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Synopsis of terrestrial isopods (Crustacea: Isopoda: Oniscidea) from Brazilian caves, with emphasis on new records from north, midwest, northeast and southeast regions

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ABSTRACT

Terrestrial isopods are one of the most diverse groups in the subterranean environment. To date, 39 oniscidean species are known from Brazilian caves; however, this number falls far short of the real diversity of the group, because even in the best studied areas new records are still frequent. During the last years many surveys in several caves from the states of Bahia, Minas Gerais, Goiás and Pará have been conducted. These efforts resulted in a representative scientific collection with great diversity of oniscideans. Here we addressed the current state of knowledge of oniscidean fauna from Brazilian caves compiling the described species and adding new records of our own surveys. We present a list of 24 new records of terrestrial isopods from 53 caves, with brief comments about the presence of troglomorphic character states and known distribution, in- and outside of caves. Also, we addressed the need of validation of new species and of additional efforts to assign a conservation category to each one, which is the key step to the preservation of the subterranean environment and its biodiversity. Any delay may yield permanent loss of biodiversity of these localities, considering the several conservation concerns the Brazilian caves have been facing.

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Introduction

Terrestrial isopods (Oniscidea) are one of the best represented groups of Crustaceans found in subterranean environments, particularly in caves (Vandel 1964; Taiti and Howarth 1997; Taiti 2004, 2014; Taiti and Gruber 2008; Taiti and Xue 2012; Tabacaru and Giurginca 2013; Campos-Filho et al. 2014, 2016, 2017a; Reboleira et al. 2015; Taiti and Wynne 2015; Taiti and Montesanto 2018). The colonization of subterranean environments by oniscideans is favoured by the high or stable humidity and great variety of

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substrates. Those conditions probably explain their great, and yet poorly documented, subterranean diversity (Taiti 2004; Campos-Filho et al. 2014).

In Brazil, a great number of species with different levels of specialization for the subterranean evolutionary regime have been reported in faunistic lists and taxonomic and ecological papers (e.g. Pinto-da-Rocha 1995; Souza-Kury 1998; Trajano 2000; Trajano and Bichuette 2010; Gallão 2012; Silva and Ferreira 2015, 2016).

The first synopsis counted 26 morphospecies recorded from several Brazilian states, but only four species were recognized as valid: *Benthana iporangensis* Lima and Serejo, 1993, *Trichorhina guanophila* Souza-Kury, 1993, *Amazoniscus eleonorae* Souza, Bezerra and Araujo, 2006, and *Porcellionides pruinosus* (Brandt, 1833; Pinto-da-Rocha 1995). Later, two studies increased the knowledge of the cavernicolous terrestrial isopods to seven known species. The first study was conducted by Souza et al. (2010) describing the first troglomorphic species of the family Armadillidae from the Brazilian states of Ceará and Rio Grande do Norte, *Gabunillo aridicola* Souza, Senna and Kury, 2010. The second study was made by Campos-Filho and Araujo (2011), describing two troglobitic species of the family Scleropactidae, *Circoniscus buckupi* Campos-Filho and Araujo, 2011, and *Circoniscus carajasensis* Campos-Filho and Araujo, 2011. Campos-Filho et al. (2014) compiled the available information about all species from Brazilian caves and described 11 species and three new genera, which has become the major contribution about the subterranean fauna of terrestrial isopods. Souza et al. (2015) described an amphibious new genus and new species of the family Styloniscidae from the state of Bahia, *Iuiuniscus iuiuensis* Souza, Ferreira and Senna, 2015. Campos-Filho et al. (2016) described three new species from the state of Minas Gerais, including the second amphibious species of the genus *Xangoniscus* Campos-Filho, Araujo and Taiti, 2014 (Styloniscidae), *X. odara* Campos-Filho, Bichuette and Taiti, 2016. Campos-Filho et al. (2017a) described *Cylindroniscus flaviae* Campos-Filho, Araujo and Taiti, 2017 from the state of São Paulo. This genus was previously allocated in the family Trichoniscidae, but based on the disposition of the muscles of the first pleopods (see Erhard 1997) the authors moved it to the family Styloniscidae. Campos-Filho et al. (2017b) described the first troglobitic species of the family Pudeoniscidae, *Iansaoniscus iraquara* Campos-Filho, Araujo and Taiti, 2017 and *Iansaoniscus georginae* Campos-Filho, Araujo and Taiti, 2017, both from caves in Bahia. Bastos-Pereira et al. (2017) described the new species *X. itacarambiensis* Bastos-Pereira, Souza and Ferreira, 2017 from the state of Minas Gerais. Cardoso et al. (2017) described *Neotroponiscus iporangaensis* Cardoso and Araujo, 2017 from the state of São Paulo and *N. tuberculatus* Cardoso and Araujo, 2017 from the state of Minas Gerais. Recently, Campos-Filho et al. (2019) described *Pectenoniscus liliae* Campos-Filho, Bichuette and Taiti, 2019 and *Benthana xiquinhoi* Campos-Filho, Bichuette and Taiti, 2019 from the state of Bahia, extended the distribution of *X. aganju* for Serra do Ramalho karst area and re-described *Venezillo congener* from the state of Goiás.

To date, 39 described species distributed in the families Styloniscidae, Philosciidae, Scleropactidae, Dubioniscidae, Platyarthridae, Porcellionidae, Armadillidae, Pudeoniscidae and Armadillidiidae are known from Brazilian caves (Campos-Filho et al. 2014; 2016, 2017a, 2017b, 2017c; Bastos-Pereira et al. 2017, Campos-Filho et al. 2019). Among them, 16 species are considered troglobitic (Gallão and Bichuette 2018; Campos-Filho et al. 2019), and the other species are considered troglophiles or accidentals, whose distinction is difficult to establish because of the scarcity of data about the distribution of isopods outside the caves

(Campos-Filho et al. 2014, 2018a, 2018b). This figure falls far short of the real diversity, considering the unidentified or undescribed species already reported in the literature from different localities, which are currently without formal description because of the scarcity of specialists able to describe this diversity. Therefore, the representability of this taxon in the Brazilian caves tends to increase both as new species are described and new areas are surveyed (Campos-Filho et al. 2014).

In the last years, extensive field surveys encompassing several caves located in the states of Bahia, Goiás and Pará have been conducted. These surveys resulted in a representative scientific collection with a great diversity of oniscideans. The present study aims to contribute to the knowledge about terrestrial isopods from Brazilian caves.

Material and methods

The list of terrestrial isopods presented here includes previous studies and material deposited in the collection 'Laboratório de Estudos Subterrâneos', Universidade Federal de São Carlos. The specimens were identified to the most specific taxonomic level possible. Adult specimens of both sexes were examined under stereomicroscope and light microscopy, and when necessary, the morphotypes were compared with original species descriptions. All species have a brief subtopic about its known distribution and, when necessary, remarks are given. Species recorded outside caves are indicated as Campos-Filho et al. (2014). Finally, the material examined was compared with literature (e.g. Trajano and Gnaspini-Netto 1991; Gnaspini and Trajano 1994; Pinto-da-Rocha 1995; Souza-Kury 1998; Leistikow and Wägele 1999; Schmalfuss 2003; Schmidt and Leistikow 2004; Campos-Filho et al. 2014). As defining the ecological evolutionary status for some isopods may be difficult, considering the current state of knowledge about its distribution, the classifications presented here were based on morphology and/or in the distribution of the species in- and outside caves. When a species presented troglomorphic character states (*sensu* Christiansen 1962), those absent in epigean relatives and found only in the hypogean environment, it was considered troglobitic, and when frequently present in both environments, troglophilic. In cases when ecological evolutionary status is absent, there is no sufficient knowledge of its distribution for classification. The results are presented here by family and area of occurrence; only species recorded in caves are included and only new records are plotted in maps. Lastly, a table with the subterranean classification of all species mentioned here is given.

Study areas

Our field samples encompassed a large latitudinal extension of the Brazilian territory, comprising many biogeographic regions (see Campos-Filho et al. 2014) and morphoclimatic domains of Brazil (sensu Ab' Saber 1977). We covered from the humid climate and vegetation of the Amazonian domain with its tropical rainforests, to the dryer climates of Cerrado, with typical Savannah-like vegetation and, finally, the Caatinga, with its prolonged dry season and its shrubby and thorny components (Ab' Saber 1977). Some environments sampled here are illustrated in Figure 1.

