zoosystema

2018 • 40 • 11

New species of subterranean and endogean terrestrial isopods (Crustacea, Oniscidea) from Tuscany (central Italy)

Stefano TAITI &
Giuseppe MONTESANTO

art. 40 (11) — Published on 5 June 2018
www.zoosystema.com

MUSÉUM
NATIONAL D'HISTOIRE NATURELLE
PUBLICATIONS
SCIENTIFIQUES

Couverture / *Cover* :

Typhlarmadillidium occidentale n. sp., ♀ paratype from Grotta del Cane di Uliveto, Monte Pisano.

Zoosystema est indexé dans / Zoosystema *is indexed in:*
– Science Citation Index Expanded (SciSearch®)
– ISI Alerting Services®
– Current Contents® / Agriculture, Biology, and Environmental Sciences®
– Scopus®

Zoosystema est distribué en version électronique par / Zoosystema *is distributed electronically by:*
– BioOne® (http://www.bioone.org)

Les articles ainsi que les nouveautés nomenclaturales publiés dans *Zoosystema* sont référencés par / *Articles and nomenclatural novelties published in* Zoosystema *are referenced by:*
– ZooBank® (http://zoobank.org)

Zoosystema est une revue en flux continu publiée par les Publications scientifiques du Muséum, Paris / **Zoosystema** *is a fast track journal published by the Museum Science Press, Paris*

Les Publications scientifiques du Muséum publient aussi / *The Museum Science Press also publish:*
Adansonia, ***Anthropozoologica***, ***European Journal of Taxonomy***, ***Geodiversitas***, ***Naturae***.

Diffusion – Publications scientifiques Muséum national d'Histoire naturelle
CP 41 – 57 rue Cuvier F-75231 Paris cedex 05 (France)
Tél. : 33 (0)1 40 79 48 05 / Fax : 33 (0)1 40 79 38 40
diff.pub@mnhn.fr / http://sciencepress.mnhn.fr

ISSN (imprimé / *print*) : 1280-9551/ ISSN (électronique / *electronic*) : 1638-9387

New species of subterranean and endogean terrestrial isopods (Crustacea, Oniscidea) from Tuscany (central Italy)

Stefano TAITI
Istituto per lo Studio degli Ecosistemi, Consiglio Nazionale delle Ricerche,
Via Madonna del Piano 10, 50019 Sesto Fiorentino, Florence (Italy)
Museo di Storia Naturale, Sezione di Zoologia "La Specola",
Via Romana 17, 50125 Florence (Italy)
stefano.taiti@ise.cnr.it

Giuseppe MONTESANTO
Dipartimento di Biologia, Università di Pisa,
Via A. Volta 4bis, 56126 Pisa (Italy)
giuseppe.montesanto@unipi.it

Submitted on 16 February 2018 | Accepted on 18 April 2018 | Published on 5 June 2018

urn:lsid:zoobank.org:pub:E8AFD7E7-4FDD-408E-BB77-75E61F2BF22F

Taiti S. & Montesanto G. 2018. — New species of subterranean and endogean terrestrial isopods (Crustacea, Oniscidea) from Tuscany (central Italy). *Zoosystema* 40 (11): 197-226. https://doi.org/10.5252/zoosystema2018v40a11. http://zoosystema.com/40/11

KEY WORDS
Isopoda,
Trichoniscidae,
Armadillidiidae,
Tuscany,
Italy,
new species.

ABSTRACT
Seven new species of subterranean and endogean terrestrial isopods from Tuscany (central Italy) are described in the families Trichoniscidae Sars, 1899 (*Leucocyphoniscus pisanus* n. sp., *Moserius gruberae* n. sp., *Moserius talamonensis* n. sp.) and Armadillidiidae Brandt, 1833 (*Typhlarmadillidium occidentale* n. sp., *Paraschizidium ferrarai* n. sp., *Trogleluma pilosa* n. sp. and *Alloschizidium labronicum* n. sp.). The diagnostic characters and the affinities of the new species are discussed.

MOTS CLÉS
Isopoda,
Trichoniscidae,
Armadillidiidae,
Toscane,
Italie,
espèces nouvelles.

RÉSUMÉ
Nouvelles espèces d'Isopodes terrestres souterrains et endogés (Crustacea, Oniscidea) de Toscane (Italie centrale).
Sept nouvelles espèces d'Isopodes terrestres souterrains et endogés de Toscane (Italie centrale) sont décrites dans les familles Trichoniscidae Sars, 1899 (*Leucocyphoniscus pisanus* n. sp., *Moserius gruberae* n. sp., *Moserius talamonensis* n. sp.) et Armadillidiidae Brandt, 1833 (*Typhlarmadillidium occidentale* n. sp., *Paraschizidium ferrarai* n. sp., *Trogleluma pilosa* n. sp., *Alloschizidium labronicum* n. sp.). Les caractéristiques diagnosiques et les affinités des nouvelles espèces sont discutées.

INTRODUCTION

Until 2004, about 300 species of troglobiotic oniscidean isopods were known worldwide, mostly from caves in the northern hemisphere (Taiti 2004). In the last decade, new biospeleological surveys have been conducted in Europe, Australia, Asia and South America considerably increasing the number of troglobiotic Oniscidea species (Garcia 2008; Taiti & Gruber 2008; Taiti & López 2008; Bedek & Taiti 2009; Taiti & Argano 2009; Taiti & Checcucci 2009; Souza *et al.* 2010; Campos-Filho & Araujo 2011; Caruso & Bouchon 2011; Taiti & Xue 2012; Andreev 2013a, b; Tabacaru & Giurginca 2013; Kashani *et al.* 2013; Taiti 2014; Gongalsky & Taiti 2014; Campos-Filho *et al.* 2014, 2015, 2016, 2017a, b; Taiti & Rossano 2015; Taiti & Wynne 2015; Reboleira *et al.* 2015; Souza *et al.* 2015; Turbanov & Gongalsky 2016; Javidkar *et al.* 2016, 2017; Cardoso *et al.* 2017). The number of subterranean species of terrestrial isopods is certainly not exhaustive, and recently a large amount of new taxa have been collected in many parts of the world.

In Tuscany, a region of central Italy, more than 2000 caves are present in different areas, as reported in the website of the Tuscan Speleological Federation (see also at the following links, Commissioni, Catasto, in Italian: www.speleotoscana.it). The terrestrial isopods of Tuscany have been studied quite intensively in the last 40 years (Ferrara & Taiti 1978; Taiti & Ferrara 1980, 1989, unpublished data) and the present number of species recognised is about 140. Despite the fact that speleological and biospeleological research is rather intensive in the region, the subterranean terrestrial isopods are still not satisfactory known and new taxa are continuously discovered when intensive collections are made in caves. A summary of the terrestrial isopods from the Tuscan caves is reported in Taiti & Ferrara (1995). Many Tuscan species occur also in the endogean (or edaphic) environment, i.e., the soil layer (for definition see Giachino & Vailati 2005, 2010).

In recent years new investigations in caves and endogean habitats were conducted in many parts of Tuscany and several new species were discovered. In this paper we describe four troglobiotic and three endogean new species in the families Trichoniscidae Sars, 1899 and Armadillidiidae Brandt, 1833.

MATERIAL AND METHODS

The specimens were stored in 75% ethanol and identifications were based on morphological characters. For each new species the material examined, diagnosis, description, etymology and remarks are given. The species were illustrated with the aid of a camera lucida mounted on Wild M5 and M20 microscopes. Figures were digitally drawn following the method described in Montesanto (2015, 2016). The material is deposited in the collections of the Museo di Storia Naturale, sezione di Zoologia "La Specola" of the University of Florence, Italy (MZUF), and the Muséum national d'Histoire naturelle, Paris, France (MNHN). The geographical coordinates of the localities are in decimal degrees (datum WGS84).

SYSTEMATIC ACCOUNT

Family TRICHONISCIDAE Sars, 1899
Subfamily HAPLOPHTHALMINAE Verhoeff, 1908

Genus *Leucocyphoniscus* Verhoeff, 1900

TYPE SPECIES. — *Leucocyphoniscus verruciger* Verhoeff, 1900 by monotypy.

Leucocyphoniscus pisanus n. sp.
(Figs 1-3, 21A)

urn:lsid:zoobank.org:act:2C35B10A-CEA5-46BC-BCF6-1C8BD85810BC

TYPE MATERIAL. — **Holotype.** ♂, Monte Pisano, Buca delle Fate di Cima Sugheretta, 1823 T/PI, 43°44'37"N, 10°29'03"E, San Giuliano Terme, Prov. Pisa, leg. S. Taiti and G. A. Gruber, 20.I.2007 (MZUF 9664). **Paratypes.** 3 ♂, 12 ♀, same data as holotype (MZUF 9664); 9 ♂, 6 ♀, same locality as holotype, leg. S. Taiti, 25.I.2008 (MZUF 9665); 1 ♂, 2 ♀, same data (MNHN-IU-2017-1438); 1 ♀, Monti d'Oltreserchio, Tana della Volpe di Baccanella, 247 T/PI, 43°47'05"N, 10°24'09"E, Baccanella, Vecchiano, Prov. Pisa, leg. S. Taiti and M. Del Guasta, 10.II.2007 (MZUF 9666).

DIAGNOSIS. — A species of *Leucocyphoniscus* characterized by the cephalon with three large tubercles and a very prominent tubercle on pleonite 3.

ETYMOLOGY. — The new species in named after the sampling locality (Monte Pisano).

DESCRIPTION

Maximum length: ♂, 3.8 mm; ♀, 4.1 mm. Body colourless, ovoidal, outline not interrupted between pereon and pleon; pereon tergites strongly convex, epimera obliquely directed outwards (Fig. 1A). Dorsum bearing distinct ribs and tubercles (Fig. 1A-C): cephalon with one central tubercle with two rounded tips, and two large tubercles near rear margin; pereonites with 1 + 1 well developed longitudinal paramedian ribs almost as long as tergites, and 3 + 3 faint external ribs; pleonite 3 with one prominent median tubercle. Cephalon (Fig. 1B, C) with large subquadrangular frontal lateral lobes, directed outwards and not protruding compared with widely rounded median lobe. Eyes absent. Pereonites with right-angled posterior corners (Fig. 1A). Pleonites 3-5 (Fig. 1A) with large epimera obliquely directed backwards. Telson (Fig. 1D) wider than long, distal part trapezoidal with concave sides and truncate apex. Antennula (Fig. 1E) of three articles, basal article longest; two aestethacs at apex as long as third article. Antenna (Fig. 1F) with fifth article of peduncle slightly longer than flagellum; flagellum of three articles, with three aesthetascs on second article. Mandibles (Fig. 2A, B) with two free penicils on left and one free penicil on right. Maxillula (Fig. 2C) outer branch with 4 + 4 teeth, setose stem among outer group of teeth; inner branch with three stout penicils at apex, outer penicil much longer than other two. Maxilla (Fig. 2D) with

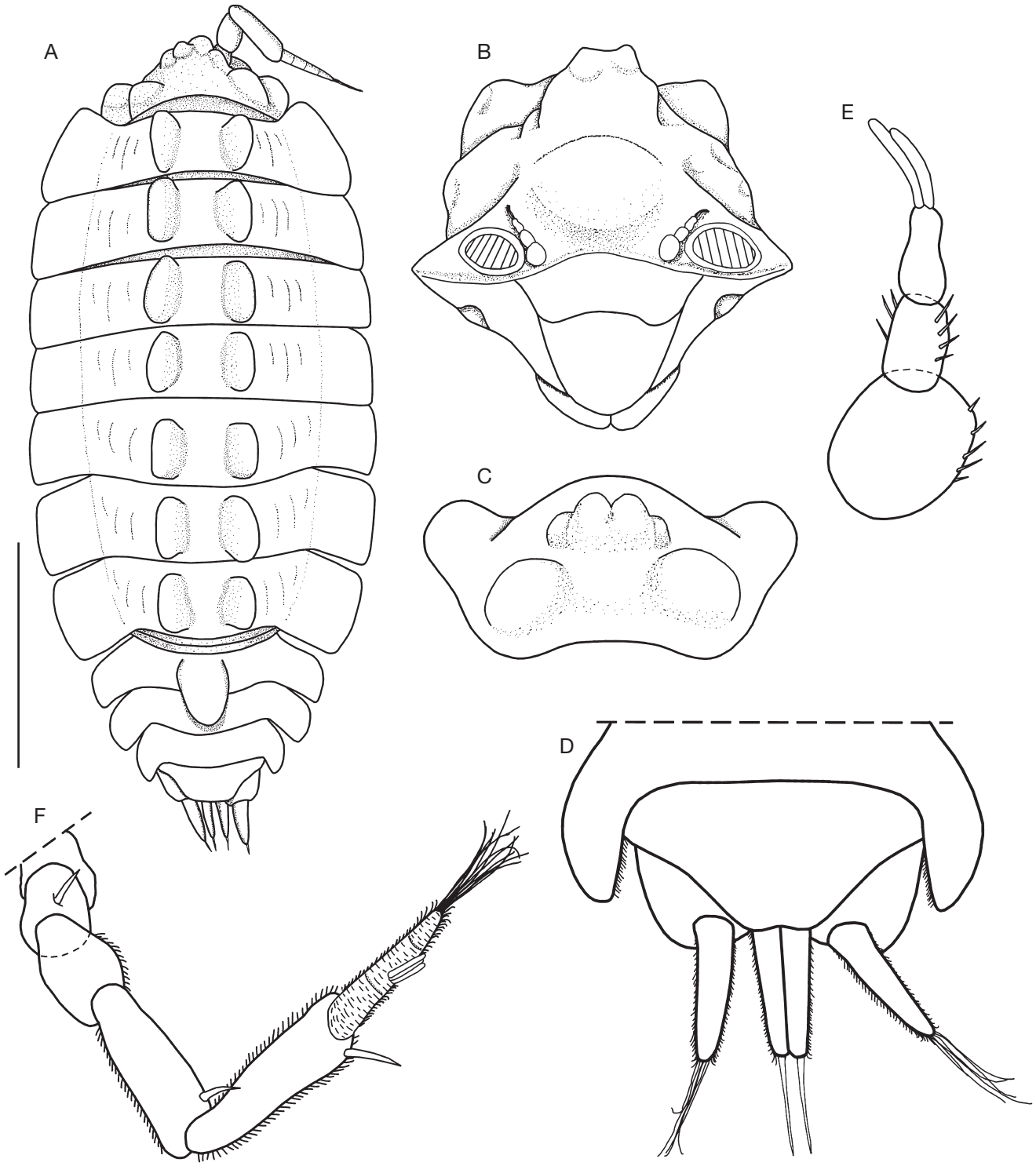

Fig. 1. — *Leucocyphoniscus pisanus* n. sp., from Buca delle Fate di Cima Sugheretta, Monte Pisano, ♂ paratype: **A**, adult specimen, dorsal view; **B**, cephalon, frontal view; **C**, cephalon, dorsal view; **D**, telson and uropods, dorsal view; **E**, antennula; **F**, antenna. Scale bar: A, 1 mm.

bilobed and setose apex. Maxilliped (Fig. 2E) endite with stout subtriangular penicil at apex, palp distally rounded with long setae with basal article bearing two setae. Uropod (Fig. 2F) with flattened protopod; endopod slightly longer than exopod, with one apical seta; exopod with a tuft of five apical setae.

