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RECOGNITION AND DISTRIBUTION OF *LEPTODACTYLUS MYSTACEUS* (ANURA; LEPTODACTYLIDAE) IN THE STATE OF SÃO PAULO, SOUTHEASTERN BRAZIL

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Abstract

Leptodactylus mystaceus, a widespread species over South America, is diagnosed based on specimens from the State of São Paulo, its southernmost geographic distribution limit. Here we present the first record of this species for Southeastern Brazil, extending its distribution for approximately 1,300 km to the southeast. We also include a description of its advertisement call, natural history data, photograph in life and morphological illustrations that make easier the identification of the species.

Key words: *Geographic distribution, advertisement call, Leptodactylus mystaceus.*

Resumo

Leptodactylus mystaceus, uma espécie com ampla distribuição geográfica pela América do Sul, é diagnosticada com base em exemplares do Estado de São Paulo, seu limite meridional de distribuição geográfica. Apresentamos aqui o primeiro registro da espécie para o Sudeste do Brasil, ampliando sua distribuição conhecida em cerca de 1.300 km ao sudeste. Também incluímos a descrição da vocalização de anúncio, informações sobre história natural, fotografia em vida e desenhos de caracteres morfológicos que auxiliam na identificação desta espécie.

Palavras-chave: *Distribuição geográfica, vocalização de anúncio, Leptodactylus mystaceus.*

Introduction

The genus *Leptodactylus* Fitzinger includes more than 60 recognized species distributed throughout the Americas (Frost 2004). These species are currently divided into four morphological groups [*fuscus* (Schneider), *melanonotus* (Hallowell), *ocellatus* (Linnaeus), and *pentadactylus* (Laurenti)], the *L. fuscus* group being the one that encloses the greatest number of species. After the latest systematic review of the *L. fuscus* group (Heyer 1978), new species have been added (e.g., Sazima & Bokermann 1978; Heyer 1983; Heyer et al. 1996) totaling 26 species in the group. One of these species is *Leptodactylus mystaceus*, which is morphologically identical to *L. didymus*, differing only on its advertisement calls (see Heyer et al. 1996). Besides *L. didymus*, *L. mystaceus* is closely related to other species in the *L. fuscus* group; but they present a few morphological differences. Here we identify *Leptodactylus mystaceus* in the State of São Paulo, detail its distribution in the State, expand its geographic distribution range, and review the literature that identify the species inadequately. Furthermore, to help in the identification of *L. mystaceus*, we present the description of its advertisement call, information about its natural history, and illustrations of some morphological features of a specimen (CFBH 7373) captured in the Municipality of Rio Claro, State of São Paulo, Brazil.

Methods

Specimens from museum collections in the State of São Paulo, Brazil, were examined and measured with digital caliper of 0.01 mm of precision. The measurements of the adults follow Cei (1980). Museum abbreviations are: CFBH for the Célio F. B. Haddad collection, deposited in the Departamento de Zoologia, Unesp, Rio Claro; DZSJRP for the collection of the Departamento de Zoologia, Unesp, São José do Rio Preto; and ZUEC for Museu de História Natural, Unicamp, Campinas.

Observational data on natural history were obtained at the Floresta Estadual Edmundo Navarro de Andrade, Municipality of Rio Claro, São Paulo, between November 2001 and January 2002. The subterranean chambers were found by hand-digging during the search for calling males. Vocalizations were recorded at the same site with a Nagra-E tape recorder and a Sennheiser ME 80 microphone at tape speed of 19 cm/s. The sound analyses were made in a Macintosh computer, using the Canary 1.2.4 software, configured with 16 bits of resolution, 22 kHz of frequency sampling, FFT and frame length of 256. Drawings of an adult male were made using a stereomicroscope Zeiss SV11.

Results

Leptodactylus mystaceus is a large-sized species for the *L. fuscus* group (see Table 1 for measurements of adult

specimens collected in the São Paulo State) with brownish dorsal coloration (Fig. 1). The snout is rounded in dorsal view and acuminate in lateral view (Fig. 2). Two pairs of dorsolateral folds. Shoulder blades readily perceptible. Round conspicuous subarticular and supranumeral tubercles on hands and feet (Fig. 2).



Figure 1. Adult male of *Leptodactylus mystaceus* in life collected at Floresta Estadual Edmundo Navarro de Andrade, Municipality of Rio Claro, São Paulo, Brazil.

