

Article

New Species of Terrestrial Isopods (Crustacea, Isopoda, Oniscidea) from Liguria and Surrounding Regions, Northern Italy

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Abstract: Five new species of terrestrial isopods from Liguria and surrounding regions are described: *Buddelundiella zoiai* sp. n. (Buddelundiellidae), *Sardoniscus marmoratus* sp. n. (Oniscidae), *Cylisticus poggii* sp. n. (Cylisticidae), *Porcellio incavatus* sp. n. (Porcellionidae), and *Alloschizidium segestanum* sp. n. (Armadillidiidae). *Buddelundiella zoiai*, *Cylisticus poggii* and *Alloschizidium segestanum* were collected in edaphic environments, while *Sardoniscus marmoratus* and *Porcellio incavatus* were found in leaf litter or under not deeply embedded rocks. The diagnostic characters, the affinities and the distribution of the new species are discussed.

Keywords: Crustacea; Isopoda; Oniscidea; new species; Liguria; Italy



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1. Introduction

Liguria is a small region in the north-west of Italy, enclosed by the Ligurian Sea to the south and crossed by two distinct mountain ranges, the Ligurian Alps to the west and the Ligurian Apennines to the east. These two ranges compose a continuous chain across the region and are, respectively, linked to the Maritime Alps and the Tuscan-Emilian Apennines. Despite its limited territorial extension (5418 km²), the region is of remarkable faunistic and floristic value, since it includes a great variety of environments: from littoral and dry Mediterranean habitats to meso-thermophilic deciduous woods, up to montane and Alpine habitats. Moreover, it is noteworthy in the presence of a high number of caves (more than 2000) throughout the region, especially in the western part, as reported by the Delegazione Speleologica Ligure on the speleological cadastre [1]. Due to its geographic position and geoclimatic context, Liguria represents a significant biogeographic crossroads, hosting at the same time species with Tyrrhenian, Alpine or north-Apennine distribution. The westernmost portion of the region is of particular interest due to the presence of Ibero–French taxa, which are absent in the rest of the Italian peninsula [2–9].

Such a diverse set of environments makes this region suitable to host a rich fauna of terrestrial isopods, which are an ideal biological model for faunistic and biogeographical studies, due to their reduced dispersal ability and strong stenoecy. The Ligurian oniscidean fauna currently includes 97 described species, belonging to 37 genera and 17 families (unpublished data). For comparison, 78 species are recorded for Corsica, 94 for Sardinia, 103 for Sicily and surrounding islands, 131 for Tuscany, and approximately 380 for the whole of Italy [10].

Rather extensive studies on oniscideans from this region were carried out over the first half of the last century, especially by Arcangeli [11–21], Brian [22–37], and Verhoeff [38–54]. A few other papers were published within the same time frame, most of them concerning

cave-dwelling species [55–66]. Despite the relatively high number of articles, there are great uncertainties on the systematics and taxonomy of many species from Liguria and surrounding areas, mainly due to the poor descriptions provided by the authors and to the absence of subsequent taxonomic revisions. Indeed, from the 1970s onwards, the works dealing with terrestrial isopods from Liguria have considerably decreased [2,67–69], despite the large amount of undetermined material collected over the years and deposited in the scientific collections of several museums. Moreover, many areas have been little investigated, creating geographic biases in the knowledge of the fauna of terrestrial isopods within this region.

In the last five years, the examination of both preserved and newly collected material has allowed us to resume the study of terrestrial isopods from this region. In this paper, we describe five new species from Liguria and surrounding regions in the families Buddelundiellidae, Oniscidae, Cylisticidae, Porcellionidae, and Armadillidiidae.

2. Materials and Methods

2.1. Collection, Preparation and Drawing of Specimens

The examined material comes both from museum collections and newly collected samples. The specimens were collected by hand or by litter sifting or were extracted from soil samples with the aid of Berlese-Tullgren funnels. The material was stored in 75% ethanol and identifications were based on morphological characters. The dissected specimens were mounted on slides and illustrated with the aid of a camera lucida mounted on Wild M5 and M20 microscopes. Figures were digitally drawn following the method described by Montesanto [70,71]. For each new species, the material examined, etymology, description, ecology, and remarks are given.

2.2. Depositories

Studied material is deposited in the following institutions and collections, which are referred to in the text by their abbreviations:

MZUF—Museo di Storia Naturale, Sezione di Zoologia “La Specola”, University of Florence, Italy.

MSNG—Museo Civico di Storia Naturale “Giacomo Doria”, Genoa, Italy.

MCCI—Museo Civico di Storia Naturale, Carmagnola, Italy.

PG—Private collection of P. Gardini.

3. Results

Taxonomy

Class **Malacostraca** Latreille, 1802

Order **Isopoda** Latreille, 1817

Suborder **Oniscidea** Latreille, 1802

Family **Buddelundiellidae** Verhoeff, 1930

Genus **Buddelundiella** Silvestri, 1897

***Buddelundiella zoiai* sp. n.**

Figures 1–3

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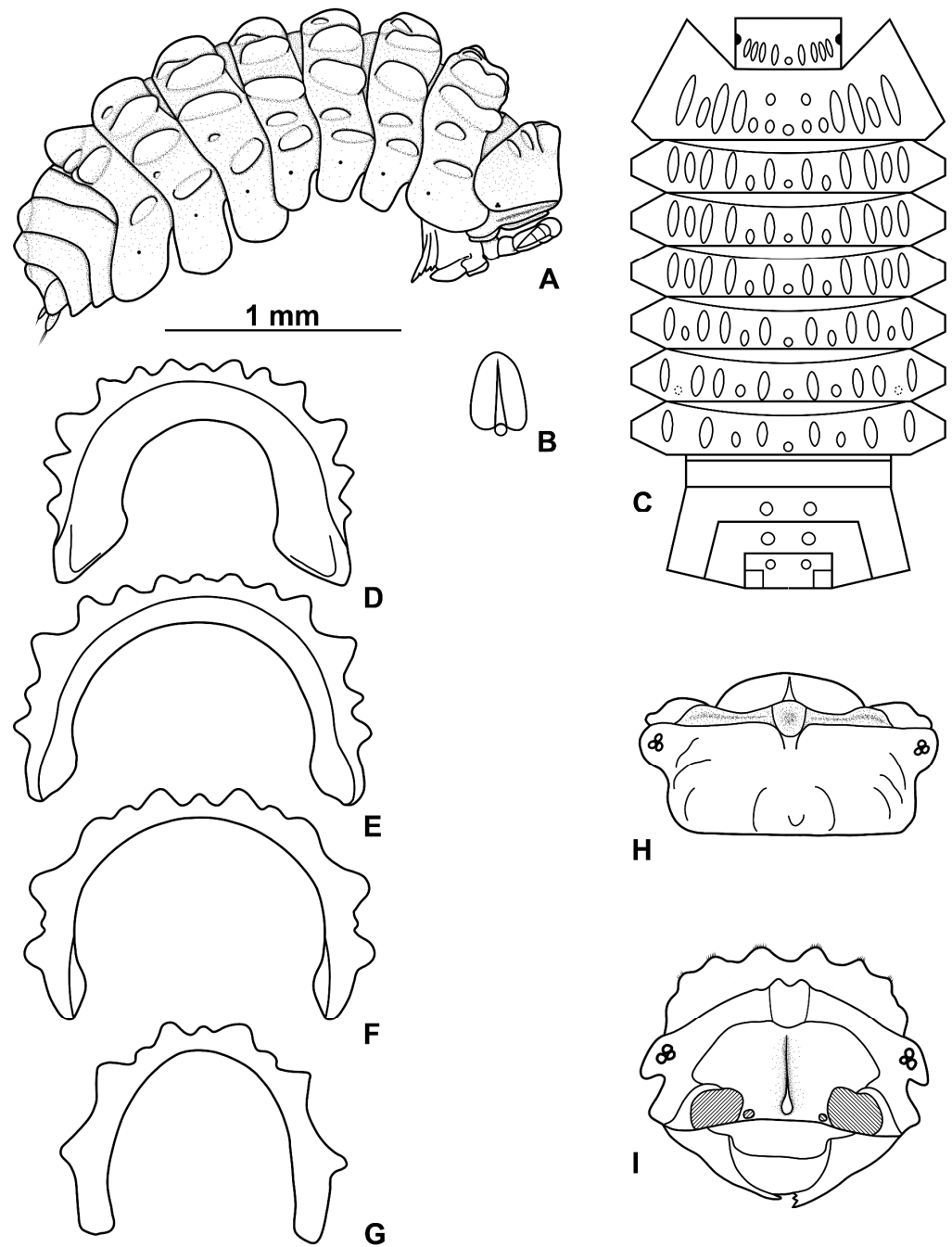


Figure 1. *Buddelundiella zoiai* sp. n., paratype ♀ from Murialdo. (A) Specimen in lateral view. (B) Dorsal scale-seta. (C) Disposition of dorsal tubercles. (D) Pereonite 1, caudal view. (E) Pereonite 2, caudal view. (F) Pereonite 6, caudal view. (G) Pereonite 7, caudal view. (H) Cephalon, dorsal view. (I) Cephalon, frontal view.

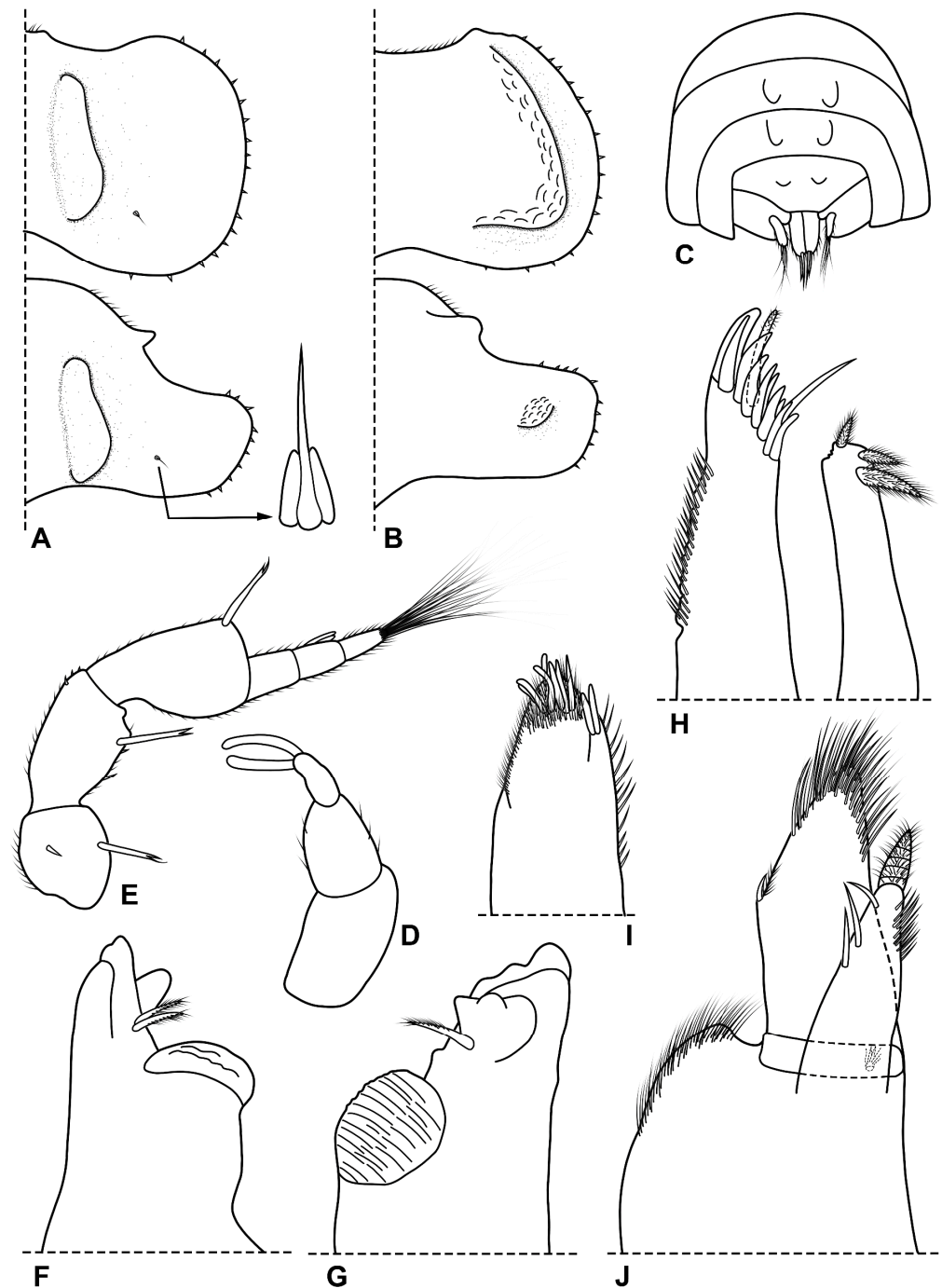


Figure 2. *Buddelundiella zoiai* sp. n., paratype ♀ from Murialdo. (A) Epimera of pereonites 1 and 2, dorsal view. (B) Epimera of pereonites 1 and 2, ventral view. (C) Pleon, telson and uropods, dorsal view. (D) Antennula. (E) Antenna. (F) Left mandible. (G) Right mandible. (H) Maxillula. (I) Maxilla. (J) Maxilliped.

