

## New species and records of *Exalloniscus* Stebbing, 1911 from southern Asia (Malacostraca, Isopoda, Oniscidea)

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**Abstract:** The genus *Exalloniscus* is widely distributed in southern and eastern Asia. In this contribution, eight species are described as new: *Exalloniscus schmalfussi* from Nepal; *E. siamensis* from Thailand; *E. kampucheaensis* from Cambodia; *E. tortilis* and *E. deharvengi* from Vietnam; *E. stilifer* from southern China; *E. burmaensis* from Myanmar; and *E. convexus* from Laos. Ten more species are recorded: *E. nepalensis* from Nepal; *E. coecus*, *E. brincki*, *E. bicoloratus*, *E. caudatus* and *E. maschwitz* from West Malaysia; *E. sumatranus* from Sumatra, Indonesia, and Singapore; *E. papillosus* from West Malaysia and Vietnam; and *E. thailandensis* from Laos. *Exalloniscus bessoni* Dalens, 1992 and *E. yinae* Nunomura & Xie, 2000 are considered to be junior synonyms of *E. thailandensis* Dalens, 1987. A map with the recorded distributions of all the 28 species of *Exalloniscus* is provided and their habitat is discussed.

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**Key words:** Terrestrial isopods; *Exalloniscus*; Oriental region; new species; distribution.

### Introduction

The genus *Exalloniscus* Stebbing, 1911 has a wide distribution in the Oriental Region and in the Manchurian Subregion, Palearctic Region. Up to date, it included 22 species recorded from India, Sri Lanka, Nepal, Thailand, Laos, Vietnam, Malaysia, Indonesia, Philippines, China, Korea and Japan (Schmalfuss 1983; Taiti and Ferrara 1988; Manicasteri and Taiti 1991; Kwon and Taiti 1993; Dalens 1992; Nunomura 2000; Nunomura and Xie 2000; Taiti and Gruber 2008). The genus has been redefined by Taiti and Ferrara (1988) but its placement in one of the family of Oniscidea is still uncertain (see also Schmalfuss 1983; Schmalfuss 2003; Schmidt and Leistikow 2004). Most of the species of *Exalloniscus* are associated with ants and termites (Taiti and Ferrara 1988; Ferrara et al. 1988), and some occur also in caves (Taiti and Ferrara 1988; Dalens 1992; Taiti and Gruber 2008).

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The present paper deals with new records and descriptions of eight new species of *Exalloniscus* collected in Nepal, southern China, Myanmar, Laos, Vietnam, Thailand, Cambodia, Malaysia, Singapore and Indonesia.

### Materials and methods

All material is preserved in 70% ethanol. Identifications are based on morphological characters with the use of micropreparations. Line drawings were made with the aid of a camera lucida mounted on Wild M5 and M20 microscopes. The program GNU Image Manipulation Program (GIMP) was used to compose the digital images (Montesanto 2015, 2016). The specimens examined are deposited in the following museums:

MHNG = Muséum d'Histoire Naturelle, Geneva;

MNHN = Muséum National d'Histoire Naturelle, Paris;

MZUF = Museo di Storia Naturale, sezione di Zoologia "La Specola" dell'Università di Firenze, Florence;

SMNS = Staatliches Museum für Naturkunde, Stuttgart.

### Systematic account

#### Genus *Exalloniscus* Stebbing, 1911

Type species: *Alloniscus coecus* Dollfus, 1898 by monotypy, according to Stebbing (1911).

#### *Emended diagnosis*

Length between 2.7 and 7.5 mm. Animals with flattened or moderately convex body; body outline without interruption between pereon and pleon. Tergites with scattered scale-setae; one line of noduli laterales per side, very small and inserted on posterior margins and far from lateral margins of pereonites; gland pores absent. Cephalon semicircular, flattened in front, with lateral lobes often protruding laterally; frontal and suprantennal lines present. Eyes reduced or absent. Epimera of pleonites 3-5 well developed, directed backwards. Telson short, triangular. Antennal flagellum three-jointed. Outer branch of maxillula with 11-12 teeth and one or two accessory setae. Maxilliped endite with penicil. Pereopods with flagelliform dactylar seta, often plumose apically. Basis of pereopod 7 usually with water conducting system in form of longitudinal groove on rostral surface covered with lamellar scales (not present in *E. maschwitzi* and *E. vietnamensis*). Pleopodal exopods without respiratory structures. Uropodal endopod inserted proximally to exopod; exopod slightly grooved on outer margin.

#### *Remarks*

The diagnosis of the genus *Exalloniscus* according to Taiti and Ferrara (1988) is emended to include some characters present in the new species described below, in particular the convex, instead of flat, body of *Exalloniscus convexus* n. sp.

Among the Oniscidea, the genus is certainly included in the section Crinocheta but the family is still incertae sedis. In having an antennal flagellum of three articles the genus should belong to the taxon Oniscoidea sensu Schmalfuss (1989) (see also Schmidt 2008) but it shows also plesiomorphic characters present in the lower families of Crinocheta, e. g., the water conducting system on the pereopod 7 basis. A compared molecular analysis of species of *Exalloniscus* with representatives of genera included in the present families of Crinocheta might clarify the systematic position of the genus.

***Exalloniscus coecus* (Dollfus, 1898)**

Figures 1 and 2

*Alloniscus coecus* Dollfus 1898: 375, fig. 22a, pl. XV fig. 22 (partim: specimens from Sumatra); Herold 1931: 308.

*Exalloniscus coecus*; Schmalzfuss 1983: 380; Manicasteri and Argano 1986: 38; Taiti and Ferrara 1986: 237; 1988: 343, fig. 2; Dalens 1987: 47; Schmalzfuss 2003: 112.

? *Exalloniscus coecus*; Stebbing 1911: 191, pl. XII fig. A; Jackson 1936: 79, fig. 2; Ferrara and Taiti 1982: 478, fig. 11.

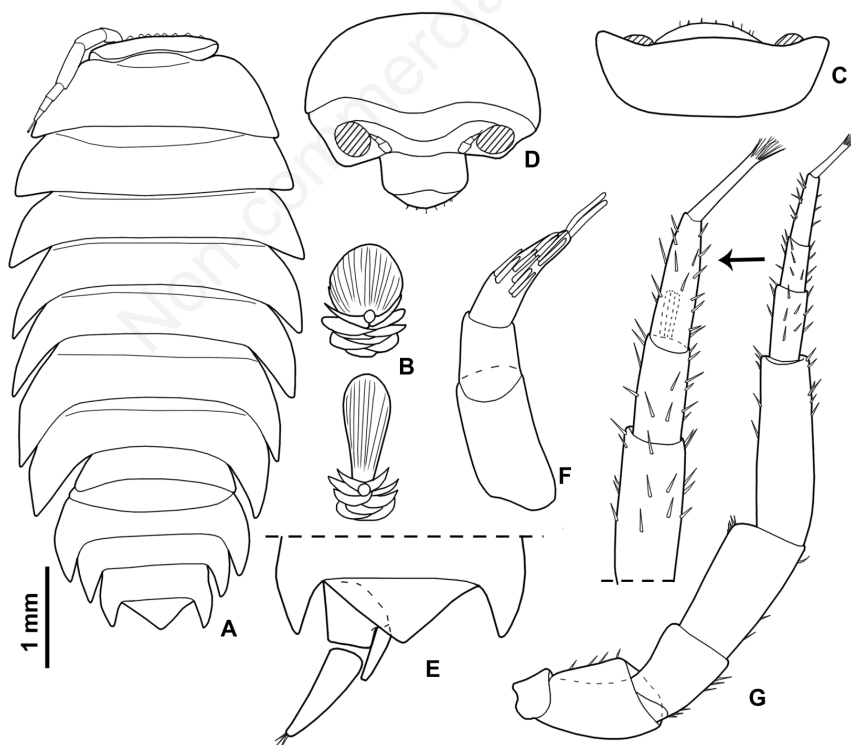
*nec Alloniscus coecus*; Dollfus 1898: 375 (partim: specimens from Java); Taiti and Ferrara 1988: 343.

*Material examined*

MALAYSIA: 1 ♂, 1 ♀ (MZUF), Tioman Island, 23.IV.1999, leg. L.A. Ballerio.

*Previous records*

INDONESIA: Sumatra, Kajoe Tanam (Dollfus 1898). ? INDIA: Maddathorai, Travancore (Stebbing 1911); Andaman Islands: South Andaman, Port Blair, Chiryiatapu (Ferrara and Taiti 1982). ? WEST MALAYSIA: Kuala Legap, Pelus Valley, Perak (Jackson 1936).



**Figure 1.** *Exalloniscus coecus* (Dollfus, 1898), ♂ from Tioman Island, Malaysia. A, dorsal view; B, dorsal scale-setae; C, cephalon, dorsal view; D, cephalon, frontal view; E, pleonite 5, telson and left uropod, dorsal view; F, antennula; G, antenna.

### Distribution

The species is present with certainty on Sumatra (Indonesia) and Tioman Island (Malaysia) while the records from Travancore and Andaman Islands (India) and Perak (Malaysia) need to be confirmed.

### Remarks

The two specimens from Tioman Island (♂ 5.5 mm, ♀ 4.5 mm long) correspond very well to *E. coecus* from Sumatra as figured by Taiti and Ferrara (1988) and are here illustrated to confirm the identification (Figures 1 and 2). In particular, the following characters are identical to those of the type specimens: the oval, flattened and colourless body (Figure 1A), shape of cephalon and lack of eyes (Figure 1B,C), telson triangular with straight sides (Figure 1E), male pleopod 1 exopod with sinuous outer margin and triangular distal point bent outwards, and endopod straight with bilobed apex (Figure 2D).



**Figure 2.** *Exalloniscus coecus* (Dollfus, 1898), ♂ from Tioman Island, Malaysia. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

*Exalloniscus nepalensis* Schmalzfuss, 1983

*Exalloniscus nepalensis* Schmalzfuss 1983: 380, figs 24-32, map 3; Taiti and Ferrara 1986: 237; Manicacstri and Argano 1986: 40; Dalens 1987: 47; Taiti and Ferrara 1988: 350, figs 1, 8, 9; Schmalzfuss 2003: 112.

*Material examined*

NEPAL: 1 ♂, 6 ♀♀ (MZUF), Taplejung Distr., between Gunsu und Kibla, 3050 m a.s.l., 11.XI.1983, leg. J. Martens and B. Daams; 1 ♀ (SMNS 1984), Panchthar Distr., near Deorali, Pusapati and Sheldoti, 28.VIII.1983, 2500-2800 m a.s.l., *Tsuga, Lithocarpus*, leg. J. Martens and W. Shawaller; 1 ♂ (SMNS), Taplejung Distr., upper Simbua Khola ascent to pasture Lassetham, 3000-3150 m a.s.l., mature mixed *Tsuga-Rhododendron* broad leaved forest, 15.V.1988, leg. J. Martens and W. Shawaller; 5 ♀♀ (SMNS), Sankhua Sabha Distr., between Pomri La and Pahakhola, 3150-3450 m a.s.l., *Abies-Rhododendron* forest with bamboo, 30.V.1988, leg. J. Martens and W. Shawaller; 1 ♀ (SMNS), Taplejung Distr., upper Simbua Khola Valley, 2900-3100 m a.s.l., *Abies-Tsuga* forest, 15.V.1988, leg. J. Martens and W. Shawaller; 3 ♂♂, 8 ♀♀ (SMNS), Sankhua Sabha Distr., above Pahakhola, 2600-2800 m a.s.l., *Quercus semecarpifolia, Rhododendron*, 31.V.-3.VI.1988, leg. J. Martens and W. Schawaller.

*Previous records*

NEPAL: Godawari, Mt. Phulchoki, Kathmandu valley; north of Mai Pokhari, Gitang Khola valley (Schmalzfuss 1983; Taiti and Ferrara 1988).

*Distribution*

Nepal.

*Remarks*

*Exalloniscus nepalensis* is a forest dwelling species, apparently not associated with ants or termites like many other species in the genus.

*Exalloniscus brincki* Manicacstri & Argano, 1986

*Exalloniscus brincki* Manicacstri and Argano 1986: 40, figs 1-3; Dalens 1987: 47; Ferrara et al. 1988: 45; Taiti and Ferrara 1988: 354, figs 1, 12, 13; Schmalzfuss 2003: 112.

*Material examined*

MALAYSIA: 2 ♂♂, 6 ♀♀ (MZUF), Pahang State, Genting Tea Estate, with termites, 19.XI.1987, leg. S. Taiti and L. Bartolozzi; 1 ♂, 1 ♀ (MZUF), same locality, 8-13.XI.1993, leg. S. Turillazzi; 5 ♂♂, 9 ♀♀ (MZUF), Kuala Lumpur, Templer Park, 13.XII.1987, leg. S. Taiti and L. Bartolozzi; 1 ♂ (MZUF), Perak, Kuala Woh, 10 km NE of Tapah, with termites, 18.IV.1999, leg. L.A. Ballerio.

*Previous records*

SRI LANKA: Yakkala, north-east of Colombo; Deerwood, Kuruwita, north-north-west of Ratnapura; Kegalla (Manicacstri and Argano 1986). MALAYSIA: Pahang State, Genting Tea Estate (Taiti and Ferrara 1988).

*Distribution*

Sri Lanka and West Malaysia.

*Remarks*

*Exalloniscus brincki* in Malaysia occurs in nests of the termite *Macrotermes malaccensis* (Haviland, 1898) (Taiti and Ferrara 1988). This is the only species in the genus living in association with termites.

***Exalloniscus sumatranus* Manicasteri & Taiti, 1991**

*Exalloniscus sumatranus* Manicasteri and Taiti 1991: 185, figs 1-16; Schmalzfuss 2003: 113.

*Material examined*

INDONESIA: 1 ♂, 1 ♀ (MZUF), Sumatra, Tahura National Park, 1.II.2001, leg. I.H. Tuff and I. Ozanová. SINGAPORE: 1 ♂, 1 ♀ (MHNG), Bukit Timah Nature Reserve, Taban Valley, 50 m a.s.l., 18.XII.1987, leg. B. Hauser.

