



## A new epigean species of *Trichoniscoides* (Isopoda: Oniscidea: Trichoniscidae) from the northwest of the Iberian Peninsula

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**ZOOBANK:** <https://zoobank.org/urn:lsid:zoobank.org:pub:4B370203-8C57-45EF-AA9A-2B72C5319BDA>

### ABSTRACT

The genus *Trichoniscoides* Sars, 1899 is composed mostly of cave-dwelling species. In the Iberian Peninsula, 32 species, and three additional species of uncertain status (partially described but not named), are currently known to occur. We were able to study one of these unnamed species, clarify its status, and name it. Most of the Iberian species of this genus are troglobiotic (22) and the ten remaining are epigean or troglphilic. The description of the new species from the surface can help in understanding the variability observed in the troglobiotic species. The new, formally described, species has morphological characteristics that fit in several currently proposed groups for the genus, therefore, it is not possible to attribute *Trichoniscoides gallaecus* n. sp. to any of them.

### KEYWORDS

New species, Portugal, Spain, taxonomy, terrestrial isopod

### INTRODUCTION

The genus *Trichoniscoides* Sars, 1899 is part of the family Trichoniscidae Sars, 1899 that is mostly comprised of cave-dwelling species. So far, the genus comprises 52 described species, of which 32 have been recorded in the Iberian Peninsula with 22 being further troglobiotic (Cifuentes et al., 2021; Cifuentes and Prieto, 2022). The genus has a known Atlantic

Editor-in-chief  
Christopher Tudge

Associate Editor:  
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Submitted 24 October 2022  
Accepted 18 January 2023  
Published 17 July 2023

DOI 10.1590/2358-2936e2023016



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distribution, being mostly present in Western Europe, with very few species reported from outside this area. Only *Trichoniscoides sarsi* Patience, 1908 was found in greenhouses in Finland and introduced into North America (Schmallfus, 2003). The genus was recently revised in the Iberian Peninsula and an identification key is available (Cifuentes, 2019a), although a few more species have been described since then (e.g., Cifuentes and Prieto, 2021; 2022). Nevertheless, more species remain undescribed in the region. For example, there are three potential species based on morphology with an uncertain status, since they were not formally described nor named, but simply mentioned as *Trichoniscoides* species A, B, and C (Gregory et al., 2012). More work is needed to better know the diversity of this genus and have a better understanding of its radiation and evolution.

A survey carried out on Portuguese isopods allowed collection of several specimens that match the short description made by Gregory et al. (2012) of *Trichoniscoides* species A. Considering that there has been a decade since this publication, the description of these authors is not exhaustive and does not provide important information on this species morphology, and that it was not formally described, we believe it is convenient to name it, provide a more detailed description, and discuss the morphological characters that allow it to be associated with, but also differentiated from, the rest of the species in the genus.

## MATERIAL AND METHODS

Oniscidea specimens were captured in the northwest of Portugal, in the west of the Minho region (Fig. 1), by direct search underneath rocks, litter, dead wood, and tree bark. The region is composed of a heterogenous landscape with forest, agricultural, and urban areas. Forest areas are dominated by *Eucalyptus globulus* plantations, but there are other tree species plantations, namely that of *Pinus pinaster*. Some areas, mostly along watercourses or the edge of fields and plantations, have native tree cover usually dominated by *Quercus robur* or with invasive species such as *Acacia melanoxylon*, *Acacia dealbata* and *Acacia longifolia*. Agricultural areas are diverse, mainly with subsistence

farming or corn plantations. Urbanized areas range from small rural villages with a large proportion of agricultural and forest areas, to cities with a few tens of thousands of inhabitants. The region is mainly composed of metamorphic and granitic rocks from the Palaeozoic (Direção Geral de Minas e Serviços Geológicos, 1952). The region has annual mean temperatures between 11 and 13 °C and between 2,200 and 2,500 mm of precipitation, being one of the rainiest regions in Portugal (IPMA, 2019).

The holotype and one paratype are deposited in the Museo Nacional de Ciencias Naturales de Madrid (MNCN), 4 paratypes are in the invertebrate collection of InBIO Barcoding Initiative (IBI, reference start with INV), from Centro de Investigação em Biodiversidade e Recursos Genéticos (CIBIO), Campus de Vairão, University of Oporto, and the remaining two are in the collection of the first author (JC).

Distribution map (Fig. 1) was created using QGIS Desktop 3.22.2, using the coordinates obtained in the field during the capture of the analyzed Portuguese specimens and the coordinates of the bibliographic locations available in Gregory et al. (2012). To facilitate species identification, a figure of the studied species was included (Fig. 2). The drawings (Fig. 3) were prepared with the graphic editor Inkscape (<https://inkscape.org/es/>).