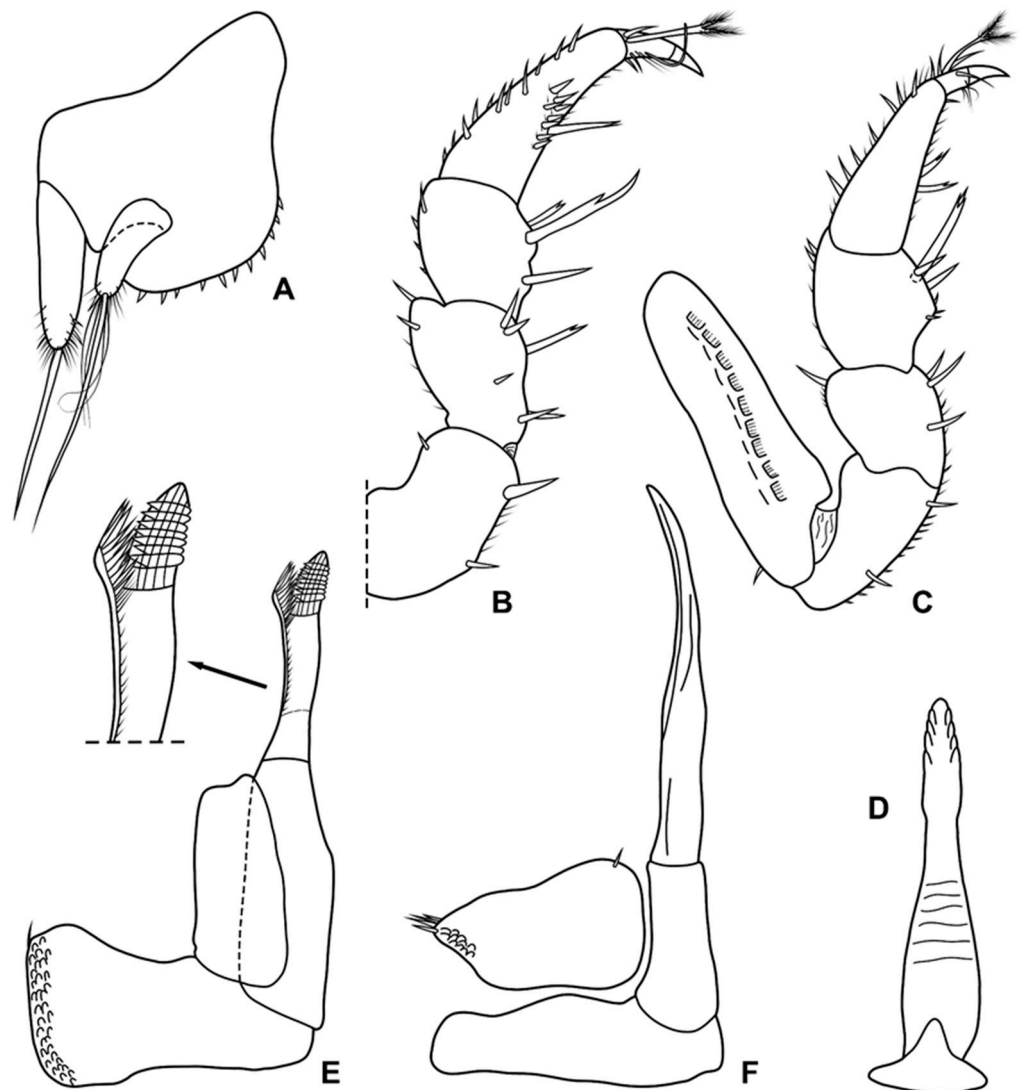


Figure 3. *Buddelundiella zoiai* sp. n., paratype ♂ from Murialdo. (A). Uropod. (B). Pereopod 1. (C). Pereopod 7. (D). Genital papilla. (E). Pleopod 1. (F). Pleopod 2.

Type Material Examined

Holotype

LIGURIA, Savona Province: ♀, Murialdo, 19.VIII.1982, C. Torti and S. Zoia leg. (MZUF 9966).

Paratypes

LIGURIA, Savona Province: 1 ♂, 15 ♀♀, same data as holotype (MZUF 9966); 67 ♂♂, 121 ♀♀, Colle del Melogno, Calizzano, 900 m asl., 9.X.1979, S. Zoia leg. (MZUF 9967); 14 ♂♂, 11 ♀♀, same locality, beech forest, 13.II.1984, G. Gardini, R. Rizzerio and S. Zoia leg. (MSNG); 2 ♀♀, Passo del Faiallo, Urbe, 1000 m asl, 27.VIII.1980, G. Gardini and S. Zoia leg. (MZUF 9968); 1 ♂, 14 ♀♀, Martina Olba, Urbe, 500 m asl, 12.IV.1982, C. Giusto leg. (MZUF 9969); 2 ♀♀ Dego, Girini, 400 m asl, 21.V.2021, R. Poggi leg. (PG).

PIEDMONT, Cuneo Province: 8 ♀♀, Bric Boscasso, Trezzo Tinella, 680 m asl, 3.V.1992, G.B. Delmastro leg. (PG); 1 ♀, woods along Rio Gatto, Gorzegno, 600 m asl, 6.VII.1992, G.B. Delmastro leg. (MCCI); 1 ♀, woods along Rio Gambulogna, Bagnasco, 540 m asl, 15.VI.1993, G.B. Delmastro leg. (PG); 1 ♀, Ponte Murato, Rastello, Roccaforte Mondovì, 1250 m asl, 14.IX.1995, G.B. Delmastro leg. (MCCI).

Etymology

The new species is named after our colleague and friend Stefano Zoia (Milan), who first collected material of this small *Buddelundiella* species.

Description

Maximum length: ♂, 1.8 mm, ♀, 2.5 mm. Body convex, able to roll up into a ball, endoantennal conglobation (Figure 1A). Color pale brown. Dorsal cuticle with sparse ovoid scale-setae (Figure 1B). Pereonites with one line of noduli laterales per side more or less on same line, distant from both lateral and posterior margins (Figures 1A and 2A). Dorsum covered with ribs and tubercles as follows (Figure 1A,C–I and Figure 2C): cephalon with 4 + 4 short longitudinal ribs and small median tubercle on posterior part of vertex; all pereonites with small median tubercle on posterior part; pereonites 1–6 with 6 lines of ribs and tubercles per side; pereonite 7 with 4 lines of ribs and tubercles per side; pleonites 4, 5 and telson with 2 paramedian tubercles. Cephalon with frontal shield slightly grooved and centrally depressed; eye small, consisting of three ommatidia. Pereonite 1 with anterolateral corner slightly protruding frontwards; posterolateral corner rounded; ventral epimeron with longitudinal thickening and lateral margin grooved (Figure 2A,B). Pereonites 2–7 with subrectangular epimera (Figure 1A). Pereonite 2 with small and rounded thickening on ventral side of epimera (Figure 2B). Pleonite 3 without epimera as in all species of *Buddelundiella* (Figures 1A and 2C). Telson trapezoidal, approximately twice as wide as long (Figure 2C). Antennula of three articles diminishing in length from first to third; two apical aesthetascs (Figure 2D). Antenna short and stout, fifth article of peduncle enlarged; flagellum of three articles with two aesthetascs on second article (Figure 2E). Mandibles with two free penicils in left and one in right (Figure 2F,G). Maxillula outer branch with 4 + 6 teeth and two long slender setae; inner branch with one apical and two subapical penicils, proximal one longest (Figure 2H). Maxilla with very small inner lobe bearing two thick setae; outer lobe setose with line of thick setae (Figure 2I). Maxilliped with proximal segment of palp bearing one seta, distal segment apically setose and with thick seta on outer margin; endite triangular with three strong setae on outer margin and large segmented apical penicil (Figure 2J). Uropod with quadrangular protopod; exopod inserted near medial margin, not surpassing distal margin of protopod; endopod distinctly longer than exopod (Figure 3A).

Male. Pereopod 1 without distinct sexual specializations (Figure 3B). Pereopod 7 ischium with slightly convex sternal margin; carpus slightly enlarged distally (Figure 3C). Genital papilla fusiform (Figure 3D). Pleopod 1 exopod subrectangular, approximately twice as long as wide, distal margin slightly concave; endopod of two articles, proximal article as long as but wider than distal article; distal article with thin suture on basal third, apical part triangular, striped; outer margin with thin appendix distally setose (Figure 3E). Pleopod 2 exopod trapezoidal, with rounded distal part bearing short seta; endopod with two narrow articles, distal article more than twice longer than basal one.

Ecology

Humicolous species, can also be found in edaphic environments. The examined specimens were collected by litter sifting or extracted from soil samples.

Remarks

Buddelundiella zoiai sp. n. is similar to *B. voluta* Verhoeff, 1930, *B. cataractae* Verhoeff, 1930, *B. borgensis* Verhoeff, 1936, *B. insubrica* Verhoeff, 1938 and, to a lesser extent, to *B. armata* Silvestri, 1897 and *B. zimmeri* Verhoeff, 1930. It differs from *B. voluta* in having pleonites 4 and 5 with two paramedian tubercles; from *B. cataractae* in the number of dorsal tubercles on the pereonites (6 + 6 + a median one instead of 5 + 5 + a median one on pereonite 1, 4 + 4 + a median one instead of 3 + 3 on pereonite 7) and on the pleonites and telson (1 + 1 on pleonites 4, 5 and telson instead of 2 + 2 only on pleonite 4); from *B. borgensis*, even if poorly described by Verhoeff [54] based on a single female specimen, in the number of dorsal tubercles on pereonites 2–6 (6 + 6 + a median one instead of 4 + 4) and presence of tubercles on pleonites 4 and 5; from *B. insubrica* in the number of dorsal tubercles on pereonite 7 (4 + 4 + a median one instead of 3 + 3) and pleonites 4 and

5 with two paramedian tubercles. The new species differs from *B. armata* and *B. zimmeri* in the less developed dorsal ornamentation, also in pereonite 7 with 4 + 4 tubercles + a median one (1 + 1 in *B. armata* and 2 + 2 in *B. zimmeri*).

