

Five new species of *Exalloniscus* Stebbing, 1911 (Crustacea, Isopoda, Oniscidea) from China

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Abstract

Exalloniscus Stebbing, 1911 is investigated from China, and eleven species of the genus are now recorded from China. Five of them are described as new: *E. duospinatus* Li & Jiang, **sp. nov.**, *E. curvispinatus* Li & Jiang, **sp. nov.**, *E. triangulus* Li & Jiang, **sp. nov.**, *E. tridentatus* Li & Jiang, **sp. nov.** and *E. taitii* Li & Jiang, **sp. nov.** A map of China showing the recorded localities of *Exalloniscus* members is provided.

Key Words

China, distribution, morphology, new species, taxonomy

Introduction

The genus *Exalloniscus* was established by Stebbing (1911) to allocate *Alloniscus coecus* Dollfus, 1898 from Indonesia. To date, the genus includes twenty-eight species with Oriental and Palaearctic distribution, occurring in South Asia (India, Sri Lanka, Nepal), Southeast Asia (Cambodia, Laos, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam), and East Asia (China, Korea, Japan) (Manicasteri and Argano 1986; Taiti and Ferrara 1988; Manicasteri and Taiti 1991; Kwon 1993, 1995; Kwon and Taiti 1993; Nunomura 2000; Nunomura and Xie 2000; Taiti and Gruber 2008; Taiti and Cardoso 2020). The genus has been redefined (Taiti and Ferrara 1988), and its diagnosis has also been amended (Taiti and Cardoso 2020). Prior to this study, six *Exalloniscus* species were known from China (Taiti and Ferrara 1986; Kwon and Taiti 1993; Nunomura and Xie 2000; Chen

2003; Taiti and Gruber 2008; Taiti and Cardoso 2020). The present study aimed to describe five new species of the genus collected in China.

Materials and methods

Specimens were collected by hand using tweezers and preserved in 75% ethanol. The appendages were stained with acid fuchsin and mounted on micro-preparations in a neutral balsam mounting medium. Habitus were recorded with a Zeiss AxioCam Icc 5 digital camera attached to a Zeiss Stereo Discovery V12 microscope. Illustrations of the appendages were prepared using an Optec DV E3 630 digital camera attached to an Optec BK6000 microscope. GNU Image Manipulation Program (Montesanto 2015) was used for line drawings. The terminology for morphological structures followed Taiti and Cardoso (2020). The

specimens are deposited at the Insect Museum, Jiangxi Agricultural University, Nanchang, China (JXAUM) and National Resource Center for Chinese Materia Medica, China Academy of Chinese Medical Sciences, Beijing, China (CMMI).

Taxonomic account

Exalloniscus duospinatus Li & Jiang, sp. nov.

<https://zoobank.org/3F019AA6-3E86-4AD0-828F-20E115548925>

Figs 1A, 2

Type material. *Holotype*. CHINA: male, Sichuan Province, Qionglai, Datong Town (30°30'N, 103°18'E), alt. 770 m, 16 April 2021, Chao Jiang leg., habitus no. QL2301, prep. slide no. L23098 (JXAUM).

Paratypes. CHINA, Sichuan Province: One female, same data as holotype, no. 20210416044; two males, one female, Dayi County, near Xiling Snow Mountain Tunnel (30°37'N, 103°19'E), alt. 860 m, 16 April 2021, Chao Jiang leg., no. 20210416031–202104160033;

one female, Dayi County, Heishuihe Nature Reserve, Dafeishui (30°38'N, 103°10'E), alt. 1290 m, 16 April 2021, Chao Jiang leg., no. 20210416026; one male, Chengdu, Jincheng Park (30°34'N, 104°02'E), alt. 450 m, 19 April 2021, Chao Jiang leg., no. 20210419001 (CMMI).

Diagnosis. Male pleopod 1 endopod has two spinelike lobes at apical part of outer margin.

Description. Maximum length: male 3.6 mm and female 4.2 mm.

Body oval, flattened and pale brown. Cephalon with lateral lobes slightly protruding laterally, apex rounded. Eyes with three ommatidia. Pereonites 1–2 with postero-lateral corners nearly right-angled, pereonites 3–7 with postero-lateral corners directed backwards. Pleonites 3–5 with epimera falciform, protruding backwards. Telson triangular, twice as wide as long, lateral margin slightly concave, ending with rounded apex. Uropod exopod as long as endopod (Fig. 1A).

Antenna with fifth article of peduncle slightly longer than flagellum; ratio of flagellum approximately 3:2:2 (Fig. 2A).

