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## New species and records of Eubelidae from Djibouti, eastern Africa (Isopoda: Oniscidea)

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**Abstract.** The terrestrial isopods of Djibouti are still very poorly known. Two new species of Eubelidae are here described: *Periscyphis ugolinii* n. sp. and *Koweitoniscus agnellii* n. sp. A third species is recorded, *Periscyphis sudanensis* Taiti, Ferrara & Allspach, 1997, previously known only from two localities in Sudan.

**Riassunto.** Nuove specie e nuovi dati di Eubelidae (Isopoda: Oniscidea) di Gibuti, Africa orientale. Gli isopodi terrestri di Gibuti sono ancora poco conosciuti. In questo lavoro vengono descritte due nuove specie di Eubelidae: *Periscyphis ugolinii* n. sp. e *Koweitoniscus agnellii* n. sp. Viene inoltre riportata una terza specie, *Periscyphis sudanensis* Taiti, Ferrara & Allspach, 1997, finora nota solo per due località del Sudan.

**ملخص.** أنواع وسجلات جديدة من فصيلة يوبيليدى (*Eubelidae*) من جيبوتى ، شرق أفريقيا (إيسوبودا (*Isopoda*): أونيسيديا (*Oniscidea*)). لا تزال متشابهة الأرجل فى جيبوتى شبه مجهولة. يقدم البحث الحالى وصف نوعين جديدين من فصيلة يوبيليدى (*Eubelidae*): بيريسيفيس *Periscyphis ugolinii* n. sp. وكويتونيسكوس أنيللى *Koweitoniscus agnellii* n. sp. مع تسجيل نوع ثالث - بيريسيفيس سوداننسيس *Periscyphis sudanensis* Taiti, Ferrara & Allspach, 1997 - معروف سابقاً من منطقتين اثنتين فقط فى السودان.

**Résumé.** Nouvelles espèces et données d'Eubelidae de Djibouti, Afrique orientale (Isopoda: Oniscidea). Les isopodes terrestres de Djibouti sont encore très peu connus. Dans ce travail, deux nouvelles espèces d'Eubelidae sont décrites: *Periscyphis ugolinii* n. sp. et *Koweitoniscus agnellii* n. sp. Une troisième espèce est signalée, *Periscyphis sudanensis* Taiti, Ferrara & Allspach, 1997, jusqu'ici connu seulement de deux localités au Soudan.

**Key words.** Oniscidea, Eubelidae, *Periscyphis*, *Koweitoniscus*, new species, Djibouti.

### Introduction

Very little is known about the terrestrial isopods (Oniscidea) from Djibouti. DOLLFUS (1897) recorded *Porcellio laevis* Latreille, 1804 from Obock and later (DOLLFUS, 1899) *Ligia exotica* Roux, 1828, *Porcellionides pruinosus* (Brandt, 1833) (as *Metoponorthus pruinosus*), *Mesarmadillo* n. sp. and *Periscyphis* n. sp. from Obock and Djibouti. The last two species have never been formally described. BUDDE-LUND (1913) described the littoral *Olibrinus olivaceus* from Djibouti, a species considered to be a junior synonym of *O. antennatus* (Budde-Lund, 1902) by TAITI & FERRARA (2004). This species was also cited from Djibouti by MONOD (1933). OMER-COOPER (1926) described *Periscyphis vittatus* from Obock and Djibouti and recorded *P. convexus* (Budde-Lund, 1885) from the same localities. ERHARD & SCHMALFUSS (1997) redescribed *P. convexus* and pointed out that the records for Djibouti by OMER-COOPER (1926) were doubtful since the species is present along the Nile Valley in Egypt and northern Sudan.

In 2013 and 2016 two zoological expeditions were carried out in Djibouti by the Museo di Storia Naturale, Sezione di Zoologia "La Specola" and the Dipartimento di Biologia of the University of

Florence. Three species of Eubelidae were collected, two of which are new to Science and described herein.

### Material and methods

The specimens are stored in 70% ethanol and identifications are based on morphological characters. For each new species the material examined, 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 methods described in MONTESANTO (2015, 2016). The photographs were obtained with a Nikon D7000 attached to a Wild M5 microscope with an AmScope DSLR adapter. 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).

### Systematic account

#### Family Eubelidae Budde-Lund, 1899

#### Genus *Periscyphis* Gerstaecker, 1873

Type species: *Periscyphis trivialis* Gerstaecker, 1873 by monotypy.

#### *Periscyphis sudanensis* Taiti, Ferrara & Allspach, 1997 (Figs 1-3, 10)

Material examined: **Djibouti**: 1 ♂, 2 ♀♀, Orobor, Obock, 11°54'31" N 43°08'07" E (WGS84), ca. 30 m a.s.l., 27.I.2016, leg. A. Nistri, P. Agnelli & A. Ugolini (MZUF, coll. n. 9764).

Distribution: Sudan and Djibouti.

Remarks: The specimens from Djibouti here examined show all the main characters of *Periscyphis sudanensis*, especially the male pereopod 7 and pleopods 1 and 2 are identical (compare Figs 3B, D, E and Figs 4B-D in TAITI *et al.*, 1997). The species was previously known only from two localities in Sudan: village Erkowit at Mt. Erkowit, ca. 50 km SW of Suakin, and Sanganeb Island, N of Port Sudan. Most probably the species is present also in Eritrea even if not yet recorded. A full set of figures based on the specimens from Djibouti (Figs 1-3) are provided to confirm the identification and illustrate some characters not included in the original description, e.g. the shape of the dorsal scale-setae (Fig. 2B), mouth parts (Fig. 2E-I), and male pleopod 3-5 exopods (Fig. 3F-H).

#### *Periscyphis ugolini* n. sp. (Figs 4-6, 10)

Material examined: **Djibouti**: Holotype ♂, near Dittilou, Day Forest National Park, Tadjoura, 11°47' N 42°41' E (WGS84), 700-1000 m a.s.l., 28-30.I.2016, leg. A. Nistri, P. Agnelli & A. Ugolini (MZUF coll. n. 9765). Paratypes: 4 ♂♂, 3 ♀♀, same data as holotype; 1 ♂, between Medeho and Gola Forest, 11°57'24" N 43°00'18" E (WGS84), 25.II.2013, leg. A. Nistri, P. Agnelli & A. Ugolini (MZUF coll. n. 9766).

Description: Maximum length: ♂, 10.5 mm; ♀, 11.5 mm. Body very convex with almost vertical epimera (Figs 4A, 5A). Colour grey-brown, epimera of pereonites 1-6 with pale lateral margins. One line of *noduli laterales* more or less at same distance from lateral margins of pereonites (Fig. 5A). Dorsum covered with numerous upright scale-setae (Fig. 5B). Cephalon (Fig. 4B-D) with profrons slightly protruding frontwards; frontal shield with continuous margin slightly protruding over vertex; eyes with about 25 ommatidia. Pereonite 1 (Fig. 4D) with lateral margin thickened; deep *sulcus arcuatus* along almost whole lateral margin, anterior part bent medially; posterior margin slightly concave at sides; posterolateral corners rounded. Pereonites 2-7 quadrangular (Figs 4A, 5A). Pleonites 3-5 (Fig. 4A, E) continuing body outline with triangular epimera. Telson (Fig. 4E) slightly wider than long, with distal part triangular, narrowly rounded apex. Antennula (Fig. 5C) of three articles with apex equipped with some 10 aesthetascs. Antenna (Fig. 5D) with fifth article of peduncle as long as flagellum; second flagellar article slightly shorter than first. Mandible (Fig. 5E, F) with semidichotomized molar penicil; 2+1 free penicils on left mandible and 1+1 on right. Maxillula (Fig.

