

A new species of *Cerapus* (Amphipoda, Senticaudata, Ischyroceridae) from Mae Klong Estuary, with a discussion on their nesting and types of mating behaviour

Chanikan Katnour^{1,2}, Tosaphol Saetung Keetapithchayakul¹,
Azman Abdul Rahim³, Koraon Wongkamhaeng^{1,2}

¹ Department of Zoology, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand

² Biodiversity Center Kasetsart University, Bangkok 10900, Thailand

³ Marine Ecosystem Research Centre, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

<https://zoobank.org/1549ABF3-4A14-448B-89AF-549F2088D947>

Corresponding author: Koraon Wongkamhaeng (koraon@gmail.com)

Academic editor: Luiz F. Andrade ♦ Received 14 June 2023 ♦ Accepted 9 November 2023 ♦ Published 4 December 2023

Abstract

The first representative of the genus *Cerapus* in the Gulf of Thailand, *Cerapus rivulus* sp. nov., is described from specimens sampled from Mae Klong Estuary, the inner Gulf of Thailand. The main identifying characteristics of this new amphipod species are pereonites 1 and 2 without constriction; male gnathopod propodus palm transverse with long posterior defining tooth and well-developed anterodistal recurved tooth adjacent to propodus articulation; pereopod 6 coxa without fine fringe setae ventrally, basis with setae on posterior margin; and telson with deep cleft. An updated identification key for the 25 known species in the genus is also presented. A discussion on their nesting and types of mating behaviour is provided.

Key Words

Amphawa, *Cerapus*, mating behaviour, nesting behaviour

Introduction

Lowry and Berents (1996) recognised five genera of tube building amphipods in the Cerapodini (*Cerapus* Say, 1817, *Runanga* Barnard, 1961, *Paracerapus* Budnikova, 1989, *Bathypoma* Lowry & Berents, 1996 and *Notopoma* Lowry & Berents, 1996). In 2018, Berents and Lowry (2018) proposed a new genus from Australia (*Kapalana* Berents and Lowry 2018). The tubicolous genus *Cerapus* can be recognised by: 1) antenna 1 without vestigial accessory flagellum, 2) antenna 1 peduncular article 1 posterior margin with strong posterior projection, 3) gnathopod 2 of adult male, carpochele, subchele in female, 4) pereopod 5 with the distal part directed posteriorly, 5) dactyli of pereopods 6 and 7 with 1–2 small accessory spines, 6) pleopods 2 and 3 with inner rami reduced, 1-articulate, 7) uropod 1 with the outer margin of the ramus

dentate, 8) uropod 2 uniramus, outer margin of the ramus dentate, without robust setae and 9) uropod 3 uniramous, ramus vestigial bearing recurved spines (Lowry and Berents 1996; Souza-Filho and Serejo 2014; Berents and Lowry 2018; Nurshazwan et al. 2020).

Most species of Cerapodini are found on the soft bottom of estuaries and various coastal habitats, i.e. seagrass beds, algal beds, mangrove forests and coral reefs (Shen 1936; Lowry and Berents 2002; Lowry and Berents 2005; Nurshazwan et al. 2020). There are various types of tubes, with Lowry and Berents (2005) classifying *Cerapus* tubes into three types: the detrital tube, algal tube and sandy tube. Most tubes are constructed in a turf of the interwoven tube with various substrates attached, including hydroids, algae, fleshy and calcareous gorgonians and sponges (Lowry and Thomas 1991). The study of Nurshazwan et al. (2020) reported 23 species, but did not include *C. longicervicum*

Lim, Park & Min, 2008 from South Korea (Lim et al. 2008). Adding the newly-discovered *C. rivulus* sp. nov., there are now a total of 25 *Cerapus* species worldwide. From that, only six species of *Cerapus* have been described in the waters of Southeast Asia, including Singapore: *C. tubularis* Say, 1817; Thailand: *C. chaomai* Lowry & Berents, 2002 and *C. yuyatalay* Lowry & Berents, 2002; Korea: *C. longirostris* Shen, 1936 and *C. longicervicum* Lim, Park & Min, 2008; Malaysia: *C. bumbumiensis* Nurshazwan, Ahmad-Zaki & Azman, 2020. However, there have been no recorded species from the South China Sea, including the Gulf of Thailand (Lowry and Berents 2002; Lim et al. 2008; White 2015; Nurshazwan et al. 2020; Azman 2022).

The present study describes *Cerapus rivulus* sp. nov. as a new species from the Gulf of Thailand. A distribution map with brief biological notes and a key to the world species of the genus are also provided.

Materials and methods

The *Cerapus* sampling was carried out using the experimental model set, based on Aikins and Kikuchi (2001). The experimental models were set up around Mae Klong estuarine for two and four months (Fig. 1).

The Mae Klong River is located in west-central Thailand and passes through Kanchanaburi, Ratchaburi and Samut Songkhram before reaching the upper Gulf of Thailand. Along the river, there are urban and aquaculture zones which make this area important for fishing activities and aquaculture. The Mae Klong Estuary is situated in the Amphawa District of Samut Songkhram Province with salinity ranges from 0.05–2.00 ppt due to tide and water runoff.

The specimens were selected from experimental material and preserved in 95% ethanol. The male holotype and female paratype specimens were transferred from ethanol on to a glycerol slide for morphological study in the laboratory. Drawings were made using a camera lucida attached to an Olympus CH30 light microscope. The pencil drawings were scanned and digitally inked using a WACOM bamboo CTH-970 graphics board in Adobe Illustrator CC 2017, following the method described in Coleman (2003). Terminology for setae and mouthparts described by Zimmer et al. (2009).

The representative specimens were dehydrated with absolute ethanol, critical-point-dried using carbon dioxide, placed on holders and coated with gold for examination with an FEI Quanta 450 scanning electron microscope. Institutional abbreviation: THNHM, Thailand Natural History Museum, Bangkok, Thailand.



Figure 1. Map showing the three river mouths along the Gulf of Thailand. Red circle represents the type locality of *Cerapus rivulus* sp. nov.

Systematics

Suborder Senticaudata Lowry & Myers, 2013

Infraorder Corophiida Leach, 1814 (*sensu* Lowry & Myers, 2013)

Parvorder Caprellidira Leach, 1814 (*sensu* Lowry & Myers, 2013)

Superfamily Photoidea Boeck, 1871

Family Ischyroceridae Stebbing, 1899

Subfamily Ischyrocerinae Stebbing, 1899

Tribe Cerapodini Smith, 1880

Genus *Cerapus* Say, 1817

Type species. *Cerapus tubularis* Say, 1817

Current species composition. *Cerapus* contains 24 species + 1 new species: *C. tubularis* Say, 1817, *C. calamicola* (Giles, 1885), *C. longirostris* Shen, 1936, *C. erae* Bulyčeva, 1952, *C. benthophilus* Thomas & Heard, 1979, *C. alquirta* (Barnard & Drummond, 1981), *C. oceanicus* Lowry, 1985, *C. pacificus* Lowry, 1985, *C. cudjoe* Lowry & Thomas, 1991, *C. micronesicus* Myers, 1995, *C. thomasi* Ortiz & Lemaitre, 1997, *C. chaomai* Lowry & Berents, 2002, *C. yuyatalay* Lowry & Berents, 2002, *C. bundegi* Lowry & Berents, 2005, *C. murrayae* Lowry & Berents,

2005, *C. volucola* Lowry & Berents, 2005, *C. ortei* Ortiz & Thomas, 2007, *C. jonsoni* Valério-Berardo, Thiago de Souza & Waiteman Rodrigues, 2008, *C. longicervicum* Lim, Park & Min, 2008, *C. nudus* Just, 2009, *C. maculani-gra* Zeina & Asakura, 2017, *C. ryanadamsi* Drumm, 2018, *C. slayeri* Drumm, 2018, *C. bumbumiensis* Nurshazwan, Ahmad-Zaki & Azman, 2020; *C. rivulus* sp. nov.

***Cerapus rivulus* sp. nov.**

<https://zoobank.org/3074048C-ECA2-499C-A3D4-C54C6DAECB7C>

Figs 2–10

Material examined. **Holotype.** THAILAND • ♂, 10 mm; Samut Songkhram Province, Mae Klong River, Darunanukroh School; 13°29'41.0"N, 99°55'25.3"E; 5 m depth; 10 Apr 2021; C. Katnoum leg.; THNHM-lv-19376.

Paratype. THAILAND • 5 ♂, 5 ♀; same data as for holotype • THNHM-lv-19379.

Type locality. Darunanukroh School (13°29'41.0"N, 99°55'25.3"E) Mae Klong River, Amphawa District, Samut Songkhram Province, Thailand.

Habitat. Freshwater and brackish water (0.05–2.03 ppt) in Mae Klong River of Amphawa District, Samut Songkhram Province, Thailand.



Figure 2. *Cerapus rivulus* sp. nov. **A.** Holotype male lateral (THNHM -19377); **B.** A specimen in its tube with protruding head and antennae; **C.** Paratype female front (THNHM-19379).

Etymology. The species is named after their habitat which is located in the river (*Rivulus*: Latin for river/stream).

Description. Based on holotype, male, size 10 mm, body elongated, cylindrical THNHM-lv-19376.