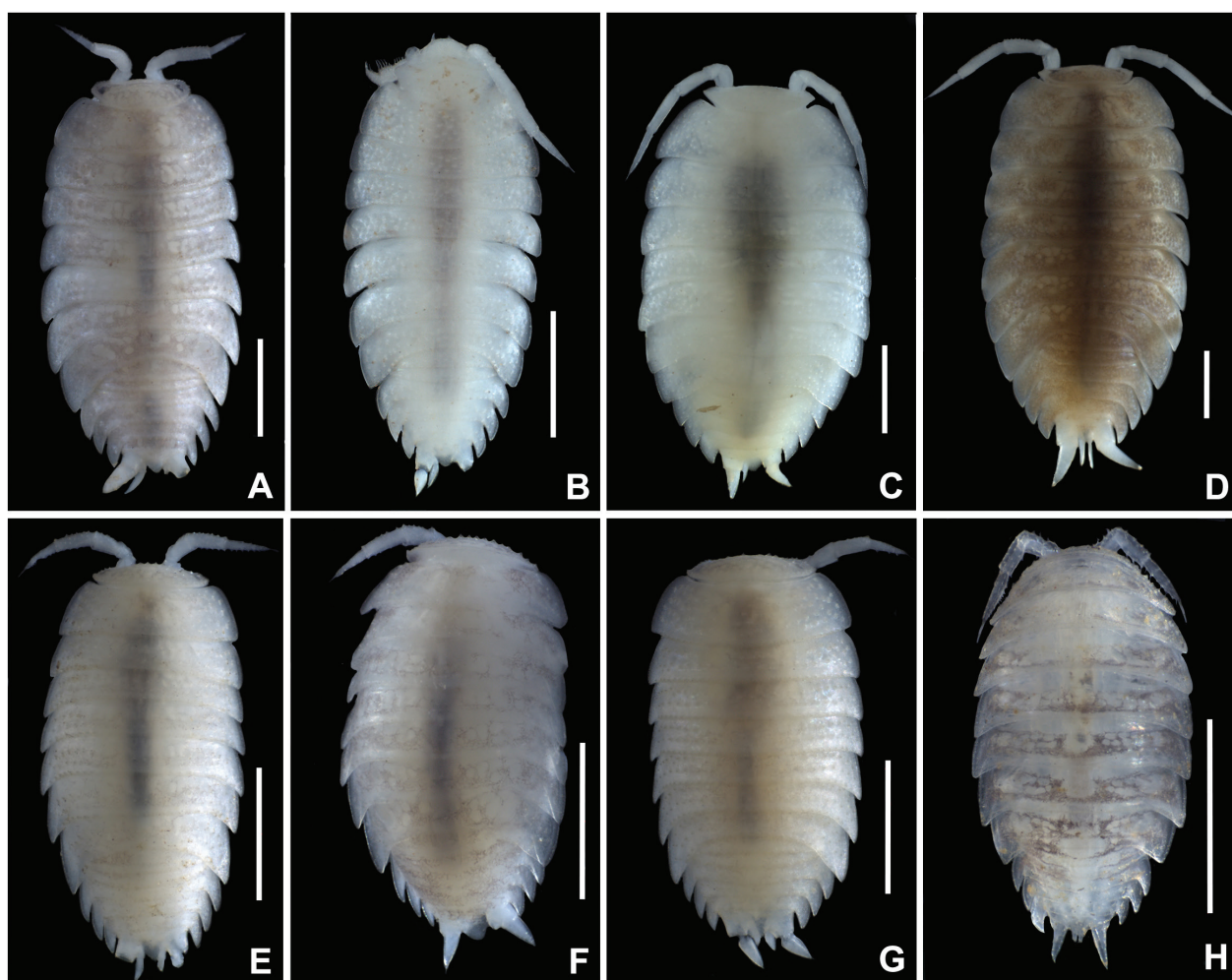


Figure 1. Habitus of *Exalloniscus* species. A. *E. duospinatus* sp. nov., holotype; B (holotype); C (paratype). *E. curvispinatus* sp. nov.; D. *E. thailandensis*, male; E. *E. triangulus* sp. nov., holotype; F. *E. tridentatus* sp. nov., holotype; G. *E. cortii*, male; H. *E. taitii* sp. nov., holotype. Scale bar: 1 mm.

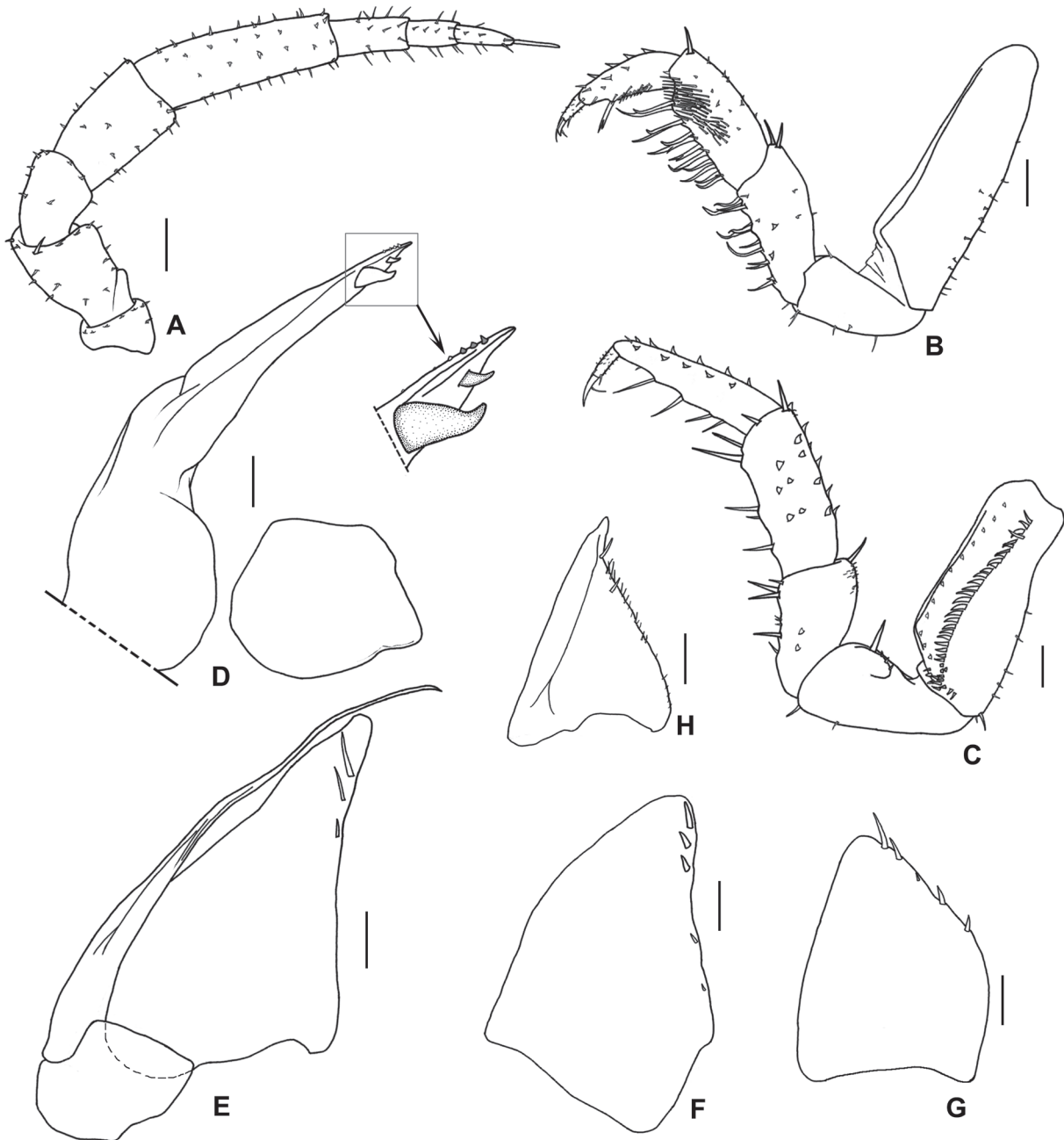


Figure 2. *Exalloniscus duospinatus* sp. nov., holotype. **A.** Antenna; **B.** Pereopod 1; **C.** Pereopod 7; **D.** Pleopod 1; **E.** Pleopod 2; **F.** Pleopod 3 exopod; **G.** Pleopod 4 exopod; **H.** Pleopod 5 exopod. Scale bar: 0.1 mm.

Pereopod 1 with long strong setae on sternal margin of merus and carpus, carpus with transversal antennal grooming brush (Fig. 2B). Pereopod 7 with several strong setae on sternal margin; basis with distinct water conducting system; ischium gently concave on rostral surface of base, and straight on sternal margin (Fig. 2C).