*Previous records*

INDONESIA: Northern Sumatra, Berastagi (Manicasteri and Taiti 1991).

*Distribution*

Northern Sumatra and Singapore.

*Remarks*

In the original description of *Exalloniscus sumatranus*, Manicasteri and Taiti (1991) stated that the colour faded due to long conservation in alcohol. Examination of the new material showed that the species is light brown with pale antennae and uropods. The species was found in association with the ant *Myrmicaria brunnea subcarinata* (Smith, 1857) (Manicasteri and Taiti 1991).

***Exalloniscus bicoloratus* Taiti & Ferrara, 1988**

*Exalloniscus bicoloratus*; Ferrara et al. 1988: 45 (nomen nudum).

*Exalloniscus bicoloratus* Taiti and Ferrara 1988: 36, figs 1, 24, 25; Schmalzfuss 2003: 112.

*Material examined*

MALAYSIA: 1 ♂ (MZUF), Pahang State, Genting Tea Estate, 16.XI.1987, leg. S. Taiti and L. Bartolozzi.

*Previous records*

MALAYSIA: Selangor State, Batu Caves; Ulu Gombak, 24 km north-east of Kuala Lumpur (Taiti and Ferrara 1988).

*Distribution*

West Malaysia.

*Remarks*

This species was collected in nests of the ant *Camponotus* sp. (*maculatus*-group) and in caves (Taiti and Ferrara 1988).

***Exalloniscus caudatus* Taiti & Ferrara, 1988**

*Exalloniscus caudatus*; Ferrara et al. 1988: 45 (nomen nudum).

*Exalloniscus caudatus* Taiti and Ferrara 1988: 362, figs 1, 20, 21; Schmalfuss 2003: 112.

*Material examined*

MALAYSIA: 10 ♂♂, 6 ♀♀ (MZUF), Pahang State, Genting Highlands, 1725 m a.s.l., forest margin, 18.I.1987, leg. S. Taiti and L. Bartolozzi.

*Previous records*

MALAYSIA: Pahang State, Genting Highlands (Taiti and Ferrara 1988).

*Distribution*

West Malaysia.

*Remarks*

*Exalloniscus caudatus* was collected in nests of ants of the genus *Pseudolasius* Emery, 1887a (Taiti and Ferrara 1988).

***Exalloniscus papillosus* (Budde-Lund, 1912)**

*Kisuma papillosa* Budde-Lund 1912: 169, pl. 8 figs 1-10; Herold 1931: 308.

*Exalloniscus papillosus*; Taiti and Ferrara 1986: 242, figs 4, 5A-D; 1988: 347, figs 1, 4, 5; Manicasterri and Argano 1986: 40; Dalens 1987: 47; Ferrara et al. 1988: 45; Schmalfuss 2003: 113; Beron 2015: 182.

*Exalloniscus* sp.; Taiti and Ferrara 1986: 245, fig. 5E.

*Material examined*

MALAYSIA: 1 ♀ (MZUF), Kuala Lumpur, 21.XI.1987, leg. S. Taiti and L. Bartolozzi. VIETNAM: 1 ♂ (MNHN), Dong Nai Province, Tan Phu, 11°15'01.7"N 107°24'14.4"E, lava tunnel, on guano, 16.XII.2006, leg. L. Deharveng and A. Bedos.

*Previous records*

INDONESIA: Java, Semarang (Budde-Lund 1912); Bali, Klungkung (Taiti and Ferrara 1986); Bali, near Tanah Lot (Taiti and Ferrara 1988). PHILIPPINES: Mindoro (Taiti and Ferrara 1986). MALAYSIA: Selangor State, Ulu Gombak; Selangor State, Batu Caves; Selangor State, near Sungai Pusu, about 13 km north-east of Kuala Lumpur (Taiti and Ferrara 1988). SINGAPORE (Taiti and Ferrara 1988).

*Distribution*

West Malaysia (Selangor State), Singapore, Indonesia (Java, Bali), Philippines (Mindoro) and Vietnam.

*Remarks*

*Exalloniscus papillosus* lives in association with different ants but it is not a strictly myrmecophilous species. It was recorded with *Pseudoneoponera tridentata* (Smith, 1858), *Anoplolepis gracilipes* (Smith, 1857), *Diacamma rugosum* (Le Guillou, 1842), and *Polyrhachis proxima* Roger, 1863 (Taiti and Ferrara 1988). This species occurs also in caves but it does not show troglomorphic characters.



***Exalloniscus maschwitzi* Taiti & Ferrara, 1988**

*Exalloniscus maschwitzi*; Ferrara et al. 1988: 45 (nomen nudum)

*Exalloniscus maschwitzi* Taiti and Ferrara 1988: 357, figs 1, 16-20; Schmalzfuss 2003: 112.

*Material examined*

MALAYSIA: 2 ♂♂, 5 ♀♀ (MZUF), Negeri Sembilan, Pasoh Forest Reserve, with *Leptogenys processionalis distinguenda* (Emery, 1887b), 8.III.1992, leg. K. Rościszewski.

*Previous records*

MALAYSIA: Selangor State, Ulu Gombak, 24 km north-east of Kuala Lumpur (Taiti and Ferrara 1988).

*Distribution*

West Malaysia.

*Remarks*

*Exalloniscus maschwitzi* lives in association with migrating ants of the genus *Leptogenys* Roger, 1861 (Ferrara et al. 1988; Taiti and Ferrara 1988).

***Exalloniscus rotundatus* Taiti & Ferrara, 1986**

*Exalloniscus rotundatus* Taiti and Ferrara 1986: 239, figs 1-3; 1988: 352, figs 1, 10, 11; Manicastro and Argano 1986: 40; Dalens 1987: 47; Kwon and Taiti 1993: 27; Schmalzfuss 2003: 113; Taiti and Gruber 2008: 112.

*Material examined*

CHINA: 2 ♂♂, 1 ♀ (MHNG), Hong Kong, Shing Mun Country Park, Tai Shing family walk, above Shing Mun Reservoir, 250-320 m a.s.l., 4.XII.1988, leg. B. Hauser.

*Previous records*

CHINA: Hong Kong, Tai Po, 20 km from Tai Lou (Taiti and Ferrara 1986; 1988; Kwon and Taiti 1993).

*Distribution*

China (Hong Kong).

***Exalloniscus thailandensis* Dalens, 1987**

Figure 3

*Exalloniscus thailandensis* Dalens 1987: 45, pl. 2 figs 7-14; Taiti and Ferrara 1988: 357, figs 14, 15; Schmalzfuss 2003: 113; Beron 2015: 182.

*Exalloniscus bessoni* Dalens 1992: 17, figs 1-16; Schmalzfuss 2003: 112; Beron 2015: 182, n. syn.

*Exalloniscus yinae* Nunomura and Xie 2000: 61, fig. 9, n. syn.



*Material examined*

THAILAND: 3 ♂♂, 10 ♀♀ (MZUF), Chiang Mai Province, Mae Tae, village Pamiang, Bat Cave, 19.VII.2018, leg. S. Polak.

LAOS: 3 ♂♂, 10 ♀♀, 5 juvs (MZUF), Louangprabang Province, Kuang Si Waterfalls, ca. 30 km S of Luang Prabang, 19°44'58.0"N 101°59'31.6"E, 515 m a.s.l., with ants, 4.III.2007, leg. S. Taiti.

*Previous records*

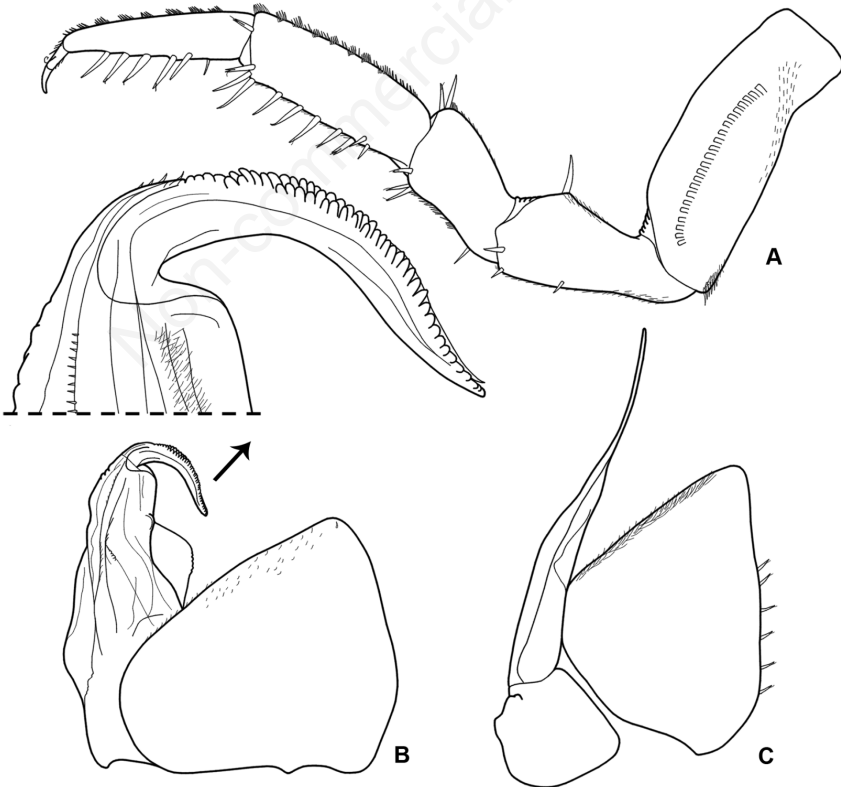
THAILAND: Nam Hu Hoa Koa Cave, 17 km from Mae Hong Son (Dalens 1987); Chiang Mai Prov., Doi Inthanon National Park; Chiang daw (Taiti and Ferrara 1988). LAOS: Luang Prabang, Tham Russi (Dalens 1992). CHINA: Yunnan, Xishuangbanna, Tropic Botanic Garden (Nunomura and Xie 2000).

*Distribution*

Northern Thailand, northern Laos and southern China.

*Remarks*

*Exalloniscus thailandensis* was described by Dalens (1987) from specimens collected in a cave in north-western Thailand. Taiti and Ferrara (1988) added new figures of this species from specimens collected in Chang Mai Province, Thailand. The species is characterized by



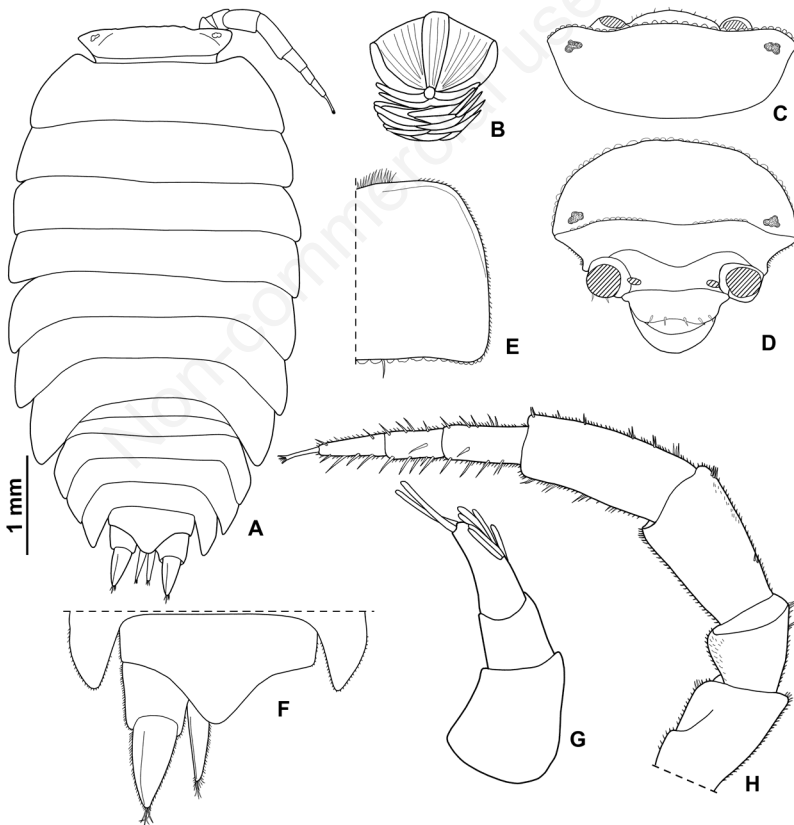
**Figure 3.** *Exalloniscus thailandensis* Dalens, 1987, ♂ from Kuang Si Waterfalls, Luang Prabang, Laos. A, pereopod 7; B, pleopod 1; C, pleopod 2.

having colourless body, absence of eyes and complex male pleopod 1 endopod with a long pointed apical part recurved outwards and a triangular lobe on its outer margin. These and all the other characters are present also in the *Exalloniscus bessoni* described by Dalens (1992) from a cave of Luang Prabang, northern Laos. Dalens stated that *E. bessoni* is very similar to *E. thailandensis* but did not mention which differences distinguish the two species. The examination of several specimens from the same area in Laos allowed us to consider *E. bessoni* as a junior synonym of *E. thailandensis* since all the characters described for *E. bessoni* are present also in *E. thailandensis*, including the typical shape of the male pleopod 1. The male characters of the specimens from Luang Prabang here examined are illustrated in Figure 3. Moreover, also *Exalloniscus yinae*, described by Nunomura and Xie (2000) from south-western Yunnan, China, close to the border with Laos, shows the same characters of *E. thailandensis* and is also considered to be a junior synonym of that species.

*Exalloniscus schmalfussi* n. sp.

Figures 4-6, 22A

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**Figure 4.** *Exalloniscus schmalfussi* n. sp. ♂ paratype from Tinjura Dara, Chauki to Basantapur, Nepal. A, adult specimen, dorsal view; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 4, dorsal view; F, pleonite 5, telson and left uropod, dorsal view; G, antennula; H, antenna.