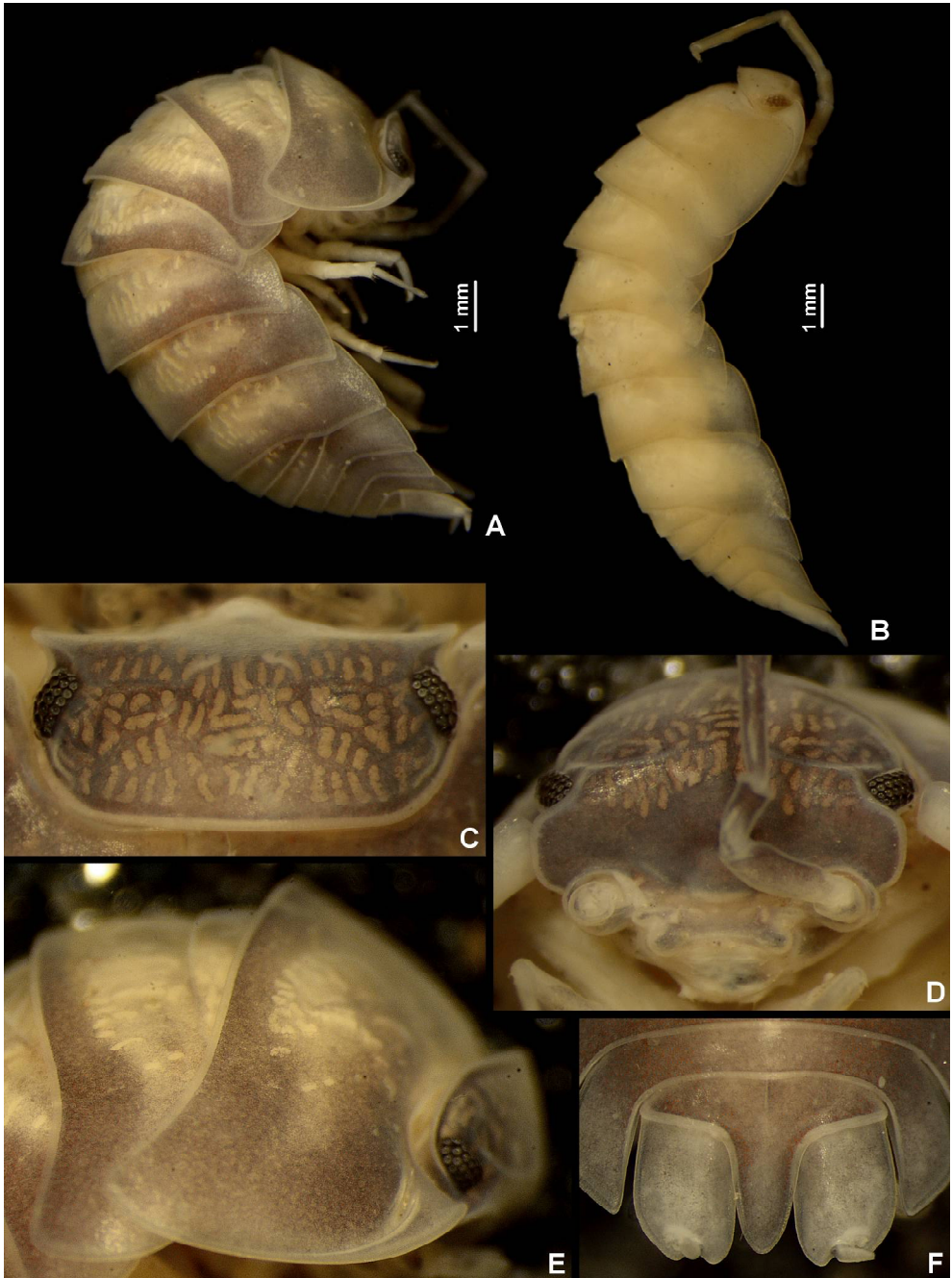


Fig. 1. *Periscyphis sudanensis* Taiti, Ferrara & Allspach, 1997: A, adult female, lateral; B, adult male, lateral. ♀: C, cephalon, dorsal; D, cephalon, frontal; E, cephalon and pereonites 1, 2, lateral; F, telson and uropods, dorsal.

