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Snout mites from caves in Brazil, with description of a new species (Acari: Trombidiformes: Bdellidae)

Fabio A. Hernandes[a]*, Leopoldo F. De O. Bernardi[b,c] and Rodrigo L. Ferreira[c]

[a]*PPG – Biologia Animal, UNESP-São Paulo State University, S.J. do Rio Preto, SP, Brazil;* [b]*PPG – Ecologia Aplicada, scholarship CAPES, UFLA-Universidade Federal de Lavras, Lavras, MG, Brazil;* [c]*Setor de Zoologia/Departamento de Biologia, UFLA-Universidade Federal de Lavras, Lavras, MG, Brazil*

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In this paper we describe the first species of the genus *Cyta* from Brazil, *Cyta troglodyta* sp. nov., with a key to the world species of the genus. New records of mites of the family Bdellidae are reported from caves in Brazil.

Keywords: Acari; Bdellidae; *Cyta*; snout mites; cave; Brazil

Introduction

The snout mites of the family Bdellidae Dugès (Acari: Trombidiformes) are active predators of small arthropods and their eggs (Alberti 1973; Gerson et al. 2003), commonly found on soil litter, moss, lichens and similar microhabitats in epigean environments. Although bdellids have been collected in almost every continent, few species were described or even reported from South America. Recently, four species were described from plants in Brazil (Hernandes and Feres 2006; Hernandes et al 2007, 2008): *Tetrabdella neotropica* Hernandes and Feres, *Hexabdella cinquaginta* Hernandes, Daud and Feres, *Bdella ueckermanni* Hernandes, Daud and Feres and *Spinibdella denheyeri* Hernandes, Daud and Feres.

Notwithstanding, little is known regarding the bdellids of caves and their probable associations with other inhabitants of these environments. The only species nominally reported from Brazilian caves is *Spinibdella cronini* (Baker and Balock 1944) collected in the state of Paraná (Pinto-da-Rocha 1993).

The genus *Cyta* von Heyden (Bdellidae: Cytinae) is characterized by having relatively stout and short chelicerae, two ventral setae on hypostome, and all but one species bear an unpaired median eye on anterior region of prodorsum, the only exception being *Cyta magdalenae* den Heyer 1981, which has no eyes at all. Ten species have been reported from several continents, except Antarctica. The only record of any species of this genus so far reported from South America is *Cyta latirostris* var. *fusca* (Canestrini), described from Bolivia (Thor 1931).

Alberti (1973) reported the feeding habits and ecology of *C. latirostris* Hermann, 1803, which feeds on springtails (Collembola) and oribatid mites of the genera *Galumna* (Galumnidae) and *Oppia* (Oppiidae), immobilizing its prey with silk threads.

*Corresponding author. Email: abakashi@gmail.com

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Wallace and Mahon (1972) recognized three species groups for the genus *Cyta*, based on the number of trichobothria on leg segments: three (on tibia I, IV and tarsus III), one (on tibia IV), and no trichobothria. Most species bear three sets of leg trichobothria, whereas the other two groups are represented by only one species each: *C. latirostris* with trichobothria only on tibiae IV and one undescribed species lacking leg trichobothria (Wallace and Mahon 1972).

In this paper we describe the first species of the genus *Cyta* from Brazil, with a world key to species of this genus. Records of the family Bdellidae from caves in Brazil are briefly reviewed, with additional records included.

Materials and methods

Collecting site: "Gruta do Janelão"

The new species was collected in the "Gruta do Janelão", located in Cavernas do Peruaçu National Park, Northern Minas Gerais State, Brazil. The region is relatively hot and dry, subequatorial and has two distinct seasons: drought from April to August, and rainy from October to March.

The "Gruta do Janelão" has a total extension of 4740 m, followed by the Peruaçu river along its main channel (Auler et al. 2001). It represents a distinct cave system in Brazil, with conduits up to 100 m high; there is a main gallery connected to an adjacent gallery (by the channel of the Minotaur). The main gallery has several connections to the epigean environment, each of them with a distinct conformation. Some of these large entrances are horizontals, others verticals and some are of diagonal conformation and steeply inclined (Auler et al. 2001). As a result of its large dimensions and numerous connections to the external environment, there is a high level of interference from the latter. The various entrances of the cave are commonly used by several animals as natural shelters, including the Rock cavy, *Kerodon rupestris* (Wied, 1820) (Rodentia, Caviidae). These mammals often drop huge quantities of dung pellets, which support large communities of small invertebrates, such as parasitoid microhymenopterans, springtails, psocopterans (Liposcelididae), caterpillars, ants and mites.

A thorough search was made for mites on the grounds and walls of the caves. During samplings, special attention was given to decaying vegetable matter (e.g. leaves and tree barks), animal carcasses, vertebrate faeces, furrows in the ground and walls, and underneath rocks. Mites were captured with a fine brush and kept in vials with ethanol 70%. Samples of rock cavy faeces were also collected for further investigation. The material was taken to the laboratory in sealed parcels and processed in a Berlese–Tullgren funnel for 72 hours. Specimens collected from the funnels were also kept in ethanol 70%.

Taxonomy

The standard procedure of mounting the mites on glass slides (7.5 × 2.5 cm) was accomplished using Hoyer's medium (Krantz and Walter 2009). Measurements and drawings were made on a phase-contrast microscope with a drawing tube, and are given in micrometres (μm); values for the holotype are followed by the range of paratypes in parenthesis. The body length was measured from the apex of hypostome to posterior margin of idiosoma, and body width at the level of setae *c2*. Setal lengths were recorded from the setal base to tip. Legs were measured from the proximal insertion of coxae to the base of ambulacra.