Buddelundiellidae are considered here as a separate family within Synocheta as remarked by Tabacaru and Giurginca [72]. Schmalzfuss [73], however, considered this taxon as a subfamily of the family Trichoniscidae closely related to the subfamily Haplophthalminae. Tabacaru and Giurginca [72] pointed out the differences with Haplophthalminae (e.g., the eye of three ommatidia in *Buddelundiella*, not present in any genera of this subfamily) and listed many characters, even if some not so reliable, distinguishing Buddelundiellidae from Trichoniscidae. The presence of noduli laterales in *Buddelundiella* species was never observed before and constitutes an additional important character. Apart from *B. zoiai* sp. n., this trait has also been found in *B. zimmeri* Verhoeff, 1930, *B. cataractae* Verhoeff, 1930 and *B. voluta* Verhoeff, 1930, examined by us, and most probably it is present in all the species of the genus. According to Schmidt [74], the noduli laterales are present only in the higher taxa of the section Crinocheta, excluding the families Olibrinidae, Detonidae, Scyphacidae and Alloniscidae, and possibly in some taxa of the family Styloniscidae (section Synocheta). The presence of noduli laterales in species of *Buddelundiella* could therefore represent more robust evidence suggesting the distinction of Buddelundiellidae from Trichoniscidae.

Family **Oniscidae** Latreille, 1802

Genus *Sardoniscus* Arcangeli, 1939

Sardoniscus marmoratus sp. n.

Figures 4–6

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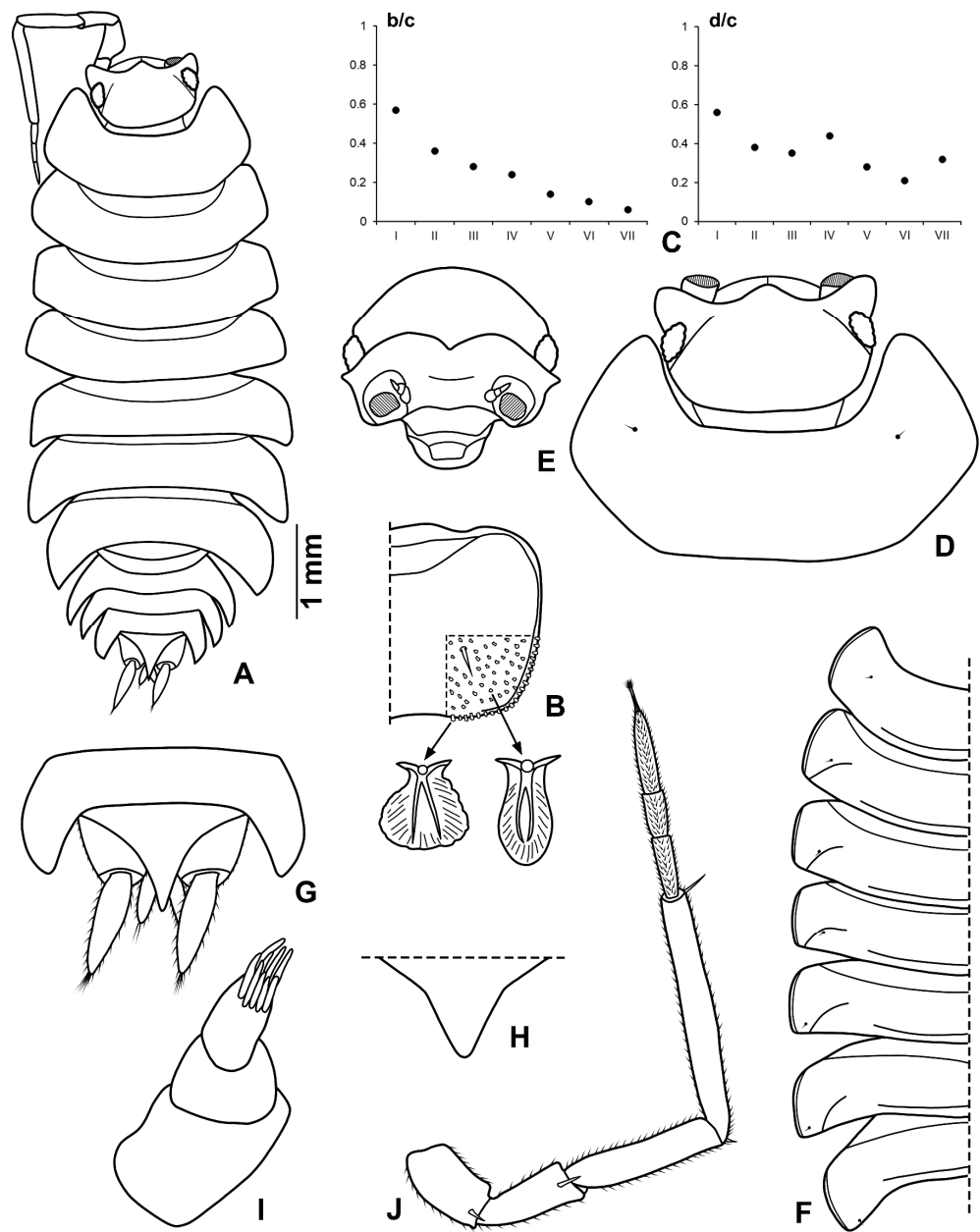


Figure 4. *Sardoniciscus marmoratus* sp. n. (A–D,F,G,J) Paratype ♂ from Tann-a da Scaggia, Bargagli. (E,H,I) Paratype ♀, same locality. (A) Specimen in dorsal view. (B) Right side of pereonite 2, with central and marginal scale-setae. (C) Coordinates of noduli laterales. (D) Cephalon and pereonite 1, dorsal view. (E) Cephalon, frontal view. (F) Left side of pereon showing disposition of noduli laterales. (G) Pleonite 5, telson and uropods, dorsal view. (H) Telson, dorsal view. (I) Antennula. (J) Antenna.

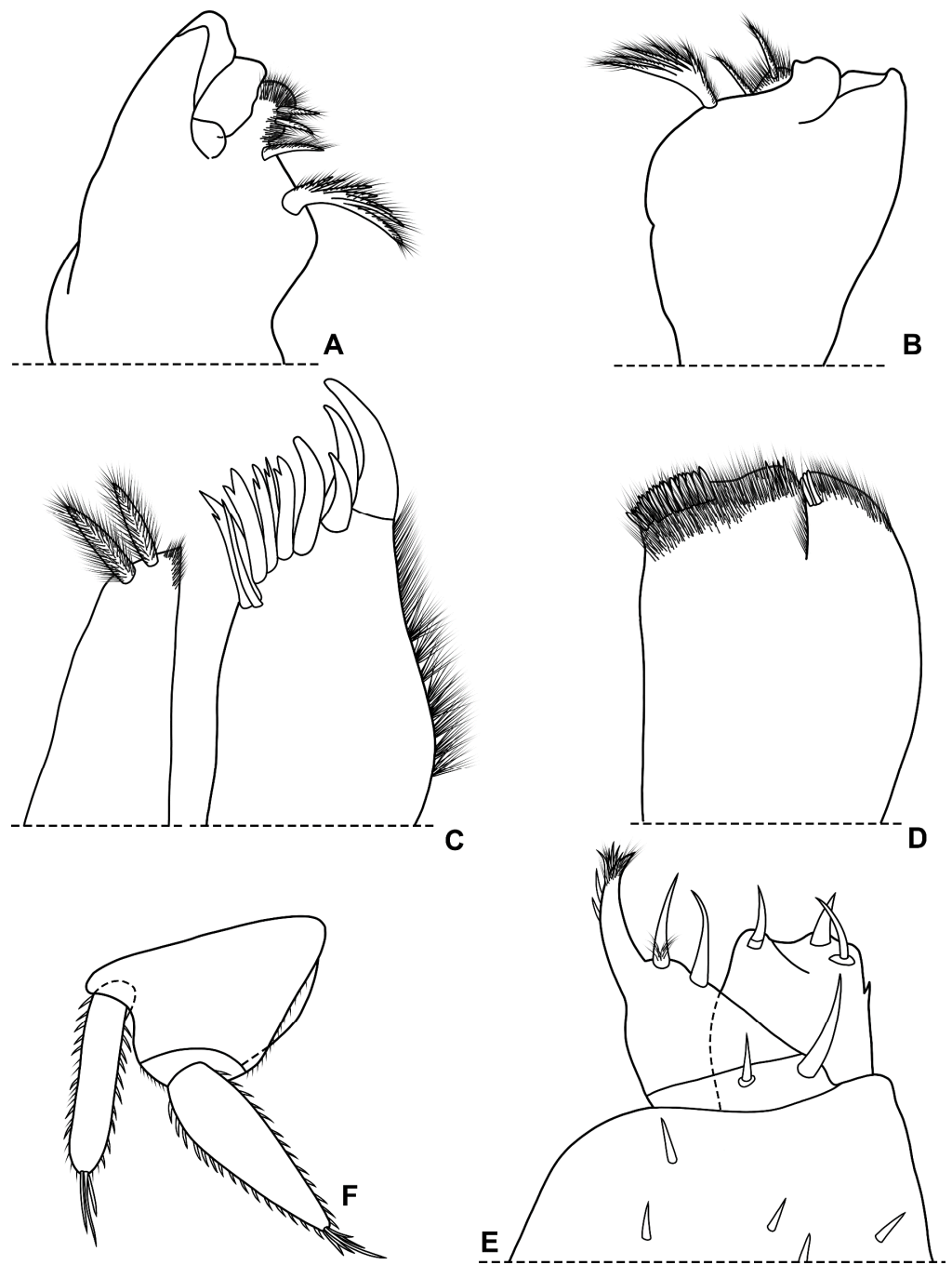


Figure 5. *Sardoniscus marmoratus* sp. n., paratype ♀ from Tann-a da Scaggia, Bargagli. (A) Left mandible. (B) Right mandible. (C) Maxillula. (D) Maxilla. (E) Maxilliped. (F) Right uropod.

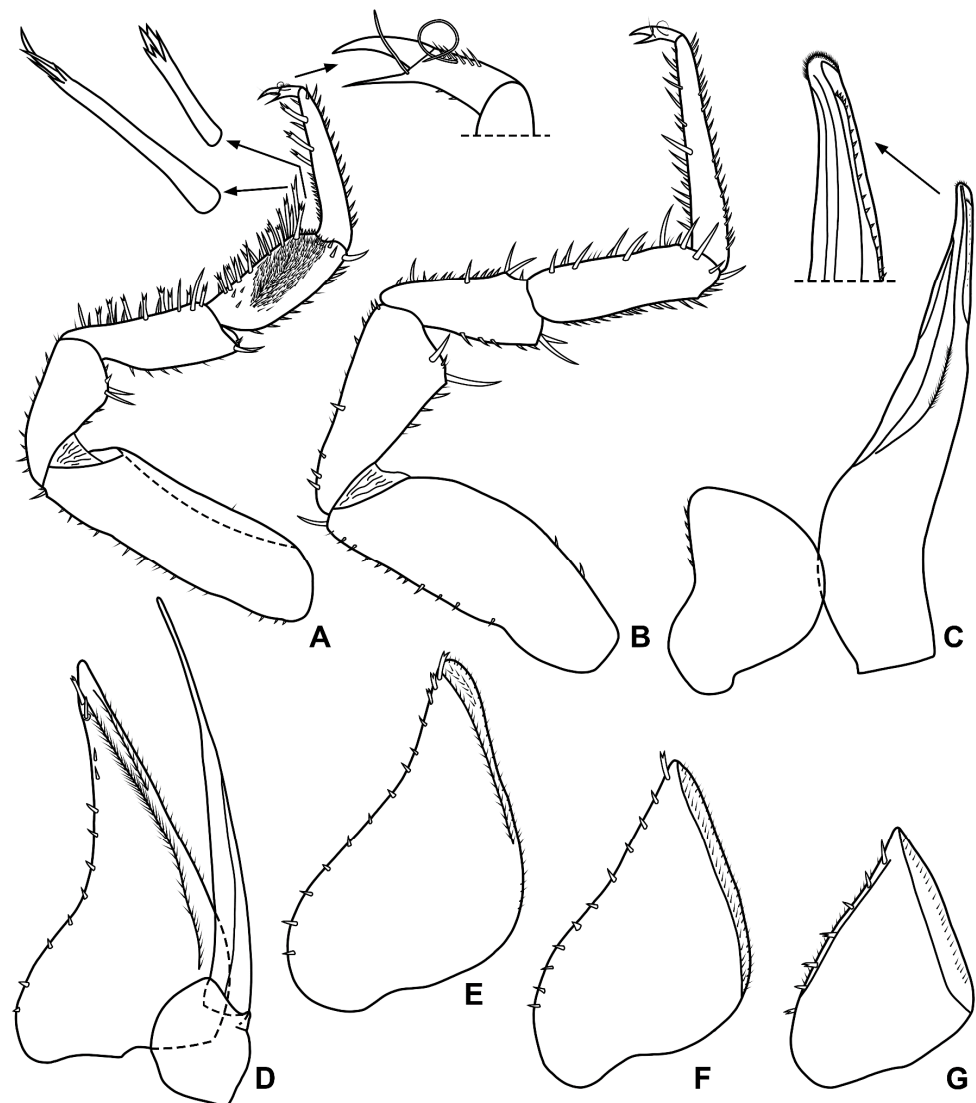


Figure 6. *Sardonicus marmoratus* sp. n., paratype ♂ from Tann-a da Scaggia, Bargagli. (A) Pereopod 1. (B) Pereopod 7. (C) Pleopod 1. (D) Pleopod 2. (E) Pleopod 3 exopod. (F) Pleopod 4 exopod. (G) Pleopod 5 exopod.

