Zootaxa 2737: 61–68 (2011)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

A new species of *Bachia* Gray, 1845 (Squamata: Gymnophthalmidae) from the Cerrado of Midwestern Brazil

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Abstract

A new species of *Bachia* is described from two localities in the states of Mato Grosso and Rondônia, in Midwestern Brazil. The new species mostly resembles *Bachia bresslaui* in pholidosis and biometry, differing from this and from all other taxa from *bresslaui* group by the presence of two clawed digits in the forefeet.

Key words: *Bachia*, new species, Mato Grosso State, Rondônia State, two digits, *bresslaui* group

Resumo

Uma nova espécie de *Bachia* é descrita de duas localidades situadas nos estados de Mato Grosso e Rondônia, no centro-oeste brasileiro. A nova espécie assemelha-se a *Bachia bresslaui* em folidose e biometria, distinguindo-se desta e das demais espécies do grupo *bresslaui* pela presença de dois dígitos com garras nos membros locomotores anteriores.

Introduction

Among the 26 genera presently included in the family Gymnophthalmidae (Pellegrino *et al.* 2001), the genus *Bachia* comprises 21species (Rodrigues *et al.* 2008) of snake-like lizards with reduced eyes and appendages, lacking external ears, and presenting semi- and/or fossorial habits (Dixon 1973). Reduction in the number or even the loss of digits, as well as of other skeletal elements and head scales, together with reduction of eyes, of external ear openings, and reduction or elongation of internal organs, are usually considered adaptations to a fossorial lifestyle (Dixon 1973; see also Galis *et al*. 2009 and references therein). Some of these traits may also be associated to the use of microhabitats of dense vegetation (Lande 1978; Gans 1985, 1986; Shine 1986; Pinto & Ávila-Pires 2004). Representatives of the genus *Bachia* are distributed both in forested and open areas in the Neotropics, from Costa Rica to Paraguay, and in some of the Caribbean islands (Castrillon & Strüssmann 1998). Based on morphological similarities, Dixon (1973) classified the species into four groups: *bresslaui*, *dorbignyi*, *heteropa*, and *flavescens*. Although not supported by recent molecular studies (*e.g.*, Kohlsdorf & Wagner 2006; Kohlsdorf *et al.* 2010), this classification is still in use (see Rodrigues *et al*. 2008), due to the lack of a new consensual proposal.

Accepted by S. Carranza: 22 Nov. 2010; published: 12 Jan. 2011

Originally composed of only three species: *B. bresslaui*, *B. scolecoides*, and *B. panoplia* (Dixon, 1973), the *bresslaui* group now comprises eight species, five of them described in the last two decades: *B. cacerensis*, *B. pyburni*, *B. psamophila*, *B. micromela* and *B. oxyrhina*. Species in this group are characterized (according to Dixon 1973) by lanceolate, keeled, and imbricate dorsal and lateral body scales; juxtaposed squared ventrals; 2/2 femoral pores, and 1/1 preanal pores in males; interparietal, supraoculars, and superciliary scales present, prefrontals present (except in *B. bresslaui*, in which these scales are fused with anterior supraoculars).

Additionally, species in the *bresslaui* group were originally characterized by possessing four digits on each anterior appendage (Dixon 1973). Actually, this condition is verified only in *B. scolecoides*, *B. panoplia*, and *B. pyburni* (Dixon 1973; Kizirian & McDiarmid 1998). *Bachia bresslaui*, *B. psamophila*, *B. micromela* and *B. oxyrhina* have only one finger (Dixon 1973; Rodrigues *et al*. 2007; Rodrigues *et al*. 2008), while *B. cacerensis* has three or four fingers (Castrillon & Strüssmann 1998).

