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The first record of *Pseudopaludicola atragula* Pansonato, Mudrek, Veiga-Menoncello, Rossa-Feres, Martins & Strüssmann, 2014 (Anura: Leptodactylidae) in the state of Goiás, central Brazil

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Abstract: *Pseudopaludicola atragula* is one of the most recently described species for the genus. Distributional records for this species were restricted to two municipalities in northwestern São Paulo state. Herein, we extend its distribution range and report the first record of the species in Cerrado areas of the state of Goiás, central Brazil.

Key words: advertisement call; Cerrado; distribution; Leiuperinae; Neotropical frogs

Leptodactylidae is a family of frogs that is widely distributed in the Neotropics, ranging from the southern border of Texas (USA), across Central America and the West Indies, and throughout South America on both sides of the Andes (Frost 2016). To date, Leptodactylidae is composed of 201 species classified into three subfamilies: Leiuperinae, Leptodactylinae, and Paratelmatobiinae (Pyron and Wiens 2011). The genus *Pseudopaludicola* Miranda-Ribeiro, 1926 (Leiuperinae) currently contains 19 species distributed throughout South America (Frost 2016), which are usually associated with open environments, but may also be associated with dry forest habitats (Lynch 1989; Pansonato et al. 2012; Andrade and Carvalho 2013; Pansonato et al. 2014). *Pseudopaludicola atragula* Pansonato, Mudrek, Veiga-Menoncello, Rossa-Feres, Martins & Strüssmann, 2014 is one of the most recently described species in the genus. Distributional records for *P. atragula* were restricted to two municipalities (Nova Aliança and the type locality at Icém), in northwestern São Paulo state, as reported in the original description (Pansonato et al. 2014). Herein, we report the first record of *P. atragula* in the state of Goiás, central Brazil. In addition, because *P. atragula* has a distinctive advertisement call in the genus *Pseudopaludicola*, we provide the advertisement call of specimens in the field to aid the species identification.

Fieldwork was carried out in the municipality of Itarumã, southwestern state of Goiás, central Brazil (Figure 1), in November 2015. The study region is covered with vegetation physiognomies of the Cerrado biome (Oliveira and Marquis 2002), and the climate is classified as a tropical savanna climate with wet and dry season (Aw) according to the Köppen classification (Peel et al. 2007). During different occasions at the study site, individuals were commonly heard and observed on both margins of the Corrente River, part of the Paranaíba River basin: (i) in marshy areas with grassy vegetation, bordered by a riparian forest (19°08′12.8″S, 051°06′45.0″W), (ii) palm grove marsh, regionally called Veredas (19°05′18.0″S, 051°16′37.0″W), and (iii) artificial reservoirs (19°05′44.0″S, 051°05′11.0″W). These three sites were all scattered on a pasture matrix. The individuals were found in calling/breeding activity on all occasions. We assigned the specimens collected by us to *P. atragula* based on morphological and acoustic characters provided in the original description of the species (Pansonato et al.