Male

Pereopod 1 (Fig. 3A) with no distinct modifications. Pereopod 7 (Fig. 3B) ischium with slightly convex sternal margin, carpus with three large setae on sternal margin. Genital papilla as in Fig. 3C. Pleopod 1 (Fig. 3D) exopod subtriangular, longer than wide, slightly concave outer margin and straight medial

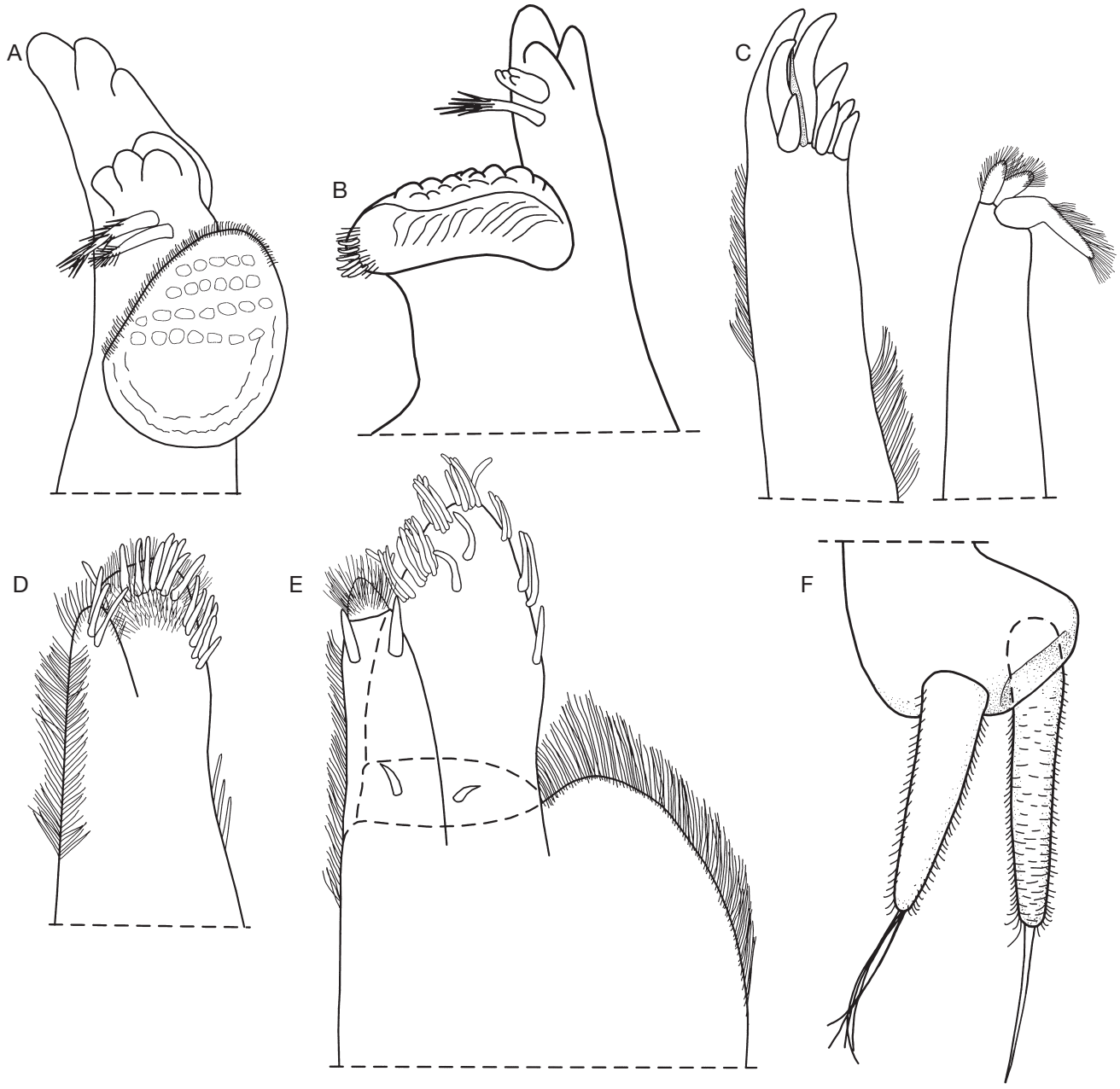

Fig. 2. — *Leucocyphoniscus pisanus* n. sp., from Buca delle Fate di Cima Sugheretta, Monte Pisano, ♂ paratype: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped; **F**, left uropod.

margin, apex rounded; endopod distinctly longer than exopod, second article with parallel sides and rounded apex, slightly bent outwards. Pleopod 2 (Fig. 3E) exopod much wider than long; endopod with distal part narrow. Pleopod 3-5 exopods as in Fig. 3F-H.

Remarks

The new species is included in the genus *Leucocyphoniscus* for the pattern of dorsal ornamentation, i.e., two paramedian large ribs on the pereonites and a single large tubercle on the pleonite 3. The genus was previously known only from three species: *L. verruciger* Verhoeff, 1900, from Monte Generoso (southern Switzerland) and Como Province (northern Italy); *L. solarii* Brian, 1914, from some caves in Como Province; and *L. torrii* Arcangeli, 1946, from Grotta del Böter (or Grotta di Opreno), Lecco Province (northern Italy). Although the descriptions of these species are not detailed and with poor illustrations, our specimens are definitely belonging to a new species. It differs from all the other species in the disposition of the dorsal tubercles on the cephalon and the extreme development of the median tubercle on the pleonite 3. It also differs from *L. verruciger*

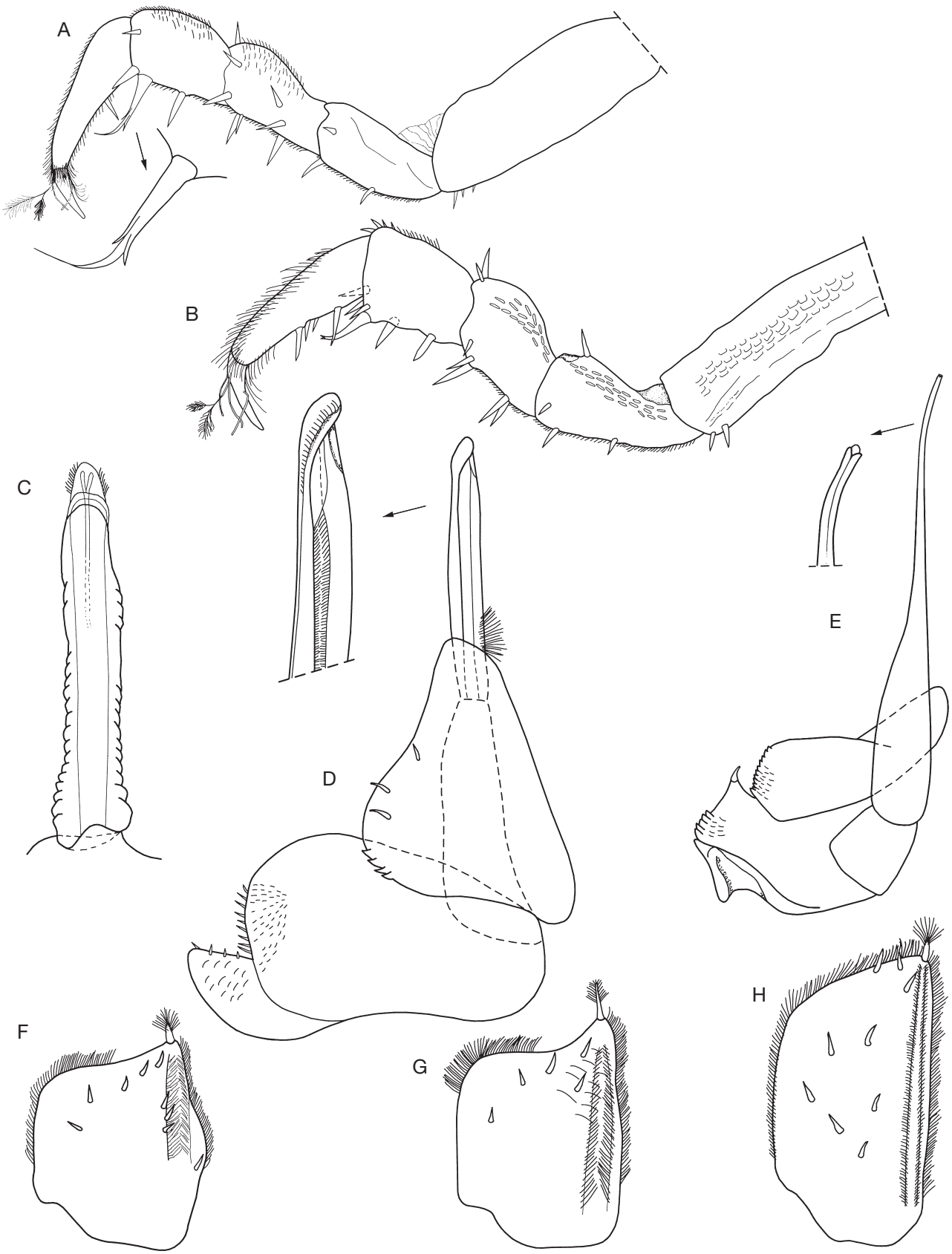

FIG. 3. — *Leucocyphoniscus pisanus* n. sp., from Buca delle Fate di Cima Sugheretta, Monte Pisano, ♂ paratype: **A**, pereopod 1; **B**, pereopod 7; **C**, genital papilla; **D**, pleopod 1; **E**, pleopod 2; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

in having the antennula with two instead of three aesthetascs (compare Fig. 1E and Arcangeli 1923: fig. 6a) and in the male pleopod 1 exopod with a rounded instead of pointed apical part (compare Fig. 3D and Arcangeli 1923: fig. 8b). The discovery of this new species from caves in Monte Pisano (northwestern Tuscany) considerably enlarges the distribution of the genus.

Genus *Moserius* Strouhal, 1940

TYPE SPECIES. — *Moserius percoi* Strouhal, 1940 by monotypy.

Moserius gruberae n. sp.
(Figs 4-6, 21B)

urn:lsid:zoobank.org:act:E737A91A-335D-4E97-BF61-52D2DB4F25DD

TYPE MATERIAL. — **Holotype**. ♂, Monte Pisano, Grotta del Cane di Uliveto, 137 T/PI, 43°42'09"N, 10°31'14"E, Caprona, Uliveto Terme, Prov. Pisa, leg. S. Taiti, G. A. Gruber and P. Maestrini, 3.II.2007 (MZUF 9667). **Paratypes.** 21 ♂, 19 ♀, same data as holotype (MZUF 9667); 2 ♂, 2 ♀, same data (MNHN-IU-2017-1439); 11 ♂, 13 ♀, Monte Pisano, Grotta dello Strinato, 79 T/PI, 43°42'03"N, 10°31'05"E, Uliveto Terme, Vicopisano, Prov. Pisa, leg. S. Taiti and G. A. Gruber, 3.II.2007 (MZUF 9668).

DIAGNOSIS. — A species of *Moserius* characterized by the male pleopod 1 endopod with the second article having parallel sides, distally with sinuous outer margin and rounded apex, and the male pleopod 2 endopod with apical part bent outwards.

ETYMOLOGY. — The new species in named after Dr Gertrud Anna Gruber, Bolzano, for her invaluable help in collecting the specimens.

DESCRIPTION
Maximum length: ♂, 3.3 mm; ♀, 3.5 mm. Body colourless, ovoidal, outline not interrupted between pereon and pleon (Fig. 4A). Dorsum bearing ribs and tubercles (Fig. 4A-C): cephalon with three small tubercles on profrons, vertex with one large central tubercle with 3 + 3 rounded tips, and 3 + 3 rounded tubercles near rear margin; pereonite 1 with 4 + 4 longitudinal ribs; pereonites 2-6 with 3 + 3 longitudinal ribs; pereonite 7 with 2 + 2 ribs; pleonite 3 with two large paramedian tubercles. Cephalon (Fig. 4B, C) with short, subquadrangular frontal lateral lobes, directed outwards and not protruding compared with median lobe. Eyes absent. Pereonites 5-7 with epimera slightly pointing backwards (Fig. 4A). Pleonites 3-5 (Fig. 4A, D) with large epimera directed backwards. Telson (Fig. 4D) about twice as wide as long, distal part trapezoidal with concave sides and truncate apex. Antennula (Fig. 4E) of three articles subequal in length, with three long aestethacs at apex. Antenna (Fig. 4F) with fifth article of peduncle slightly longer than flagellum; flagellum of three articles, with three aesthetascs on second article. Mandibles (Fig. 5A, B) with one free penicil on the right and two free penicils on the left. Maxillula (Fig. 5C) outer branch with 4 + 6 teeth, setose stem among outer group of teeth, inner branch with three stout penicils at apex, inner penicil smaller than other two. Maxilla (Fig. 5D) with bilobed and setose apex. Maxilliped (Fig. 5E) endite with stout subtriangular penicil at apex, palp distally rounded with long setae, basal article with two setae. Uropod (Fig. 5F) with flattened protopod; exopod slightly shorter than endopod, with tuft of apical setae; endopod with single apical seta.

Male
Pereopod 1 (Fig. 6A) with no distinct modifications. Pereopod 7 (Fig. 6B) ischium with slightly convex sternal margin, carpus with large distal lobe on sternal margin. Genital papilla as in Fig. 6C. Pleopod 1 (Fig. 6D) exopod triangular, longer than wide, slightly concave outer margin and straight medial margin; endopod distinctly longer than exopod, second article with parallel sides, distally with sinuous outer margin and rounded apex. Pleopod 2 (Fig. 6E) exopod longer than wide, with concave outer margin and sinuous medial margin; endopod much longer than exopod with apical part bent outwards. Pleopod 3-5 exopods as in Figs 6F-H.

REMARKS
The new species is included in the genus *Moserius* for the dorsal ornamentation, i.e. presence of 4 + 4 longitudinal ribs on the pereonite 1, 3 + 3 on the pereonites 2-6, 2 + 2 on pereonite 7, and two tubercles on the pleonite 3. As pointed out by Taiti & Ferrara (1995) the genus *Moserius* is very similar in the dorsal ornamentation to *Carloniscus* Verhoeff, 1936, which comprises only the species *C. dollfusi* (Carl, 1908) from south-eastern France and Corsica. *Moserius* seems to be also very similar to the genus *Beroniscus* Vandel, 1967 with two cave-dwelling species from Bulgaria (*B. capreolus* Vandel, 1967) and from Sicily (*B. marcelli* Vandel, 1969) (see Vandel 1967, 1969). It is uncertain that the three genera are really distinct and a molecular analysis might clarify this problem.

To date, the genus *Moserius* includes three species: *M. percoi* recorded from caves in Slovenia, Tuscany and the subspecies *M. percoi ribaldonei* Brian, 1963, from Liguria, *M. elbanus* Taiti & Ferrara, 1995, from a cave on Elba Island, Tuscany, and *M. inexpectatus* Reboleira & Taiti, 2015, from a cave in central Portugal. The new species differs from *M. percoi* in the number and disposition of the dorsal tubercles on the cephalon and in the longer second rib from the median line on the pereonite 1 (see Strouhal 1940 and Taiti & Ferrara 1995); from *M. elbanus* in having all the ribs on the pereonite 1 of equal length, the presence of a lobe on the male pereopod 7 carpus, and the distal part of the male pleopod 1 endopod with rounded instead of pointed apex (see Taiti & Ferrara 1995); from *M. inexpectatus* in the absence of dorsal tubercles on the pleonites 4, 5 and telson, and especially in the male pleopod 1 exopod with a rounded instead of sinuous distal margin (see Reboleira *et al.* 2015).

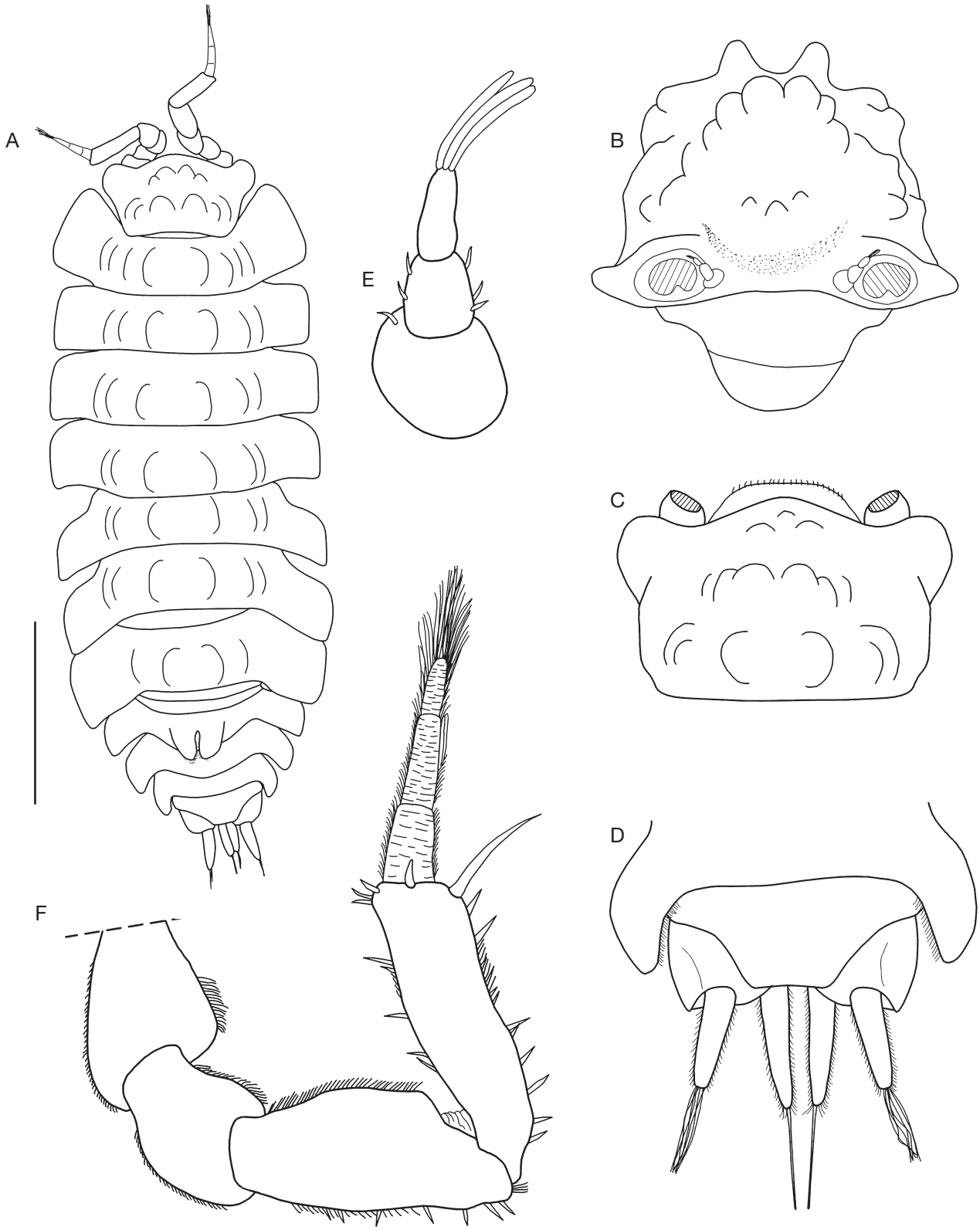

FIG. 4. — *Moserius gruberae* n. sp., from Grotta del Cane di Uliveto, Monte Pisano, ♂ paratype: **A**, adult specimen, dorsal view; **B**, cephalon, front view; **C**, cephalon, dorsal view; **D**, telson and uropods, dorsal view; **E**, antennula; **F**, antenna. Scale bar: A, 1 mm.