The setal nomenclature of Kethley (1990) is followed, except for the scapular setae, which follows the proposition of Den Heyer and Castro (2008: 43). Abbreviations follow van der Schyff et al. (2003) – propodosomal setae: internal verticals (*vi*), external verticals (*ve*), internal scapular (*sci*), external scapular (*sce*); opisthosomal setae: internal humeral (*c1*), external humeral (*c2*), internal dorsal (*d1*), internal lumbal (*e1*), internal sacral (*f1*), external sacral (*f2*), internal clunal (*h1*), external clunal (*h2*); anal region: postanal (*ps*); ventral hypostomal setae (*vh*); leg setae: solenidion (*s*), trichobothrium (*tr*), tactile seta (*t*).

Type specimens are deposited in the Acari Collection of Departamento de Zoologia e Botânica (DZSJRP) – http://www.splink.cria.org.br, Universidade Estadual Paulista (UNESP), Campus de São José do Rio Preto, São Paulo, Brazil.

Family **BDELLIDAE** Dugès, 1834
Subfamily **CYTINAE** Grandjean, 1938
Genus ***Cyta*** von Heyden, 1826
Cyta troglodyta Hernandes sp. nov.
(Figures 1–5)

Description

Male

Measurements of holotype in μm are followed by range for two male paratypes in parenthesis. Body length 968 (957–1111), width 484 (462–539); length of legs I 660 (660–715), legs II 660 (660–715), legs III 770 (759–814), legs IV 880 (880–935); hypostome length 258 (258–286), width 155 (144–166); palp setae ventral end setae 264 (258–277), dorsal end setae 190 (188–204); palp segments: trochanter 19 (19–22), basifemur 177 (171–193), telofemur 27 (27–41), genu 22 (19–22), tibiotarsus 82 (73–84); prodorsal setae *vi* broken in holotype (277–280), *ve* 84 (84–95), *sci* 109 (103–117), *sce* broken in holotype (389–408), *c1* 92 (87–98), *c2* 92 (92–101), *d1* 90 (84–98), *e1* 90 (87–95), *f1* 92 (87–98), *f2* 98 (95–103), *h1* 95 (87–98), *h2* 95 (87–103).

Gnathosoma (Figure 1). Two pairs of large ventral hypostomal setae (*vh1* and *vh2*), proximal pair 95 (84–90), about twice the length of distal pair 41 (35–41); two pairs of short adoral setae near the tip of gnathosoma, and a small dorsal pair near the base posterior to *vh1*. Chelicerae with thin longitudinal striae, two dorsal setae, proximal setae 117 (112–117), about twice the length of distal one, 54 (46–52); movable and fixed chelae similar in shape, movable chelae without teeth and slightly shorter than movable (Figure 1B). Setae on palp: trochanter 0, basifemur 4t (proximal seta slightly longer than other setae on segment), telofemur 1t, genu 3t, tibiotarsus 4t, 1s distal, two long end setae (ventral and dorsal end setae).

Dorsum (Figures 2, 3). Central region of prodorsum with continuous longitudinal striae; sparsely broken striae antero-laterad to setae *ve* (Figure 2); two pairs of eyes on lateral region of prodorsum, separated by distance approximately 1.7 to 2.5 times diameters of eyes, with transverse striae between each pair; unpaired median eye anterior to setae *vi*. Prodorsal and hysterosomal regions separated by slightly visible sejugal furrow. Prodorsal apodeme weakly expressed. Hysterosomal setae smooth and thick (Figure 4), each pair almost reaching bases of subsequent setae behind them.