Male pleopod 1 exopod almost quadrangular, outer margin convex; endopod with apical part bearing two spinelike lobes on outer margin and four tiny spines on inner margin (Fig. 2D). Pleopod 2 exopod triangular with several setae on outer margin; endopod flagelliform, longer than exopod (Fig. 2E). Pleopods 3–5 exopods triangular with several setae on outer margin (Fig. 2F–H).

Etymology. Latin: prefix *duo-* = double plus *spinatus* = spinous. The new species name refers to the male pleopod 1 endopod with two spinelike lobes at the apical part of outer margin.

Remarks. This new species is similar to *E. silvestrii* Kwon & Taiti, 1993, but it can be distinguished by pereopod 7 ischium slightly concave at the base of the rostral surface, and pleopod 1 endopod bearing two spinelike lobes at the apical part of the outer margin (Fig. 2C, D). In *E. silvestrii*, the base of pereopod 7 ischium with a large flat rounded lobe on the rostral surface, and the apical part of pleopod 1 endopod with three triangular lobes on the outer margin (Kwon and Taiti 1993: figs 110, 112).

***Exalloniscus curvispinatus* Li & Jiang, sp. nov.**

<https://zoobank.org/1CFF7EBE-9FBA-46A3-857C-25511D27B65E>

Figs 1B, C, 3

Type material. *Holotype*. CHINA: male, Yunnan Province, Mengla County, Xiaomo Road (21°14'N, 101°42'E), alt. 650 m, 18 August 2023, Chao Jiang leg., habitus no. ML23002, prep. slide no. L23104 (JXAUM).

Paratypes. CHINA, Yunnan Province: Two males, one female, same data as the holotype, no. 20230818301; one male, Menglian County, Nayunzhen (22°19'N, 99°35'E), 23 August 2023, Han Qiu leg., habitus no. NYZ23001, prep. slide no. L23105 (JXAUM); one male, Jinghong, Jinuo Village, Bakaxiaozhai (21°57'N, 101°12'E), 15 August 2023, Chao Jiang leg., no. 20230815301; three males, one female, Menglian County, Nayun Town,

23 August 2023, Han Qiu leg., nos. 20230302301 and 20230302202 (CMMI).

Diagnosis. Male pleopod 1 exopod almost pentagonal, and endopod recurved outwards at apical part.

Description. Maximum length: male 5.0 mm and female 4.2 mm.

Body oval, flattened and white. Cephalon with lateral lobes slightly protruding laterally, nearly triangular with blunted apex. Eyes absent. Pereonites with postero-lateral corner progressively more acute, directed backwards. Pleonites 3–5 with epimera falciform, protruding backwards. Telson triangular, twice as wide as long, lateral margin gently concave, ending with rounded apex. Uropod exopod as long as endopod (Fig. 1B).

Antenna with fifth article of peduncle slightly longer than flagellum; ratio of flagellum approximately 4:3:3 (Fig. 3A).

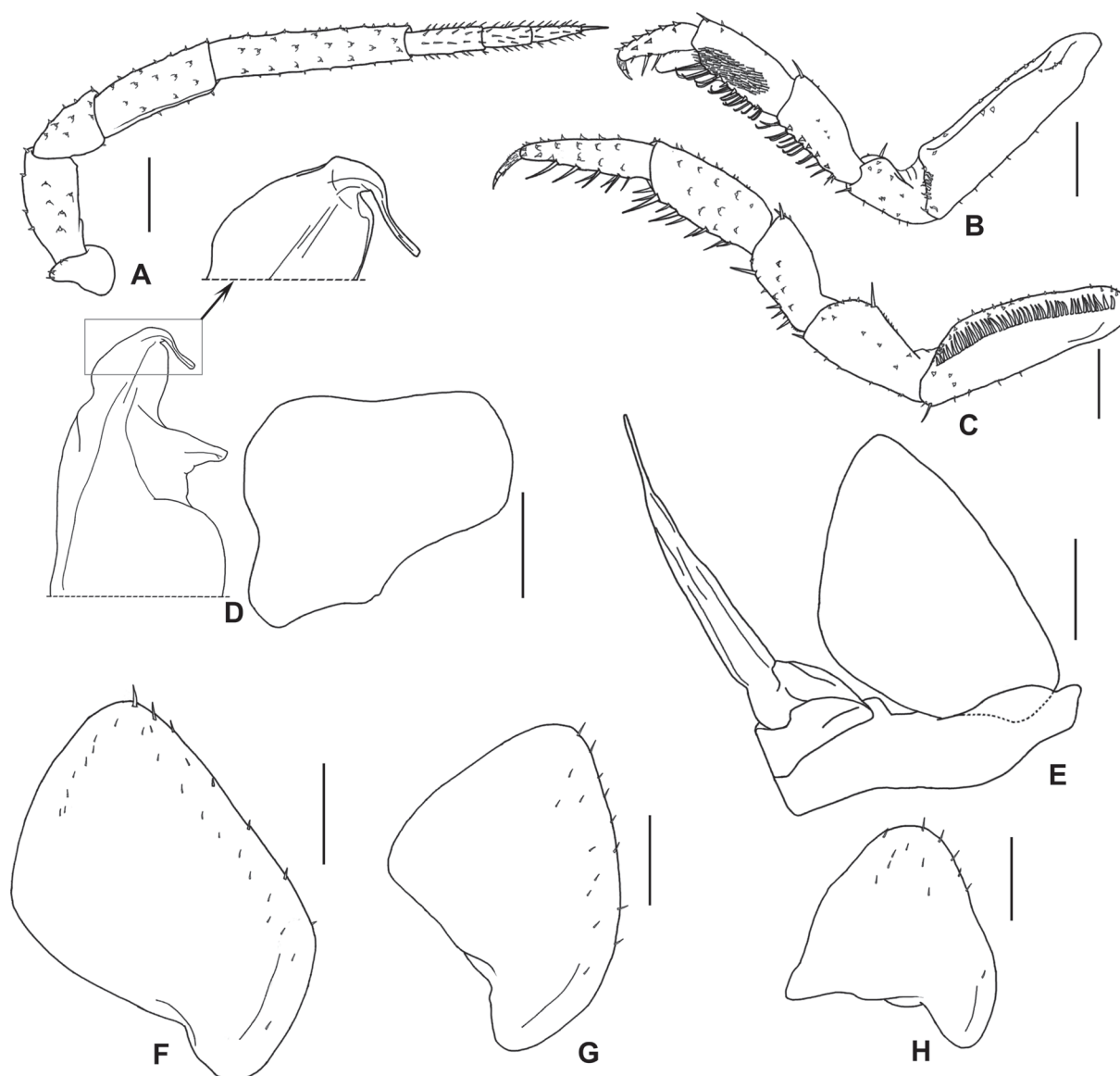


Figure 3. *Exalloniscus curvispinatus* sp. nov., holotype. A. Antenna; B. Pereopod 1; C. Pereopod 7; D. Pleopod 1; E. Pleopod 2; F. Pleopod 3 exopod; G. Pleopod 4 exopod; H. Pleopod 5 exopod. Scale bar: 0.2 mm.

