

Freshwater Shrimps from Karst Caves of Southern China, with Descriptions of Seven New Species and the Identity of *Typhlocaridina linyunensis* Li and Luo, 2001 (Crustacea: Decapoda: Caridea)

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Yixiong Cai and Peter Kee Lin Ng (2018) Seven new atyid shrimp species of the genus *Caridina* H. Milne Edwards, 1837 are described from southern China: *C. longshan* sp. nov., *C. alu* sp. nov., *C. spinicrus* sp. nov., *C. beiliu* sp. nov., *C. jiangkou* sp. nov., *C. guilin* sp. nov. and *C. laticarpalis* sp. nov. Descriptions and figures for all taxa are provided, and taxa are compared with their closest congeners. An updated list of all cave atyid and palaemonid shrimp species found in China is provided. *Caridina semiblepsia* Guo, Choy and Gui, 1996 is here regarded as a junior subjective synonym of *C. ablepsia* Guo, Jiang and Zhang, 1992. One poorly known species, *Typhlocaridina linyunensis* Li and Luo, 2001, described from a cave in Guangxi is here shown to be a palaemonid instead of an atyid, and is actually the senior synonym of *Macrobrachium linyunense* Li, Cai and Clarke, 2006.

Key words: Shrimp, Karst cave, Atyidae, Palaemonidae, *Caridina*, *Macrobrachium*, China.

BACKGROUND

Many atyid shrimps exclusively inhabit rivers or streams inside caves. These cave dwelling species, although relatively few in number, have long intrigued carcinologists (Holthuis 1956a, 1986a). The first subterranean shrimp species from China was described by Liang and Yan (1981), who reported a new troglotic genus and new species, *Typhlocaridina lanceifrons*, from Guangxi. In the last three decades, the exploration of the cave fauna in China has resulted in the discovery of 16 more species, all from southern China (cf. Pan et al. 2010).

Seven new species of *Caridina* were found as part of a taxonomic review of the atyid shrimps

of southern China. All were exclusively collected from karst cave streams in an environment of total darkness. These species are described here and added to the Chinese cave fauna.

Specimens are deposited in the following institutions: National Zoological Museum of China, Institute of Zoology, Chinese Academy of Sciences (IZCAS); Shanghai Ocean University (formerly Shanghai Fisheries University), Shanghai, China (SFU); Zoological Reference Collection, Lee Kong Chian Natural History Museum (formerly Raffles Museum of Biodiversity Research), National University of Singapore (ZRC); Muséum national d'Histoire naturelle, Paris, France (MNHN); Naturalis, National Museum of Natural History, Leiden, The Netherlands (formerly Rijksmuseum

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van Natuurlijke Historie, RMNH); and University of Ljubljana, Slovenia (UL). The abbreviation cl is used for carapace length (measured from the postorbital margin to the posterior margin of carapace). Rostral formula follows Chace and Bruce (1993).

TAXONOMY

Family Atyidae De Haan, 1849
Genus *Caridina* H. Milne Edwards, 1837

***Caridina longshan* sp. nov.**
 (Figs. 1-3)

urn:lsid:zoobank.org:act:866065C2-69B7-4EB1-9110-5B4A30487650

Material examined: Holotype: male, cl 8.0 mm, IZCAS DE 5028, stream at end of cave,

Panon Cave, Huaoyan Village, Longshan County, Hunan Province southern China, coll. Cao and B. Sket, 13 Apr 1997. Paratypes: 2 males, cl 6.6-9.0 mm; 1 female, cl 6.5 mm, ZRC 2018.0480, same data as holotype; 1 female, cl 7.0 mm, UL, same data as holotype; 1 female, cl 6.8 mm, RMNH.CRUS.D.57289, Cave of Flying Tiger, Hoyan Village, Longshan County, Hunan, coll. L. Deharveng and A. Bedos, 14 Aug 1995; 1 male, cl 8.8 mm, ZRC 2018.0489, 1 female, cl 7.4 mm, UL, Parking Cave, near Hoyan Village, coll. Canto and Delprat, 25 Aug 1995.

Comparative material examined: *Caridina cavaleriei cavaleriei* Bouvier, 1919 - Syntype 1 female, MNHN Na 689, Gan-chouen-fou, Kouy-Tcheou (Guizhou), China. *Caridina dentifrons* NK Ng and Cai, 2000 - Paratypes: 2 males, cl 4.7 mm, 1 female, cl 5.2 mm, ZRC 1997.593, Baijin Village, Huishui County, Guizhou Province, China, coll. 16 May 1983.