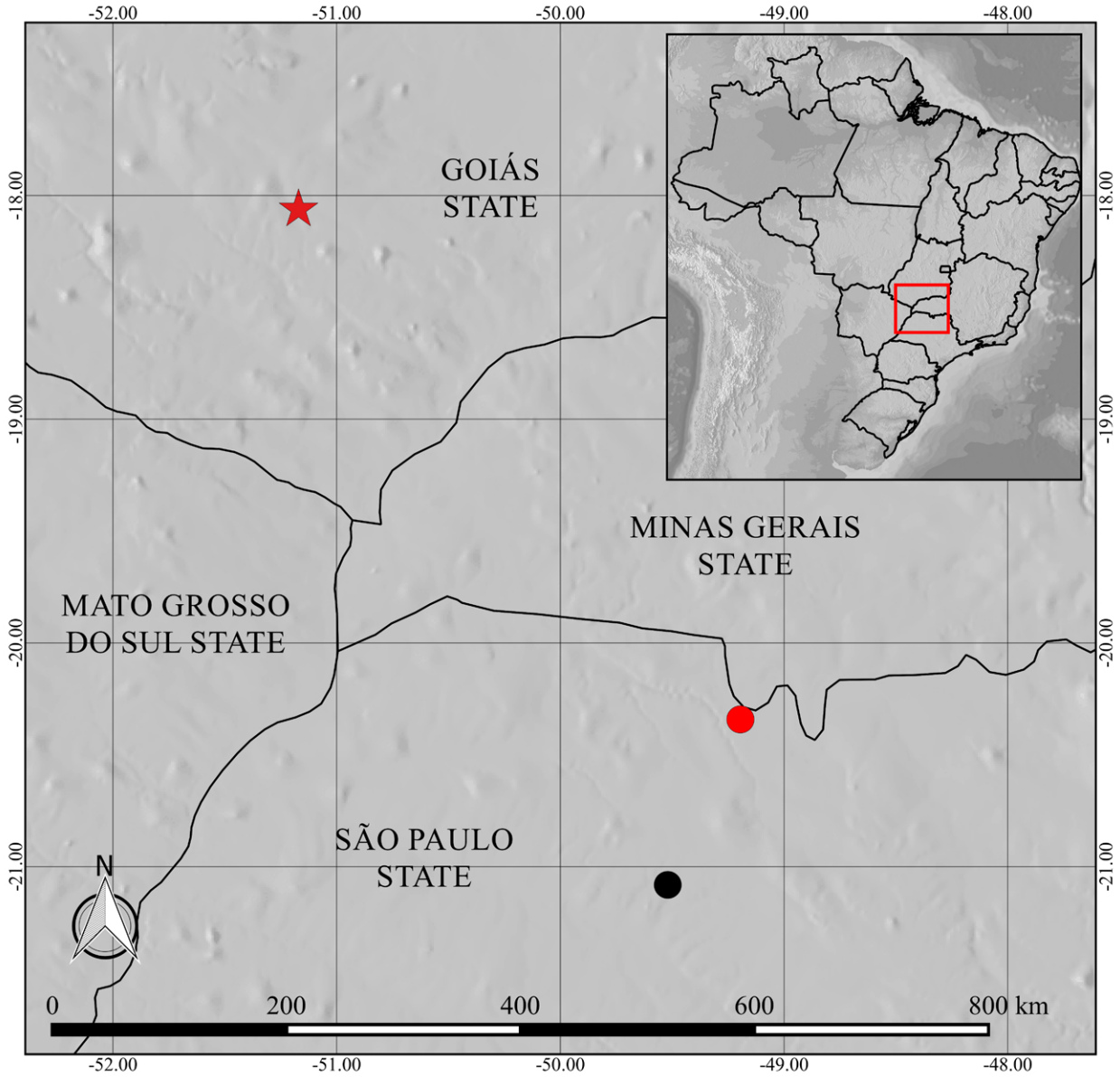

Figure 1. Distribution of *Pseudopaludicola atragula* in Brazil. Circles represent distributional records from the species original description (Pansonato et al. 2014): the red circle is the type locality (municipality of Icém, state of São Paulo); the red star is the new state record (municipality of Itarumã, state of Goiás; present study).

2014). Specimens were collected under permits granted by Secretaria de Meio Ambiente, Recursos Hídricos, Infraestrutura, Cidades e Assuntos Metropolitanos (SECIMA #15671/2015 and #15666/2015) and deposited in the Coleção Herpetológica da Universidade Federal de Goiás (ZUFG), Goiânia, Brazil, accession numbers ZUFG 10050 to ZUFG 10052.