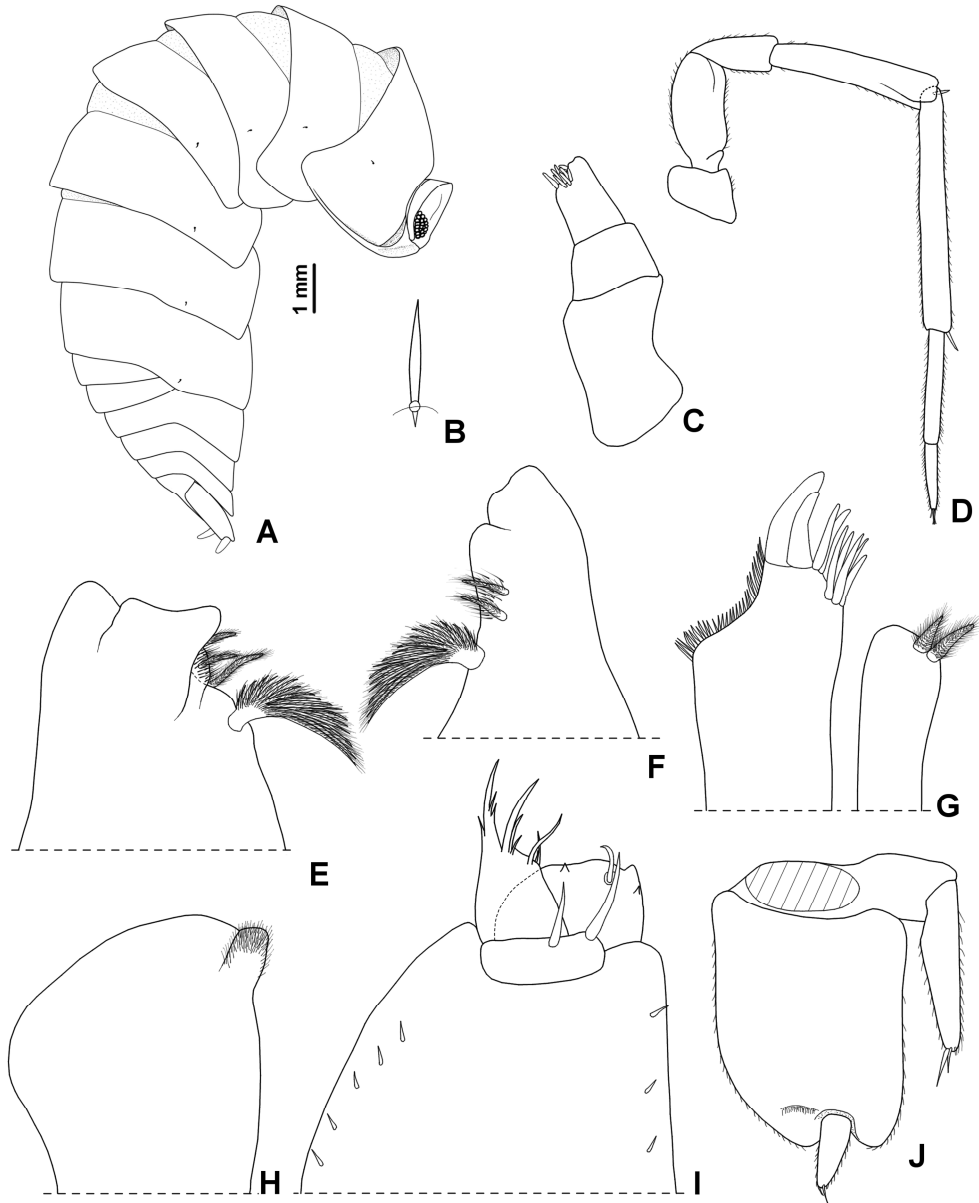


Fig. 2. *Periscyphis sudanensis* Taiti, Ferrara & Allsach, 1997, ♀: A, specimen in lateral view showing position of *noduli laterales*; B, dorsal scale-seta; C, antennula; D, antenna; E, left mandible; F, right mandible; G, maxillula; H, maxilla; I, maxilliped; J, uropod.

5G) outer branch with 4+5 simple teeth; inner branch bearing two long penicils. Maxilla (Fig. 5H) with setose distal part slightly bent medially, inner lobe smaller than outer lobe. Maxilliped (Fig. 5I) with distal article of palp bearing three tufts of setae on medial margin, proximal article with two large setae; endite with a small triangular spine on medial and distal margin. Only pleopod 1 and 2 exopods (Fig. 6C, D) with monospiracular *Periscyphis*-type lungs (cf. FERRARA *et al.*, 1997).

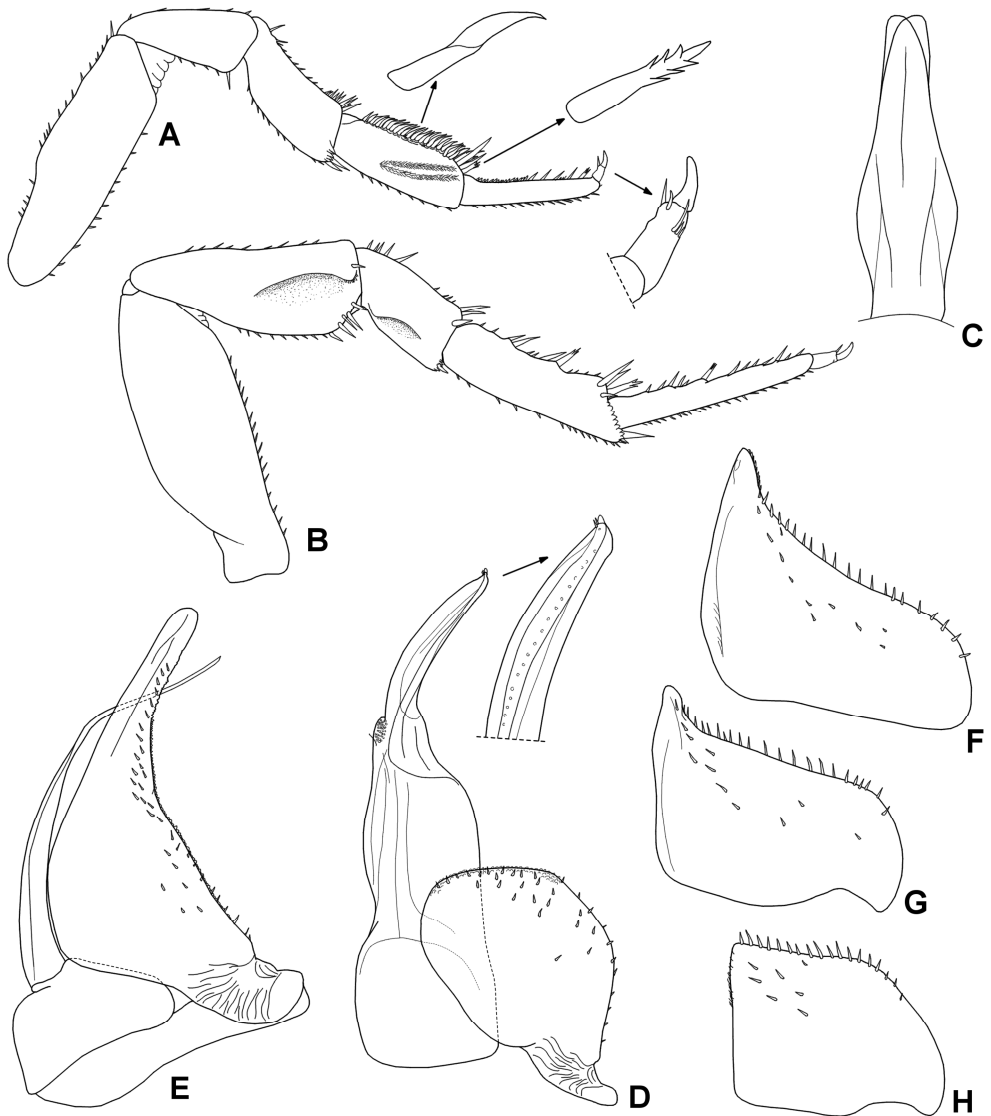


Fig. 3. *Periscyphis sudanensis* Taiti, Ferrara & Allspach, 1997, ♂: A, pereopod 1; B, pereopod 7; C, genital papilla; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

Uropodal protopod (Figs 4E, 5J) subrectangular with rounded posterior corners, indented posterior margin with small exopod not protruding backwards, elongate ovoidal glandular field laterally to exopod insertion.