Males of *L. mystaceus* were observed calling at the onset of the wet and warm season of the year (October–November) in the open or in the border of forested areas and were syntopic with *L. fuscus* and *L. mystacinus* (Toledo et al. 2003). Calling activity began about one hour before sunset and persisted until the middle of the night. Advertisement calls were given frequently, on muddy ground near or inside a subterranean nest. The openings of the nests were about 2.5 cm wide and 1.5 cm high. The subterranean elliptic chambers were about 5 cm deep, 4 cm wide, and 4 cm high. Nests were probably dug up by the males and were apparently formed by multiple subterranean connections. These subterranean galleries allowed the frogs to move over 1 m underground, a tactic that may provide protection against visually hunting predators. The only gravid female collected yielded 379 yellowish ovules accounting for 10.31% of its body mass.

Each note of the advertisement call of *L. mystaceus* (Fig. 3) is constituted by a series of about 11 pulses, interspaced by 18–22 ms (Table 2). From the beginning of the sequence, the pulses progressively increase in duration and intensity. However, the last pulse of each sequence is the longest and a little less intense than the precedent pulse. The first pulse has about 10 ms duration and the latest (the more variable) has from 27–49 ms duration. The mean duration of the call is about 240 ms (Table 2). The fundamental frequency ranges 700–1500 Hz, and harmonics may reach 3000 Hz. The frequency gradually increases from the beginning to the end of the note, but the last pulse may present a decreasing frequency modulation (see 2nd note in Fig. 3).

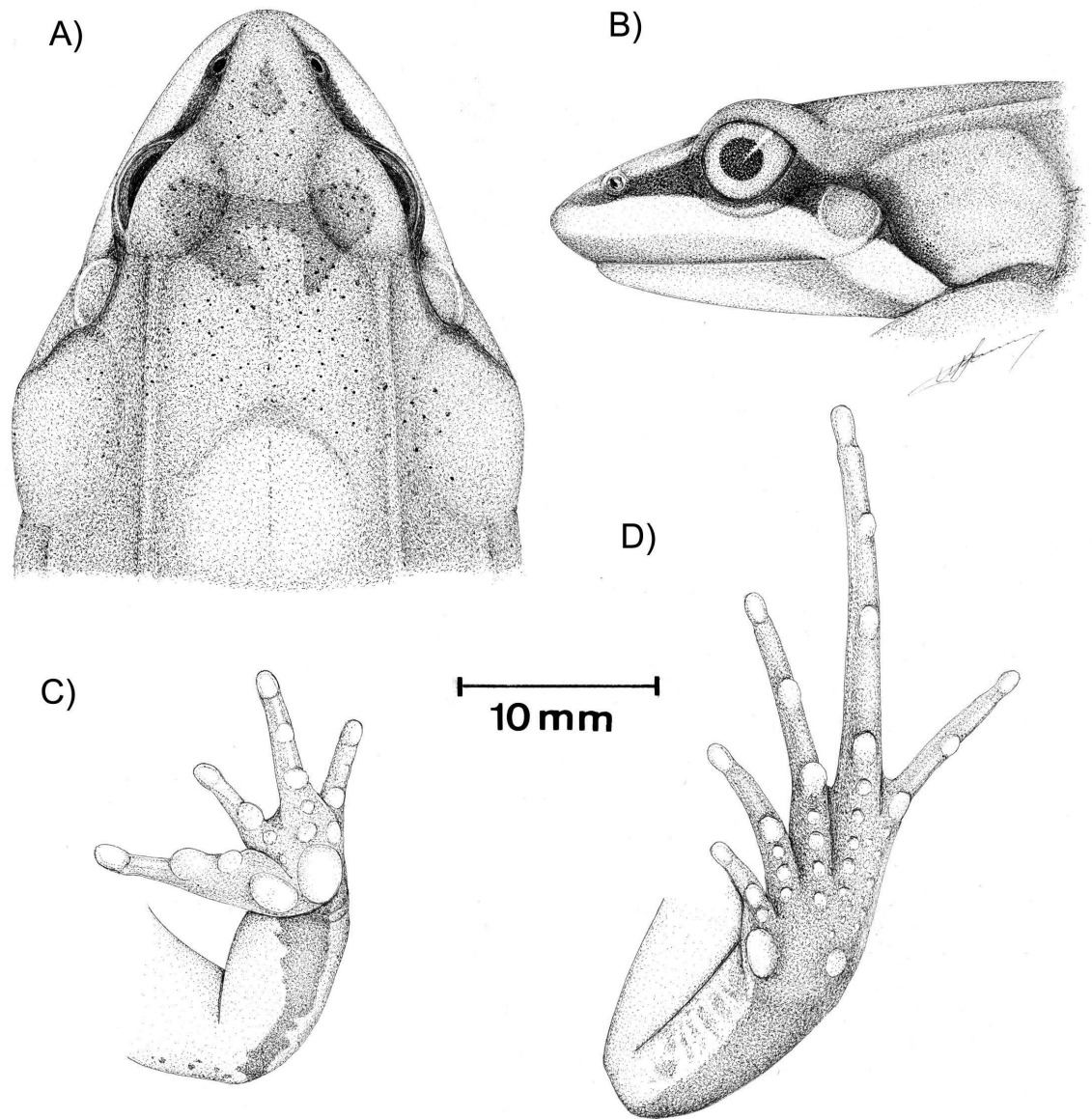


Figure 2. Adult male of *Leptodactylus mystaceus* (CFBH 7373) collected at Floresta Estadual Edmundo Navarro de Andrade, Municipality of Rio Claro, São Paulo, Brazil. A) dorsal view of the head; B) lateral view of head; C) ventral view of left hand; D) ventral view of left foot.