Head. (Fig. 3A) *Eye* medium, 0.1 mm (0.14× head length); rostrum short (0.16× length of head), acute; Head lateral cephalic lobe well-developed and distally round.

Antenna 1 (Fig. 3B) anterior margin with short setae, posterior margin with long setae, about 0.4× the body length, peduncle 3.1× the length of flagellum peduncle article 1 with proximoventral swelling, peduncle article 3 subequal to peduncle article 2, both are slender, several aesthetascs, flagellum with 5 articles, article 1 being the longest, flagellum article 5 the shortest with 1 aesthetasc.

Antenna 2 (Fig. 3C) anterior margin with short setae, posterior margin with long setae, slightly shorter than antenna 1, setation similar to antenna 1; peduncle article 5 subequal to article 4.

Upper lip (Fig. 6F) symmetrical, notched, with small setulae apically. **Lower lip** (Fig. 6G) with inner lobe, smooth, setulose on inner and outer lobes. **Mandibles** (Fig. 6A, B) left incisor with 4 teeth; right lacinia mobilis 4-cuspidate (4 teeth); right mandible with 3 broad accessory spines; molar triturative; molar flake absent; palp elongated, robust; article 2 1.3× as long as article 3, with 17 marginal setae; article 3 with 10 long setae. **Maxilla 1** (Fig. 6E) inner plate small without setae; outer plate with 7 apical robust setae; palp biarticulate, with 6 serrated apical robust setae and 4 subapical setae. **Maxilla 2** (Fig. 6D) outer plate broader than inner plate, with 12 simple setae; inner plate with 12 setae.

Pereon. Gnathopod 1 (Fig. 3D, E) length ratio from basis to dactylus 2.6:1:1:1.7:1.8; coxa 2× as broad as deep, carpus subequal length to propodus, lobate posterior margin with setae and plumose setae, anterior margin less setae; propodus oval, length 1.7× the width, posterior margin with setae and plumose setae, palm oblique, serrated and with setae; dactylus well developed, palmar margin serrated, crenulated posterior margin with one robust seta. **Gnathopod 2** (Fig. 3F, G) carpocheate, length ratio from basis to dactylus 3:1:2:3.5:3:2.5; coxa broader than deep, subequal to coxa 1; basis longer than wide, with 2 marginal setae on anterior margin; carpus massive, length 1.6× the width, palm margin transverse with long posterior defining tooth and well-developed anterodistal recurved spine adjacent to propodus articulation; propodus length 2× the width, with two acute spines and 1 rounded projection on posterior margin, with long setae on anterior and posterior margins; dactylus length 3× the width, with long setae on posterior margin and one seta on anterior margin.

Pereopod 3 (Fig. 4A) length ratio from basis to dactylus 14:6:4.5:4:5.5:3.5; coxa 2.2× as broad as deep, with 2 anterodistal setae; basis length 2.2× the width, anterior margin with 10 setae; merus with 3 anterodistal setae and 3 posterodistal plumose setae; carpus with 2 anterodistal setae and 2 posterodistal setae; propodus with 3 anterodistal setae.

Pereopod 4 (Fig. 4B) length ratio from basis to dactylus 12.5:6.5:6:4:5:3; coxa 1.8× as broad as deep, with a anterodistal seta; basis, length 1.9× the width, anterior margin with 8 setae; ischium subequal to merus, with 4 posterodistal setae; merus without ridges, with a posterodistal plumose seta; carpus with an anterodistal seta and 2 posterodistal setae; propodus with 4 posteromarginal setae; dactylus with unguis.

Pereopod 5 (Fig. 4C) length ratio from basis to dactylus 8:3:4.5:3:5.5: 3; coxa 1.2× as broad as deep; basis globular, length equals to width; ischium subrectangular; merus posterior lobe with 1 plumose seta, smaller anterior lobe with 1 seta; carpus smaller than merus, posterior lobe with fine hair, bearing a seta; propodus subovate; dactylus unguis with 2 accessory hooks.

Pereopod 6 (Fig. 4D) length ratio from basis to dactylus 8.5:2:4:3:5:3; coxa lobate, about 1.3× as broad as deep; basis length 1.6× the width, with setae on posterior margin; ischium subrectangular, length 1.25× width; merus 2.1× as long as broad with distal setae on both sides; carpus as long as broad, with 3 long setae on anterodistal corner and 2 long setae on posterodistal corner; propodus with 2 anterodistal long setae and 1 short marginal seta; dactylus unguis with 2 accessory hooks, with 1 seta on anterior side.

Pereopod 7 (Fig. 4E) length ratio from basis to dactylus 9:3:5:3:5:3; coxa lobate, about 1.6× as broad as deep; basis length 2.25× the width, with setae on anterior margin; ischium subrectangular, length 1.5× the width; merus 2× as long as broad with distal long setae on both sides; carpus as long as broad, with 1 marginal seta and 3 long setae on anterodistal corner and 3 long setae on posterodistal corner; propodus with 3 marginal setae on both sides and 8 long posterodistal setae; dactylus unguis with 2 accessory hooks.

Pleon. Pleopods 1 to 3 decreasing in size. **Pleopod 1** (Fig. 5A) peduncle bearing 2 retinacula, without setae; outer ramus slightly shorter than inner ramus, with 6 articles; outer ramus broader than inner ramus, with 2 articles, first article is the largest. **Pleopod 2** (Fig. 5B) peduncle with 2 retinacula, without setae; outer ramus 3.1× as long as inner ramus, with a single article; inner ramus reduced, 1.6× as long as broad, 1 plumose seta and single article. **Pleopod 3** (Fig. 5C) peduncle with 2 retinacula, without plumose setae distomarginally; outer ramus 3× as long as inner ramus; single article; inner ramus reduced, about 1.75× as long as broad, single article with 1 plumose seta.

Urosome. (Fig. 5D) **Uropod 1** (Fig. 5E) biramous; peduncle 2.1× as long as wide, with 3 dorsodistal setae; outer ramus shorter than peduncle, 1.5× longer than inner ramus, with outer row of spinules and 1 large apical robust seta, inner ramus with a large apical robust seta, corona of short robust setae surrounding large terminal robust seta.

Uropod 2 (Fig. 5D) uniramous; peduncle 3.75× as long as broad, 6.3× as long as vestigial ramus; ramus with 1 row of short setae and a terminal seta. **Uropod 3** (Fig. 5D) uniramous; peduncle 2.7× as long as wide, with