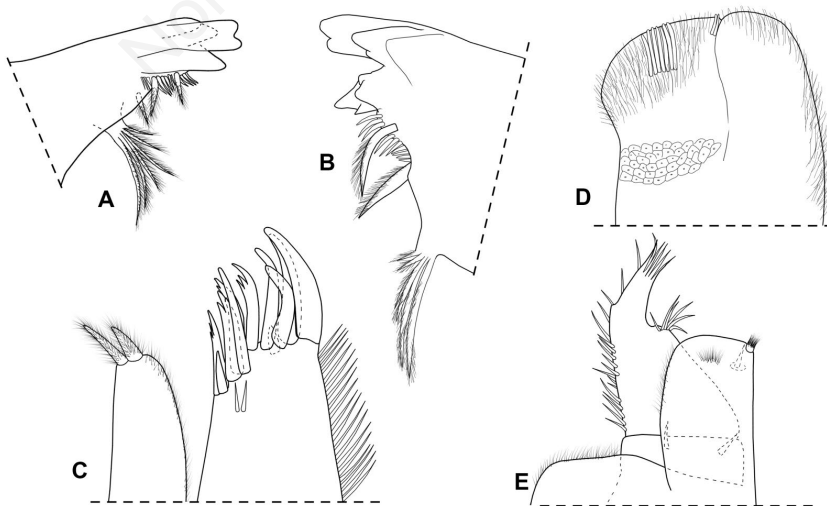
*Material examined*

NEPAL: Holotype: ♂ (SMNS), Terhathum/Dhankuuta District, Tinjura Dara, Chauki to Basantapur, 2550-2650 m a.s.l., deciduous forest, 18.IX.1983, leg. J. Martens and B. Daams. Paratypes: 1 ♂, 5 ♀♀ (SMNS), 1 ♂, 3 ♀♀ (MZUF), same data as holotype.

*Description*

Maximum length: ♂ and ♀ 5.5 mm. Body oval, flattened and colourless (Figures 4A, 22A). Dorsum covered with large triangular scale-setae (Figure 4B). Cephalon (Figure 4C, D) with lateral lobes with rounded apex, slightly protruding laterally; frontal line almost straight, suprantennal line bent down in middle; eyes with three ommatidia. Pereonites 1-3 (Figure 4A,E) with postero-lateral corners right-angled, pereonites 4-7 with postero-lateral corners directed backwards. Pleonites 3-5 with epimera falciform, protruding backwards. Telson triangular, wider than long, with slightly concave sides and rounded apex (Figure 4F). Antennula (Figure 4G) third article with six superimposed aesthetascs plus apical pair. Antenna (Figure 4H) with fifth article of peduncle shorter than flagellum; ratio of flagellum joints 8:6:7. Mandibles (Figure 5A,B) with molar penicil consisting of several plumose setae; right mandible with 1+1 penicils, left mandible with 2+1 penicils. Maxillula (Figure 5C) outer branch with 5+6 (4 cleft) teeth and two setae on caudal surface; inner branch with two subequal penicils. Maxilla (Figure 5D) with bilobed and setose distal part; inner lobe twice as wide as outer lobe; inner lobe with row of thick setae subapically. Maxilliped (Figure 5E) with rectangular endite bearing penicil; palp basal article with two setae. Pereopods with flagelliform dactylar seta with fine setae at apex. Pereopod 1 carpus with transversal antennal grooming brush. Pereopod 7 (Figure 6B) basis with distinct water conducting system. Uropod (Figure 4F) exopod as long as endopod.

Male: Pereopod 1 and, to a lesser extent, 2 carpus with long strong setae on sternal margin (Figure 6A). Pereopod 7 (Figure 6B) with few strong setae on sternal margin, ischium sternal margin straight. Pleopod 1 (Figure 6C) exopod triangular, longer than wide, with sinuous outer margin and rounded posterior point; endopod straight, with small rounded lobe on distal inner margin. Pleopod 2 (Figure 6D) exopod triangular with few setae on



**Figure 5.** *Exalloniscus schmalfussi* n. sp., ♂ paratype from Tinjura Dara, Chauki to Basantapur, Nepal. A, left mandible; B, right mandible; C, maxillula; D, maxilla; E, maxilliped.

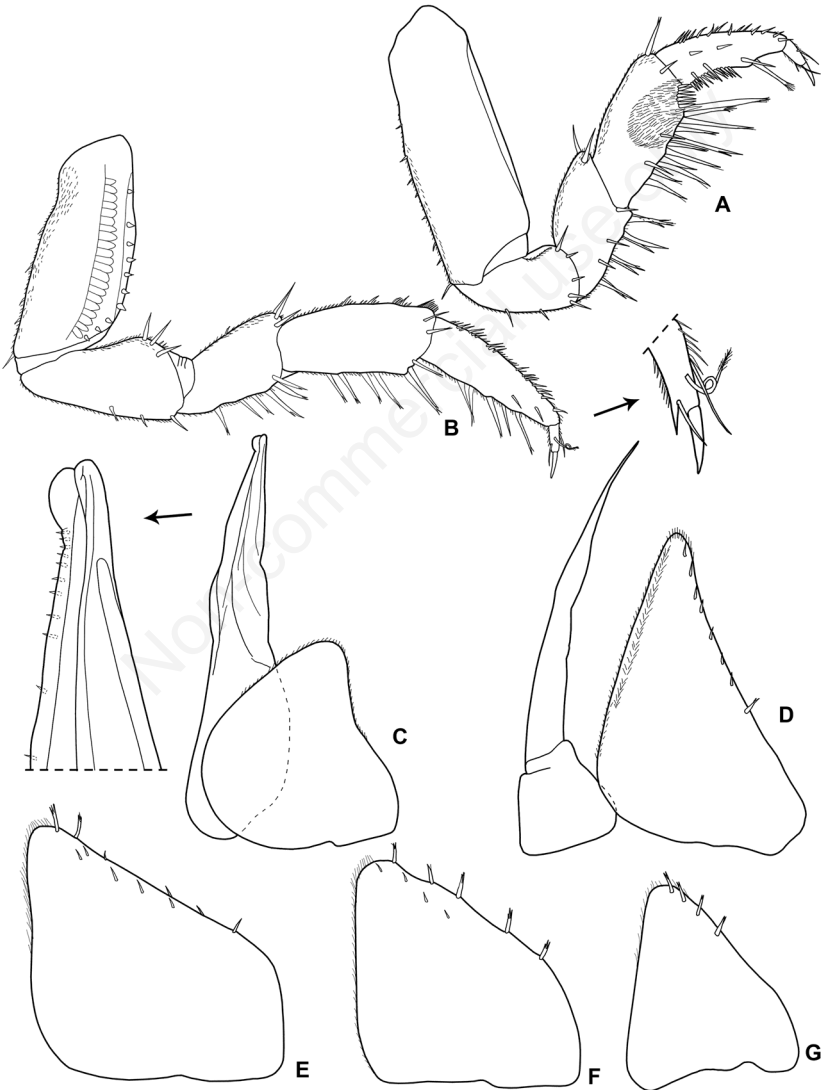
outer margin; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods (Figure 6E-G) triangular with few setae on outer margin.

*Etymology*

The new species is named after our colleague and friend Dr H. Schmalzfuss, SMNS, for his studies on the systematics of Oniscidea on a global scale.

*Remarks*

The new species is characterized by colourless body, eyes with three ommatidia, male pleopod 1 with a triangular exopod and endopod with a small rounded distal lobe. A small



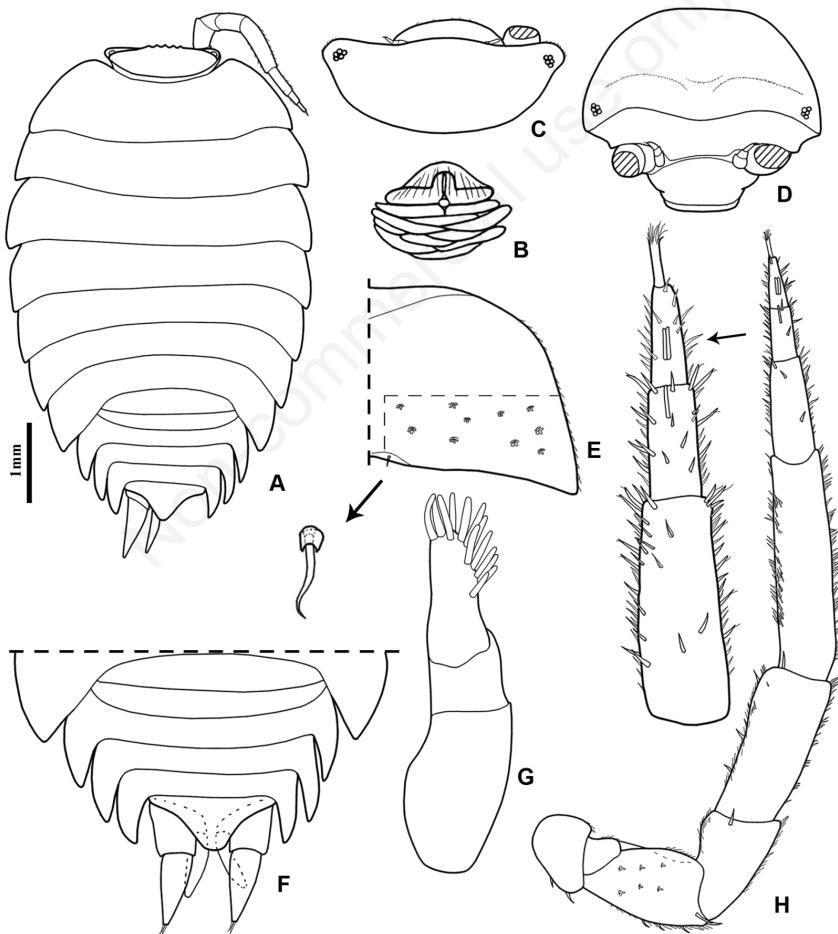
**Figure 6.** *Exalloniscus schmalzfussi* n. sp., ♂ paratype from Tinjura Dara, Chauki to Basantapur, Nepal. A, pereopod 1; B, pereopod 7; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

distal lobe on the male pleopod 1 endopod is also present in *Exalloniscus coecus* (compare Figure 2D) but in that species the lobe is located on the distal outer, instead of inner, margin. Moreover, it differs from *E. coecus* in the presence of eyes, telson with slightly concave, instead of straight, sides, and male pleopod 1 exopod with rounded, instead of acute, distal point. Another species of *Exalloniscus* is known from Nepal, *E. nepalensis*. *Exalloniscus schmalzfussi* n. sp. differs from *E. nepalensis* in having colourless body, male pleopod 1 exopod with wider distal point and endopod with distal part straight with a rounded inner lobe instead of bent outwards and pointed (compare fig. 9D in Taiti and Ferrara 1988).

*Exalloniscus siamensis* n. sp.

Figures 7, 8, 22B

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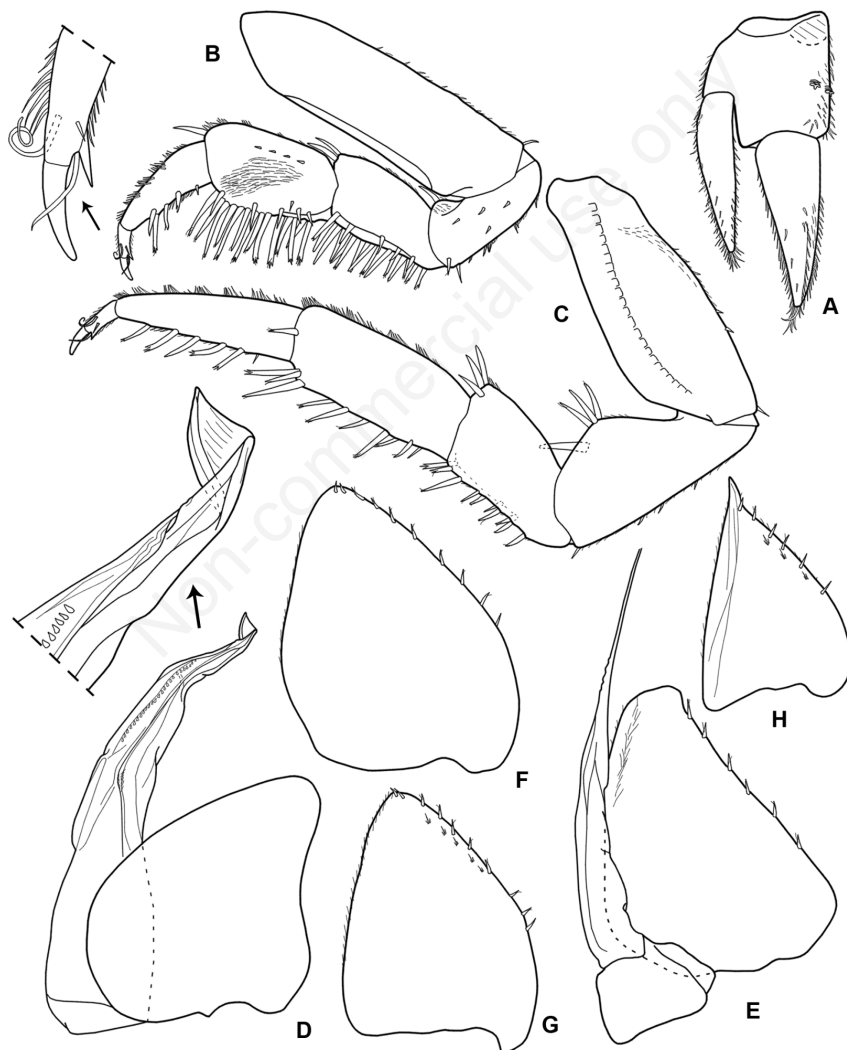
**Figure 7.** *Exalloniscus siamensis* n. sp., ♀ paratype from Phangnga, near Tham Pong Chang sink, Thailand. A, adult specimen, dorsal view; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 7, dorsal view; F, pereonite 7, pleon, telson and uropods, dorsal view; G, antenna; H, antenna.

*Material examined*

THAILAND: Holotype: ♂ (MNHN), Phangnga Province, Phangnga, near Tham Pong Chang sink, 8°26'34.3"N 98°30'54.6"E, 10 m a.s.l., forest litter and soil, 19.VII.1987, leg. L. Deharveng and A. Bedos. Paratypes: 3 ♀♀ (MNHN), 2 ♂♂, 3 ♀♀ (MZUF), same data as holotype.