## SYSTEMATICS

### Family Trichoniscidae Sars, 1899

#### Genus *Trichoniscoides* Sars, 1899

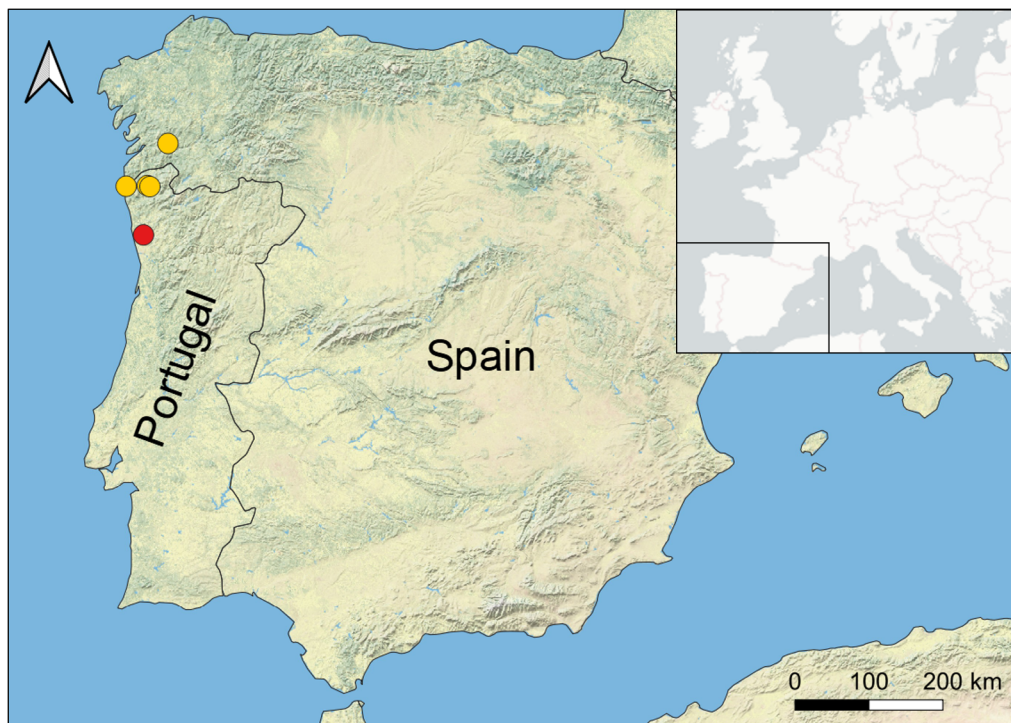
##### *Trichoniscoides gallaecus* n. sp.

(Figs. 2, 3; Gregory et al., 2012: 12, fig. 2)

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*Type material.* Holotype: male (MNCN 20.04/20602), 27 May 2022, Fradelos, Braga, Portugal, (41°21'16"N 8°36'22"W), coll. L.P. da Silva. Paratypes: 2 females (INV18000, INV18001), 27 March 2022, same data as holotype; 1 male (JC667), same data as holotype; 4 females (INV18002, INV18003, JC668, MNCN 20.04/20568), same data as holotype.



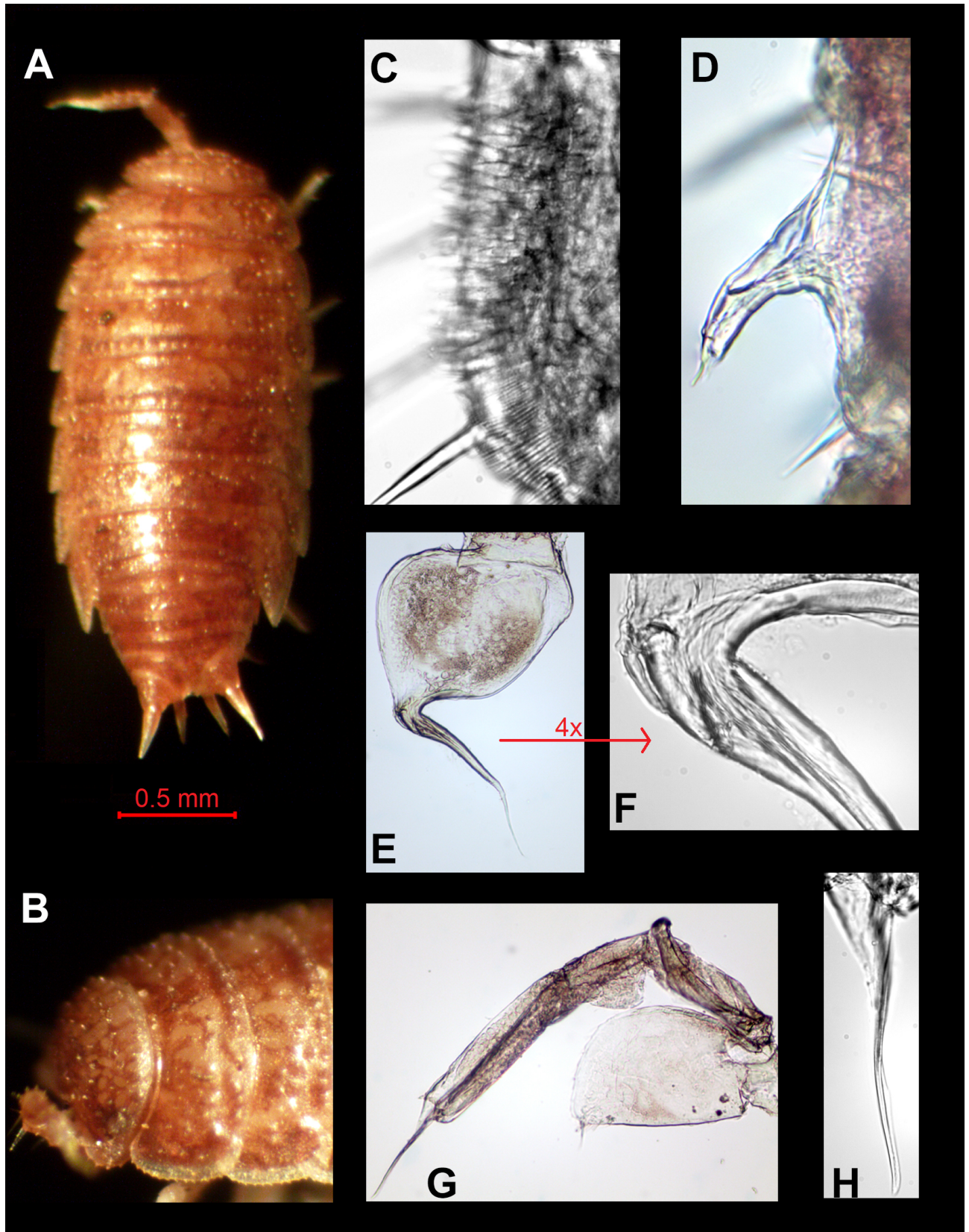
**Figure 1.** Location of the Iberian Peninsula (Spain and Portugal) in western Europe and distribution of *Trichonisoides gallaecus* n. sp. (bibliographical references in yellow circles; current material studied in red circles).