Male: Pereopods 1-3 merus and carpus with brushes of pointed setae (Fig. 6A). Pereopod 7 (Fig. 6B) ischium with slightly sinuous sternal margin, rostral surface excavated on the distal part, a row of strong setae on distal margin; merus with distal half swollen; carpus with convex tergal margin, distally with small and setose rounded lobe near tergal margin and short lobe bearing three strong setae near sternal margin. Genital papilla as in Fig. 6C. Pleopod 1 (Fig. 6D) exopod about 3 times as wide as long, with a broadly rounded posterior margin equipped with some setae; endopod with distal part slightly bent outwards, triangular apical part directed outwards with a rounded subapical lobe on



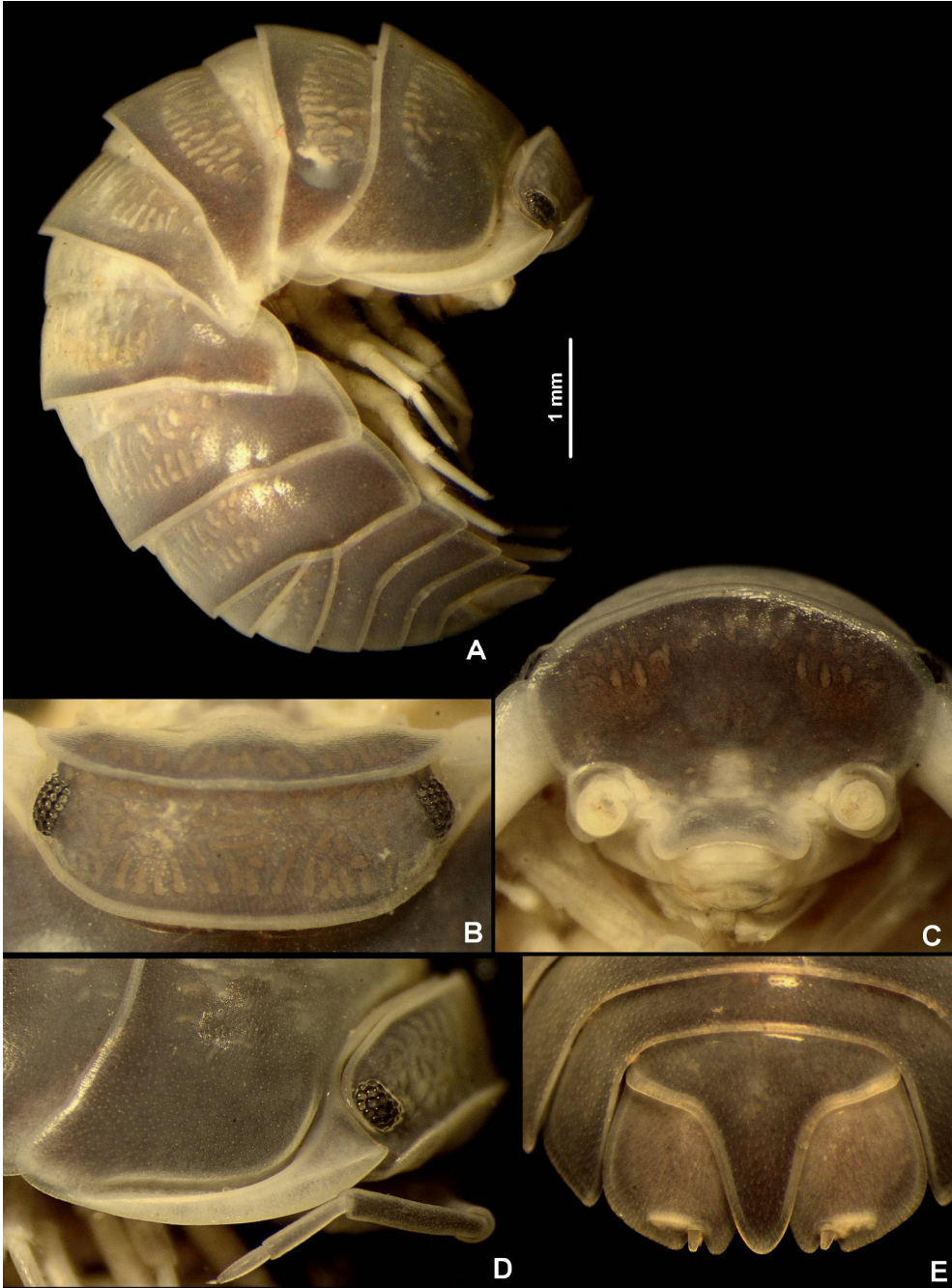


Fig. 4. *Periscyphis ugolinii* n. sp., ♀ paratype: A, adult specimen, lateral; B, cephalon, dorsal; C, cephalon, frontal; D, cephalon and pereonite 1, lateral; E, telson and uropods, dorsal.

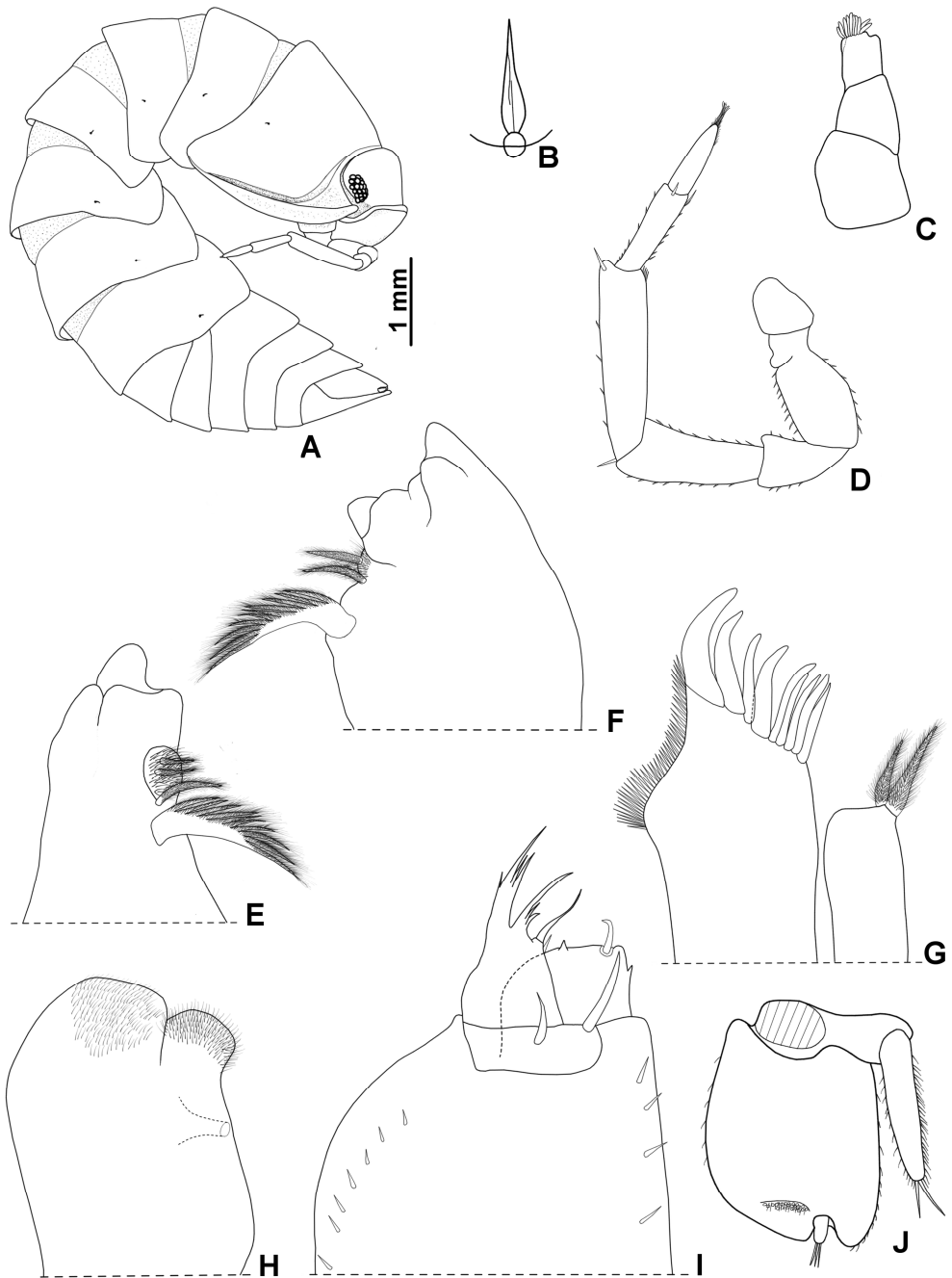


Fig. 5. *Periscyphis ugoi* n. sp., ♀ paratype: A, specimen in lateral view showing position of *noduli laterales*. ♂ paratype: B, dorsal scale-seta; C, antennula; D, antenna; E, left mandible; F, right mandible; G, maxillula; H, maxilla; I, maxilliped; J, uropod.