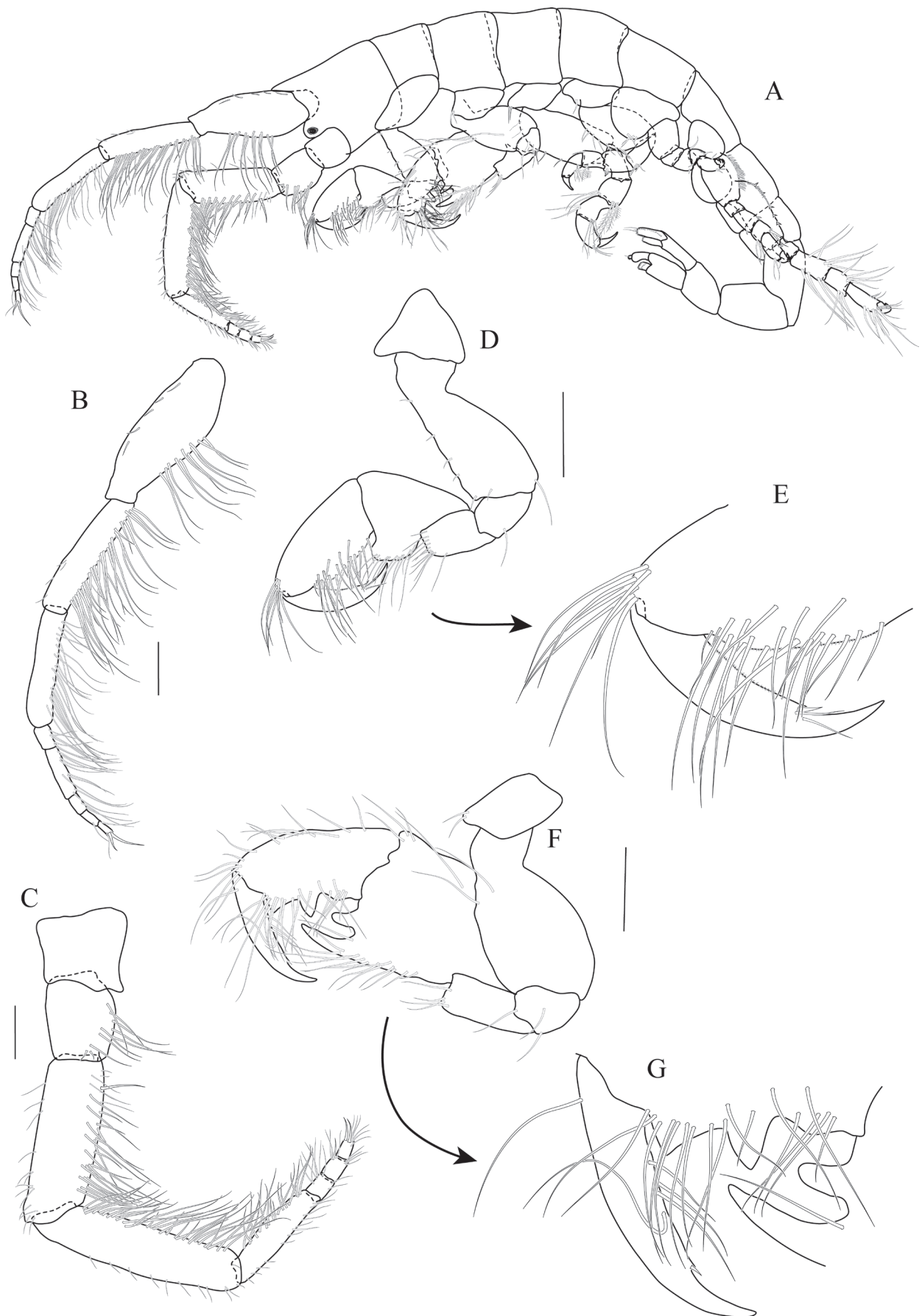


Figure 3. *Cerapus rivulus* sp. nov., holotype, male (THNHM -19377). **A.** Habitus of the male holotype; **B.** Antenna 1; **C.** Antenna 2; **D.** Gnathopod 1; **E.** Palm of gnathopod 1; **F.** Gnathopod 2; **G.** Palm of gnathopod 2. Scale bars: 0.2 mm.



Figure 4. *Cerapus rivulus* sp. nov., holotype, male (THNHM -19377). **A.** Pereopod 3; **B.** Pereopod 4; **C.** Pereopod 5; **D.** Pereopod 6; **E.** Pereopod 7. Scale bars: 0.2 mm.

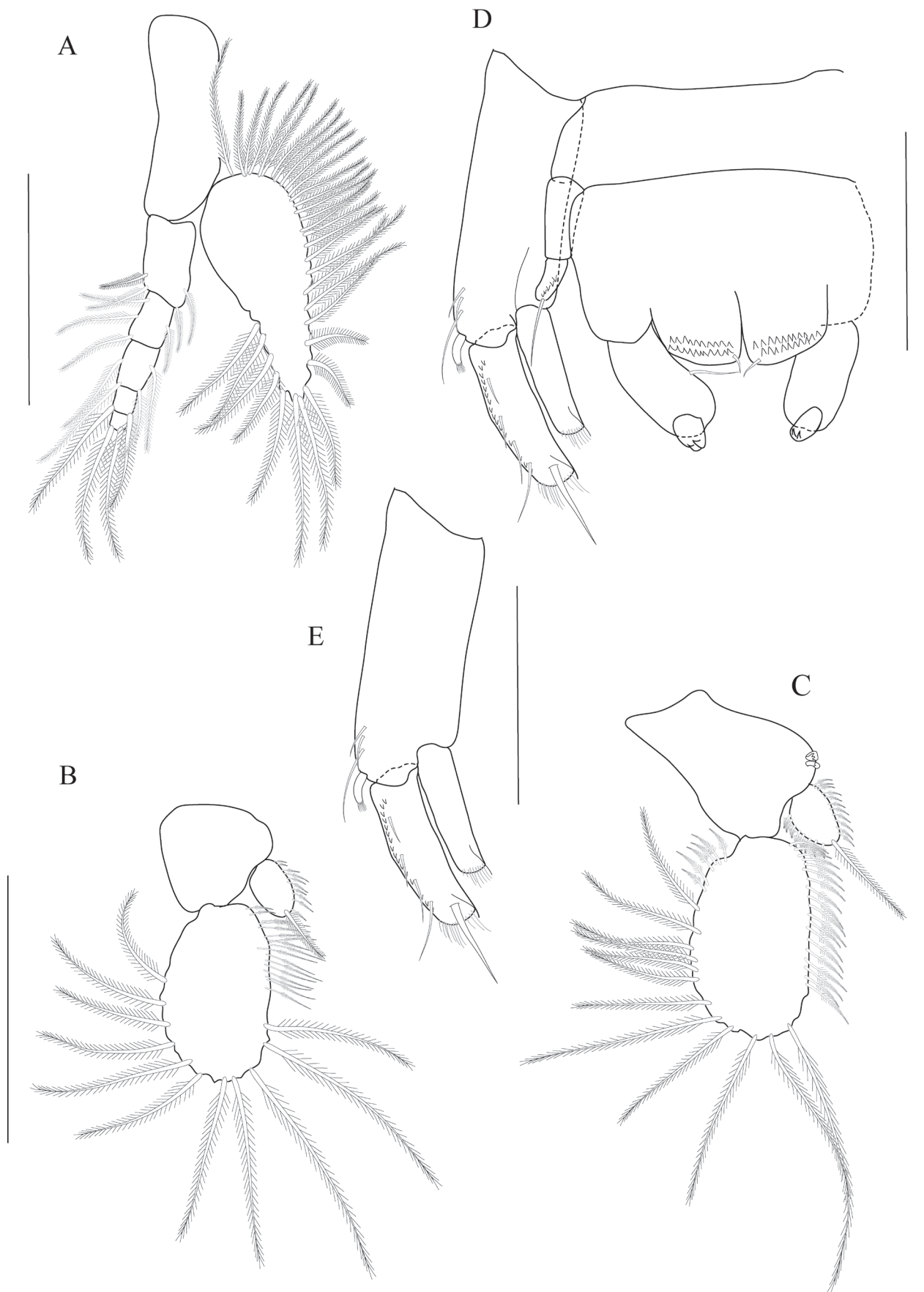


Figure 5. *Cerapus rivulus* sp. nov., holotype, male (THNHM -19377). **A.** Pleopod 1; **B.** Pleopod 2; **C.** Pleopod 3; **D.** Uropods 1–3 and Telson; **E.** Uropod 1. Scale bars: 0.1 mm.



Figure 6. *Cerapus rivulus* sp. nov., holotype, male (THNHM -19377). **A.** Left mandible; **B.** Right mandible; **C.** Maxilliped; **D.** Maxilla 2; **E.** Maxilla 1; **F.** Upper lip; **G.** Lower lip. Scale bars: 0.1 mm.

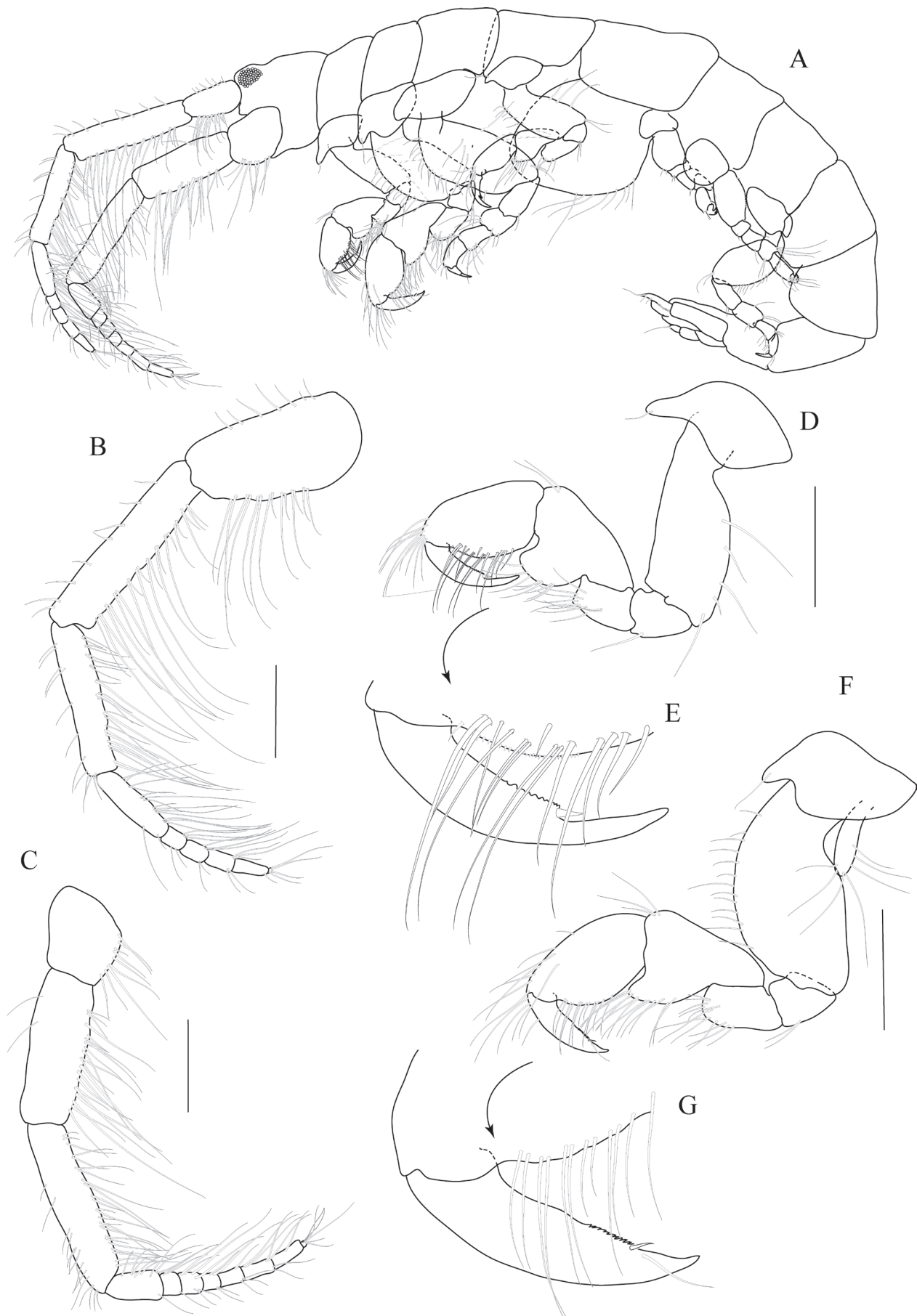


Figure 7. *Cerapus rivulus* sp. nov., paratype, female (THNHM -19379). **A.** Habitus of the female paratype; **B.** Antenna 1; **C.** Antenna 2; **D.** Gnathopod 1; **E.** Palm of gnathopod 1; **F.** Gnathopod 2; **G.** Palm of gnathopod 2. Scale bars: 0.2 mm.