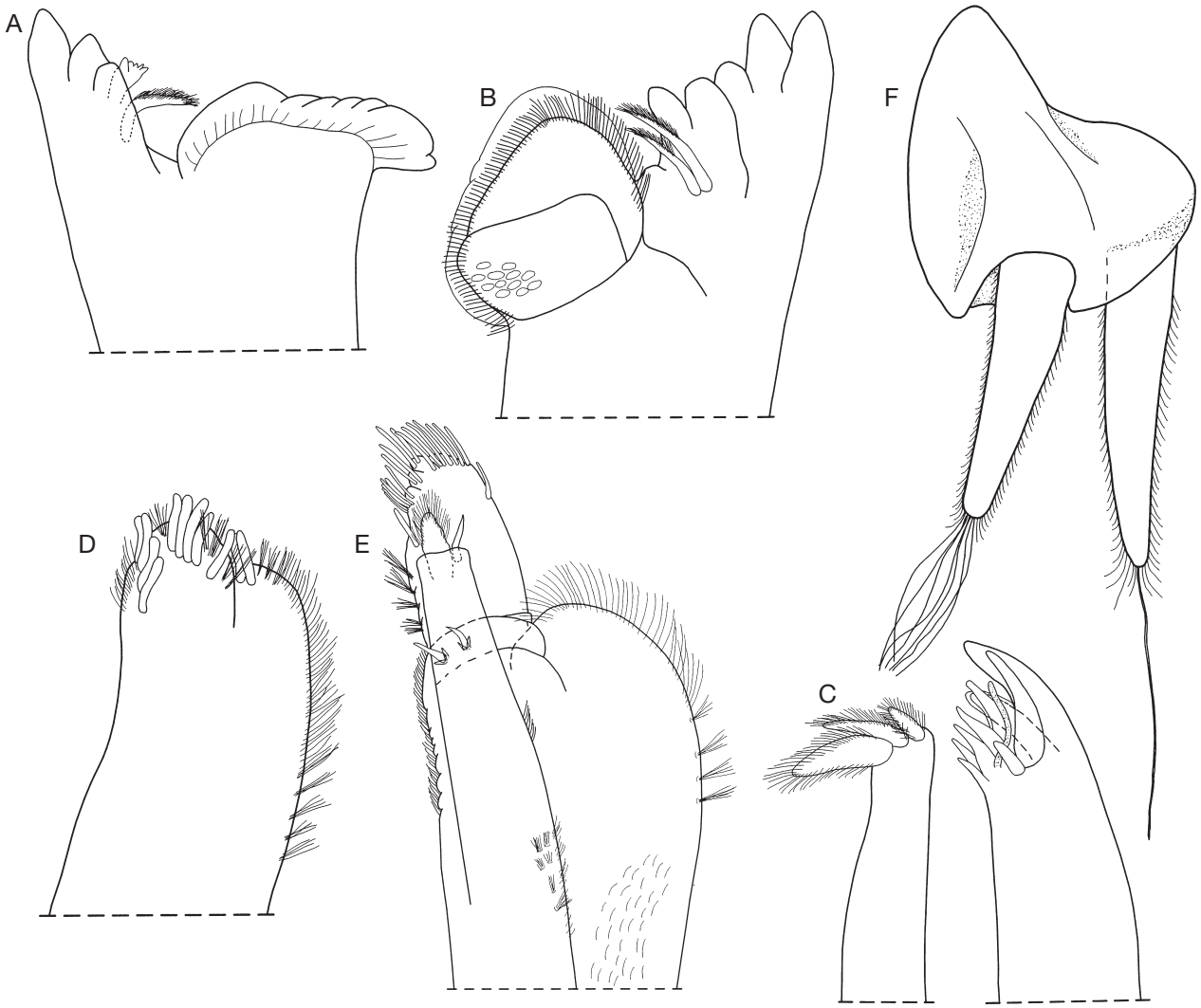

FIG. 5. — *Moserius gruberae* n. sp., from Grotta del Cane di Uliveto, Monte Pisano, ♂ paratype: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped; **F**, left uropod.

Moserius talamonensis n. sp.
(Figs 7, 8, 21C)

urn:lsid:zoobank.org:act:5D3C40FC-F78A-4E30-950D-A1FF3F68179D

Moserius sp. – Taiti 2007: 94.

TYPE MATERIAL. — **Holotype.** ♂, Parco Regionale della Maremma, Grotta di Gianninoni, 1594 T/GR, 42°34'09"N, 11°07'16"E, Punta del Corvo, Talamone, Orbetello, Prov. Grosseto, leg. S. Taiti, G. A. Gruber and C. Rossano, 3.IV.2004 (MZUF 9669). **Paratypes.** 36 ♂, 26 ♀, same data as holotype (MZUF 9669); 3 ♂, 3 ♀, same data (MNHN-IU-2017-1440).

DIAGNOSIS. — A species of *Moserius* characterized by the disposition of the dorsal ornamentation on the pereonite 1 with 4 + 4 longitudinal ribs almost as long as tergites and a small tubercle between ribs 2 and 3.

ETYMOLOGY. — The new species is named after the locality of sampling (Talamone, Province of Grosseto), where the cave is located.

DESCRIPTION

Maximum length: ♂, 3 mm; ♀, 3.4 mm. Body colourless, ovoidal, outline not interrupted between pereon and pleon; pereon tergites very convex, with epimera obliquely directed outwards (Fig. 7A). Dorsum bearing ribs and tubercles (Fig. 7A, B): cephalon with three small tubercles on front margin, two large central tubercle with 3 + 3 rounded tips, and 3 + 3 tubercles near rear margin; pereonite 1 with 4 + 4 longitudinal ribs almost as long as tergites and a small tubercle between ribs 2 and 3; pereonites 2-6 with 3 + 3 longitudinal ribs almost as long as tergites and reduced rib externally; pereonite 7 with 2 + 2 ribs almost as long as tergites, reduced rib and small tubercle externally; pleonite 3 with two large paramedian tubercles. Cephalon (Fig. 7B) with short, subquadrangular frontal lateral lobes directed outwards and not protruding compared with median lobe. Eyes absent. Pereonites with rounded posterior corners (Fig. 7A). Pleonites 3-5 (Fig. 7A) with large epimera directed backwards. Telson (Fig. 7C) slightly wider than long, with

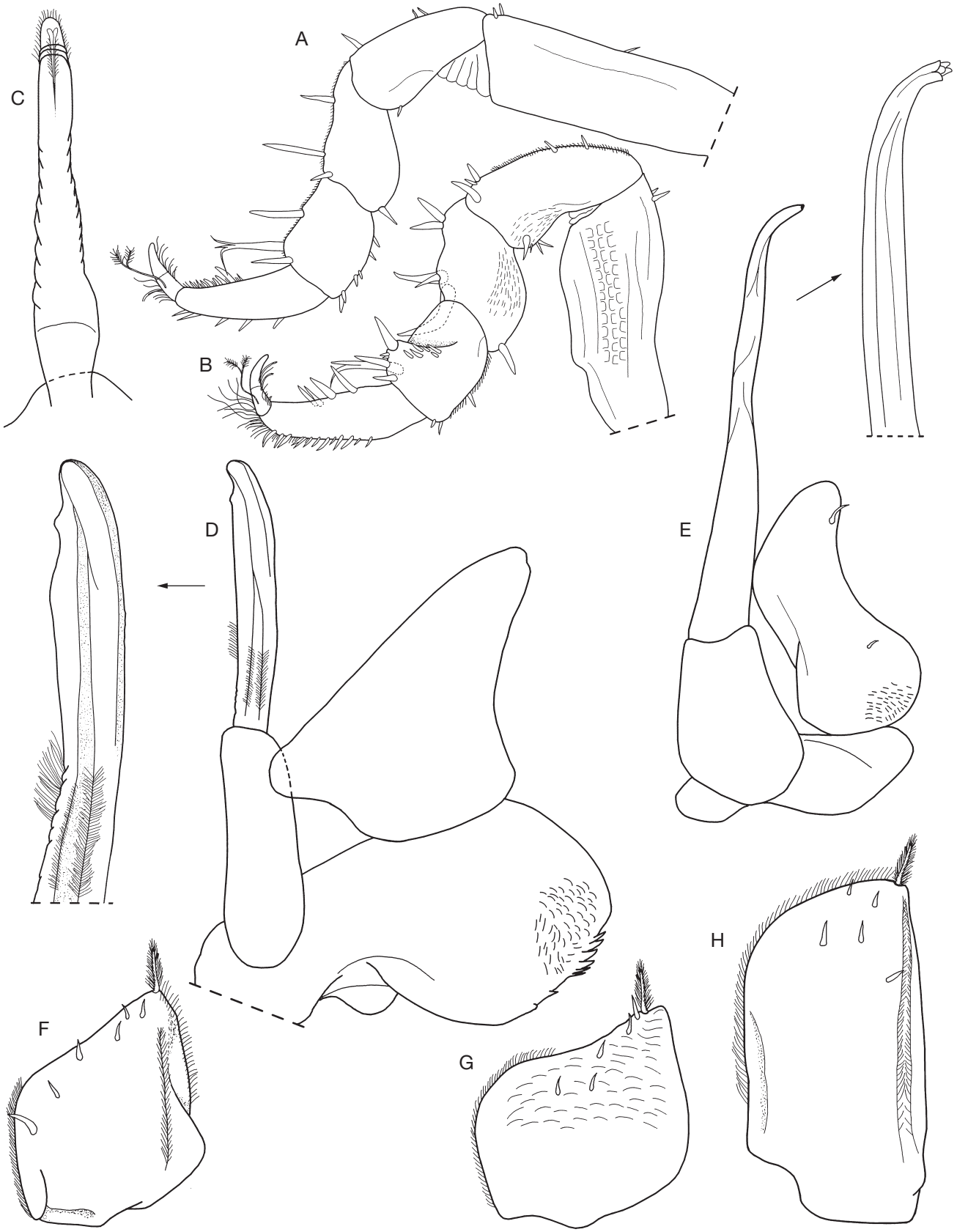

FIG. 6. — *Moserius gruberae* n. sp., from Grotta del Cane di Uliveto, Monte Pisano, ♂ paratype: **A**, pereopod 1; **B**, pereopod 2; **C**, genital papilla; **D**, pleopod 1; **E**, pleopod 2; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

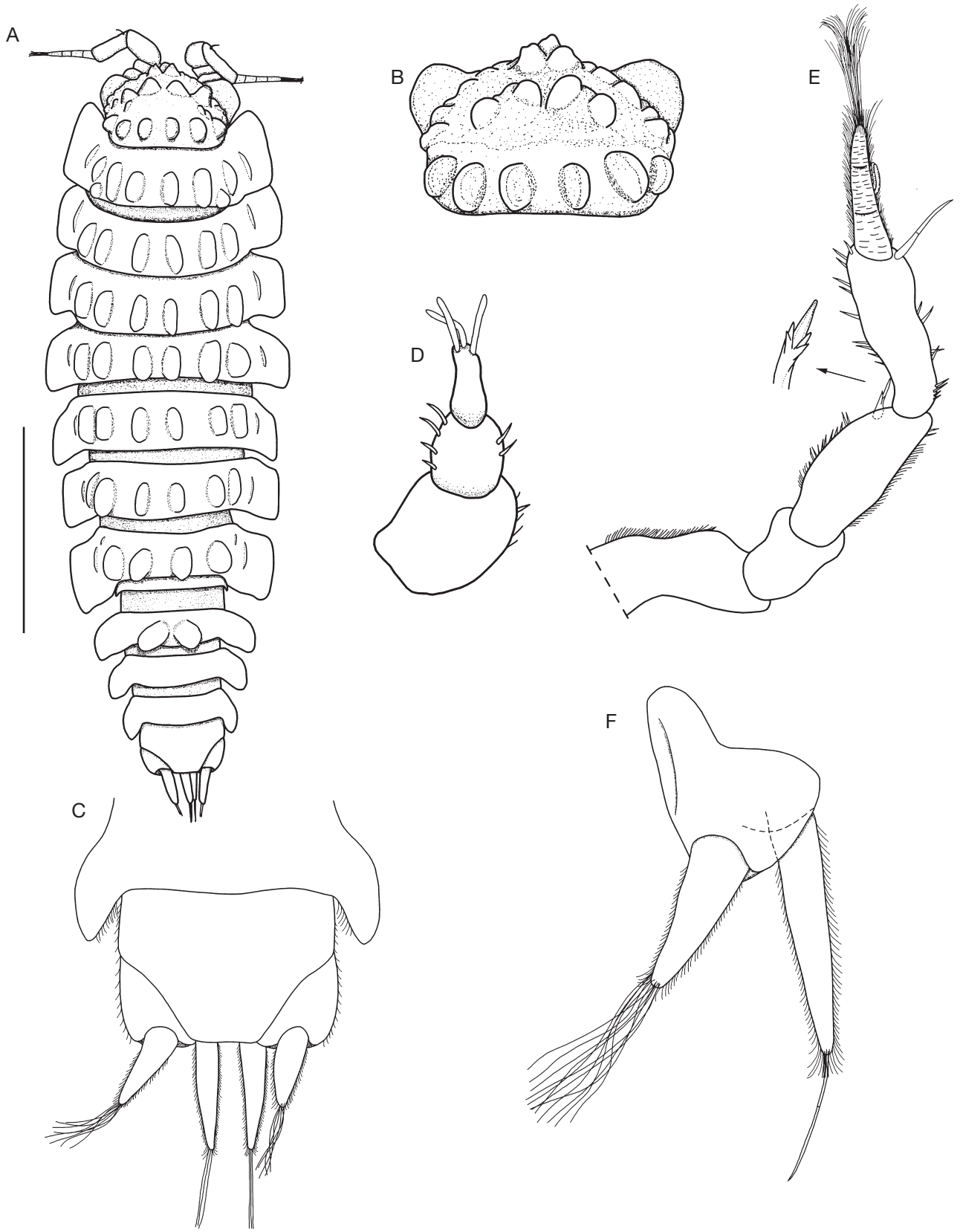

FIG. 7. — *Moserius talamonensis* n. sp., from Grotta Gianninoni, Uccellina, ♂ paratype: **A**, adult specimen, dorsal view; **B**, cephalon, dorsal view; **C**, telson and uropods, dorsal view; **D**, antennula; **E**, antenna; **F**, left uropod. Scale bar: A, 1 mm.

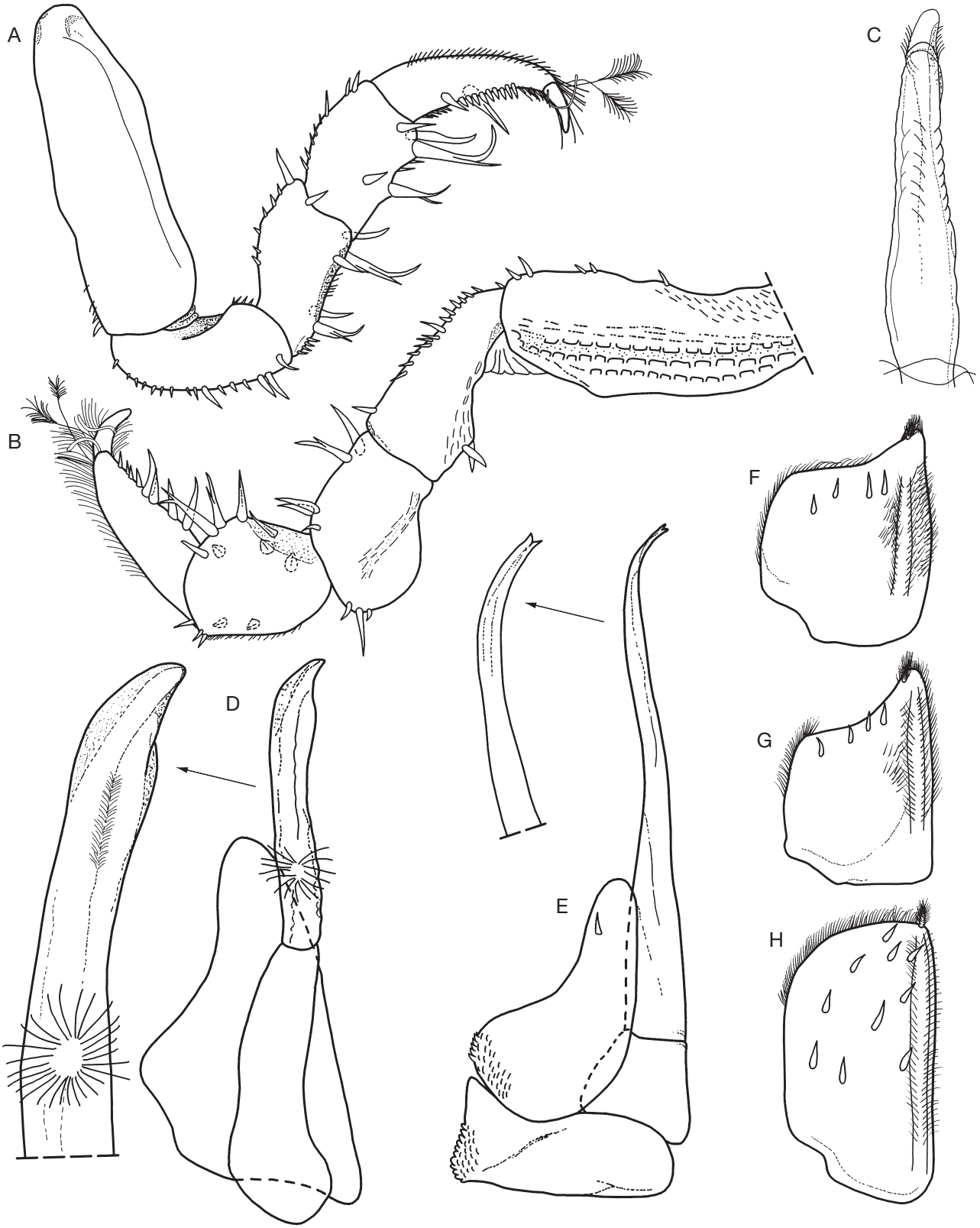

FIG. 8. — *Moserius talamonensis* n. sp., from Grotta Gianninoni, Uccellina, ♂ paratype: **A**, pereopod 1; **B**, pereopod 7; **C**, genital papilla; **D**, pleopod 1; **E**, pleopod 2; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

distal part trapezoidal, with concave sides and truncate apex. Antennula (Fig. 7D) of three articles with three aestethacs at apex. Antenna (Fig. 7E) with fifth article of peduncle slightly longer than flagellum; flagellum with three articles, second article with two aesthetascs. Mouth parts as in the previous species. Uropod (Fig. 7F) with flattened protopod; exopod shorter than endopod, with tuft of apical setae; endopod with a sigle apical seta.