Representatives of species in the *bresslaui* group are known to occur in Amazonia (more specifically, in Amazonas, Teles Pires, and Juruena river basins) as well as in the savannah-like Cerrado (both in Paraguay and Araguaia river basins) (Dixon 1973; Colli *et al.* 1998; Strüssmann 2000; Rodrigues *et al.* 2008). While working on herpetofaunal inventories in eastern Rondônia and western Mato Grosso states, Midwestern Brazil, we collected specimens of *Bachia* that did not fit the diagnosis of any previously known species. Herein, we describe this material as a new species of *Bachia* of the *bresslaui* group.

Material and methods

All measurements were taken on museum specimens using a digital paquimeter Mitutoyo (accuracy 0.1 mm). The number and shape of scales of each specimen were counted and examined under a stereomicroscope.

Scale nomenclature follows Dixon (1973), except for the expression "preanal" which we substitute by the expression "precloacal". For temporal scales, we followed Hoogmoed and Dixon (1977).

The type-series of the new species is deposited at Coleção Zoológica de Vertebrados da Universidade Federal de Mato Grosso (UFMT; Cuiabá, Mato Grosso, Brazil), and Coleção Herpetológica da Universidade de Brasília (CHUNB; Brasília, Distrito Federal, Brazil). For comparisons, representatives of other species in the *Bachia bresslaui* group were loaned from UFMT, CHUNB, and Museu de Zoologia da Universidade de São Paulo (MZUSP; São Paulo, Brazil).

Results

Taxon Description

***Bachia didactyla*, sp. nov.**
Bachia cacerensis: Gainsbury & Colli 2003 (Vilhena-RO)
(Figs. 1–3)

Holotype. UFMT 6755 (Figs. 1, 2 and 3), an adult male, collected by B. Rondon on September 2006, in the surroundings of the hydroeletric powerplant AHE Cachoeirão (13º 32'S; 58º 48'W), Juruena river, Sapezal municipality, state of Mato Grosso, Brazil.

Paratypes. UFMT 6752, UFMT 6753, UFMT 6754, and UFMT 6766 (males), same collecting data as holotype; CHUNB 12784 and CHUNB 12792 (females) from Vilhena municipality (12º 32'S; 60º 25'W), state of Rondônia, Brazil, collected by Daniel Mesquita on September 1999.

Etymology. The specific epithet derives from Greek ("*di*" = two, "*dactylo*" = digit). The presence of two fingers is the most striking character distinguishing the new species among other members of the *bresslaui* group.

Diagnosis. *Bachia didactyla* **sp. nov.** belongs to the group of *B. bresslaui* by having keeled, pentagonal, lanceolate dorsal scales; smooth and lanceolate lateral scales; smooth and quadrangular ventral scales, juxtaposed laterally and imbricate posteriorly; lanceolate tail scales, imbricate and keeled both dorsally and laterally, and smooth ventrally. Interparietal, supraocular, and superciliars present; 47–49 dorsals; 36–39 ventrals, 34–37 scales around midbody. Femoral pores 1-1 or 2-2 in males, absent in females; precloacal pores 1-1 in males and in females. Snout slightly prominent, covering the lower jaw in dorsal view. Two fingers with claws in each forelimb. Hind limbs

stiliform, each of them ending in an apical scale without claw. Six supralabials, the fifth the largest, separated from the parietal by two scales: a postocular, and a temporal; sixth supralabial separated from the parietal by three temporal scales. Five infralabials, the first the smallest, contacting mental, second infralabial, and postmental in anterior, posterior, and ventral margins, respectively; second supralabial the largest, twice longer than wide, contacting postmental and first pair of gular scales ventrally; third infralabial square, forth and fifth of similar size and elongate, all contacting the second pair of gular scales; a pair of anterior temporals contacting postocular; two rows of posterior temporals; first row with three temporals: the first the largest, contacting the parietal; second of intermediate size, and the third the smallest; second row of posterior temporals with two scales, both contacting parietal. Two supraoculars, visible both in dorsal and lateral views; the first the largest, longer than wide, contacting superciliary scales, second supraocular, frontonasal, preocular, and frontal scales; second smaller than first, contacting parietal, postocular, and slightly contacting frontal. The anterior margin of first supraocular is one-quarter smaller than anterior margin of the contacting frontal.