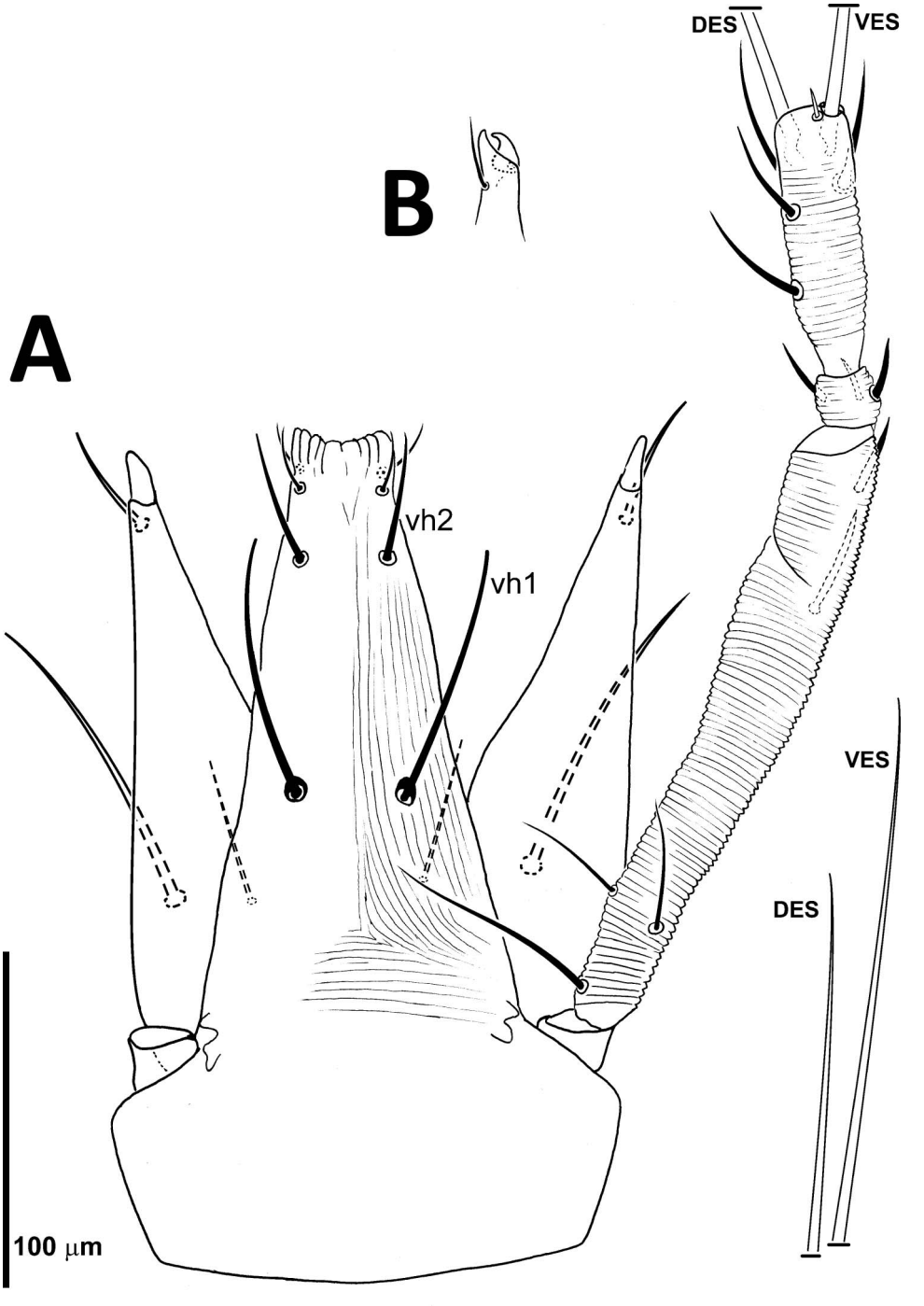

Figure 1. Ventral view of gnathosoma of *Cyta troglodyta* sp. nov. (A); detail of chelicera, lateral view (B).

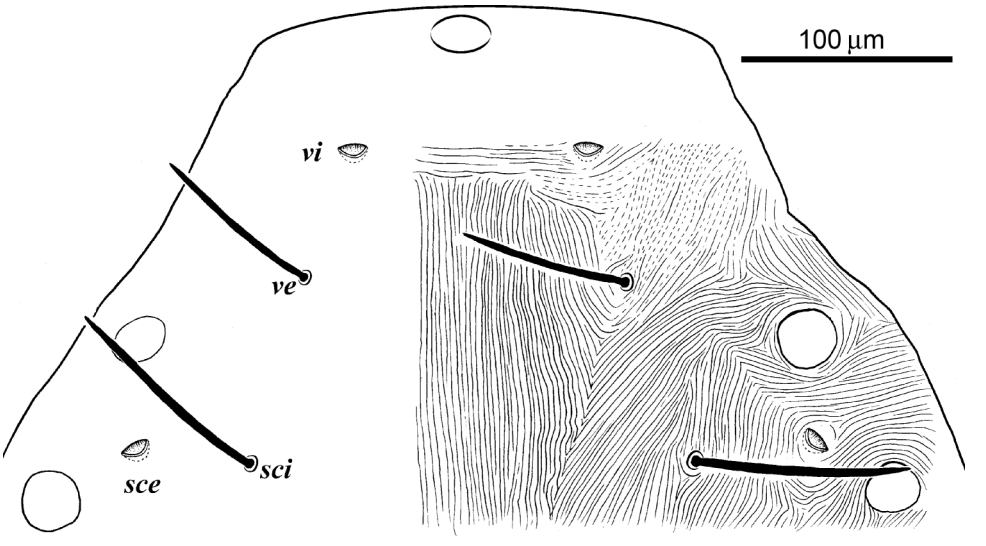

Figure 2. *Cyta troglodyta* sp. nov., prodorsal region.

Fine and continuous striae on medial region of hysterosoma; striae continuous along dorsum; cupules in lateral region of hysterosoma, approximately at level of setae *d1*, *e1* and *f2* (Figure 3).

Venter (Figures 4, 5). Genital valves each with 10 setae aligned in roughly longitudinal arrangement (Figures 4, 5A); nine paragenital setae; setae *ps1–ps3* present, smooth; one unpaired seta between coxae IV (Figure 4); amphioid sclerite with eight setae arranged as in Figure 5B.

Leg (Figure 6). Setae on leg segments as follows: coxae I–IV 5-2-5-2, all setae on coxae tactile, setiform, one seta medio-distally on coxa I about twice the length of other setae on coxae. Trochanters I–IV 2-2-2-1, all setae tactile. Basifemora I–IV 8-8-7-4, all setae tactile. Telofemora I–IV 5-5-4-4, all setae tactile. Genua I–IV 4t, one pair duplex setae, proximal member minutely reduced, sometimes only its alveoli perceptible (same chaetotaxy on genua I to IV). Tibiae I–IV 8t, 3s, 1tr-8t, 2s-9t, 1s-9t, 1 tr. Tarsi I–IV 26t, 3s-28t, 1s-24t, 1 tr-22t, 1s; one thin sensorial seta on proximal quarter of tarsi I, two on third fourth of segment; trichobothria on medial portion of tibiae I and IV, and proximal on tarsi III.

Female

As described for male except for differences in genitalia: evertible ovipositor present.