Type Material Examined

Holotype

LIGURIA, Genoa Province: ♂, entrance of Tann-a da Scaggia cave, 15 Li/GE, 44°26′07.6″ N 9°3′24″ E WGS84, Bargagli, Viganego, 390 m asl, 20.IX.2018, G. and P. Gardini leg. (MZUF 9970).

Paratypes

LIGURIA, Genoa Province: 1 ♂, 3 ♀♀, same data as holotype (MZUF 9970); 2 ♀♀, entrance of Pertuzo do Paolin cave, 8 Li/GE, 44°24′48.136″ N 9°1′45.796″ E WGS84, Apparizione, Genova, 10.IV.1983, C. Bonzano leg. (MZUF 9971); 5 ♂♂, 8 ♀♀, entrance of Peruzo do Canté cave, 7 Li/GE, 44°24′08.1″ N 9°1′50″ E WGS84, Mt Fasce, Genova, 534 m asl, 2.V.2020, P. Gardini leg. (PG); 1 ♂, 5 ♀♀, ridge between Mt Moro and Mt Fasce, Quinto al Mare, Genova, 490 m asl, same date and collector (MZUF 9972); 2 ♂♂, 11 ♀♀, S slope Mt Fasce, Quinto al Mare, Genova, 727 m asl, 18.V.2020, P. Gardini leg. (PG); 1 ♀, entrance of Tann-a da Dragunea cave, 6 Li/GE, 44°26′08.1″ N 8°55′23.3″ E WGS84, 313 m asl, Genova Righi, 13.XII.2020, P. Gardini leg. (PG); 5 ♂♂, 7 ♀♀, Gola di Sisa, Creto, Montoggio, 760 m asl, mixed forest, 22.V.2020, G. and P. Gardini and C. Giusto leg. (MZUF 9973).

TUSCANY, Lucca Province: 1 ♂, 1 ♀, Gorfigliano, 800 m asl, chestnut grove, 30.VIII.1997, D. Zanaga leg. (MZUF 7412).

Etymology

From Latin: *marmoratus* = marbled. The name refers to the brown and yellow color pattern of the dorsal side of the species.

Description

Maximum length: ♂, 6 mm, ♀, 8 mm. Body slightly convex, not able to conglobate (Figure 4A). Color: pereon brown with yellow speckling, pale spot at base of epimera; pleon brown with median pale stripe on pleonites 3–5. Dorsal cuticle covered with lanceolate scale-setae, posterior margins of pereonites with fan-shaped scale-setae (Figure 4B). Pereonite 1 with two gland pores. One line of noduli laterales per side, coordinates as in Figure 4C. Cephalon with distinct frontal line and suprantennal line visible only in middle part; lateral lobes well developed, triangular with rounded apices, distinct frontal lobe protruding almost as lateral lobes; eyes small with approximately nine ommatidia. Pereonites 1–4 with straight posterior margin, pereonites 5–7 with epimera pointing backwards (Figure 4A,F). Pleonites 3–7 with falciform epimera (Figure 4A,G). Telson triangular with concave sides and pointed apex (Figure 4G,H). Antennula of three articles, second article shortest, tuft of approximately nine aesthetascs at apical part (Figure 4I). Antenna surpassing posterior margin of pereonite 3 when pulled backwards; flagellum of three articles, second article shortest and third longest, line of 4 or 5 aesthetascs on second flagellum article and 2 aesthetascs on third (Figure 4J). Mandibles with semidichotomized molar penicil, 2 + 1 free penicils on left mandible and 1 + 1 on right (Figure 5A,B). Maxillula outer branch with 4 + 6 teeth, 5 apically cleft; inner branch with two subequal penicils (Figure 5C). Maxilla apically setose; inner lobe twice as wide as outer lobe, with line of apical thick setae (Figure 5D). Maxilliped palp with two setae on basal article; endite with one subapical and two apical thick setae (Figure 5E). Pereopods with simple unguis and dactylar setae. Uropod with proximal endopod insertion; exopod slightly longer than endopod (Figure 5F).

Male. Pereopod 1 with brush of setae on sternal margin of carpus and, to lesser extent, merus (Figure 6A). Pereopod 7 with no distinct modifications; ischium with straight sternal margin. (Figure 6B). Pleopod 1 exopod with triangular distal part apically rounded, outer margin with some short setae; endopod with straight distal part, setose apex (Figure 6C). Pleopod 2 exopod triangular with outer margin concave; endopod slightly longer than exopod (Figure 6D). Pleopods 3–5 triangular (Figure 6E–G).

Ecology

Epigeal and humicolous species, normally found in leaf litter or under not deeply embedded rocks. It can also be easily found at the entrance to caves or artificial cavities. The examined specimens were collected by hand.

Remarks

Previously to this paper, the genus *Sardoniscus* comprised two species: *S. pygmaeus* (Budde-Lund, 1885) from Corsica, Sardinia and Tuscany, and *S. verhoeffi* (Ferrara and Taiti, 1978) from peninsular Italy. In the shape of cephalon the new species is similar to *S. pygmaeus*, from which it differs in the larger size, the noduli laterales of pereonite 7 being not so eccentric and the male pleopod 1 exopod with a triangular posterior part (cfr. [75] (figs 262, 265A) and [76] (figs X.3, XI.1)). Compared to *S. verhoeffi*, *S. marmoratus* sp. n. shows a similar disposition of the noduli laterales, but it is readily distinguished by the protruding frontal lobes of the cephalon and the more developed distal part of the male pleopod 1 exopod (cfr. [76], figs XI.2 and XII.3,4).

Family *Cylisticidae* Verhoeff, 1949

Genus *Cylisticus* Schnitzler, 1853

Cylisticus poggii sp. n.

Figures 7–9

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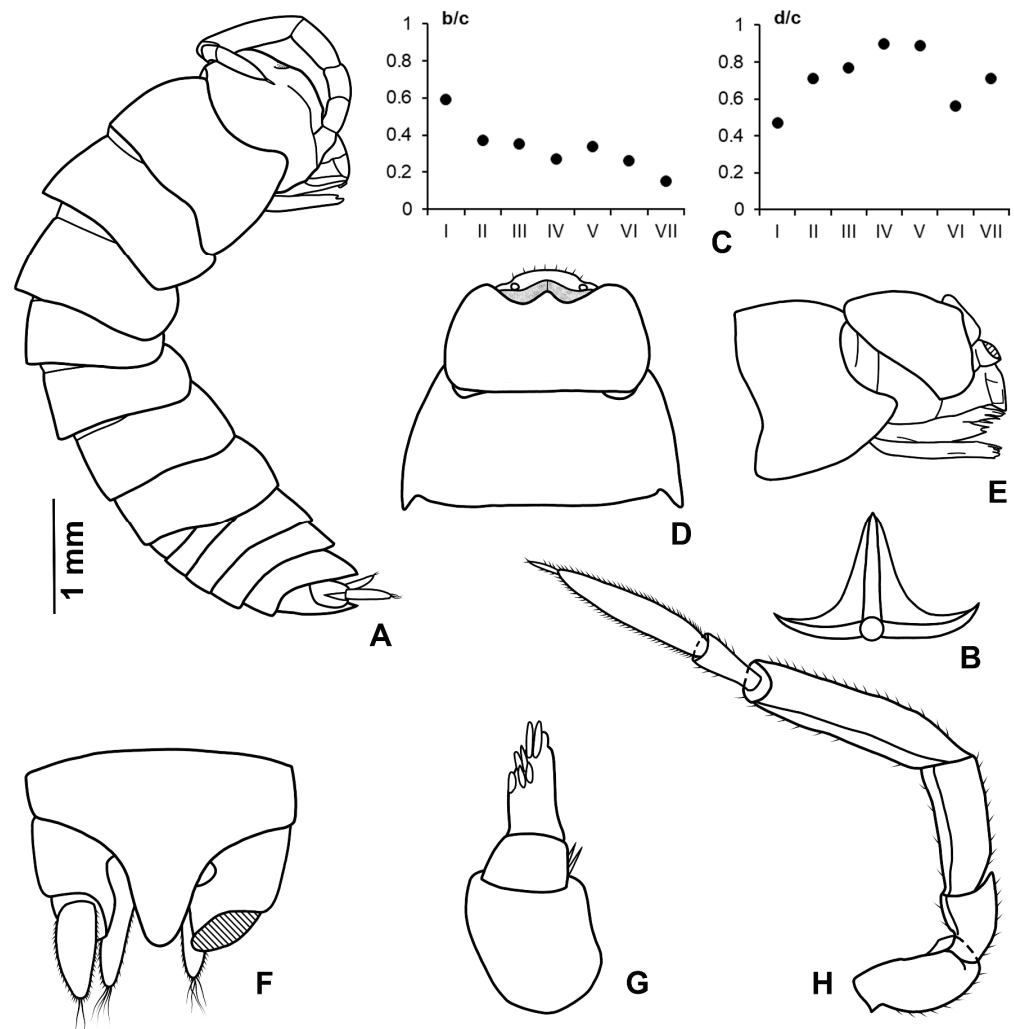


Figure 7. *Cylisticus poggii* sp. n. (A) Paratype ♀ from Isola del Tino. (B–H) Paratype ♂, same locality. (A) Specimen in lateral view. (B) Dorsal scale-seta. (C) Coordinates of noduli laterales. (D) Cephalon and pereonite 1, dorsal view. (E) Cephalon and pereonite 1, lateral view. (F) Telson and uropods, dorsal view. (G) Antennula. (H) Antenna.