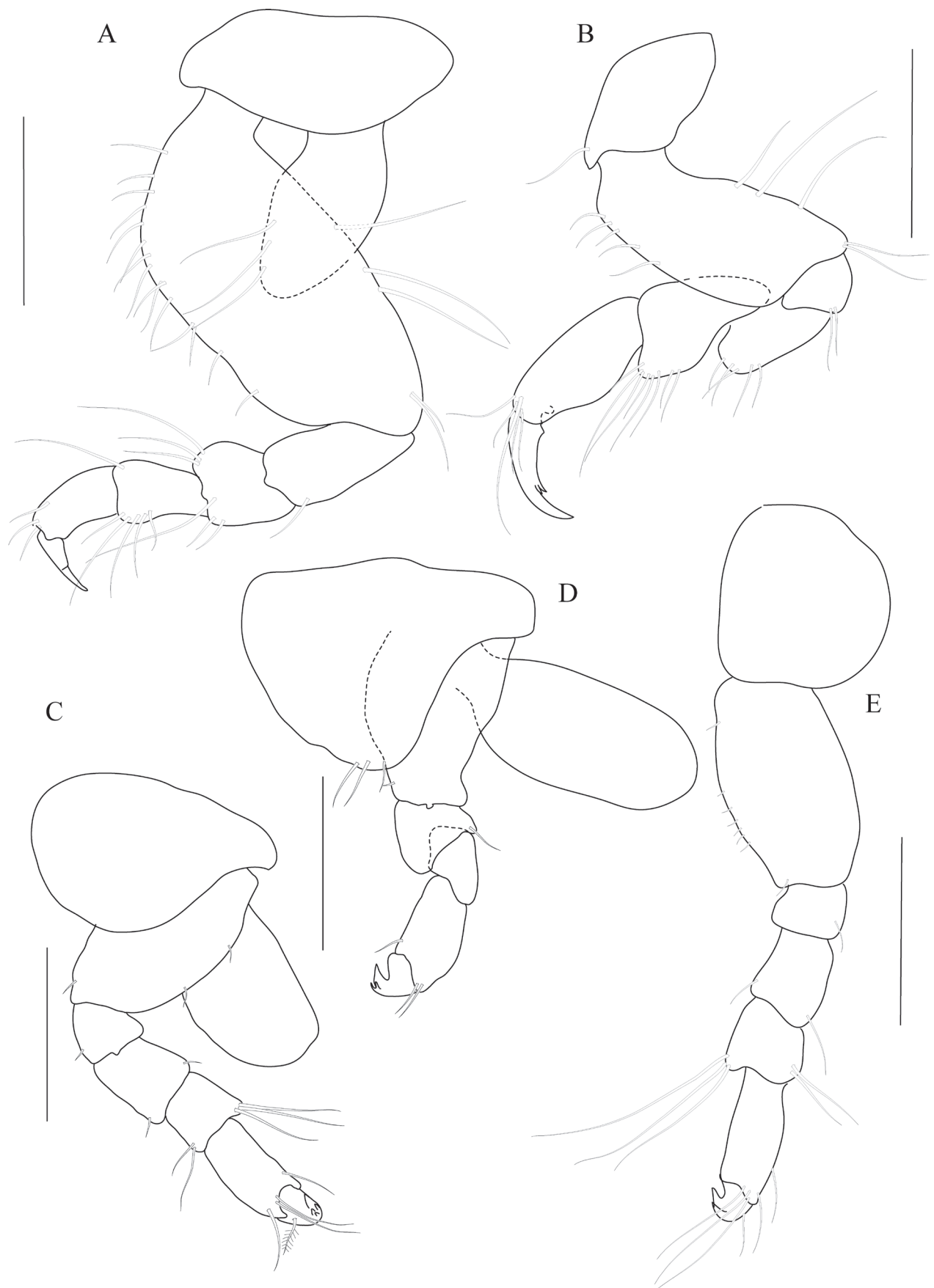


Figure 8. *Cerapus rivulus* sp. nov., paratype, female (THNHM -19379). **A.** Pereopod 3; **B.** Pereopod 4; **C.** Pereopod 5; **D.** Pereopod 6; **E.** Pereopod 7. Scale bars: 0.2 mm.

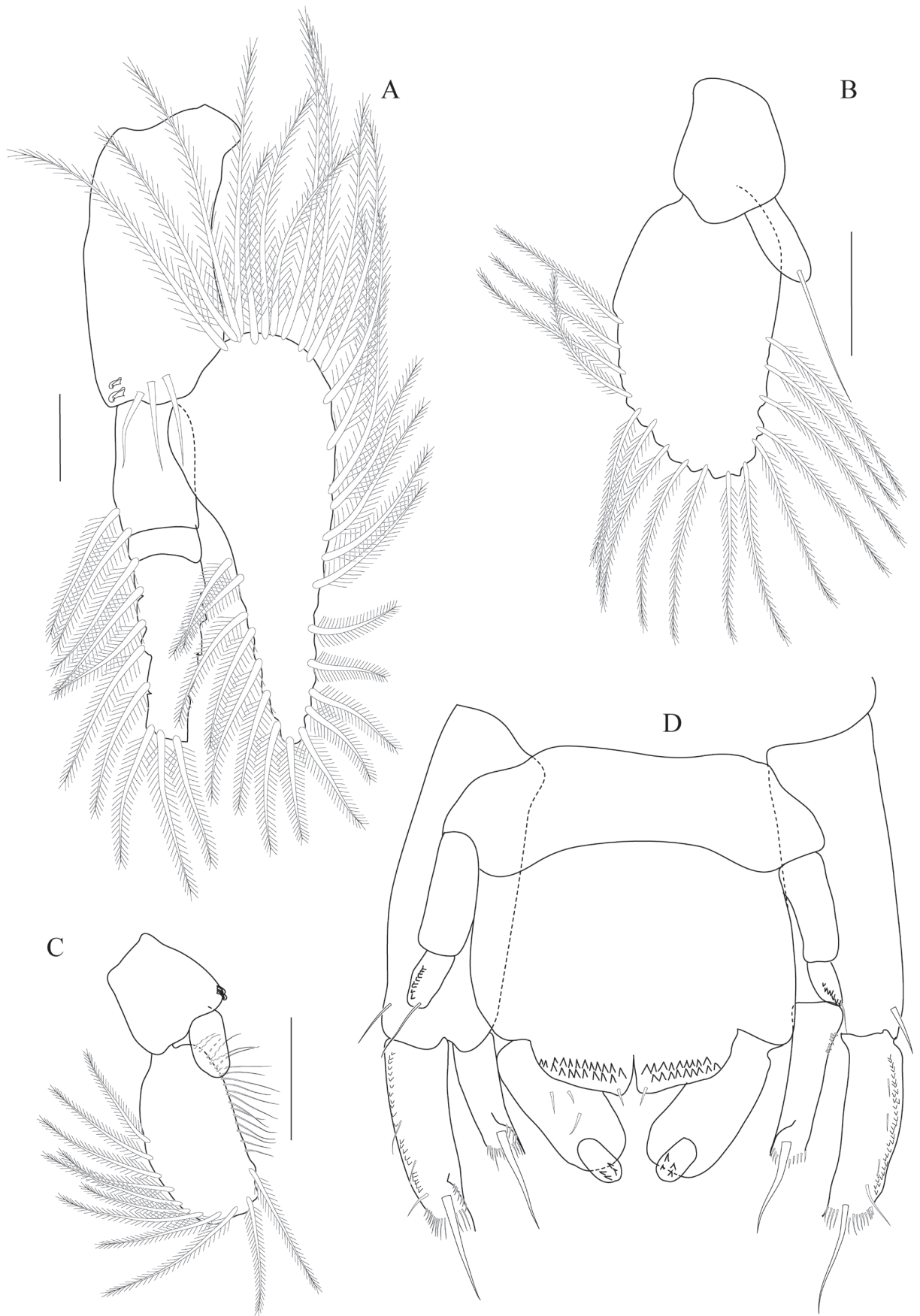


Figure 9. *Cerapus rivulus* sp. nov., paratype, female (THNHM -19379). **A.** Pleopod 1; **B.** Pleopod 2; **C.** Pleopod 3; **D.** Uropods 1–3 and Telson. Scale bars: 0.1 mm (**A–C**); 0.2 mm (**D**).