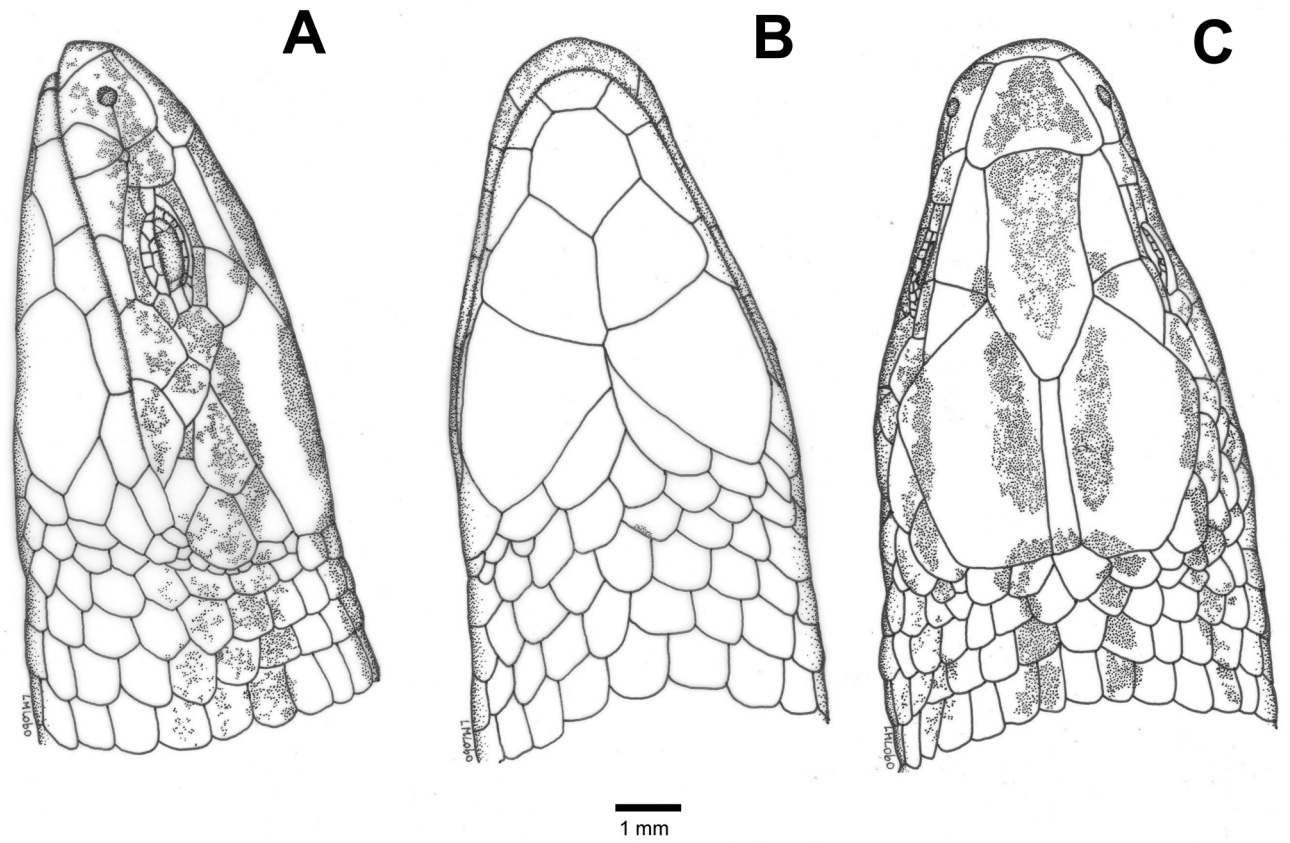

FIGURE 1. Holotype of *Bachia didactyla* sp.nov. (UFMT 6755). (A) Lateral, (B) ventral, and (C) dorsal views of the head.