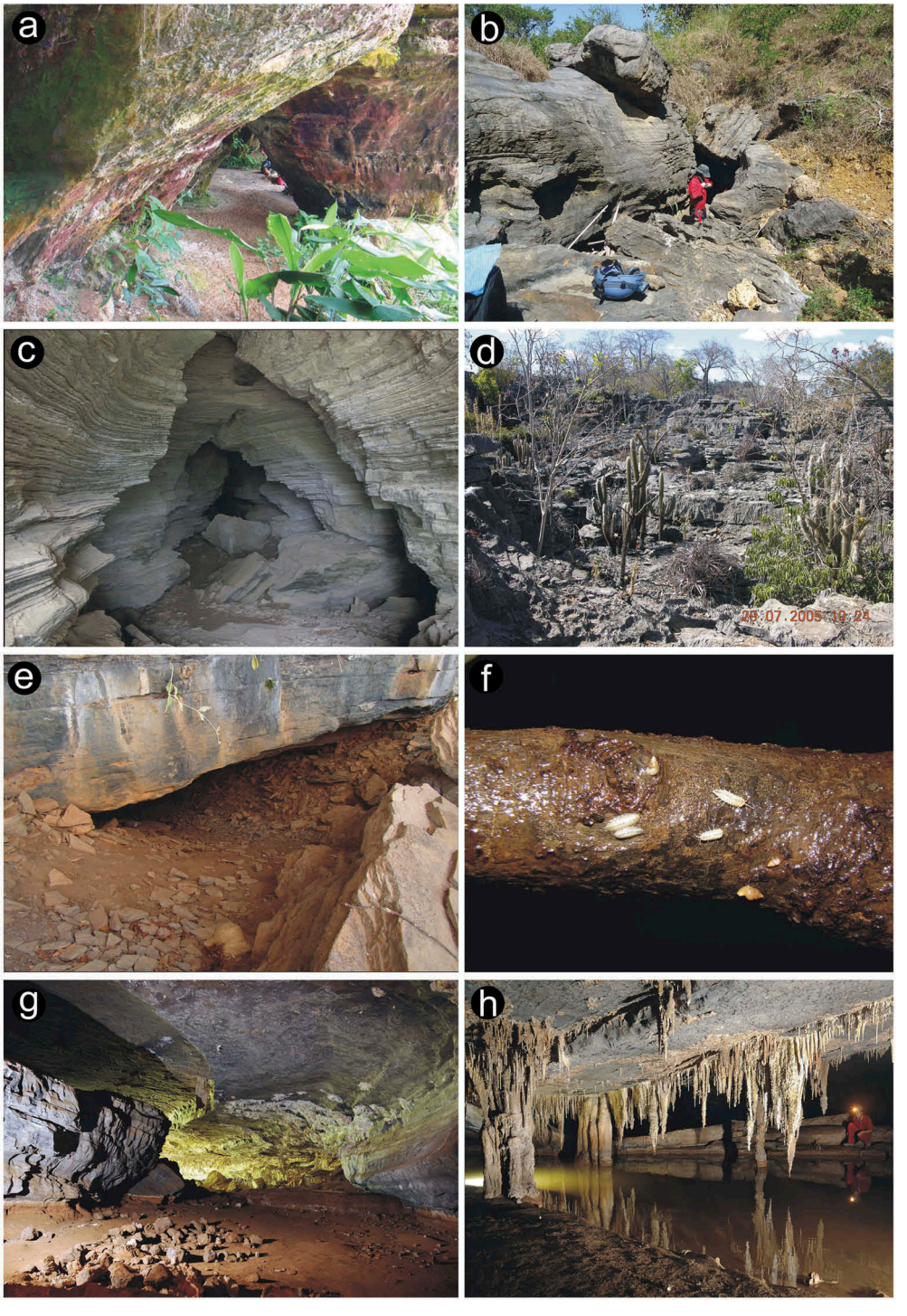

Figure 1. Some examples of the environments we sampled. a. arenitic outcrop near Sugiro-Roncador cave, Altamira (photo: M. E. Bichuette); b. Sumidouro do Engenho cave entrance, São Desidério (photo: J. E. Gallão); c. Lapa do Bode cave, Chapada Diamantina (photo: M. E. Bichuette); d. karst near Gruna do Enfurnado, Serra do Ramalho (photo: M. E. Bichuette); e and f. Domingão cave, Serra do Ramalho, with a detail of *Xangoniscus aganju* (photos: P. P. Rizzato); g and h Lapa do Angélica cave, São Domingos (photos: A. Gambarini).

Altamira, central state of Pará, northern Brazil

The speleological province of Altamira is located at the center of the state of Pará, at the margins of Xingu River. There, caves are developed over continuous arenitic outcrops appearing as kilometers of steep slopes, predominantly from Maecuru formation, Amazon basin (Vasquez et al. 2008). This kind of geomorphological development of the caves results from chemical weathering favoured by the hot and humid Monsoon climate, typical of the Amazonian domain, 'Am' according to Köppen's criteria (Alvares et al. 2014). The exuberant vegetation cover of the Tropical rainforest guarantees that the caves in this region receive abundant and continuous input of food (Ab' Saber 1977). Subterranean environments of Altamira are currently threatened by intense degradation activities caused by reservoir construction (Belo Monte) and deforestation for pastures (Gallão and Bichuette 2018).

Chapada Diamantina region, central state of Bahia, northeasthern Brazil

Chapada Diamantina is considered a spot of high cave biodiversity in Brazil and it is partly protected by law at the Chapada Diamantina National Park (Trajano et al. 2016). Among the areas not yet protected, the impacts in the subterranean environments are innumerous, like the lowering of the water table, the uncontrolled tourism, deforestation for agribusiness and illegal garimpo (Gallão and Bichuette 2018). With a semi-arid tropical climate, 'Aw' according to Köppen's criteria (Alvares et al. 2014), and inserted in the Caatinga domain, its landscapes are dominated by karst landforms with carbonate and, to a lesser extent, siliciclastic rocks (Trajano et al. 2016). More specifically, the region comprises three structurally different geomorphological regions: carbonate rocks from Una Group, intercalated with other rocks, including the Irecê formation. This last one is, in turn, contoured by the metamorphic sandstones of Serra do Espinhaço (Karmann and Sánchez 1979). Altitudes vary from 1000 to 1700 m a.s.l., representing a natural drainage divide between the São Francisco and East basins (Trajano et al. 2016).

The next three regions, São Desidério and Serra do Ramalho, state of Bahia, and São Domingos, state of Goiás, are all part of Bambuí geomorphological unit. This unit is located in the Brazilian Central Plateau, and it has the largest set of carbonate rocks favourable to the formation of caves in Brazil (Karmann and Sánchez 1979).

São Desidério region, state of Bahia, northeasthern Brazil

São Desidério is inside of the limits of Cerrado domain (Ab' Saber 1977), with tropical humid climate, 'Aw' according to Köppen's criteria (Alvares et al. 2014). The region stands out by its speleological patrimony rich in rare or unique geological features, forming cave systems extensively irrigated by drainages from the João Rodrigues River karst system, which flows predominantly over subterranean environments, forming karst aquifers and huge subterranean lakes (Galvão et al. 2012). In addition, São Desidério is very rich in subterranean taxa, which gives to the region national relevance (Bichuette et al. 2013). Despite its importance, the subterranean environments of São Desidério are currently threatened by intensive farming and, in the near future, with road construction and pollution of subterranean drainages (Gallão and Bichuette 2018).

São Domingos region, state of Goiás, midwest Brazil

This region is also part of Cerrado domain with humid tropical climate, 'Aw' according to Köppen's criteria (Alvares et al. 2014). The area is crossed by several parallel streams running westwards to join the Paraná River, Upper Tocantins River, Amazonas basin. Each larger stream, and some small streams, enter in caves through sinkhole, pass hundreds to thousand meters through subterranean conduits, alternating lotic and lentic reaches (mostly in caves), and surface through a resurgence (Bichuette and Trajano 2003). All cave systems where isopods were collected comprise extensive caves, traversed by these large allochthonous rivers. Consequently, the caves receive large inputs of organic matter annually, resulting in a great biospeological potential (Bichuette and Trajano 2003). Even though part of São Domingos is inside a conservation unit (Parque Estadual Turístico de Terra Ronca – PETER), the integrity of its subterranean environments is still vulnerable because the headwaters of all subterranean streams and rivers are unprotected (Gallão and Bichuette 2012). Its environs are under the threat of deforestation for pastures and charcoal production, uncontrolled tourism and illegal mining (Gallão and Bichuette 2018).

Serra do Ramalho karst region, state of Bahia, northeasthern Brazil

Serra do Ramalho comprises several municipalities on southwestern from the state of Bahia to state of Minas Gerais, along middle São Francisco River basin. Kilometers of limestone plateaus, also from Bambuí Group, dominate the landscape. It has two sections, the lower plateau at south and upper plateau at north, with several cave systems on both (Trajano et al. 2016). Our records were limited to the municipalities of Carinhanha and Coribe, state of Bahia. This area is located at the transition between Cerrado and Caatinga domains, with hot semi-humid to semi-arid tropical climate, with a prolonged dry season, 'Aw' according to Köppen's criteria (Alvares et al. 2014). Serra do Ramalho is extremely relevant from the biospeological point of view, considered a spot of high cave diversity in Brazil (Trajano et al. 2016). Contrasting with the uniqueness of its subterranean fauna, Serra do Ramalho is unprotected by law. Currently, deforestation for charcoal production in areas near the caves is increasing and, in the near future, mining projects may also be threatening the area (Gallão and Bichuette 2018).

