leptodactylidae) from Minas Gerais, southeastern Brazil. *Herpetologica* 47:148–151.
- CARAMASCHI, U., R. N. FEIO, AND A. S. GUIMARÃES-NETO. 2003. A new, brightly colored species of *Physalaemus* (Anura: Leptodactylidae) from Minas Gerais, southeastern Brazil. *Herpetologica* 59:519–524.
- FEIO, R. N., J. P. POMBAL JR., AND U. CARAMASCHI. 1999. New *Physalaemus* (Anura: Leptodactylidae) from the Atlantic Forest of Minas Gerais, Brazil. *Copeia* 1999:141–145.
- FROST, D. R. 2002. Amphibian Species of the World: an online reference. V2.21 (15 July 2002). Electronic database available at <<http://research.amnh.org/herpetology/amphibia/index.html>>.
- HEYER, W. R., A. S. RAND, C. A. G. CRUZ, O. L. PEIXOTO, AND C. E. NELSON. 1990. Frogs of Boracéia. *Arquivos de Zoologia* 31:231–410.
- IZECKSOHN, E. 1965. Uma nova espécie de *Physalaemus* Fitzinger, do Estado do Rio de Janeiro (Amphibia, Anura). *Revista Brasileira de Biologia* 25:165–168.
- LYNCH, J. D. 1970. Systematic of the American leptodactylid frog genera *Engystomops*, *Eupemphix*, and *Physalaemus*. *Copeia* 1970:488–496.
- SAZIMA, I., AND U. CARAMASCHI. 1986. Descrição de *Physalaemus deimaticus*, sp. n., e observações sobre comportamento deimático em *P. nattereri* (Steindn.).—Anura, Leptodactylidae. *Revista de Biologia* 13:91–101.

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## APPENDIX 1

*Specimens Examined*

*Physalaemus aguirrei*: MNRJ 20938–20943 (Conceição da Barra, ES). *Physalaemus albifrons*: MNRJ 24062–24063 (Brejo Santo, CE). *Physalaemus barrioi*: MZUSP 84821, MZUSP 84823, MZUSP 84285–26, MZUSP 84828–29 (topotypes, São José do Barreiro, SP). *Physalaemus cicada*: EI 6152 (paratopotype, Maracás, BA); MNRJ 28552, MNRJ 26040 (Brejo Santo, CE). *Physalaemus cuvieri*: MNRJ 6601–6615 (Fortaleza, CE). *Physalaemus jordanensis*: ZUEC 4479–4480, ZUEC 6257–6258 (Poços de Caldas, MG). *Physalaemus kroyeri*: MZUSP 96515–96518, MZUSP 96522, MZUSP 96527, MZUSP 96544–96545, MZUSP 96472, MZUSP 96478, MZUSP 96483, MZUSP 96485, MZUSP 96487, MZUSP 96490, MZUSP 96493, MZUSP 96501 (Maracás, BA). *Physalaemus soaresi*: EI 1782–1783 (paratopotypes, Seropédica, RJ).