Cylindroniscus platoi (Isopoda: Oniscidea: Styloniscidae), a new cave-dwelling species from Lagoa Santa Karst, Southeastern Brazil

Article *in* Zootaxa · August 2018

DOI: 10.11646/zootaxa.4464.3.6

CITATIONS
7

READS
290

3 authors:

Camile Sorbo Fernandes
Universidade Federal de São Carlos
13 PUBLICATIONS **120** CITATIONS
SEE PROFILE

Ivanklin Soares Campos-Filho
University of Cyprus
56 PUBLICATIONS **404** CITATIONS
SEE PROFILE

Maria Elina Bichuette
Universidade Federal de São Carlos
202 PUBLICATIONS **1,569** CITATIONS
SEE PROFILE

Zootaxa 4461 (3): 411–420
http://www.mapress.com/j/zt/

Article

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

https://doi.org/10.11646/zootaxa.4461.3.6
http://zoobank.org/urn:lsid:zoobank.org:pub:1D0CCDDF-6D05-4DCA-A454-B7512501003F

Cylindroniscus platoi (Isopoda: Oniscidea: Styloniscidae), a new cave-dwelling species from Lagoa Santa Karst, Southeastern Brazil

CAMILE SORBO FERNANDES[1,3], IVANKLIN SOARES CAMPOS-FILHO[2] & MARIA ELINA BICHUETTE[1]

[1]*Universidade Federal de São Carlos, Departamento de Ecologia e Biologia Evolutiva, Rodovia Washington Luís, Km 235, 13565-905 São Carlos, São Paulo, Brazil.*

[2]*Universidade Federal de Campina Grande, Programa de Pós-Graduação em Recursos Naturais, Av. Aprígio Veloso, 882, Bairro Universitário, 58429-140 Campina Grande, Paraíba, Brazil.*

[3]*Corresponding author. E-mail: camilesorbofernandes@yahoo.com.br*

Abstract

The new species *Cylindroniscus platoi* **n. sp.** is herein described. As far as known, the species occurs only in three caves developed in a continuous limestone outcrop at Pedro Leopoldo municipality, Minas Gerais State. *Cylindroniscus platoi* **n. sp.** is regarded as an endemic troglobite based on its limited distribution and on non-obvious troglomorphisms found on its body surface.

Key words: Troglobite, Pedro Leopoldo, Minas Gerais, *Cylindroniscus*, Brazil

Introduction

Species colonizing subterranean environments have to cope with the permanent darkness compromising visual guidance and all biological processes related to luminosity, such as photosynthesis. Environmental parameters are nearly constant in the deeper zones, where humidity is high and the food web is based on detritus imported from adjacent ecosystems (Poulson 1963; Langecker 2000).

In this scenario, hygrophilic and blind detritivores are favoured, including great number of oniscideans (Campos-Filho *et al*. 2014). Some of them use subterranean environments as an extension of their natural habitat, while others are specialized and restricted to it. Among those isopods with affinities to subterranean environments, the family Styloniscidae stands out, with representatives that adopted an endogeous or amphibious lifestyle and established different ecological-evolutionary relationships with subterranean environments. A spectrum of specialization can be found, ranging from no relationship at all (accidental) perpassing those which have source populations in- and outside of the subterranean environments (troglophiles) and culminating with those which only survive in subterranean environments (troglobites) (Barr 1968; Trajano 2012).

Terrestrial isopods comprise more than 3,700 described species distributed in almost all terrestrial habitats around the globe, including subterranean environments (Schmalfuss 2003; Sfenthourakis & Taiti 2015). To date, more than 180 species are known from Brazil (Campos-Filho *et al*. in press), of which 36 are recorded from caves (Souza-Kury 1993; Souza *et al*. 2006, 2015; Campos-Filho & Araujo 2011; Campos-Filho *et al*. 2014, 2015, 2016, 2017a, 2017b; Souza *et al*. 2015; Cardoso *et al*. 2016; Bastos-Pereira *et al*. 2017). Among the aforementioned cave-dwelling species, only 14 are considered to be troglobionts, i.e. *Cylindroniscus flaviae* Campos-Filho, Araujo & Taiti, 2017, *Iuiuniscus iuiuensis* Souza, Ferreira & Senna, 2015, *Spelunconiscus castroi* Campos-Filho, Araujo & Taiti, 2014, *Xangoniscus aganju* Campos-Filho, Araujo & Taiti, 2014, *Xangoniscus itacarambiensis* Bastos-Pereira, Souza & Ferreira, 2017 and *Xangoniscus odara* Campos-Filho, Bichuette & Taiti, 2016 (Styloniscidae), *Benthana iporangensis* Lima & Serejo, 1993, *Leonardoscia hassalli* Campos-Filho, Araujo & Taiti, 2014 (Philosciidae), *Amazoniscus eleonorae* Souza, Bezerra & Araújo, 2006, *Amazoniscus leistikowi* Campos-Filho, Araujo & Taiti, 2014, *Circoniscus buckupi* Campos-Filho & Araujo, 2011, *Circoniscus carajasensis* Campos-Filho

Accepted by P. Mullin: 8 Jun. 2018; published: 22 Aug. 2018

& Araujo, 2011 (Scleropactidae), *Iansaoniscus iraquara* Campos-Filho, Araujo & Taiti, 2017, and *Iansaoniscus georginae* Campos-Filho, Araujo & Taiti, 2017 (Pudeoniscidae).