Matozinhos, Lagoa Santa Karst, state of Minas Gerais, southeastern Brazil

Matozinhos municipality is inside the limits of the Cerrado domain, with transition spots of Atlantic rainforest (Ab' Saber 1977). The climate is tropical humid, with hot summers and dry winters (Köppen's 'Cwa') (Alvares et al. 2014). Isopods were collected in Matozinhos, inside limestone caves from Lagoa Santa Karst, approximately 30 km north of Belo Horizonte, capital of the state of Minas Gerais, being under direct influence of its metropolitan sprawl. Its landscapes comprise Precambrian limestone outcrops of the Sete Lagoas formation (Bambuí Group) of unique scenic and archaeological values. Despite its relevance, the karst of Lagoa Santa has been threatened by mining activities and urbanization, which have already caused

groundwater pollution and loss of caves and its original vegetation (Auler and Piló 2015). Part of the Lagoa Santa karst is now protected by the Environmental Protection Area of Lagoa Santa karst (IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis; Companhia de Pesquisa de Recursos Minerais – CPRM) 1998) and Sumidouro State Park (PESU) (Minas Gerais, Decree n° 20.375 of 1980), but the caves where the isopods were found is still unprotected.

Results

Oniscidean isopods already found in Brazilian caves are mentioned below. We included 24 new records, 16 of which are of probably new species. Some of them are illustrated in Figure 2, and the new records are shown in Figure 3.

Section **SYNOCHETA** Legrand, 1946
Family **TRICHONISCIDAE** Sars, 1899
Genus ***Miktoniscus*** Kesselyák, 1930

Miktoniscus medcofi (Van Name, 1940)

Distribution

Miktoniscus medcofi is widely distributed from southern and central USA, Mexico, and Brazil (states of Amapá, Pará, Paraná, Rio de Janeiro, São Paulo and Rio Grande do Sul) (Schmalfuss 2003; Campos-Filho et al. 2014, 2017b). In caves, it is recorded from SB karst area, Canaã dos Carajás, state of Pará, and Água Boa cave, Almirante Tamandaré, state of Paraná (Campos-Filho et al. 2014; Campos-Filho et al. 2015a).

Family **STYLONISCIDAE** Vandel, 1952
Genus ***Pectenoniscus*** Andersson, 1960

Pectenoniscus liliae Campos-Filho, Bichuette and Taiti, 2019

Material examined

Bahia, Coribe: 1♀, Gruna do Enfurnado cave (13°38′45.69″S, 44°12′8″W), 24 November 2006, leg. E Trajano and D Sansone (LES 6419); 1♀, Gruna do Enfurnado cave, 5 May 2007, leg. E Trajano and D Sansone (LES 6420); 1 ♂, 2 ♀, Caverna Chico Pernambuco cave (13°49′10.37″S, 44°4′15.74″W), 28 July 2012, leg. ME Bichuette, JE Gallão and PP Rizzato (LES 6449).

Distribution

Gruna do Enfurnado and Caverna Chico Pernambuco caves, Coribe, state of Bahia (Campos-Filho et al. 2019).

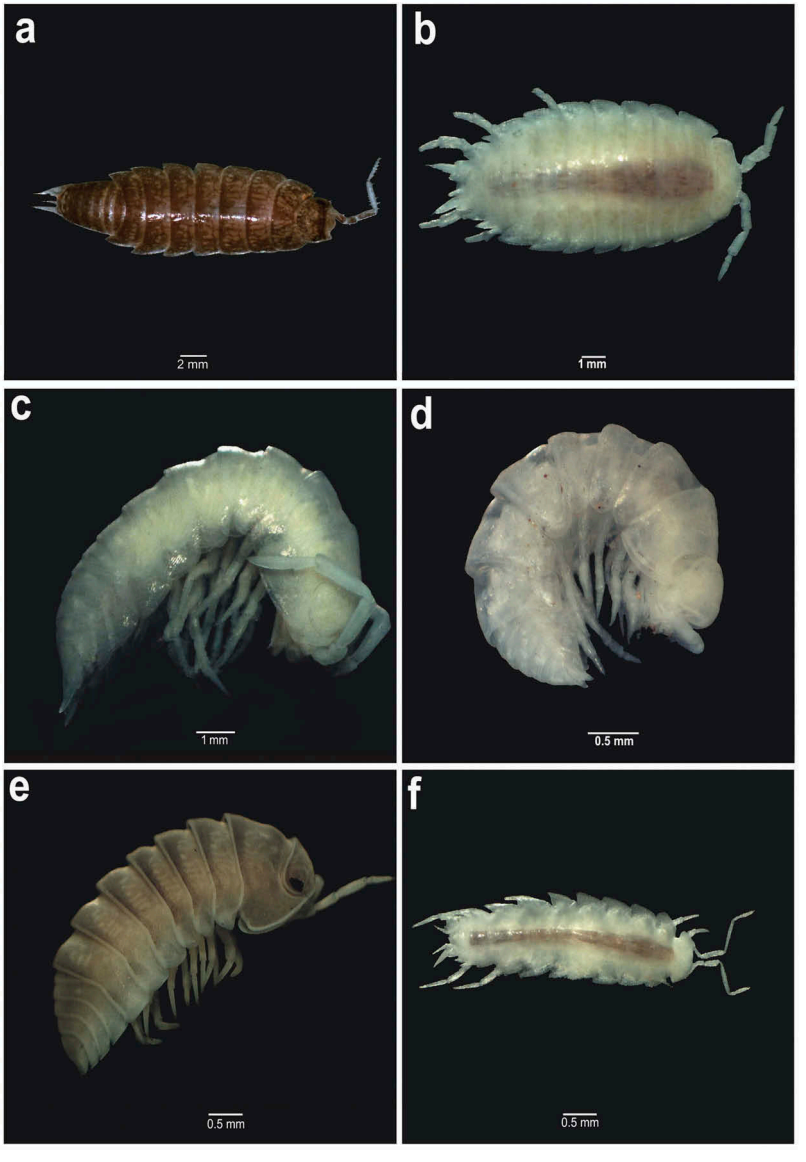

Figure 2. Some isopods recorded in this synopsis. a. *Metaprosekia caupe*; b. *Trichorhina* sp. 5; c. *Iansaoniscus iraquara*; d. *Microsphaeroniscus* sp.; e. *Venezillo congener*; f. *Pectenoniscus liliae*. Photos: CS Fernandes.

Remarks

Troglobitic and endemic species (Campos-Filho et al. 2017a, 2019). Gruna do Enfurnado and Caverna Chico Pernambuco is near from each other, then the species probably dispersed via subterranean routes.

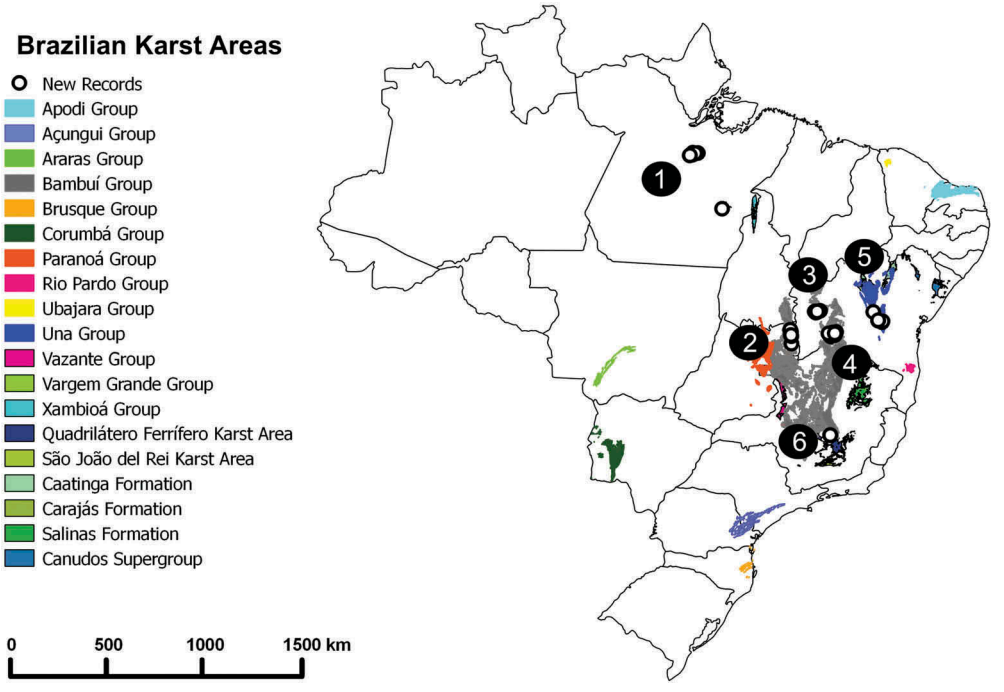

Figure 3. Distribution of the new records of Isopods from the North, Midwest, Southwest and Northeast Regions. 1. Altamira (Pará); 2. São Domingos (Goiás); 3. São Desidério (Bahia); 4. Serra do Ramalho (Bahia); 5. Chapada Diamantina (Bahia); 6. Matozinhos (Minas Gerais).

Genus ***Cylindroniscus*** Arcangeli, 1929

Cylindroniscus flaviae Campos-Filho, Araujo and Taiti, 2017

Distribution

Several caves in the Açungui karst area, Iporanga, state of São Paulo, Brazil (see Campos-Filho et al. 2017a).