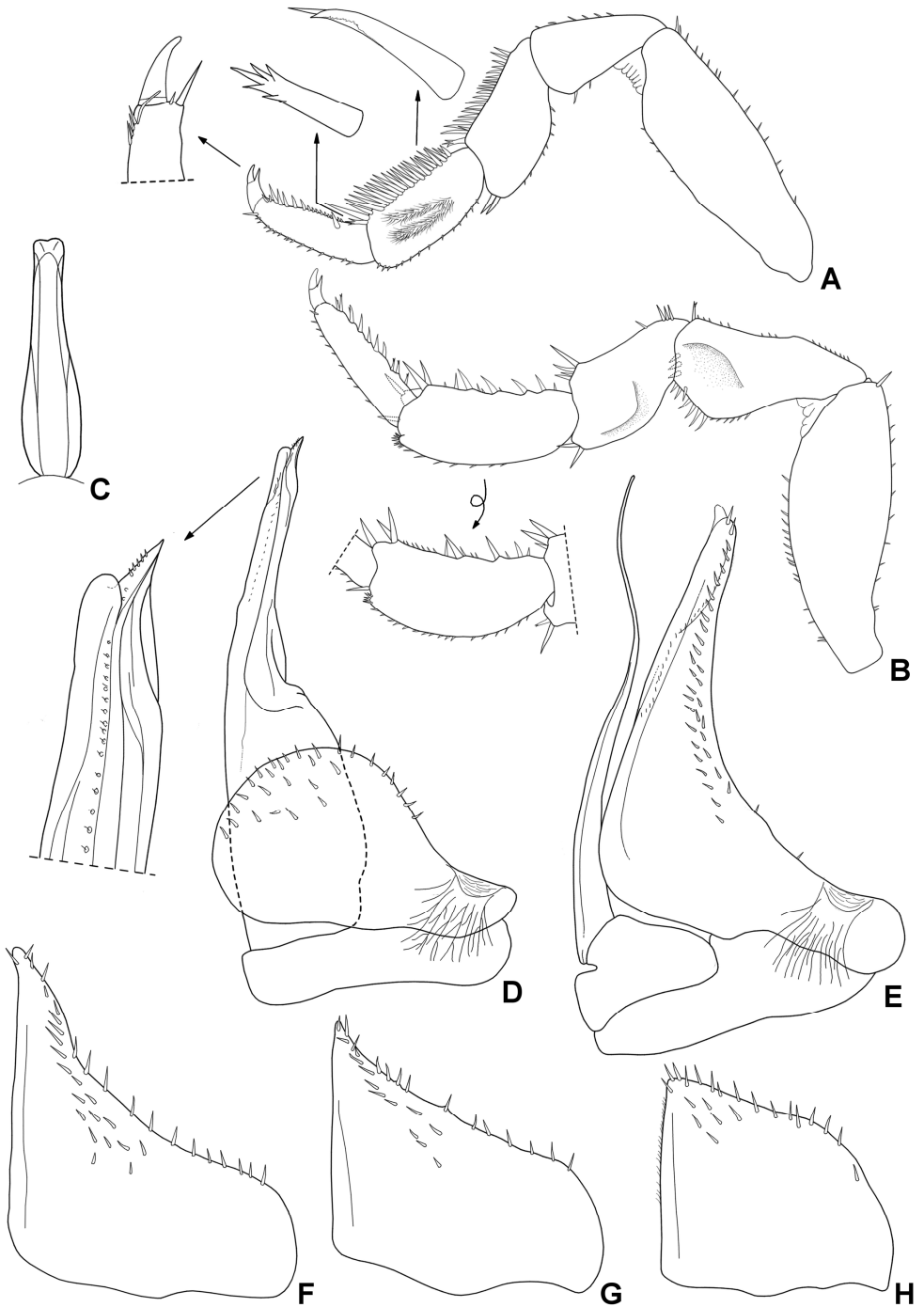


Fig. 6. *Periscyphis ugoi* n. sp., ♂ paratype: A, pereopod 1; B, pereopod 7; C, genital papilla; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

medial margin. Pleopod 2 (Fig. 6E) exopod triangular bearing numerous setae near deeply concave outer margin; endopod slightly longer than exopod, with a flagelliform distal part. Pleopod 3-5 exopods as in Fig. 6F-H.

**Etymology:** The new species is named after Prof. Alberto Ugolini, Florence, who collected the material described herein.

**Remarks:** The genus *Periscyphis* comprises 45 species mainly distributed in eastern Africa and Arabian Peninsula (SCHMALFUSS, 2003; TAITI & CHECCUCCI, 2011; TAITI & SCHOTTE, 2016). *Periscyphis ugolinii* n. sp. belongs to the *granai*-group, which includes *P. granai* Arcangeli, 1929, *P. latissimus* Omer-Cooper, 1926, *P. arabicus* Barnard, 1941, *P. barnardi* Ferrara & Taiti, 1986, *P. buettikeri* Ferrara & Taiti, 1986, *P. omanensis* Taiti & Ferrara, 1991, *P. insularis* Ferrara & Taiti, 1988, *P. minor* Ferrara & Taiti, 1996, *P. albomarginatus* Taiti, Ferrara & Allspach, 1997, and *P. dhofarensis* Taiti, Ferrara & Davolos, 2000 (FERRARA & TAITI, 1986, 1996; TAITI & FERRARA, 1991; TAITI *et al.*, 1997, 2000).

In possessing a cephalon with a continuous frontal margin, the new species is similar to *P. granai*, *P. latissimus*, *P. arabicus*, *P. barnardi*, *P. omanensis* and *P. dhofarensis*, and differs from all the other species of the *granai*-group. In the male pleopod 1 endopod with an apical lobe on the medial margin, it shows closest affinities with *P. granai* from Eritrea, from which it differs in the *sulcus arcuatus* starting at the level of the posterior part of the eye instead of the middle part (compare Fig. 4D and Fig. 22 in FERRARA, 1972), wider basal part of telson and uropodal protopod (compare Fig. 4E and Fig. 23 in FERRARA, 1972), and the male pereopod 7 carpus less enlarged and lacking a distinct distal lobe (compare Fig. 7B and Figs 26, 27 in FERRARA, 1972). It mainly differs from all the other species in the shape of the male pleopod 1 endopod with a subapical rounded lobe on medial margin and a pointed apical part bent outwards.