The genus *Cylindroniscus* Arcangeli 1929 was recently placed into Styloniscidae by Campos-Filho *et al.* (2017a), based on the position of the muscles of the male pleopod 1 (see Erhard 1997). Up to now, the genus includes six species: *C. seurati* Arcangeli, 1929 from Cuba, *C. maya* Rioja, 1958, *C. yucatanensis* (Mulaik, 1960), *C. cavicola* (Mulaik, 1960) and C. *vallensensis* Schultz, 1970 from Mexico, and *C. flaviae* Campos-Filho, Araujo & Taiti, 2017, from Brazil. As far as known, all species of the genus established some relationship with caves, probably favoured by their endogeous way of life. The only exceptions are *C. seurati* and *C. yucatanensis*, whose records did not specify the habitat of the specimens (Schultz 1970; Campos-Filho *et al.* 2016).

A second species of *Cylindroniscus* is described for caves in Brazil, from three cavities of Pedro Leopoldo municipality, state of Minas Gerais. The ecological-evolutionary relationship of the species with the caves is discussed, as well as its conservation status.

Material and methods

The material was preserved and stored in 75% ethanol and identification was based on morphological characters. Micropreparations were mounted in Hoyer's medium (Borror & DeLong 1964). Species were illustrated with the aid of a camera lucida mounted on Leica MZ12.5 and DMLS microscopes. Final illustrations were prepared using Corel Draw version 12.0. Maps were constructed using the software QGIS (version 2.4) with shape files from Brazilian Geological Survey (CPRM 2015). Google Earth (online version, 2017) was used to obtain the satellite image showing the surrounding area of the caves and the threats hanging over those environments.

The material used in this study is deposited in the cave fauna collection of the Universidade Federal de São Carlos, São Carlos (LES).

Study Area (Fig. 1)**.** The study area is Pedro Leopoldo, Lagoa Santa Karst, State of Minas Gerais, Southeastern Brazil. Lagoa Santa Karst is inserted on Cerrado domain with transition spots of Atlantic rainforest (Ab'Saber 1977), and tropical humid climate, with hot summers and dry winters (Köppen's "Cwa") (Alvares 2014). It is located at approximately 30 km north of the metropolis of Belo Horizonte, with its core area encompassing the municipalities of Lagoa Santa, Pedro Leopoldo, and Matozinhos (Auler & Piló 2015). In the region, a high density of typical dissolution features are developed in calcarenites of Sete Lagoas Formation (Bambuí Group), mostly covered by soil. This region shows several caves with a well-developed system of subterranean hydric networks, which are connected to the surface via multiple points of capture of the surficial waters. In this context, hundreds of caves are developed in this net of subterranean channels (Berbert-Born 2000; Auler & Piló 2015). The caves where the isopods were sampled are inside the boundaries of the Environmental Protection Area of the Lagoa Santa Karst, a conservation unit of sustainable use (IBAMA 1998). Nevertheless, they still face several threats related to the urban areas and mining companies surrounding the conservation unit (Auler & Piló 2015).

Systematics

Styloniscidae Vandel, 1952

Cylindroniscus Arcangeli, 1929

Type species. *Cylindroniscus seurati* Arcangeli, 1929 by monotypy.

Diagnosis (after Campos-Filho *et al.* 2017a). Eyes and colour absent; pereon with cylindrical shape and pleon continuous with body outline; pleonites 3–5 with reduced epimera; telson triangular; cephalon with suprantennal line, no antennary lobes and no frontal line; antennula of three articles, with distal article bearing line of stout aesthetascs, often apically cleft; antennal flagellum of 3–5 articles; mandibles with long seta near outer margin, left mandible with two penicils, right mandible with one penicil, sometimes one penicil on molar process; maxillula outer branch with 3+4 or 5 teeth, inner branch with two stout apical penicils and long seta; maxilliped endite with apical penicil; pereopod 6 and 7 propodus with distal tuft of setae on tergal margin; uropod exopod and endopod

inserted at same level. Male pleopod 1 endopod consists of two articles, distal article flagelliform; male pleopod 2 endopod stout, consisting of two articles.