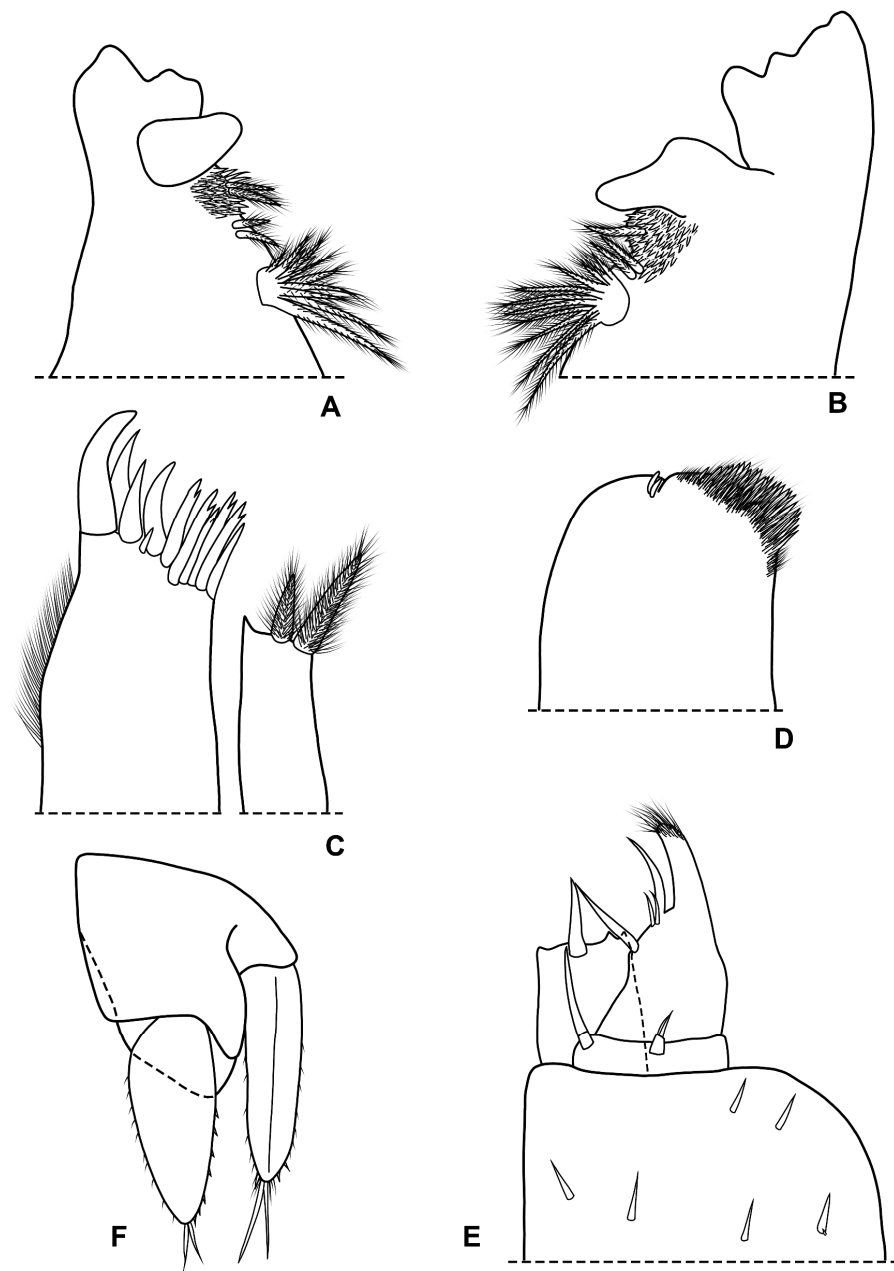


Figure 8. *Cylisticus poggii* sp. n., paratype ♀ from Isola del Tino. (A) Left mandible. (B) Right mandible. (C) Maxillula. (D) Maxilla. (E) Maxilliped. (F) Left uropod.

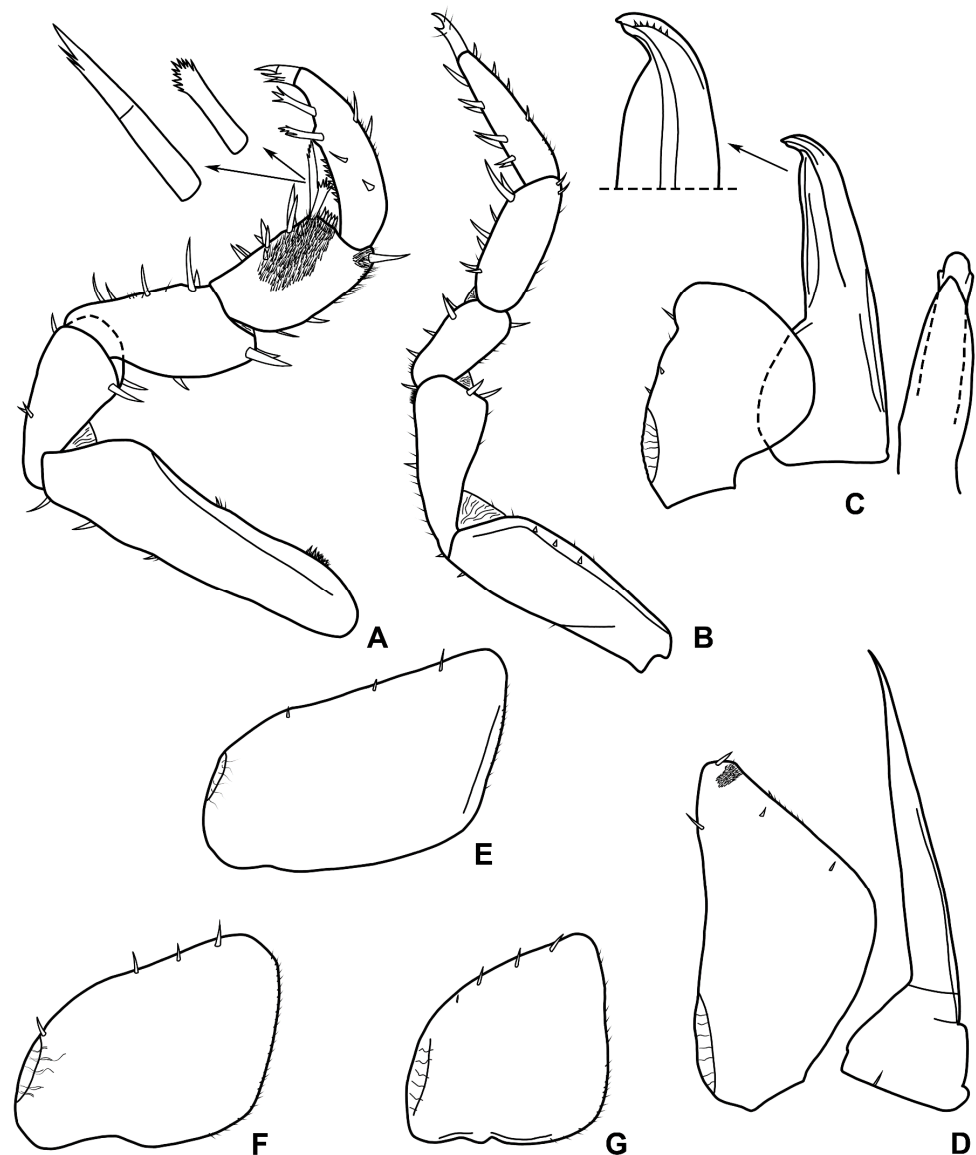


Figure 9. *Cylisticus poggii* sp. n., paratype ♂ from Isola del Tino. (A) Pereopod 1. (B) Pereopod 7. (C) Pleopod 1 and genital papilla. (D) Pleopod 2. (E) Pleopod 3 exopod. (F) Pleopod 4 exopod. (G) Pleopod 5 exopod.

Type Material Examined

Holotype

LIGURIA, La Spezia Province: ♂, Isola del Tino, Portovenere, 20.IX.1987, R. Poggi leg. (MSNG).

Paratypes

LIGURIA, La Spezia Province: 3 ♂♂, 4 ♀♀, same data as holotype (MSNG); 2 ♂♂, 2 ♀♀, same data (MZUF 9974).

Etymology

The new species is named after our colleague and friend Dr Roberto Poggi (MSNG), who collected the specimens.

Description

Maximum length: ♂ and ♀, 2.5 mm. Body colorless, strongly convex, able to roll up into a ball, exoantennal conglobation (Figure 7A). Dorsal cuticle with sparse triangular scale-setae (Figure 7B). One line of noduli laterales per side, coordinates as in Figure 7C.

Cephalon with triangular median lobe, slightly protruding above vertex; rounded lateral lobes slightly protruding frontwards; eyes absent (Figure 7D,E). Pereonite 1 with posterior margin slightly concave at sides (Figure 7A). Telson with concave sides and rounded apex, slightly longer than uropodal protopods (Figure 7F). Antennula of three articles, second article shortest; two apical and five subapical aesthetascs (Figure 7G). Antenna surpassing posterior margin of pereonite 1; flagellum of two articles, second article more than twice as long as first (Figure 7H). Mandibles with molar penicil dichotomized; left mandible with 2 + 2 and right mandible with 1 + 2 free penicils (Figure 8A,B). Maxillula outer branch with 4 + 6 (5 cleft) teeth plus small accessory tooth; inner branch with triangular apical point and two penicils, medial one distinctly longer (Figure 8C). Maxilla with setose inner lobe approximately twice as wide as outer lobe (Figure 8D). Maxilliped palp with two setae on basal article; endite quadrangular with one subapical strong seta (Figure 8E). All pleopods with *Cylisticus*-type lungs (Figure 9C–G). Uropod with exopod slightly flattened; endopod inserted distally, as long as exopod (Figure 8F).

Male. Pereopods with no distinct sexual modifications (Figure 9A,B). Pleopod 1 exopod with rounded posterior point, three short setae on outer margin; endopod with distal part bent outwards (Figure 9C). Pleopod 2 exopod triangular with slightly concave outer margin bearing one seta; endopod longer than exopod (Figure 9D). Pleopods 3–5 as in Figure 9E–G.

Ecology

Edaphic species, can be found in the first soil layers or under deeply embedded rocks.

Remarks

The new species belongs to the *nasutus*-group of the genus *Cylisticus*, characterized by a depigmented body, reduced or absent eyes, and noduli laterales more or less on the same line [77]. This group includes 17 species distributed in northern and central continental Italy, the Tuscan Archipelago, Sardinia, Corsica and in the south-eastern France. All species are endogean and can be found under deeply embedded stones with some also occurring in caves.

In the bent apical part of the male pleopod 1 endopod, *Cylisticus poggii* sp. n. is similar to *C. caprariae* Ferrara and Taiti, 1978, *C. cavernicola* Racovitza, 1907, *C. igiliensis* Taiti and Ferrara, 1980, *C. littoralis* Ferrara and Taiti, 1980, *C. lobatus* Ferrara and Taiti, 1985, *C. nasutus* Verhoeff, 1931, *C. pierantonii* Arcangeli, 1923, and *C. vandeli* Taiti and Ferrara, 1980. In the male pereopod 7 with no modifications, the new species is readily distinguished from *C. caprariae*, *C. littoralis*, *C. lobatus*, *C. nasutus* and *C. vandeli*. It differs from *C. cavernicola* and *C. igiliensis* in the different shape of the male pleopod 1 exopod. It shows closest morphological affinities with *C. pierantonii* from Sardinia, from which it differs in the less protruding median lobe and rounded lateral lobes of the cephalon, the telson with rounded instead of pointed apex, and uropods with shorter exopods and endopods.

Family **Porcellionidae** Brandt, 1831

Genus *Porcellio* Latreille, 1804

Porcellio incavatus sp. n.