**Diagnosis.** Dark red coloration. Eye apparatus composed of single large ocellus. Integument with granulations. Antennae with scaly tubercles and 3 flagellar segments. Male pereopods 1 and 7 with sexual dimorphism. Male pleopods: endopod I with large triangular distal lobe; exopod I trapezoidal, with 2 very different hairy protuberances; endopod II very wide, narrowing sharply near tip; exopod II trapezoidal, lacking inner tip.

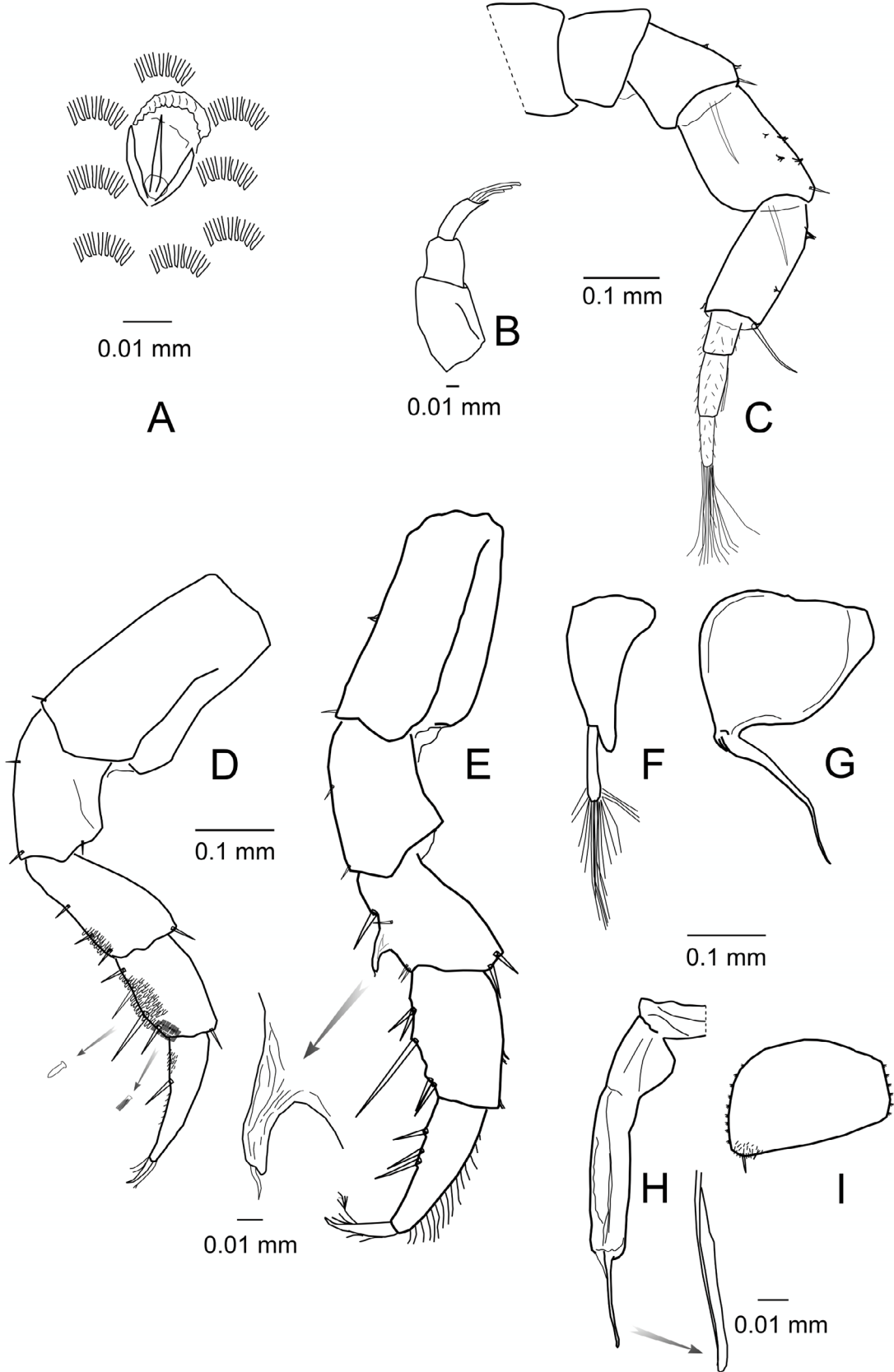
**Description.** Maximum observed length: female 2.5 mm, male 2.1 mm. Coloration intense dark red (Fig. 2A, B), stable in ethanol for at least 6 months, interrupted by light color from muscle attachments. Tegument covered by granulations (Fig. 2A, B) with large triangular scale-setae with crenated edge surrounded by accessory scales (Fig. 3A). Cephalon with 5 granulation rows, including 1 row on posterior edge. Pereon with 3 rows on first pereonite and 2 rows on remaining pereonites, plus another row on posterior edge of each tergite. These granulations fading towards posterior region. Pleon with row of small granulations on posterior edge of all pleonites. Eye apparatus formed by large ocellus (Fig. 2B) in black pigmented spot. Antennules with 3 segments,