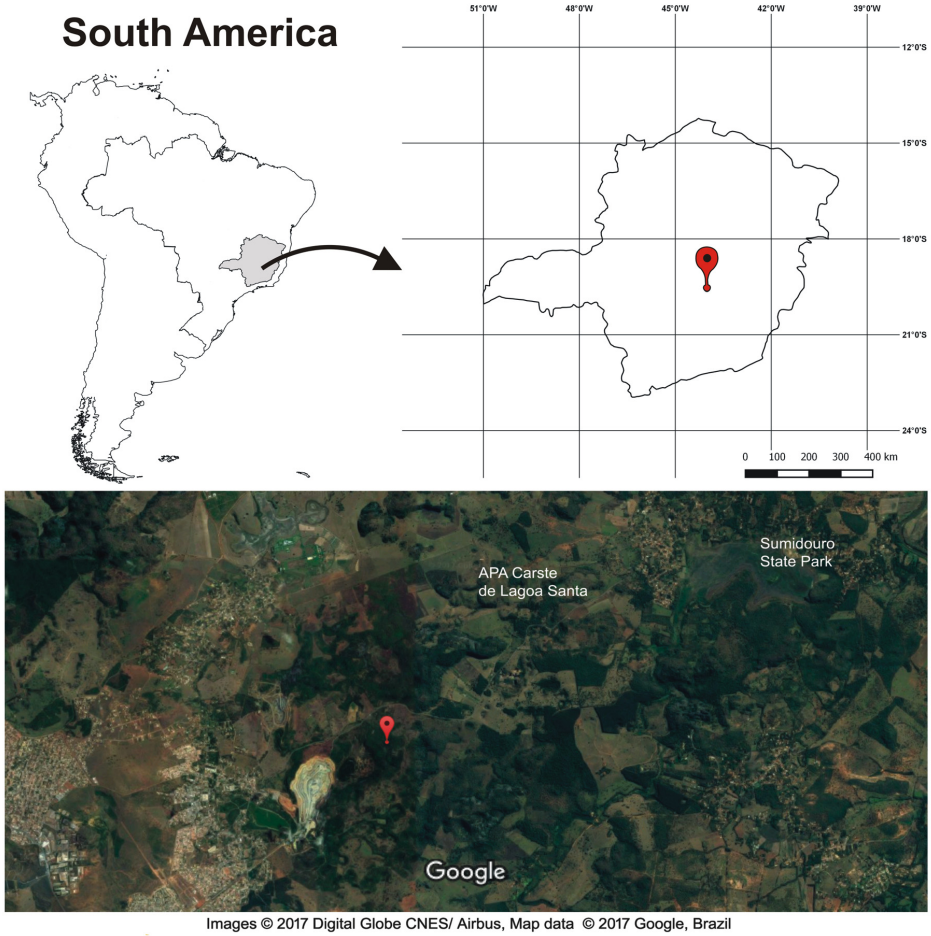

FIGURE 1. Distribution map of *Cylindroniscus platoi* **n. sp.** in Pedro Leopoldo, state of Minas Gerais. The caves CAMP_013, CAMP_024 and CAMP_038 are marked with the red pin.

Cylindroniscus platoi n. sp.

Material examined. *Holotype* 1 ♂ (in micropreparations) (LES 6125), CAMP_038 cave (44°0'21.280"W/ 19°33'48.444"S), Minas Gerais, Pedro Leopoldo, 3–21 November 2014, leg. Spelayon Consultoria staff. *Paratypes* 1 ♂, 1 ♀ (both in micropreparations) (LES 6118), CAMP_013 cave (44°0'28.322"W/ 19°34'4.227"S), Minas Gerais, Pedro Leopoldo, 3–21 November 2014, leg. Spelayon Consultoria staff; 3 ♂, 3 ♀ (part in micropreparations) (LES 6127), CAMP_024 cave (44°0'36.663"W/19°34'9.608"S), Minas Gerais, Pedro Leopoldo, 3–21 November 2014, leg. Spelayon Consultoria staff.

Diagnosis. Antennal flagellum of three articles; inner endite of maxillula with one penicil stout on distal margin plus two proximal penicils; male pleopod 1 exopod triangular, wider than longer; male pleopod 2 endopod with distal portion of second article stout, almost spherical in shape.

Description. Maximum *body* length: ♂ and ♀ 3 mm. Colourless. Outline of body as in Fig. 3A. *Cephalon* and *pereon* with granulated surface, *pleon* smooth with setae on margins (Figs 2, 3A–B, F). *Pereonite 1* epimera directed frontwards, 2–7 gradually more directed backwards (Figs 2, 3A–B). Dorsum covered with tricorn-shaped scale setae and semi-circular scale setae on lateral margins (Fig. 3C, D). *Cephalon* (Figs 2, 3E) with no antennary lobes, frontal line absent, suprantennal line bent downwards medially. Outline of *pleon* (Fig. 3A, F) continuous with that of pereonite 7; epimera of pleonites 3–5 without glandular pores and bearing setae on lateral margins. *Telson* (Fig. 3F) twice as wide as long, lateral sides slightly concave, rounded apex.

FIGURE 2. Habitus of *Cylindroniscus platoi* **n. sp.** in dorsal view.

Antennula (Fig. 3G) of three articles, distal article longest bearing 7–9 stout aesthetascs apically cleft. *Antenna* (Fig. 3H) with distal article of peduncle bearing one strong seta; flagellum of three articles subequal in length, apical organ with many free sensory setae.

Mandibles with strong incisive process, left mandible (Fig. 4A) with one penicil, right mandible (Fig. 4B) with two penicils. *Maxillula* (Fig. 4C) inner endite with one stout apical penicil and two lateral subapical penicils; outer endite of 4+3 simple teeth. *Maxilla* (Fig. 4D) inner lobe wider than outer lobe, covered with thick setae; outer lobe covered with thin setae. *Maxilliped* (Fig. 4E) endite subrectangular bearing one stout apical penicil and laterally covered with simple seta.

Uropod (Fig. 5A) protopod subrectangular, exopod longer than endopod bearing long setae, endopod inserted almost at the same level with one long seta.

Pereopods (Fig. 5B–D) bearing sparse setae on sternal margin of merus and carpus, pereopods 6 and 7 with water conducting system, pereopod 7 propodus bearing tuft of setae on distal tergal margin; dactylus with long dactilar seta apically cleft.

Male. *Genital papilla* (Fig. 6A) elongated, slightly enlarged on median portion, apical portion narrow. *Pleopod 1* (Fig. 6B) exopod triangular, twice as wide as long; endopod of two articles, distal article twice as long as proximal article. *Pleopod 2* endopod of three articles, distal article long and robust, distal portion stout, almost spherical in shape. *Pleopod 3* exopod (Fig. 6D) almost losangular bearing five setae. *Pleopod 4* exopod (Fig. 6E) subquadrangular with four setae. *Pleopod 5* exopod (Fig. 6F) ovoid bearing three setae.

Remarks. Regarding that only *C. flaviae* had male specimens described (see Campos-Filho *et al.* 2017a), comparisons with other species of the genus are limited. Nevertheless, *Cylindroniscus platoi* **n. sp.** is readily distinguishable from the other species in the genus by the shape of the pleopod 2 endopod, which is stout and almost spherical on its distal portion. In having the dorsal surface granulated *Cylindroniscus platoi* **n. sp.** resembles *C. flaviae*; however, it differs in having the antennal flagellum of three articles (vs. four in *C. flaviae*), maxillula inner endite with one stout penicil (vs. two in *C. flaviae*), male pleopod 1 exopod wider than long (vs. longer than wide in *C. flaviae*), male endopod 1 longer than exopod (vs. similar in length in *C. flaviae*), male endopod 2 with distal portion stout and semi-circular (vs. narrow and triangular in *C. flaviae*).