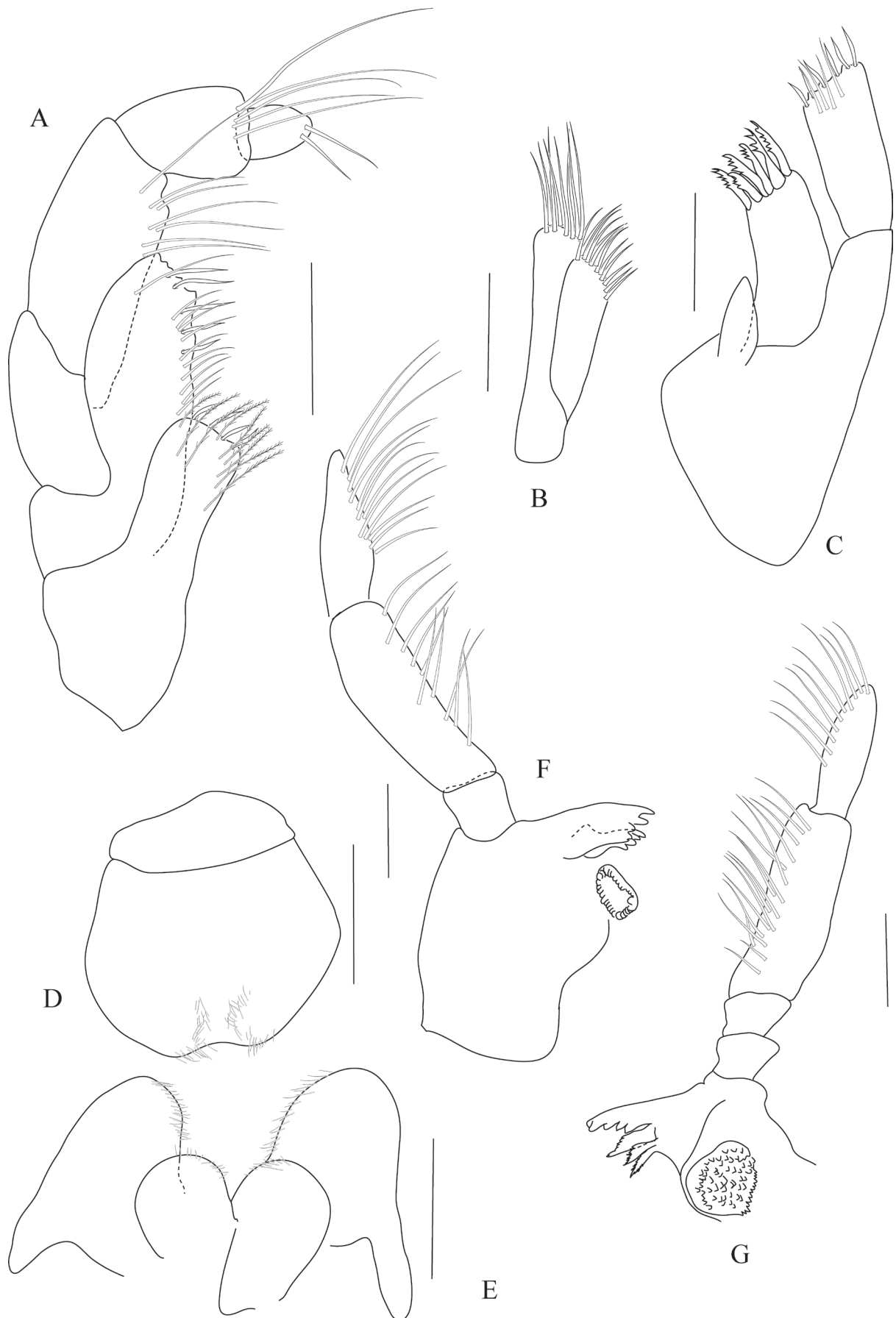


Figure 10. *Cerapus rivulus* sp. nov., paratype, female (THNHM-19379). **A.** Maxilliped; **B.** Maxilla 2; **C.** Maxilla 1; **D.** Upper lip; **E.** Lower lip; **F.** Left mandible; **G.** Right mandible. Scale bars: 0.2 mm.

one seta on inner margin; ramus vestigial, inconspicuously small with 2 hooks. **Telson** (Fig. 5D) deeply cleft, $0.5\times$ the length of uropod 3, each lobe with 19 or 20 recurved hooks in two rows and an apical seta.

Female (Figs 7–10) (Sexually dimorphic characters). Based on allotype (THNHM-iv-19379), length 3.5 mm (Fig. 7A). Similar to male, except for the following: **Antenna 1** (Fig. 7B) with fewer setae and fewer aesthetascs. **Antenna 2** (Fig. 7C) more slender than in male. **Gnathopod 1** (Fig. 7D, E) dactylus posterior margin serrated, with one spine. **Gnathopod 2** (Fig. 7F, G) slightly larger than gnathopod 1; carpus triangular, posterodistal corner with plumose setae and normal setae; propodus palm not serrated, with plumose setae and simple setae; dactylus posterior margin crenulated. **Pereopod 5** (Fig. 8C) coxa larger, about $2.7\times$ as broad as deep, about $6.3\times$ longer than the basis width; basis slightly globular; dactylus with 2 accessory hooks; with a pair of oostegites on each segment from 4 to 6.

Remarks. *Cerapus rivulus* sp. nov. is similar to *C. nudus* and *C. longirostris* which has synapomorphic character states, such as: (1) pereonites 1–2 without constriction; (2) pereopod 5 merus without plumose seta on posterior lobe; (3) pereopod 6 coxa without setae on ventral margin; (4) uropod 1 without hook on ventrodistal margin. They are distinguished by the following: (1) head subequal in length to pereonites 1 + 2 [*C. nudus* longer than pereonites 1 + 2, *C. longirostris* subequal to pereonites 1 + 2]; (2) gnathopod 2 propodus twice as long as wide [*C. nudus* and *C. longirostris* less than twice as long as wide]; (3) telson deeply cleft ($> 50\%$) [*C. nudus* and *C. longirostris* semi-cleft]; (4) telsonic lobe with 19–20 hooks in two transverse rows [*C. nudus* with ten recurved hooks on three transverse rows and *C. longirostris* with eight recurved hooks on two transverse rows].

This study brings the number of identified *Cerapus* species from Southeast Asia to seven. *Cerapus rivulus* sp. nov. can be separated from Southeast Asian congeners by a combination of characteristics as follows (other species in parentheses): absence of constriction between pereonite 1 and 2 (present in *C. yuyatalay*, *C. bumbumiensis* and *C. longicervicum*); antenna 1 peduncular article 1 shorter than article 3 (longer in *C. chaomai*, *C. bumbumiensis* and *C. longicervicum*); gnathopod 2 propodus with tooth in male (without tooth in *C. chaomai*, *C. yuyatalay*, *C. bumbumiensis* and *C. longicervicum*); telson fused with pleonite 3 (not fused in *C. yuyatalay*, *C. bumbumiensis*, and *C. longicervicum*); telson with more than ten hooks (fewer than ten in *C. bumbumiensis*).

C. tubularis was described from Long Island Sound, New York, U.S.A. and after that reported in Japan by Morino (1976). However, Lowry and Berents (1989) re-described *C. tubularis* and excluded the record of Morino (1976). Lastly, White (2015) reported *Cerapus* sp. in Singapore and noted that the amphipod resembles *C. tubularis* and possibly was introduced to Singapore. The presence of *C. tubularis* in the eastern Pacific and South China Sea is still unclear and needs clarification.

Geographic distribution. The *Cerapus* are distributed worldwide and mainly inhabit marine and brackish water (Fig. 11) (Lowry and Thomas 1991; Lowry and Berents 2002; Drumm 2018; Nurshazwan et al. 2020). Interestingly, *C. rivulus* sp. nov. was found in freshwater and brackish water (salinity less than 3 ppt), so this is the first report for freshwater habitats. They were dominant in the coarse filter substrate used for benthos sampling because the tubes are retained on the coarse filter.

Biological notes. Generally, tube-building amphipods build tubes using amphipod silk which is observed as silk strands adhering to the tip of the dactylar surface close to the pore on P3 and P4 (Kronenberger et al. 2012).