***Cylindroniscus* sp.**

Material examined

Goiás, São Domingos: 1♂, Lapa do Angélica cave, 5 October 2011, leg. ME Bichuette and LB Simões (LES 6388); 1♀, Lapa do Angélica cave, 18 June 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6396).

Distribution

Lapa do Angélica cave, São Domingos, state of Bahia.

Remarks

New record. The specimens examined show the body slender, and absence of eyes and body pigments. As in the previous species, these characters can be related with endogean way of life. Further surveys in- and outside caves are necessary to confirm its subterranean classification.

Genus ***Iuiuniscus*** Souza, Ferreira and Senna, 2015

Iuiuniscus iuiuensis Souza, Ferreira and Senna, 2015

Material examined

Bahia, Iuiu: 3♂, 2♀, Lapa do Baixão cave, Serra do Ramalho (LES 14353).

Distribution

Lapa do Baixão cave, Iuiu, state of Bahia (Souza et al. 2015).

Genus ***Spelunconiscus*** Campos-Filho, Araujo and Taiti, 2014

Spelunconiscus castroi Campos-Filho, Araujo and Taiti, 2014

Distribution

Gruta MOC-32 cave, Matozinhos, state of Minas Gerais (Campos-Filho et al. 2014, 2018a).

Genus ***Xangoniscus*** Campos-Filho, Araujo and Taiti, 2014

Xangoniscus aganju Campos-Filho, Araujo and Taiti, 2014

Material examined

Bahia: Carinhanha: 1♂ Mandiaçu cave, 11 September 2008, leg. ME Bichuette, B Rantin and L Senna-Horta (LES 6427); Coribe: 1♂, 4♀, Caverna Domingão cave, 27 July 2012, leg. ME Bichuette, JE Gallão and PP Rizzato (LES 6437); 4♂, 1♀ (LES 6435), 1♀ (LES 6436), 1♂ 2♀ (LES 6454), 1♀ (LES 6456), Caverna Chico Pernambuco cave, 28 July 2012, leg. ME Bichuette, JE Gallão and PP Rizzato.

Distribution

This species is recorded from Gruna do Mandiaçu cave, Carinhanha, Caverna Domingão cave, and Caverna Chico Pernambuco cave, all in the state of Bahia (Campos-Filho et al. 2014, 2019).

Remarks

Troglobitic and amphibious species (Campos-Filho et al. 2014, 2018a). As mentioned by Campos-Filho et al. (2019), specimens of *X. aganju* from Caverna Domingão and Chico Pernambuco caves are morphologically very similar with specimens from Gruna do

Mandiaçu cave (type-locality), with few differences on male pleopod 2 endopod (see figure 14 in Campos-Filho et al. 2014, and figure 7 in Campos-Filho et al. in press). It is, therefore, possible that each population represent a lineage undergoing evolutionary differentiation. Future molecular studies are needed to confirm if these populations belong to the same or distinct taxonomic entities.

Xangoniscus odara Campos-Filho, Bichuette and Taiti, 2016

Distribution

Lapa do Cipó cave, Itacarambi, state of Minas Gerais (Campos-Filho et al. 2016).

Xangoniscus itacarambiensis Bastos-Pereira, Souza and Ferreira, 2017

Distribution

Olhos D'Água Cave, Northern Minas Gerais, Brazil (Bastos-Pereira et al. 2017).

Section **CRINOCHETA** Legrand, 1946
Family **PHILOSCIIDAE** Kinahan, 1857
Genus ***Androdeloscia*** Leistikow, 1999

Androdeloscia sp.

Material examined

Pará, Altamira: 1♂, 1♀, Gruta do Jôa cave, 13 May 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES 6328); Região de Paratizinho, Epigean, 4 April 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES: 1 juv., 6333; 1♂, 1♀, 6334).

Distribution

Gruta do Jôa cave, Altamira, state of Pará.

Remarks

The genus *Androdeloscia* comprises 25 species distributed in Bolivia, Brazil, Guatemala, Mexico, Venezuela and Peru (Schmalfuss 2003; Schmidt and Leistikow 2005; Grangeiro and Souza 2006; Grangeiro and Christoffersen 2010; López-Orozco et al. 2016; Campos-Filho et al. 2017b). This is the first record of the genus for the subterranean environment. *Androdeloscia* sp. can be considered troglophilic, based on its well-developed eyes and pigmented body as well as on its distribution in- and outside of Gruta do Jôa cave.

Genus ***Benthana*** Budde-Lund, 1908

Benthana iporangensis Lima and Serejo, 1993

Distribution

Benthana iporangensis is recorded from the three caves part of the Areias system, PETAR (Parque Estadual Turístico do Alto Ribeira – Turistic State Park from Alto Ribeira), Iporanga, state of São Paulo (Lima and Serejo 1993; Campos-Filho et al. 2014).

Benthana taeniata Araujo and Buckup, 1994

Distribution

Widely distributed species in many Brazilian states (see distribution on Campos-Filho et al. 2015b). *Benthana taeniata* was also recorded inside the Gruta Zeferino I cave, São Roque de Minas, Serra da Canastra, state of Minas Gerais (Campos-Filho et al. 2014).

Benthana xiquinhoi Campos-Filho, Bichuette and Taiti, 2019.

Material examined

Bahia, Andaraí, Povoado de Igatu: Gruna Parede Vermelha cave: 1♀, 29 October 2010, leg. ME Bichuette and JE Gallão (LES 6337), 1♀, 28 October 2010, same collectors (LES 6342); 1♂, 2 April 2013, leg. ME Bichuette, JE Gallão and DM Schmonsky (LES 6352); 1♂, same as previous (LES 6353); Gruna Lava Pé cave: 2♀, 1 juvenile, 30 March 2013, leg. ME Bichuette, JE Gallão and DM Schmonsky (LES 6348).

Distribution

Gruna Parede Vermelha and Gruna Lava Pé caves, Andaraí, state of Bahia.

Remarks

Based on morphological traits, i.e. eyes composed of 12 ommatidia, appendages elongated (antennae, pereopods and uropod exopods) and some specimens with reduced body pigments, this species is considered troglomorphic. However, additional surveys should be conducted outside caves to confirm the classification of this species.

Genus ***Ischioscia*** Verhoeff, 1928

Ischioscia amazonica Lemos de Castro, 1955

Distribution

Ischioscia amazonica is recorded from the Brazilian states of Amazonas and Pará (Schmalfuss 2003). In caves, it is recorded at Cav 18S11 cave, Canaã dos

Parauapebas, and Cav 28S11 cave, Parauapebas, both in the state of Pará (Campos-Filho et al. 2014).

Leonardoscia hassalli Campos-Filho, Araujo and Taiti, 2014

Material examined

Pará, Altamira: 1♀, Leonardo da Vinci cave, 17 December 2010, leg. ME Bichuette, DM Schimonsky and JE Gallão (LES 6307); 1♂, 1♀, Sugiro-Roncador cave, 13 December 2010, leg. ME Bichuette, DM Schimonsky and JE Gallão (LES: 6301, 1 ♂ 6305).

Distribution

Leonardoscia hassalli was originally described from Leonardo da Vinci cave (Campos-Filho et al. 2014). The present study extends the distribution of this species for Sugiro Roncador, Altamira, state of Pará.

Remarks

Based on the reduced number of ommatidia and absence of body pigments, allied with the occurrence only inside in Leonardo da Vinci cave, *L. hassalli* was at first considered troglobitic (Campos-Filho et al. 2014). The new record presented here, Sugiro-Roncador cave, suggests that the species probably is troglophilic, instead of troglobitic. Subterranean dispersion between the Leonardo da Vinci (type-locality) and Sugiro-Roncador caves is very improbable, because both caves are far from each other and isolated by the Xingu River (CPRM 2015).

Genus ***Metaprosekia*** Leistikow, 2000

Metaprosekia caupe Campos-Filho, Araujo and Taiti, 2014

Material examined

Pará, Altamira: Sugiro-Roncador cave, 2 April 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES: 1♂, 2♀, 6316; 1♀, 6317; 1♂, 6318; 2♀, 6319; 2♀, 6320; 1♂, 6323); Abrigo Igarapé cave, 14 December 2010, leg. ME Bichuette, DM Schimonsky and JE Gallão (LES: 1♂, 6302; 3♀, 6303); 6♀, Abrigo Paratizinho cave, 4 April 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES 6324); Abrigo Cama de Vara cave, 2 April 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES: 5♀, 6325; 6♀, 6326); 1♂, Abrigo Turiá cave, 5 April 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES 6322).

Distribution

Several caves at Altamira, state of Pará.

Remarks

Metaprosekia caupe was originally described from Caverna Sugiro-Roncador cave, Altamira, state of Pará (Campos-Filho et al. 2014). The present records considerably expand its distribution for several caves in Altamira region. It is regarded as troglophile.

Metaprosekia quadriocellata Campos-Filho, Araujo and Taiti, 2014

Distribution

This species is recorded from three caves in Altamira region, state of Pará: Leonardo da Vinci, Abrigo do Sismógrafo and Abrigos Assurini (Campos-Filho et al. 2014).