Bachia didactyla **sp. nov.** differs from *B. panoplia*, *B. pyburni*, and *B. scolecoides* by the absence of prefrontals (present and in broad contact at midline in the first two species, and small and not in contact at midline in *B. scolecoides*). *Bachia didactyla* **sp. nov.** shares with *B. bresslaui*, *B. micromela*, *B. oxyrhina*, *B. psamophila*, and *B. cacerensis* the absence of prefrontals. Nevertheless, it differs from these taxa by having two clawed fingers in fore limbs, instead of stiliform fore limbs ending with a single apical scale (as observed in the first four species) or apical scales without claws (as in *B. cacerensis*). Additionally, hind limbs are also stiliform in *B. didactyla* **sp. nov.**, each of them ending in an apical scale without claw, while in *B. psamophila* they have four flat clawed fingers.

The fifth and sixth supralabials are separated from the parietal by a large postocular, as well as by temporal scales in *Bachia didactyla* **sp. nov.** In contrast, *B. psamophila* has an elongate sixth supralabial contacting the parietal; *B. oxyrhina* has six supralabials, the fifth contacting the parietal; *B. micromela* has a narrow postocular, and the fifth supralabial is taller than wide, contacting the parietal.

Description of the holotype. Elongated body and tail; tail nearly twice longer than body; slight constriction after the head. Prominent snout covering the mandible. Rostral wide, slightly covering mental, and contacting first supralabial, nasal, and frontonasal. In dorsal view, rostral is approximately three times wider than long; in lateral

view, it is slightly projected forward. Frontonasal almost trapezoid, longer than wide, large posteriorly, and narrow anteriorly, contacting frontal, first supraocular, loreal, nasal, and rostral. Prefrontal absent. Frontal pentagonal, twice longer than wide, anterior border straight in wide contact with frontonasal; lateral margin contacting two supraoculars; narrow posteriorly, in wide contact with parietals, and in short contact with interparietal. Frontal twice longer than first supraocular. Interparietal narrow, longer than wide, roughly quadrangular, shorter than frontal and shorter than parietal. Parietal large, pentagonal, longer than wide, slightly larger than frontal, anterior border narrow and forming a "V", in wide contact with frontal, and laterally contacting the second supraocular, postocular, and three temporals; parietal also contacting dorsals posteriorly, and contacting frontal and interparietal dorsally. The posterior border of parietal, interparietal, and dorsals lie on cervical constriction at the occipital region. Two supraoculars, the first the largest, approximately three times longer than wide, in broad contact with frontal, frontonasal, loreal, and first superciliar, and in slight contact with the second supraocular. Second supraocular small, roughly triangular, between second superciliar and postocular; anterior margin contacting first supraocular, posterior margin contacting parietal, and dorsal margin contacting frontal. Two superciliars, both elongate, first longer than second. Large nasal, wider than long, visible from above, contacting rostral anteriorly, contacting first and second supralabials ventrally, loreal posteriorly, and frontonasal dorsally. Nares sit on the ventral half of the nasal scales. Loreal roughly quadrangular, contacting nasal, second, and third supralabials, frontonasal, first supraocular, first superciliar, preocular, and first subciliar. Six supralabials, the third, fourth, and fifth below orbital region; the fifth the largest, in broad contact with postocular, first temporal, and first and second subciliaries. Two subciliaries, the first larger than second. Eyelids present, semitransparent. One large postocular, its dorsal border contacting parietal and second supraocular; ventral border contacting fifth supralabial; anterior margin contacting second sub and superciliaries; posterior margin contacting first temporal. One anterior temporal scale, two rows of posterior temporal scales: first with three, and second with two scales. External ear opening absent. All head scales smooth and juxtaposed. Mental trapezoid, wider than long, slightly longer than ventral surface of rostral. Postmental heptagonal, slightly longer than wide, contacting mental, first and second infralabials, and first pair of gular scales. Two pairs of gular scales, both contacting infralabials; the anterior pair smaller than the posterior, in wide contact at midline; the second pair larger than first, in narrow contact at midline. Following the second pair of gulars, one pair of pre-gulars, in wide contact at midline. Five infralabials, the second the largest.