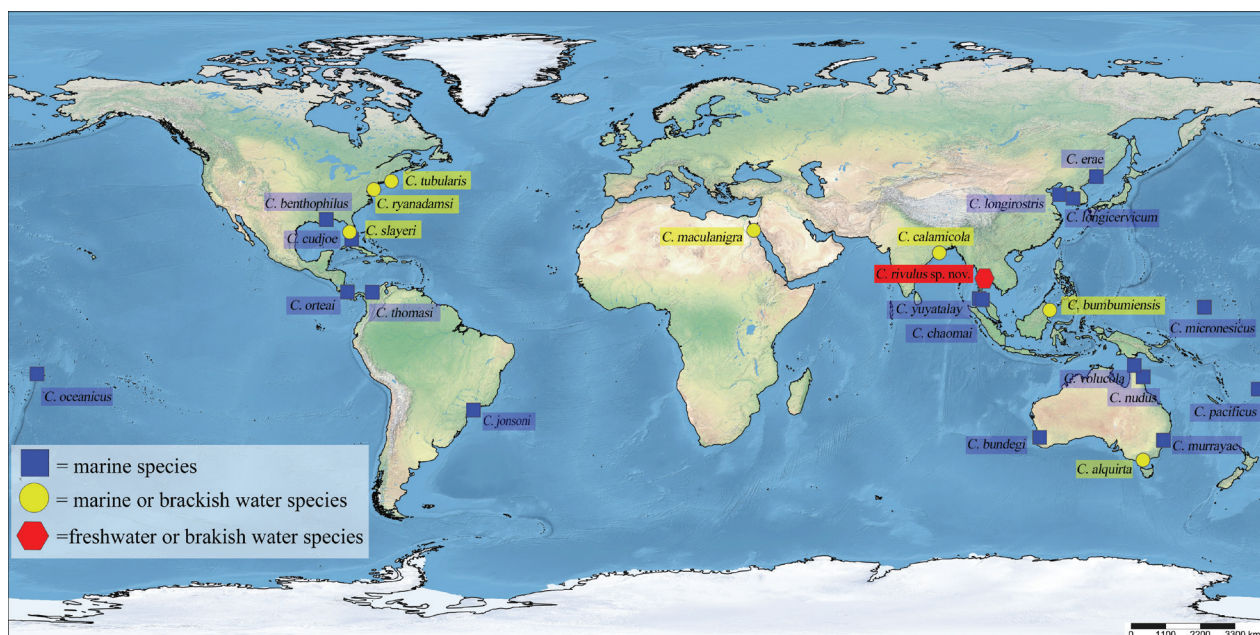


Figure 11. Distribution of *Cerapus* spp.

Cerapus rivulus sp. nov. also presents this characteristic (Fig. 12). The outer surface of the tube consists of uniformly coarse sediment and detritus with a mix of fragmented fibres and algae (Fig. 2) (small tubes of juvenile attached to the larger tube) (Fig. 13A–D); the inner surface, on the other hand, exhibits a fine network of amphipod silk. Laboratory observations on *C. rivulus* sp. nov.: feeding behaviour, both antennae 1 and 2 were used to gather food and move chunks of organic material back inside their tube. From the gut con-

tent analysis, the major food items consist of fungus, algae, diatoms, organic substances and protozoa. Moreover, mating behaviour showed that males wander about the habitat investigating the tube of female individuals. During these encounters, males try to contact females with their antennae. After that, females withdraw the posterior part of the body into their tubes, while males use their urosome to stimulate the ventral surface of the female pleosome. These situations are assumed to be a possible prelude to mating (Fig. 14).

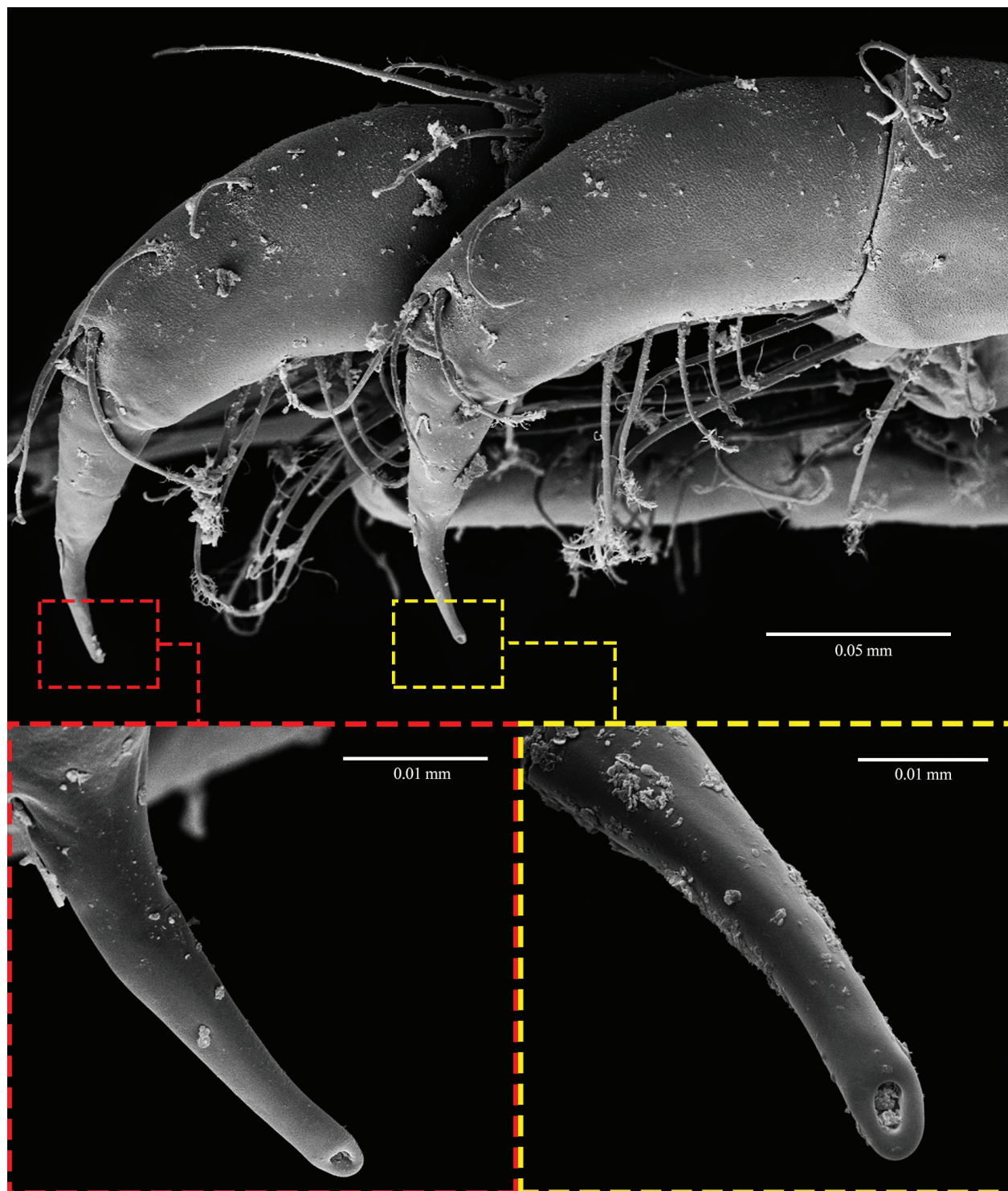


Figure 12. Distal end of P3 and P4 of *Cerapus rivulus* sp. nov. Red dash line represents distal end of P3 dactylus with amphipod silk opening and yellow dash line represents distal end of P4 dactylus with amphipod silk opening.

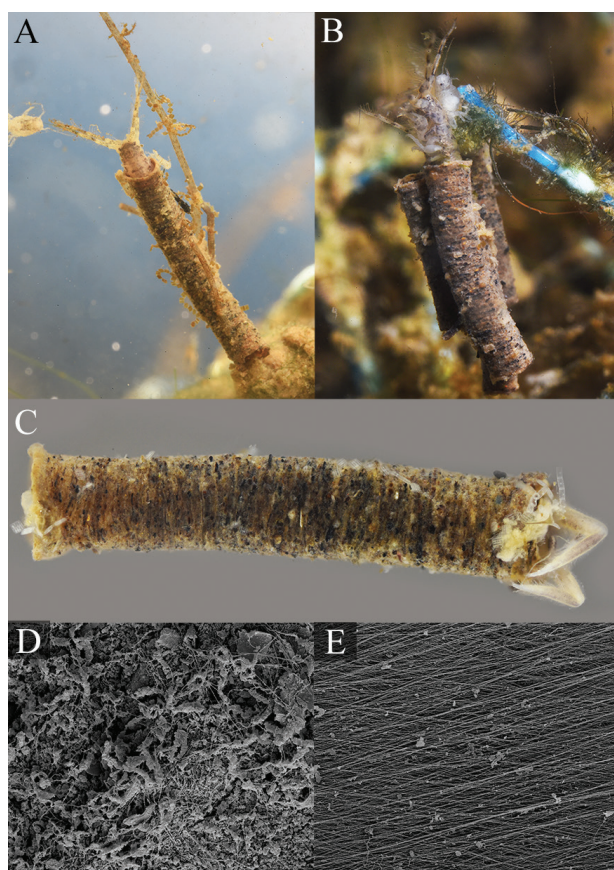


Figure 13. *Cerapus rivulus* sp. nov. **A.** Showing a mix of fragmented fibres and algae on its tube; **B.** Showing small tubes of juvenile attached on the larger tube; **C.** Uniformly coarse sediment on the outer surface of the tube; **D.** Ultrastructure of uniformly coarse sediment on the outer surface of the tube (scanning electron microscope); **E.** Ultrastructure of fine network of amphipod silks on the inner surface of the tube (scanning electron microscope).