Differential diagnosis

The new species resembles *Cyta spuria* Atyeo, 1960 by the prodorsal setae *vi*, *ve* and *sce* being arranged in line, and also by the chaetotaxy of palpal basifemur with four setae. It can be distinguished by the genital setae being smooth (barbulate in *C. spuria*), four tactile setae plus one solenidium distal and two long end setae on palp tarsus (three

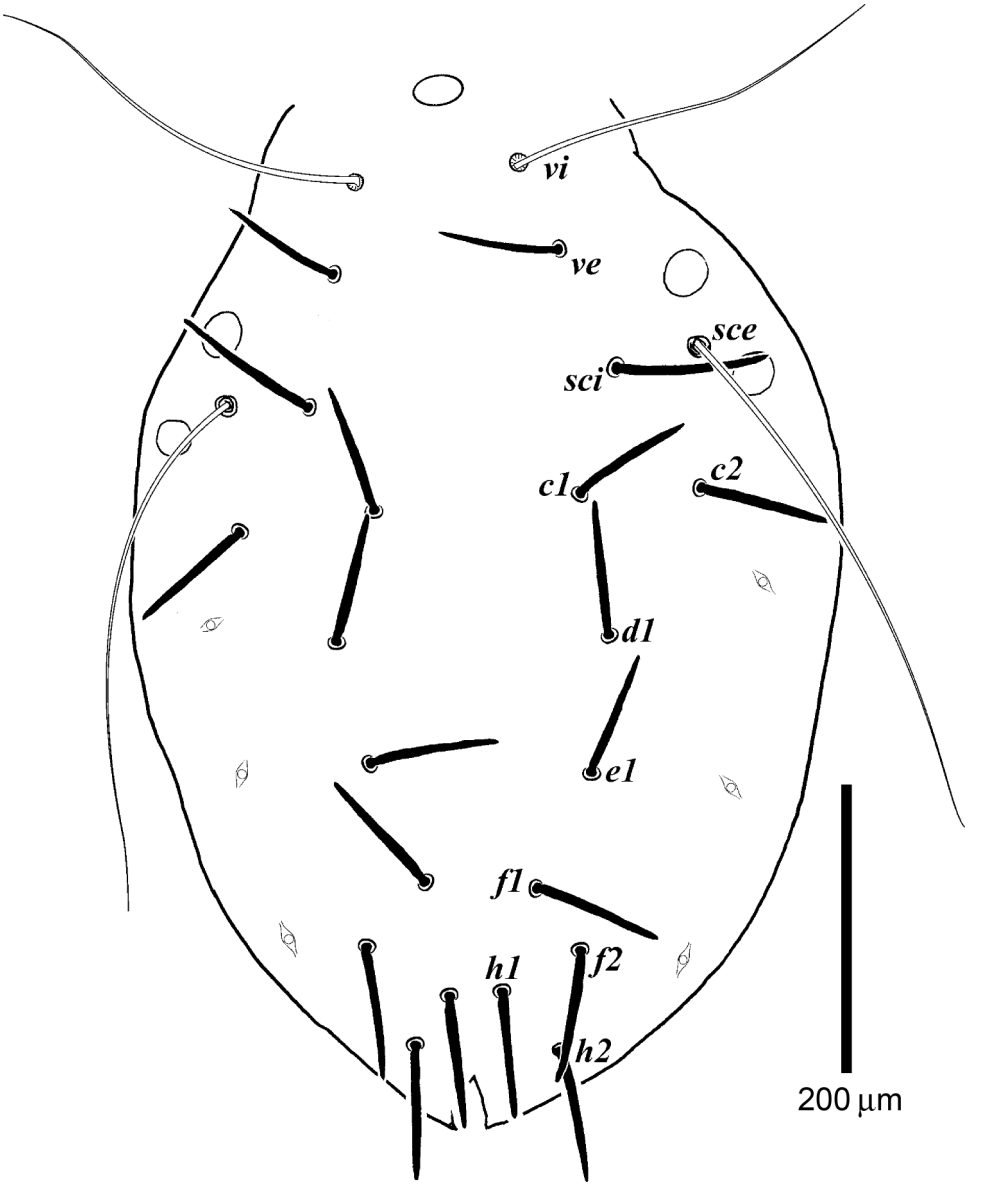

Figure 3. Dorsal view of idiosoma of *Cyta troglodyta* sp. nov.

tactile setae in *C. spuria*, plus solenidium and end setae). Additionally prodorsal striae of the new species prodorsal striae are strong and continuous opposed to finely broken as in *C. spuria*.

Type material

Holotype male, paratypes two males and three females, collected from faeces of *Kerodon rupestris* (Wied, 1820) (Rodentia, Caviidae), Gruta do Janelão cave (15°06′54″ S, 44°14′27″ W), Cavernas do Peruaçu National Park, between