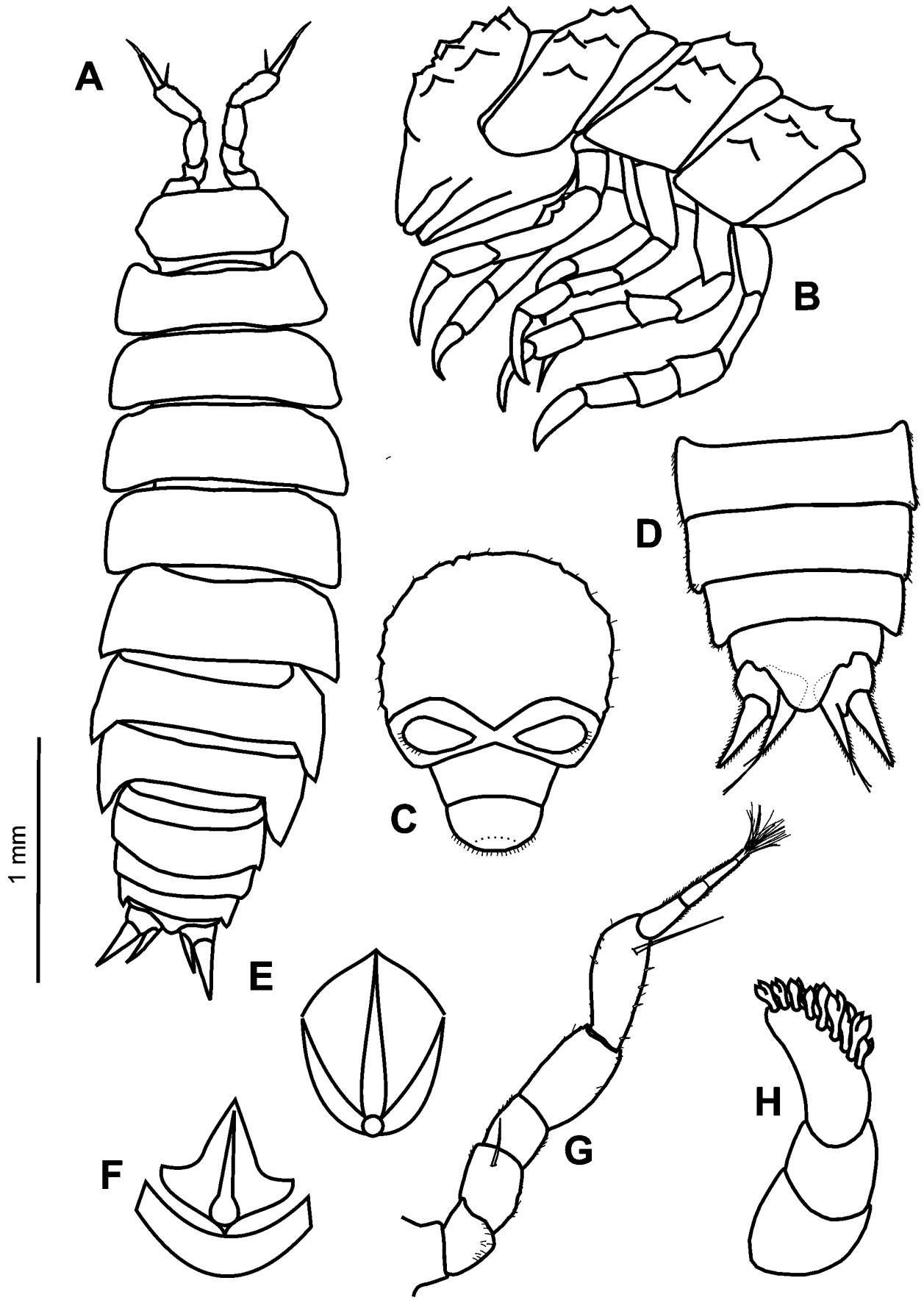

FIGURE 3. *Cylindroniscus platoi* **n. sp.** A. habitus; B. cephalon and pereonites 1-3, lateral view; C. cephalon, frontal view, D. pleonites 3-5, telson and uropods; E. lateral scale-seta; F. dorsal scale-seta; G. antenna; H. antennula.

Considering that all species of *Cylindroniscus,* despite the habitat of origin, are devoid of eyes and color, these traits cannot be considered as troglomorphisms for the group (*sensu* Christiansen 1962). The troglobitic and endemic status are attributed to *Cylindroniscus platoi* **n. sp**. based on the fact that this species was found only inside of caves in a continuous limestone outcrop, which putatively allows subterranean dispersion. With the exception of *C. flaviae*, an ecological evolutionary status for species of the genus found in caves is still lacking, denoting the need of morphological and field studies to raise the not-so-obvious troglomorphisms, which may be present in the troglobites of the genus. As proposed by Schmalfuss (1984), the granulated or tuberculated dorsal surface of *Cylindroniscus platoi* **n. sp.** can be attributed as an adaptation to cope with the high humidity in the cave environment. This condition is more conspicuous when compared to *C. seurati*, the only species collected outside caves, which shows the dorsal surface smooth.