Male

Pereopod 1 (Fig. 8A) with no distinct modifications. Pereopod 7 (Fig. 8B) ischium with straight sternal margin, merus very convex on tergal margin, carpus with distal lobe on sternal margin. Genital papilla as in Fig. 8C. Pleopod 1 (Fig. 8D) exopod with a rounded lobe on outer margin and straight medial margin, rounded apex; endopod distinctly longer than exopod, second article with parallel sides, distal part slightly bent outwards and rounded apex. Pleopod 2 (Fig. 8E) exopod triangular, with concave outer margin and straight medial margin; endopod much longer than exopod with distal part bent outwards and bifid apex. Pleopod 3-5 exopods as in Figs 8F-H.

Remarks

Moserius talamonensis n. sp. differs from all the other species in the number and disposition of the dorsal tubercles on the cephalon and on the pereonite 1; from *M. inexpectatus* also in the absence of dorsal tubercles on the pleonites 4 and 5 and telson, and in the male pleopod 1 exopod with a rounded instead of sinuous distal margin. In the shape of the male pleopod 1 exopod, the new species is similar to *M. elbanus* and *M. gruberae* n. sp., from which it differs also in the shape of the distal part of the male pleopod 1 endopod.

Family Armadillidiidae Brandt, 1833

Genus *Typhlarmadillidium* Verhoeff, 1900

Type species. — *Armadillidium* (*Typhlarmadillidium*) *trebinjanum* Verhoeff, 1900 by subsequent designation (Verhoeff 1933).

Typhlarmadillidium occidentale n. sp.
(Figs 9-11, 21D)

urn:lsid:zoobank.org:act:78E1A6C8-9D88-483F-87C1-F33FD25FA02E

Type material. — **Holotype.** ♂ Monte Pisano, Grotta del Cane di Uliveto, 137 T/PI, 43°42'09"N, 10°31'14"E, Caprona, Uliveto Terme, Prov. Pisa, leg. S. Taiti, G. A. Gruber and P. Maestrini, 3.II.2007 (MZUF 9670). **Paratypes.** 1 ♂, 7 ♀, same data as holotype (MZUF 9670); 5 ♂, 3 ♀, Monte Pisano, Buca della Croce di Agnano N. 2, 78 T/PI, 43°44'09"N, 10°28'25"E, Agnano, Prov. Pisa, leg. S. Taiti, 12.X.2011 (MZUF 9671); 2 ♂, 10 ♀, same locality, leg. S. Taiti and F. Stoch, 10.IX.2011 (MZUF 9672); 2 ♀, same data (MNHN-IU-2017-1438); 1 ♀, Monti d'Oltreserchio, Grotta della Spoletta, 1431 T/PI, 43°47'44"N, 10°23'35"E, Vecchiano, Prov. Pisa, leg. S. Taiti, 25.I.2008 (MZUF 9673).

Diagnosis. — A blind, colourless species of *Typhlarmadillidium* characterized by the pereonite 1 with postero-lateral corner slightly sinuous, telson with broadly rounded apex, uropod exopod shorter than telson, male pleopod 1 endopod with triangular apical part bent outwards and exopod with sinuous outer margin.

Etymology. — Latin: *occidentalis* = western. The name refers to the most western distribution of the species within the genus.

Description

Maximum length: ♂, 8.5 mm; ♀, 9.5 mm. Body colourless, strongly convex, able to roll up into a perfect ball (Fig. 9A). Back smooth with sparse small triangular scale-setae (Fig. 9B); one line of noduli laterales per side on pereonites, more or less at the same distance from the lateral margin (Fig. 9A). Cephalon (Fig. 9C, D) with a V-shaped scutellum clearly opened dorsally and depressed, antennary lobes small, eyes absent. Pereonite 1 (Fig. 9E, F) with posterior margin slightly concave, postero-lateral corner slightly sinuous with no schisma, small rounded tooth on ventral surface. Pereonite 2 (Fig. 9G) and 3 with a small ventral rounded tooth. Telson (Fig. 9H) subtriangular, longer than wide, with broadly rounded apex. Antennula (Fig. 9I) of three articles, second article much shorter than first and third, third article with pointed apex and subapical row of seven aestethacs. Antenna (Fig. 9J) with fifth article of peduncle slightly longer than flagellum, second flagellar article about three times as long as first, five rows of 1-3 aesthetascs each on second article. Mandibles (Fig. 10A, B) with molar penicil semidichotomized, 2 + 3 free penicils on the left and 1 + 3 on the right mandible. Maxillula (Fig. 10C) outer branch with 4 + 6 (4 cleft) teeth, inner branch with two penicils. Maxilla (Fig. 10D) with bilobed and setose apex, outer lobe twice as wide as inner lobe. Maxilliped (Fig. 10E) endite with two triangular terminal spines, one subterminal strong seta and bilobed distal-medial corner. Pleopods 1 and 2 (Fig. 11D, E) with monospiracular covered lungs. Uropod (Fig. 10F) protopod slightly longer than exopod, exopod twice as long as wide, endopod much longer than exopod.

Male

Pereopod 1 (Fig. 11A) carpus with row of strong setae on sternal margin. Pereopod 7 (Fig. 11B) with no distinct sexual modifications, ischium with straight sternal margin. Genital papilla as in Fig. 11C. Pleopod 1 (Fig. 11D) exopod wider than long with sinuous outer margin and broadly rounded apex; endopod with triangular apical part slightly bent outwards bearing row of short setae. Pleopod 2 (Fig. 11E) exopod slightly shorter than endopod. Pleopod 3-5 exopods as in Fig. 11F-H.

Remarks

The new species is included in the genus *Typhlarmadillidium* since it has a V-shaped scutellum clearly opened dorsally, small antennary lobes, pereonite 1 with no schisma, telson triangular, and uropod much longer than wide.

To date, the genus *Typhlarmadillidium* included three species: *T. kratochvili* (Frankenberger, 1938) from Croatia,

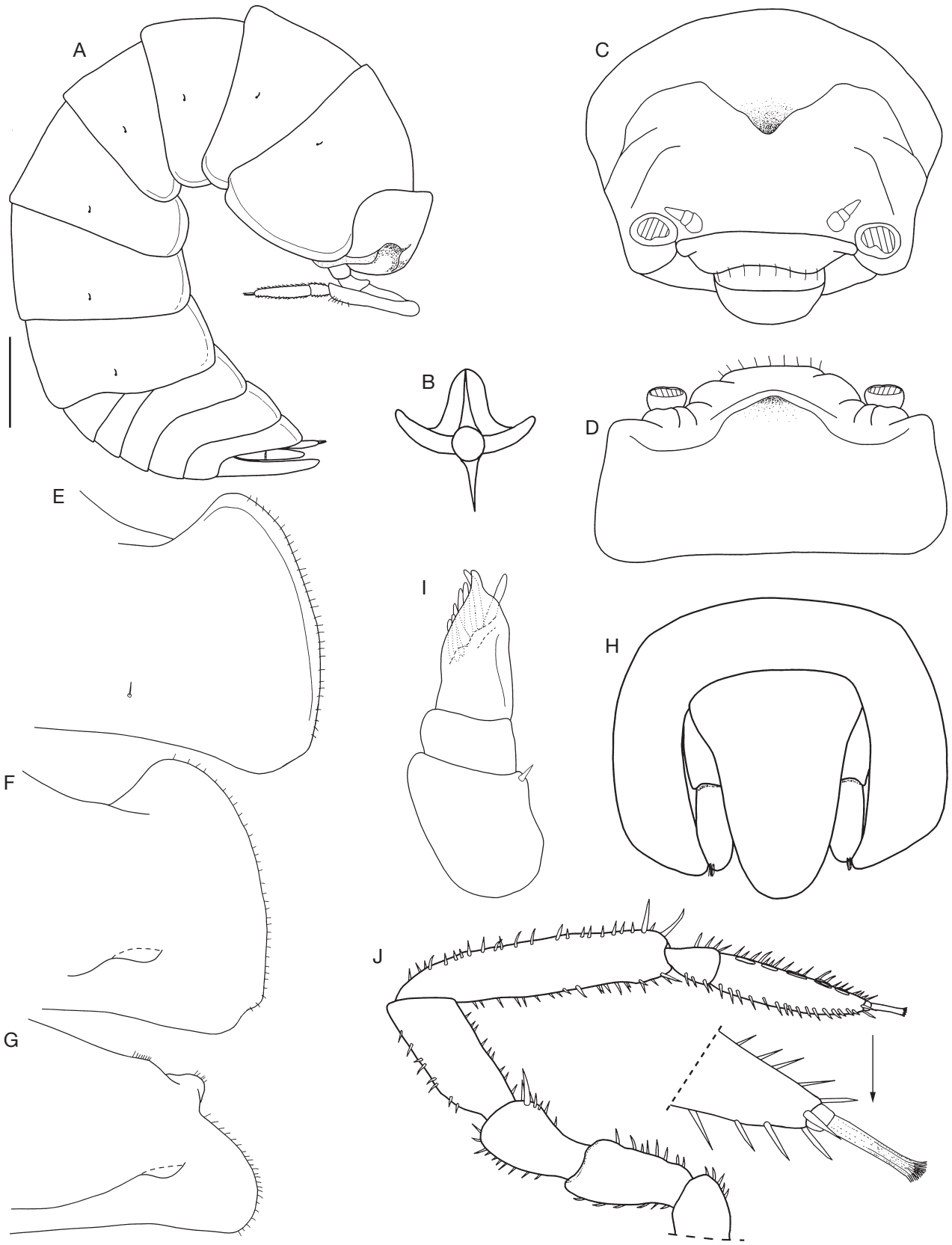

Fig. 9. — *Typhlarmadillidium occidentale* n. sp., from Grotta del Cane di Uliveto, Monte Pisano, ♂ paratype: **A**, adult specimen, lateral view; **B**, dorsal scale-seta; **C**, cephalon, frontal view; **D**, cephalon, dorsal view; **E**, epimeron of pereonite 1, dorsal view; **F**, epimeron of pereonite 1, ventral view; **G**, epimeron of pereonite 2, ventral view; **H**, telson and uropods, dorsal view; **I**, antennula; **J**, antenna. Scale bar: A, 1 mm.

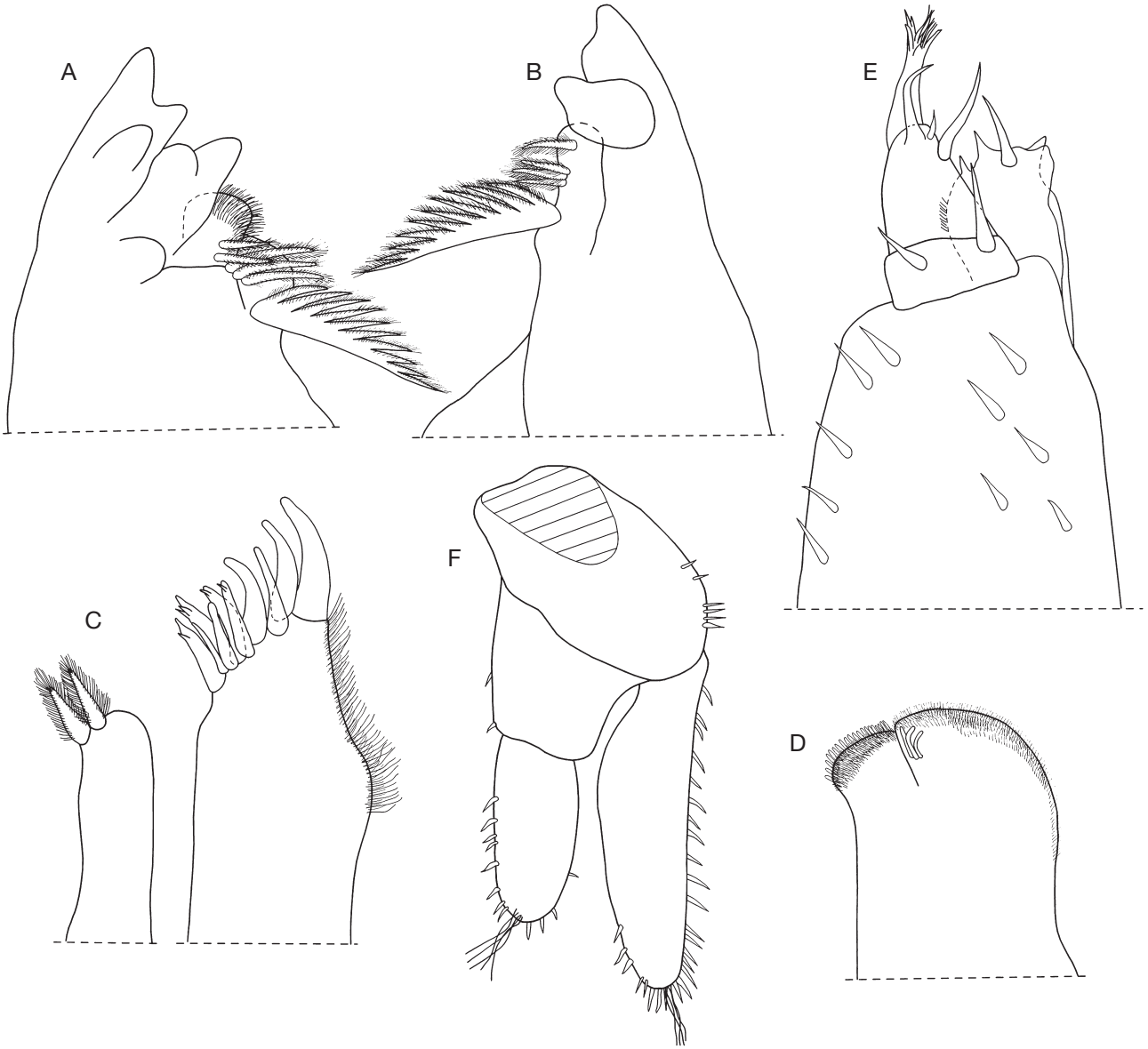

Fig. 10. — *Typhlarmadillidium occidentale* n. sp., from Grotta del Cane di Uliveto, Monte Pisano, ♂ paratype: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped; **F**, right uropod.

T. trebinjanum (Verhoeff, 1900) from Croatia, Herzegovina and Montenegro, and *T. ruffoi* Ferrara & Taiti, 1996 from north-eastern Italy. The new species considerably enlarges the genus distribution towards the West. The new species is readily distinguished from *T. kratochvili* and *T. trebinjanum* in the uropodal exopods not surpassing the apex of telson and in the shape of the telson with a broader distal part; from *T. trebinjanum* also in the male pereopod 7 ischium with straight instead of concave sternal margin (compare Fig. 11B and Strouhal 1939: fig. 12); from *T. ruffoi* in the telson being longer than wide, the uropodal exopod being comparatively longer, the male pleopod 1 exopod with sinuous outer margin and endopod with apical part pointed and bent outwards instead of rounded (compare Ferrara & Taiti 1996).

Genus *Paraschizidium* Verhoeff, 1919

Type species. — *Armadillidium* (*Paraschizidium*) *olearum* Verhoeff, 1919 by monotypy.

Paraschizidium ferrarai n. sp.
(Figs 12-14, 21E)

urn:lsid:zoobank.org:act:70FC4AC6-19FA-4234-AA6E-2E562594A3A1

Paraschizidium olearum – Taiti & Ferrara 1980: 285; 1989: 81.