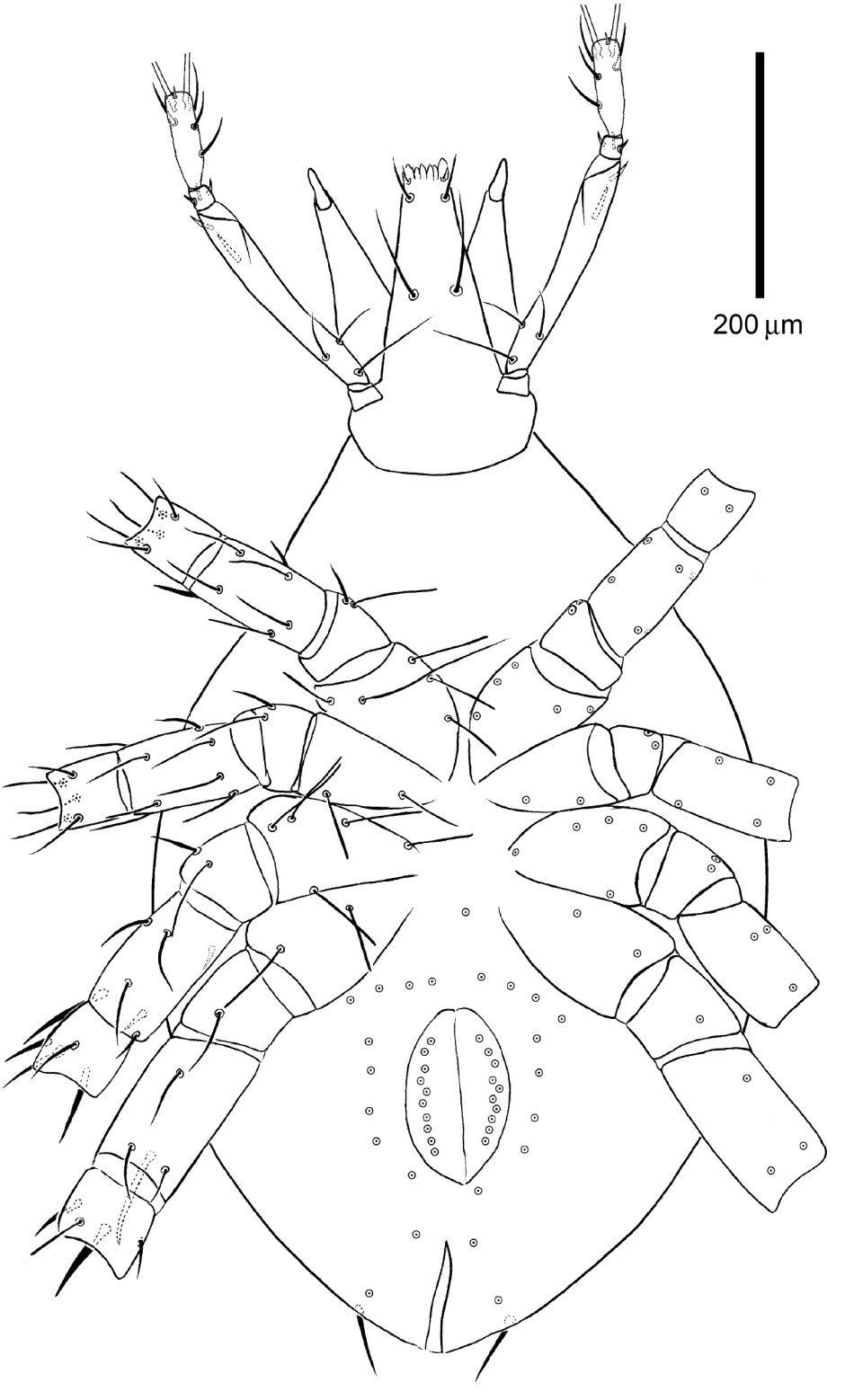

Figure 4. Ventral view of *Cyta troglodyta* sp. nov.

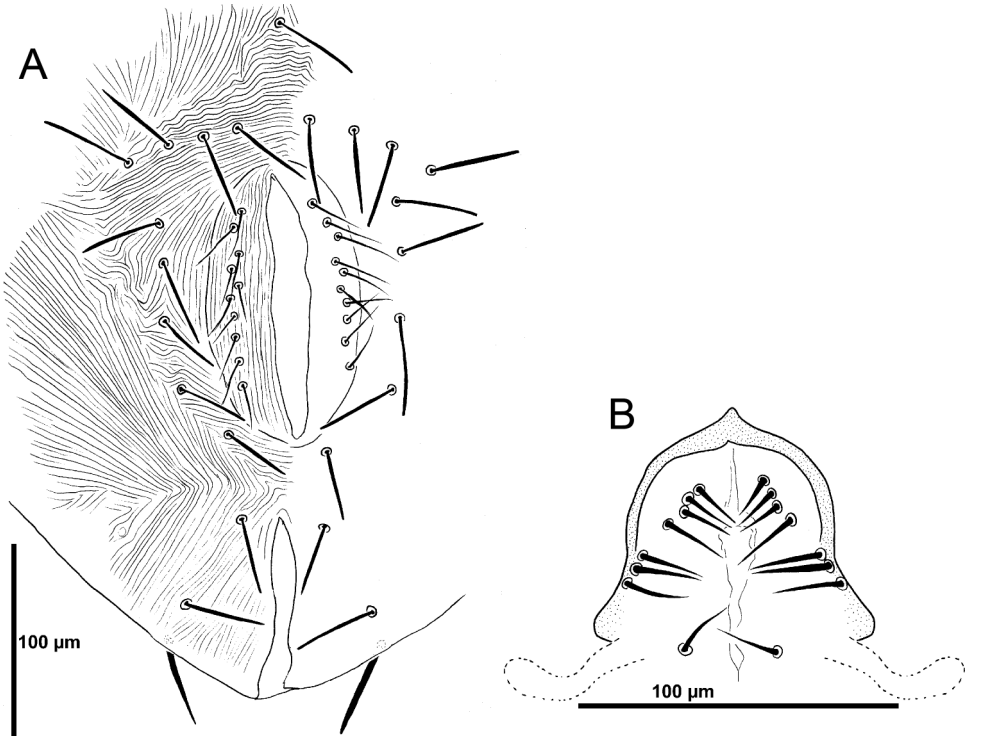

Figure 5. *Cyta troglodyta* sp. nov.: genital and anal regions (A); amphioid sclerite of male (B).

municipalities of Januária/Itacarambi, Minas Gerais State, Brazil, coll. L.F.O. Bernardi, 8 May 2008, deposited at DZSJRP.