last one with group of 3 long aesthetascs (Fig. 3B). Antennae short, and not reaching posterior edge of 2<sup>nd</sup> pereon tergite and presenting hairy tubercles (Fig. 3C). Antennal flagellum composed of 3 segments, first the shortest, second with group of long aesthetascs inserted in middle and extending behind insertion of 3<sup>rd</sup> segment. Pereopod 1 of both sexes bearing fan-shaped group of setae in carpus tip (Fig. 3D).

Male sexual characters: Pereopod 1 merus and carpus with hyaline scales (Figs. 2C, 3D), but in merus only present in distal half. Pereopod 7 merus with strong curved hook (Figs. 2D, 3E) inserted in middle and with small seta at hook tip. Pleopod I: endopod triangular, with large distal lobe (Fig. 3F); exopod trapezoidal, with 2 hairy protuberances of very different sizes, internal one very small, external one very long and thick, getting progressively thinner until ending in sharp tip (Figs. 2E, F, 3G). Pleopod II: endopod surrounded by hyaline membrane (Figs. 2G, 3H), with distal segment 3 times longer than basal segment, sharply narrowing at two-thirds of its length, ending in fine but flattened tip (Figs. 2H, 3H); exopod trapezoidal, lacking distal tip and bearing small hairy protuberance surrounded by many fan-shaped setae; these setae also on inner and outer edges (Figs. 2G, 3I).



**Figure 2.** *Trichoniscoides gallaecus* n. sp. **A**, Habitus; **B**, cephalon and anterior pereonites, lateral view; **C**, male pereopod 1, carpus hyaline scales; **D**, male pereopod 7, merus curved hook; **E**, male pleopod I exopod; **F**, male pleopod I exopod, protuberances; **G**, male pleopod II endopod and exopod; **H**, male pleopod II endopod, tip.



**Figure 3.** *Trichonisoides gallaecus* n. sp. **A**, Tegument granules and scale-setae; **B**, antennule; **C**, antenna; **D**, male pereopod 1; **E**, male pereopod 7; **F**, male pleopod I endopod; **G**, male pleopod I exopod; **H**, male pleopod II endopod; **I**, male pleopod II exopod.

**Etymology.** The specific epithet is a reference to *gallaecus*, a Latin word used by the Romans to identify the indigenous peoples who lived north of the Douro River in Portugal and a large part of Galicia (Spain).

**Ecology.** Epigeal species found below (or within) deep moist litter (usually > 10cm), mostly composed of dead leaves of *Q. robur*. It was found together with *Porcellio herminiensis* Vandel, 1946a, *Porcellio debueni* Dollfus, 1892, and *Trichoniscus pusillus* s.l. Brandt, 1833. Gregory et al. (2012) mentioned that it can also be found beneath dead wood and stones among leaf-litter.

**Distribution.** The species is so far known from the northwest of Portugal, in the Minho region, and in the southwest of Galicia, Spain (Fig. 1).

**Remarks.** Gregory et al. (2012) found females of 3 mm length and males of 2.25 mm. They also mentioned that all pigmentation is rapidly lost after preservation in alcohol.