A video recording (MP4 file format) of a calling male was made by one of us (M.S.A.) in the field using a Canon Powershot SX40HS camera. The audio was extracted from the video file and converted into a WAVE file so we could generate a sound figure (Figure 3A and B). The video file was deposited in the sound recording collection (Fonoteca) of the Coleção Zoológica da Universidade Federal de Goiás, Goiânia, Brazil (accession number: FONO1514; voucher male: ZUFG 10051). An additional sound figure (Figure 3C) was generated for comparative purposes from a recording of *P. atragula* that was made by Ariovaldo Giaretta at the species type locality (municipality of Icém, state of São Paulo); sound file (accession label in AAG acoustic database): Pseudop_atragulaIcemSP1aAAGm671 (unvouchered recording). Sound figures were generated with Seewave package, version 1.7.3 (Sueur et al. 2008), R software, version 3.2.2 (R Core Team 2015), under the following settings: window type = Hanning; window length = 256 samples (FFT); overlap = 85%. Frequencies lower than 500 Hz were filtered out before we generated the sound figures. We are aware of potential issues associated with format conversion, such as file compressing or stretching in the time domain, and consequently altering the frequency domain as well. So we decided to be precautionary and

Figures 2. Adult male of *Pseudopaludicola atragula* (ZUFG 10051; SVL = 13.5 mm) collected in the municipality of Itarumã, state of Goiás, central Brazil. **A**: specimen in life; **B**: ventral view depicting the white-colored vocal sac with dark-colored reticulations and warty texture.

refrain from conducting quantitative analysis; thus, we only explored the distinctive structural features of the call for the ascertainment of the new population to *P. atragula*, despite the fact that the audio file did not seem to be affected by format conversion after a comparison with both calls provided in the original description (Figures 4A and B in Pansonato et al. 2014) and those of topotypes (Figure 3C).

The specimens collected in the state of Goiás were assigned to *P. atragula* based on the advertisement call and the distinctive skin texture and coloration of the vocal sac (white vocal sac with warty texture and dark-colored reticulations; Pansonato et al. 2014). These morphological and color features (Figures 2A and B) differentiate this species from all congeners except for *P. facureae* Andrade & Carvalho, 2013 (Carvalho et al. 2015a). Even so, these species can easily be differentiated through their advertisement calls: the advertisement call of *P. atragula* consists of a long (300–700 ms), pulsed note (Figure 3 in the present study; Figures 4A and B in Pansonato et al. 2014), whereas that of *P. facureae* consists of short (14–26 ms), non-pulsed notes emitted in series (trilled call; Carvalho et al. 2015a).

This study provides the first record of *P. atragula* in the state of Goiás (first record outside the state of São Paulo), extending the species distribution approximately 245 km northwest from its type locality (municipality of Icém, state of São Paulo; Figure 1). The new distributional record for *P. atragula* reveals that the distribution range of this species is more widespread than previously expected, and also encompasses areas of Cerrado, because *P. atragula*'s type locality was originally covered with seasonal forests, which were mostly converted into open areas to serve as agricultural land (Pansonato et al. 2014). *Pseudopaludicola* species almost always have their distribution restricted to open areas (see Lynch 1989 for the occurrence in dry forests), so we hypothesize that *P. atragula* might have colonized, or became more widespread and abundant, in the northwestern state of São Paulo after anthropogenic alterations because such actions artificially generated typical breeding habitats for this species.

As previously recognized (Carvalho 2012; Andrade and Carvalho 2013; Pansonato et al. 2013, 2014; Magalhães et al. 2014), species diagnoses of *Pseudopaludicola* species almost always benefit from information on their advertisement calls, and some morphologically cryptic species can only be recognized by their distinctive call patterns (e.g., *P. giarettai* Carvalho, 2012, *P. canga* Giaretta & Kokubum, 2003; Carvalho et al. 2015a, 2015b). Therefore, this dataset should be assessed particularly for this Neotropical frog group as a tool for reliable species assignments, contributing to future studies on taxonomy, distribution patterns, and conservation of its comprising species in South America.