Pereopod 1 with long strong setae on sternal margin of merus and carpus, carpus with basal part as wide as apical part, bearing transversal antennal grooming brush (Fig. 3B). Pereopod 7 with several strong setae on sternal margin; basis with distinct water conducting system; ischium straight on sternal margin (Fig. 3C).

Male pleopod 1 exopod almost pentagonal; endopod with triangular lobe on outer margin, apical part thin and long, recurved outwards (Fig. 3D). Pleopod 2 exopod oval, apical part narrowed toward round apex; endopod flagelliform, longer than exopod (Fig. 2E). Pleopods 3–5 exopods oval with several setae on outer margin (Fig. 3F–H).

Etymology. Latin: prefix *curv-* = curved plus *spinatus* = spinous. The new species name refers to the apical apex of male pleopod 1 endopod with a spinelike projection recurved outwards.

Remarks. This species varied in body shapes (Fig. 1B *versus* 1C). Specimens collected in Mengla (Fig. 1B) are distinctly thinner than the specimens found in Menglian (Fig. 1C).

The new species is similar to *E. thailandensis* in having a recurved pleopod 1 endopod (Fig. 3 *versus* Fig. 4). However, it can be distinguished by pereopod 1 with the basal part as wide as the apical part, pleopod 1 exopod almost pentagonal, and endopod without transversal sclerotized projections at the apical part (Fig. 3B, D). In *E. thailandensis*, the basal part of pereopod 1 is distinctly narrower than the apical part, pleopod 1 exopod is almost rounded, and endopod armed with transversal sclerotized projections at the apical part (Fig. 4B, D). Moreover, the body pigments of the new species (white, Fig. 1B, C) differ from *E. thailandensis* (brown, Fig. 1D) based on two

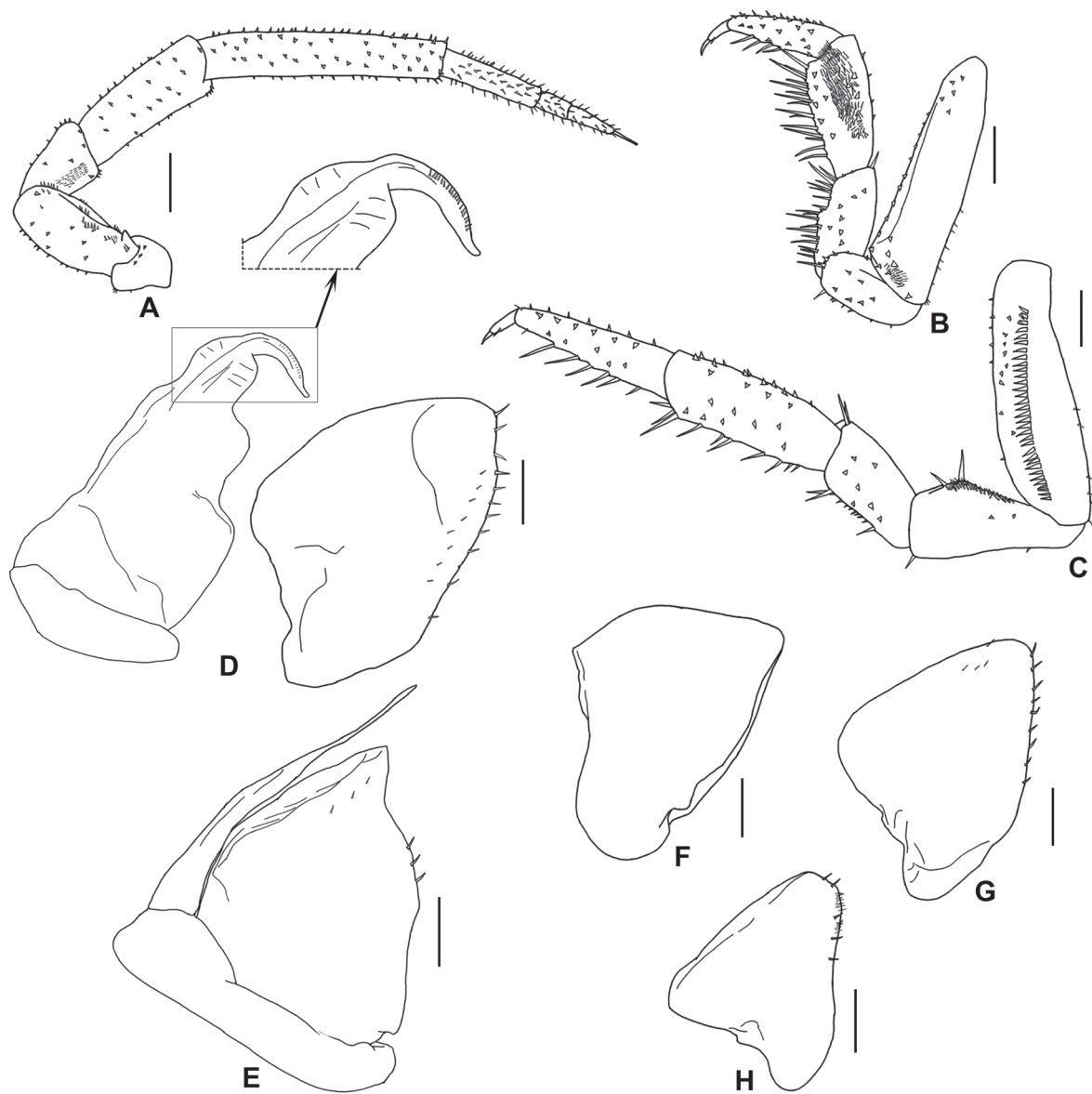


Figure 4. *Exalloniscus thailandensis* (two males, China, Yunnan Province, Mengla, County, Guanlei Town, Baojiaoni Cave, 17 August 2023, Chao Jiang leg., prep. slide no. L23106). **A.** Antenna; **B.** Pereopod 1; **C.** Pereopod 7; **D.** Pleopod 1; **E.** Pleopod 2; **F.** Pleopod 3 exopod; **G.** Pleopod 4 exopod; **H.** Pleopod 5 exopod. Scale bar: 0.2 mm.

male specimens from China, Yunnan Province, Mengla County, Guanlei Town, Baojiaoni Cave. However, the colourless individuals of *E. thailandensis* have been described previously (see Taiti and Ferrara 1988). Thus, the body shape and colour should not be considered as exact characters to identify species of the genus.