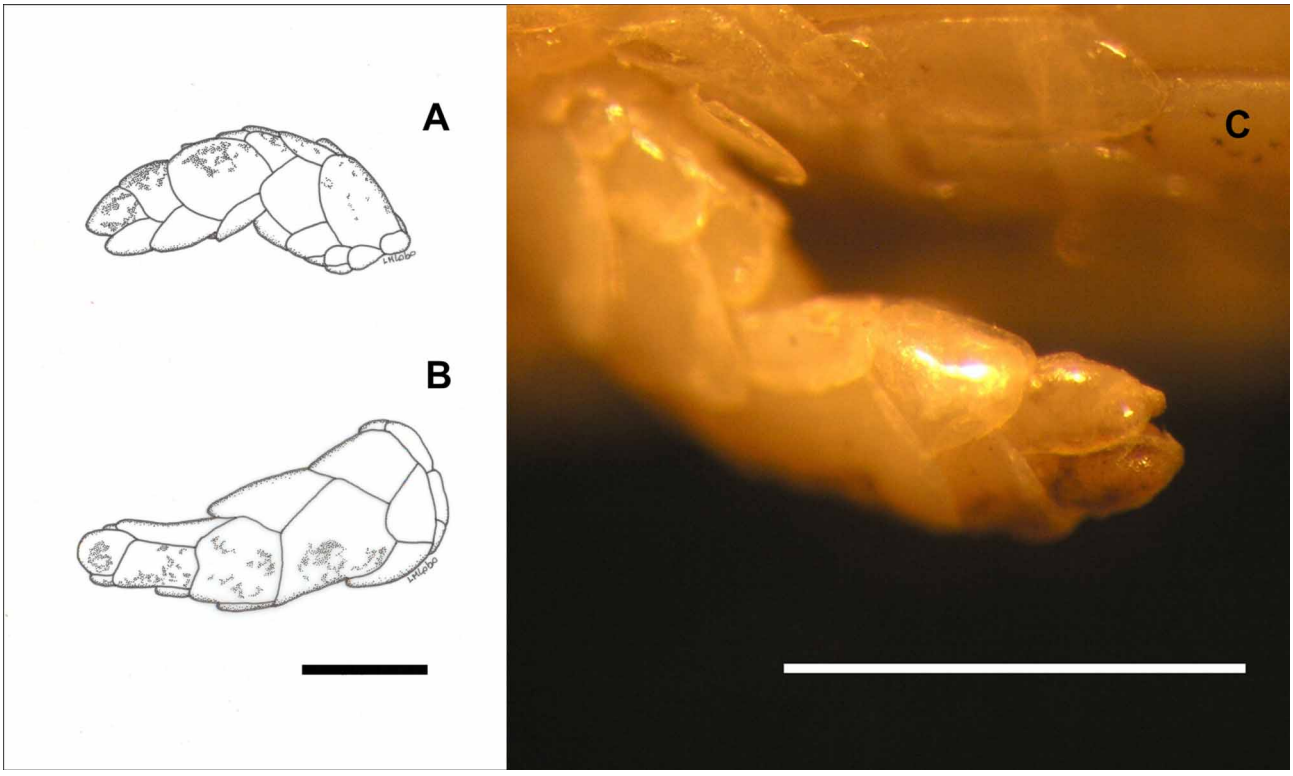

FIGURE 2. Holotype of *Bachia didactyla* **sp. nov.** (UFMT 6755). (A) Left forelimb with two fingers; (B) Left hindlimb; (C) picture of the right forelimb showing a claw. Each of the bars equals 1 mm.