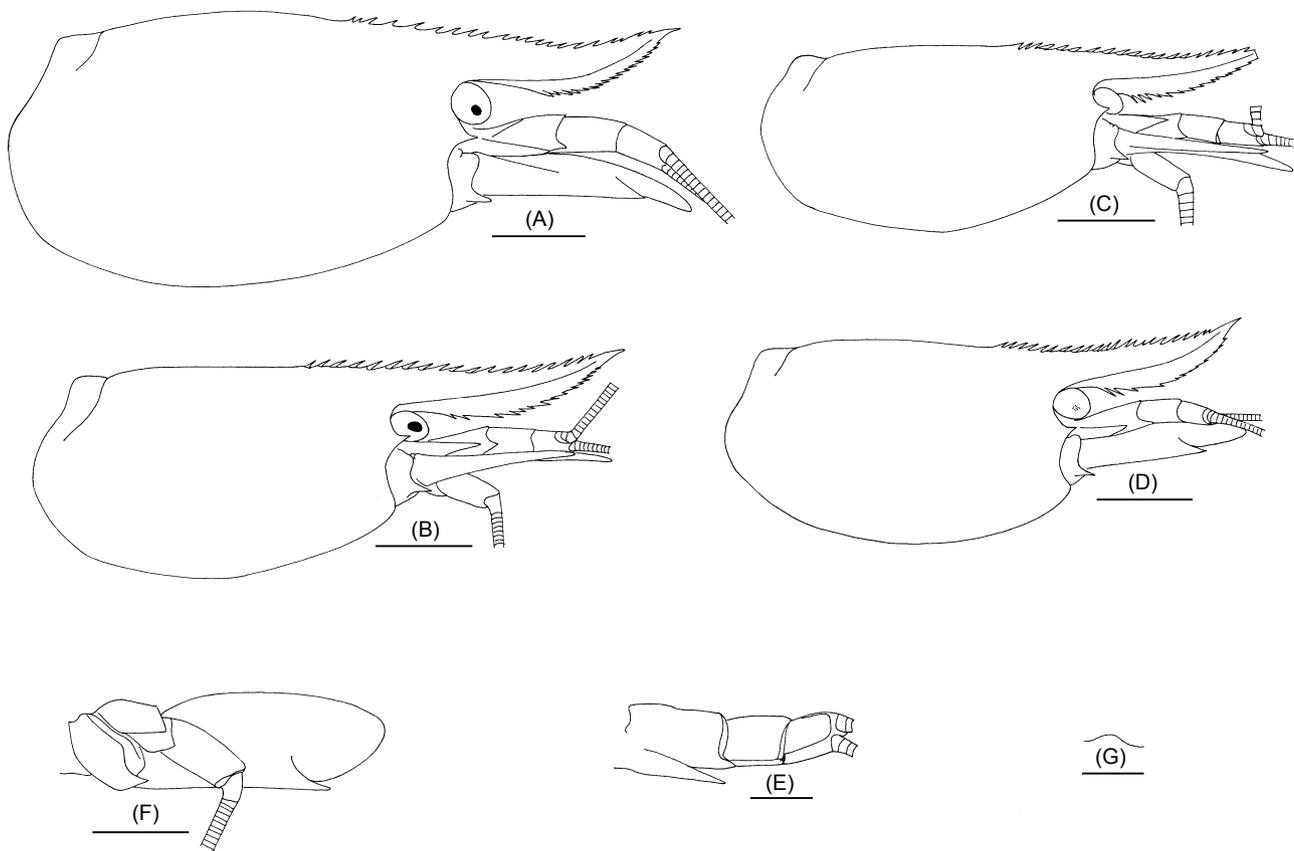


Fig. 1. *Caridina longshan* sp. nov. (A-D) cephalothorax and cephalic appendages, lateral view, (E) antennular peduncle, ventral view, (F) scaphocerite, (G) preanal carina. Scale bars: A-D, F = 2.0 mm; E = 1.0 mm; G = 0.5 mm. (A, E-G, male, cl 8.8 mm, Parking Cave, near Hoyan Village, Longshan County, paratype, ZRC 2018.0489; B, female, cl 7.4 mm, Parking Cave, near Hoyan Village, Longshan County, Hunan Province, paratype, UL; C, female, cl 6.5 mm, Panon Cave, Huaoyan Village, Longshan County, Hunan Province, paratype, ZRC 2018.0480; D, female, cl 6.8 mm, Cave of flying Tiger, Hoyan Village, Longshan County, Hunan Province, paratype, RMNHCRUS.D.57289).