Type material. — **Holotype.** ♂, Isola di Gorgona, above Cala Scirocco, Prov. Livorno, 43°25'23"N, 9°53'59"E, under deeply enbed-

Fig. 11. — *Typhlarmadillidium occidentale* n. sp., from Grotta del Cane di Uliveto, Monte Pisano, ♂ paratype: **A**, pereopod 1; **B**, pereopod 7; **C**, genital papilla; **D**, pleopod 1; **E**, pleopod 2; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

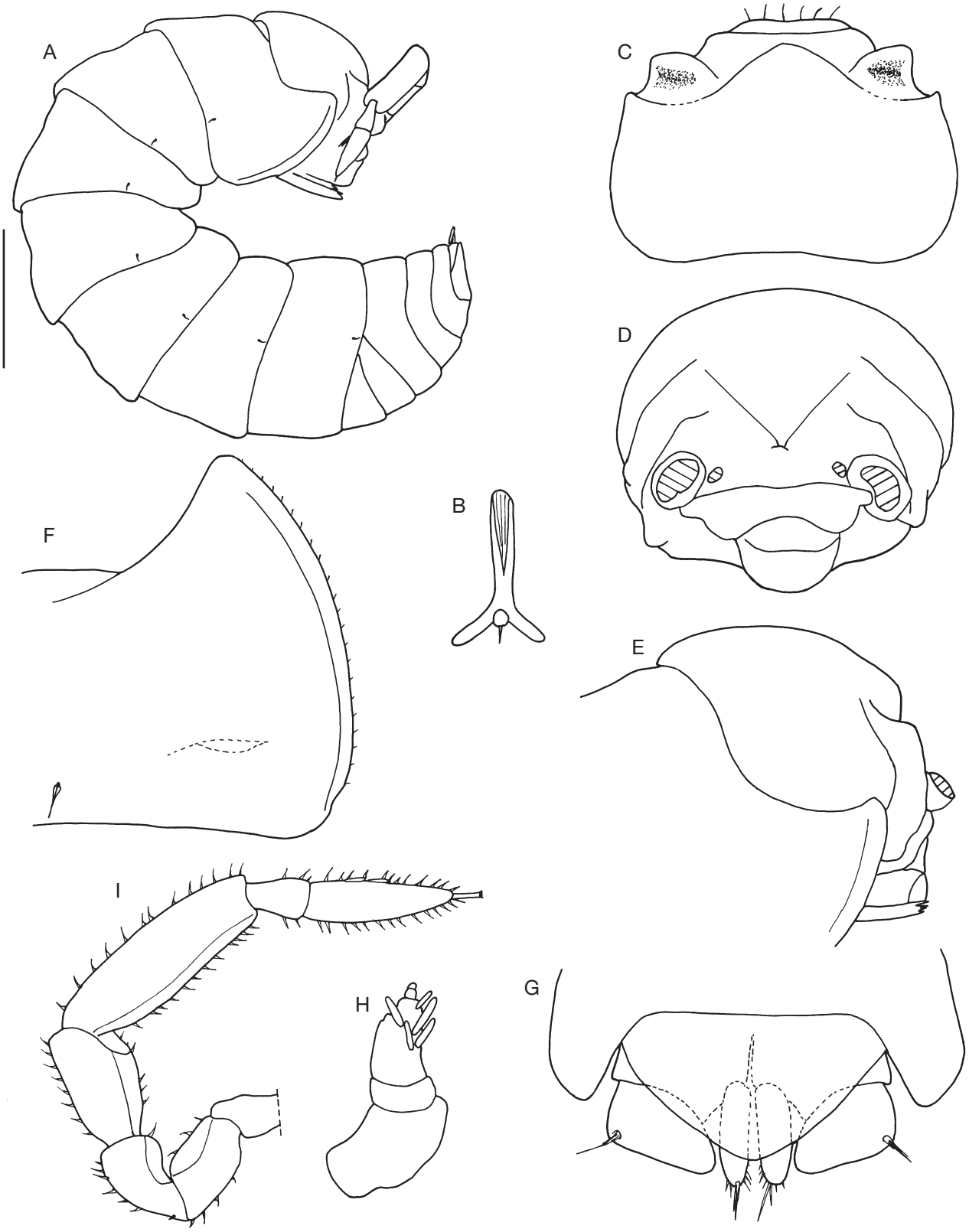

Fig. 12. — *Paraschizidium ferrarai* n. sp., from Gorgona, ♂ paratype: **A**, adult specimen, lateral view; **B**, dorsal scale-seta; **C**, cephalon, frontal view; **D**, cephalon, dorsal view; **E**, cephalon, lateral view; **F**, epimeron of pereonite 1, dorsal view; **G**, telson and uropods, dorsal view; **H**, antennula; **I**, antenna. Scale bar: A, 1 mm.

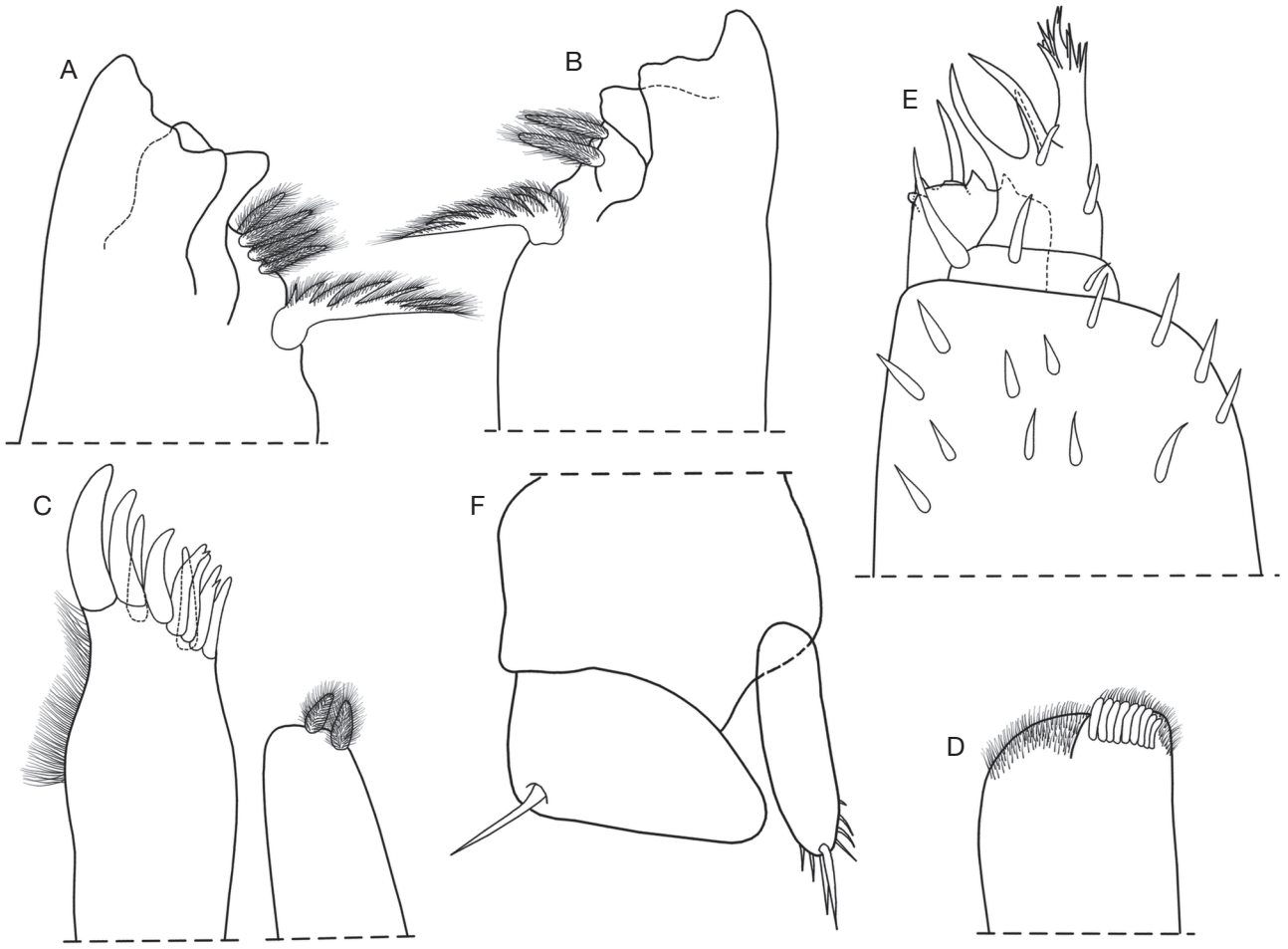

Fig. 13. — *Parachizidium ferrarai* n. sp., from Gorgona, ♂ paratype: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped; **F**, uropod.

ded stones, leg. S. Taiti, S. Vanni and A. Nistri, 19.IV.1995 (MZUF 9674). **Paratypes**. 1 ♂, 1 ♀, same data as holotype (MZUF 9674); 1 ♀, Isola di Gorgona, Prov. Livorno, 43°25'51"N, 9°54'23"E, above harbour, pine wood under deeply enbedded stones, leg. S. Taiti and S. Vanni, 30.X-1.XI.1979 (MZUF 449); 2 ♂, same locality, leg. S. Taiti, S. Vanni and A. Nistri, 21.IV.1995 (MZUF 9675).

Diagnosis. — A blind, colourless species of *Paraschizidium* characterized by claviform dorsal scale-setae, antennula of three articles, male pleopod 1endopod with bilobed apex.

Etymology. — The new species is named after Dr Franco Ferrara (Florence) for his invaluable contribution on the taxonomy of Oniscidea.

Description

Maximum length: ♂, 2.3 mm; ♀, 2.8 mm. Body colourless, strongly convex, able to roll up into a perfect ball (Fig. 12A), dorsally covered with claviform scale-setae (Fig. 12B); one line of noduli laterales per side on pereonites, more or less at the same distance from lateral margin (Fig. 12A). Cephalon (Fig. 12C-E) with a V-shaped scutellum clearly opened dorsally, antennary lobes narrow, quadrangular; eyes absent. Pereonite 1 (Fig. 12F) with posterior margin almost straight, postero-lateral corner slightly sinuous but with no schisma, ventrally with a small rounded tooth. Telson (Fig. 12G) subtriangular, wider than long, with slightly convex sides and broadly rounded apex. Antennula (Fig. 12H) of three articles, second article shortest, five aesthetascs at apex. Antenna (Fig. 12I) with fifth article of peduncle slightly longer than flagellum; second flagellar article about three times as long as first, with two rows of aesthetascs. Mandibles (Fig. 13A, B) with molar penicil semidichotomized and 1 + 3 free penicils on left and 1 + 1 on right mandible. Maxillula (Fig. 13C) outer branch with 4 + 5 (2 cleft) teeth, inner branch with two small stout penicils. Maxilla (Fig. 13D) with bilobed and setose apex. Maxilliped (Fig. 13E) endite with two triangular terminal spines, one subterminal strong seta and a triangular spine on medial corner. Pleopod 1 and 2 with monospiracular covered lungs. Uropod (Fig. 13F) with exopod flattened and wider than long, endopod longer than exopod.

Male

Pereopod 1 (Fig. 14A) carpus with some strong setae on sternal margin. Pereopod 7 (Fig. 14B) with no distinct sexual

FIG. 14. — *Paraschizidium ferrarai* n. sp., from Gorgona, ♂ paratype: **A**, pereopod 1; **B**, pereopod 7; **C**, pleopod 1; **D**, pleopod 2; **E**, pleopod 3 exopod; **F**, pleopod 4 exopod; **G**, pleopod 5 exopod.

modifications, ischium with straight sternal margin. Pleopod 1 (Fig. 14C) exopod trapezoidal, much wider than long, with crenulate outer margin; endopod with bilobed apex, slightly bent outwards and bearing short setae near medial margin. Pleopod 2 (Fig. 14D) exopod triangular, with one seta on outer margin; endopod much longer than exopod. Pleopod 3-5 exopods as in Fig. 14E-G.

Remarks

At present, the genus *Paraschizidium* comprises four species: *P. coeculum* (Silvestri, 1897) widely distributed from Spain to Croatia and Hungary, *P. hispanum* Arcangeli, 1935 from Spain, *P. roubali* Frankenberger, 1940 from Czech Republic, which is most probably a junior synonym of *P. coeculum* (Manicastri & Taiti 1994), and *P. esterelanum* Juchault & Legrand, 1962 from France. Two more species from Greece (*P. levithae* Sfenthourakis, 1995 and *P. polyvotisi* Sfenthourakis, 1995) are presently included in the genus but they should belong to the genus *Schizidium* Verhoeff, 1901. In fact, Schmalfuss (2008) clearly stated that all the Greek species of *Paraschizidium* possessing a schisma on the pereonite 1 should be transferred to the genus *Schizidium*, even if he forgot to include those two species in the list of *Schizidium* species (S. Sfenthourakis pers. comm.). The new species is readily distinguished from *P. coeculum* and *P. roubali* in having claviform instead of piliform dorsal scale-setae; from *P. hispanum* in having the antennula of three instead of two articles, the male pereopod 7 ischium with straight instead of concave sternal margin, the male pleopod 1 endopod slightly, instead of distinctly, bent outwards. *Paraschizidium ferrarai* n. sp. is similar to *P. esterelanum* in having the antennula of three segments and the same shape of the uropodal exopod; it differs in the male pleopod 1 exopod trapezoidal instead of rectangular, with outer margin crenulate instead of straight, and in the endopod with distinctly bilobed apex. As pointed out by Manicastri & Taiti (1994) the populations reported by Vandel (1962) as *P. olearum*, or at least some of them, might belong to the new species *P. ferrarai* n. sp. (see also Séchet & Noël 2015 and Noël & Séchet 2017).

Genus *Trogleluma* Vandel, 1946

Type species. — *Troglarmadillidium* (*Trogleluma*) *machadoi* Vandel, 1946 by monotypy.

Trogleluma pilosa n. sp.
(Figs 15-17, 21F)

urn:lsid:zoobank.org:act:40EECF8F-2A3C-4FB0-9414-F21F6A4B7267

"*Paraschizidium*" sp. – Taiti & Ferrara 1989: 81, fig. 5.

Trogleluma sp. – Taiti 2007: 96.

Type material. — **Holotype.** ♂, Poggio Capalbiaccio, Prov. Grosseto, 42°27'N, 11°22'E, oak wood, under deeply enbedded stones, leg. F. Ferrara, S. Taiti and A. Poggesi, 5.XI.1984 (MZUF 1772).

Paratypes. 3 ♀, same data as holotype (MZUF 1772); 1 ♀, Poggio Forane, Prov. Grosseto, 42°31'N, 11°22'E, downy oak wood, under deeply enbedded stones, leg. A. Poggesi, F. Ferrara and S. Taiti, 5.XI.1984 (MZUF 9676); 1 ♀, Parco Naturale della Maremma, near San Rabano, Prov. Grosseto, 42°38'06"N, 11°05'49"E, under deeply enbedded stones, leg. S. Vanni, 23.IV.1986 (MZUF 7639).

Diagnosis. — A blind, colourless species of *Trogleluma* characterized by dorsal surface covered with piliform scale-setae, uropodal exopod with parallel sides, male pereopod 7 ischium with concave sternal margin, male pleopod 1 exopod triangular with broadly rounded apex and some setae near inner margin.

Etymology. — From the Latin *pilosus* = hairy. The name refers to the dorsal surface covered with long piliform scale-setae.

Description

Maximum length: ♂, 5 mm; ♀, 5.5 mm. Body colourless, strongly convex, able to roll up into a perfect ball (Fig. 15A), dorsally covered with long piliform scale-setae (Fig. 15B); one line of noduli laterales per side on pereonites, more or less at the same distance from lateral margin (Fig. 15A). Cephalon (Fig. 15C, D) with a V-shaped scutellum and continuous frontal line; antennary lobes oblique; eyes absent. Pereonite 1 (Fig. 15E) with posterior margin slightly concave at sides; no schisma on postero-lateral margin and with small ventral tooth. Telson (Fig. 15F) subtriangular, as wide as long, with slightly concave sides and rounded apex. Antennula (Fig. 15G) of three articles, second article shortest, two subapical rows with nine aestethacs in total and pointed apex. Antenna (Fig. 15H) with fifth article of peduncle slightly longer than flagellum; second flagellar article about three times as long as first bearing three rows of aesthetascs. Mandibles (Fig. 16A, B) with molar penicils semidichotomized and 2 + 3 penicils on the left and 1 + 3 on the right mandible. Maxillula (Fig. 16C) outer branch with 4 + 6 (5 cleft) teeth, inner branch with two slender penicils. Maxilla (Fig. 16D) with bilobed and setose apex, outer lobe wider than inner one. Maxilliped (Fig. 16E) endite with two triangular terminal spines, one subterminal strong seta. Pleopod 1 and 2 exopods with monospiracular covered lungs. Uropod (Fig. 16F) protopod as long as exopod; exopod rectangular, flattened, longer than wide with parallel sides; endopod slightly longer than exopod.

Male

Pereopod 1 (Fig. 17A) with some strong setae on sternal margin of merus and carpus. Pereopod 7 (Fig. 17B) ischium with concave sternal margin. Pleopod 1 (Fig. 17C) exopod triangular with broadly rounded apex and some setae near inner margin; endopod with pointed apex, slightly bent outwards and bearing a row of short setae. Pleopod 2 (Fig. 17D) exopod triangular much longer than wide; endopod elongated and much longer than exopod. Pleopod 3-5 exopods as in Fig. 17E-G.