Despite being an area of high scientific and cultural value, the Karst of Lagoa Santa has been threatened by the expansion of the metropolitan sprawl of Belo Horizonte and its satellite cities, including Pedro Leopoldo. Mining activities and the urbanisation have already caused groundwater pollution, loss of caves and its original vegetation (Auler & Piló 2015). Although environmental impacts in the area are regulated because of the Environmental Protection Area of the Lagoa Santa Karst (IBAMA 1998), the caves are near a mining pit, as can be seen in Fig 1, and possibly suffer the impacts resulting from this activity. To Auler & Piló (2015) the creation of other preservation areas in the vicinity, including the Sumidouro State Park (PESU) (created by the Law Decree n° 20.375 of 1980 from the state of Minas Gerais), are changing this framework towards the effective protection of a significant portion of the karst.

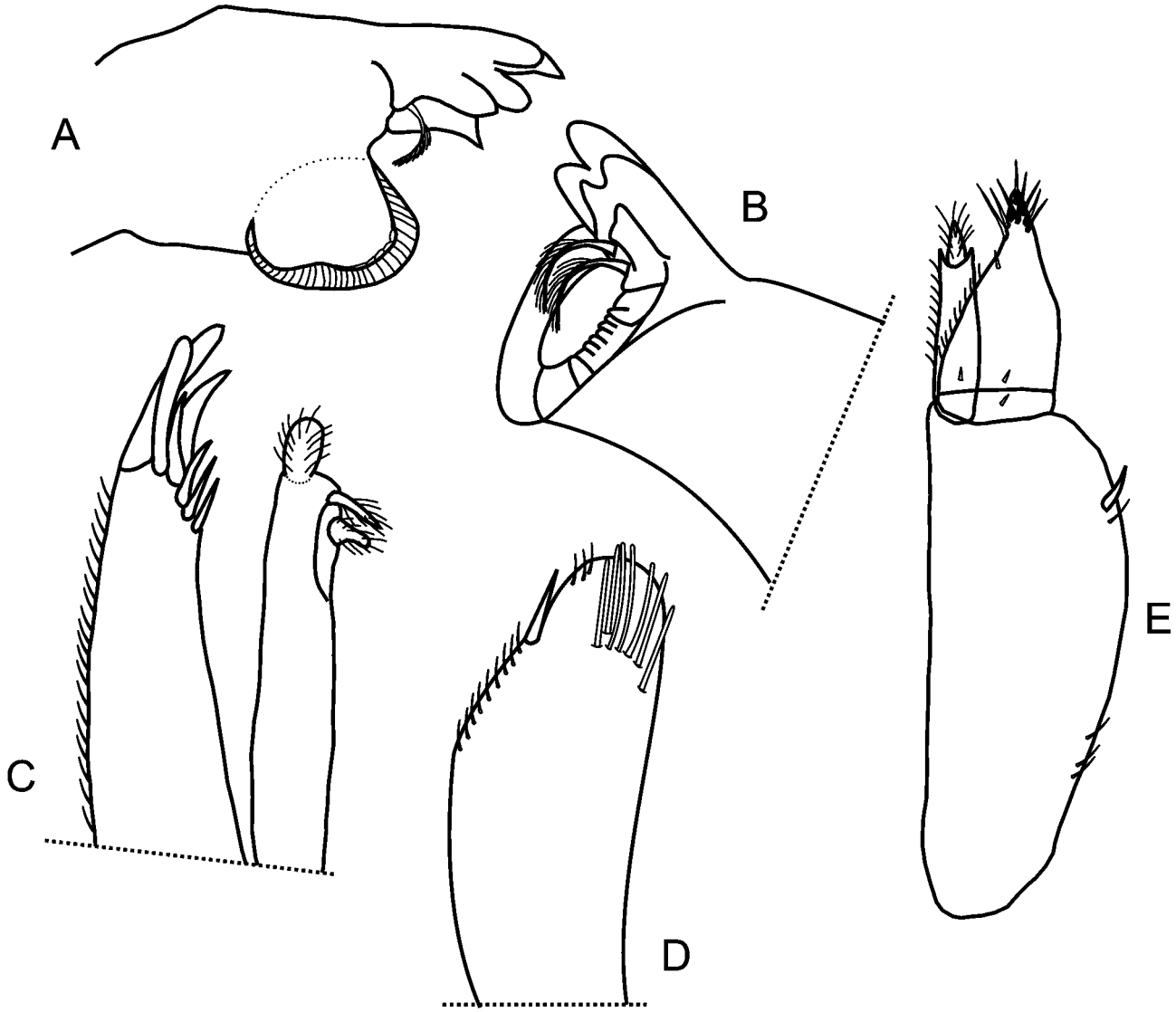

FIGURE 4. *Cylindroniscus platoi* **n. sp.** A. left mandible; B. right mandible; C. maxillula; D. maxilla; E. maxilliped.