Description: Rostrum long (Fig. 1A-D), reaching from end of antennular peduncle to end of scaphocerite, anterior half distinctly upturned, armed dorsally with 18-21 slender teeth, of which 6 or 7 teeth situated on carapace behind posterior margin of orbit, occupied 0.25-0.33 carapace length, armed ventrally with 12-17 teeth, of which posterior 4 or 5 teeth are wider separated than others. Antennal spine sharp, completely fused with suborbital angle; pterygostomial margin broadly rounded.

Sixth abdominal somite 1.8 times as long as fifth abdominal somite, as long as telson (Fig. 2K, L) without posteriomedian projection, lateral pair of spines on posterior margin longer than intermediate pairs, surface of proximal half covered by fine setae and spinules. Sublateral pair of spines shortest.

Eyes degenerated (Fig. 1A-D), eye stalk

absent, cornea pigmentation variable, from totally absent to with small black spot. Antennular peduncle slender (Fig. 1E), about half carapace length. Stylocerite sharp, long, reaching near end of basal segment of antennular peduncle. Scaphocerite 2.8 times as long as wide (Fig. 1F).

Mouthparts as figured. Mandible with blunt teeth at extremity of incisor process (Fig. 2A). Maxillula with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight, with dense setae and teeth (Fig. 2B). Maxilla with slender palp, upper endite subdivided, scaphognathite tapering with numerous long hooked setae posteriorly (Fig. 2C). Palp of first maxilliped stout, terminating in sub-acute angle (Fig. 2D). Endopod of second maxilliped with fused dactylus and propodal segments (Fig. 2E). Third maxilliped ending in single terminal claw; exopod reaching posterior quarter of penultimate segment