*Description*

Maximum length: ♂ 4.5 mm; ♀ 6 mm. Body oval, flattened (Figure 7A); cephalon, pereon and pleonites 1, 2 brown with yellowish muscles spots, antennae, pleonites 3-5, telson and uropods colourless (Figure 22B). Dorsum covered with large triangular scale-setae (Figure 7B). Cephalon (Figure 7C,D) with lateral lobes triangular, slightly protruding lat-



**Figure 8.** *Exalloniscus siamensis* n. sp., ♂ paratype from Phangnga, near Tham Pong Chang sink, Thailand. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

erally; frontal line sinuous, suprantennal line straight in middle part; eyes with five ommatidia. Pereonites with postero-lateral corners acute, directed backwards (Figure 7A,E). Pleonites 3-5 with epimera falciform, directed backwards. Telson wider than long, triangular with slightly concave sides and rounded apex reaching posterior margin of pleonite 5 epimera (Figure 7F). Antennula (Figure 7G) third article with many superimposed aesthetascs. Antenna (Figure 7H) fifth article of peduncle as long as flagellum; ratio of flagellum joints 2:1:1; one aesthetasc on second and two aesthetascs on third article. Buccal pieces as in *E. schmalfussi* n. sp. Pereopods with dactylar seta flagelliform. Pereopod 1 carpus with transversal antennal grooming brush (Figure 8B). Pereopod 7 (Figure 8C) basis with distinct water conducting system. Uropod (Figures 7F, 8A) protopod slightly surpassing tip of telson; exopod slightly longer than endopod and twice as long as protopod.

Male: Pereopods 1-3 carpus and merus with long strong setae on sternal margin (Figure 8B). Pereopod 7 (Figure 8C) sternal margin of merus, carpus and propodus with some strong setae, ischium sternal margin straight. Pleopod 1 (Figure 8D) exopod triangular, longer than wide, outer margin slightly sinuous, posterior point rounded; endopod distal part bent outward, with subapical flat triangular lobe directed inward. Pleopod 2 (Figure 8E) exopod triangular with outer margin almost straight bearing few setae; endopod flagelliform, distinctly longer than exopod. Pleopod 3-5 exopods (Figure 8F-H) triangular with few setae on outer margin.

#### *Etymology*

The new species is named for Siam, the former name of Thailand.

#### *Remarks*

The new species is characterized by the colour pattern (brown with pale antennae, pleonites 3-5, telson and uropods) and by the shape of the male pleopod 1 endopod with distal part bent outward and bearing a subapical flat triangular lobe directed inwards. A similar colour pattern is also present in *E. bicoloratus* Taiti & Ferrara, 1988, but in the latter the cephalon and first pereonite are colourless. In having the male pleopod 1 exopod with a long and rounded posterior point, the new species resembles *E. maschwitzi* and *E. sumatranus* but it is readily distinguishable from both in the shape of the distal part of the male pleopod 1 endopod.

### ***Exalloniscus kampucheaensis* n. sp.**

Figures 9, 10, 22C

urn:lsid:zoobank.org:act:5FDA677B-1E34-4480-AF36-7CEBCE179F9F

#### *Material examined*

CAMBODIA: Holotype: ♂ (MNHN), Kampot, Tuk Meas, Phnom Teng Ngai, "Grotte Sauna", cave, 22.XI.2005, leg. L. Deharveng and A. Bedos. Paratype: 1 ♀ (MNHN), same data as holotype.

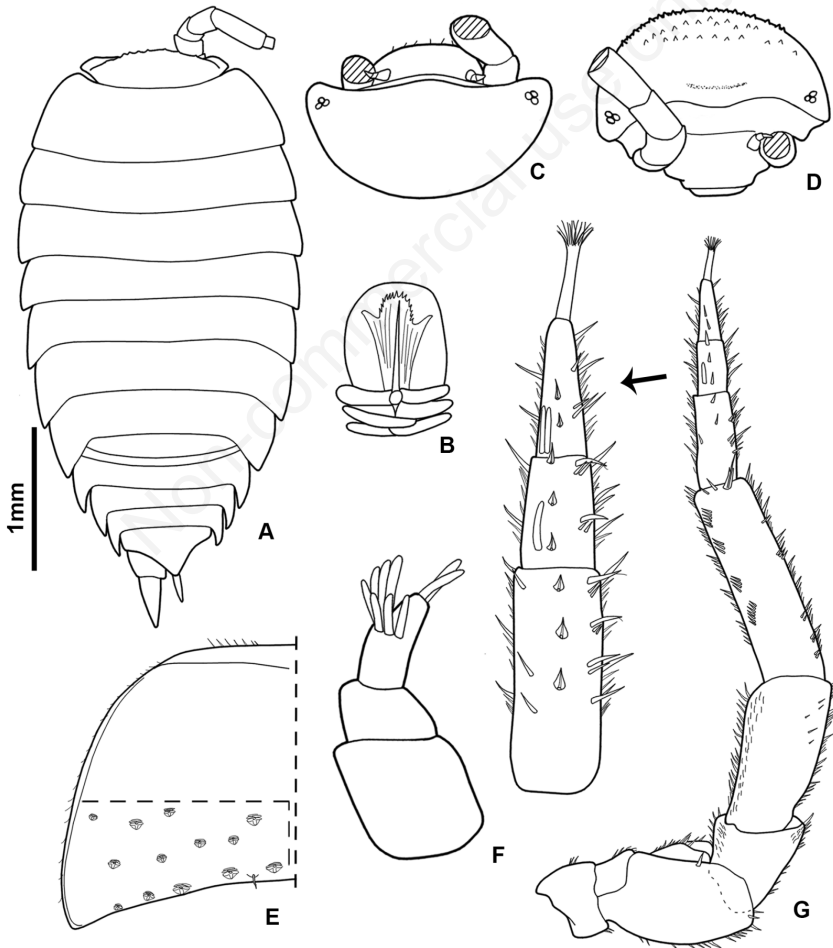
#### *Description*

Length: ♂ 3.5 mm; ♀ 2.5 mm. Body oval, flattened (Figure 9A); colour pale (Figure 22C). Dorsum covered with large rounded scale-setae (Figure 9B). Cephalon (Figure 9C,D) with lateral lobes triangular with rounded apices, slightly protruding laterally; frontal line slightly bent down in middle, suprantennal line straight; eyes with three ommatidia. Pereonites 1-3



with postero-lateral corners right-angled, pereonites 4-7 with postero-lateral corners progressively more acute, directed backwards (Figure 9E). Pleonites 3-5 with epimera falciform, protruding backwards. Telson triangular, wider than long, with slightly concave sides and acute apex. Antennula (Figure 9F) third article with two rows of aesthetascs plus apical pair. Antenna (Figure 9G) with fifth article of peduncle as long as flagellum; ratio of flagellum joints 10:5:6; one aesthetasc on second and two aesthetascs on third flagellar article. Buccal pieces as in *E. schmalfussi* n. sp. Pereopods with dactylar seta flagelliform. Pereopod 1 carpus with transversal antennal grooming brush (Figure 10B). Pereopod 7 (Figure 10C) basis with distinct water conducting system. Uropod (Figure 10A) exopod slightly longer than endopod.

Male: Pereopods 1-3 carpus and merus with brush of long setae on sternal margin (Figure 10B). Pereopod 7 (Figure 10C) merus, carpus and propodus with some long setae on sternal margin, ischium with sternal margin slightly concave. Pleopod 1 (Figure 10D) exopod triangular, wider than long, outer margin almost straight, posterior point widely rounded; endopod thickset, with triangular distal part. Pleopod 2 (Figure 10E) exopod tri-



**Figure 9.** *Exalloniscus kampucheaensis* n. sp., ♂ holotype from Kampot, Tuk Meas, Phnom Teng Ngai, Cambodia. A, dorsal view; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 7, dorsal view; F, antennula; G, antenna.

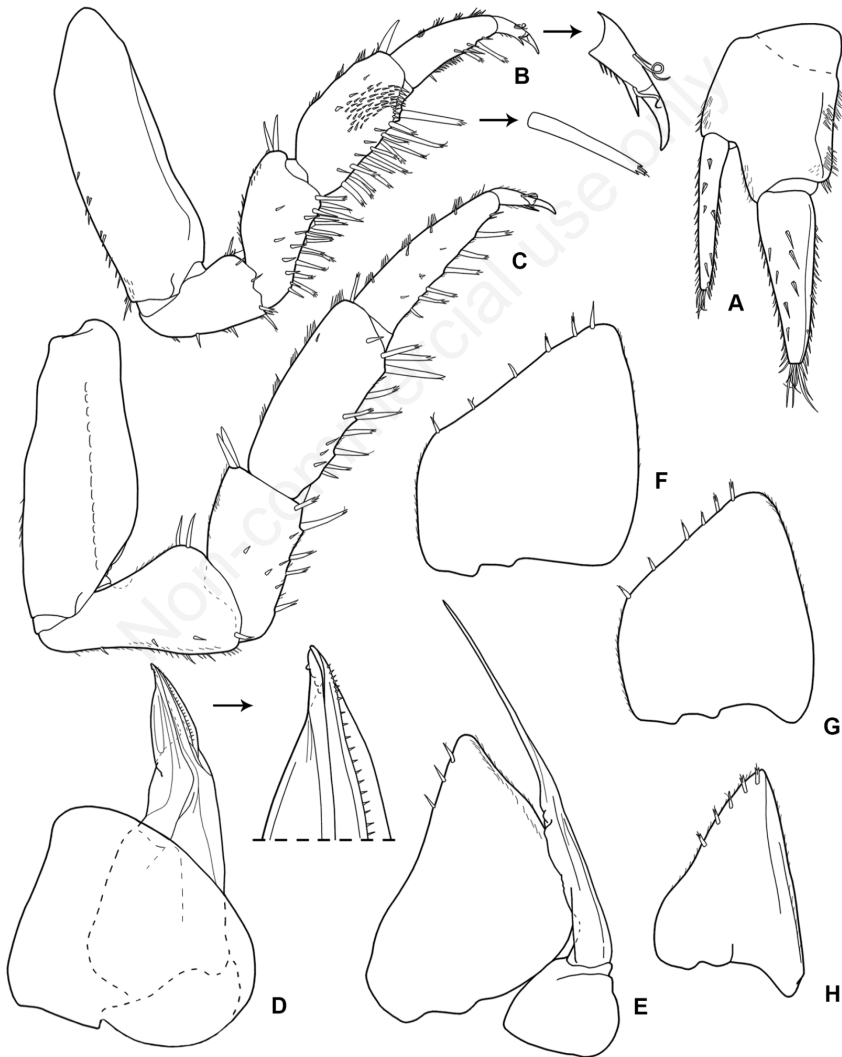
angular with few setae on outer margin; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods (Figure 10F-H) triangular with few setae on outer margin.

### *Etymology*

The new species is named for Kampuchea, the Khmer name of Cambodia, where the species was collected.

### *Remarks*

The new species is characterized by pale colour, presence of eyes, male pereopod 7 ischium with sternal margin slightly concave, male pleopod 1 exopod short, triangular, with posterior point largely rounded, and endopod with triangular distal part. *Exalloniscus kam-*



**Figure 10.** *Exalloniscus kampucheaensis* n. sp., ♂ holotype from Kampot, Tuk Meas, Phnom Teng Ngai, Cambodia. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

*pucheensis* n. sp. resembles *E. caudatus* in the similar shape of the male pleopod 1 endopod, but it differs in the presence of eyes, telson with a wider distal part, male pleopod 1 exopod with outer margin less concave, and male pleopod 2 exopod with only a few setae on distal part of outer margin (compare figs 20, 21 in Taiti and Ferrara 1988).