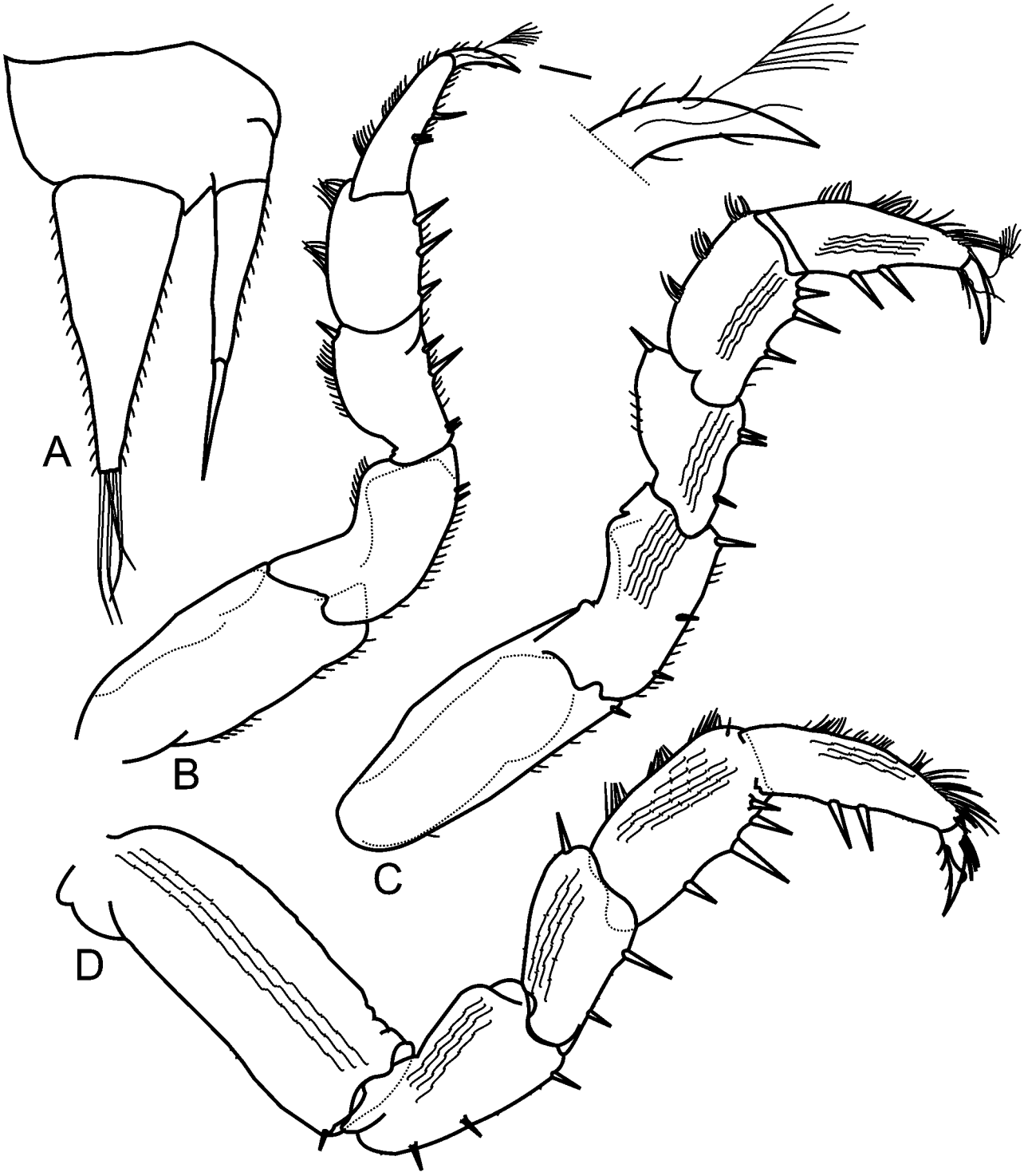

FIGURE 5. *Cylindroniscus platoi* **n. sp.** A. uropod; B. pereopod 1; C. pereopod 6; D. pereopod 7.

Living in this unique region and facing these threats, *Cylindroniscus platoi* **n. sp.** is the first troglobite described for caves of Pedro Leopoldo, emphasizing the importance of the cave fauna of the region.

Etymology. The new species is named after the 'Allegory of the Cave' by the Greek philosopher Plato, in his work Republic (514–520 B.C.). This work reminds us of the importance of the scientific knowledge and its democratization.