Remarks

Trogleluma was erected by Vandel (1946) as a subgenus of *Troglarmadillidium* Verhoeff, 1900 to include the new spe-

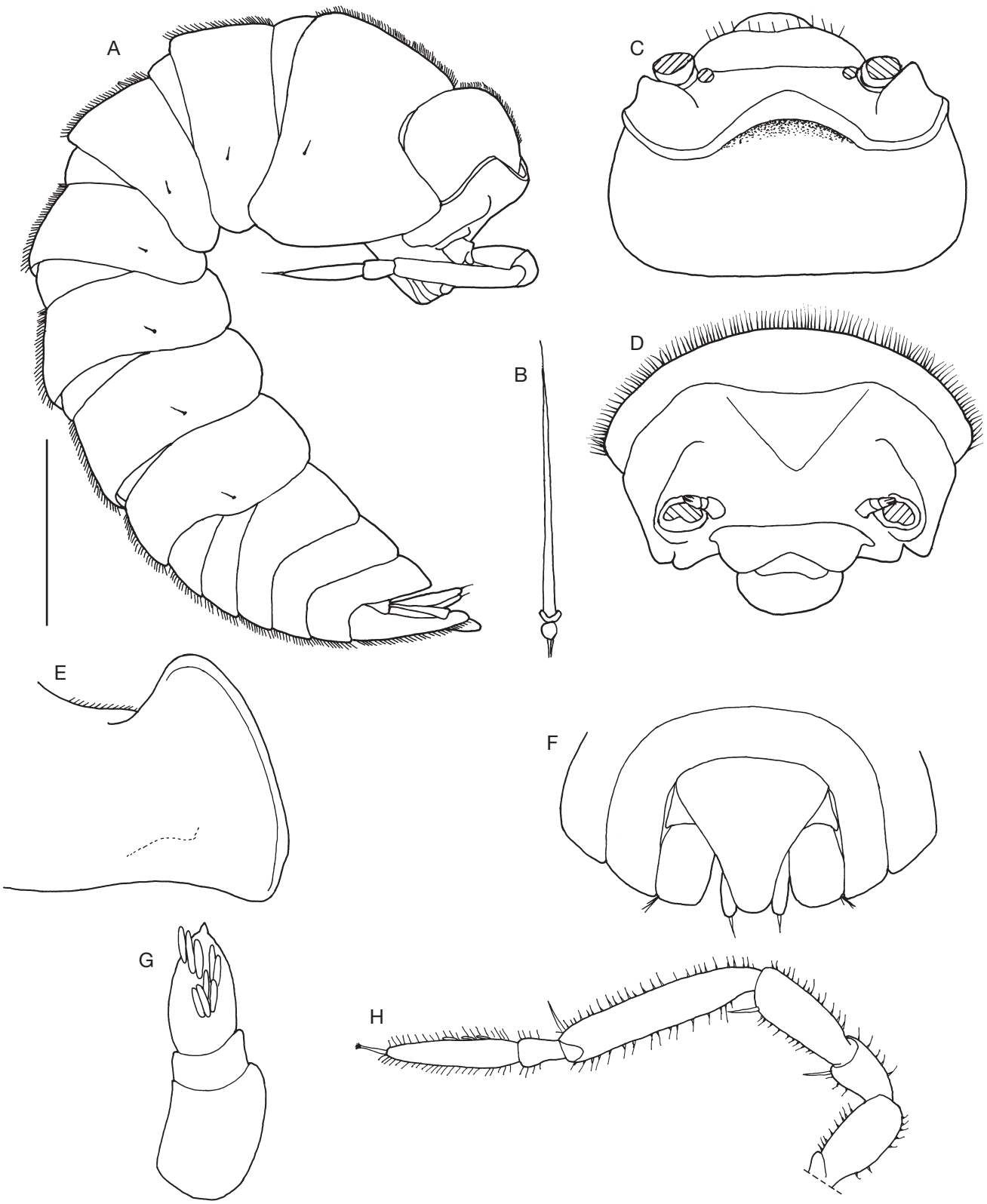

Fig. 15. — *Trogleluma pilosa* n. sp., from Poggio Capalbiaccio, ♀ paratype: **A**, adult specimen, lateral view; **B**, dorsal scale-seta; **C**, cephalon, frontal view; **D**, cephalon, dorsal view; **E**, epimeron of pereonite 1, dorsal view; **F**, telson and uropods, dorsal view; **G**, antennula; **H**, antenna. Scale bar: A, 1 mm.

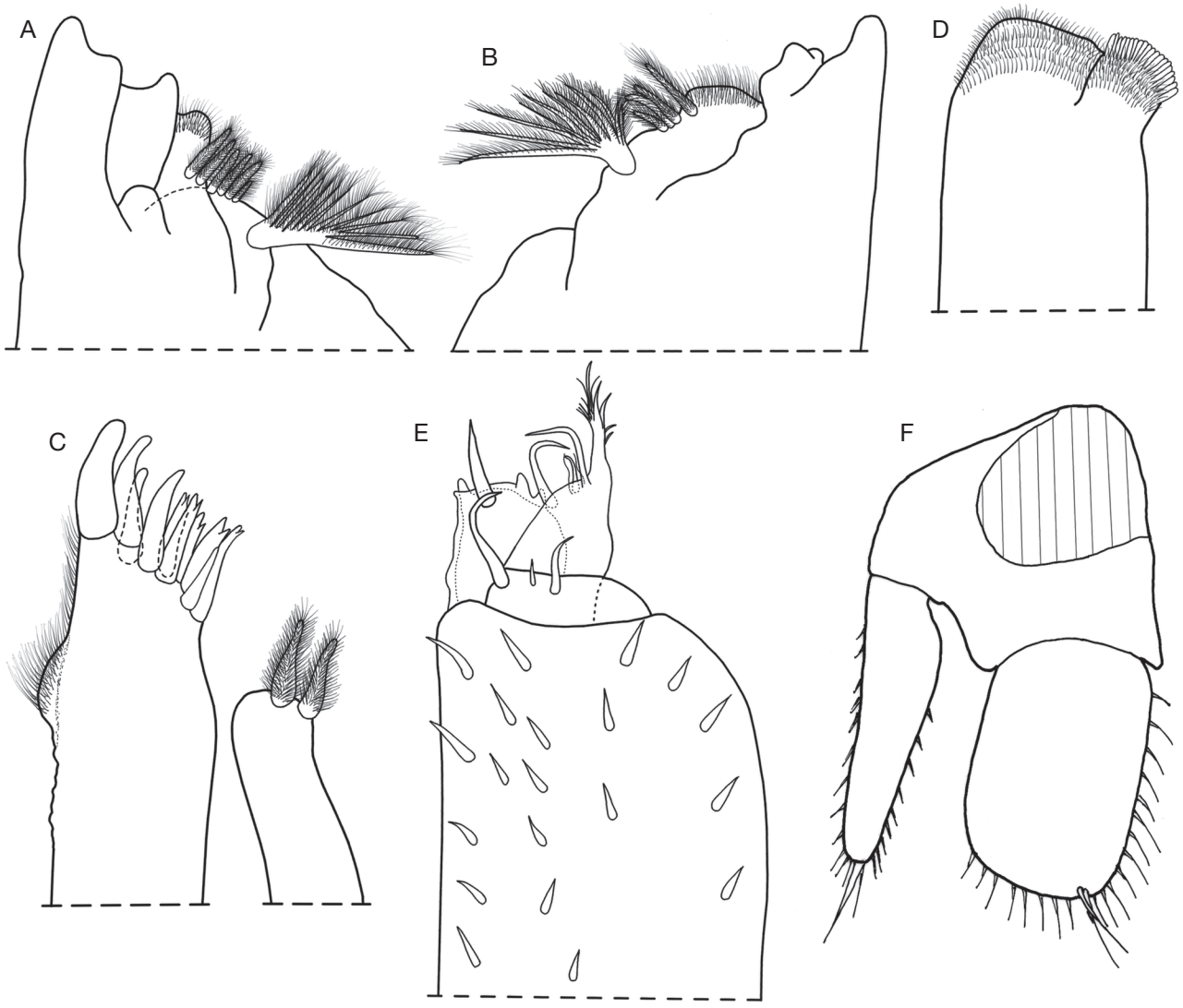

Fig. 16. — *Trogleluma pilosa* n. sp., from Poggio Capalbiaccio, ♀ paratype: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped; **F**, left uropod.

cies *Troglarmadillidium* (*Trogleluma*) *machadoi* from caves in southern Portugal. Reboleira *et al.* (2015) raised it to genus level and redescribed the type species which is the only species in the genus presently known. The new species differs from *T. machadoi* in having piliform instead of triangular dorsal scale-setae, the telson with more rounded apex, the male pereopod 7 ischium with concave, instead of straight, sternal margin, the male pleopod 1 exopod with a more pronounced distal part, and the male pleopod 2 exopod with slightly, instead of deeply, concave outer margin (compare Figs 15-17 with Reboleira *et al.* 2015: figs 33, 34). The record of this new species considerably enlarges the distribution of the genus.

Genus *Alloschizidium* Verhoeff, 1919

Type species. — *Armadillidium pruvoti* Racovitza, 1907 by monotypy.

Remarks

Schmalfuss (2008) pointed out that all the genera of Armadillidiidae possessing a schisma on the pereonite 1 (*Eluma* Budde-Lund, 1885, *Ballodillium* Vandel, 1961, and *Alloschizidium*) fall within his definition of the genus *Schizidium* Verhoeff, 1901. However, he was not certain that all these genera belong to a monophyletic group and the presence of the schisma might be due to convergence. Therefore, he kept *Schizidium* as a separate genus distributed from Greece to Iran. The genus *Alloschizidium* appears to be very similar to *Paraschizidium*, with a possible synapomorphic character for these two genera being the subovoidal, instead of spherical, shape of the ball when the animals roll up (see also discussion in Taiti & Ferrara 1996). Then, the autapomorphic characters for *Alloschizidium* compared with *Paraschizidium* is the presence of the schisma. As remarked by Schmalfuss (2008) a molecular investigation might help to clarify the interrelationships among all the above mentioned genera.

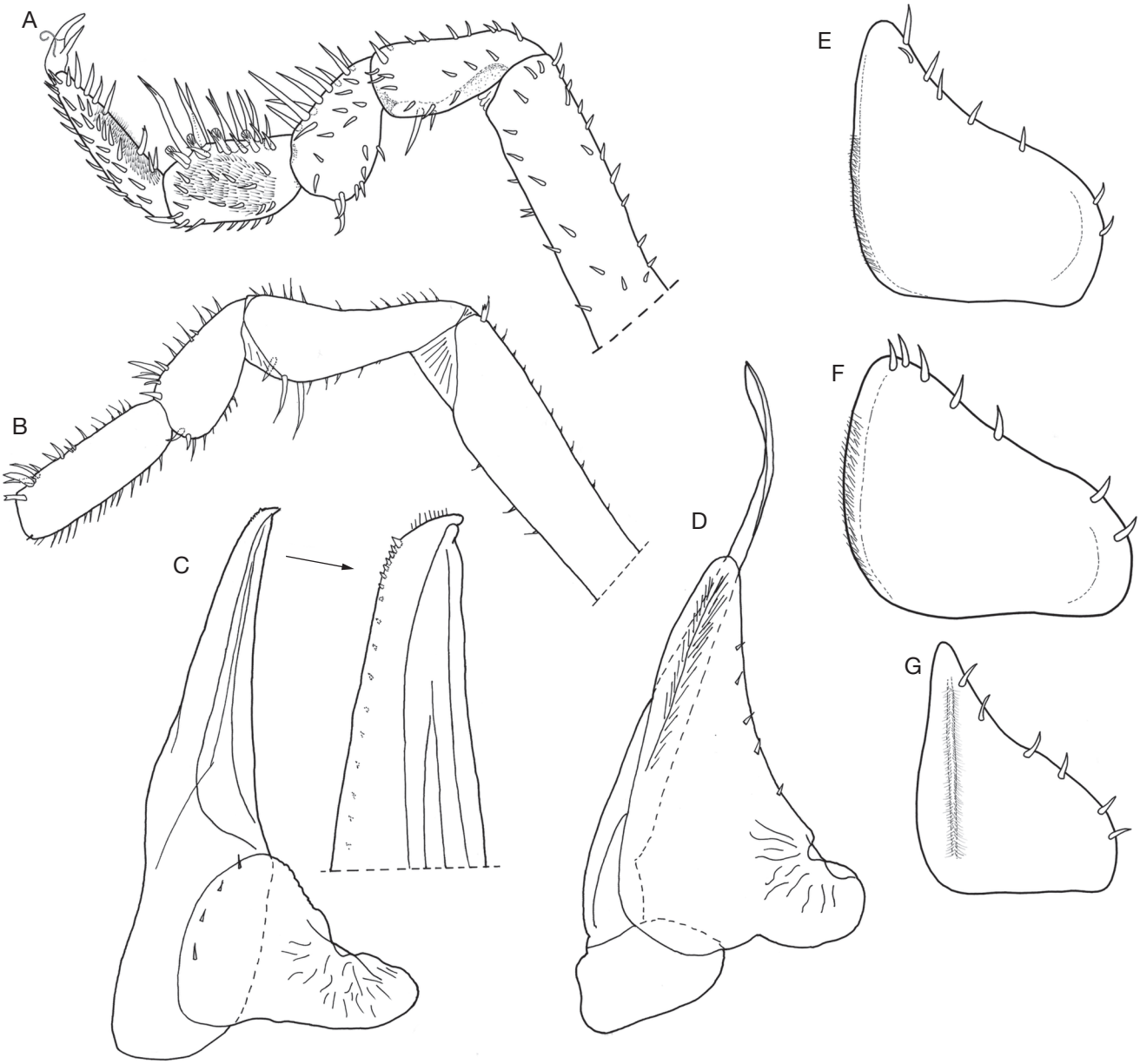

Fig. 17. — *Trogleluma pilosa* n. sp., from Poggio Capalbiaccio, ♂ holotype: **A**, perepod 1; **B**, pereopod 7; **C**, pleopod 1; **D**, pleopod 2; **E**, pleopod 3 exopod; **F**, pleopod 4 exopod; **G**, pleopod 5 exopod.

Alloschizidium labronicum n. sp.
(Figs 18-20, 21G)

urn:lsid:zoobank.org:act:3B200712-4876-4ED3-BEA3-1607966B9900

Type material. — **Holotype.** ♂, Ponte Maroccone, Antignano, 1.5 km S of Antignano, 43°28'47"N, 10°20'02"E, 20 m a.s.l., holm oak wood, under deeply enbedded stones, leg. S. Taiti, 29.III.1986 (MZUF 9677). **Paratypes.** 2 ♀, same data as holotype (MZUF 9677); 1 ♀, near Livorno, holm oak wood, leg. S. Zoia, 28.V.1980 (MZUF 9678).

Diagnosis. — A blind, colourless species of *Alloschizidium* characterized by piliform dorsal scale-setae, cephalon with reduced postscutellar line, telson trapezoidal, as wide as long with truncate apex, uropodal exopod as wide as long, male pleopod 1 exopod with broadly rounded medial margin.

Etymology. — From the Latin name *labronicus* = inhabitant of *Labro*, cited in a letter by Marcus Tullius Cicero, and which refers to the Tuscan town of Leghorn (Livorno in Italian).

Description
Maximum length: ♂, 3 mm; ♀, 4 mm. Body colourless, strongly convex with vertical epimera, able to roll up into a perfect ball (Fig. 18A). Back smooth covered with piliform scale-setae (Fig. 18B). Cephalon (Fig. 18C, D) with triangular scutellum slightly depressed in the middle and distinctly

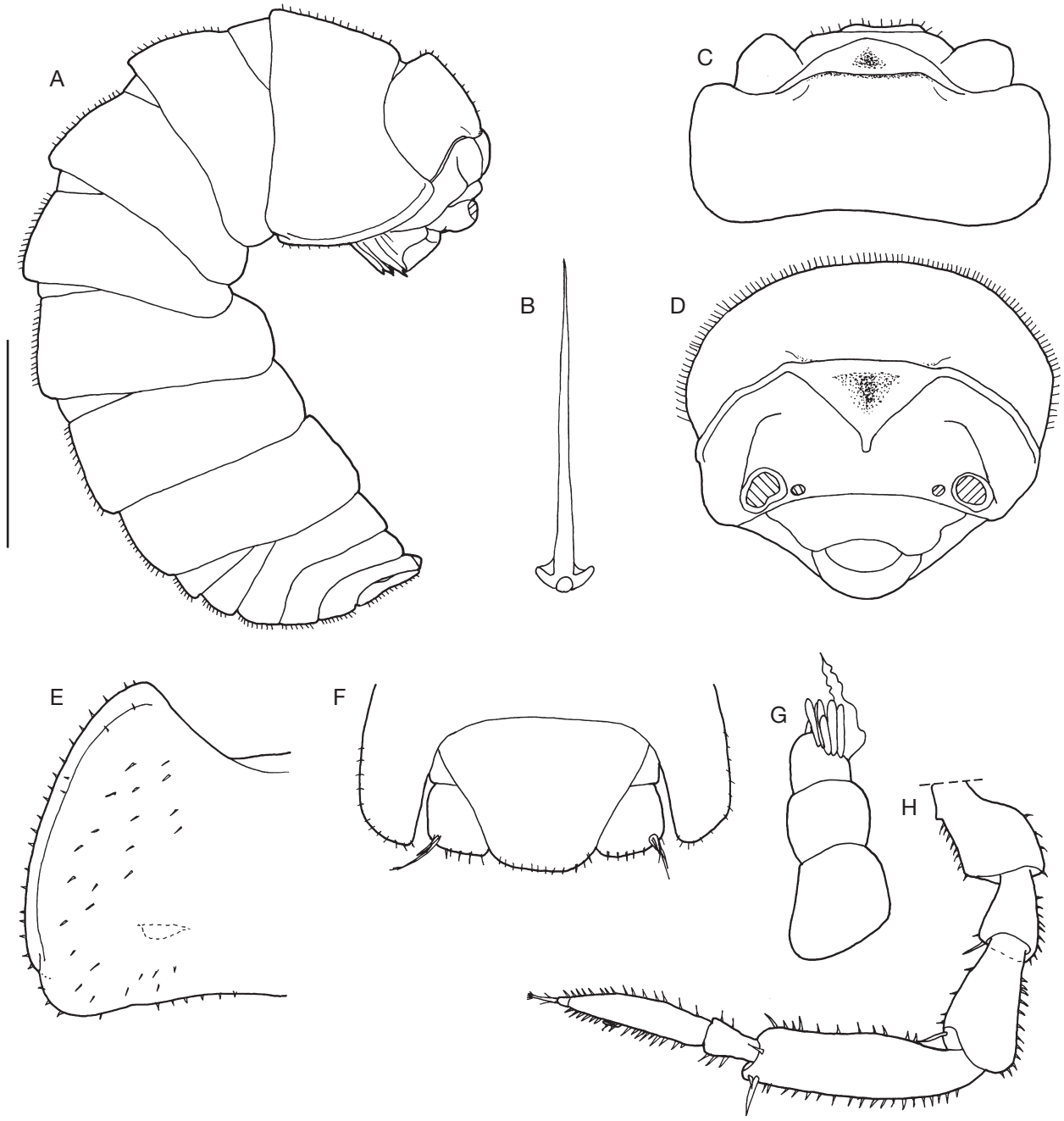

Fig. 18. — *Alloschizidium labronicum* n. sp., from Maroccone, ♀ paratype: **A**, adult specimen, lateral view; **B**, dorsal scale-seta; **C**, cephalon, frontal view; **D**, cephalon, dorsal view; **E**, epimeron of pereonite 1, dorsal view; **F**, telson and uropods, dorsal view; **G**, antennula; **H**, antenna. Scale bar: A, 1 mm.