Metaprosekia sp.

Material examined

Bahia, Andaraí: 2♂, 3♀, 1 juvenile, Povoado de Igatu, Gruna Rio dos Pombos cave, 31 March 2013, leg. leg. ME Bichuette, JE Gallão and DM Schmonsky (LES 6349).

Distribution

Gruna Rio dos Pombos cave, Andaraí, state of Bahia.

Remarks

The genus *Metaprosekia* includes three species, *M. caupe* Campos-Filho, Araujo and Taiti, 2014 and *M. quadriocellata* Campos-Filho, Araujo and Taiti, 2014 from the state of Pará, and *M. nodilinearis* Leistikow, 2000 from Venezuela (Leistikow 2000; Campos-Filho et al. 2014). The specimens examined here show the typical characters of the genus: body covered by fan-shaped scale setae, eyes composed of four ommatidia, antennula with two divergent sets of aesthetascs and antennal flagellum of three articles with very long apical organ (see Leistikow 2000). As mentioned by Campos-Filho et al. (2014), these characters can also be related with endogean way of life. In order to clarify the classification of these specimens, more surveys are necessary in- and outside caves. The present record considerably enlarges the distribution of the genus.

Family **SCLEROPACTIDAE** Verhoeff, 1938

Genus ***Amazoniscus*** Lemos de Castro, 1967

Amazoniscus eleonorae Souza et al., 2006

Material examined

Pará, Altamira: Pedra da Cachoeira cave, 15 December 2010, leg. ME Bichuette, DM Schimonsky and JE Gallão (LES: 2♂, 1♀, 6306; 1♂, 6309); same locality, 3 April 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES: 9♂, 14♀, 6310; 4♂, 9♀, 6311; 1♀, 6312; 1♂, 6313; 1♂, 6332).

Distribution

This species is recorded from three caves of Altamira region, state of Pará: Pedra da Cachoeira, Planaltina and Limoeiro (Souza et al. 2006; Campos-Filho et al. 2014).

Amazoniscus leistikowi Campos-Filho, Araujo and Taiti, 2014

Distribution

Abrigo do Sismógrafo cave, Altamira region, state of Pará (Campos-Filho et al. 2014).

Remarks

Based on the absence of ommatidia and body pigments, and records in epigean habitats, this species is considered troglobitic (Trajano 2012; Campos-Filho et al. 2014, 2018a).

Circoniscus bezzii Arcangeli, 1931

Distribution

Circoniscus bezzii is recorded from the Brazilian states of Espírito Santo, Mato Grosso, Minas Gerais and São Paulo, and with dubious record from Paraguay (Souza-Kury and Lemos de Castro 1991; Schultz 1995; Schmidt 2007). In caves, it is recorded from Caverna Vereda da Palha cave, Presidente Olegário, state of Minas Gerais (Campos-Filho et al. 2014).

Remarks

Arcangeli (1931) described *Circoniscus bezzii* from Carandasinho, state of Mato Grosso. Souza-Kury and Lemos de Castro (1991) extended its distribution for the states of Espírito Santo, Minas Gerais and São Paulo. Schultz (1995) recorded this species from province of Canendiyu, Paraguay, mentioned that *C. gracilidens* Souza and Lemos de Castro, 1991 [synonym of *C. incisus* (see Schmidt 2007)], *C. incisus* Souza and Lemos de Castro, 1991, and *C. pallidus* Arcangeli, 1936 probably are synonyms of *C. bezzii* (the author did not include these species in the synonym list of *C. bezzii*), and misinterpreted its distribution for the Brazilian state of Rio de Janeiro to Rio de La Plata drainage; the latter without accuracy (this drainage is located between Argentina and Uruguay) (see Schultz 1995). Leistikow and Wägele (1999) considered the paper of Schultz (1995) and misunderstood the distribution of *C. bezzii* for the states of Pára and Minas Gerais. This species has never been recorded from Pará and this misinterpretation was followed by subsequent authors (Schmalfuss 2003; Campos-Filho et al. 2014, 2018a). Schmidt (2007) with material from Rio de Janeiro and São Paulo re-described the species and based on pereonites 1 and 2 epimera with ventral lobes, mentioned that Schultz's specimens probably belong to *C. incisus*. Regarding the previous information, the correct distribution of *C. bezzii* are those localities in Souza-Kury and Lemos de Castro (1991), Schmidt (2007) and Campos-Filho et al. (2014).

This species occurs in Atlantic forest and Pantanal areas (Souza-Kury and Lemos de Castro 1991; Schmidt 2007), and it is considered accidental in cave environments.

Circoniscus buckupi Campos-Filho and Araujo, 2011

Distribution

Several caves in FLONA Carajás (FLONA – National Forest), Parauapebas, state of Pará (see localities on Campos-Filho and Araujo 2011).

Circoniscus carajasensis Campos-Filho and Araujo, 2011

Distribution

S11-07 cave, Canaã dos Carajás, state of Pará (Campos-Filho and Araujo 2011).

Circoniscus incisus Souza and Lemos de Castro, 1991

Distribution

States of Espírito Santo, Mato Grosso, Pará and Rio de Janeiro and, probably, Paraguay (Souza-Kury and Lemos de Castro 1991; Schmidt 2007; Campos-Filho et al. 2014). In caves, this species is recorded in three caves from Pará: S11D-12 cave, Canaã dos Carajás; S11D-69 cave, Canaã dos Parauapebas; and N4E66 cave, Parauapebas (Campos-Filho et al. 2014).

Circoniscus intermedius Souza and Lemos de Castro, 1991

Material examined

Pará, Canaã dos Carajás: 1♀, CAV-19 cave, 6º24'21"S 50º22'09"W, 8–15 March 2012, leg. Oliveira *et al*. (UFRGS).

Distribution

States of Mato Grosso, Mato Grosso do Sul and Pará (Campos-Filho et al. 2014). In caves, it was collected in Abrigo do Sismógrafo cave, Altamira region, state of Pará (Campos-Filho et al. 2014).

Genus ***Microsphaeroniscus*** Lemos de Castro, 1984

Microsphaeroniscus sp.

Material examined

Bahia, Coribe: Serra do Ramalho, Gruna do Enfurnado cave, 26 September 2006, leg. E Trajano and D Sansone (LES: 4♀, 6415; 1♂, 18♀, 6416; 3♀, 6417; 16♀, 6418); same locality as previous, July 2007, leg. ME Bichuette, FD Passos and BS Brito (LES: 2♀, 6421; 2♀, 6423; 8♀, 6425); 1♀, same locality as previous, 5 May 2007, leg. E Trajano and D Sansone (LES 6422); 1♀, same locality as previous, 11 August 2007, leg. ME Bichuette, FD Passos and BS Brito (LES 6426); same locality as previous, September 2007, leg. E Trajano and D Sansone (LES: 7♀, 6428; 1♀, 6429; 1♀, 6430).

Distribution
Gruna do Enfurnado cave, Coribe, state of Bahia.

Remarks
New record. *Microsphaeroniscus* sp. differs from its congeners by the presence of classical troglomorphisms, absence of eyes and body pigments. The present record considerably enlarges the distribution of the genus.

Family **DUBIONISCIDAE** Schultz, 1995
Genus ***Calycuoniscus*** Collinge, 1915

Calycuoniscus goeldii (Lemos de Castro, 1967)

Distribution
This species occurs in many caves from the state of Pará: Abrigo do Paratizão, Abrigos Assurini and Abrigo do Sismógrafo, Altamira region; Gruta S11-17, Canaã dos Carajás; and Gruta 24S11 and 34S11, Parauapebas (as *Dubioniscus goeldii* in Campos-Filho et al. 2014).

Genus ***Dubioniscus*** Vandel (1963)

Dubioniscus marmoratus Lemos de Castro (1970)

Distribution
Caverna do Riacho Subterrâneo cave, Itu, state of São Paulo (Campos-Filho et al. 2014).

Dubioniscus sp. 1

Material examined
Goiás, São Domingos: Caverna São Bernardo cave, 11 February 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES: 1♂, 6389; 1 ♂, 2 juv., 6390; 1♀, 6391; 1♂, 6392); same locality as previous, 18 July 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES: 1♂, 2♀, 6401; 1♀, 6402).

Distribution
Caverna São Bernardo cave, São Domingos, state of Goiás.

Remarks
New record. The specimens examined show antennae very long, body pigments ranging from yellowish to light brown and presence of eyes, supporting its non-troglomorphic status.

Dubioniscus sp. 2

Material examined

Bahia, São Desidério: 1♀, Gruta Garganta do Bacupari cave, 6 May 2008, leg. ME Bichuette, T Scatolini and D Pedroso (LES 6267). Goiás, São Domingos: 1♀, Terra Ronca I cave, 30 October 2012, leg. ME Bichuette, JE Gallão, LB Simões, CS Fernandes and T Zepon (LES 6411); 1♂, Terra Ronca II cave (or Buraco das Araras cave), 6 October 2011, leg. ME Bichuette and LB Simões (LES 6387); 1♀, same locality as previous, 1 October 2012, leg. ME Bichuette, JE Gallão, LB Simões, CS Fernandes and T Zepon (LES 6407); 1♂, 1♀, Gruta Revolucionários cave, 20 June 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6404).