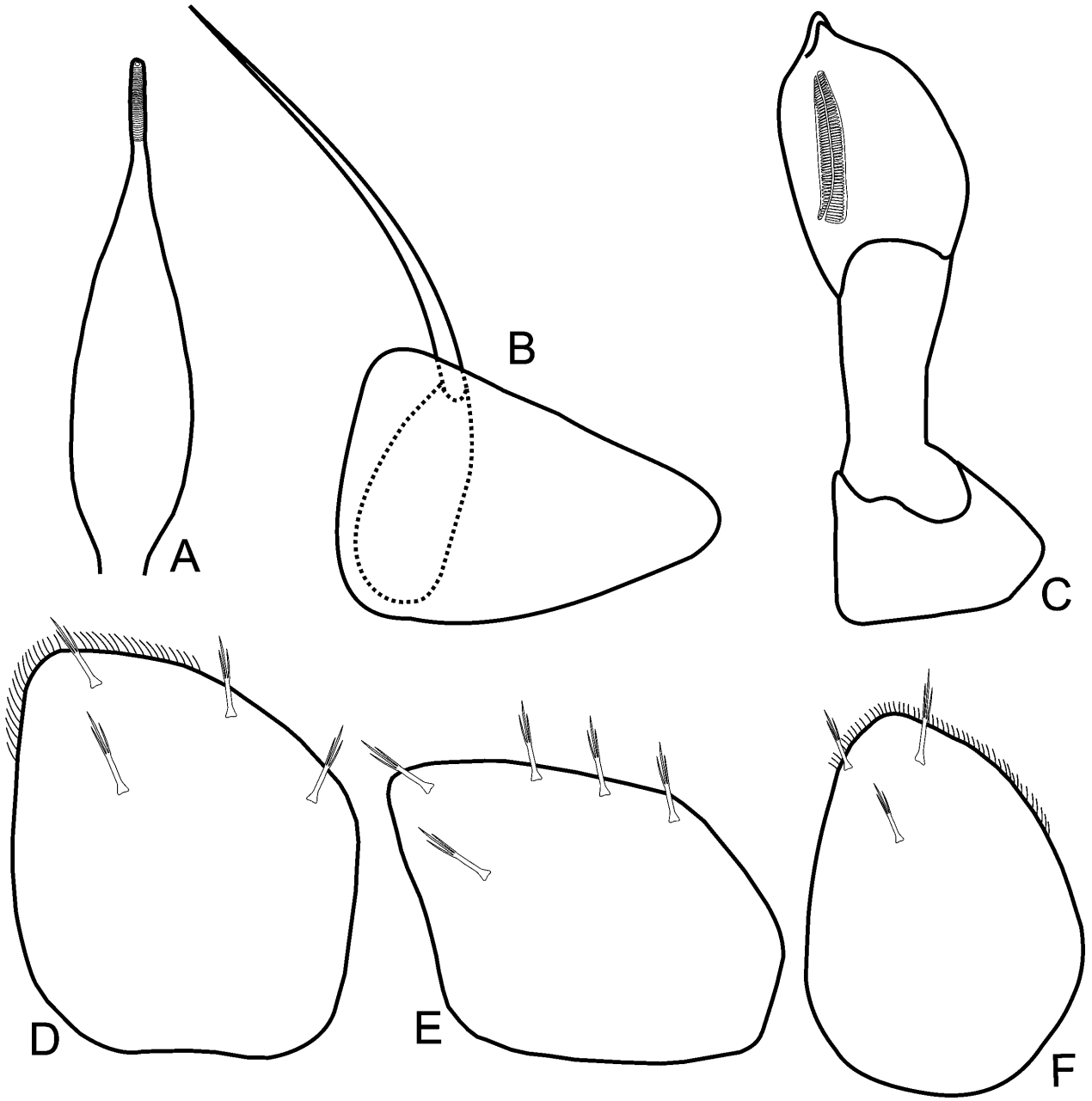

FIGURE 6. *Cylindroniscus platoi* **n. sp.** A. genital papilla; B. pleopod 1; C. pleopod 2 endopod; D. pleopod 3 exopod; E. pleopod 4 exopod; F. pleopod 5 exopod.

Acknowledgements

We are grateful to the Agência de Desenvolvimento Econômico e Social de Itabirito (Adesita) for funding sources granted to the Laboratório de Estudos Subterrâneos UFSCar to describe the troglobites from Minas Gerais (#01-2017); to Spelayon Consultoria for collecting the specimens used herein; to Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, processes 303715/2011-1 and 57413/2014-0) for financial support to ME Bichuette; to CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for the fellowship granted to ISC-F (CAPES/PNPD/UFCG/CTRN/PPGRN 201713705-5); to Dr. O Rocha, Professor of DEBE/UFSCar for permission to use the microscope for illustrations; to Dr. Luciana B. R. Fernandes, DEBE/ UFSCar for taking the photograph; to Dr AMPM Dias, coordinator of the National Institute of Science and Technology of the Hymenoptera Parasitoids from Brazilian Southeast Region (INCT Hympar Sudeste, Fapesp grant 2008/57949-4 and CNPq grant 573802/2008-4), for permission to use the Leica stereomicroscope coupled with digital image software.

References

Ab' Saber, A.N. (1977) Os domínios morfoclimáticos da América do Sul. *Geomorfologia*, 52, 1–21.

Alvares, C.A., Stape, J.L., Sentelhas, P.C., Gonçalves, J.L.M. & Sparovek, G. (2014) Köppen's climate classification map for Brazil. *Meteorologische Zeitschrift*, 22 (6), 711–728. https://doi.org/10.1127/0941-2948/2013/0507

Auler, A.S. & Piló, L.B. (2015) Lagoa Santa Karst: Cradle of Brazilian Cave Studies. *In:* Vieira, B.C., Salgado, A.A.R. & Santos, L.J.C. (Eds.), *Landscapes and Landforms of Brazil, World Geomorphological Landscapes.* Springer, Dordrecht, pp. 183–190. https://doi.org/10.1007/978-94-017-8023-0_16

Barr, T.C. (1968) Cave Ecology and the Evolution of Troglobites. *Evolutionary Biology*, 2, 72–97.

Bastos-Pereira, R., Souza, L.A. & Ferreira, R.L. (2017) A new amphibious troglobitic styloniscid from Brazil (Isopoda, Oniscidea, Synocheta). *Zootaxa*, 4294 (2), 292–300. https://doi.org/10.11646/zootaxa.4294.2.11

Berbert-Born, M. (2002) Carste de Lagoa Santa, MG. Berço da paleontologia e da espeleologia brasileira. *In:* Schobbenhaus, C., Campos, D.A., Queiroz, E.T., Winge, M. & Berbert-Born, M.L.C. (Eds.), *Sítios Geológicos e Paleontológicos do Brasil*. *Vol. I.* DNPM/CPRM—Comissão Brasileira de Sítios Geológicos e Paleobiológicos (SIGEP), Brasília, pp. 415–430.

Borror, D.J. & Delong D.M. (2005). *Introdução ao estudo dos insetos.* EDUSP, Rio de Janeiro, 653 pp.