separated from vertex but not protruding above it; frontal line continuing the scutellar upper margin; postscutellar line reduced; antennary lobes quadrangular, obliquely directed frontwards; eyes absent. Pereonite 1 (Fig. 18E) with posterior margin slightly concave; postero-lateral schisma with outer lobe rounded and distinctly protruding backwards; lateral margin slightly thickened. Pereonites 1-3 with small rounded ventral tooth. Telson (Fig. 18F) trapezoidal, almost as long as wide, with slightly concave sides and truncate apex. Antennula (Fig. 18G) of three articles, tuft of about five aesthetascs. Antenna (Fig. 18H) with flagellum as long as fifth article of peduncle; second flagellar article about three times as long as first and bearing 1 + 1 + 3 aesthetascs. Mandibles (Fig. 19A, B) with molar penicil consisting of many setae and 2 + 2 free penicils on the left and 1 + 2 on the right mandible. Maxillula (Fig. 19C) outer branch with 4 + 6 (5 slightly cleft) teeth, inner branch with two stout penicils. Maxilla (Fig. 19D) with bilobed and setose apex.

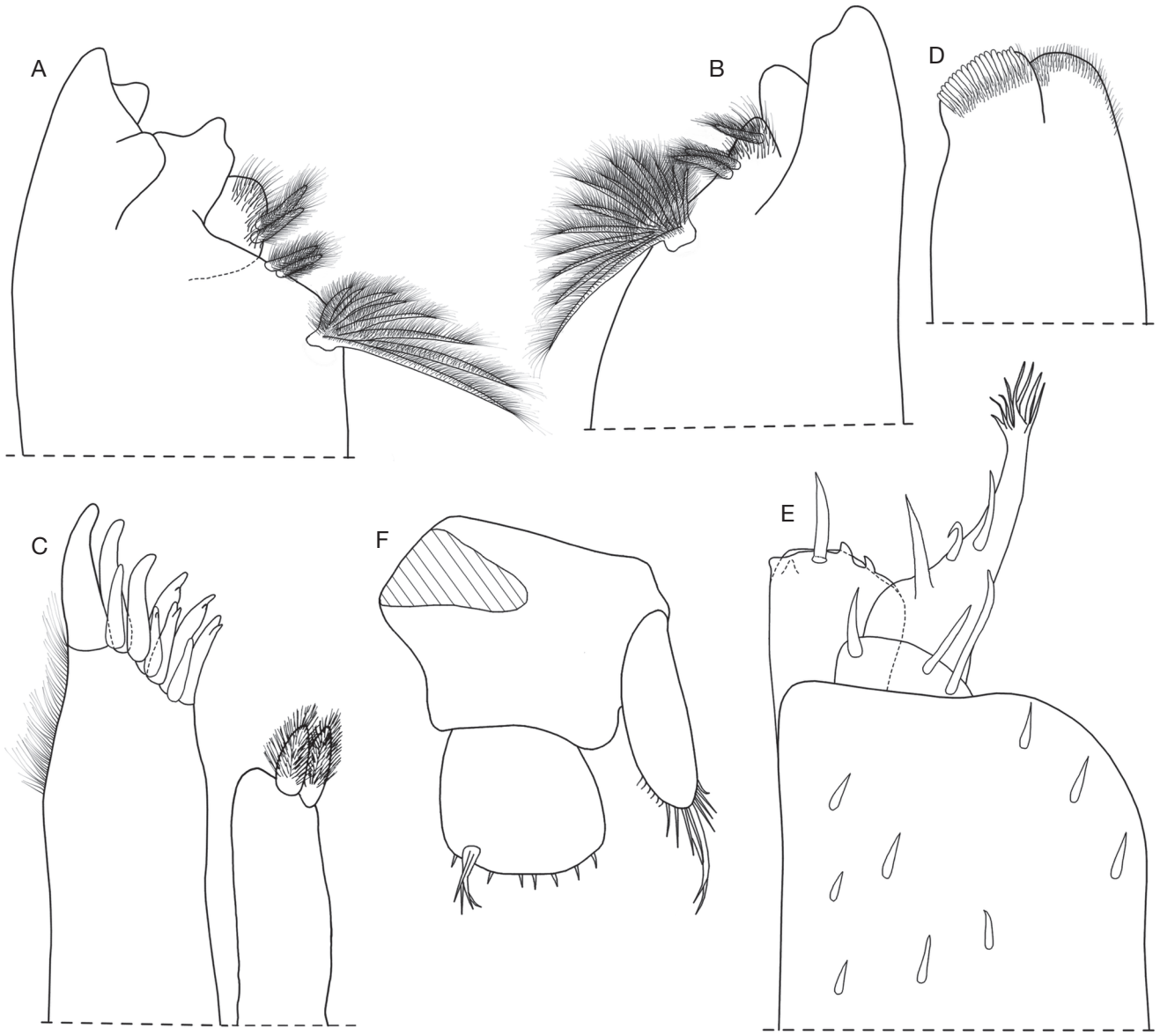

Fig. 19. — *Alloschizidium labronicum* n. sp., from Maroccone, ♀ paratype: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped; **F**, uropod.

Maxilliped (Fig. 19E) endite with two triangular terminal spines, one subterminal strong seta and triangular spine on medial margin. Pleopod 1 and 2 exopods with monospiracular covered lungs. Uropod (Fig. 19F) with exopod flattened, almost as long as wide; endopod longer than exopod.

Male

Pereopod 1 (Fig. 20A) carpus with two lines of strong setae with multipointed apices near sternal margin. Pereopod 7 (Fig. 20B) with no distinct sexual modifications, ischium with straight sternal margin. Pleopod 1 (Fig. 20C) exopod about twice as wide as long, with broadly rounded medial margin; endopod with apical part thickset, straight, and bearing a row of short setae. Pleopod 2 (Fig. 20D) exopod triangular with slightly concave outer margin bearing single seta; endopod narrow and distinctly longer than exopod. Pleopod 3-5 exopods as in Fig. 20E-G.

Remarks

The genus *Alloschizidium* comprises 12 species with a Tyrrhenian distribution (Schmalfuss 2003; Taiti & Argano 2009). In having the dorsal surface covered with piliform scale-setae, the new species resembles *A. sardoum* (Arcangeli, 1933) from Sardinian caves, *A. remyi* (Vandel, 1944) from Corsica, *A. eeae* Argano & Utzeri, 1973 from Ponza Island, and *A. cavernicolum* Taiti & Ferrara, 1995 from a cave in southern Tuscany.

Fig. 20. — *Alloschizidium labronicum* n. sp., from Maroccone, ♂ holotype: **A**, pereopod 1; **B**, pereopod 7; **C** pleopod 1; **D**, pleopod 2; **E**, pleopod 3 exopod; **F**, pleopod 4 exopod; **G**, pleopod 5 exopod.

It differs from *A. sardoum* and *A. eeae* in having shorter telson and uropodal exopods as wide as long instead of longer than wide; from *A. sardoum*, *A. remyi* and *A. eeae* in the male pleopod 1 exopod without posterior point; from *A. remyi* also in the absence of any trace of eyes (a single ocellum in *A. remyi* is distinctly visible, see Taiti & Ferrara 1996).

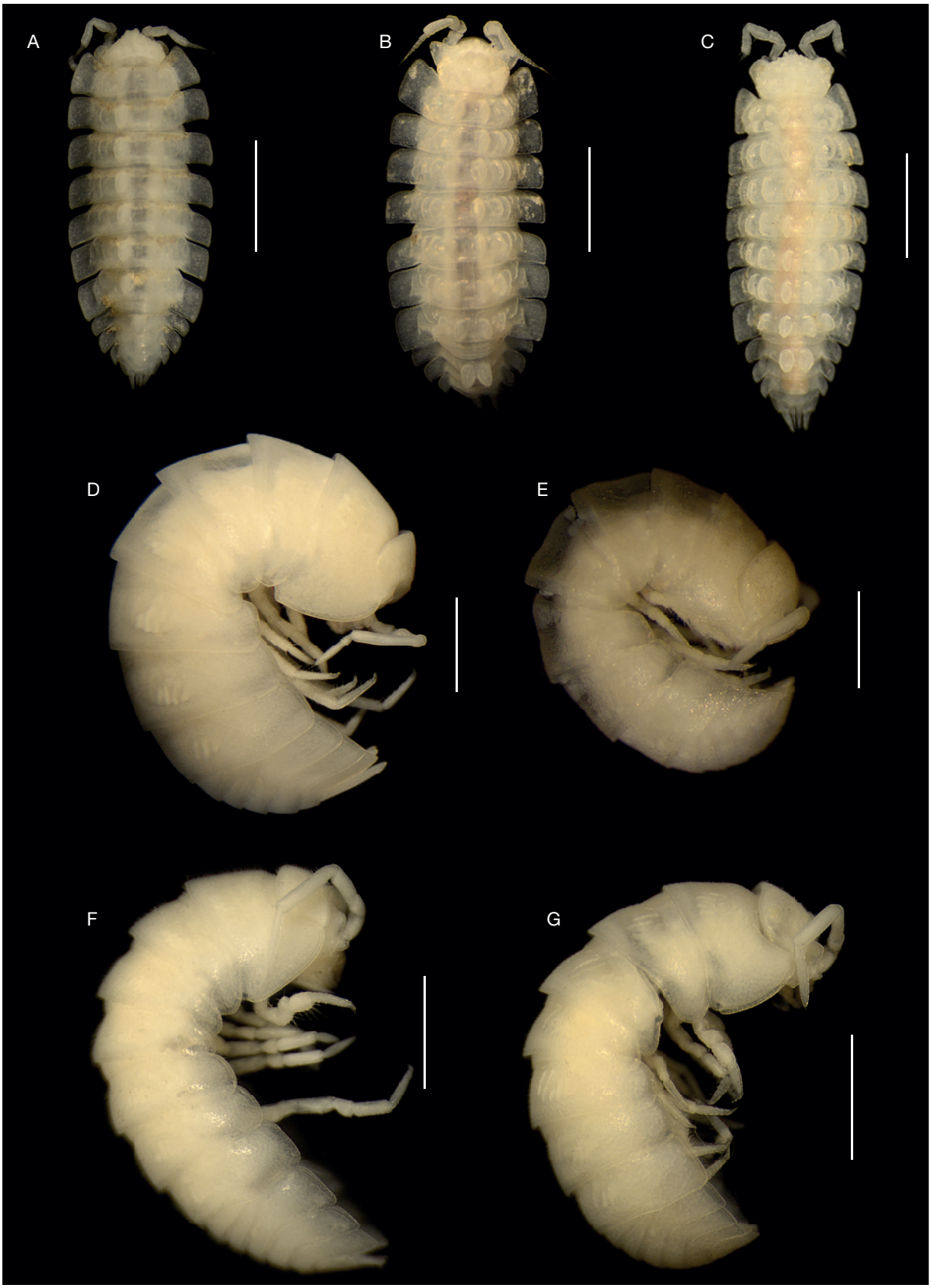

Fig. 21. — **A**, *Leucocyphoniscus pisanus* n. sp., ♀ paratype from Buca delle Fate di Cima Sugheretta, Monte Pisano; **B**, *Moserius gruberae* n. sp., ♀ paratype from Grotta del Cane di Uliveto, Monte Pisano; **C**, *Moserius talamonensis* n. sp., ♀ paratype from Grotta Gianninoni, Uccellina; **D**, *Typhlarmadillidium occidentale* n. sp., ♀ paratype from Grotta del Cane, Monte Pisano; **E**, *Paraschizidium ferrarai* n. sp., ♀ paratype, from Gorgona; **F**, *Trogleluma pilosa* n. sp., ♀ paratype from Poggio Capalbiaccio; **G**, *Alloschizidium labronicum* n. sp., ♀ paratype from Maroccone. Scale bars: A-D, F, G, 1 mm; E, 0.5 mm.

TABLE 1. — List of subterranean and endogean species of Oniscidea from Tuscany (trogloxenous species not included) (from Taiti & Ferrara 1989; 1995). Tuscan endemic species are marked with *.

	Troglobiont	Troglophile	Endogean
Trichoniscidae			
1. *Finaloniscus franciscoloi* (Brian, 1951)	–	×	–
2. *Oritoniscus* cf. *ocellatus* Vandel, 1953	–	×	–
3. *Spelaeonethes mancinii* (Brian, 1913)	–	×	–
4. *Androniscus dentiger* Verhoeff, 1908	–	×	–
5. *Nesiotoniscus sebaouensis* Vandel, 1955	–	×	–
6. *Trichoniscus baschierii* Brian, 1953*	×	–	–
7. *Trichoniscus matulici* Verhoeff, 1901	–	×	–
8. *Trichoniscus jeanneli* Vandel, 1955	×	–	–
9. *Trichoniscus fragilis* Racovitza, 1908	–	×	–
10. *Trichoniscus maremmanus* Taiti & Ferrara, 1995*	–	×	–
11. *Trichoniscus apenninicus* Taiti & Ferrara, 1995*	–	×	–
12. *Leucocyphoniscus pisanus* n. sp.*	×	–	–
13. *Moserius elbanus* Taiti & Ferrara, 1995*	×	–	–
14. *Moserius gruberae* n. sp.*	×	–	–
15. *Moserius percoi* Strouhal, 1940	×	–	–
16. *Moserius talamonensis* n. sp.*	×	–	–
17. *Buddelundiella sanfilippoi* Brian, 1951	–	×	–
Philosciidae			
18. *Chaetophiloscia cellaria* (Dollfus, 1884)	–	×	–
Cylisticidae			
19. *Cylisticus bergomatius* Verhoeff, 1928	–	×	–
20. *Cylisticus caprariae* Ferrara & Taiti, 1978*	–	–	×
21. *Cylisticus igiliensis* Taiti & Ferrara, 1980*	–	–	×
22. *Cylisticus littoralis* Ferrara & Taiti, 1978*	–	–	×
23. *Cylisticus* cf. *lobatus* Strouhal, 1953	–	–	×
24. *Cylisticus nasutus* Verhoeff, 1931*	–	×	–
25. *Cylisticus urgonis* Taiti & Ferrara, 1980*	–	–	×
26. *Cylisticus suberorum* Verhoeff, 1931*	–	–	×
Porcellionidae			
27. *Porcellio dilatatus dilatatus* Brandt, 1831	–	×	–
Armadillidiidae			
28. *Typhlarmadillidium occidentale* n. sp.*	×	–	–
29. *Paraschizidium coeculum* (Silvestri, 1897)	–	–	×
30. *Paraschizidium ferrarai* n. sp.*	–	–	×
31. *Trogleluma pilosa* n. sp.*	–	–	×
32. *Alloschizidium cavernicolum* Taiti & Ferrara, 1995*	×	–	–
33. *Alloschizidium igiliense* (Ferrara & Taiti, 1978)*	–	–	×
34. *Alloschizidium labronicum* n. sp.*	–	–	×
Total	9	14	11

DISCUSSION

Previous to the present paper, the cavernicolous Oniscidea of Tuscany were recorded by Taiti & Ferrara (1995) and the endogean species by Ferrara & Taiti (1978) and Taiti & Ferrara (1980, 1989). With the new species described herein, the subterranean and endogean fauna of Tuscan Oniscidea comprises 34 species (Table 1): nine troglobionts, 14 troglophiles and 11 endogeans (trogloxenous species are not included). Nineteen species are endemic to Tuscany. The distributions of the new species are presented in Fig. 22.

Considering their systematic affinities, the new subterranean and endogean species from Tuscany show a different origin. Three species of Trichoniscidae Haplophthalminae (*Leucocyphoniscus pisanus* n. sp., *Moserius gruberae* n. sp. and *M. talamonensis* n. sp.) have an Alpine-Appenninic origin, while two species of Armadillidiidae (*Paraschizidium ferrarai* n. sp. and *Alloschizidium labronicum* n. sp.) have a Tyrrhenian origin. *Trogleluma pilosa* n. sp. is the second species of the genus, previously known only from caves in southern Portugal. The genus shows a West-Mediterranean-Atlantic distribution as confirmed by other new species from Sardinia which will be described in a paper in preparation. *Typhlarmadillidium occidentale* n. sp. belongs to a genus previously known from Croatia, Herzegowina, Montenegro and north-eastern Italy. The record from caves in Monte Pisano, northwestern Tuscany, represent the most western range of the genus distribution.