Figures 10–12

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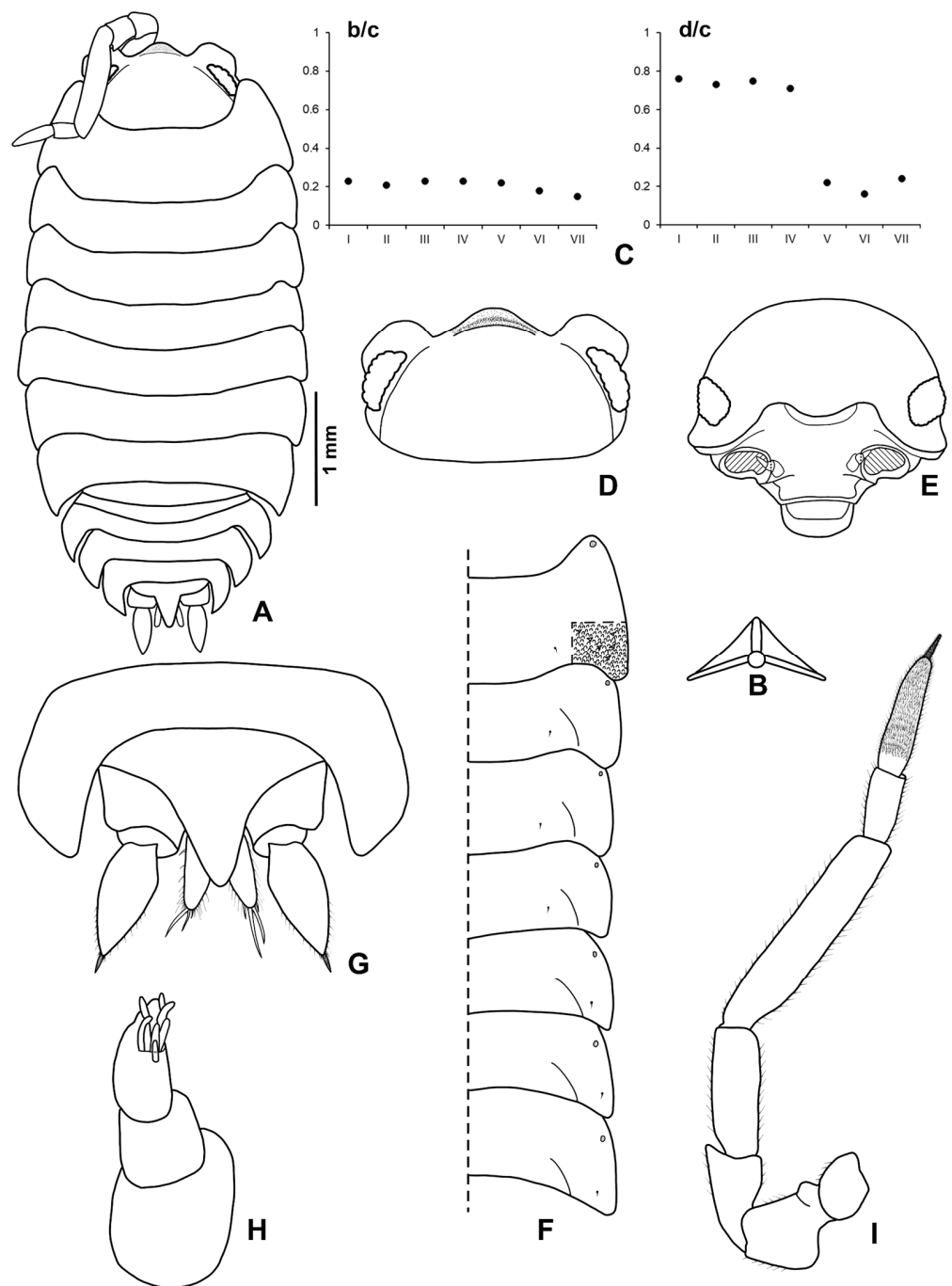


Figure 10. *Porcellio incavatus* sp. n., paratype ♂ from Santo Stefano d'Aveto. (A) Specimen in dorsal view. (B) Dorsal scale-seta. (C) Coordinates of noduli laterales. (D) Cephalon, dorsal view. (E) Cephalon, frontal view. (F) Right side of pereon showing disposition of noduli laterales and gland pores. (G) Pleonite 5, telson and uropods, dorsal view. (H) Antennula. (I) Antenna.

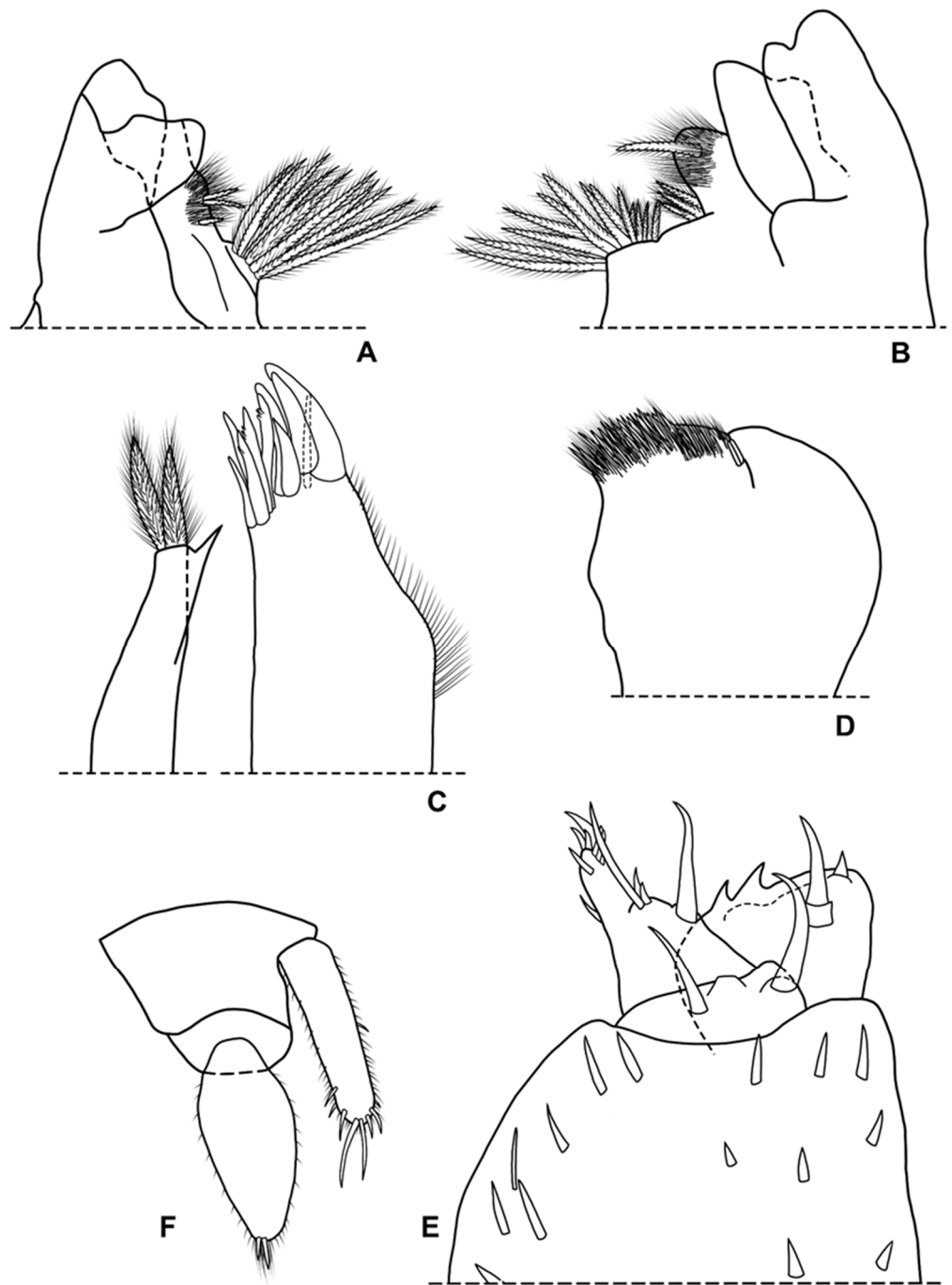


Figure 11. *Porcellio incavatus* sp. n., paratype ♂ from Santo Stefano d'Aveto. (A) Left mandible. (B) Right mandible. (C) Maxillula. (D) Maxilla. (E) Maxilliped. (F) Left uropod.

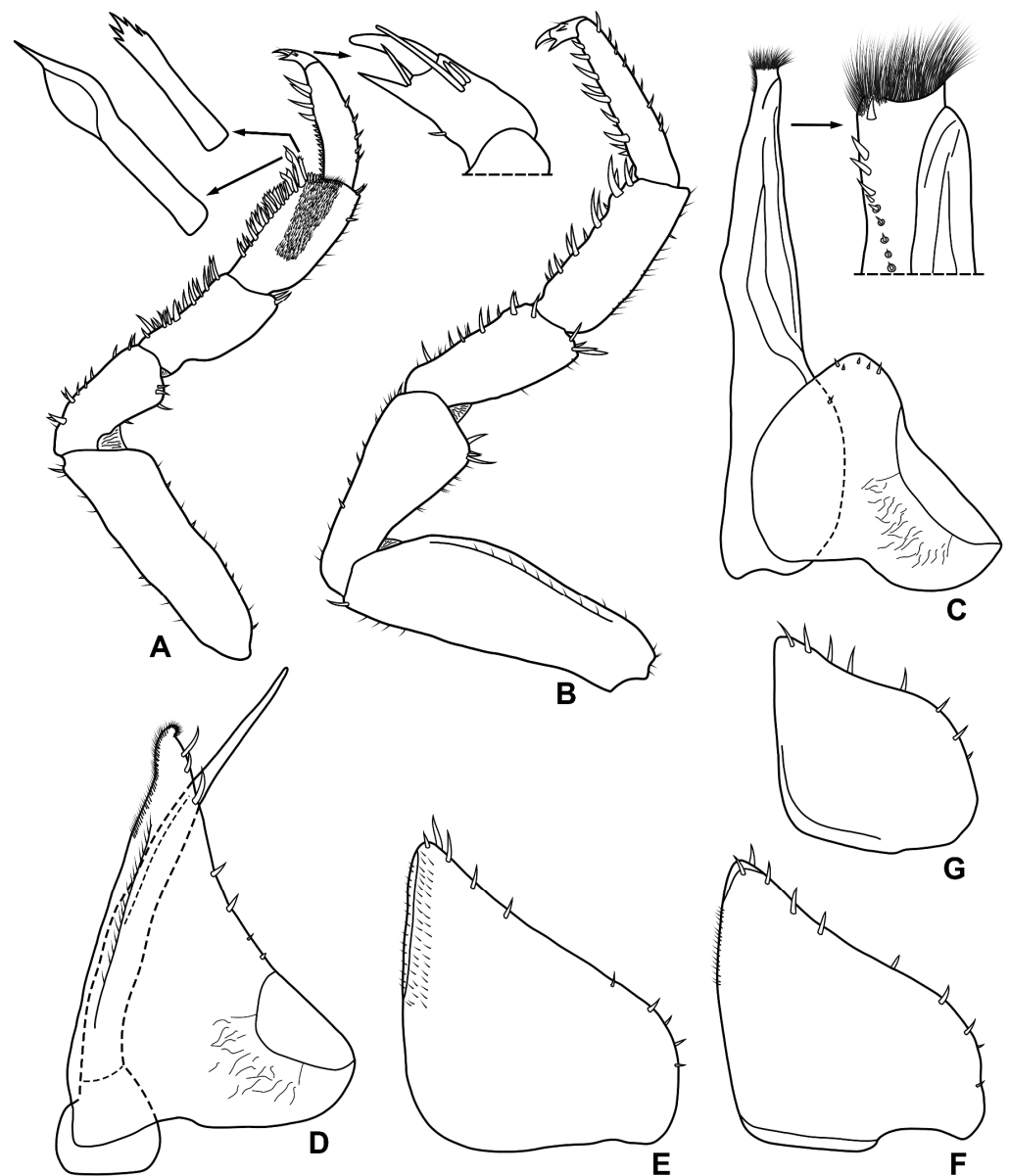


Figure 12. *Porcellio incavatus* sp. n., paratype ♂ from Santo Stefano d’Aveto. (A) Pereopod 1. (B) Pereopod 7. (C) Pleopod 1. (D) Pleopod 2. (E) Pleopod 3 exopod. (F) Pleopod 4 exopod. (G) Pleopod 5 exopod.

Type Material Examined

Holotype

LIGURIA, Genoa Province: ♂, Santo Stefano d’Aveto, IX.1918, A. Andreini leg. (MSNG).

Paratypes

LIGURIA, Genoa Province: 1 ♂, same data as holotype (MSNG); 2 ♂♂, same data (MZUF 9975).

Etymology

From Latin *incavatus* = hollow, concave. The name refers to the deeply concave sides of the posterior margins of the anterior pereonites.

