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## Bioacoustics reveals two new syntopic species of *Adenomera* Steindachner (Anura: Leptodactylidae: Leptodactylinae) in the Cerrado of central Brazil

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### Abstract

In this paper, we describe two syntopic species of *Adenomera* from the Chapada dos Veadeiros microregion, northern State of Goiás, central Brazil, recognized based on morphology, color patterns, and bioacoustics. Specimens and calls were obtained in the Municipality of Teresina de Goiás, central Brazil. *Adenomera cotuba* **sp. nov.** is diagnosed from the other 16 congeneric species by its 1) small size (adult male SVL 18.6–20.5 mm) and very robust body; 2) dorsum glandular/granular with no distinctive dorsal granular rows or dorsolateral folds; 3) black or very dark dorsal coloration with no distinctive color patterns (e.g., dorsolateral or vertebral stripes); 4) toe tips not developed into flattened disks; 5) presence of antebrachial tubercle; and 6) advertisement call consisting of a well-defined series of pulsed calls (7–32 calls/series) with progressive increment in amplitude in the first third of each call series when it reaches a sustained plateau. *Adenomera juikitam* **sp. nov.** is diagnosed from the other 16 congeneric species by its 1) dorsum profusely glandular/granular with no distinctive dorsal granular rows or dorsolateral folds; 2) dorsum with a marble-like and red coloration with no distinctive color patterns (e.g., dorsolateral or vertebral stripes); 3) toe tips not developed into flattened disks; 4) small size (adult male SVL 19.1–19.5 mm) and very robust body; and 5) long (148–202 ms) advertisement call composed of 16–21 pulses. Both new taxa occur in syntopy, and our data allow us to differentiate them both in temporal (pulses/call) and spectral (frequency peaks) traits of their advertisement calls. Besides, dorsal coloration is distinctive, *Adenomera cotuba* **sp. nov.** has a black or very dark-colored dorsum, whereas *Adenomera juikitam* **sp. nov.** has a marble-like and red-colored dorsum, in addition to the presence (*A. cotuba* **sp. nov.**) or absence (*A. juikitam* **sp. nov.**) of antebrachial tubercle.

**Key words:** Advertisement call, Chapada dos Veadeiros microregion, State of Goiás, Syntopy, taxonomy

### Introduction

The genus *Adenomera* Steindachner currently comprises 16 recognized species distributed throughout South America east of the Andes (Carvalho & Giaretta 2013; Frost 2013). Several studies have revised and discussed the definition and phylogenetic position of *Adenomera*, as well as the interrelationships of its comprising taxa (Heyer 1969a, b, 1973, 1974a). While there have been additional subsequent studies, the phylogenetic position of *Adenomera* is still disputed based upon different lines of evidence (external morphology, osteology, molecular biology, and natural history), with two current hypotheses: i) corroboration of the preferred phylogenetic relationship hypothesis in Heyer (1974a), placing *Adenomera* + *Lithodytes* as sister group of *Leptodactylus* in the narrow sense (Frost *et al.* 2006; Ponssa 2008; Ponssa *et al.* 2010), in spite to the phylogenetic position and generic status of *Leptodactylus discodactylus* (including other generic combinations, under *Lithodytes* and *Vanzolinius*; see Heyer 1974a, b; Heyer 1998; De Sá *et al.* 2005; Ponssa 2008; Pyron & Wiens 2011); ii) or rendering its comprising taxa (*L. marmoratus* group) paraphyletic in relation to *Leptodactylus*, embedded within the *L. fuscus* group (Heyer 1998), or placed as a subset of this species group (Giaretta *et al.* 2011). It worth mentioning that Frost *et al.* (2006) changed the generic status of *Adenomera* and *Lithodytes*, synonymizing the former with the latter, which was

**Additional examined material.** BRAZIL: GOIÁS: Colinas do Sul (CHUNB 36029–36030).

**Remarks and discussion.** Both newly described species occur in syntopy, and our acoustic data distinguish one from the other in call emission pattern, temporal (pulses/call) and spectral (frequency peaks) traits of their advertisement calls (see Table 4). Besides, both the dorsal coloration pattern [*A. cotuba* **sp. nov.** (black or very dark-colored dorsum), *A. juikitam* **sp. nov.** (marble-like and red dorsum)], and the presence (*A. cotuba* **sp. nov.**) or absence (*A. juikitam* **sp. nov.**) of antebrachial tubercles are distinctive between both taxa. Given that the localities from where we heard calling males have no association with water bodies, we assume that both *A. cotuba* **sp. nov.** and *A. juikitam* **sp. nov.** possess a terrestrial reproductive mode with non-feeding larvae.