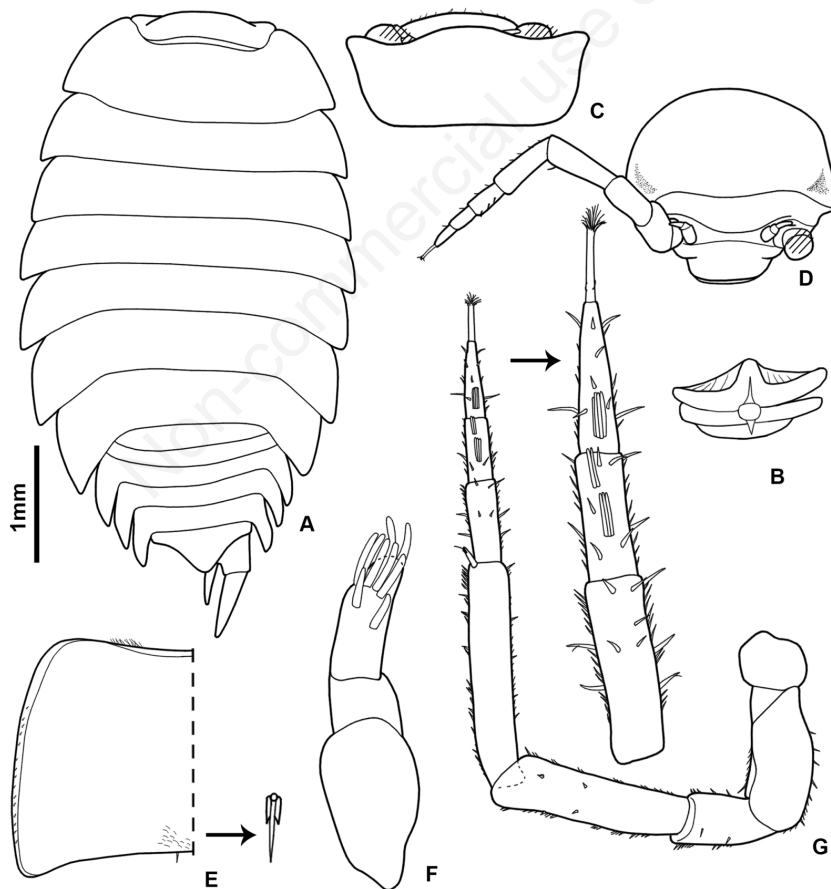
***Exalloniscus tortilis* n. sp.**

Figures 11, 12, 22D

*urn:lsid:zoobank.org:act:5D550EFB-0329-4078-ACD3-80F362FBC2FA*

*Material examined*

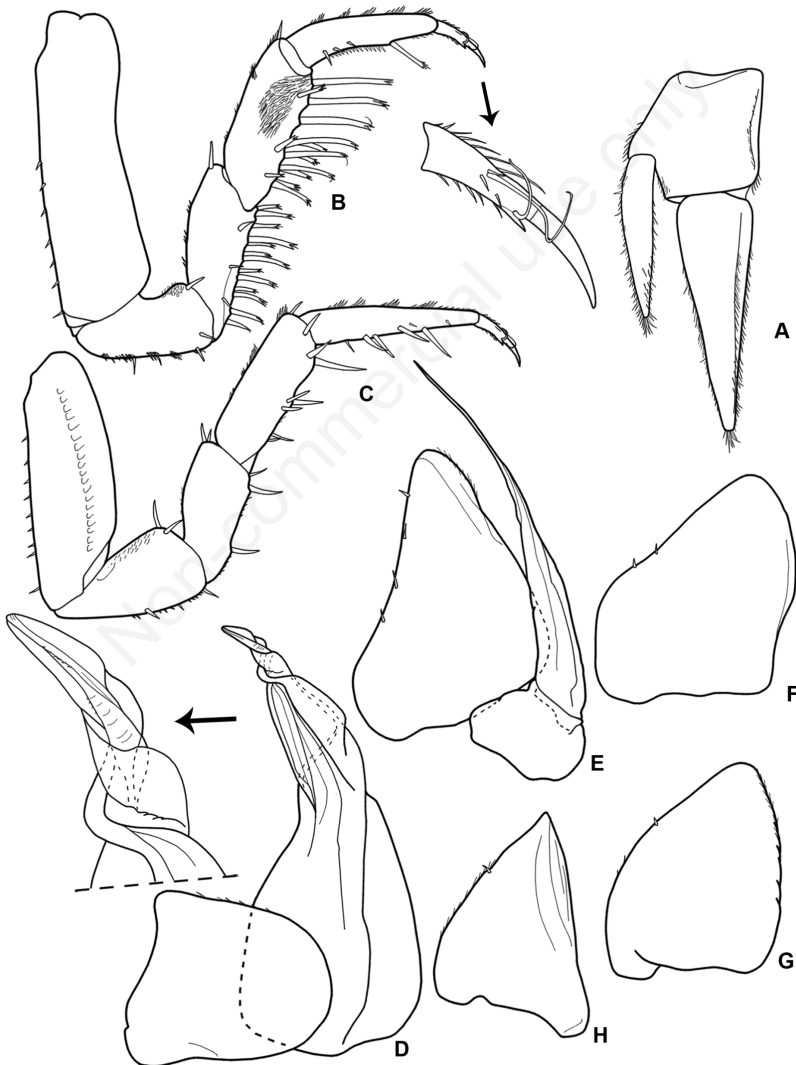
VIETNAM: Holotype: ♂ (MNHN), Yen Bai Province, Nghia Lo, Xa Som, Tham Han, 21°38'52.7"N 104°31'11.2"E, cave, 20.XII.2003, leg. L. Deharveng and A. Bedos. Paratypes: 1 ♂, 3 ♀♀ (MNHN), 1 ♂, 3 ♀♀ (MZUF), same data as holotype; 2 ♀♀ (MNHN), Yen Bai Province, Nghia Lo, Hang Dan Khao, 21°39'21.1"N 104°31'39.2"E, cave, 20.XII.2003, leg. L. Deharveng and A. Bedos.



**Figure 11.** *Exalloniscus tortilis* n. sp., ♂ paratype from Nghia Lo, Xa Som, Tham Han, Vietnam. A, adult specimen, dorsal view; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 7, dorsal view; F, antennula; G, antenna.

*Description*

Maximum length: ♂ and ♀ 4.5 mm. Body oval, flattened (Figure 11A): colourless, (Figure 22D). Dorsum with scattered short triangular scale-setae (Figure 11B). Cephalon (Figure 11C,D) with lateral lobes triangular with rounded apices, slightly protruding laterally; frontal line almost straight, suprannal line bent in middle; eyes absent. Pereonites with posterolateral corners progressively more directed backwards (Figure 11E). Pleonites 3-5 with epimera falciform, directed backwards. Telson triangular, wider than long, with slightly concave sides and rounded apex. Antennula (Figure 11F) third article with two rows of aesthetascs plus apical pair. Antenna (Figure 11G) fifth article of peduncle as long as flagellum; ratio of flagellum joints 9:6:7; second flagellar article with two rows of three and two aesthetascs, third article with one row of four aesthetascs. Buccal pieces as in *E. schmalfussi* n.



**Figure 12.** *Exalloniscus tortilis* n. sp., ♂ paratype from Nghia Lo, Xa Som, Tham Han, Vietnam. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2. F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

sp. Pereopods with very long flagelliform dactylar seta. Pereopod 1 carpus with transversal antennal grooming brush (Figure 12B). Pereopod 7 (Figure 12C) basis with distinct water conducting system. Uropod (Figure 12A) exopod distinctly longer than endopod, twice as long as protopod.

Male: Pereopod 1 carpus and merus with long setae on sternal margin (Figure 12B). Pereopod 7 (Figure 12C) ischium with slightly convex sternal margin. Pleopod 1 (Figure 12D) exopod triangular, wider than long, with outer margin concave, posterior point short with rounded apex; endopod with distal part twisted, slightly bent outward. Pleopod 2 (Figure 12E) exopod triangular with few setae on outer margin; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods (Figure 12F-H) triangular with few setae on outer margin.

### *Etymology*

Latin: *tortilis* = twisted. The species name refers to the twisted shape of the distal part of the male pleopod 1 endopod.

### *Remarks*

*Exalloniscus tortilis* n. sp. is easily distinguished from all the other species by the shape of male pleopod 1 endopod, with distal part twisted and slightly bent outward. A similar character is present also in *E. papillosus* (compare fig. 5D in Taiti and Ferrara 1988) from which the new species differs in having colourless body, lack of eyes, and different shape of the male pleopod 1 exopod. The new species was collected only in caves.

### ***Exalloniscus deharvengi* n. sp.**

Figures 13, 14, 22E

*urn:lsid:zoobank.org:act:E9BF3E15-E07C-4B2A-83AF-EE0F340EBEC2*

### *Material examined*

VIETNAM: Holotype: ♂ (MNHN), Dong Nai Province, Tan Phu, 11°15'01.7"N 107°24'14.4"E, lava tunnel, on guano, 16.XII.2006, leg. L. Deharveng and A. Bedos. Paratypes: 1 ♂, 1 ♀ (MNHN), 1 ♂, 2 ♀♀ (MZUF), same data as holotype.

### *Description*

Maximum length: ♂ 3.5 mm; ♀ 4 mm. Body oval, flattened (Figure 13A); colour brown with pale antennae and uropods (Figure 22E). Dorsum covered with large triangular scale-setae (Figure 13B). Cephalon (Figure 13C,D) with triangular lateral lobes with rounded apices, slightly protruding outwards; frontal line slightly bent down in middle, suprantennal line straight; eyes visible as spots of ocular pigment, without external lenses. Pereonites with postero-lateral corner progressively more acute, directed backwards (Figure 13E). Pleonites 3-5 with epimera falciform, directed backwards. Telson triangular, wider than long, with slightly concave sides and narrowly rounded apex. Antennula (Figure 13F) third article with three rows of aesthetascs plus apical pair. Antenna (Figure 13G) fifth article of peduncle as long as flagellum; ratio of flagellum joints 12:5:5; third article with two aesthetascs. Buccal pieces as in *E. schmalzfussi* n. sp. Pereopods with dactylar seta flagelliform. Pereopod 1 carpus with longitudinal antennal grooming brush (Figure 14B). Pereopod 7 (Figure 14C) basis with distinct water conducting system. Uropod (Figure 14A) exopod as long as endopod.

Male: Pereopod 1 carpus and merus with brush of long setae on sternal margin (Figure 14B). Pereopod 7 (Figure 14C) merus, carpus and protopod with some long setae on sternal

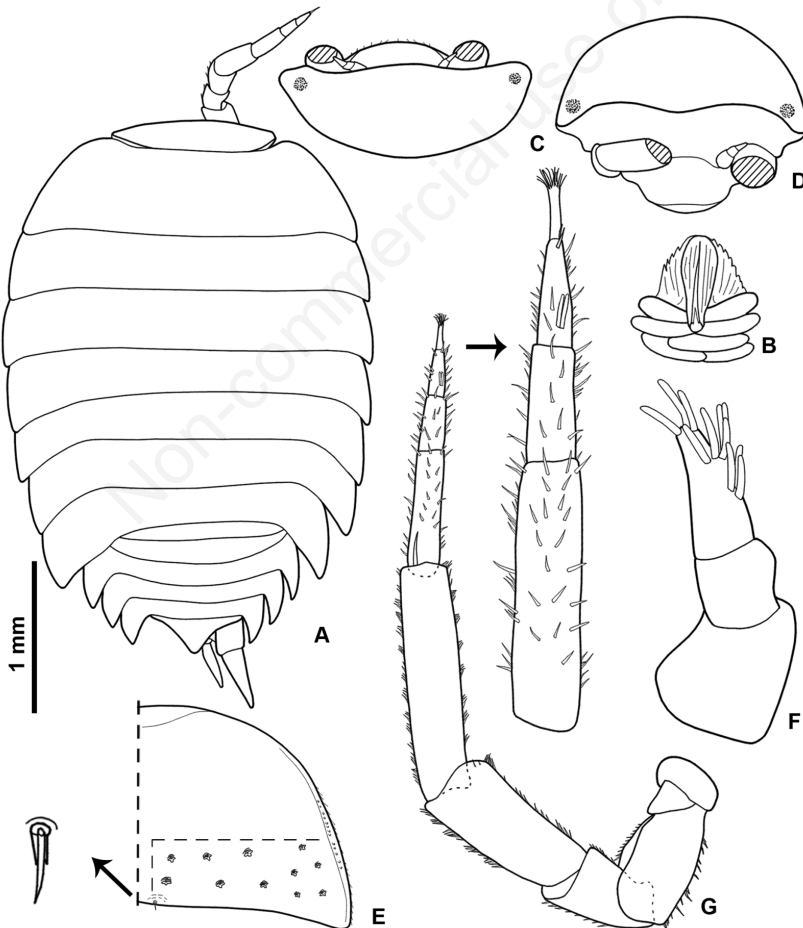
margin, ischium sternal margin straight. Pleopod 1 (Figure 14D) exopod triangular, as wide as long, with slightly concave outer margin, posterior point with rounded apex; endopod with distal part slightly bent outward without particular specializations at apex. Pleopod 2 (Figure 14E) exopod triangular with few setae on the outer margin; endopod flagelliform slightly longer than exopod. Pleopod 3-5 exopods (Figure 14F-H) triangular with setae on outer margin.

### Etymology

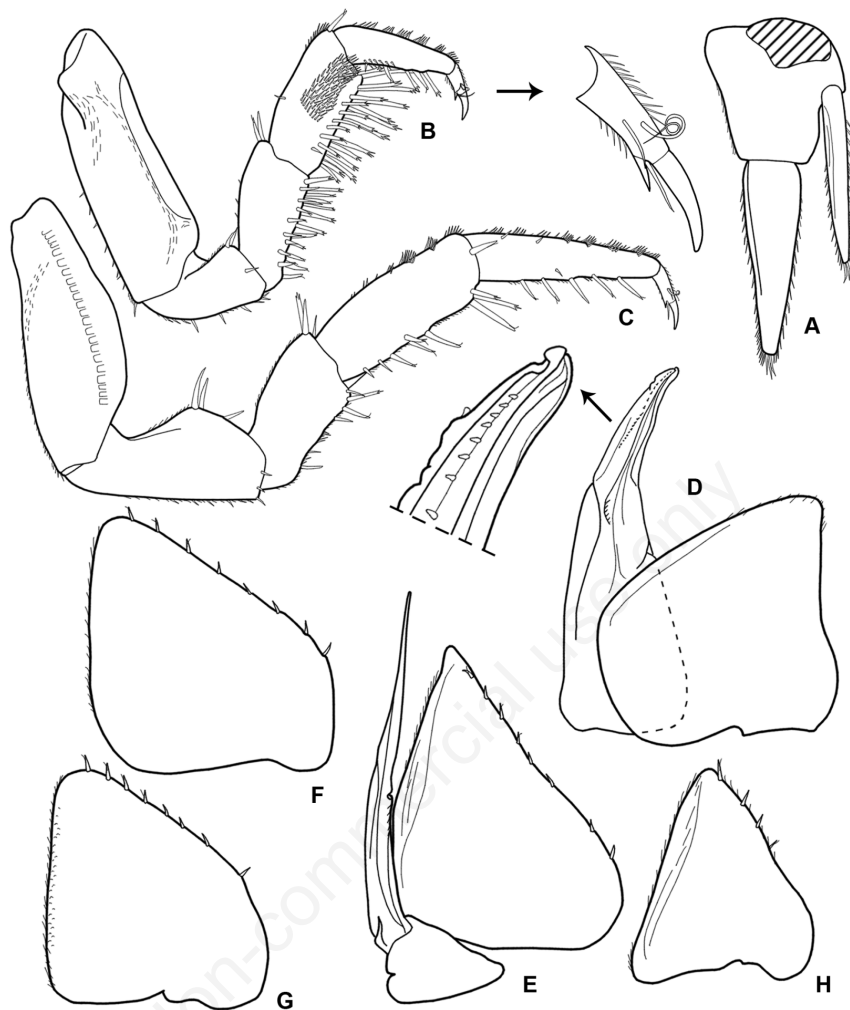
This new species is named after Dr L. Deharveng (MNHN) for his great contribution to the knowledge of the soil invertebrate fauna of the Oriental Region.