### Genus *Koweitoniscus* Vandel, 1975

Type species: *Koweitoniscus ahmadii* Vandel, 1975 (= *Periscyphis tamei* Omer-Cooper, 1923) by original designation and monotypy.

#### *Koweitoniscus agnellii* n. sp. (Figs 7-10)

**Material examined:** **Djibouti:** Holotype ♂, quarry about 10 km SSW of Djibouti City, 11°31'01" N 43°07'14" E (WGS84), 45 m a.s.l., 21.I.2016, leg. A. Nistri, P. Agnelli & A. Ugolini (MZUF coll. n. 9767). Paratypes: 2 ♂♂, 4 ♀♀, same data as holotype.

**Description:** Maximum length: ♂, 6 mm; ♀, 8 mm. Body very convex, with vertical epimera, able to roll up into a perfect ball (Figs 7A, 8A). Colour brown-grey with pale muscle spots. Dorsum smooth with small lanceolate scale-setae (Fig. 8B). One line of small *noduli laterales* per side at the same distance from the lateral margins of the pereonites (Fig. 8A). Cephalon (Fig. 7B-D) with frontal shield not protruding over vertex, frontal margin broadly interrupted in the middle; eyes with about 12 ommatidia. Pereonite 1 (Figs 7D, 8C) with lateral margin thickened; wide *sulcus arcuatus* with anterior part bending towards middle part of body; posterior margin slightly concave; inner lobe of schisma shorter than outer lobe. Pereonite 2 (Figs 7D, 8A, C) with small rounded ventral lobe, visible in dorsal view. Pereonite 3 (Fig. 8C) with small transverse thickening. Telson (Fig. 7E) about 1.5 times as wide as long, with concave sides and distal part triangular with rounded apex. Antennula (Fig. 8D) with second article shortest; third article bearing a tuft of aesthetascs at apex. Antenna (Fig. 8E) with a longitudinal groove with scales for water conducting system; fifth article of peduncle as long as flagellum; second article of flagellum slightly longer than first. Mandible (Fig. 8F, G) with semidichotomized molar penicil; 2+1 free penicils on the left mandible and 1+1 on the right. Maxillula (Fig. 8H) outer branch with 4+5 simple teeth; inner branch bearing two long penicils. Maxilla (Fig. 8I) with rounded and setose inner lobe; outer lobe wide, transversally directed. Maxilliped (Fig. 8J) with distal article of palp bearing three tufts of setae on medial margin, proximal article with two large setae; endite with distal part narrower than proximal part. Only pleopod 1 and 2 exopods (Fig. 9C, D) with monospiracular *Periscyphis*-type lungs. Uropod (Fig. 8K) protopod

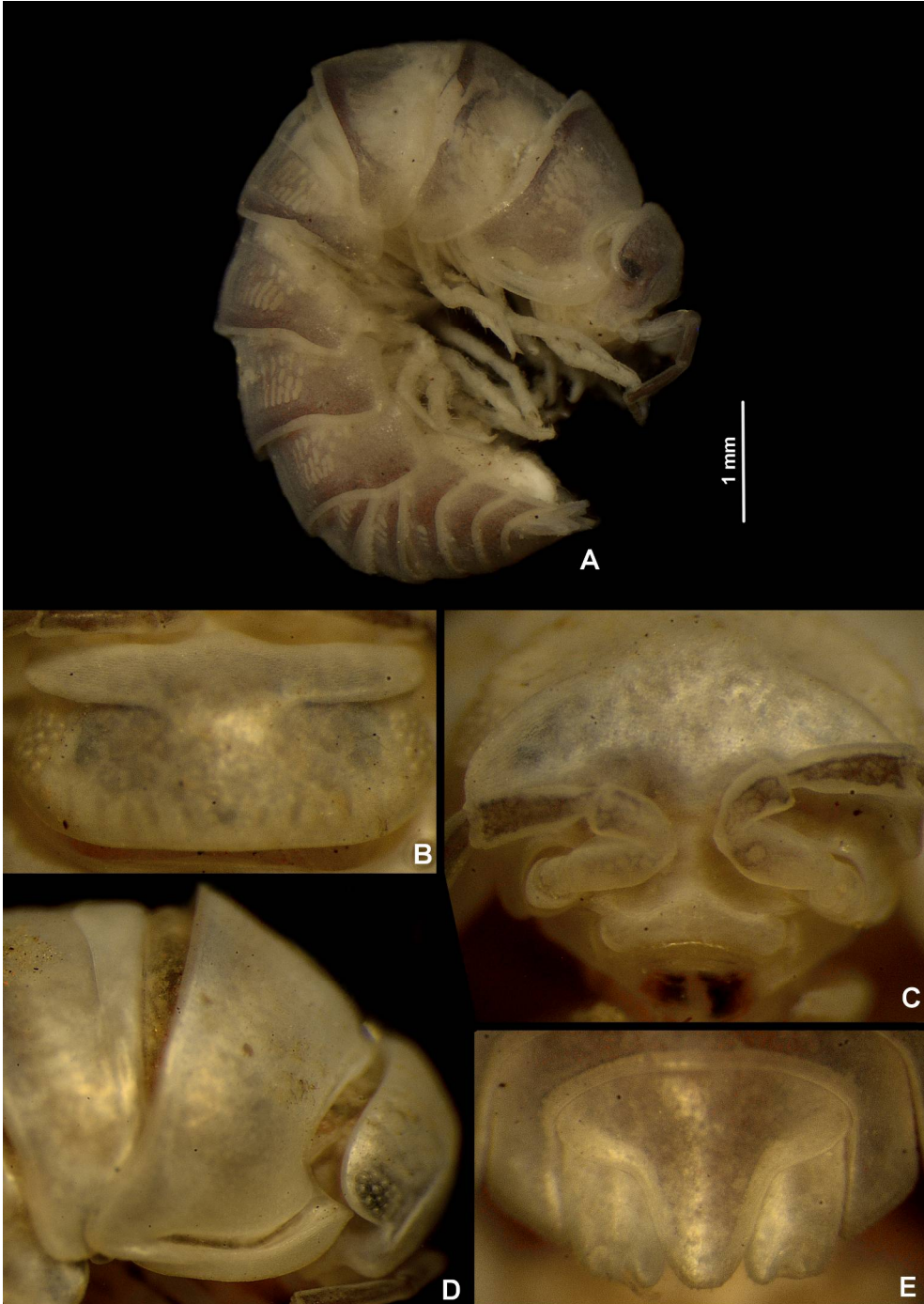


Fig. 7. *Koweitoniscus agnellii* n. sp., ♀ paratype: A, adult specimen, lateral; B, cephalon, dorsal; C, cephalon, frontal; D, cephalon and pereonites 1, 2, lateral; E, telson and uropods, dorsal.