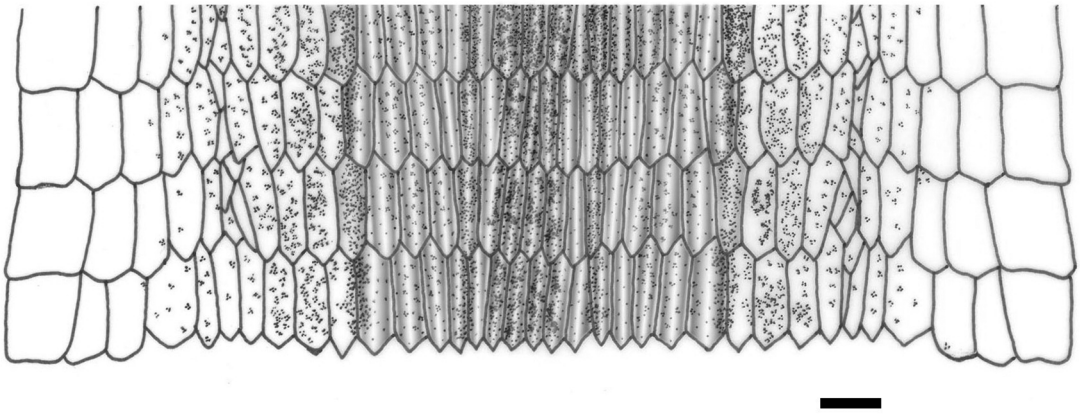

FIGURE 3. Holotype of *Bachia didactyla* **sp. nov.** (UFMT 6755). Schematic view of the midbody pattern of scalation and coloration. Bar equals 1 mm.

Interbrachial region with four scales, the middle two larger and twice as long as lateral scales. In the lateral side of neck, scales roughly rounded, smooth, and imbricate, forming transverse rows. Dorsal scales imbricate, forming transverse rows. Dorsals smooth, subrectangular, and large in the occipital region, becoming longer, pentagonal (although at first glance they appeared hexagonal in shape), lanceolate, and strongly keeled. Forty-seven transverse rows between interparietal and the region above the insertion of hind limbs. Lateral scales approximately the same size as dorsals but smooth, becoming larger next to ventral scales. A distinct region composed by small granular scales surrounds the insertion zone of both fore and hind limbs.

Thirty-five scales around midbody. Ventral scales smooth, imbricate longitudinally, juxtaposed laterally; quadrangular before interbrachial row, becoming gradually longer and wide, and then rounded. Following the brachial row, two central scales larger and more quadrangular than scales in their surroundings; posteriorly, these scales become narrower and similar in shape to others. Thirty-six transversal rows, from interbrachials to the row anterior to precloacal scales.

Precloacal scales divided into two transversal rows, the anteriormost with six scales, and each of the lateral ones with one precloacal pore; the posterior row with five scales, the central ones always larger than the others. Tail with one hundred and twenty-four caudal rows. Dorsal scales on its anterior portion are similar to the body scales, lanceolate and pentagonal in shape, becoming more keeled, more imbricate, and more elongated than body scales towards the distal portion of the tail. Lateral scales on the tail also lanceolate, pentagonal, and imbricate, but only slightly keeled. Subcaudals slightly longer than wide in the first two postcloacal rows, becoming gradually similar to lateral and dorsal tail scales, although smooth rather than keeled.

Fore limbs with length equivalent to approximately two and a half rows of lateral scales; covered by smooth and imbricate scales, with two clawed fingers. Stiliform hind limbs, approximately three lateral scales in length, covered by smooth, elongate, and imbricate scales, ending with a single apical scale, and two femoral pores on each side. Background color of dorsal, lateral body surface, and tail light brown. Two dorsolateral stripes, longitudinal, and symmetric from the beginning of body to distal portion of the tail; two lateral stripes lighter than previous ones, symmetric, disappearing towards the tail. Ventral surfaces of tail and body light cream, with light transversal stripes in the subcaudal region.