***Exalloniscus triangulus* Li & Jiang, sp. nov.**

<https://zoobank.org/1E234552-69F1-4128-BACA-9FC8609F649F>

Figs 1E, 5

Type material. Holotype. CHINA: male, Hubei Province, Jingshan County, Kongshandong Scenic Area (30°58'N, 113°02'E), alt. 100 m, 9 April 2021, Zhidong Wang and Tianyun Chen leg., habitus no. KSD2302, prep. slide no. L23097 (JXAUM).

Diagnosis. Male pleopod 1 exopod distinctly convex on outer margin, and endopod with a triangular lobe and a seta recurved inwards at apical part.

Description. Length 2.9 mm.

Body oval, flattened and white mixed with pale brown. Cephalon with lateral lobes slightly protruding laterally, apex rounded. Eyes with three ommatidia. Pereonites 1 with postero-lateral corner nearly right-angled, pereonites 2–7 with postero-lateral corners directed backwards. Pleonites 3–5 with epimera falciform, protruding backwards. Telson triangular, twice as wide as long, lateral margin gently concave, ending with rounded apex. Uropod exopod almost as long as endopod (Fig. 1E).

Antenna with fifth article of peduncle longer than flagellum; ratio of flagellum approximately 3:2:2 (Fig. 5A).

Pereopod 1 with long strong setae on sternal margin of merus and carpus, carpus with transversal anten-

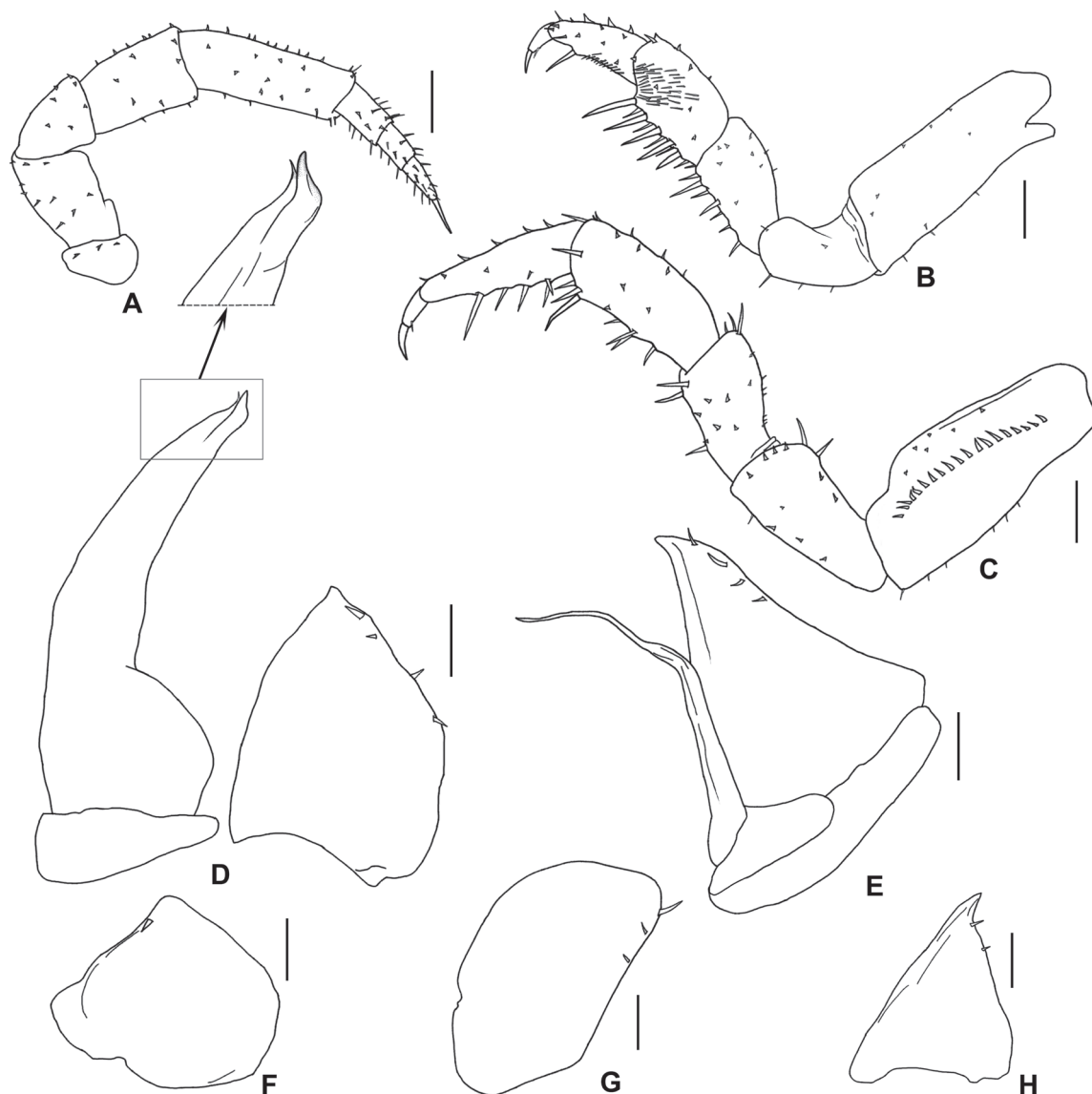


Figure 5. *Exalloniscus triangulus* sp. nov., holotype. A. Antenna; B. Pereopod 1; C. Pereopod 7; D. Pleopod 1; E. Pleopod 2; F. Pleopod 3 exopod; G. Pleopod 4 exopod; H. Pleopod 5 exopod. Scale bar: 0.1 mm.

nal grooming brush (Fig. 5B). Pereopod 7 with several strong setae on sternal margin; basis with distinct water conducting system; ischium slightly convex on sternal margin (Fig. 5C).

Male pleopod 1 exopod basal half broad, distal half narrowed towards blunted apex, distinctly convex on outer margin; endopod ending with triangular lobe and seta recurved inwards (Fig. 5D). Pleopod 2 exopod triangular with several setae on outer margin; endopod flagelliform, longer than exopod (Fig. 5E). Pleopods 3 and 4 exopods almost oval, pleopod 5 triangular with several setae on outer margin (Fig. 5F–H).

Etymology. Latin: *triangulus* = triangular. The new species name refers to the male pleopod 1 endopod ending with a triangular lobe.

Remarks. This new species is similar to *E. malaccensis* Taiti & Ferrara, 1988 in having a triangular lobe at

the apical part of male pleopod 1 endopod. But it can be distinguished by pleopod 1 exopod distinctly convex on the outer margin, and the apical part of endopod with a triangular lobe and a seta recurved inwards (Fig. 5D). In *E. malaccensis*, pleopod 1 exopod is distinctly concave on the outer margin, and the apical lobe of endopod is thinner and recurved outwards (Taiti and Ferrara 1988: fig. 23D).