Distribution

Caves from São Desidério and São Domingos, states of Bahia and Goiás, respectively.

Remarks

New record. The specimens examined show eyes with reduced number of ommatidia and absence of body pigments. Such characteristics can be related with endogean life-style (Campos-Filho et al. 2014) and not troglomorphisms. Further surveys outside caves will elucidate its correct subterranean classification.

Genus *Novamundoniscus* Schultz, 1995

Novamundoniscus altamiraensis Campos-Filho, Araujo and Taiti, 2014

Distribution

Abrigos Assurini cave, Altamira, state of Pará (Campos-Filho et al. 2014).

Novamundoniscus sp. 1

Material examined

Bahia, São Desidério: Gruta do Catão cave, 30 October 2011, leg. ME Bichuette, JE Gallão, CS Fernandes and D Pedroso (LES: 2♀, 6275; 2♀, 6276); same locality as previous, 20 March 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES: 1♀, 6284; 4♀, 6285; 1♀, 6286); same locality as previous, 3 November 2012, ME Bichuette, JE Gallão, LB Simões, CS Fernandes and T Zepon (LES: 1♀, 6293; 1♂, 1♀, 6294; 1♀, 6295); Gruta Sumidouro do João Baio cave, 2 November 2011, ME Bichuette, J. Gallão, CS Fernandes and D Pedroso (LES: 2♀, 6277; 1♀, 6278; 2♀, 6279); 1♀, Gruta 159 cave, 7 November 2008, leg. ME Bichuette, T Scatolini and D Pedroso (LES 6268); Gruta Sucupira cave, 31 October 2011, leg. ME Bichuette, JE Gallão, CS Fernandes and D Pedroso (LES: 1♀, 6280; 1♀, 6281; 1♂, 6282); 1♀, Poço de Pedra cave, 21 April 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES 6291).

Distribution

Novamundoniscus sp. 1 was recorded only at São Desidério, state of Bahia.

Remarks

New record. Non-troglomorphic. The specimens were collected in- and outside caves, supporting its troglophilic status.

Novamundoniscus sp. 2

Material examined

Bahia, Carinhanha, Serra do Ramalho: 1♂, 1♀, Caverna Bem Bom cave, 6 December 2012, leg. ME Bichuette and JE Gallão (LES 6439); 1♂, 1♀, Gruna do Valdecir cave, 26 July 2012, leg. ME Bichuette, JE Gallão and PP Rizzato (LES 6450).

Distribution

Novamundoniscus sp. 2 was found at the caves Caverna Bem Bom and Gruna do Valdecir, Carinhanha, state of Bahia.

Remarks

Based on the pale brown pigment, these specimens can be considered troglomorphic. The color reduction can be sometimes associated with endogean lifestyle. More surveys outside caves are necessary to confirm this classification.

Novamundoniscus sp. 3

Material examined

Bahia: 2♀, Carinhanha, Caverna Bem Bom cave, 6 December 2012, leg. ME Bichuette and JE Gallão (LES 6440). Goiás, São Domingos: 1♀, Lapa do Angélica cave, 18 June 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6395); Terra Ronca I cave, 30 October 2012, leg. ME Bichuette, JE Gallão, LB Simões, CS Fernandes and T Zepon (LES: 1♂, 1♀, 6409; 1♀, 6412); 1♂, Terra Ronca II cave, 6 October 2011, leg. ME Bichuette and LB Simões (LES 6386); 1♀, near São Domingos River (Epigean), 25 April 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES 6370); 1♀, Russão System (Epigean), 23 April 2011, leg. ME Bichuette, PP Rizzato and JE Gallão (LES 6381).

Distribution

Novamundoniscus sp. 3 was found in- and outside of the caves listed above.

Remarks

New record. Non-troglomorphic. The specimens examined show body pigments light brown, eyes constituted of ten ommatidia and elongated antennae and uropod exopod. Considering these characters and its occurrence in- and outside caves, this species is considered troglophilic.

Family **PLATYARTHRIDAE** Verhoeff, 1949
Genus ***Trichorhina*** Budde-Lund, 1908

Trichorhina anhanguera Campos-Filho, Araujo and Taiti, 2014

Distribution
Gruta MP-10 cave, Morro do Pilar, state of Minas Gerais (Campos-Filho et al. 2014).

Trichorhina cipoensis Campos-Filho, Bichuette and Taiti, 2016

Distribution
Lapa do Cipó cave, state of Minas Gerais (Campos-Filho et al. 2016).

Trichorhina curupira Campos-Filho, Araujo and Taiti, 2014

Material examined
Pará, Altamira: Caverna Pedra da Cachoeira cave, 15 December 2010, leg. ME Bichuette, DM Schimonsky and JE Gallão (LES: 10♂, 11♀, 6304; 1♂, 5♀, 6308); same locality, 3 April 2011, leg. ME Bichuette, DM Schimonsky, JE Gallão and D Pedroso (LES: 2♀, 6314; 10♂, 14♀, 6327; 1♂, 5♀, 6329; 6♂, 34♀, 6330; 7♂, 6♀, 6331).

Distribution
Caverna Pedra da Cachoeira cave, Altamira, state of Pará (Campos-Filho et al. 2014).

Trichorhina guanophila Souza-Kury, 1993

Distribution
Lapa do Convento cave, Campo Formoso, state of Bahia (Souza-Kury 1993; Campos-Filho et al. 2014).

Remarks
Bastos-Pereira et al. (2017) mentioned that *T. guanophila* lacks troglomorphic traits and, therefore, the species should be considered troglophilic instead of troglobitic. Souza-Kury (1993) mentioned that this species has reduced eyes and body pigment, typical troglomorphic traits. As mentioned in Campos-Filho et al. (2014), these characters can also represent traits of endogeous lifestyle, which could misinterpret their subterranean classification. More surveys in- and outside cave will clarify the subterranean classification of this species.

Trichorhina pataxosi Campos-Filho, Bichuette and Taiti, 2016

Material examined

Minas Gerais, Matozinhos: August-September 2016, leg. Equipe Spelayon: 1♂, Caverna BM 050 cave, August-September 2016 (LES 10950); 1 juvenile, same locality (LES 10952); 1♀, 2 juveniles, Caverna BM 104 cave (LES 10961); 5♀, 3 juvenis, 1 manca, same locality (LES 11031); 2♀, Caverna BM 013 cave (LES 10976); 1♂, 1♀, Caverna BM 024 cave (LES 10980); 1♂, 1♀, same locality (LES 10981); 1♀, Caverna BM 064 cave (LES 11007); 1♀, 2 mancas, Caverna BM 085 cave (LES 11021); 1♀, Caverna BM 111 cave (LES 11035); 1♀, Caverna BM 142 cave (LES 11050); 1♀, Caverna BM 152 cave (LES 11051), 1♀, Caverna BM 157 cave (LES 11052); 1♂, 2 juveniles, same locality (LES 11053); 1♀, Caverna SUPRAM 003 cave, same date and collectors (LES 11054).

Distribution

Trichorhina pataxosi occurs at two caves from Pedro Leopoldo and at the caves from Matozinhos, state of Minas Gerais.

Remarks

New record. Troglophilic species. *Trichorhina pataxosi* was described from Gruta do Sufoco and Gruta do Nei caves, state of Minas Gerais (Campos-Filho et al. 2016). The caves mentioned here are inserted in the same karst region, Bambuí Group, ca. 20 km from the type locality (see Campos-Filho et al. 2016).

Trichorhina tomentosa (Budde-Lund, 1893)

Material examined

São Paulo, Eldorado: 1♂♀, Caverna do Diabo cave (Gruta da Tapagem), Parque Estadual Caverna do Diabo, 24º38'17"S 48º24'04"W, 16–20 April 2009, leg. Pellegati-Franco *et al.* (LES 3056).

Distribution

Pantropical species (Schmalfuss 2003).

Remarks

Accidental species in caves. This is the first record of *T. tomentosa* in the subterranean environment.

Trichorhina yiara Campos-Filho, Araujo and Taiti, 2014

Distribution

Abrigo do Sismógrafo and Abrigo do Abutre caves, Altamira, state of Pará (Campos-Filho et al. 2014).

Trichorhina sp. 1

Material examined

Bahia, Andaraí: 6♀ Povoado de Igatu, Gruna Lava Pé cave (LES 6340); same locality, 10 March 2012, leg. ME Bichuette, JE Gallão and A Giupponi (LES: 3♀, 6345; 2♀, 6346); 6♀, same locality, 3 March 2013, leg. ME Bichuette, JE Gallão and DM Schimonsky (LES 6347).

Distribution

Gruna Lava Pé cave, Andaraí, state of Bahia.

Remarks

New record. The specimens examined here lack eyes and body pigments; however, these characters are common in representatives of the group with endogean way of life (Souza et al. 2011; Campos-Filho et al. 2014). More surveys outside caves are necessary to confirm its subterranean classification.