## DISCUSSION

Vandel (1952; 1960) classified the species in the genus *Trichoniscoides* into four groups based on the structure of the endopod of the male pleopod II. These groups are an Atlantic group, with a long and fine tip; a Pyrenean group, with a short, thin, sharp, and recurved tip; an Aquitanian-Languedocian group, with a very short, broad, and recurved tip; and an Alpine group, with the tip straight or recurved, but less long than in the Atlantic group. In the Alpine group, Vandel (1952; 1960) included five species: *Trichoniscoides helveticus* (Carl, 1908) known from Germany, Belgium, France, the Netherlands, and the Czech Republic (Schmalfuss, 2003); *Trichoniscoides heroldi* Vandel, 1952, and *Trichoniscoides mixtus* Racovitza, 1908, that are only known from France (Schmalfuss, 2003); *Trichoniscoides pulchellus* Legrand, 1950 cited from France and Switzerland (Schmalfuss, 2003) and *Trichoniscoides remyi* Bonnefoy, 1945 also only known from France (Schmalfuss, 2003). Among these species the endopod differs in structure. In *T. mixtus* and *T. pulchellus*, the endopod tip has a wide hyaline membrane; in *T. helveticus*, the endopod tip

is complex, with two appendages; and in *T. heroldi* and *T. remyi*, the endopod tip is short and flattened, similar to that present in *T. gallaecus* n. sp. Considering this character alone, the new species should belong to the Alpine group, despite its known distribution being very different from any of the previous species.

In this genus there is an important derived character, sexual dimorphism in the pereopods, that can be in the first pair, the first two or three pairs, or in the seventh pair, but it is possible to find different combinations of these, in different species. For example, in *Trichoniscoides cantabricus* Cifuentes and Prieto, 2021, the dimorphism is only present in the anterior pereopods; in *Trichoniscoides picturarum* Vandel, 1952, it is only in the seventh pair; and, finally, in some species the dimorphism occurs in both the anterior pereopod pairs and the seventh pair, as in *T. gallaecus* n. sp., that has sexual dimorphism in the first and seventh pairs. In the anterior pairs, the dimorphism is characterized by the presence or absence of hyaline scales on the inner side of the merus and carpus. The differences in the seventh pair are more variable and can be found in species belonging to different groups, as for example in the Atlantic group, *Trichoniscoides broteroi* Vandel, 1946a, *Trichoniscoides irregularis* Schmölzer, 1955, and *Trichoniscoides subterraneus* Vandel, 1946a; in the Pyrenean group, *Trichoniscoides calcaris* Cruz and Dalens, 1989, *Trichoniscoides picturarum* and *Trichoniscoides vandeli* Dalens, 1966; in the Aquitanian-Languedocian group, *Trichoniscoides bonneti* Vandel, 1946b, *Trichoniscoides cadurcensis* Vandel, 1934, *Trichoniscoides consoranensis* Vandel, 1952, *Trichoniscoides drescoi* Vandel, 1954 and *Trichoniscoides sarsi* or even *Trichoniscoides sicoensis* Reboleira and Taiti, 2015 which is not clear to which of the groups established by Vandel (1952; 1960) it belongs, as indicated by Reboleira and Taiti (2015). Nevertheless, none of the species that Vandel (1952; 1960) included in the Alpine group has sexual dimorphism in the seventh pair of pereopods. A hook with a short seta on the merus is one of the different forms of dimorphism indicated by Vandel (1952; 1960) important to define the Aquitanian-Languedocian group. This character is present in the five species previously mentioned as belonging to this group, but is also present in *T. gallaecus* n. sp. The structure of this hook in *T. gallaecus* n. sp. allows it to resemble

more closely *T. broteroi*, *T. cadurcensis*, *T. consoranensis*, *T. sarsi*, and *T. sicoensis*. In *T. consoranensis* and *T. sarsi*, the hook is located at the merus base and the endopod II does not end in a narrow, flattened tip as in *T. gallaecus* n. sp. *Trichoniscoides cadurcensis* has the male exopod of the pleopod II very similar to that of *T. gallaecus* n. sp., but in *T. cadurcensis*, in pereopod 7, the position of the hook is at the base of the merus and the tip of the pleopod II is different from *T. gallaecus* n. sp. *Trichoniscoides broteroi* and *T. sicoensis* also have the hook in the middle of the merus?, but in *T. broteroi* the male exopod I has small, equally hairy, protuberances, which are subequal in *T. sicoensis*. The male endopod II of both species is very different from *T. gallaecus* n. sp., where in the exopod I the outer protuberance is hypertrophied, the inner protuberance is very small, and the endopod II tip is narrow and flattened. Summarizing, the structure of the endopod of the male pleopod II would place the newly described species in the Alpine group of Vandel (1952; 1960), a group that for this author is very close to the Atlantic group, with which the new species shares its distribution, being known from Portugal and Spain (Fig. 1), but from which it is separated by the sexual dimorphism of the male pereopod 7. It also has some characteristics similar to the species in the Aquitanian-Languedocian group, but it cannot be included in this group if we stick to the original divisions of Vandel (1952; 1960). It would be useful to make new criteria for the division of the groups of this genus, especially after having more knowledge of other European species, outside the Iberian Peninsula, allowing more effective grouping of all *Trichoniscoides* species, which currently cannot be confidently placed in any of the groups referred to above.