***Exalloniscus tridentatus* Li & Jiang, sp. nov.**

<https://zoobank.org/C7A742F7-5BCF-4A53-AA09-099FB4E8DDB3>

Figs 1F, 6

Type material. Holotype. CHINA: male, Shaanxi Province, Zhashui County, Dongshan Forestry Park (33°42'N, 109°01'E), alt. 1020 m, 12 May 2021, Chao Jiang leg., habitus no. ZS2301, prep. slide no. L23095 (JXAUM).

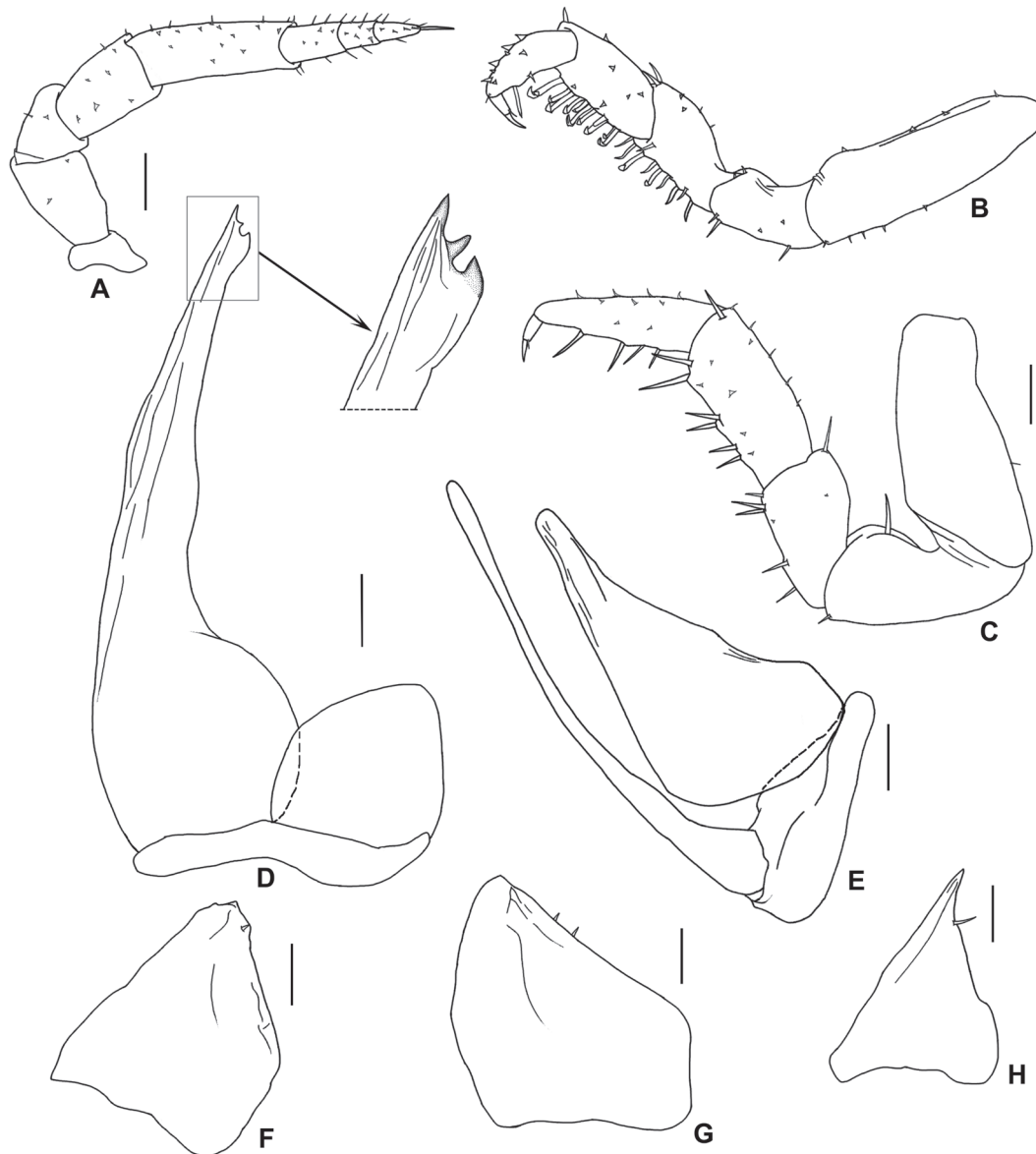


Figure 6. *Exalloniscus tridentatus* sp. nov., holotype. A. Antenna; B. Pereopod 1; C. Pereopod 7; D. Pleopod 1; E. Pleopod 2; F. Pleopod 3 exopod; G. Pleopod 4 exopod; H. Pleopod 5 exopod. Scale bar: 0.1 mm.

Paratypes. CHINA: two males, two females, same data as the holotype, nos. 20210512007–20210512009 (CMMI).

Diagnosis. Male pleopod 1 exopod straight on outer margin, and endopod bearing three well-developed dentations at apical part.

Description. Maximum length: male 2.5 mm and female 2.8 mm.

Body oval, slightly convex. Colour white mixed with pale brown. Cephalon with lateral lobes slightly protruding laterally, apex rounded. Eyes with three ommatidia. Pereonites with postero-lateral corners directed backwards. Pleonites 3–5 with epimera falciform, protruding backwards. Telson triangular, twice as wide as long, lateral margin slightly concave, apex rounded. Uropod exopod approximately twice as long as endopod (Fig. 1F).

Antenna with fifth article of peduncle slightly longer than flagellum; ratio of flagellum approximately 3:2:2 (Fig. 6A).

Pereopod 1 with long strong setae on sternal margin of merus and carpus (Fig. 6B). Pereopod 7 with several strong setae on sternal margin; basis without water conducting system; ischium almost straight on sternal margin (Fig. 6C).

Male pleopod 1 exopod oval, straight on outer margin; endopod with apical portion bearing rounded hyaline lobe and three well-developed dentations (Fig. 6D). Pleopod 2 exopod triangular; endopod flagelliform, longer than exopod (Fig. 6E). Pleopods 3–5 nearly triangular with several setae on outer margin (Fig. 6F–H).

Etymology. Latin: *tridentatus* = trident. The new species name refers to the male pleopod 1 endopod with three dentations at apical portion.