Variation. In the type-series of *Bachia didactyla* (six specimens), snout-vent length varies between 49.19–88.59 mm, and tail length, between 161.42–168.86 mm. The tail is in regeneration process in paratypes UFMT 6752 and 6754, and mutilated in paratypes UFMT 6766 and 6753. Variation in the scale rows is: dorsals 47–49; ventrals 36–40; midbody 34–37; subcaudals 112–129. In the holotype and in the paratype CHUNB 12784, the first supraocular does not contact nasal; it contacts left nasal in UFMT 6752, and both nasals in UFMT 6754 and UFMT 6766. UFMT 6754 has background coloration darker than the other available specimens, and consequently its longitudinal stripes are not evident.

Distribution. Up until now, *Bachia didactyla* is known from only two localities (Fig. 4), both situated in Chapada dos Parecis, a huge plateau (300–800 m above sea level) in Midwestern Brazil, between the headwaters of upper rio Paraguay (Platina Basin) and upper rio Tapajós (Amazon Basin). Extending from eastern Mato Grosso

State to eastern Rondônia, the plateau is situated in a contact region between two major vegetation zones: the open Cerrado from Central Brazil, and the southernmost limits of the forested Amazonia domain. Large tracts of interfluvial savannas originally covered most of the summit surfaces of the Parecis plateau (IBGE 1993; SEPLAN 2010). Habitat data are not available for specimens collected during faunal monitoring activities in the region of the hydroeletric powerplant AHE Cachoeirão, rio Juruena, in Sapezal municipality, state of Mato Grosso.

In Vilhena municipality, state of Rondônia, two specimens of *Bachia didactyla* were obtained from sandy Cerrado enclaves. Brief descriptions on local vegetation and climate were provided by Gainsbury & Colli (2003), who mistakenly attributed their two specimens to *B. cacerensis*.

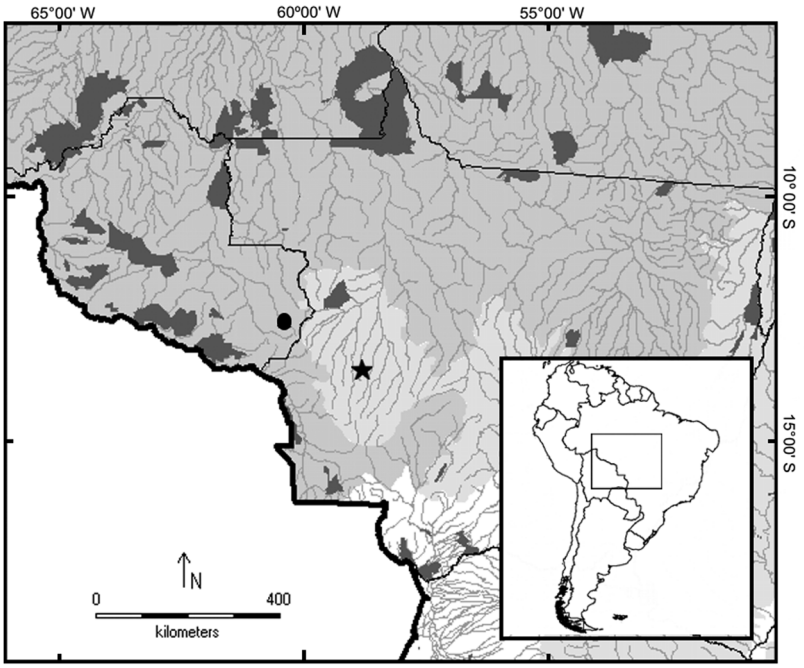

FIGURE 4. Distribution map of *Bachia didactyla* **sp. nov.**, in Midwestern Brazil. Black star: type locality, Sapezal municipality, state of Mato Grosso. Black dot: Vilhena municipality, state of Rondônia, from which some paratypes were obtained. Dark gray: federal protected areas. Gray: Amazon Rainforest. Light gray: Cerrado biome, mostly covered by open, savannah-like vegetation. White: Pantanal wetlands.