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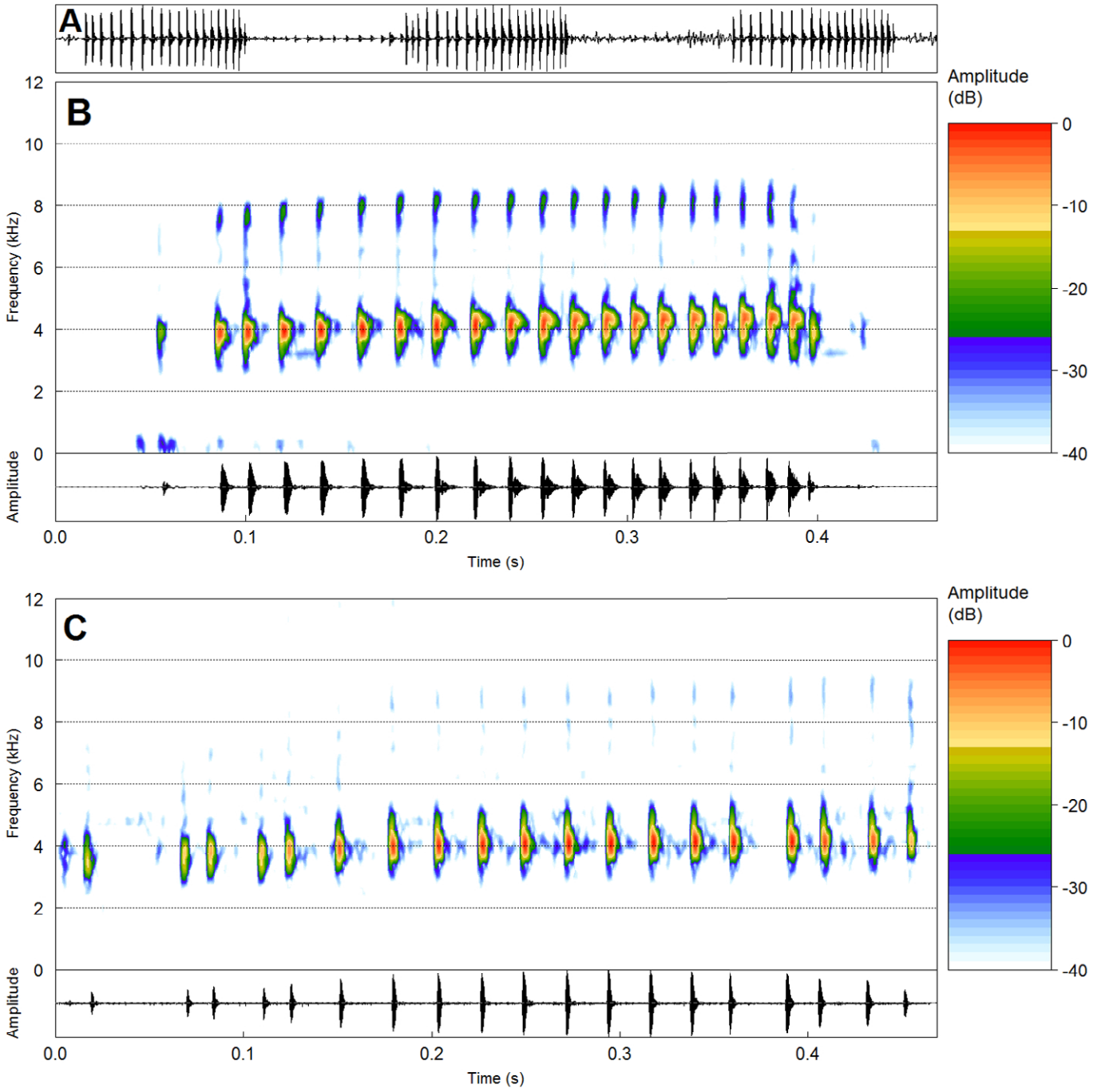

Figure 3. Advertisement call of *Pseudopaludicola atragula* (voucher male: ZUFG 10051; sound file: FONO1514). **A**: Section (ca. 1.7 s) containing three advertisement calls in the time domain from Itarumã, state of Goiás, central Brazil. **B**: Spectrogram and corresponding oscillogram of the third advertisement call from A; and a comparative advertisement call (**C**) from the type locality (municipality of Icém, state of São Paulo, southeastern Brazil).

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