Remarks. This new species is similar to *E. cortii* Arcangeli, 1927 by body shape and male pleopod 1 endopod bearing a rounded hyaline lobe at the apical portion (Figs 1F, 6D versus Figs 1G, 7D). But it can be distinguished by pereopod 7 basis without water conducting

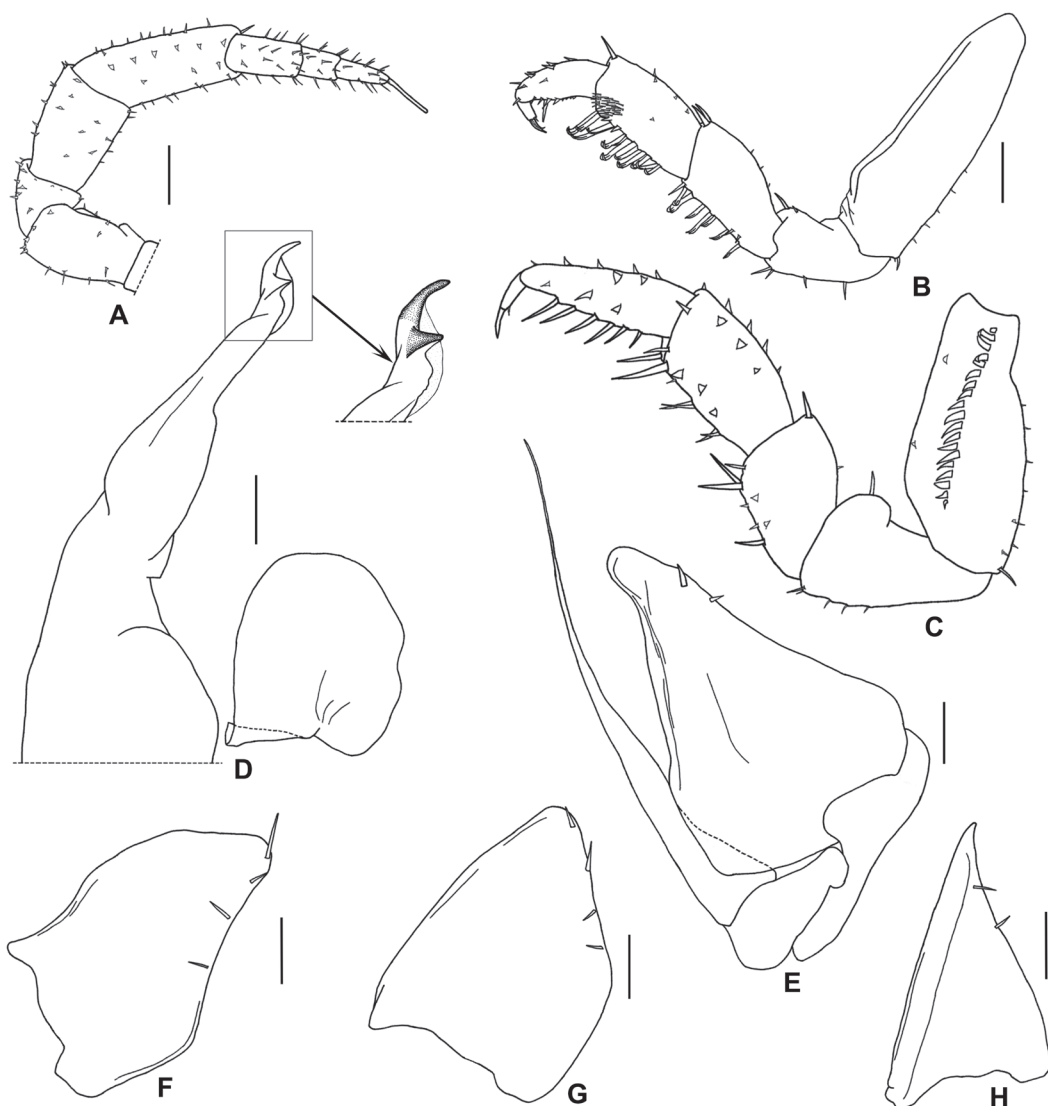


Figure 7. *Exalloniscus cortii* (one male, China, Hunan Province, Yongzhou, Puliqiao Town, 21 March 2019, Chao Jiang leg., prep. slide no. L23099). A. Antenna; B. Pereopod 1; C. Pereopod 7; D. Pleopod 1; E. Pleopod 2; F. Pleopod 3 exopod; G. Pleopod 4 exopod; H. Pleopod 5 exopod. Scale bar: 0.1 mm.

system, pleopod 1 exopod straight on the outer margin, and endopod bearing three well-developed dentations at the apical portion (Fig. 6C, D). In *E. cortii*, pereopod 7 basis has a well-developed water conducting system, pleopod 1 exopod is sinuous on the outer margin, and endopod with two spinelike projections at the apical apex (Fig. 7C, D).

***Exalloniscus taitii* Li & Jiang, sp. nov.**

<https://zoobank.org/D814EDC9-41DF-44F6-A6D6-FD5B4C9D9EF8>

Figs 1H, 8

Type material. *Holotype*. CHINA: male, Yunnan Province, Gengma County, Daxing Village (23°45'N, 99°46'E), alt. 2270 m, 29 May 2021, Chao Jiang leg., habitus no. DXX2302, prep. slide no. L23100 (JXAUM).

Diagnosis. Male pleopod 1 endopod conspicuously concave near middle of outer margin and bearing a tiny

spine at apical part of inner margin, pleopods 3 concave on outer margin.

Description. Length 2.0 mm.

Body oval, slightly convex. Colour pale brown. Cephalon with lateral lobes slightly protruding laterally, apex rounded. Eyes with three ommatidia. Pereonites with postero-lateral corners directed backwards. Pleonites 3–5 with epimera falciform, protruding backwards. Telson triangular, twice as wide as long, lateral margin slightly concave, apex rounded. Uropod exopod approximately twice as long as endopod (Fig. 1H).

Antenna with fifth article of peduncle slightly shorter than flagellum; ratio of flagellum approximately 3:3:4 (Fig. 8A).

Pereopod 1 with long strong setae on sternal margin of merus and carpus, carpus without transversal antennal grooming brush (Fig. 8B). Pereopod 7 with several strong setae on sternal margin; basis without water conducting system; ischium almost straight on sternal margin (Fig. 8C).