### Remarks

*Exalloniscus deharvengi* n. sp. is characterized by the wide oval body, brown colour, eyes visible as dots of dark pigment, and male pleopod 1 endopod without particular specializations on the distal part. For this last character, the new species resembles *E. vietnamensis* Taiti & Ferrara, 1988, and *E. caudatus* but it differs from both species in having the male pleopod 1



**Figure 13.** *Exalloniscus deharvengi* n. sp., ♂ holotype from Tan Phu, Vietnam. A, dorsal view; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 7, dorsal view; F, antenna; G, antenna.



**Figure 14.** *Exalloniscus deharvengi* n. sp., ♂ holotype from Tan Phu, Vietnam. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

exopod with longer and narrower distal point, and endopod with distal part wider and not pointed; from the former also in the more rounded body shape, pigmented body, and eyes more reduced; from the latter also in having visible eye pigment and wider distal part of the telson.

***Exalloniscus stilifer* n. sp.**

Figures 15, 16, 22F

[urn:lsid:zoobank.org:act:C544D7E6-0FB7-4E5C-A3FE-F94A5FB81ADA](https://zoobank.org/urn:lsid:zoobank.org:act:C544D7E6-0FB7-4E5C-A3FE-F94A5FB81ADA)

*Material examined*

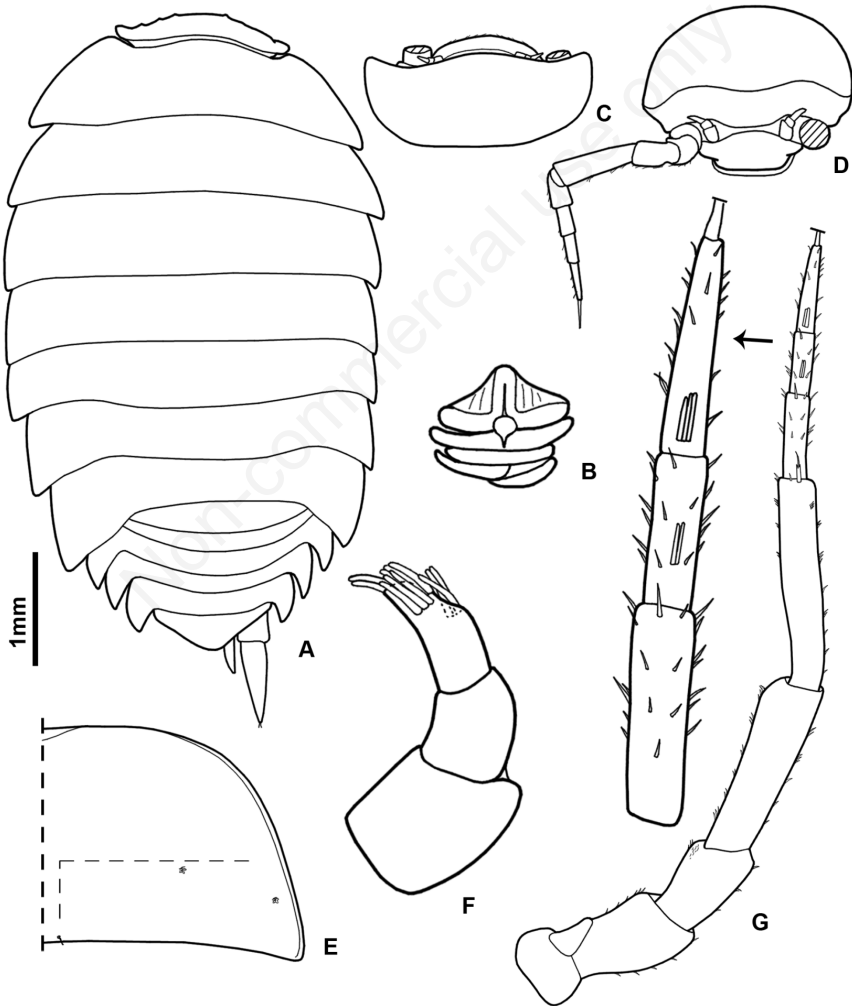
CHINA: Holotype: ♂ (MNHN), Guangxi Province, Chongzuo, Longzhou Xian, Shanglong Xiang, Nong Guang, 22°28'26.1"N 107°00'16.7"E, 177 m a.s.l., cave,



14.IV.2010, leg. L. Deharveng, M.Y. Tian and A. Bedos. Paratype: 1 ♀ (MNHN), same data as holotype.

*Description*

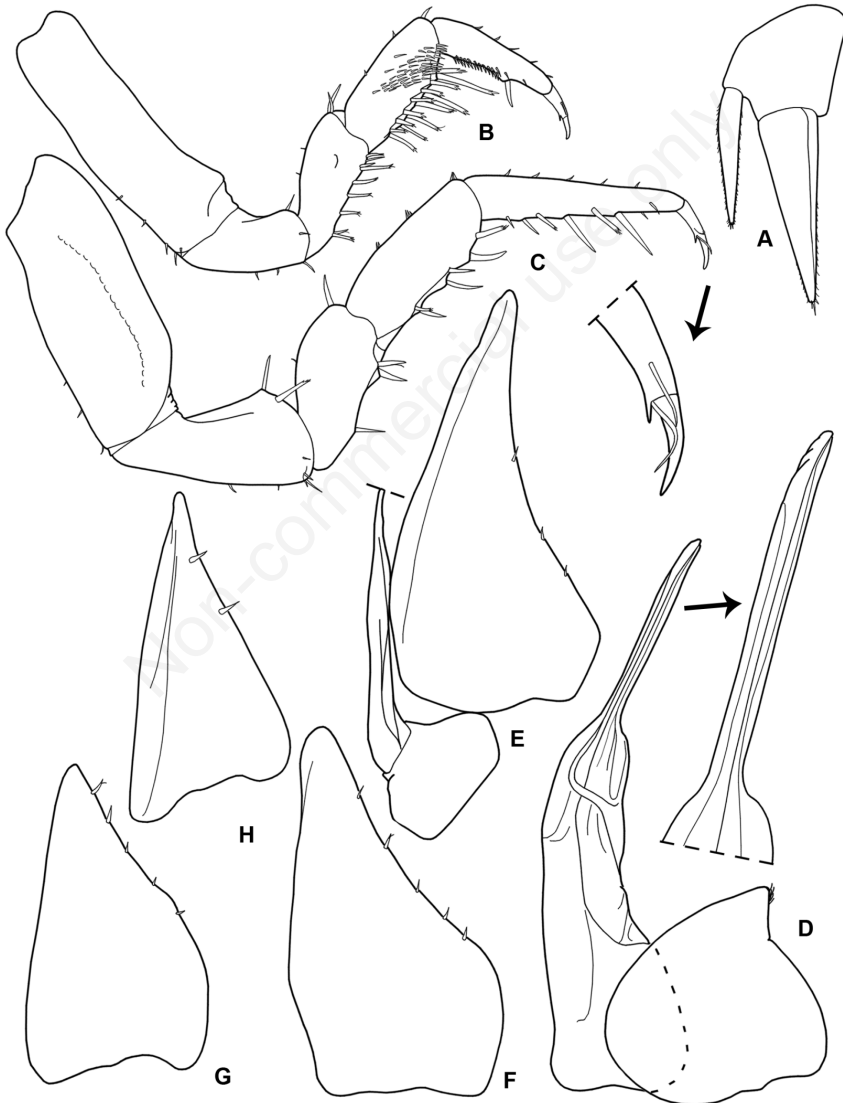
Length: ♂ 5 mm; ♀ 6 mm. Body oval, flattened (Figure 15A); colour pale brown (Figure 22F). Dorsum covered with large scattered triangular scale-setae (Figure 15B). Cephalon (Figure 15C,D) with lateral lobes triangular with rounded apices, slightly protruding frontally; frontal and suprantennal line slightly bent down in middle; eyes absent. Pereonites with postero-lateral corner progressively more acute, directed backwards (Figure 15A,E). Pleonites 3-5 with epimera falciform, directed backwards. Telson triangular, wider than long, with straight sides and widely rounded apex. Antennula (Figure 15F) third article with several superimposed aesthetascs plus apical pair. Antenna (Figure 15G) fifth article



**Figure 15.** *Exalloniscus stilifer* n. sp., ♀ paratype from Chongzuo, Longzhou Xian, Shanglong Xiang, Nong Guang, China. A, dorsal view. ♂ holotype. B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 7, dorsal view; F, antennula; G, antenna.

of peduncle shorter than flagellum; ratio of flagellum joints 12:9:13; second flagellar article with two and third article with three aesthetascs. Buccal pieces as in *E. schmalzfussi* n. sp. Pereopods with dactylar seta flagelliform. Pereopod 1 (Figure 16B) carpus with transversal antennal grooming brush. Pereopod 7 (Figure 16C) basis with distinct water conducting system. Uropod (Figure 16A) exopod distinctly longer than endopod.

Male: Pereopod 1-3 carpus with long setae on sternal margin (Figure 16B). Pereopod 7 (Figure 16C) merus, carpus and propodus with sparse setae on sternal margin, ischium sternal margin straight. Pleopod 1 (Figure 16D) exopod triangular, wider than long, outer margin concave, posterior point acute with some short setae at apex; endopod with distal part styliform. Pleopod 2 exopod (Figure 16E) triangular, longer than wide, with few setae



**Figure 16.** *Exalloniscus stilifer* n. sp. ♂ holotype from Chongzuo, Longzhou Xian, Shanglong Xiang, Nong Guang, China. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

on outer margin. Pleopod 3-5 exopods (Figure 16F-H) triangular, longer than wide, with few setae on outer margin.

*Etymology*

Latin: *stilus* = stylet + stem of *ferre* = to bear. The name refers to the styliform distal part of the male pleopod 1 endopod.

*Remarks*

The new species is readily distinguishable from all the other species in the genus by the shape of male pleopod 1 endopod with a long and narrow distal part.

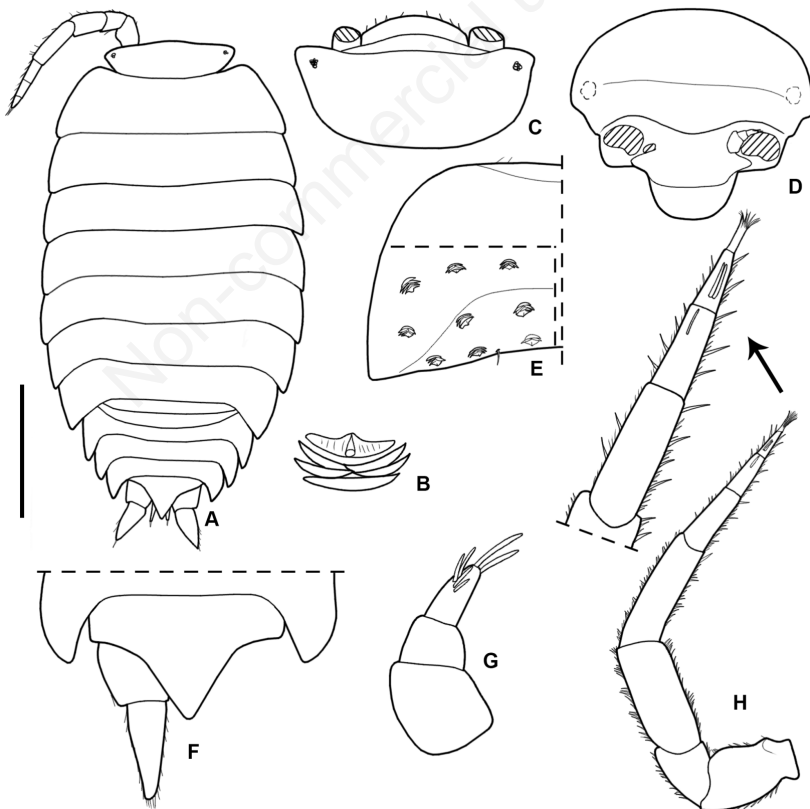
***Exalloniscus burmaensis* n. sp.**

Figures 17, 18, 22G

urn:lsid:zoobank.org:act:B0232251-4068-4AD4-9D1B-88B23A639E63

*Material examined*

MYANMAR: Holotype: ♂ (MZUF), Mon State, Saddan Sin Gu Cave, 16°31'43"N, 97°43'02"E, 26.XI.2015, leg. F. Brehier. Paratypes: 1 ♂, 3 ♀♀ (MZUF), 3 ♀♀ (MNHN), same data as holotype.

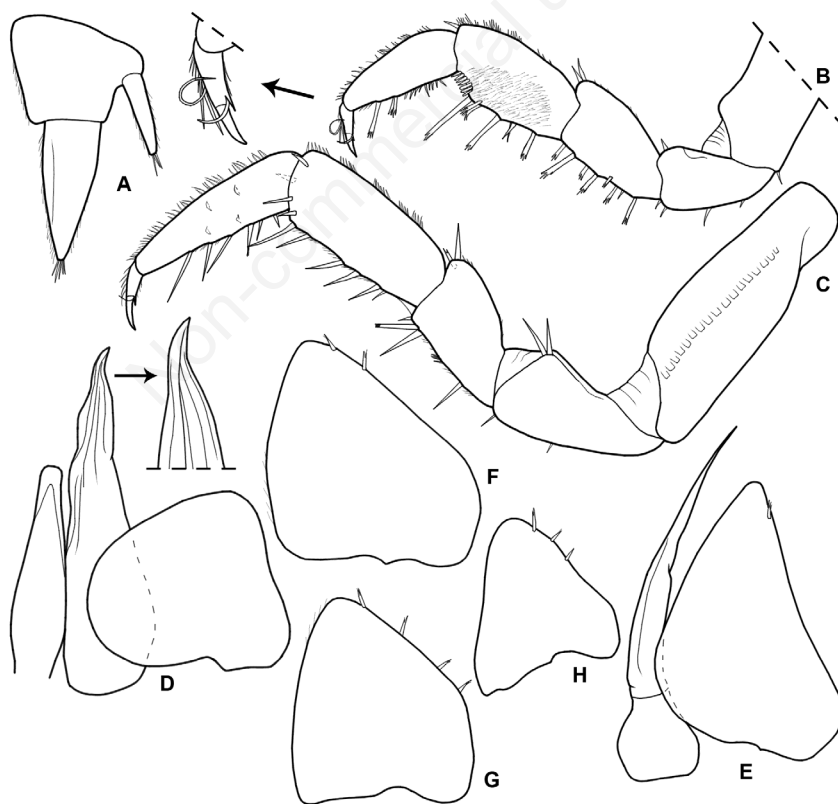


**Figure 17.** *Exalloniscus burmaensis* n. sp., ♀ paratype from Saddan Sin Gu Cave, Myanmar. A, dorsal view; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 7, dorsal view; F, telson and left uropod; G, antennula. H, antenna.