Additional material examined

From Minas Gerais State, Brazil – two females from Bocaininha Cave, Arcos, coll. L.F.O. Bernardi, 29 November 2008; one female from Helinho II Cave, Pains, coll. R.A. Zampaulo, 26 July 2010; one male from Janelão Cave, Januária/Itacarambi, coll. R.L. Ferreira, 18 March 2003; one deutonymph from Davi Cave, Pains, coll. R.A. Zampaulo, 5 September 2010; one female from Ronco Cave, Pains, coll. R.A. Zampaulo, 28 November 2010; one female from Dolina dos Angicos Cave, Pains, coll. R.A. Zampaulo, 25 June 2010; one female from Massambará Cave, Pains, coll. R.A. Zampaulo, 5 November 2010; one male from Buraco do Nando Cave, Pains, coll. R.A. Zampaulo, 28 November 2010. Specimens deposited in the Invertebrate Collection of Lavras (ISLA) in the Section of Zoology/Departament of Biology in University of Lavras (UFLA), Lavras, Minas Gerias, Brazil and at MZ-ESALQ – Museum of Zoology, Departamento de Entomologia e Acarologia, Escola Superior de Agricultura "Luiz de Queiroz", Piracicaba, SP, Brazil.

Etymology

From *troglo*, Greek for cave, cave dwelling, referring to the habitat where the specimens were collected.

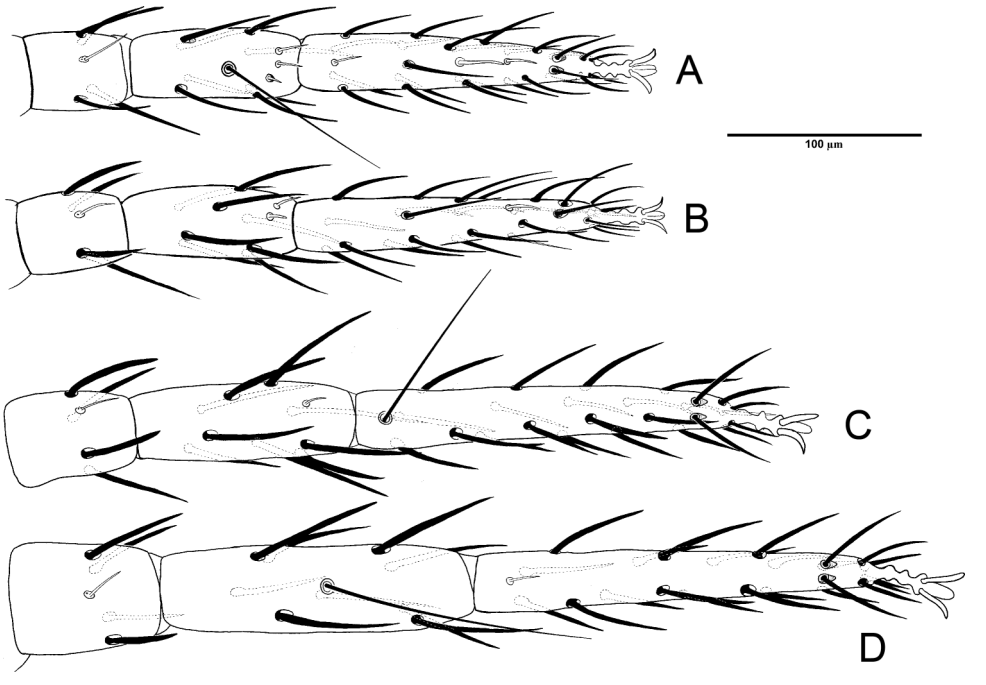

Figure 6. Dorsal view of leg segments of *Cyta troglodyta* sp. nov., genua, tibiae and tarsi I to IV (A–D).

Ecology

The specimens of the new species described herein were found among the communities living in faeces of the rock cavy (*Kerodon rupestris*), approximately 40 m from the cave entrance. Little is known about the communities of small invertebrates living on the faeces of these mammals, especially in caves, so it is likely that additional taxa are yet to be discovered, revealing new and interesting ecological relationships.

Key to species of the genus *Cyta* von Heyden of the world

1. Coxae and ventral hypostome reticulate ..... *C. reticulata* Soliman and Zaher, 1975
   Coxae and ventral hypostome without reticulation 2
2. Prodorsal setae *vi*, *ve* and *sci* arranged in line 3
   Prodorsal setae *vi*, *ve* and *sci* arranged not in line, *sci* inserted approximately at the same longitudinal level of *vi* 6
3. Dorsal setae serrate ..... *C. murrayi* den Heyer, 1981
   Dorsal setae smooth 4
4. Seven setae on palp basifemur ..... *C. longiseta* Wallace and Mahon, 1972
   Four setae on palp basifemur 5

5. Microseta on proximal portion of tarsi I and II; prodorsal striae faint and finely broken ..... *C. spuria* Atyeo, 1960
   Microseta absent on tarsi I and II; prodorsal striae strong and continuous .. .. *C. troglodyta* sp. nov.
6. Trichobothrium present only on tibia IV ..... *C. latirostris* Hermann, 1804
   Trichobothrium present on tibia I, IV and tarsus III 7
7. Prodorsal setae *vi* and *sce* (prodorsal trichobothriae) longitudinally aligned forming a square or rectangle 8
   Prodorsal setae *vi* and *sce* not longitudinally aligned, setae *sce* clearly further apart as *vi*, forming a widely based trapezium 9
8. Eyes absent; posterior trichobothriae (*sce*) spatulate .... *C. magdalenae* den Heyer, 1981
   Eyes present; posterior trichobothriae setiform... *C. brevipalpa* Ewing, 1909
9. Integument heavily sclerotized (dark) and purple .... *C. coerulipes* (Dugès, 1834)
   ..... (including subspecies *C. c. quadrisetusus* den Heyer, 1981)
   Integument lightly sclerotized and not purple 10
10. Prodorsal setae *sci* reaching the bases of *ve* and *sce* .... *C. kauaiensis* Swift and Goff, 1987
    Prodorsal setae *sci* only reaching halfway to bases of *ve* and *sce*..... ..... *C. americana* (Banks, 1902)