Description

Maximum length: ♂, 4 mm. Body slightly convex, outline between pereon and pleon continuous, not able to conglobate (Figure 10A). Color pale after long preservation in alcohol. Dorsal cuticle covered with numerous short triangular scale-setae (Figure 10B). One line of noduli laterales per side close to posterior margin and far from lateral margins on pereonites 1–4 (Figure 10C,F). Some gland pores in small circles near anterior corners on all pereonites (Figure 10F). Cephalon with rounded median lobe, slightly depressed dorsally, and large quadrangular lateral lobes; large eyes with approximately 26 ommatidia (Figure 10D,E). Pereonites 1–3 with deeply concave posterior margin at sides (Figure 10A,F). Pleonites 3–5 with well-developed epimera (Figure 10A,G). Telson wider than long, with concave margins and narrowly rounded apex (Figure 10G). Antennula of three subequal articles, distal article with 7 or 8 subapical aesthetascs (Figure 10H). Antenna reaching back posterior margin of second pereonite; flagellum of two articles, with second article almost twice as long as first and covered with numerous thin and short setae (Figure 10I). Mandibles with molar penicil dichotomized; left mandible with 2 + 1 and right mandible with 1 + 3 free penicils (Figure 11A,B). Maxillula outer branch with 4 + 6 teeth, 4 of which subapically serrated; inner branch with long triangular apical point and two subequal penicils (Figure 11C). Maxilla inner lobe with apical part covered with fine and thick setae, distinctly wider than outer lobe (Figure 11D). Maxilliped palp with two strong setae on basal article; endite quadrangular, with triangular short seta and two acute lobes on distal margin (Figure 11E). Pleopods 1 and 2 exopods with *Porcellio*-type covered lungs (Figure 12C,D). Uropod with flattened exopod; endopod inserted distally, as long as exopod (Figure 11F). Pereopod 1 and, to lesser extent, pereopod 2, with brushes of setae on sternal margin of merus and carpus; unguis seta short, not reaching tip of outer claw, dactylar seta simple (Figure 12A). Pereopod 7 without distinct sexual modifications, ischium sternal margin straight (Figure 12B). Pleopod 1 exopod triangular with rounded posterior part bearing a few short setae apically; endopod with thickset apical part bearing truncate apex covered with thick tuft of long and thin setae (Figure 12C). Pleopod 2 exopod triangular with slightly concave outer margin with some setae; endopod distinctly longer than exopod (Figure 12D). Pleopods 3–5 exopods triangular (Figure 12E–G).

Ecology

Epigeal species. No details on the collection method are available.

Remarks

This small *Porcellio* species is readily distinguishable from all the other species in the genus by the pereonites 1–3 having the posterior margins deeply concave at sides and by the male pleopod 1 endopod with truncate apex covered with a tuft of long and thin setae.

Family **Armadillidiidae** Brandt, 1833

Genus *Alloschizidium* Verhoeff, 1919

Alloschizidium segestanum sp. n.

Figures 13–15

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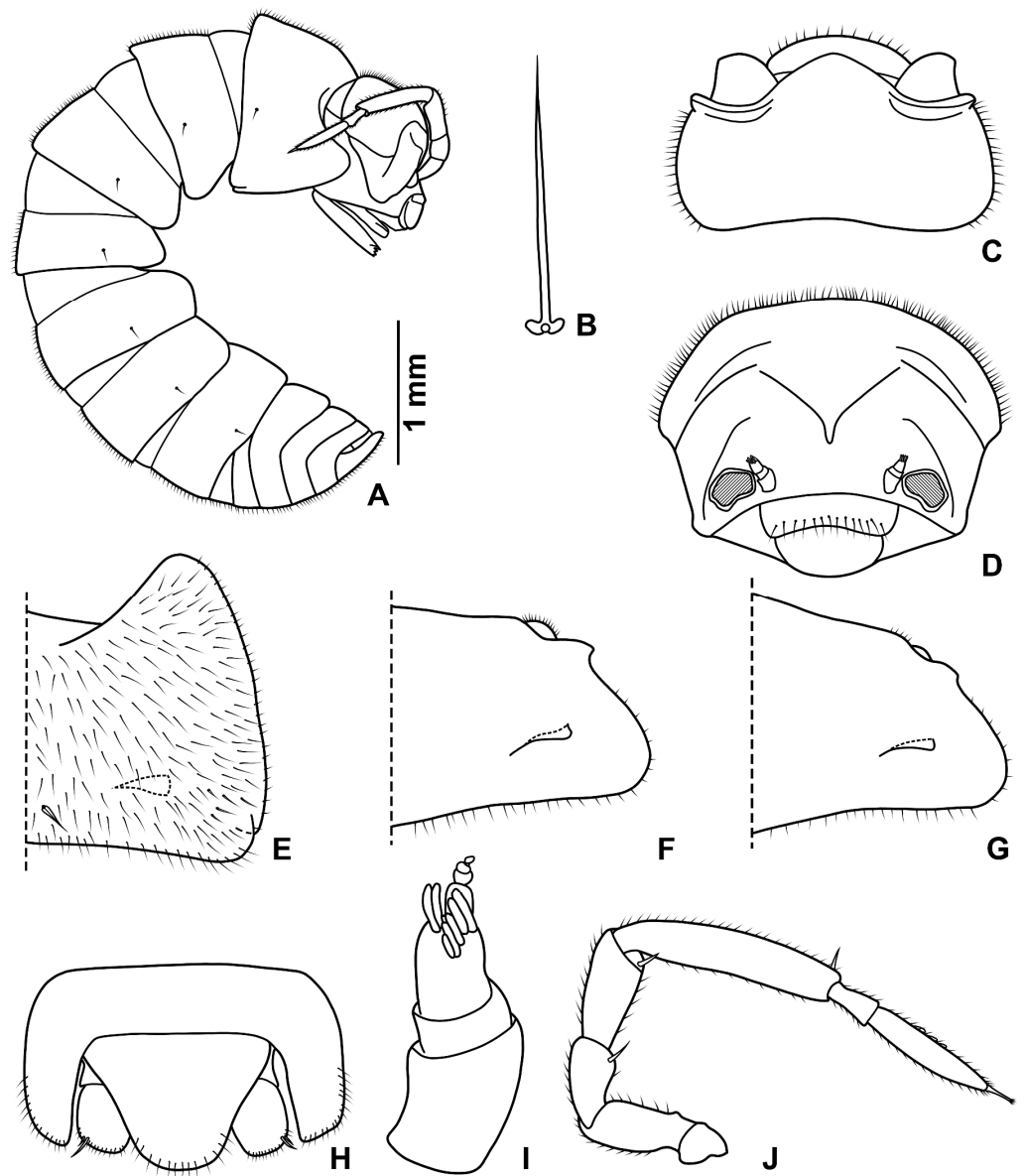


Figure 13. *Alloschizidium segestanum* sp. n., paratype ♀ from Punta Manara. (A) Specimen in lateral view, showing disposition of noduli laterales. (B) Dorsal scale-seta. (C) Cephalon, dorsal view. (D) Cephalon, lateral view. (E) Epimeron of pereonite 1, dorsal view. (F) Epimeron of pereonite 2, ventral view. (G) Epimeron of pereonite 3, ventral view. (H) Pleonite 5, telson and uropods, dorsal view. (I) Antennula. (J) Antenna.

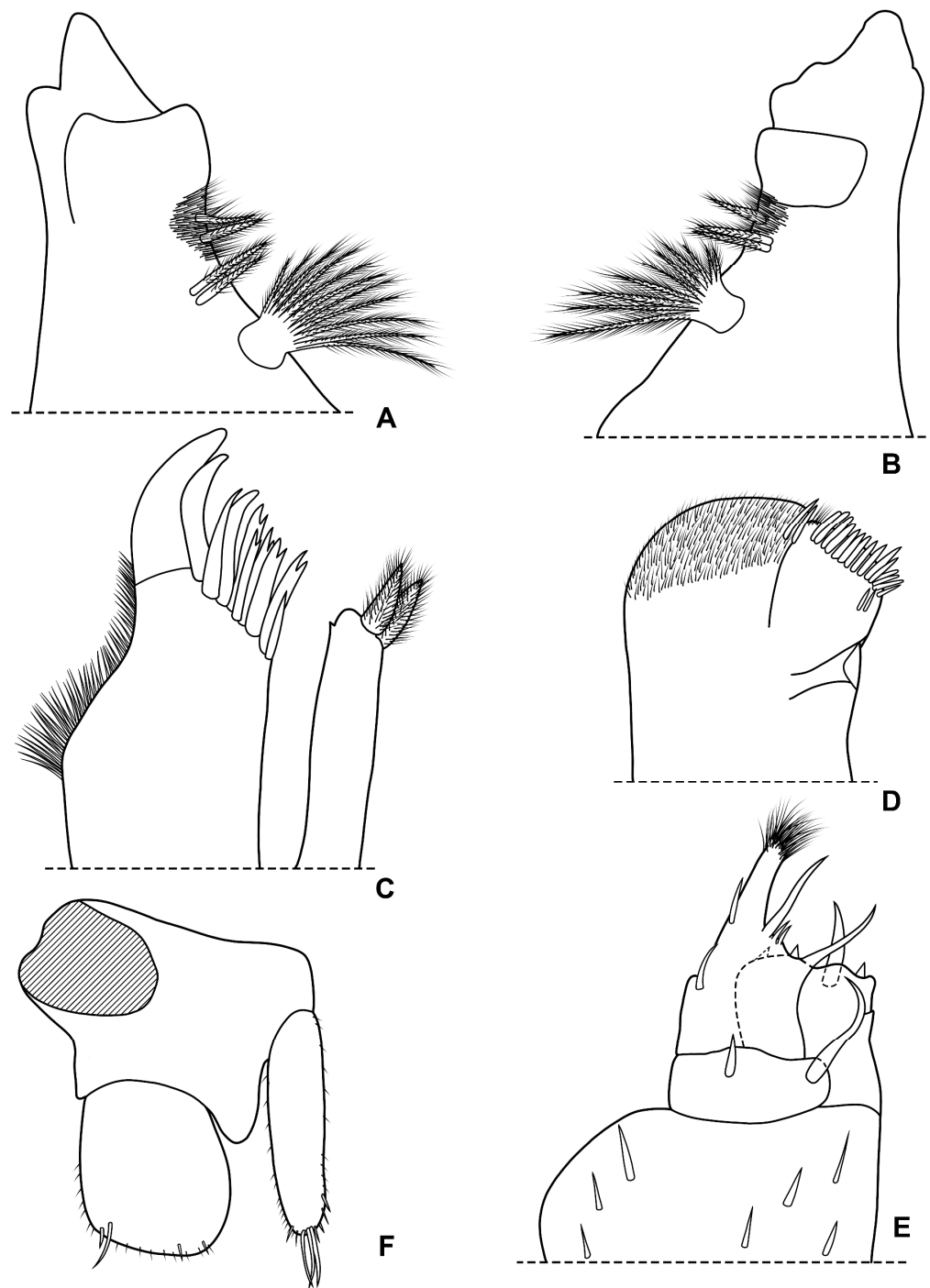


Figure 14. *Alloschizidium segestanum* sp. n., paratype ♀ from Punta Manara. (A) Left mandible. (B) Right mandible. (C) Maxillula. (D) Maxilla. (E) Maxilliped. (F) Left uropod.