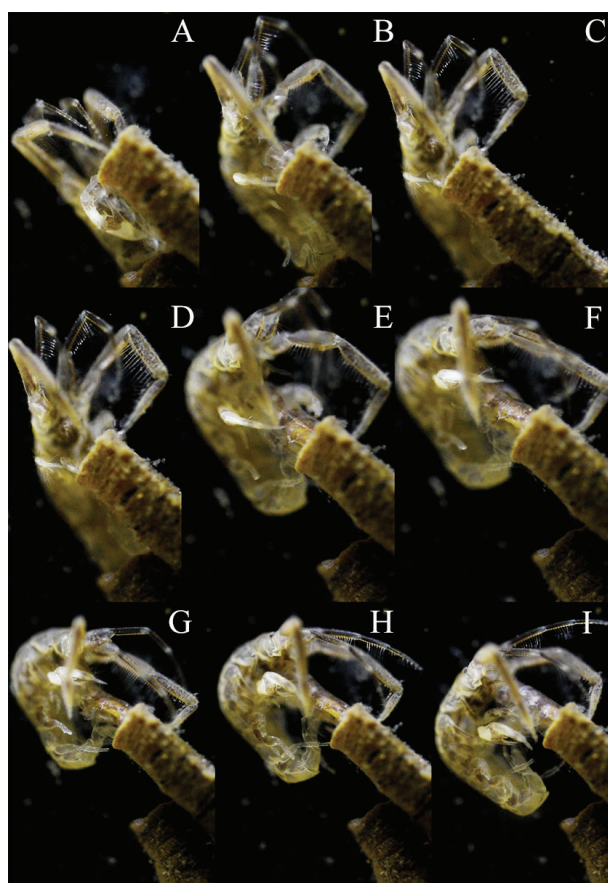


Figure 14. Series of mating of *Cerapus rivulus* sp. nov. (created from video of Suppl. material 1).

Key to world species of *Cerapus*

1	Uropod 1 with conspicuously large lateral peduncular hook on ventrodiscal margin.....	2
–	Uropod 1 without hook on ventrodiscal margin	5
2(1)	Pereonites 1–2 with constriction	<i>C. cudjoe</i> Lowry & Thomas, 1991
–	Pereonites 1–2 without constriction.....	3
3(2)	Head longer than pereonite 1+2.....	<i>C. slayeri</i> Drumm, 2018
–	Head subequal in length to pereonites 1+2	4
4(3)	Rostrum well developed, more than 20% of head length; antennal flagella 1 and 2 conspicuously short, composed of two or three articles; telson with 11 or 12 recurved spines.....	<i>C. ryanadamsi</i> Drumm, 2018
–	Rostrum conspicuously short, less than 20% of head length; antennal flagella 1 and 2 long, composed of more than three articles; telson with 9 or 10 recurved spines	<i>C. thomasi</i> Ortiz & Lemaitre, 1997
5(1)	Pereonites 1–2 with constriction	6
–	Pereonites 1–2 without constriction.....	12
6(5)	Telson entirely cleft.....	7
–	Telson semi-cleft.....	8
7(6)	Antenna 2 shorter than antenna 1, peduncle article 4 shorter than 5	<i>C. micronesicus</i> Myers, 1995
–	Antenna 2 longer than antenna 1, peduncle article 4 longer than 5.....	<i>C. longicervicum</i> Lim, Park & Min, 2008
8(7)	Telson with deep cleft (> 50%).....	9
–	Telson with shallow cleft (< 45%).....	10
9(8)	Telsonic lobe with 3–5 recurved spines on two transverse rows	<i>C. bumbumiensis</i> Nurshazwan, Ahmad-Zaki & Azman, 2020
–	Telsonic lobe with 9–11 recurved spines on two transverse rows	<i>C. yuyatalay</i> Lowry & Berents, 2002

10(8)	Rostrum well developed, more than 20% of head length; antenna 2 longer than antenna 1; pereopod 5 merus without plumose seta on posterior lobe.....	<i>C. benthophilus</i> Thomas & Heard, 1979
–	Rostrum short, less than 20% of head length; antenna 2 shorter than antenna 1; pereopod 5 merus with more than one plumose seta on posterior lobe	11
11(10)	Pereopod 5 merus with three to six plumose setae at posterior lobe	<i>C. jonsoni</i> Valério-Berardo, Thiago de Souza & Waiteman Rodrigues, 2008
–	Pereopod 5 merus with seven to ten plumose setae at posterior lobe.....	<i>C. murrayae</i> Lowry & Berents, 2005
12(5)	Pereopod 6 coxa with long or short setae on ventral margin	13
–	Pereopod 6 coxa without setae on ventral margin	17
13(12)	Pereopod 5 merus without plumose seta on posterior lobe.....	<i>C. longirostris</i> Shen, 1936
–	Pereopod 5 merus with one or more than one plumose setae on posterior lobe.....	14
14(13)	Pereopod 5 with one plumose seta on posterior lobe.....	<i>C. chaomai</i> Lowry & Berents, 2002
–	Pereopod 5 merus with more than one plumose seta on posterior lobe.....	15
15(14)	Male gnathopod 2 palm without inner tooth	<i>C. pacificus</i> Lowry, 1985
–	Male gnathopod 2 palm with inner tooth	16
16(15)	Pereopod 5 merus with two plumose setae at posterior lobe.....	<i>C. calamicola</i> (Giles, 1885)
–	Pereopod 5 merus with three to six setae at posterior lobe.....	<i>C. erae</i> Bulyčeva, 1952
17(12)	Pereopod 5 merus without plumose seta on posterior lobe.....	18
–	Pereopod 5 merus with one or more than one plumose setae on posterior lobe.....	20
18(17)	Rostrum conspicuously short; pereopod 5 merus with one seta at posterior lobe.....	<i>C. rivulus</i> sp.nov.
–	Rostrum well developed; pereopod 5 merus without setae at posterior lobe.....	19
19(18)	Telsonic lobe with ten recurved hooks on three transverse rows	<i>C. nudus</i> Just, 2009
–	Telsonic lobe with eight recurved hooks on two transverse rows.....	<i>C. longirostris</i> Shen, 1936
20(17)	Pereopod 5 merus with one plumose seta on posterior lobe	<i>C. alquirta</i> (Barnard & Drummond, 1981)
–	Pereopod 5 merus with more than one plumose setae on posterior lobe	21
21(20)	Pereopod 7 basis with spines along posteroproximal margin	<i>C. tubularis</i> Say, 1817
–	Pereopod 7 basis without spines along posteroproximal margin	22
22(21)	Telson entirely cleft.....	23
–	Telson semi-cleft.....	24
23(22)	Rostrum well developed; antenna 2 longer than antenna 1	<i>C. oceanicus</i> Lowry, 1985
–	Rostrum conspicuously short; antenna 1 longer than antenna 2	<i>C. erae</i> Bulyčeva, 1952
24(22)	Telson with 6–7 longitudinal rows of spines.....	<i>C. ortei</i> Ortiz & Thomas, 2007
–	Telson with two transverse rows of spines.....	25
25(24)	Antenna 2 longer than antenna 1	<i>C. maculanigra</i> Zeina & Asakura, 2017
–	Antenna 1 longer than antenna 2	26
26(25)	Pereopod 5 merus with two plumose setae at posterior lobe.....	<i>C. volucola</i> Lowry & Berents, 2005
–	Pereopod 5 merus with four plumose setae at posterior lobe.....	<i>C. bundegi</i> Lowry & Berents, 2005

Acknowledgements

The authors thank Kasetsart University for providing a Master's degree student scholarship through the Biodiversity Center Kasetsart University. This project is funded by the National Research Council of Thailand (NRCT) (Grant no. N25A660322). In remembrance and thanks also to Assistant Professor Pongrat Dumrongrojwattana for his invaluable advice on the nomenclature of the new taxa. We are grateful to Ms. Nattavadee Tipsut for provided information of gut contents in this study. We express our gratitude to Dr. Alan Myers, Dr. Jesser Fidelis de Souza Filho and Dr. Penny Berents for their valuable evaluations of a previous draft of the manuscript. Furthermore, we extend our appreciation to Dr. Luiz F. Andrade, the subject editor, for promptly facilitating and overseeing the publication process in a gracious manner. We thank the Department of Zoology, Faculty of Science, Kasetsart University, for the laboratory facilities.