Ecology and distribution of mites in caves of Brazil

Studies on the cave fauna of Brazil have been conducted since the early twentieth century (Ribeiro 1907), becoming more intense from the 1980s onwards (Dessen et al. 1980; Chaimowicz 1984, 1986; Godoy 1986; Trajano and Moreira 1991). Nevertheless, mites living in these environments were rarely reported in those studies. Pinto-da-Rocha (1994) compiled the published records on the cavernicolous fauna of Brazil, revealing 38 mite families. Ferreira and Martins (1999) and Ferreira et al. (2000) surveyed cave communities associated with bat guano and elevated the number of families to 45, but more recent studies increased it to 67, uncovering new records and ecological relationships, and increasing the geographical distribution (Barros-Battesti et al. 2003; Estrada-Pena et al. 2004; Bernardi et al. 2009, Dantas-Torres et al. 2009).

Several places, however, remain unexplored. The study of the mite fauna of caves in Brazil is still fragmentary, so more studies in this field should be encouraged, especially as these organisms are important components of the cave ecosystems as parts of several ecological processes (e.g. decay, parasitism, predation, phytophagy), with representatives in almost every trophic level.

Records of mites in the caves of Brazil are mainly concentrated in the southeastern region, especially in the States of Minas Gerais, São Paulo and Paraná (Table 1, Figure 7). However, this does not reflect the true picture of mite occurrence. Instead,

Table 1. Records of mites of the family Bdellidae in caves of Brazil; new records are followed by asterisk (*); abbreviations of Brazilian States as follows: BA = Bahia; ES = Espírito Santo; MG = Minas Gerais; PR = Paraná; SP = São Paulo.

Species	Cave	S	W	Litology	Biome
Bdellodes sp*	Gruta Mina do Pico 11 (MG)	20°13′03.8″	43°51′25.2″	Iron Ore	Cerrado/Atlantic Florest
Bdellodes sp*	Gruta Mina do Pico 5 (MG)	20°13′21.2″	43°51′13.7″	Iron Ore	Cerrado/Atlantic Florest
Bdellodes sp*	Gruta Serra Moeda Sul 150 (MG)	20°12′06″	43°58′01.4″	Iron Ore	Cerrado/Atlantic Florest
Bdellodes sp*	Gruta Serra Moeda Sul 29 (MG)	20°12′05.1″	43°58′01.6″	Iron Ore	Cerrado/Atlantic Florest
Bdellodes sp*	Capão Xavier II (MG)	19°56′15″	43°48′45″	Iron Ore	Cerrado/Atlantic Florest
Bdellodes sp*	Gruta do Rola Moça 2 (MG)	20°02′37.5″	44°00′22.4″	Iron Ore	Cerrado/Atlantic Florest
Bdellodes sp*	Gruta da Bocaininha 6 (MG)	20°17′56″	45°36′32″	Limestone	Cerrado
*Cyta coerulipes**	Gruta do André Huscki (ES)	19°56′15″	40°33′45″	Granite	Atlantic Florest
Cyta troglodyta sp. n.*	Gruta da Bocaininha 3 (MG)	20°17′58″	45°36′31″	Limestone	Cerrado
Cyta troglodyta sp. n.*	Gruta da Bocaininha 6 (MG)	20°17′56″	45°36′32″	Limestone	Cerrado
Cyta troglodyta sp. n.*	Gruta da Bocaininha 7 (MG)	20°17′56″	45°36′51″	Limestone	Cerrado
Cyta troglodita sp. n.*	Gruta do Janelão (MG)	15°06′54″	44°14′27″	Limestone	Cerrado/Caatinga
Cyta troglodita sp. n*	Gruta do Davi (MG)	20°20′18.1″	45°46′44.9″	Limestone	Cerrado
Cyta troglodita sp. n*	Gruta Massambará (MG)	20°19′42.1″	45°48′35.5″	Limestone	Cerrado
Cyta troglodita sp. n*	Gruta do Ronco (MG)	20°25′58″	45°36′41.7″	Limestone	Cerrado
Cyta troglodita sp. n*	Gruta do Helinho 2 (MG)	20°18′34.5″	45°50′47.3″	Limestone	Cerrado
Cyta troglodita sp. n*	Buraco do Nando (MG)	20°22′44.7″	45°35′54.1″	Limestone	Cerrado
Cyta troglodita sp. n*	Gruta Dolina dos Angicos (MG)	20°25′05.9″	45°40′43.7″	Limestone	Cerrado
Spinibdella sp.*	Gruta do Paredão Descoberto (MG)	20°13′50.2″	45°41′02.3″	Limestone	Cerrado
*Spinibdella cronini**	Toca dos Ossos (BA)	10°55′520″	41°03′24″	Dolomitic	Caatinga
Spinibdella cronini	Conjunto Jesuítas/Fadas (PR)	25°03′00″	49°04′20″	Limestone	Atlantic Florest
Spinibdella cronini	Gruta de Terra Boa (PR)	25°12′58″	49°31′23″	Limestone	Atlantic Florest
Spinibdella cronini	Gruta de Toquinhas (PR)	25°09′56″	49°18′05″	Dolomitic	Atlantic Florest
Undetermined	Gruta da Lavoura (MG)	19°31′27″	44°02′14″	Limestone	Cerrado
Undetermined	Lapa do Rezar (MG)	15°14′26″	44°23′66″	Limestone	Caatinga
Undetermined	Gruta Barra Bonita (SP)	24°14′03″	48°27′24″	Limestone	Atlantic Florest
Undetermined	Gruta Bethary de Baixo (SP)	24°33′05″	48°40′58″	Limestone	Atlantic Florest