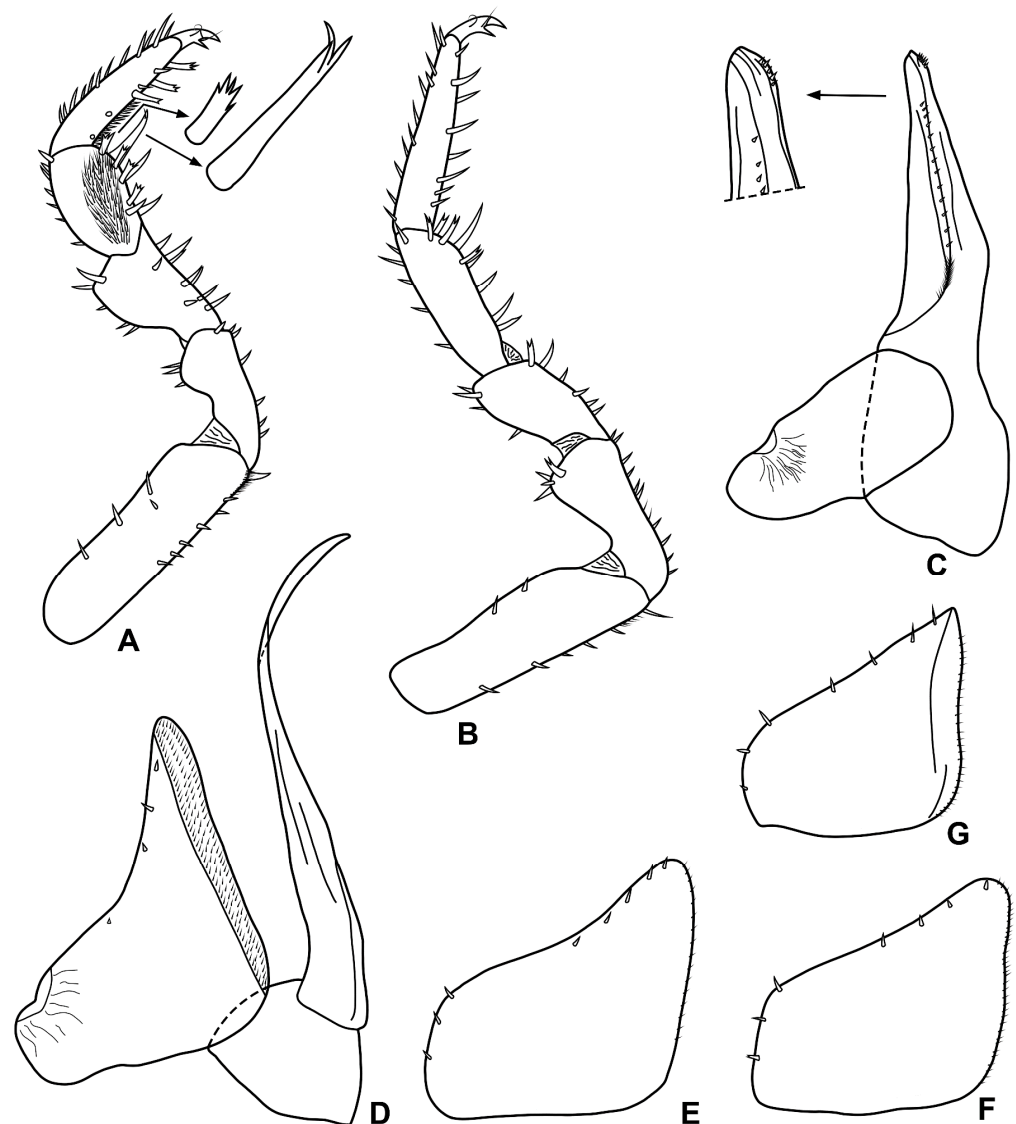


Figure 15. *Alloschizidium segestanum* sp. n., paratype ♂ from Punta Manara. (A) Pereopod 1. (B) Pereopod 7. (C) Pleopod 1. (D) Pleopod 2. (E) Pleopod 3 exopod. (F) Pleopod 4 exopod. (G) Pleopod 5 exopod.

Type Material Examined

Holotype

LIGURIA, Genoa Province: ♂, Punta Manara, Sestri Levante, 44°15'16.0" N 9°24'20.3" E WGS84, 140 m asl, 8.V.2018, G. and P. Gardini leg. (MZUF 9976).

Paratypes

LIGURIA, Genoa Province: 2 ♂♂, 7 ♀♀, same data as holotype (MZUF 9976); 2 ♂♂, 14 ♀♀, same locality, holm oak woods, 24.VII.2018, P. Gardini leg. (PG); 7 ♀♀, 2 juvs, same data (MZUF 9977); 1 ♂, 5 ♀♀, 2 juvs, same locality, 162 m asl, maquis, 24.VII.2018, P. Gardini leg. (PG); 1 ♂, 1 ♀, along SS1 towards Bracco, Sestri Levante, 44°15'40" N 9°26'44" E WGS84, 160 m asl, sub *Quercus ilex*, 20.X.2022, G. and P. Gardini leg. (PG); 1 ♂, 2 ♀♀, Punta Baffe, Sestri Levante, 300 m asl, maquis, 20.X.2022, G. and P. Gardini leg. (PG).

Etymology

From *Segesta Tigulliorum*, the Latin name of Sestri Levante where the specimens were collected.

Description

Maximum length: ♂, 3 mm; ♀, 4 mm. Body colorless, strongly convex with vertical epimera, able to roll up into a perfect ball (Figure 13A). Dorsal cuticle smooth, covered with piliform scale-setae (Figure 13B). One line of noduli laterales per side on same line, far from lateral margins of pereonites (Figure 13A,E). Cephalon with triangular scutellum not separated from vertex and not protruding above it; frontal line interrupted in middle part; distinct postscutellar line; antennary lobes quadrangular, obliquely directed frontwards; eyes absent (Figure 13C,D). Pereonite 1 with posterior margin almost straight; posterolateral schisma with outer lobe rounded and distinctly protruding backwards (Figure 13E). Pereonites 1–3 with small rounded ventral tooth (Figure 13E–G). Telson trapezoidal, wider than long, with slightly concave sides and broadly rounded apex (Figure 13H). Antennula of three articles, second article very short, third one with a tuft of approximately seven subapical aesthetascs (Figure 13I). Antenna reaching back posterior margin of pereonite 1; flagellum of two articles, slightly shorter than fifth article of peduncle; second flagellar article approximately three times as long as first and bearing 1 + 2 + 2 aesthetascs (Figure 13J). Mandibles with molar penicil dichotomized and 2 + 2 free penicils on left and 1 + 2 on right mandible (Figure 14A,B). Maxillula outer branch with 4 + 6 (5 cleft) teeth; inner branch with two stout penicils (Figure 14C). Maxilla with bilobed and setose apex, outer lobe distinctly wider than inner lobe (Figure 14D). Maxilliped palp with one short and one long seta on basal article; endite with two triangular terminal spines, one terminal triangular seta on posteromedial corner and two triangular spines on distal margin (Figure 14E). Pleopod 1 and 2 exopods with monospiracular covered lungs (Figure 15C,D). Uropod with exopod flattened, as long as wide; endopod longer than exopod (Figure 14F).

Male. Pereopod 1 carpus with two lines of strong setae with multipointed apices near sternal margin (Figure 15A). Pereopod 7 with no distinct sexual modifications, ischium with very slightly concave sternal margin (Figure 15B). Pleopod 1 exopod approximately twice as wide as long, with broadly rounded medial margin; endopod with apical part thickset, straight, apex rounded (Figure 15C). Pleopod 2 exopod triangular with concave outer margin bearing few setae; endopod narrow and distinctly longer than exopod (Figure 15D). Pleopod 3–5 exopods triangular (Figure 15E–G).

Ecology

Edaphic species, can be found in the first soil layers or under deeply embedded rocks. The examined specimens were extracted from soil samples.

Remarks

The genus *Alloschizidium* previously comprised 13 species with a Tyrrhenian distribution [78–80]. Three more species from the Iberian Peninsula (*Alloschizidium alicantinum* Cifuentes, 2022; *Alloschizidium jordanai* Cifuentes, 2022, and *Alloschizidium mateui* (Vandel, 1953)) were recently added to this genus by Cifuentes [81] but, according to the descriptions, their attribution to *Alloschizidium* is very doubtful.

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. eae* Argano and Utzeri, 1973 from Ponza Island, *A. caverniculum* Taiti and Ferrara, 1995 from a cave in southern Tuscany, and *A. labronicum* Taiti and Montesanto, 2018 from western Tuscany. It differs from all these species in having the cephalic scutellum with upper margin fused with vertex. In having the male pleopod 1 exopod without any posterior point, the new species is more similar to *A. labronicum*, from which it differs in having a longer telson with broadly rounded apex and narrower uropod exopods (see [80]). It also differs from *A. remyi* in the absence of any trace of eyes (a single ocellum in *A. remyi* is distinctly visible, see [82]).

4. Discussion

With the new species described herein, the number of species known from Liguria rises to 102 and the number of genera to 38, with the genus *Alloschizidium* reported for the first time from this region. The distributions of the new species are reported in Figure 16.

Considering the systematic affinities of the new species and their distributions, different origins can be hypothesized. *Buddelundiella zoiai* sp. n. may have a West-Alpine origin, as most of the species in the genus, even if not all, are found on the south-western portion of the Alps. *Sardoniscus marmoratus* sp. n. shows a North-Apennine distribution, more similar to that of *S. verhoeffi* than of *S. pygmaeus* (Tyrrhenian distribution), indicating a putative origin in this geographic area. *Cylisticus poggii* sp. n. and *Alloschizidium segestanum* sp. n., both showing typical adaptations to endogean life, most likely have a Tyrrhenian origin. In fact, the majority of the species to which they are, respectively, most closely related have a Tyrrhenian distribution. As regards *Porcellio incavatus* sp. n., we have not been able to highlight any affinity with other species of the genus and therefore we cannot advance any hypothesis regarding its origins. Anyway, all these are just tentative hypotheses that need to be developed with deeper studies in the future.

As stated before, Liguria has never been thoroughly and adequately investigated as regards terrestrial isopods, despite its remarkable faunistic and biogeographic value. Therefore, the discovery and description of five species new to science belonging to five different families from this region should not be surprising. Indeed, we believe that the number of recorded species is still underestimated, especially among cave-dwelling and endogean isopods, and that future and more in-depth research may lead to further increase in oniscidean diversity in this region.

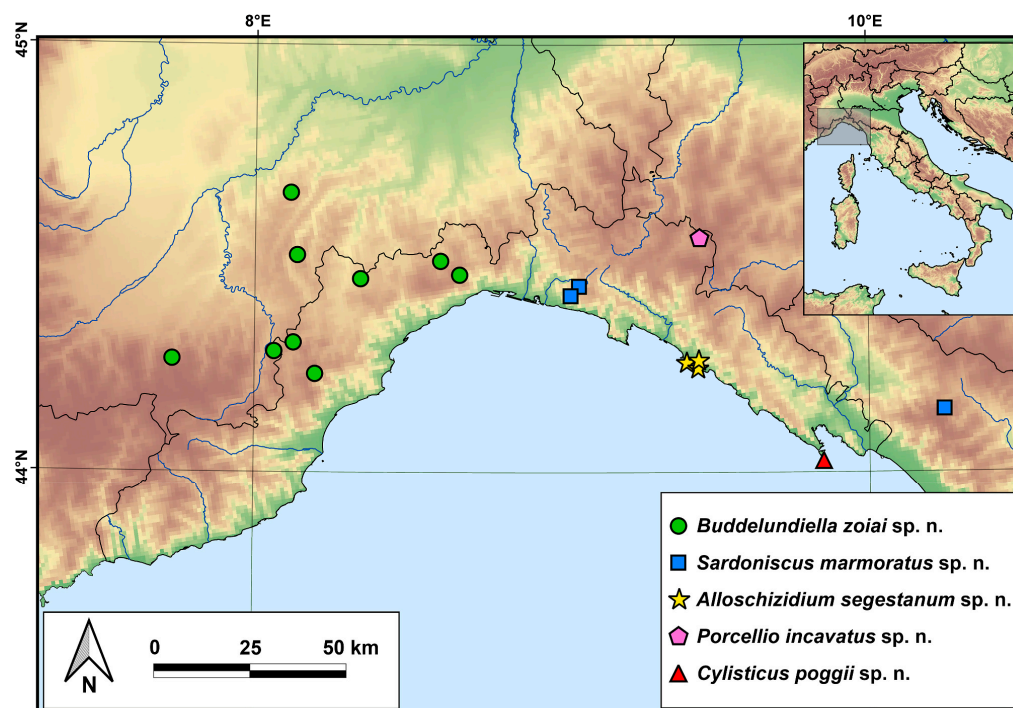


Figure 16. Distribution map of the five new species of Oniscidea from Liguria and surrounding regions.

Author Contributions: Conceptualization, P.G. and S.T.; methodology, P.G. and S.T.; formal analysis, P.G. and S.T.; investigation, P.G.; resources, P.G. and S.T.; data curation, P.G.; writing—original draft preparation, P.G.; writing—review and editing, P.G. and S.T.; supervision, S.T.; project administration, P.G.; funding acquisition, P.G. All authors have read and agreed to the published version of the manuscript.

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