Trichorhina sp. 2

Material examined

Goiás, São Domingos: Suspirinho cave, 25 April 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES: 2♀, 6369; 6♀, 6373); same locality as previous, 9 February 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES: 1♀, 6375; 3♀, 6376); Suspirão cave, 9 February 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES: 1♀, 6378; 8♀, 6380).

Distribution

Suspirinho and Suspirão caves, São Domingos, Goiás.

Remarks

New record. The specimens lack eyes and body pigments; however, as mentioned previously, these characters can be related with endogean lifestyle (Souza et al. 2011; Campos-Filho et al. 2014).

Trichorhina sp. 3

Material examined

Goiás, São Domingos: 1♂, Lapa do Angélica cave, 18 June 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6394); 4♀, Gruta dos Revolucionários cave, 20 June 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6405); 1♀, Caverna Terra Ronca II cave, 1 October 2012, leg. ME Bichuette, JE Gallão, LB Simões, CS Fernandes and T Zepon (LES 6408).

Distribution

Lapa do Angélica, Gruta dos Revolucionários and Terra Ronca II cave, São Domingos, state of Goiás.

Remarks

New record. The specimens examined show eyes reduced and body pigments absent, which could be related with endogean lifestyle (Souza et al. 2011; Campos-Filho et al. 2014).

Trichorhina sp. 4

Material examined

Bahia, São Desidério: Gruta Lapa do Manga I cave, 5 November 2008, leg. ME Bichuette, T Scatolini and D Pedroso (LES: 1♂, 2♀, 6273; 2♂, 3♀, 6274); Buraco da Sopradeira cave, 23 April 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES: 1♂, 3♀, 6289; 1♂, 6290); 1♀, Gruta Baixa Fria cave, 4 November 2008, leg. ME Bichuette, T Scatolini and D Pedroso (LES 6272); 1 juvenile, Gruta do Juraci cave, 3 November 2011, leg. ME Bichuette, JE Gallão, CS Fernandes and D Pedroso (LES 6283); 1♀, Gruta do Catão cave (Epigean), 3 November 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES 6296).

Distribution

Gruta Lapa do Manga I, Buraco da Sopradeira, Gruta Baixa Fria, Gruta do Juraci and Gruta do Catão caves, all in São Desidério, state of Goiás.

Remarks

New record. The specimens examined lack eyes and body pigments. They were collected in- and outside caves, supporting its troglophilic status.

Trichorhina sp. 5

Material examined

Bahia, São Desidério: Sumidouro do Engenho cave, 22 April 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES: 8♀, 6287; 2♀, 6288).

Distribution

Sumidouro do Engenho cave, São Desidério, state of Bahia.

Remarks

New record. The specimens examined lack eyes and body pigments. The specimens were collected in guano of frugivorous bat in only one section of the cave, which probably indicates troglobitic condition. Additional surveys outside caves are necessary to confirm this status.

Family **BATHYTROPIDAE** Vandel, 1952
Genus ***Neotroponiscus*** Arcangeli, 1936

Neotroponiscus iporangaensis Cardoso and Araujo, 2017

Distribution
Several limestone caves from Parque Estadual Turístico do Alto Ribeira (PETAR), Iporanga, state of São Paulo (Cardoso and Araujo 2017).

Neotroponiscus tuberculatus Cardoso and Araujo, 2017

Distribution
Iron ore caves from Brumadinho, state of Minas Gerais.

Family **PUDEONISCDAE** Lemos de Castro, 1973
Genus ***Iansaoniscus*** Campos-Filho, Araujo and Taiti, 2017

Iansaoniscus iraquara Campos-Filho, Araujo and Taiti, 2017

Material examined
Bahia: 1♂, Itaetê, Lapa do Bode cave, 31 July 2010, leg. ME Bichuette, B Rantin and JE Gallão (LES 6358); 1♂, Iraquara, Gruta Natal cave, 4 August 2004, leg. ME Bichuette and R Bessi (LES 6364); 1♂, Iraquara, Buraco do Cão cave, 20 June 2009, leg. ME Bichuette and L Senna-Horta (LES 6363).

Distribution
Iansaoniscus iraquara was originally described from Buraco do Cão cave, Iraquara, state of Bahia (Campos-Filho et al. 2017c). Our new records extended its distribution for Gruta Natal and Lapa do Bode caves, in Iraquara and Itaetê, respectively.

Iansaoniscus georginae Campos-Filho, Araujo and Taiti, 2017

Distribution
Borboletas cave, Paripiranga, state of Bahia (Campos-Filho et al. 2017b).

Family **ARMADILLIDAE** Brandt, 1831
Genus ***Ctenorillo*** Verhoeff, 1942

Ctenorillo ferrarai Campos-Filho, Araujo and Taiti, 2014

Distribution
Gruta N5S 07 and Gruta Cris 11 caves, FLONA Carajás (FLONA – National Forest), Canaã dos Carajás, state of Pará (Campos-Filho et al. 2014).

Genus ***Cubaris*** Brandt, 1833

Cubaris murina Brandt, 1833

Material examined
Bahia, São Desidério: 1♂, 2♀, Gruta Lapa do Manga II, 5 November 2008, leg. ME Bichuette, T Scatolini and D Pedroso (LES 6271); 1♀, Morro do Chapéu, Gruta dos Brejões cave, 15 May 2009, leg. ME Bichuette and L Senna-Horta (LES 6360); 1♂ same locality as previous, 31 December 2012, leg. L Senna-Horta (LES 6361).

Distribution
Circumtropical species (Schmalfuss 2003). In Brazilian caves, it was first recorded at Gruta dos Brejões cave, Morro do Chapéu (Campos-Filho et al. 2014); our new record extends its distribution to Gruta Lapa do Manga II cave, São Desidério, Bahia.

Genus ***Gabunillo*** Schmalfuss and Ferrara, 1983

Gabunillo aridicola Souza, Senna and Kury, 2010

Distribution
Gruta do Sobradinho cave, Aiuaba, state of Ceará, and Lajedo da Soledade, Apodi, state of Rio Grande do Norte (Souza et al. 2010).

Remarks
Souza et al. (2010) described the second species of the genus *Gabunillo, G. aridicolla* Souza, Senna and Kury, 2010, with specimens collected in the Brazilian states of Ceará and Rio Grande do Norte. The species was included in the genus *Gabunillo* based on the shape of cephalon, pereonites 2 and 3 without ventral lobes, telson triangular, shape of uropods and pleopod exopods without pleopodal lungs (see also Schmalfuss and Ferrara 1983). The authors mentioned that the uropod of *G. aridicola* resembles the genera *Synarmadillo* Dollfus, 1892, *Ethelumoris* Richardson, 1907 and *Togarmadillo* Schmalfuss and Ferrara, 1983 (see also Ferrara and Schmalfuss 1976; Schmalfuss and Ferrara 1983). However, comparing the description of *G. coecus* and mentioned genera with *G. aridicola*, it is possible to observe some differences: the uropod protopod with concave depression bearing glandular pores and distal margin

rounded (vs. absent and indented in *G. coecus*; present in species of *Synarmadillo*), and uropod exopod is inserted on median portion of the protopod (vs. exopod inserted near distal margin in *G. coecus* and all genera). Moreover, on SEM photographs of the pleopod exopods of *G. aridicola*, it seems to have covered monospiracular pleopodal lungs (see Figure 3C and E in Souza et al. 2010). Future morphological analyses are needed to elucidate if the pleopod exopods of *G. aridicola* have pleopodal lungs and confirm its taxonomic statement. Thus far, *G. aridicola* differs from all mentioned taxa in having the cephalon with frontal shield fused with vertex (vs. frontal shield well marked in all mentioned genera, except *G. coecus*), posterior corner of the pereonite 1 epimera with short schisma (vs. schisma along all epimera in *Ethelumoris* and *Synarmadillo*; half of its pereonite length in *Togarmadillo*), and pereonite 2 and 3 epimera wihout ventral lobe (vs. ventral lobe in *Ethelumoris* and *Synarmadillo*) (see Ferrara and Taiti 1976; Schmalfuss and Ferrara 1983; Souza et al. 2010). Thus, in the light of the above considerations, we recommend a re-examination of the type-material to confirm or not the placement of the species in the genus *Gabunillo*.

Genus ***Venezillo*** Verhoeff, 1928

Venezillo congener (Budde-Lund, 1904)

Material examined

Goiás, São Domingos: Suspirinho cave, 25 April 2012, leg. DM Schimonsky, JE Gallão and CS Fernandes (LES: 1♀, 6368; 1♂, 6371); 1♀, same locality, 9 February 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6374); 1♂, Suspirão cave, 9 February 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6379); Lapa do Angélica cave, 20 April 2011, leg. ME Bichuette, PP Rizzato, JE Gallão (LES: 1♀, 6382; 2♀, 6383; 1♂, 1♀, 6384; 1♂, 1♀, 6385); same locality as previous, 18 June 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES: 2♂, 1♀, 6397; 1♀, 6398); 1♀, same locality and collectors as previous, 10 February 2012 (LES 6413); 1♀, same locality as previous (epigean), 31 October 2012, ME Bichuette, JE Gallão, LB Simões, CS Fernandes and T Zepon (LES 6406); 7♀, Caverna Bezerra cave (epigean), 12 February 2012, leg. DM Schimonsky, JE Gallão and LB Simões (LES 6393); same locality and collectors as previous (Epigean), 19 June 2012 (LES: 1♂, 6399; 1♂, 6400; 1♂, 6403; 1♀, 6414).