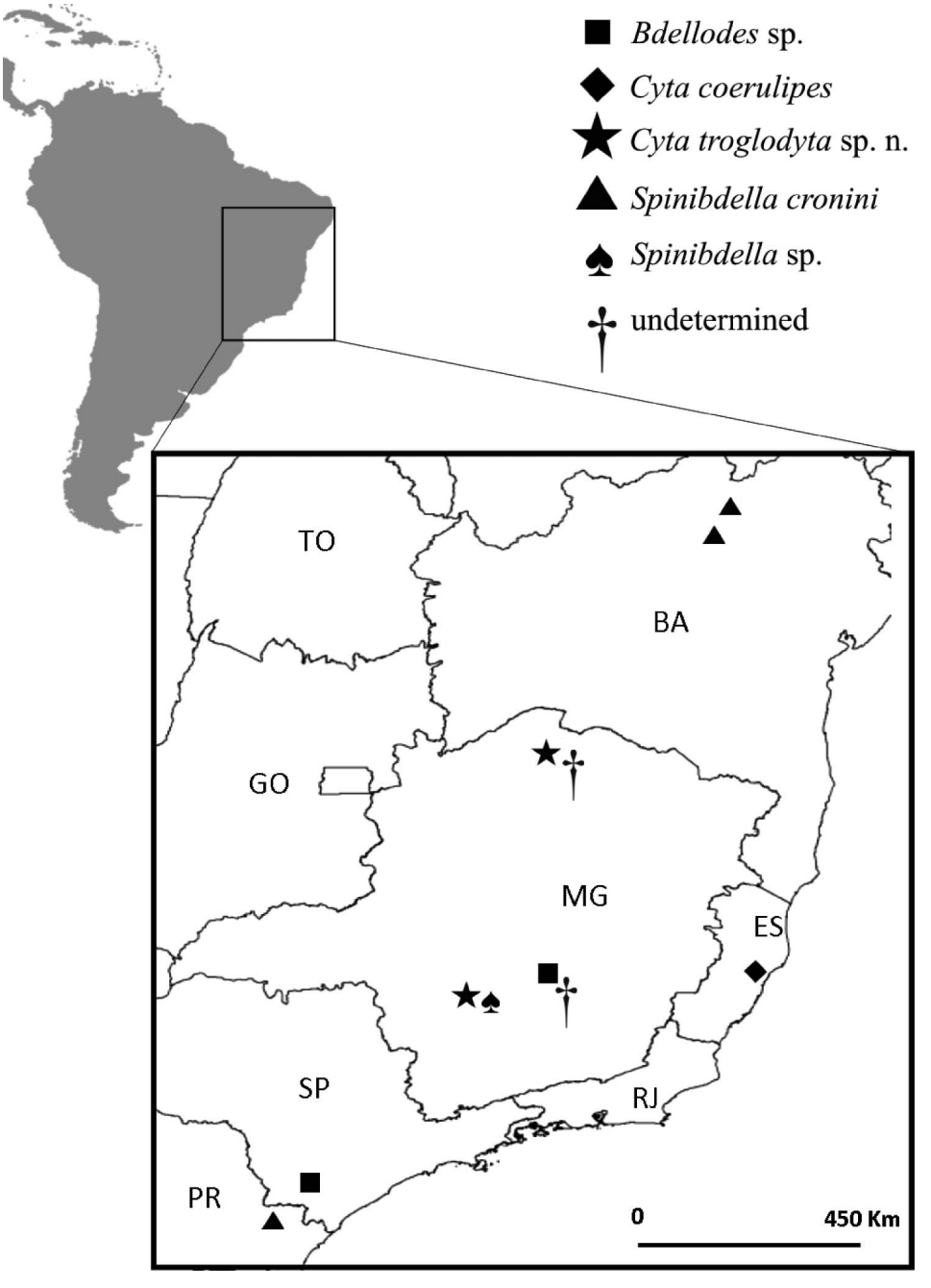

Figure 7. Records of mites of the family Bdellidae in caves of Brazil (abbreviations of Brazilian States as follows: BA, Bahia; ES, Espírito Santo; MG, Minas Gerais; GO, Goiás; PR, Paraná; TO, Tocantins; SP, São Paulo; RJ, Rio de Janeiro).

it probably represents the actual and past activities of researchers working and studying the subterraneous fauna in that region. Other Brazilian States in northeastern and northern regions, such as Rio Grande do Norte, Ceará, Bahia, Pará, Sergipe and others, are likely to harbour a higher diversity of cave mites, given that numerous natural caves are found in those states. The mite fauna of such areas has been poorly surveyed to this date.

With regard to the family Bdellidae, with the exception of *Spinibdella cronini*, reported by Pinto-da-Rocha (1993), the remaining records from caves in Brazil provide no further identification besides the family level (Table 1, Figure 7). Herein we report 13 new records of bdellids from caves in Brazil, representing only three bdellid genera (*Bdellodes*, *Cyta* and *Spinibdella*).

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