As already mentioned, the genus *Trichoniscoides* is composed mostly of cave-dwelling species, which have accessed the underground from the surface, likely through a secondary colonization in the face of unfavorable environmental conditions. In the Iberian Peninsula there are 32 valid species of the 52 known species of the genus (Cifuentes et al., 2021; Cifuentes and Prieto, 2022). Of these 32 species, 22 are troglobiotic, indicating the importance of the subterranean environment as a shelter and area for species diversification. Two of the 10 remaining Iberian species are troglaphiles, *Trichoniscoides jeanneli*

Vandel, 1952 known from the Spanish provinces of Huesca and Navarra (Vandel, 1952; 1960; Schmölzer, 1971; Cifuentes, 2019a; Cifuentes et al., 2021) and *Trichoniscoides machadoi* Vandel, 1946a, known from the Portuguese districts of Aveiro, Braga, Coimbra, Faro, Leiria, and Lisbon (Vandel, 1946a; Reboleira et al., 2015). Finally, the eight remaining species are epigeic: *Trichoniscoides ancaresi* Schmölzer, 1955, known in Spain from Asturias, Cantabria, Lugo, and Pontevedra (Schmölzer, 1955; 1971; Cifuentes, 2019b); the Asturian species *Trichoniscoides asturiensis* Dalens, 1972 and *Trichoniscoides cassagnani* Dalens, 1972 cited by Dalens (1972), *Trichoniscoides enoli* Cifuentes, 2019 by Cifuentes (2019a) and *Trichoniscoides irregularis* by Schmölzer (1955) and Cifuentes (2019a). *Trichoniscoides lusitanus* Vandel, 1946a is the only epigeic species with a large known distribution, since it has been cited from the Portuguese districts of Braga, Porto, and Viana do Castelo (Vandel, 1946a; Gregory et al., 2012) and from the Spanish provinces of A Coruña, Cantabria, Orense, and Pontevedra (Schmölzer, 1955; 1971; Gregory et al., 2012; Cifuentes, 2019a; 2019b). *Trichoniscoides pitarquensis* Cruz, 1993 is only known from the Spanish province of Teruel (Cruz, 1993) and *Trichoniscoides saeroeensis* Lohmander, 1924 is only known from the Iberian Peninsula, in the province of Cantabria (Erhard, 1997; Cifuentes et al., 2021). Summing up, the epigeic species, with the exception of *T. pitarquensis*, are located, to the best of our current knowledge, in a narrow fringe with a climatic Atlantic influence in the north of the Iberian Peninsula, between Porto (Portugal) and Cantabria (Spain), just like *T. gallaecus* n. sp. The troglaphile species have a larger known distribution, reaching the south of Portugal in the Faro district in the case of *T. machadoi*, but in this district it is only known to occur in caves (Vandel, 1946a; Reboleira et al., 2015), and reaching the Pyrenean region, in the case of *T. jeanneli*, in the Spanish provinces of Huesca and Navara. It is important to note that there is no interruption between the Cantabrian and the Pyrenees Mountains, that are in contact in Navarra. The troglaphile species of *Trichoniscoides* from the Iberian Peninsula are not only more diverse, but some species are found far from the previously mentioned areas, as for example *Trichoniscoides arlanza* Cifuentes and Prieto, 2022 in Cueva Negra (Hortigüela, Burgos); *Trichoniscoides galiana* Cifuentes and Prieto, 2022 in the

Cueva de La Galiana Alta (Ucero, Soria); *Trichoniscoides jonfernandezi* Cifuentes and Prieto, 2022 in the Cueva de la Mora (Arcos de Jalón, Soria) (see Cifuentes and Prieto, 2022); and *Trichoniscoides marinae* Cifuentes, 2019 in Cueva del Chorrillo (Tamajón, Guadalajara) according to Cifuentes (2019a). These suggest an early colonization of these areas by endogean species, whose distribution likely retracted in the past and is now considerably smaller. The discovery and description of new species inhabiting the surface can help to understand the variability and diversity observed in troglobiont species.

## ACKNOWLEDGMENTS

We would also like to thank Dra. Begoña Sánchez from the National Museum of Natural Sciences of Madrid, for her kindness in facilitating the access to the specimens deposited in the collections; and Dra. Vanessa Mata and two anonymous reviewers for reviewing the manuscript.