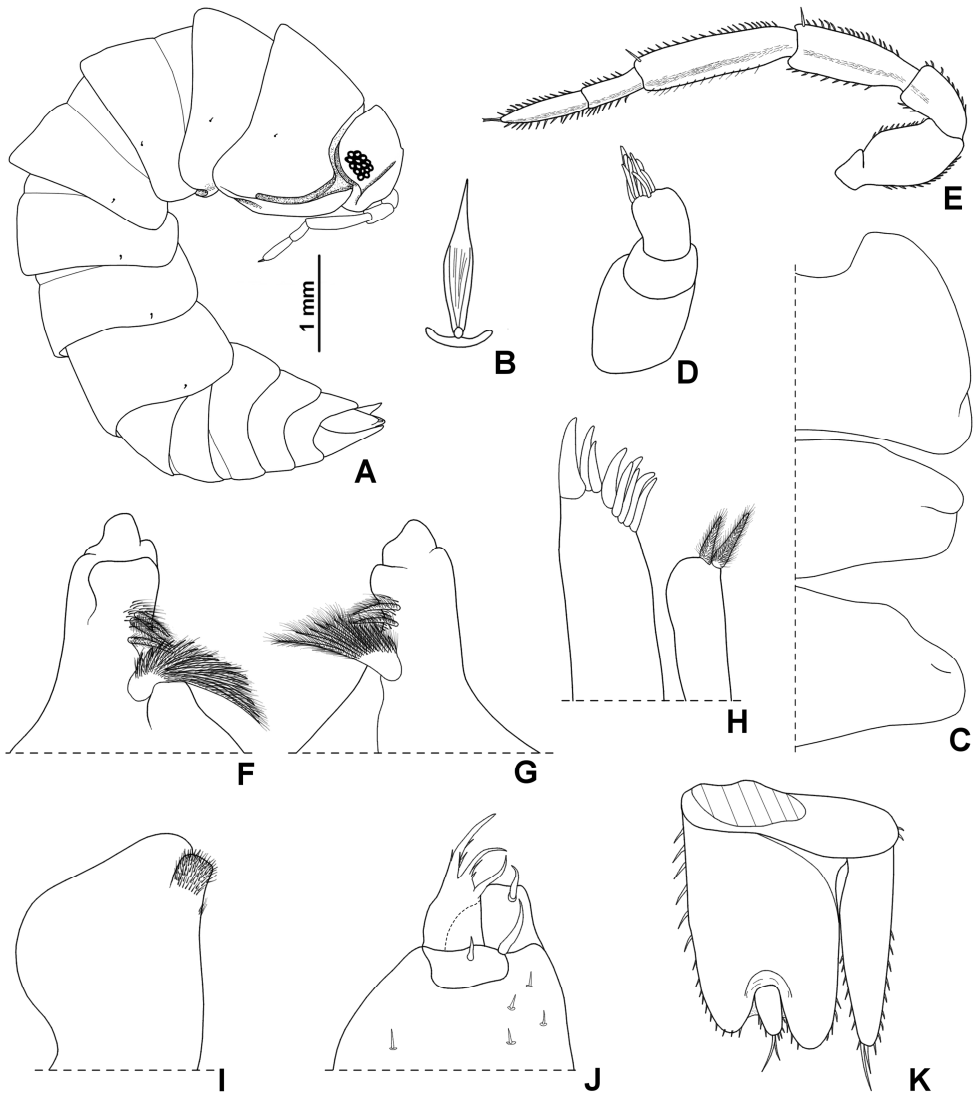


Fig. 8. *Koweitoniscus agnellii* n. sp., ♀ paratype: A, specimen in lateral view showing position of *noduli laterales*; B, epimera of pereonites 1-3, ventral; C, dorsal scale-seta; D, antennula; E, antenna; F, left mandible; G, right mandible; H, maxillula; I, maxilla; J, maxilliped; K, uropod.

subrectangular with rounded posterior corners, posterior margin deeply indented; exopod short not surpassing posteromedial corner of protopod; endopod long and thin, reaching distal margin of protopod.

Male: Pereopod 1-3 carpus with a brush of pointed setae (Fig. 9A). Pereopod 7 (Fig. 9B) ischium with sinuous sternal margin, deeply excavated on rostral surface; merus with a longitudinal depression and a rounded lobe fringed with short triangular setae; carpus without distinct specializations. Genital papilla as in Fig. 9C. Pleopod 1 (Fig. 9D) exopod about twice as wide as long, with quadrangular medial part, posterior and medial margins equipped with small scales and pointed setae; endopod with distal part bent outwards, apical part with a rounded lobe on outer margin and a triangular lobe posteriorly. Pleopod 2 (Fig. 9E) with exopod triangular, much longer than wide with numerous small

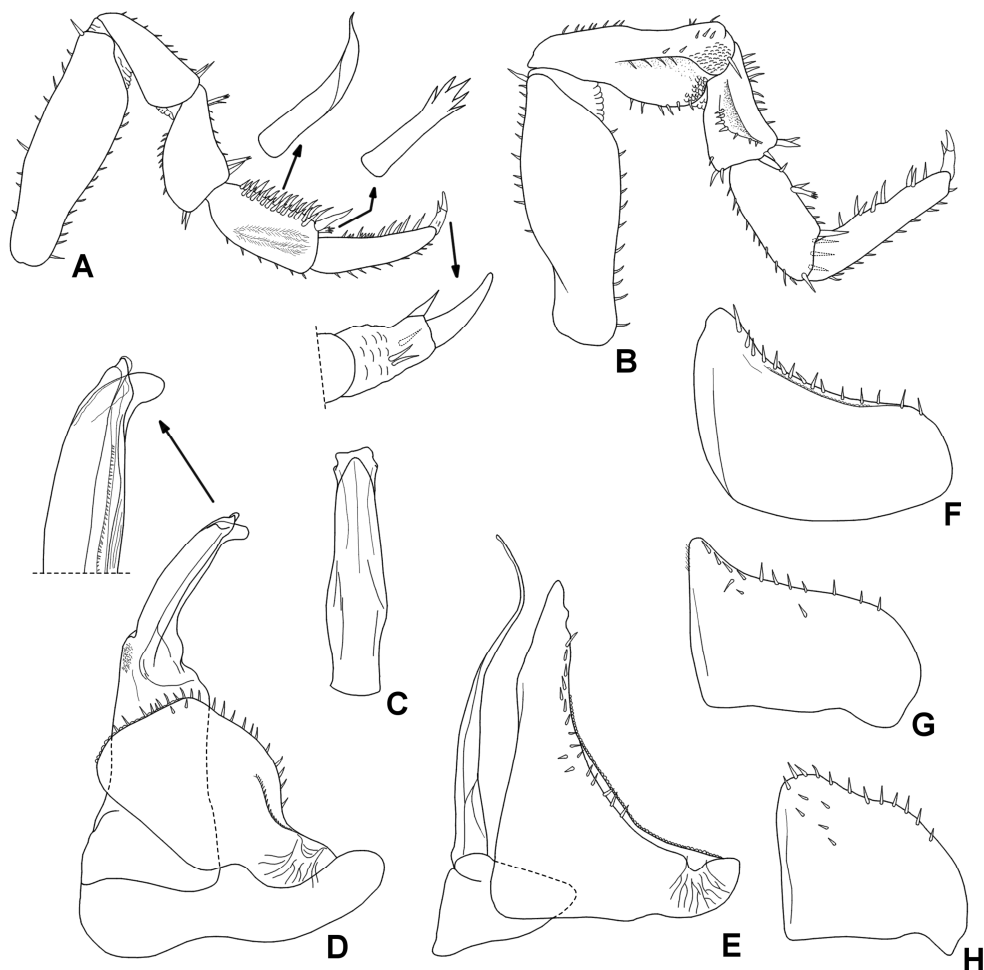


Fig. 9. *Koweitoniscus agnellii* n. sp., ♂ paratype: A, pereopod 1; B, pereopod 7; C, genital papilla; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

scales and setae on outer margin; endopod slightly longer than exopod. Pleopod 3-5 exopods as in Fig. 9F-H.