References

- Aikins S, Kikuchi E (2001) Studies on habitat selection by amphipods using artificial substrates within an estuarine environment. *Hydrobiologia* 457(1/3): 77–86. <https://doi.org/10.1023/A:1012261116232>
- Azman AR, Sivajothy K, Shafie BB, Ja'afar N, Wongkamhaeng K, Bussarawit S, Alip AE, Lee YL, Metillo EB, Won MEQ (2022) The amphipod (Crustacea: Peracarida) of the Southeast Asia and the neighbouring waters: an updated checklist with new records of endemic species. *Research Bulletin - Phuket Marine Biological Center* 79(1): 42–84.
- Barnard JL, Drummond MM (1981) Three corophioids (Crustacea, Amphipoda) from Western Port, Victoria. *Proceedings of the Royal Society of Victoria* 93(1–2): 31–41.
- Berents PB, Lowry JK (2018) The new crustacean amphipod genus *Kapalana* from Australian waters (Senticaudata, Ischyroceridae, Ischyrocerinae, Cerapodini). *Records of the Australian Museum* 70(4): 391–421. <https://doi.org/10.3853/j.2201-4349.70.2018.1711>

- Boeck A (1871) Crustacea Amphipoda borealia et arctica. Forhandlinger Videnskabs-Selskabet i Christiania 1870: 81–280. <https://doi.org/10.5962/bhl.title.2056>
- Bulyčeva AI (1952) Novye vidy bokoplavov (Amphipoda, Gammaridea) iz Japonskogo Morja. Trudy Zoologicheskogo Instituta Akademii Nauk S.S.S.R. 12: 195–250. [Nouvelles espèces amphipodes (Amphipoda, Gammaridea) de la Mer du Japon]
- Coleman C (2003) “Digital inking”: How to make perfect line drawings on computers. *Organisms, Diversity & Evolution* 3(4): 1–14. <https://doi.org/10.1078/1439-6092-00081>
- Drumm DT (2018) Two new species of *Cerapus* (Crustacea: Amphipoda: Ischyroceridae) from the Northwest Atlantic and Gulf of Mexico. *Zootaxa* 4441(3): 495–510. <https://doi.org/10.11646/zootaxa.4441.3.4>
- Giles GM (1885) Natural history notes from H.M.’s Indian marine survey steamer “Investigator”, commander Alfred Carpenter, R.N. commanding. N° 1. On the structure and habits of *Cyrtophium calamicola*, a new tubicolous amphipod from the Bay of Bengal. *Journal of the Asiatic Society of Bengal* 54: 54–59.
- Just J (2009) Ischyroceridae. In: Lowry JK, Myers AA (Eds) Benthic Amphipoda (Crustacea: Peracarida) of the Great Barrier Reef, Australia. *Zootaxa* 2260: 1–930. <https://doi.org/10.11646/zootaxa.1980.1.1>
- Kronenberger K, Moore PG, Halcrow K, Vollrath F (2012) Spinning a Marine Silk for the Purpose of Tube-Building. *Journal of Crustacean Biology* 32(2): 191–202. <https://doi.org/10.1163/193724011X615532>
- Lim B, Park J, Min G (2008) A New Species of *Cerapus* from Korea (Crustacea: Amphipoda: Ischyroceridae). *Animal Systematics, Evolution and Diversity* 24(1): 9–16. <https://doi.org/10.5635/KJSZ.2008.24.1.009>
- Lowry JK (1985) Two new species of *Cerapus* from Samoa and Fiji (Crustacea: Amphipoda: Ischyroceridae). *Records of the Australian Museum* 36(4): 157–168. <https://doi.org/10.3853/j.0067-1975.36.1985.344>
- Lowry JK, Berents PB (1989) A redescription of *Cerapus tubularis* Say, 1818, based on material of the first reviewer, S.I. Smith, 1880, (Crustacea: Amphipoda: Corophioidea). *Journal of Natural History* 23: 1341–135. <https://doi.org/10.1080/00222938900770711>
- Lowry JK, Berents PB (1996) The *Erichthonius* group, a new perspective on an old problem (Crustacea: Amphipoda: Corophioidea). *Records of the Australian Museum* 48(1): 75–109. <https://doi.org/10.3853/j.0067-1975.48.1996.281>
- Lowry JK, Berents PB (2002) The genus *Cerapus* in the Andaman Sea (Crustacea, Amphipoda, Ischyroceridae). *Phuket Marine Biological Center Special Publication* 23: 189–196.
- Lowry JK, Berents PB (2005) Algal-tube Dwelling Amphipods in the Genus *Cerapus* from Australia and Papua New Guinea (Crustacea: Amphipoda: Ischyroceridae). *Records of the Australian Museum* 57(2): 153–164. <https://doi.org/10.3853/j.0067-1975.57.2005.1439>
- Lowry JK, Myers AA (2013) A phylogeny and classification of the Senticaudata subord. nov. (Crustacea: Amphipoda). *Zootaxa* 3610(1): 1–80. <https://doi.org/10.11646/zootaxa.3610.1.1>
- Lowry JK, Thomas JD (1991) A new species of *Cerapus* from Cudjoe Channel, Lower Florida Keys, USA, with notes on male behaviour (Crustacea: Amphipoda: Corophioidea). *Journal of Natural History* 25(6): 1461–1467. <https://doi.org/10.1080/00222939100770931>
- Morino H (1976) On two new forms of *Cerapus tubularis*, a tube dwelling Amphipoda, from shallow waters of Japan. *Publications of the Seto Marine Biological Laboratory* 23(1/2): 179–189. <https://doi.org/10.5134/175915>
- Myers AA (1995). Marine Amphipoda of Micronesia: Kosrae. *Records of the Australian Museum* 47: 27–38. <https://doi.org/10.3853/j.0067-1975.47.1995.4>
- Nurshazwan J, Ahmad-Zaki AB, Azman BAR (2020) A new species of *Cerapus* (Amphipoda: Senticaudata: Ischyroceridae) from Pulau Bum Bum, Sabah, Malaysia, with an identification key to *Cerapus* species. *Zootaxa* 4802(3): 519–533. <https://doi.org/10.11646/zootaxa.4802.3.7>
- Ortiz M, Lemaitre R (1997) Seven new amphipods (Crustacea: Peracarida: Gammaridea) from the Caribbean coast of South America. *Boletín de Investigaciones Marinas y Costeras* 26: 71–104. <https://doi.org/10.25268/bimc.invenmar.1997.26.0.365>
- Ortiz M, Thomas JD (2007) *Cerapus ortei* (Corophioidea: Corophiidae) a new amphipod crustacean from the Caribbean coast of Costa Rica. *Avicennia* 19: 17–24.
- Say T (1817) On a new genus of Crustacea, and the species on which it is established. *Journal of the Academy of Natural Sciences of Philadelphia* 1(4): 49–52.
- Shen CJ (1936) Description of a new tube-dwelling amphipod collected on the coast of Shantung peninsula. *Bulletin of the Fan Memorial Institute of Biology (Zoology)* 6: 265–273.
- Smith SI (1880) On the amphipodous genera, *Cerapus*, *Unciola*, and *Lepidactylis*, described by Thomas Say. *Transactions of the Connecticut Academy of Arts and Sciences* 4: 268–285.
- Souza-Filho JF, Serejo CS (2014) On the phylogeny of Ischyroceridae (Amphipoda, Senticaudata, Corophiida), with the description of a new genus and eight new species from deep-sea Brazilian waters. *Zoological Journal of the Linnean Society* 170(1): 34–85. <https://doi.org/10.1111/zoj.12099>
- Thomas JD, Heard RW (1979) A new species of *Cerapus* Say, 1817 (Crustacea: Amphipoda) from the northern Gulf of Mexico with notes on its ecology. *Proceedings of the Biological Society of Washington* 92(1): 98–105.
- Valério-Berardo MT, De Souza AMT, Rodrigues CW (2008) Description of two new species of Ischyroceridae (Crustacea: Amphipoda) from the coast of Southeastern Brazil. *Zootaxa* 1857(1): 55–65. <https://doi.org/10.11646/zootaxa.1857.1.5>
- White K (2015) A checklist of Amphipoda (Crustacea) collected from the mudflats of Pulau Ubin, Singapore. *The Raffles Bulletin of Zoology* 31: 139–142.
- Zeina A, Asakura A (2017) A new species of *Cerapus* Say, 1817 (Amphipoda: Ischyroceridae) from the Red Sea, with a key to the worldwide species of the genus. *Journal of Crustacean Biology* 37(3): 296–302. <https://doi.org/10.1093/jcbl/rux024>
- Zimmer A, Arriagada A, Bond Backup G (2009) Diversity and arrangement of the cuticular structures of *Hyalella* (Crustacea: Amphipoda: Dogielinotidae) and their use in taxonomy. *Zoologia* 26(1): 127–142. <https://doi.org/10.1590/S1984-46702009000100019>

Supplementary material 1

Video of mating of *Cerapus rivulus* sp. nov.

Authors: Chanikan Katnour, Tosaphol Saetung Keetapithchayakul, Azman Abdul Rahim, Koraon Wongkamhaeng

Data type: mp4

Copyright notice: This dataset is made available under the Open Database License (<http://opendatacommons.org/licenses/odbl/1.0/>). The Open Database License (ODbL) is a license agreement intended to allow users to freely share, modify, and use this Dataset while maintaining this same freedom for others, provided that the original source and author(s) are credited.

Link: <https://doi.org/10.3897/zse.99.107974.suppl1>

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Zoosystematics and Evolution](#)

Jahr/Year: 2023

Band/Volume: [99](#)

Autor(en)/Author(s): Katnoum Chanikan, Keetapithchayakul Tosaphol Saetung, Rahim Azman Abdul, Wongkamhaeng K.

Artikel/Article: [A new species of Cerapus \(Amphipoda, Senticaudata, Ischyroceridae\) from Mae Klong Estuary, with a discussion on their nesting and types of mating behaviour 557-574](#)