## REFERENCES

- Bonnefoy F 1945. Note sur quelques Trichoniscidae (Isopodes terrestres) des Alpes françaises. *Bulletin Societe Zoologique de France*, 70: 3–7.
- Brandt I 1833. Conspectus Monographiae Crustaceorum Oniscodorum Latreillii. *Byulleten moskovskogo Obshchestva Ispytatelei Prirody*, 6: 171–193.
- Carl J 1908. Monographie der Schweizerischen Isopoden. *Denkschriften Schweizerischen Naturforschenden Gesellschaft*, 42: 107–242.
- Cifuentes J 2019a. Contribution à la connaissance des *Trichoniscoides* Sars, 1899 ibériques, avec la description de deux nouvelles espèces: *Trichoniscoides marinae* n. sp. et *Tr. enoli* n. sp (Crustacea, Isopoda, Trichoniscidae). *Boletín Asociación española de Entomología*, 43(1–2): 27–54. <http://www.entomologica.es/publicaciones-boletin/art1773>
- Cifuentes J 2019b. Los isópodos terrestres de Galicia, España (Crustacea: Isopoda, Oniscidea). *Graellsia*, 75(2): e098. <https://doi.org/10.3989/graellsia.2019.v75.243>.
- Cifuentes J and Prieto CE 2021. Descripción de dos nuevas especies cavernícolas de Trichoniscinae Verhoeff, 1908 de la Cordillera Cantábrica (Crustacea: Isopoda: Trichoniscidae). *Graellsia*, 77(1): e124. <https://doi.org/10.3989/graellsia.2021.v77.275>
- Cifuentes J and Prieto CE 2022. Revisitando las antiguas localidades del Sistema Ibérico de *Trichoniscoides cavernicola* (Budde-Lund, 1885) (Crustacea: Isopoda: Trichoniscidae), con la descripción de tres especies nuevas (España). *Boletín de la Sociedad Entomológica Aragonesa*, 70: 335–343.
- Cifuentes J; Beruete E and Prieto CE 2021. Isópodos oniscídeos en cuevas de la región Vasco-Cantábrica, España (Crustacea: Isopoda). *Boletín de la Sociedad Entomológica Aragonesa*, 68: 270–288.
- Cruz A 1993. Especies nuevas o poco conocidas de isópodos terrestres de la Península Ibérica. III. *Trichoniscoides pitarquensis* sp. n. y *T. serrai* sp. n. (Crustacea, Oniscidea, Trichoniscidae). *Bulletin de la Société d'Histoire naturelle de Toulouse*, 127: 15–21.
- Cruz A and Dalens H 1989. Especies nuevas o poco conocidas de isópodos terrestres de la Península Iberica. I. Isópodos cavernícolas de la España oriental (Crustacea; Oniscidea). *Bulletin de la Societe d'Histoire Naturelle de Toulouse*, 125: 91–98. <https://gallica.bnf.fr/ark:/12148/bpt6k6556448v/f93.image.r=Oniscidea>
- Dalens H 1966. Une nouvelle espece endogene de *Trichoniscoides*, *T. vandeli* n. sp. provenant des Asturies: *T. cassagnai* n. sp. et *T. asturiensis* n. sp. (crustaces, isopodes terrestres). *Annales de Speleologie*, 21: 651–653.
- Dalens H 1972. Deux nouvelles espèces de *Trichoniscoides* provenant des Asturies: *T. cassagnani* n. sp. et *T. asturiensis* n. sp. (crustacés; isopodes terrestres). *Bulletin de la Société d'Histoire naturelle de Toulouse*, 108: 426–432. <https://gallica.bnf.fr/ark:/12148/bpt6k6556269b/f94.image.r=Dalens>
- Direcção Geral de Minas e Serviços Geológicos 1952. Carta geológica de Portugal. Direcção Geral de Minas e Serviços Geológicos, Serviços Geológicos, Portugal.
- Dollfus A 1892. Catalogue raisonné des isopodes terrestres de l'Espagne (espèces signalées jusqu'à ce jour et description d'espèces nouvelles). *Anales de la Sociedad Española de Historia Natural*, 21: 161–190. <https://www.biodiversitylibrary.org/item/235119 - page/175/mode/1up>
- Erhard F 1997. Das pleonale Skelet-Muskel-System von *Titanethes albus* (Synocheta) und weiterer Taxa der Oniscidea (Isopoda), mit Schlußfolgerungen zur Phylogenie der Landasseln. *Stuttgarter Beiträge zur Naturkunde, Serie A (Biologie)*, 550: 1–70. [https://www.zobodat.at/pdf/Stuttgarter-Beitraege-Naturkunde\\_550\\_A\\_0001-0070.pdf](https://www.zobodat.at/pdf/Stuttgarter-Beitraege-Naturkunde_550_A_0001-0070.pdf)
- Gregory S; Lee P; Read HJ and Richards P 2012. Woodlice (Isopoda: Oniscidea) collected from northwest Spain and northern Portugal in 2004 by the British myriapod and isopod group. *Bulletin of the British Myriapod & Isopod Group*, 26: 6–23. [https://www.bmig.org.uk/sites/www.bmig.org.uk/files/bulletin/BullBMIG26\(2012\)p6-23\\_Gregory-et-al\\_NWSpain.pdf](https://www.bmig.org.uk/sites/www.bmig.org.uk/files/bulletin/BullBMIG26(2012)p6-23_Gregory-et-al_NWSpain.pdf)
- IPMA (Instituto Português do Mar e da Atmosfera) 2019. Portal do Clima. Instituto Português do Mar e da Atmosfera. Available at [portaldoclima.pt](http://portaldoclima.pt). Accessed on 28 June 2022.
- Legrand J 1950. Les isopodes terrestres des Alpes de Savoie. *Bulletin de la Société zoologique de France*, 75: 45–62.
- Lohmander H 1924. *Trichoniscoides saeroensis* n. sp. *Entomologisk Tidskrift*, 45: 80–82.
- Patience, A. 1908. On *Trichoniscoides albidus* (Budde-Lund) and *T. sarsi*, Patience (nom. nov.). *Annals and Magazine of Natural History* (Ser. 8), 2: 84–88. <https://doi.org/10.1080/00222930808692454>
- Racovitza E-G 1908. Isopodes terrestres (Second Serie). Biospéologica. IX. Isopodes terrestres (2 serie). *Archives de Zoologie Experimentale et Generale (IV<sup>e</sup> Série)*, 9: 239–415. <https://www.biodiversitylibrary.org/item/28438 - page/338/mode/1up>