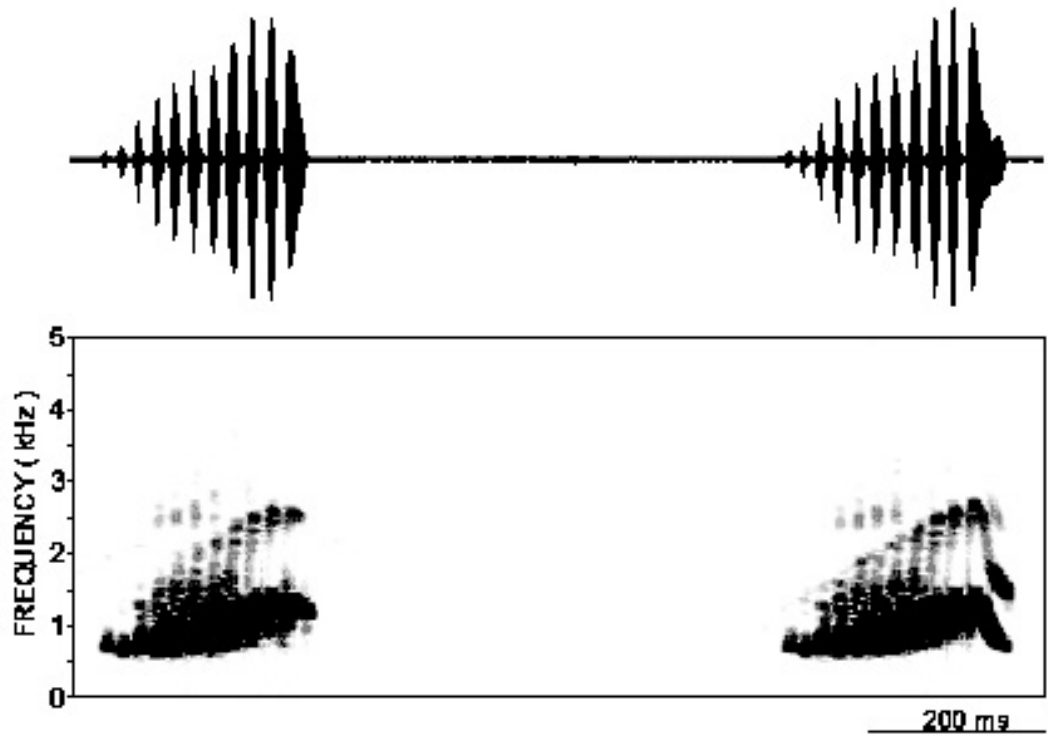


Figure 3. Waveform (upper) and spectrogram (lower) of two notes of the advertisement call of *Leptodactylus mystaceus* recorded at the Municipality of Rio Claro, São Paulo, Brazil; air temperature = 23°C.

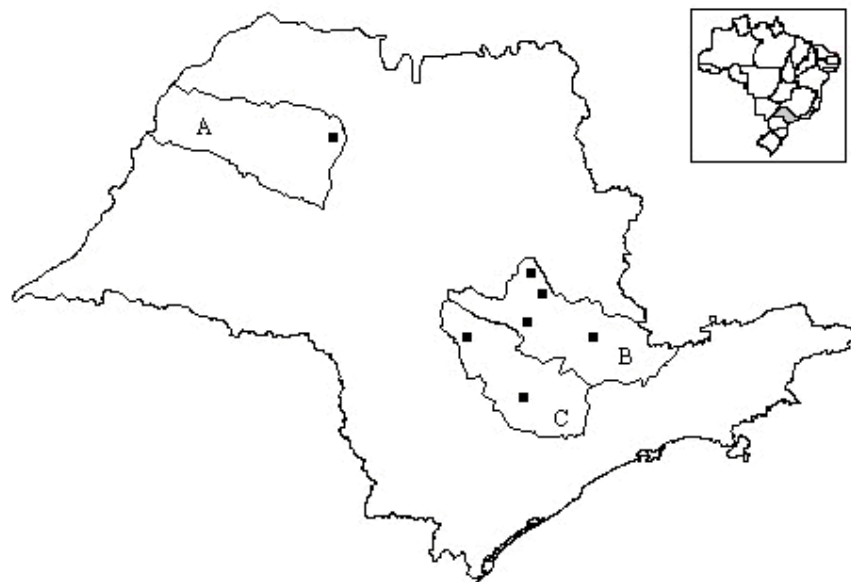


Figure 4. Geographic distribution of *Leptodactylus mystaceus* in the State of São Paulo, Brazil (dark squares). The limits of the river basins of (A) Baixo Tietê, (B) Piracicaba/Capivari/Jundiaí, and (C) Sorocaba/Médio Tietê are also represented.