Campos-Filho, I.S. & Araujo, P.B. (2011) Two new troglobitic species of Scleropactidae (Crustacea: Isopoda: Oniscidea) from Pará, Brazil. *Nauplius*, 19, 27–39. https://doi.org/10.1590/S0104-64972011000100004

Campos-Filho, I.S., Araujo, P.B., Bichuette, M.E., Trajano, E. & Taiti, S. (2014) Terrestrial isopods (Crustacea: Isopoda: Oniscidea) from Brazilian caves. *Zoological Journal of Linnean Society*, 172, 360–425. https://doi.org/10.1111/zoj.12172

Campos-Filho, I.S., Mise, K.M. & Sessegolo, G.C. (2015) A new species of *Trichorhina* Budde-Lund, 1908 (Isopoda: Oniscidea: Platyarthridae) from Paraná caves, southern Brazil. *Nauplius*, 23 (2), 112–119. https://doi.org/10.1590/S0104-64972015002324

Campos-Filho, I.S., Bichuette, M.E. & Taiti, S. (2016) Three new species of terrestrial isopods (Crustacea, Isopoda, Oniscidea) from Brazilian caves. *Nauplius*, 24, e2016001. https://doi.org/10.1590/2358-2936e2016001

Campos-Filho, I.S., Bichuette, M.E., Araujo, P.B. & Taiti, S. (2017a) Description of a new species of *Cylindroniscus* Ancangeli, 1929 (Isopoda: Oniscidea) from Brazil, with considerations on the family placement of the genus. *North-Western Journal of Zoology*, 13 (2), 227–233.

Campos-Filho, IS, Cardoso, G.M. & Aguiar, JO. (in press) Catalogue of terrestrial isopods (Crustacea, Isopoda, Oniscidea) from Brazil: an update with some considerations. Nauplius.

Campos-Filho, I.S., Montesanto, G., Araujo, P.B. & Taiti, S. (2017b) New species and new records of terrestrial isopods (Crustacea, Isopoda, Oniscidea) from Brazil. *Iheringia, Série Zoologia*, 107, e2017034. https://doi.org/10.1590/1678-4766e2017034

Cardoso, G.M., Campos-Filho, I.S. & Araujo, P.B. (2016) The genus Dubioniscus Vandel, 1963 (Oniscidea, Dubioniscidae) with descriptions of two new species from Brazil. *Tropical Zoology*, 29 (3), 111–133. https://doi.org/10.1080/03946975.2016.1179024

Christiansen, K. (1962) Proposition pour la classification des animaux cavernicoles. *Spelunca*, 2, 76–78.

CPRM (2015) Serviço Geológico do Brasil (Geological Survey of Brazil). Available from: http://geobank.sa.cprm.gov.br/ (accessed 5 July 2017)

Erhard, V.F. (1997) Das pleonale Skelet-Muskel-System von *Titanethes albus* (Synocheta) und weitere Taxa der Oniscidea (Isopoda), mit Schlußfolgerungen zur Phylogenie der Landasseln. *Stuttgarter Beiträge zur Naturkunde A*, 550, 1–70.

IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis; Companhia de Pesquisa de Recursos Minerais—CPRM). (1998) *Gestão Ambiental APA Carste de Lagoa Santa.* IBAMA/Fundação Biodiversitas/CPRM, Belo Horizonte, 582 pp.

Langecker, T.G. (2000) The effects of continuous darkness on cave ecology and cavernicolous evolution. *In:* Wilkens, H., Culver, D.C. & Humphreys, W.F. (Eds.), *Ecosystems of the World 30. Subterranean Ecosystems.* Elsevier, Amsterdam, pp. 17–39.

Lima, M.I. & Serejo, C.S. (1993) A new species of *Benthana* Budde-Lund from Brazilian caves (Crustacea; Isopoda; Oniscoidea). *Proceedings of the Biological Society of Washington*, 106, 490–496.

Minas Gerais (1980) Decreto-Lei nº 20.375, de 03 de janeiro de 1980. Cria o Parque Ecológico do Vale do Sumidouro e dá outras providências. Available from: https://acervo.socioambiental.org/sites/default/files/documents/F0D00319_0.pdf (accessed 3 August 2018)

Poulson, T.L. (1963) Cave adaptation in amblyopsid fishes. *American Midland Naturalist*, 70, 257–90. https://doi.org/10.2307/2423056

Taiti, S. (2003) Crustacea: Isopoda: Oniscidea (woodlice), *In:* Gunn, J. (Ed.), *Encyclopedia of Caves and Karst Science*. Taylor

and Francis Group, London, pp. 547–551.
Trajano, E. (2012) Encyclopedia of Caves. Ecological classification of subterranean organisms. *In*: White, W.B. & Culver, D.C. (Eds.), *Encyclopedia of Caves*. Elsevier Academic Press, Amsterdam, pp. 275–277. https://doi.org/10.1016/B978-0-12-383832-2.00035-9
Schmalfuss, H. (1984) Eco-morphological strategies in terrestrial isopods. *Symposia of the Zoological Society of London,* 53, 49–63.
Schmalfuss, H. (2003) World catalog of terrestrial isopods (Isopoda: Oniscidea). *Stuttgarter Beiträge zur Naturkunde*, 654, 1–341.
Sfenthourakis, S. & Taiti, S. (2015) Patterns of taxonomic diversity among terrestrial isopods. *ZooKeys*, 515, 13–25. https://doi.org/10.3897/zookeys.515.9332
Souza-Kury, L.A. (1993) Notes on *Trichorhina* I. Two new species from northeastern Brazil (Isopoda, Oniscidea, Platyarthridae). *Revue Suisse de Zoologie*, 100, 157–210. https://doi.org/10.5962/bhl.part.82507
Souza, L.A., Bezerra, A.V. & Araújo, J.P. (2006) The first troglobitic species of Scleropactidae from Brazil (Crustacea, Isopoda, Oniscidea). *Subterranean Biology*, 4, 37–43.
Souza, L.A., Ferreira, R.L. & Senna, A.R. (2015) Amphibious shelter-builder Oniscidea species from the New World with description of a new subfamily, a new genus and a new species from Brazilian Cave (Isopoda, Synocheta, Styloniscidae). *PloS ONE*, 10 (5), e0115021. https://doi.org/10.1371/journal.pone.0115021