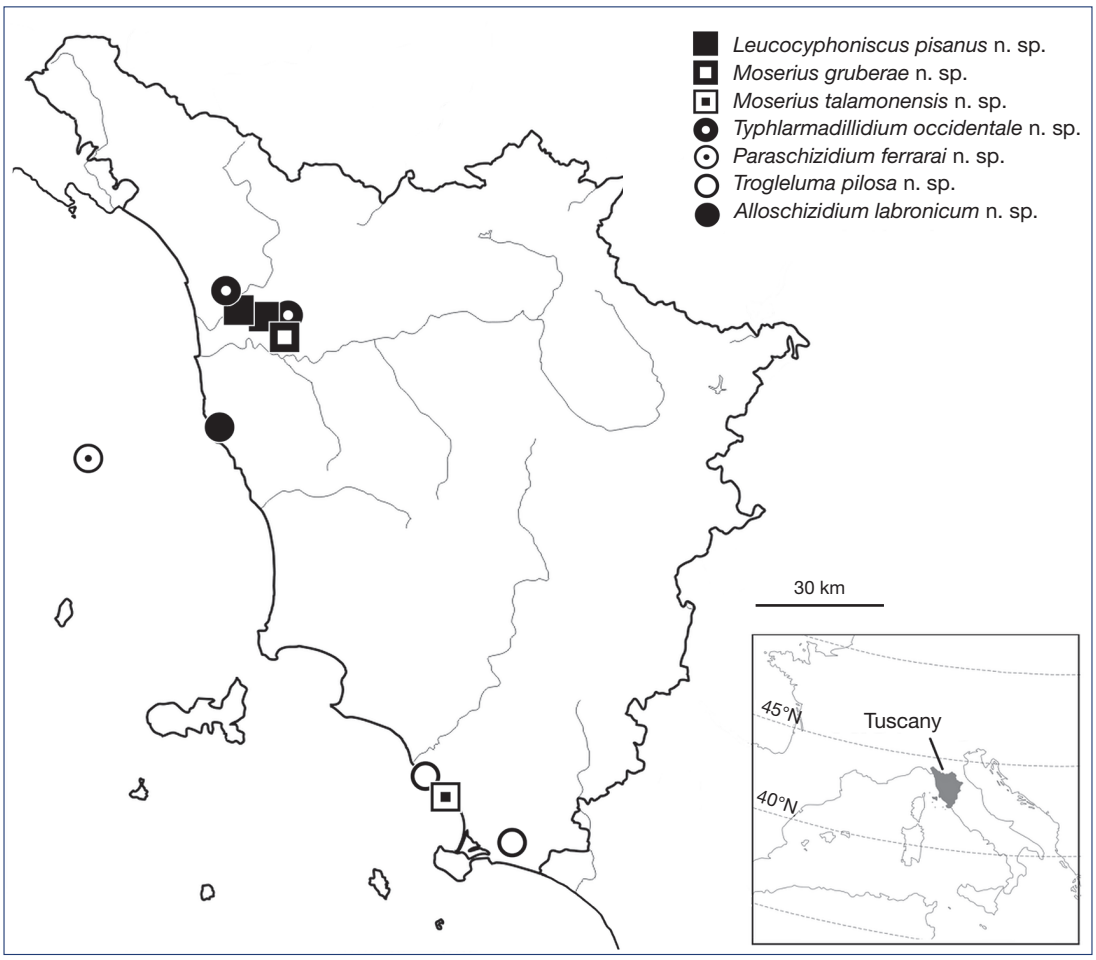

Fig. 22. — Distributions of the seven new species of Oniscidea in Tuscany (central Italy).

Acknowledgements
We wish to thank Paolo Mannucci and the Gruppo Speleologico C.A.I., Pisa, and Dr Daniele Sgherri and the Società Naturalistica Speleologica Maremmana, Grosseto, for their assistance during sampling in caves of Monte Pisano and Parco Naturale della Maremma, respectively. The two reviewers, Dr Helmut Schmalfuss and Prof. Spyros Sfenthoursakis, are particularly acknowledged for their precious suggestions that greatly improved the text.

REFERENCES

Arcangeli A. 1923. — Revisione del gruppo degli Haplophthalmi, isopodi terrestri. *Archivio zoologico italiano* 10: 259-322, pls 7-8.
Andreev S. 2013a. — A New Cave Species of Genus *Alpioniscus* (Isopoda: Trichoniscidae) from Albania. *Acta Zoologica Bulgarica* 65: 263-264.
Andreev S. 2013b. — A New Cave Species, *Alpioniscus gueorguievi* n. sp. (Isopoda, Oniscidea, Trichoniscidae) from continental Greece. *Acta Zoologica Bulgarica* 65: 297-298.
Arcangeli A. 1933. — Due nuove specie cieche della famiglia Armadillidiidae (isopodi terrestri). *Archivio Zoologico Italiano* 19: 389-403, pls 5, 6.
Argano R. & Utzeri C. 1973. — Oniscoidea delle Isole Ponziane: Eluminae (Crustacea, Isopoda, Armadillidiidae). *Fragmenta Entomologica* 9: 143-155.
Bedek J. & Taiti S. 2009. — A new species of *Strouhaloniscellus* Tabacaru, 1993 (Crustacea: Isopoda: Oniscidea) from a cave in Mt Biokovo, Croatia. *Zootaxa* 2196: 59-64.
Campos-Filho I. S. & Araujo P. B. 2011. — Two new troglobitic species of Scleropactidae (Crustacea: Isopoda: Oniscidea) from Pará, Brazil. *Nauplius* 19 (1): 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 from Brazilian caves. *Zoological Journal of the 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): 1-19. 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* Arcangeli, 1929 (Isopoda: Oniscidea) from Brazil, with considerations on the family placement of the genus. *North-Western Journal of Zoology* 13: 227-233.

CAMPOS-FILHO I., BICHUETTE M. E., MONTESANTO G., ARAUJO P. B. & TAITI S. 2017b. — The first troglobiotic species of the family Pudeoniscidae (Crustacea, Isopoda, Oniscidea), with descriptions of a new genus and two new species. *Subterranean Biology* 23: 69-84. https://doi.org/10.3897/subtbiol.23.20963

CARDOSO G. M., ARAUJO P. B. & BICHUETTE M. E. 2017. — Two new species of *Neotroponiscus* Arcangeli, 1936 (Crustacea, Isopoda, Oniscidea) from Brazilian caves. *Studies on Neotropical Fauna and Environment* 52 (2): 122-130. https://doi.org/10.1080/01650521.2017.1299440

CARUSO D. & BOUCHON D. 2011. — *Armadillidium virgo* n. sp. from caves in southeastern Sicily: is it a parthenogenetic species? (Crustacea, Isopoda, Oniscidea). *Italian Journal of Zoology* 78: 96-100. https://doi.org/10.1080/11250003.2010.490792

FERRARA F. & TAITI S. 1978. — Gli Isopodi terrestri dell'Arcipelago Toscano. Studio sistematico e biogeografico. *Redia* 61: 1-106.

FERRARA F. & TAITI S. 1996. — *Typhlarmadillidium ruffoi* nuova specie di isopodo terrestre dei Colli Euganei (Padova) (Crustacea, Oniscidea, Armadillidiidae). *Bollettino del Museo civico di Storia naturale di Verona* 20: 727-732.

GARCIA L. 2008. — *Trichoniscus perezi* sp. n. (Oniscidea: Synocheta: Trichoniscidae), un nuevo isópodo terrestre cavernicola de Jaén (Andalucía oriental, Sur de la Península Ibérica). *Endins* 32: 175-180.

GIACHINO P. M. & VAILATI D. 2005. — Problemi di protezione dell'ambiente ipogeo e note sull'impatto delle attività di ricerca in ambiente sotterraneo. *In* L'Ambiente Carsico e l'Uomo. *Atti del Convegno Nazionale*, Bossea (5-8 settembre 2003): 303-314.

GIACHINO P. M. & VAILATI D. 2010. — *The Subterranean Environment. Hypogean life, concepts and collecting techniques*. WBA Handbooks, Verona, 132 p.

GONGALSKY K. B. & TAITI S. 2014. — A new cavernicolous species of *Typhloligidium* Verhoeff, 1918 (Isopoda: Oniscidea: Ligiidae) from the Caucasus. *Arthropoda Selecta* 23: 51-56.

JAVIDKAR M., COOPER S. J. B., KING R., HUMPHREYS W. F., BERTOZZI T., STEVENS M. I. & AUSTIN A. D. 2016. — Molecular systematics and biodiversity of oniscidean isopods in the groundwater calcretes of central Western Australia. *Molecular Phylogenetics and Evolution* 104: 83-98. https://doi.org/10.1016/j.ympev.2016.07.026

KASHANI G. M., MALEKHOSSEINI M.-J. & SADEGH S. 2013. — First recorded cave-dwelling terrestrial isopods (Isopoda: Oniscidea) in Iran with a description of a new species. *Zootaxa* 3734: 591-596. https://doi.org/10.11646/zootaxa.3734.5.8

MANICASTRI C. & TAITI S. 1994. — Gli isopodi terrestri dell'Appennino umbro-marchigiano (Crustacea, Oniscidea). *Biogeographia* 17: 125-150. https://doi.org/10.21426/B617110331

MONTESANTO G. 2015. — A fast GNU method to draw accurate scientific illustrations for taxonomy. *Zookeys* 515: 191-206. https://doi.org/10.3897/zookeys.515.9459

MONTESANTO G. 2016. — Drawing setae: a GNU way for digital scientific illustrations. *Nauplius* 24: e2016017. https://doi.org/10.1590/2358-2936e2016017

NOËL F. & SÉCHET E. 2017. — Inventaire actualisé des Isopodes terrestres (Crustacea, Isopoda, Oniscidea) du Parc national de Port-Cros et de l'aire optimale d'adhésion (Var, Provence, France).

RACOVITZA E. 1907. — Biospéologica. IV. Isopodes terrestres (première série). *Archives de Zoologie expérimentale et générale, 4e Série* 7: 145-225.

RACOVITZA E. 1908. — Biospéologica. IX. Isopodes terrestres (seconde série). *Archives de Zoologie expérimentale et générale, 4e Série* 9: 239-415.

REBOLEIRA A. S. P. S., GONÇALVES F., OROMÍ P. & 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 G. O. 1899. — *An account of the Crustacea of Norway with short descriptions and figures of all the species. Vol. 2. Isopoda, Tribe 5. Oniscoida*. A. Cammermeyer Forlag, Bergen: 153-192, pls 70-83.

SCHMALFUSS H. 2003. — World catalog of terrestrial isopods (Isopoda: Oniscidea). *Stuttgarter Beiträge zur Naturkunde, Serie A* 654: 1-341.

SCHMALFUSS H. 2008. — The terrestrial isopod genus *Schizidium* (Isopoda: Oniscidea): systematics, distribution, morphology. *Stuttgarter Beiträge zur Naturkunde, A, Neue Serie* 1: 143-151.

SÉCHET E. & NOËL F. 2015. — Catalogue commenté des Crustacés Isopodes terrestres de France métropolitaine (Crustacea, Isopoda, Oniscidea). *Mémoires de la Société Linnéenne de Bordeaux* 16: 1-156.

SOUZA L. A., SENNA A. R. & KURY A. B. 2010. — A new species and first record of *Gabunillo* Schmalfuss & Ferrara, 1983 (Isopoda, Oniscidea, Armadillidae) from the Neotropics. *Zootaxa* 2677: 1-14.

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

STROUHAL H. 1939. — Landasseln aus Balkanhöhlen, gesammelt von Prof. Dr A. Absolon. 7. Mitteilung. *Zoologischer Anzeiger* 126: 68-76.

STROUHAL H. 1940. — *Moserius percoi* nov. gen. nov. spec., eine neue Höhlen-Höckerassel, nebst einer Übersicht über die Halplophthalminen. *Zoologischer Anzeiger* 129: 13-30.

TAITI S. 2004. — Crustacea: Isopoda: Oniscidea (woodlice), *in* GUNN J. (ed.), *Encyclopedia of caves and karst science*. Fitzroy Dearborn, Taylor and Francis Group, New York: 547-551.

TAITI S. 2007. — Gli Isopodi terrestri, *in* SCAPINI F. & NARDI M. (eds), *Il Parco Regionale della Maremma e il suo Territorio*. Pacini Editore, Pisa: 91-101.

TAITI S. 2014. — New subterranean Armadillidae (Crustacea, Isopoda, Oniscidea) from Western Australia. *Tropical Zoology* 27 (4): 153-165. https://doi.org/10.1080/03946975.2014.984510

TAITI S. & ARGANO R. 2009. — New species of terrestrial isopods from Sardinia (Isopoda: Oniscidea), *in* CERRETTI P., MASON F., MINELLI A., NARDI G. & WHITMORE D. (eds). Research on the terrestrial arthropods of Sardinia (Italy). *Zootaxa* 2318: 38-55.

TAITI S. & CHECCUCCI I. 2009. — New species and records of terrestrial Isopoda (Crustacea, Oniscidea) from Socotra Island, Yemen, *in* NEUBERT E., AMR Z., TAITI S. & GÜMÜS B. (eds). *Animal Biodiversity in the Middle East*. Proceedings of the First International Congress, 20-23.XI.2008, Aqaba, Jordan. *ZooKeys* 31: 73-103. https://doi.org/10.3897/zookeys.31.140

TAITI S. & FERRARA F. 1980 — Nuovi studi sugli Isopodi terrestri dell'Arcipelago Toscano. *Redia* 63: 249-300.

TAITI S. & FERRARA F. 1989. — Biogeography and ecology of terrestrial isopods from Tuscany. *Monitore Zoologico Italiano, Monografia* 4: 75-101.

TAITI S. & FERRARA F. 1995. — Isopodi terrestri (Crustacea, Oniscidea) delle grotte della Toscana (Italia Centrale). *Mémoires de Biospéologie* 12: 169-196.

TAITI S. & FERRARA F. 1996. — The terrestrial Isopoda of Corsica (Crustacea, Oniscidea). *Bulletin du Muséum national d'Histoire naturelle, Paris, 4e série* 18: 459-545.

TAITI S. & GRUBER G. A. 2008. — Cave-dwelling terrestrial isopods from southern China (Crustacea, Isopoda, Oniscidea), with descriptions of four new species, *in* LATELLA L. & ZORZIN R. (eds), Research in South China karsts. *Memorie del Museo Civico di Storia Naturale di Verona, Monografie Naturalistiche* 3: 101-123.

TAITI S. & LÓPEZ H. 2008. — New records and species of Halophilosciidae (Crustacea, Isopoda, Oniscidea) from the Canary Islands (Spain), *in* ZIMMER M., CHARFI CHEIKHROUHA F. & TAITI S. (eds). *Proceedings of the International Symposium of Terrestrial Isopod Biology – ISTIB-07*. Shaker-Verlag, Aachen: 43-58.

TAITI S. & ROSSANO C. 2015. — Terrestrial isopods from the Oued Laou basin, north-eastern Morocco (Crustacea: Oniscidea), with descriptions of two new genera and seven new species. *Journal of Natural History* 49: 2067-2138. https://doi.org/10.1080/00222933.2015.1009512

TAITI S. & WYNNE J. J. 2015. — The terrestrial Isopoda (Crustacea, Oniscidea) of Rapa Nui (Easter Island), with descriptions of two new species. *Zookeys* 515: 27-49. https://doi.org/10.3897/zookeys.515.9477

TAITI S. & XUE Z. 2012. — The cavernicolous genus *Troglonicus* nomem novum, with descriptions of four new species from southern China (Crustacea, Oniscidea, Styloniscidae). *Tropical Zoology* 25 (4): 183-209. https://doi.org/10.1080/03946975.2012.751240

TURBANOV I. S. & GONGALSKY K. B. 2016. — *Typhloligidium lithophagum* sp. n. (Isopoda, Oniscidea, Ligiidae), a new species of troglobiotic woodlouse from the Crimean peninsula. *Zoologicheskii Zhurnal* 95: 1277-1282. https://doi.org/10.7868/S0044513416110052

VANDEL A. 1946. — Crustacés isopodes terrestres (Oniscoïdea) épigés et cavernicoles du Portugal. Étude des récoltes de Monsieur A. de Barros Machado. *Anais da Faculdade de Ciências do Porto* 30: 135-427.

VANDEL A. 1962. — *Faune de France, 66. Isopodes terrestres (deuxième partie)*. Éditions Paul Lechevalier, Paris: 417-931.

VANDEL A. 1967. — Les isopodes terrestres et cavernicoles de la Bulgarie (seconde partie). *Annales de Spéléologie* 22: 333-365.

VANDEL A. 1969. — Les isopodes terrestres de la Sicile. *Atti dell'Accademia Gioenia di Scienze Naturali in Catania, série 7* 1: 1-59.

VERHOEFF K. W. 1933. — Arthropoden aus südostalpinen Höhlen, gesammelt von Karl Strasser, Triest. 7. Aufsatz. *Mitteilungen über Höhlen- und Kartphorschung* 4: 1-21.

Submitted on 16 February 2018;
accepted on 18 April 2018;
published on 5 June 2018.