Table 1. Measurements of 13 adult males and one adult female *Leptodactylus mystaceus* collected at the Floresta Estadual Edmundo Navarro de Andrade, Rio Claro, São Paulo. Values presented in mm as mean \pm SD (range).

	Males mean (SD; range)	Female
Snout-vent length	47.14 \pm 2.49 (41.6-51.71)	51.97
Head length	17.36 \pm 0.87 (15.41-19.24)	18.92
Head width	17.86 \pm 0.84 (15.45-18.6)	18.29
Eye diameter	4.38 \pm 0.38 (3.99-5.05)	5.16
Tympanum diameter	3.01 \pm 0.29 (2.54-3.52)	3.01
Interorbital distance	4.24 \pm 0.42 (3.65-4.93)	4.71
Eye to nostril distance	4.33 \pm 0.24 (3.84-4.65)	4.83
Internarial distance	4.32 \pm 0.22 (3.83-4.52)	4.77
Tibia length	26.25 \pm 1.47 (24.15-28.69)	28.51
Thigh length	23.32 \pm 1.41 (21.85-26.45)	26.01
Foot length	27.27 \pm 1.62 (25.23-30.41)	29.62

Table 2. Physical characteristics of the advertisement calls of males of *Leptodactylus mystaceus* recorded at the Floresta Estadual Edmundo Navarro de Andrade, Municipality of Rio Claro, State of São Paulo, Brazil. Values presented as mean \pm SD (range; n).

male	note duration (ms)	pulses/note	internote interval	air temp. (°C)
1	249.0 \pm 8.6 (236-262; 20)	12.0 \pm 0.0 (12-12; 20)	684.4 \pm 193.3 (472-1185; 18)	23
2	220.9 \pm 4.3 (215-229; 20)	10.9 \pm 0.2 (10-11; 20)	721.2 \pm 415.6 (431-2108; 19)	23
3	247.2 \pm 5.7 (234-259; 31)	11.5 \pm 0.5 (11-12; 31)	540.6 \pm 143.9 (423-1001; 19)	23

Discussion

Several authors were unable to identify *L. mystaceus* as such in the State of São Paulo, treating it as *Leptodactylus notoakitites* (Jim, 1980; Silva et al. 2000), *Leptodactylus* sp. (Rossa-Feres & Jim, 1994), and *Leptodactylus* sp. (gr. *fuscus*) (Toledo et al. 2003). The difficulty in identifying *L. mystaceus* is due to its very similar morphology with *L. dydimus* (so called cryptic species) and a strong resemblance with *L. notoakitites* (except for the presence of scattered white supranumerary tubercles on sole of foot, not often observed in *L. notoakitites*), the advertisement call being the most remarkable difference between these three species.

While examining specimens deposited in museum collections and recordings of their advertisement calls (which agreed with the call descriptions provided by Heyer et al.

1996) we collected data from six municipalities in the State of São Paulo where *L. mystaceus* occurs: Rio Claro (CFBH 4535, 5487, 6002; 7362-73), Corumbatai (CFBH 931; DZSJRP 5663-64), Piracicaba (CFBH 3828), Campinas (ZUEC 6890), José Bonifácio (CFBH 5998), and Araçoiaba da Serra (CFBH 5999-6001) (see Fig. 4). Among them, Araçoiaba da Serra (23°30' S; 47° 36' W) is now the southernmost limit of the species, extending its distribution range approximately 1,300 km south-eastern from the Chapada dos Guimarães (15°30' S; 56°00' W), Municipality of Cuiabá, State of Mato Grosso, Western Brazil, which was previously the southernmost known limit of its distribution based on animals with recorded advertisement calls (see Heyer et al. 1996). The population of the Municipality of Uberlândia (18°55' S; 48°16' W), State of Minas Gerais (as *L. amazonicus* in Heyer 1978), which is about 515 km from the

southern distribution of *L. mystaceus* (present study), had no advertisement calls reported; however, we believe that the population of Minas Gerais is actually composed of *L. mystaceus* rather than *L. dydimus*, which seems to be restrict to the Amazon basin (Heyer et al. 1996).

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