- Reboleira AS; Gonçalves F; Oromí P and Taiti S 2015. The cavernicolous Oniscidea (Crustacea: Isopoda) of Portugal. *European Journal of Taxonomy*, 161: 1–61. <https://doi.org/10.5852/ejt.2015.161>
- Sars GO 1899. An account of the Crustacea of Norway, with short descriptions and figures of all the species. Vol. II. Isopoda. Bergen, Bergen Museum, 270p. <https://www.biodiversitylibrary.org/item/100338> - page/9/mode/1up
- Schmalzfuss H 2003. World catalog of terrestrial isopods (Isopoda: Oniscidea). *Stuttgarter Beiträge zur Naturkunde, Serie A*, 654: 1–341. <https://www.biodiversitylibrary.org/page/60882444>
- Schmölzer K 1955. Isopoda terrarum mediterraneorum. 1. Mitteilung: Über neue und bekannte Landasseln der Pyrenäenhalbinsel. *Eos* (Madrid), 31: 155–215. [https://digital.csic.es/bitstream/10261/154616/1/1955-31-1\\_2-006.pdf](https://digital.csic.es/bitstream/10261/154616/1/1955-31-1_2-006.pdf)
- Schmölzer K 1971. Die Landisopoden der Iberischen Halbinsel. Madrid, Consejo Superior de Investigaciones Científicas, 161p.
- Vandel A 1934. Description d'une nouvelle espèce d'Isopode terrestre, *Trichoniscoides cadurcensis*, n. sp., suivie de remarques sur la distribution géographique des espèces du genre *Trichoniscoides*. *Bulletin de la Société d'Histoire Naturelle de Toulouse*, 70: 193–196. <https://gallica.bnf.fr/ark:/12148/bpt6k6555582x/f201.item>
- Vandel A 1946a. Crustacés isopodes terrestres (Oniscoidea) épigés et cavernicoles du Portugal. *Anais da Faculdade de Ciências do Porto*, 30: 135–427. <https://www.fc.up.pt/fa/index.php?p=nav&f=books.0066.0>
- Vandel A 1946b. Espèces françaises, nouvelles ou peu connues, de Trichoniscidae (Isopodes terrestres). *Bulletin de la Société Zoologique de France*, 71: 53–72.
- Vandel A 1952. Biospéologica LXXIII. Isopodes terrestres (troisième série). *Archives de Zoologie expérimentale et générale*, 88: 2313–2362.
- Vandel A 1954. Une nouvelle espèce cavernicole de *Trichoniscoides*, *T. drescoi* n. sp., provenant des Asturies (crustacés; isopodes terrestres). *Notes biospéologiques*, 9: 67–69.
- Vandel A 1960. Faune de France, vol. 64. Isopodes terrestres (première partie). Paris, Lechevalier, 416p. [https://faunedefrance.org/bibliotheque/docs/VANDEL\(FdeFr64\)IsopodeTerrestre.pdf](https://faunedefrance.org/bibliotheque/docs/VANDEL(FdeFr64)IsopodeTerrestre.pdf)

## ADDITIONAL INFORMATION AND DECLARATIONS

### Author Contributions

Conceptualization and Design: JC. Performed research: JC, LPS. Acquisition of data: JC, LPS. Analysis and interpretation of data: JC. Preparation of figures/tables/maps: JC, LPS. Writing – original draft: JC, LPS. Writing – critical review and editing: JC, LPS.

### Consent for publication

Both authors declare that they have reviewed the content of the manuscript and gave their consent to submit the document.

### Competing interests

The authors declare no competing interest.

### Data availability

All study data are included in the article.

### Funding and grant disclosures

LPS benefits from an individual research contract (CEECIND/02064/2017) funded through Fundação para a Ciência e a Tecnologia (FCT/MEC). This work was co-funded by the project NORTE-01-0246-FED-ER-000063, supported by Norte Portugal Regional Operational Programme (NORTE2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF).

### Study association

Not applicable.

### Study permits

Not applicable.