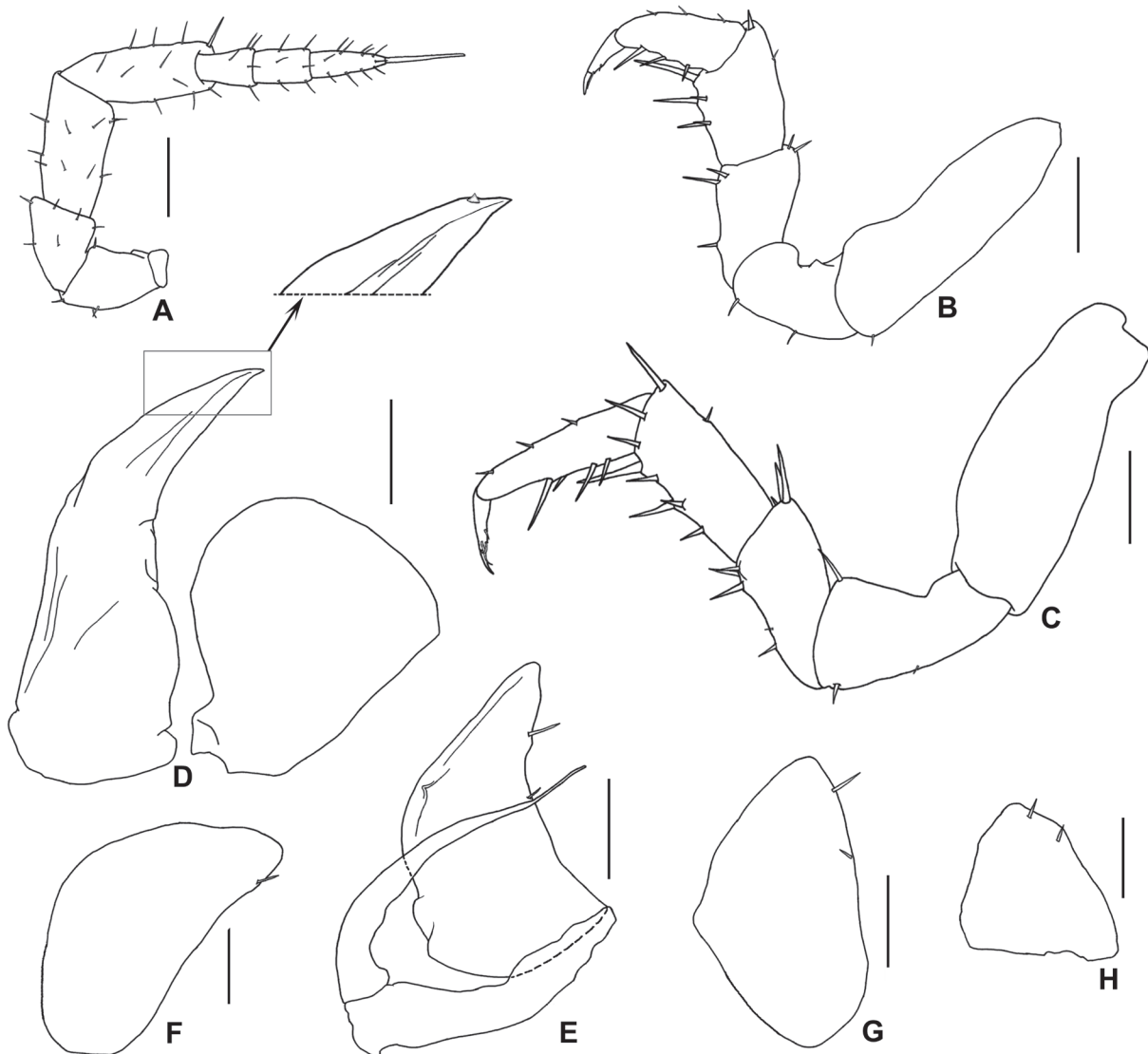


Figure 8. *Exalloniscus taitii* sp. nov., holotype. A. Antenna; B. Pereopod 1; C. Pereopod 7; D. Pleopod 1; E. Pleopod 2; F. Pleopod 3 exopod; G. Pleopod 4 exopod; H. Pleopod 5 exopod. Scale bar: 0.1 mm.

Male pleopod 1 exopod base narrow, distinctly broadened towards apical part, almost straight on outer margin; endopod base broad, narrowed towards point apex, outer margin conspicuously concave near middle, apical part with tiny spine on inner margin (Fig. 8D). Pleopod 2 exopod triangular, outer margin concave; endopod flagelliform, longer than exopod (Fig. 8E). Pleopods 3–5 nearly triangular, pleopods 3 concave on outer margin, pleopods 4–5 almost straight on outer margin (Fig. 8F–H).

Etymology. The new species name honors Dr. Stefano Taiti for his invaluable contribution to the taxonomy of terrestrial isopods.

Remarks. This new species is similar to *E. burmaensis* Taiti & Cardoso, 2020 by the traits of male pleopod 1. But it can be distinguished by the ratio of flagellum approximately 3:3:4; pereopod 1 carpus without transversal antennal grooming brush, and pereopod 7 basis without water conducting system; pleopod 1 endopod conspicuously concave near the middle of the outer margin, and bearing a tiny spine at the apical part of the inner margin, pleopods 3 concave on the outer margin (Fig. 8A–D, F). In *E. burmaensis*, flagellum is diminishing in length from the first segment to the third segment; pereopod 1 carpus with a transversal antennal grooming brush, and pereopod 7 basis has a well-developed water conducting system; pleopod 1 endopod is almost straight on the outer margin, and the apical part without spine on the inner margin, pleopods 3 is straight on the outer margin (Taiti and Cardoso 2020: Fig. 17H, 18B–D, F).

Biogeographical considerations

This taxonomic work describes five new species of the genus *Exalloniscus* from China. To date, a total of eleven species of the genus occur in China (Fig. 9). All the *Exalloniscus* species from China described here are distributed southward to the 0 °C isotherm of the coldest month (January) of the year, and their habitus almost locates in a humid area with annual precipitation above 800 mm. Among them, only *Exalloniscus cortii* Arcangeli, 1927 shows a wide distribution. In addition to South China, it is also recorded from sub-humid areas near 40°N of North China (Fig. 9). Based on our available specimens and historical records (Taiti and Ferrara 1988), *E. cortii* has the northernmost distribution in China reaching Shanhai Pass of Hebei Province, the border between Northeast China and North China (Fig. 8). Thus, all Chinese species of this genus are humidity and warmth dependent except for *E. cortii*, which has demonstrated to have some level of cold tolerance.

Furthermore, the worldwide records indicate the occurrence of *Exalloniscus* species from South Asia, South-east Asia to East Asia (Manicasteri and Argano 1986; Taiti and Ferrara 1988; Manicasteri and Taiti 1991; Kwon 1993, 1995; Kwon and Taiti 1993; Nunomura 2000; Nunomura and Xie 2000; Taiti and Gruber 2008; Taiti and Cardoso 2020). This geographical region is strongly connected to climatic variables, in which the precipitation and minimum temperature are very close to the geographic



Figure 9. Map of China showing the localities where *Exalloniscus* species are recorded.

distribution in China. This suggests that the precipitation and minimum temperature may be the important factors affecting the geographical distribution of *Exalloniscus* members. In addition, most *Exalloniscus* species live in association with ants or termites, but the available data are still only fragmentary and insufficient for the biology of many species (Taiti and Ferrara 1988; Taiti and Cardoso 2020). Further research is necessary to precisely identify biotic and abiotic requirements for *Exalloniscus* species as well as to describe the largely unstudied diversity of the genus in China.

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