Distribution

Many places in the states of Goiás and Mato Grosso do Sul (Van Name 1936; Vilela 1971, Campos-Filho et al. 2019).

Remarks

This species was recently re-described (Campos-Filho et al. 2019). As mentioned by the authors, this species inhabits decaying and humid leaf litter, and it was collected in- and outside caves, supporting its trogophilic status.

Venezillo sp. 1

Material examined

Bahia: Andaraí, Povoado de Igatu: 1♀, Canal da Fumaça cave, 14 April 2014, leg. ME Bichuette, JE Gallão and DM Schimonsky (LES 6356); 1♀, Rio dos Pombos path (epigean), 12 March 2012, leg. ME Bichuette, JE Gallão and A Giupponi (LES 6341); Carinhanha: outside Caverna Bem Bom cave (epigean), 6 December 2012, leg. ME Bichuette and JE Gallão (LES: 1♂, 6442; 1♀, 6444); 1♀, between Agrovila 15 and 16, 7 December 2012, leg. ME Bichuette and JE Gallão (LES 6446).

Distribution

Canal da Fumaça and Rio dos Pombos caves, Andaraí, and Caverna Bem Bom cave, Carinhanha, all in the state of Bahia.

Remarks

New record. The specimens examined show body pigments brown and eyes composed of several ommatidia; however, the material was collected in- and outside caves, supporting the troglophilic condition.

Armadillidae gen. *et* sp. 1

Material examined

Bahia, Carinhanha: 1♀, Gruna do Valdecir cave, 31 May 2012, leg. ME Bichuette, JE Gallão and N Hattori (LES 6432).

Distribution

Gruna do Valdecir cave, Carinhanha, state of Bahia.

Remarks

New record. The specimen examined shows body weakly pigmented and eyes composed of 12 ommatidia, indicating that the species probably is troglomorphic. As in other lineages of Oniscidea, the lack of males difficult species level identification. Future surveys will help in the correct species recognition.

Family **PORCELLIONIDAE** Brandt, 1831

Genus ***Porcellionides*** Miers, 1877

Porcellionides pruinosus (Brandt, 1833)

Material examined

Bahia: 1♂, Iraquara, Gruta Alto da Cruz cave, 24 January 2007, leg. ME Bichuette, FD Passos and T Scatolini (LES 6367); 1♀, Itaetê, Lapa do Bode cave, 31 July 2010, leg. ME Bichuette, B Rantin and JE Gallão (LES 6359); same locality as previous, 6 August 2004, ME Bichuette and R Bessi (LES: 1♀, 6365; 1♂, 6366).

Table 1. List of Oniscidea species and its subterranean classification.

Species	Troglobitic	Troglophilic	Accidental	Amphibious
Trichoniscidae				
Miktoniscus medcofi			x	
Styloniscidae				
Pectenoniscus liliae	x			
Cylindroniscus flaviae		x		
Cylindroniscus sp.		x		
Iuiuniscus iuiuensis	x			x
Spelunconiscus castroi	x			x
Xangoniscus aganju	x			x
Xangoniscus itacarambiensis	x			x
Xangoniscus odara	x			x
Philosciidae				
Androdeloscia sp.		x		
Benthana iporangensis	x			
Benthana taeniata			x	
Benthana xiquinhoi	x			
Ischioscia amazonica			x	
Leonardoscia hassalli		x		
Metaprosekia caupe		x		
Metaprosekia quadriocellata		x		
Metaprosekia sp.		x		
Scleropactidae				
Amazoniscus eleonorae	x			
Amazoniscus leistikowi	x			
Circoniscus bezzii			x	
Circoniscus buckupi	x			
Circoniscus carajasensis	x			
Circoniscus incisus			x	
Circoniscus intermedius			x	
Microsphaeroniscus sp.	x			
Dubioniscidae				
Calycuoniscus goeldii			x	
Dubioniscus marmoratus			x	
Dubioniscus sp. 1			x	
Dubioniscus sp. 2		x		
Novamundoniscus altamiraensis			x	
Novamundoniscus sp. 1		x		
Novamundoniscus sp. 2	?			
Novamundoniscus sp. 3		x		
Platyarthridae				
Trichorhina anhanguera		x		
Trichorhina cipoensis		x		
Trichorhina curupira		x		
Trichorhina guanophila		x		
Trichorhina pataxosi		x		
Trichorhina tomentosa			x	
Trichorhina yiara		x		
Trichorhina sp. 1		x		
Trichorhina sp. 2		x		
Trichorhina sp. 3		x		
Trichorhina sp. 4		x		
Trichorhina sp. 5	x			
Batythropidae				
Neotroponiscus iporangaensis			x	
Neotroponiscus tuberculatus			x	
Pudeoniscidae				
Iansaoniscus iraquara	x			
Iansaoniscus georginae	x			

(*Continued*)

Table 1. (Continued).

Species	Troglobitic	Troglophilic	Accidental	Amphibious
Armadillidae				
Ctenorillo ferrarai		x		
Cubaris murina			x	
Gabunillo aridicola	x			
Venezillo congener		x		
Venezillo sp. 1		x		
Armadillidae gen. *et* sp. 1	?			
Porcellionidae				
Porcellionides pruinosus			x	

Distribution

Cosmopolitan species of Mediterranean origin (Schmalfuss 2003). Introduced in Brazil and already with established populations in several caves (M. E. Bichuette, personal observation).

Discussion

Speleobiological studies in Brazil became more detailed and comprehensive from the study of Dessen et al. (1980), and a great number of karst areas have been investigated since then. Despite this significant knowledge already produced, several areas still remain less investigated because of the large extension of the Brazilian territory and huge amount of caves present in karst areas. Even in the best studied areas, novelties still occur (Trajano 1993). It is common to find new records at each field survey. Sometimes the material is readily sent to specialists of each group, but some groups do not have taxonomists in Brazil and, even when available, they are scarce compared to the amount of species for identification and description. This delay frequently results in the use of the less desirable operational taxonomic units (OTUs) for some ecological studies which does not depend directly on the species identity (Trajano et al. 2012).

The Oniscidea families are heterogeneously distributed among different Brazilian biogeographic subregions (*sensu* Morrone 2014), as discussed by Campos-Filho et al. (2014). We now have 11 Styloniscidae occurring in caves, nine of which are from Chacoan subregion, one of which placed in *Cylindroniscus* represents a new species. Concerning the Philosciidae, out of a total of nine species found inhabiting caves, five are from Amazonian subregion; two species are new: *Androdeloscia* sp., and *Metaprosekia* sp. and, lastly, *Benthana xiquinhoi*, regarded as troglobitic. Of eight Scleropactidae found so far, five are endemic from Amazonian subregion. On the other hand, the troglobitic *Microsphaeroniscus* sp. occurs exclusively at the Chacoan subregion, just like most of Dubioniscidae. The two new *Dubioniscus* as well as the three *Novamundoniscus* are distributed at Chacoan subregion. Platyarthridae are, by and large, well distributed at both Chacoan and Parana subregions, but the five new species occur at the former. Except for one Amazonian and one circumtropical species of Armadillidae, all species found inhabiting caves are from Chacoan subregion, including the new *Venezillo* sp. (see Table 1). All species herein regarded as new will result in a series of

contributions to the knowledge of the terrestrial isopods we are preparing in a joint effort with other taxonomists (see Campos-Filho et al. 2019).

Study areas are facing several conservation concerns related to agricultural and urban expansion, mining, or construction of hydroelectric complexes (Gallão and Bichuette 2018) as we mentioned in the study areas. Because Brazilian laws only consider valid species for conservation purposes, it is very important the description of subterranean species by proper taxonomic research, since any delay may yield permanent loss of biodiversity, even before the species are discovered and described (Campos-Filho et al. 2014; Gallão and Bichuette 2018).

Even if a species is valid, they need to be assigned under a category of threat at IUCN Red List to maximize its protection. Of all those 16 valid troglobitic species herein mentioned, ten are ranked as 'Still Not Rated' (SNR) at the IUCN Red List and four were described after the evaluation process, which means they are not included in the list yet. The inclusion of those species in the IUCN Red List elevates caves to the maximum relevance level, meaning that no impact is allowed in their habitats. All other levels of relevance (high, median or low) are subjected to impacts under some circumstances (Decree 6640/2008 and Normative Instruction n°2/2017) (Gallão and Bichuette 2018).

The amount of new records in every field campaign we carry out shows there is still a long way to go if one intends to protect even a small part of Brazilian subterranean biodiversity. Our records evidence the great need for studies and human resources on the subject. For this reason, Brazilian funding agencies should urgently prioritize projects aiming the formation of systematists in order to overcome the taxonomic impediment, still a serious obstacle for conservation.

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