Discussion

Up until the present study, the *bresslaui* group of species of *Bachia* was composed of eight species: *B. bresslaui*, *B. scolecoides*, *B. panoplia*, *B. cacerensis*, *B. pyburni*, *B. micromela*, *B. psamophila*, and *B. oxyrhina*. Even though the monophyly of the group has been questioned (Rodrigues *et al.* 2008) in view of recent molecular data (*e.g.*, Kohlsdorf & Wagner 2006), *Bachia didactyla* mostly resembles *B. bresslaui*, and thus can be undoubtedly assigned to this group. Nevertheless, this two species have striking differences regarding their fore limbs: in *B. bresslaui* they are stiliform, ending in a single apical scale, while in *Bachia didactyla* there are two clawed fingers on each of the fore limbs.

Bachia didactyla is distinguished from *B. cacerensis* mainly by the color pattern (the latter having seven longitudinal dorsolateral stripes while the former has only four), and fore limbs (the latter having three or four apical scales, while the former has two distinct fingers). In contrast to the new species, representatives of *B. scolecoides*, *B. pyburni* and *B. panoplia* have a frontal scale, and both fore- and hind limbs with four digits. The presence of two digits on the fore limb also distinguishes the new species from *Bachia micromela*, *B. psamophila*, and *B. oxyrhina*, which have fore limbs ending in a single apical scale. *Bachia micromela* has ventral keeled scales whereas *B. didactyla* has smooth ventrals, as is usual in other members of the *bresslaui* group, including *B. bresslaui*, *B. psamophila*, and *B. cacerensis*.

The historical difficulties in obtaining specimens from semi- and fossorial species traditionally resulted in an incomplete characterization of their natural history and range, which applies to most species in the genus *Bachia*.

Indeed, the lack of information on their reproductive and locomotor behaviors, as well as on social interactions and other basic biological and ecological traits was pointed by Kohlsdorf *et al.* (2010) as an obstacle to a better understanding of the selective pressures that shaped limb morphology in the genus.

From a conservationist point of view, it is an alarming fact that, most often, new species in the *B. bresslaui* group had been discovered in the Brazilian Cerrado as a consequence of permanent flooding of enormous areas, after the construction of impoundments for hydroeletric powerplants. Taking into account, also, the actual levels of conversion of Cerrado areas into agroecosystems, especially in the Parecis plateau (see Colli *et al.* 2003), it is reasonable to assume that many populations have already gone or will soon go extinct, and that topotypical material will no longer be available. Moreover, it is of major concern the fact that known or even presumed ranges of most species of *Bachia* are barely included in officially protected areas. Further studies and urgent conservation measures are needed, not only to guarantee some protection to populations of the species described herein, but also to other endemic organisms from the Parecis plateau (such as the teiid lizard *Cnemidophorus parecis*, described from a Cerrado enclave in Vilhena by Colli *et al.* 2003). In fact, this protection should be extended, as recently claimed by Rodrigues *et al*. (2008), to sandy areas within the Cerrado, from which most of the species in the *bresslaui* group were described.

Acknowledgements

We are grateful to CAPES-PRODOC (Project number 50001019003) and to FAPEMAT (Project number 4474) for financial support. We thank Hussan Zaher and Guarino R. Colli for the loan of specimens from MZUSP and CHUNB, respectively, and to Luciana Lobo, for the drawings of the holotype. Cristiano Nogueira provided insightful suggestions to improve discussion on distribution and conservation.

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