*Description*

Maximum length: ♂ 3.5 mm; ♀ 3.8 mm. Body oval, flattened (Figure 17A); colour grey-brown, with pale antennae and uropods (Figure 22G). Dorsum covered with short triangular scale-setae (Figure 17B). Cephalon (Figure 17C,D) with lateral lobes triangular with rounded apices, slightly protruding laterally; frontal line straight, suprantennal line slightly bent down in middle; eyes consisting of 4-5 dark ommatidia. Pereonites with postero-lateral corners right-angled (Figure 17E). Pleonites 3-5 with epimera falciform, directed backwards. Telson (Figure 17F) triangular, wider than long, with concave sides and acute apex, surpassing posterior margins of uropod protopods. Antennula (Figure 17G) third article with four superimposed and two apical aesthetascs. Antenna (Figure 17H) fifth article of peduncle shorter than flagellum; flagellum diminishing in length from first to third, second flagellar article with one and third article with two aesthetascs. Buccal pieces as in *E. schmalzfussi* n. sp., except for maxillula with entire teeth. Pereopods with dactylar seta flagelliform. Pereopod 1 carpus with transversal antennal grooming brush (Figure 18B). Pereopod 7 (Figure 18C) basis with distinct water conducting system. Uropod (Figure 18A) exopod twice as long as endopod.

Male: Pereopod 1 (Figure 18B) merus and carpus with some strong setae on sternal margin. Pereopod 7 (Figure 18C) ischium with slightly convex sternal margin. Pleopod 1 (Figure 18D) exopod triangular, as wide as long, outer margin almost straight, posterior point broadly rounded; endopod with distal part triangular, pointed, slightly directed outwards. Pleopod 2



**Figure 18.** *Exalloniscus burmaensis* n. sp., ♂ paratype from Saddan Sin Gu Cave, Myanmar. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

exopod (Figure 18E) triangular, longer than wide, with one subapical seta on outer margin; endopod with styliform distal part, longer than exopod. Pleopod 3-5 exopods (Figure 18F-H) triangular, as long as wide, with two to four setae on outer margin.

### *Etymology*

The new species is named for Burma, former name of Myanmar.

### *Remarks*

*Exalloniscus burmaensis* n. sp. is characterized by grey-brown coloration, eyes with 4-5 dark ommatidia, male pleopod 1 exopod triangular with a widely rounded distal point and endopod with a pointed distal part slightly directed outwards. In the external characters the new species resembles *E. papillosus* from which it differs in the male pereopod 7 ischium without deep pit on rostral surface, male pleopod 1 exopod with wider distal point and almost straight outer margin, and endopod with distal part not twisted (compare fig. 5C,D in Taiti and Ferrara 1988).

### ***Exalloniscus convexus* n. sp.**

Figures 19-21, 22H

*urn:lsid:zoobank.org:act:CD4BB8DD-CE85-485A-BB31-06283F742738*

### *Material examined*

LAOS: Holotype: ♂, (MNHN), Vang Vieng, Tham None, 18°57'04.7"N 102°26'01.7"E, 240 m a.s.l., cave, 1.I.2000, leg. L. Deharveng and A. Bedos. Paratypes: 2 ♀♀ (MNHN), 1 ♂, 2 ♀♀ (MZUF), same data as holotype.

### *Description*

Maximum length: ♂ and ♀ 7 mm. Body moderately convex (Figure 19A); colourless (Figure 22H). Dorsum with scattered triangular and pointed scale-setae (Figure 19B); noduli laterales as in all other species of *Exalloniscus*. Cephalon (Figure 19C,D) with lateral lobes triangular with narrow apices, distinctly protruding laterally; frontal and suprantennal line slightly bent down in middle; eyes absent. Pereonites with posterior margins slightly concave at sides, with postero-lateral corners rounded, slightly bent backwards (Figure 19E). Pleonites 3-5 with epimera well developed and broad, continuous with pereon outline (Figure 19A,F). Telson triangular, wider than long, with straight sides and broadly rounded apex, much shorter than tips of epimera of pleonite 5 (Figure 19F). Antennula (Figure 19G) third article with five subapical and two apical aesthetascs. Antenna elongated (Figure 19H) with fifth article of peduncle as long as flagellum; ratio of flagellum joints 7:6:10; second and third article of flagellum each with one row of several aesthetascs. Buccal pieces (Figure 20) as in *E. nepalensis* except for maxillula (Figure 20C) outer branch with only one seta on caudal surface, and maxilliped (Figure 20E) palp with basal article with one seta. Pereopods elongated; dactylar seta flagelliform, setose at apex. Pereopod 1 (Figure 21B) carpus with transversal antennal grooming brush. Pereopod 7 (Figure 21C) basis with distinct water conducting system. Uropod (Figure 21A) exopod slightly longer than endopod.

Male: Pereopod 1 carpus and merus with few long setae on sternal margin (Figure 21B). Pereopod 7 (Figure 21C) ischium with sternal margin straight. Pleopod 1 (Figure 21D) exopod triangular, longer than wide, with outer margin slightly concave, posterior point narrow with rounded apex; endopod with pointed distal part distinctly bent outwards. Pleopod

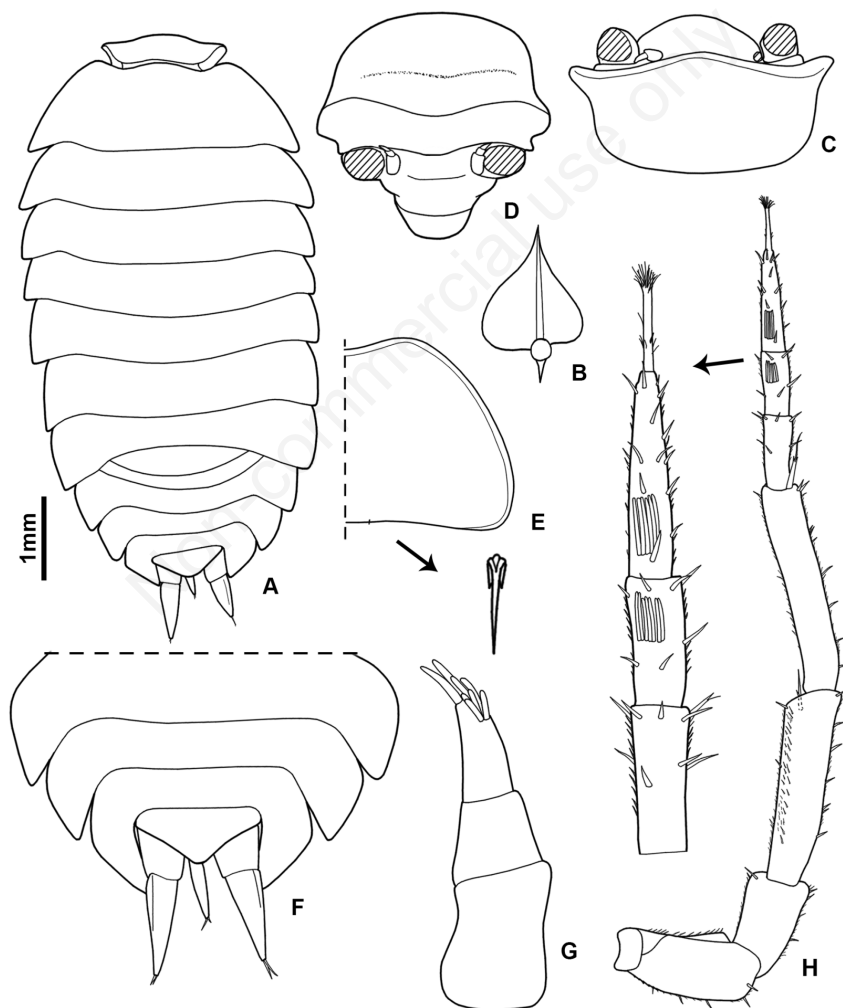
2 (Figure 21E) exopod triangular, outer margin deeply concave and truncate posterior point; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods (Figure 21F-H) triangular with few setae on outer margin.

### *Etymology*

Latin: *convexus* = convex. The name refers to the moderately but distinct convex body of the new species, a unique character within the genus.

### *Remarks*

The new species is readily distinguished from all the other species in the genus in having convex, instead of flat, body, epimera of pleonites 3-5 broader, telson distinctly shorter than epimera of the pleonite 5, elongated appendages, antenna with third article of flagellum



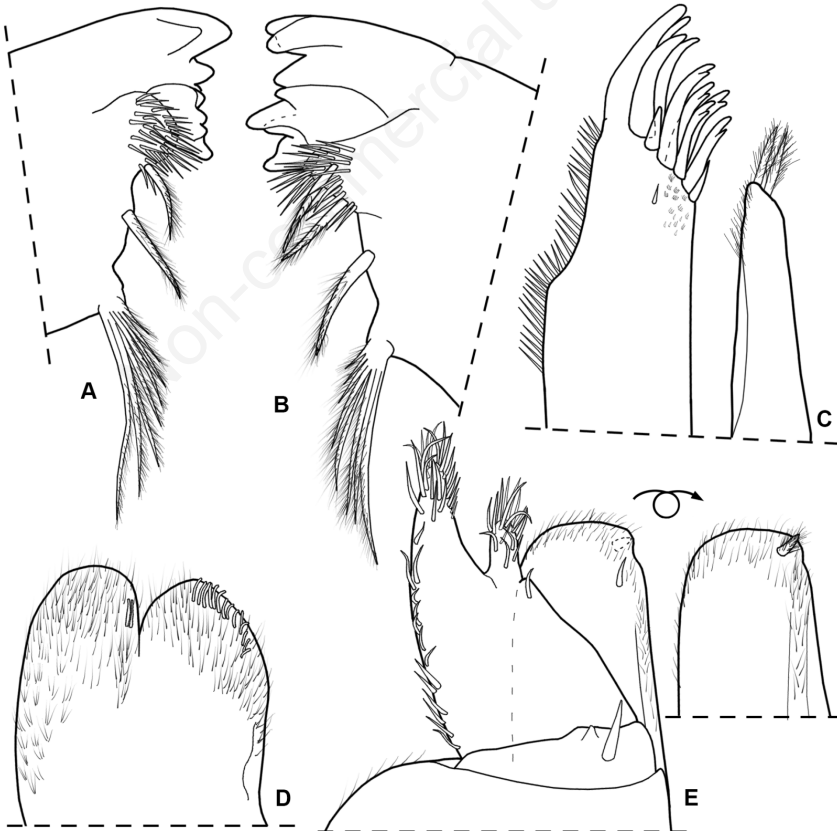
**Figure 19.** *Exalloniscus convexus* n. sp., ♂ paratype from Vang Vieng, Tham None, Laos. A, dorsal view; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, epimeron of pereonite 7, dorsal view; F, pleonites 3-5, telson and uropods, dorsal view; G, antennula; H, antenna.

distinctly longer than each second and first, and the characteristic shape of the male pleopod 1 endopod with a pointed distal part distinctly directed outwards.

**Discussion**

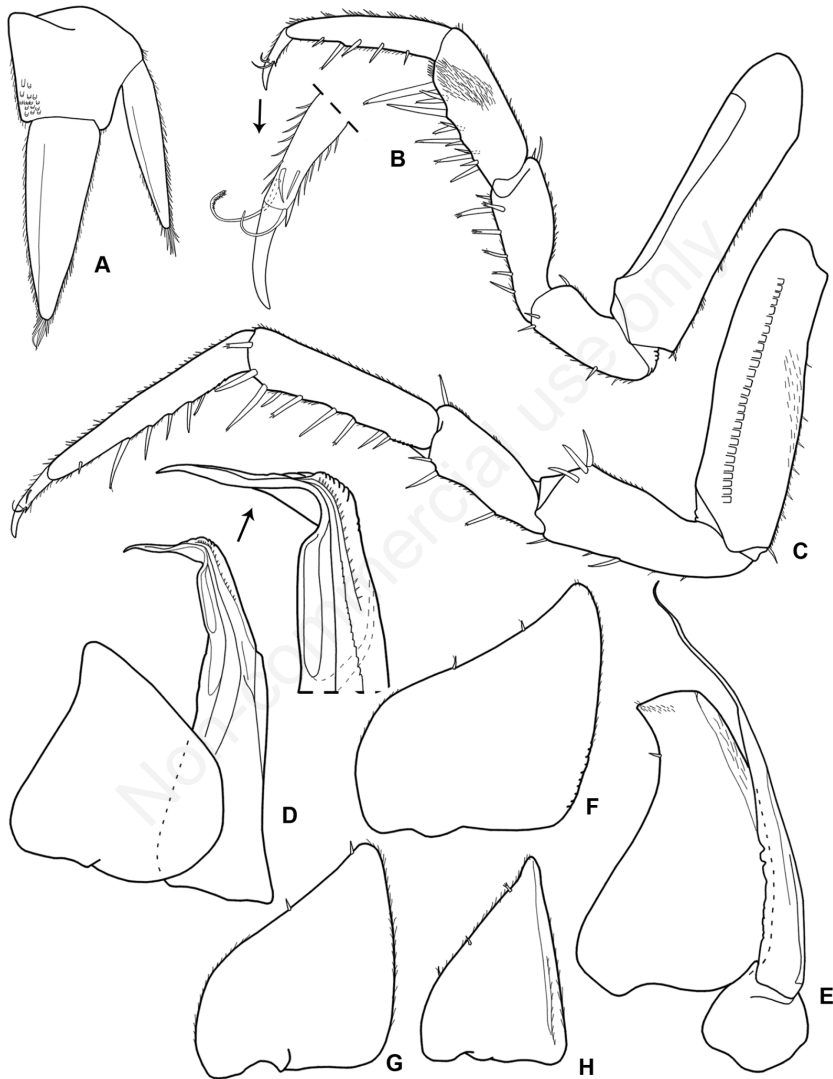
With the eight new species described here and the two new synonyms, the total number of species of *Exalloniscus* is now 28 (Table 1). One more species is certainly present in Japan (*Exalloniscus* sp. in Taiti and Ferrara 1988) that will be described when more specimens are available for examination. Ten species live in association with ants and only one (*E. brincki*) with termites. Nine species were collected in forest habitats and 10 in caves. Only three species (*E. papillosus*, *E. thailandensis* and *E. bicoloratus*) were collected with and without ants in forest habitats and in caves. Seven species were collected only in caves but we do not know if they can be considered to be troglobionts or they occur also in other habitats. Only *E. convexus* n. sp. is most probably a true troglotic species since, beside the lack of colour and eyes, it shows also elongation of the appendages (antennae and pereopods).