An in-depth morphological and distributional revision of *Adenomera* (*L. marmoratus* species group) was performed by Heyer (1973), who covered the various names that are currently placed under synonymy in other *Adenomera* species. All morphological variability and color patterns available to Heyer (1973) at that time were classified into three morphotype groups. In this respect, neither do *Adenomera cotuba* **sp. nov.** nor *Adenomera juikitam* **sp. nov.** fit any of these groups by the combination of i) lack of any distinctive dorsal coloration pattern, such as longitudinally arranged spots or dots, dorsolateral or vertebral stripes; ii) lack of dorsolateral folds or dorsal granular rows; iii) lack of toe tips developed into flattened disks. Thus, none of the available names listed by Heyer (1973) might be applied to both newly described *Adenomera* species.

The assessment of the phylogenetic positions of *Adenomera cotuba* **sp. nov.** and *A. juikitam* **sp. nov.** (an ongoing project) would be a good opportunity to better understand the evolutionary scenario of their co-occurrence, at least at the type locality: a case of closely related taxa (sister species); or a case of taxa more distantly related (recovered in different clades, more closely related to other taxa than to each other). Other cases of pairs of *Adenomera* species with co-occurrence include two undescribed forest dweller species of *Adenomera* (referred as Forest Calls I and II) in the Amazon rainforest of southeastern Peru (Angulo *et al.* 2003), *A. marmorata* and *A. ajurauna* (Berneck *et al.* 2008), and *A. araucaria* and *A. engelsi* in the Atlantic Forest (Kwet *et al.* 2009).

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#### APPENDIX 1. Additional examined specimens.

*Adenomera andreae*—BRAZIL: PARÁ: Porto Trombetas (MNRJ 52886–52887); *Adenomera* cf. *andreae*—BRAZIL: RONDÔNIA: Cacoal (AAG-UFU 2550–2556); Espigão d’Oeste (AAG-UFU 2284–2285); *Adenomera diptyx*—BRAZIL: MATO GROSSO: Chapada dos Guimarães (AAG-UFU 2138–2139); Cuiabá (AAG-UFU 2123); Santo Antônio do Leverger (AAG-UFU 1435–1438); *Adenomera engelsi*—BRAZIL: SANTA CATARINA: Rancho Queimado (MNRJ 72637, 72543–44); *Adenomera* cf. *hylaedactyla*—BRAZIL: MATO GROSSO: Rondolândia (AAG-UFU 2621); *Adenomera marmorata*—BRAZIL: RIO DE JANEIRO: Bangu (MNRJ 51091, 53817–53818, 53820, 54081–54082, 55684, 58132–58138, 58140–58142); Macaé (AAG-UFU 0529, 0756–0757); Saquarema (MNRJ 76775, 76778–76779); *Adenomera* cf. *marmorata*—BRAZIL: MINAS GERAIS: Chiador (AAG-UFU 0688); SÃO PAULO: Santo André (AAG-UFU 3031); São Sebastião (AAG-UFU 3007); *Adenomera martinezi*—BRAZIL: PARÁ: Novo Progresso: Cachimbo (AAG-UFU 1515–1525); *Adenomera saci*—BRAZIL: GOIÁS: Alto Paraíso de Goiás (Holotype: AAG-UFU 1339; Paratypes: AAG-UFU 0108–0109, 0762–0763, ZUEC 3287); *Adenomera* sp.—BRAZIL: MATO GROSSO: Pontal do Araguaia (AAG-UFU 0201, 0203); MINAS GERAIS: Perdizes (AAG-UFU 0609); Uberlândia (AAG-UFU 4633); GOIÁS: Caldas Novas (AAG-UFU 0018); *Lithodytes lineatus*—BRAZIL: AMAZONAS: Itacoatiara (MNRJ 56699); Barcelos (MNRJ 36243); PARÁ: Piçarra (MNRJ 67289–67290).