**Etymology:** The new species is named after Dr. Paolo Agnelli, Florence, who collected the material described herein.

**Remarks:** To date, the genus *Koweitoniscus* comprises four species (SCHMALFUSS, 2003; TAITI & CHECCUCCI, 2011; KASHANI, 2014): *K. tamei* (Omer-Cooper, 1923) from Syria, Kuwait, Iraq and Iran, *K. rostratus* Ferrara & Taiti, 1986 from south-western Saudi Arabia, *K. vanharteni* Ferrara & Taiti, 1996 from Yemen, and *K. korshunovi* Taiti & Checcucci, 2011 from the United Arab Emirates. *Koweitoniscus agnellii* n. sp. differs from all the other species in the genus by having the apex of the male pleopod 1 endopod with a rounded lobe on outer margin. In the cephalon with frontal margin interrupted in the middle the new species is morphologically similar to *K. tamei* and *K. korshunovi*. It differs from both in having the inner lobe of the schisma much shorter than outer one; telson with longer distal part; uropod with indented distal margin of the protopod and longer exopod; and male pereopod 7 ischium with sinuous instead of concave sternal margin and merus with a rounded lobe

(cf. Fig. 15c-g in FERRARA & TAITI, 1986 for *K. tamei* and Figs 86, 87, 97 and 98 in TAITI & CHECCUCCI, 2011 for *K. korshunovi*). *Koweitoniscus agnellii* n. sp. is readily distinguishable from both *K. rostratus* and *K. vanharteni* in having an interrupted instead of continuous frontal margin on the cephalon; from *K. rostratus* also in lacking the distal triangular lobe on the male pereopod 7 carpus (cf. Fig. 16f in FERRARA & TAITI, 1986); from *K. vanharteni* also in the male pereopod 7 carpus not enlarged and without a triangular process on the distal margin (see Fig. 5h-i in FERRARA & TAITI, 1996).

### Discussion

With the three species here treated, seven species of terrestrial isopods are known with certainty from Djibouti: *Olibrinus antennatus*, *Porcellionides pruinosus*, *Porcellio laevis*, *Periscyphis vittatus*, *P. sudanensis*, *P. ugolinii* n. sp., and *Koweitoniscus agnellii* n. sp. *Ligia exotica* recorded by DOLLFUS (1899) needs to be confirmed since in the past this species has often been confused with other tropical species of the genus. Even if Djibouti has an arid tropical climate not particularly favourable for establishment and flourishing of terrestrial isopods, its oniscidean fauna must be certainly much richer than that known at present. For instance, it is unlikely that only two littoral species (*Olibrinus antennatus* and *Ligia exotica* (?)) occur on the coasts of the country. *Porcellionides pruinosus* and *Porcellio laevis* are species of Mediterranean origin, today with a cosmopolitan distribution. With the

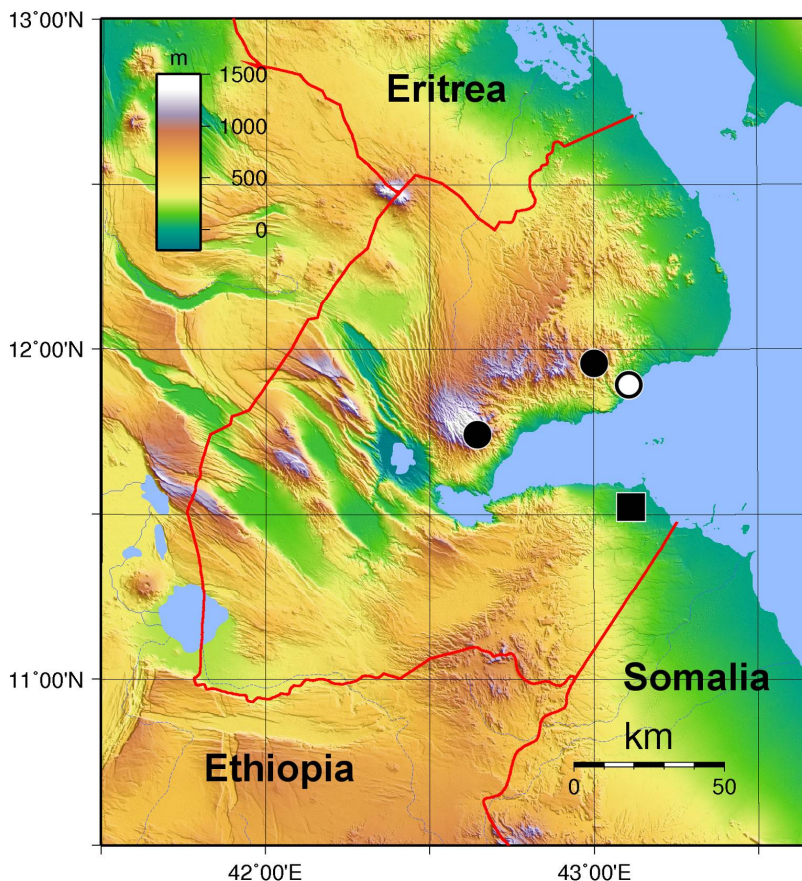


Fig. 10. Distribution of the three species of Eubelidae in Djibouti: *Periscyphis sudanensis* (white circle), *P. ugolinii* n. sp. (black circles) and *Koweitoniscus agnellii* n. sp. (black square).

exception of *Periscyphis vittatus*, a xerophilous species widespread in the lands of the western Indian Ocean, all the other species of the family Eubelidae show more or less limited distributions and affinities with species of the Horn of Africa and the Arabian Peninsula (FERRARA, 1972; FERRARA & TAITI, 1986; TAITI & FERRARA, 1991; TAITI *et al.*, 2000; TAITI & CHECCUCCI, 2011). *Periscyphis sudanensis* was previously known from central Sudan and most probably it is present also in Eritrea, while *P. ugolinii* n. sp. belongs to the *granai*-group distributed in Eritrea and the south-western part of the Arabian Peninsula. The presence of *Koweitoniscus agnellii* n. sp. in Djibouti is also particularly interesting since all the other species in the genus occur in the Arabian Peninsula and up to Syria, Iraq and Iran. These distributions are certainly related to the paleogeography of the area when the Arabian Peninsula was connected to north-eastern Africa at least until the Oligocene, 25-30 Myr ago (RÖGL, 1998) before the formation of the Red Sea and the Gulf of Aden.

### Acknowledgements

We wish to thank Dr. Annamaria Nistri and Dr. Paolo Agnelli of the Museo di Storia Naturale, Sezione di Zoologia “La Specola”, Florence, and Prof. Alberto Ugolini, Dipartimento di Biologia of the University of Florence for collecting the specimens of Oniscidea from Djibouti here recorded and described.

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