The genus has a wide distribution in southern and eastern Asia, from India to Japan (Figure 23). Most of the species (20 out of 28) occur in South-East Asia where many more species are expected to be discovered when careful investigations will be carried out.



**Figure 20.** *Exalloniscus convexus* n. sp., ♀ paratype from Vang Vieng, Tham None, Laos. A, right mandible; B, left mandible; C, maxillula; D, maxilla; E, maxilliped.





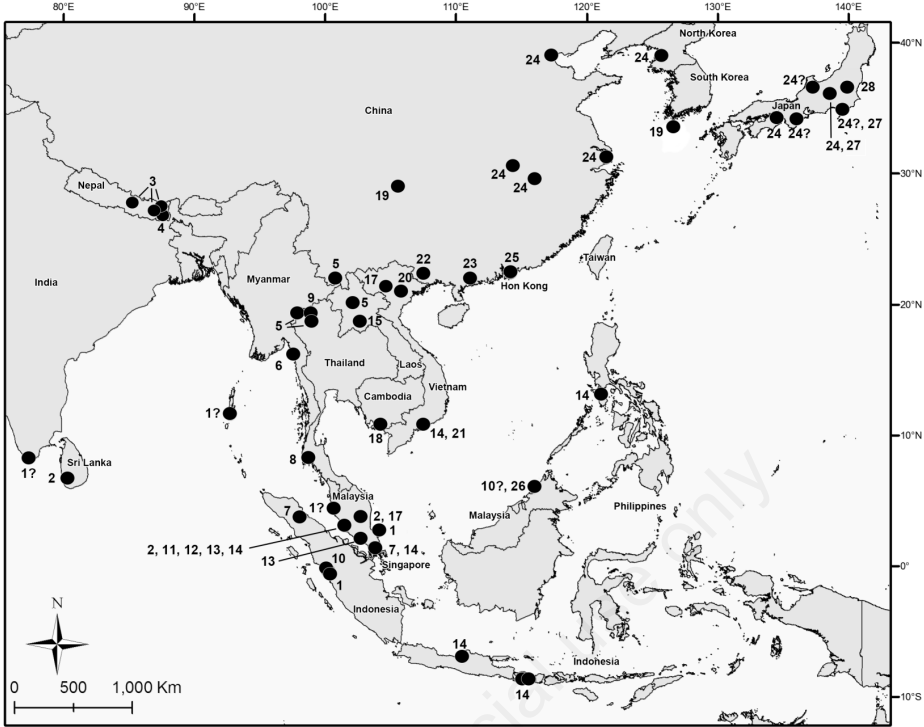
**Figure 21.** *Exalloniscus convexus* n. sp., ♂ paratype from Vang Vieng, Tham None, Laos. A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.



**Figure 22.** Adult ♀ specimens: A, *Exalloniscus schmalfussi* n. sp.; B, *Exalloniscus siamensis* n. sp.; C, *Exalloniscus kampucheaensis* n. sp.; D, *Exalloniscus tortilis* n. sp.; E, *Exalloniscus deharvengi* n. sp.; F, *Exalloniscus stilifer* n. sp.; G, *Exalloniscus burmaensis* n. sp.; H, *Exalloniscus convexus* n. sp. Scale bars = 1 mm.

**Table 1.** *Exalloniscus* species with their habitats.

Species	Ants	Termites	Forest	Cave	No data
<i>E. coecus</i> (Dollfus, 1898)					x
<i>E. albus</i> (Dollfus, 1898)					x
<i>E. papillosus</i> (Budde-Lund, 1912)	x		x	x	
<i>E. cortii</i> Arcangeli, 1927	x				
<i>E. nepalensis</i> Schmalzfuss, 1983			x		
<i>E. brincki</i> Manicasteri & Argano, 1986		x			
<i>E. rotundatus</i> Taiti & Ferrara, 1986					x
<i>E. thailandensis</i> Dalens, 1987	x		x	x	
<i>E. beroni</i> Taiti & Ferrara, 1988				x	
<i>E. bicoloratus</i> Taiti & Ferrara, 1988	x		x	x	
<i>E. borneanus</i> Taiti & Ferrara, 1988	x				
<i>E. caudatus</i> Taiti & Ferrara, 1988	x		x		
<i>E. malaccensis</i> Taiti & Ferrara, 1988	x				
<i>E. maschwitzii</i> Taiti & Ferrara, 1988	x				
<i>E. vietnamensis</i> Taiti & Ferrara, 1988			x		
<i>E. sumatranus</i> Manicasteri & Taiti, 1991			x		
<i>E. silvestrii</i> Kwon & Taiti, 1993					x
<i>E. troglophilus</i> Taiti & Gruber, 2008	x				
<i>E. japonicus</i> Taiti & Gruber, 2008	x				
<i>E. tuberculatus</i> Nunomura, 2000					x
<i>E. burmaensis</i> n. sp.				x	
<i>E. convexus</i> n. sp.				x	
<i>E. deharvengi</i> n. sp.				x	
<i>E. kampucheaensis</i> n. sp.				x	
<i>E. schmalfussi</i> n. sp.			x		
<i>E. siamensis</i> n. sp.			x		
<i>E. stilifer</i> n. sp.				x	
<i>E. tortilis</i> n. sp.				x	
	10	1	9	10	5



**Figure 23.** Distribution of *Exallioniscus* species: 1. *E. coecus*; 2. *E. brincki*; 3. *E. nepalensis*; 4. *E. schmalfussi* n. sp.; 5. *E. thailandensis*; 6. *E. burmaensis* n. sp.; 7. *E. sumatranus*; 8. *E. siamensis* n. sp.; 9. *E. beroni*; 10. *E. albus*; 11. *E. bicoloratus*; 12. *E. malaccensis*; 13. *E. maschwitzi*; 14. *E. papillosus*; 15. *E. convexus* n. sp.; 16. *E. caudatus*; 17. *E. tortilis* n. sp.; 18. *E. kampucheaensis* n. sp.; 19. *E. silvestrii*; 20. *E. vietnamensis*; 21. *E. deharvengi* n. sp.; 22. *E. stilifer* n. sp.; 23. *E. troglophilus*; 24. *E. cortii*; 25. *E. rotundatus*; 26. *E. borneanus*; 27. *E. japonicus*; 28. *E. tuberculatus*.

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**Conflict of interest**

None.

**Contributions**

ST received the material and designed the study; GMC made the figures and both authors wrote the manuscript.

## References

- Arcangeli A. 1927. Isopodi terrestri raccolti nell'Estremo Oriente dal Prof. Filippo Silvestri. *Bollettino del Laboratorio di Zoologia generale e agraria, Portici*. 20:211–269.
- Beron P. 2015. Comparative study of the invertebrate cave faunas of Southeast Asia and New Guinea. *Historia naturalis bulgarica*. 21:169–210.
- Budde-Lund G. 1912. Description of a new species of terrestrial Isopoda from Java. *Notes from the Leiden Museum*. 34:169–170, pl. 8.
- Dalens H. 1987. Sur deux oniscoïdes cavernicoles nouveaux de Thaïlande. *Travaux du Laboratoire d'Écobiologie des Arthropodes édaphiques*. 5:43–53.
- Dalens H. 1992. Sur une nouvelle espèce du genre *Exalloniscus* (Crustacea Isopoda Oniscidea) récoltée au Laos. *Arthropoda selecta*. 1:17–22.
- Dollfus A. 1898. Isopodes terrestres des Indes néerlandaises recueillis par M. Le Professeur Max Weber et par MM. Les Docteurs Fritz et Paul Sarasin (de Bâle). In: Weber M, editor. *Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien*, Vol. 4. Leiden: E.J. Brill, p. 357–381, pls 13–15.
- Emery C. 1887a. Catalogo delle formiche esistenti nelle collezioni del Museo Civico di Genova. Parte terza. Formiche della regione Indo-Malese e dell'Australia. *Annali del Museo Civico di Storia Naturale di Genova*. 24 (1886):209–240.
- Emery C. 1887b. Catalogo delle formiche esistenti nelle collezioni del Museo Civico di Genova. Parte terza. Formiche della regione Indo-Malese e dell'Australia (continuazione e fine). *Annali del Museo Civico di Storia Naturale di Genova*. 25:427–432.
- Ferrara F, Maschwitz U, Kovac S, Taiti S. 1988. The genus *Exalloniscus* Stebbing, 1911 (Crustacea, Oniscidea) and its relationship with social insects. *Pubblicazioni dell'Istituto di Entomologia dell'Università di Pavia*. 36 (1987):43–46.
- Ferrara F, Taiti S. 1982. Ricerche zoologiche della <<REEF 78>> alle Andamane. VIII. Isopodi terrestri delle Isole Andamane. *Bollettino del Museo civico di Storia naturale di Verona*. 8 (1981):459–492.
- Haviland GD. 1898. Observations on termites; with descriptions of new species. *Journal of the Linnean Society of London, Zoology*. 26(169): 358–442.
- Herold W. 1931. Land-Isopoden von den Sunda-Inseln. Ausbeuten der Deutschen Limnologischen Expedition und der Sunda-Expedition Rensch. *Archiv für Hydrobiologie*. Supplement 9:306–393.
- Jackson HG. 1936. Terrestrial Isopods from Malaysia. *Bulletin of the Raffles Museum*. 12:77–87.
- Kwon DH, Taiti S. 1993. Terrestrial Isopoda (Crustacea) from southern China, Macao and Hong Kong. *Stuttgarter Beiträge zur Naturkunde, Serie A*. 490:1–83.
- Le Guillou E.J.F. 1842. Catalogue raisonné des insectes hyménoptères recueillis dans le voyage de circumnavigation des corvettes l'Astrolabe et la Zélée. *Annales de la Société Entomologique de France*. 10 (1841):311–324.
- Manicasteri C, Argano R. 1986. Terrestrial isopods from Sri Lanka. II. *Exalloniscus brincki* n. sp. (Crustacea, Malacostraca). *Revue suisse de Zoologie*. 93:37–45.
- Manicasteri C, Taiti S. 1991. A new species of *Exalloniscus* Stebbing, 1911 from Sumatra (Crustacea, Isopoda, Oniscidea). *Treubia*. 30:185–190.
- 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>
- Nunomura N. 2000. A new species of the genus *Exalloniscus* (Isopoda, Oniscidea) from Tochigi Prefecture, eastern Japan. *Bulletin of the Toyama Science Museum*. 23:1–4.
- Nunomura N, Xie R-D. 2000. Terrestrial isopod crustaceans of Yunnan, southwest China. In: Aoki J, Yin W, Imadate G, editors. *Taxonomical Studies on the Soil Fauna of Yunnan Province in Southwest China*. Tokyo: Tokai University Press, p. 43–89.
- Roger J. 1861. Die Ponera-artigen Ameisen (Schluss). *Berliner Entomologische Zeitschrift*. 5:1–54.
- Roger J. 1863. Die neu aufgeführten Gattungen und Arten meines Formiciden-Verzeichnisses nebst Ergänzung einiger früher gegebenen Beschreibungen. *Berliner Entomologische Zeitschrift*. 7:131–214.

- Schmalfuss H. 1983. Terrestrial isopods from Nepal (Crustacea: Isopoda: Oniscoidea). *Senckenbergiana Biologica*. 63 (1982):373–392.
- Schmalfuss H. 1989. Phylogenetics in Oniscoidea. *Monitore zoologico italiano, Nuova Serie*. Monografia 4:3–27.
- Schmalfuss H. 2003. World catalog of terrestrial isopods (Isopoda: Oniscoidea). *Stuttgarter Beiträge zur Naturkunde, Serie A*. 654:1–341.
- Schmidt C. 2008. Phylogeny of the terrestrial Isopoda (Oniscoidea): a review. *Arthropod Systematics & Phylogeny*. 66:191–226.
- Schmidt C, Leistikow A. 2004. Catalogue of genera of the terrestrial Isopoda (Crustacea: Isopoda: Oniscoidea). *Steenstrupia*. 28:1–118.
- Smith F. 1857. Catalogue of the hymenopterous insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. Wallace. *Journal and Proceedings of the Linnean Society of London, Zoology*. 2:42–88.
- Smith F. 1858. Catalogue of hymenopterous insects in the collection of the British Museum. Part VI. Formicidae. London: British Museum. 216 pp.
- Stebbing TRR. 1911. XII. Indian isopods. *Records of the Indian Museum*. 4:179–191, pls X–XII.
- Taiti S, Ferrara F. 1986. Ricerche nell'Asia sudorientale. IX. Su due specie, una nuova, del genere *Exalloniscus* Stebbing, 1911 (Isopodi terrestri). *Bollettino del Museo civico di Storia naturale di Verona*. 11 (1984):237–246.
- Taiti S, Ferrara F. 1988. Revision of the genus *Exalloniscus* Stebbing, 1911 (Crustacea: Isopoda: Oniscoidea). *Zoological Journal of the Linnean Society*. 94:339–377.
- Taiti S, Gruber GA. 2008. Cave-dwelling terrestrial isopods from southern China (Crustacea, Isopoda, Oniscoidea), with descriptions of four new species. In: Latella L, Zorzin R, editors. Research in South China karsts. *Memorie del Museo civico di Storia naturale di Verona, Monografie Naturalistiche*. 3:101–123.