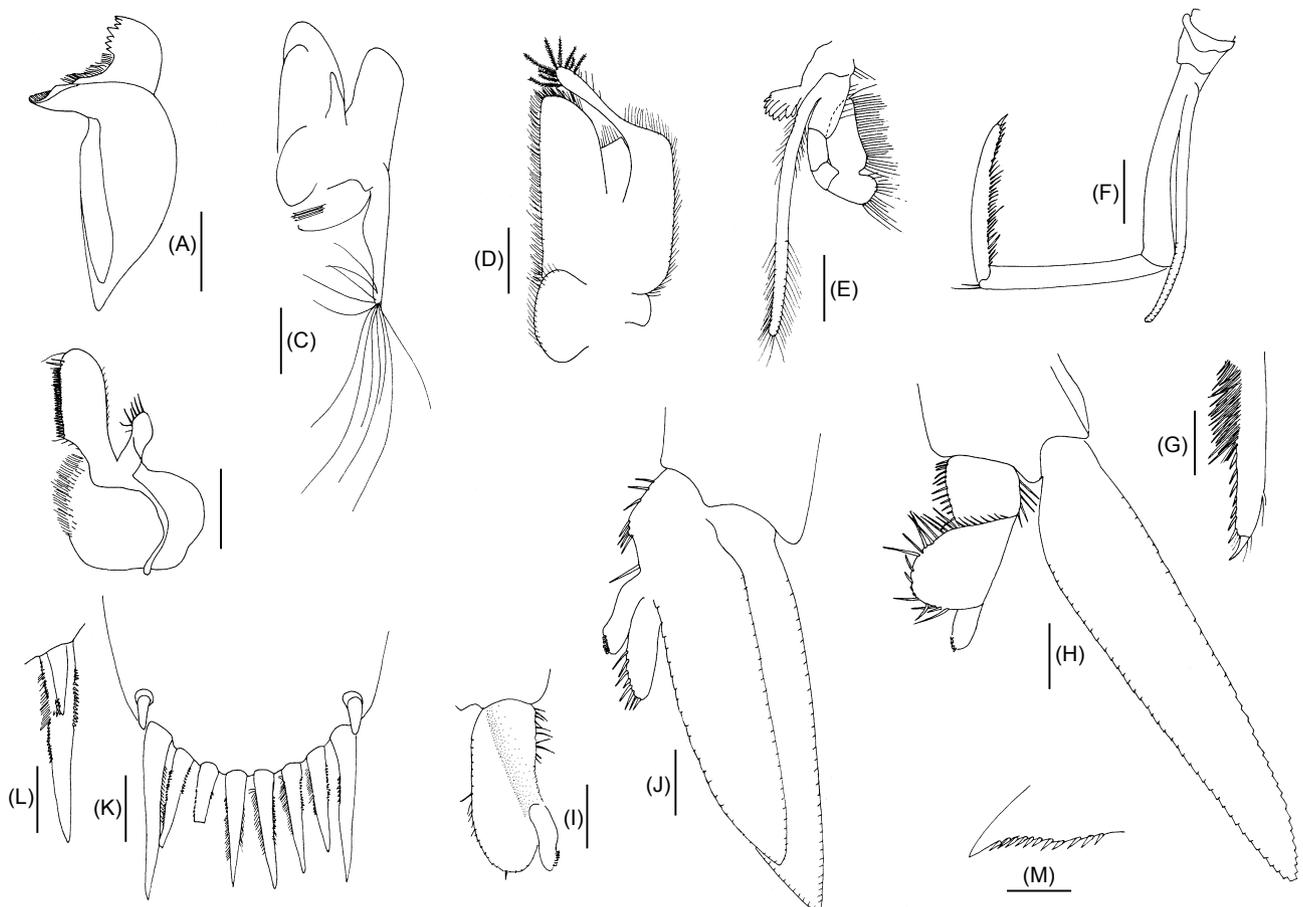


Fig. 2. *Caridina longshan* sp. nov. (A) mandible, (B) maxillula, (C) maxilla, (D) first maxilliped, (E) second maxilliped, (F) third maxilliped, (G) distal portion of third maxilliped, (H) male first pleopod, (I) endopod of male first pleopod, (J) male second pleopod, (K) distal portion of telson, (L) sublateral spine, right, (M) uropodal diaeresis. Scale bars: A-F = 1.0 mm; G-J, M = 0.5 mm; K = 0.2 mm; L = 0.1 mm. (A-G, K, L, female, cl 6.5 mm, Cave of Panon, Huaoyan Village, Longshan County, Hunan Province, Paratype, ZRC 2018.0480; H, J, cl 8.8 mm, male, Parking Cave, near Hoyan Village, Longshan County, paratype, ZRC 2018.0489).

(Fig. 2F, G). Epipods on first 4 pereopods.

First pereopod very stout (Fig. 3A), reaching to middle of basal segment of antennular peduncle; merus 3.0 times as long as wide, carpus 1.9 times as long as high; chela 2.7 times as long as broad, fingers 1.2 times as long as palm. Second pereopod (Fig. 3B) reaching to middle of second segment of antennular peduncle; merus as long as carpus; carpus longer than chela, 5.8 times as long as high; chela 3.1 times as long as broad; fingers 1.5 times as long as palm. Third pereopod (Fig. 3C, D) reaching with dactylus beyond the distal end of scaphocerite, propodus 12 times as long as wide, 4.3 times as long as dactylus (claw included); dactylus ending in 2 claws, with 7 or 8 accessory spines increasing in length and size distally on flexor margin. Fifth pereopod (Fig. 3E, F, G) reaching slightly beyond end of antennular peduncle but not beyond distal end of scaphocerite, propodus 15 times as long as wide, 3.2 times as long as dactylus; dactylus with 42-49

spinules on flexor margin.

Endopod of male first pleopod sub-elliptical (Fig. 2H, I), inner margin straight, reaching 0.4 exopod length, distal half curved posteriorly, 2.2-2.5 times as long as wide, appendix interna reaching to distal end of endopod. Appendix masculina of male second pleopod short (Fig. 2J), reaching to middle of endopod; appendix interna of male second pleopod stout.

Uropodal diaeresis with 11 or 12 spinules (Fig. 2M).

Habitat: Stream in karst caves.

Etymology: *Caridina longshan* sp. nov. is named after its type locality in Longshan County. The name is used as a noun in apposition.

Remarks: *Caridina longshan* sp. nov. is morphologically similar to *C. cavaleriei cavaleriei* Bouvier, 1919, a subspecies known only from the original specimens from Guizhou Province, southern China. It can be distinguished by its strongly upturned rostrum (Fig. 1A-D) (vs. straight

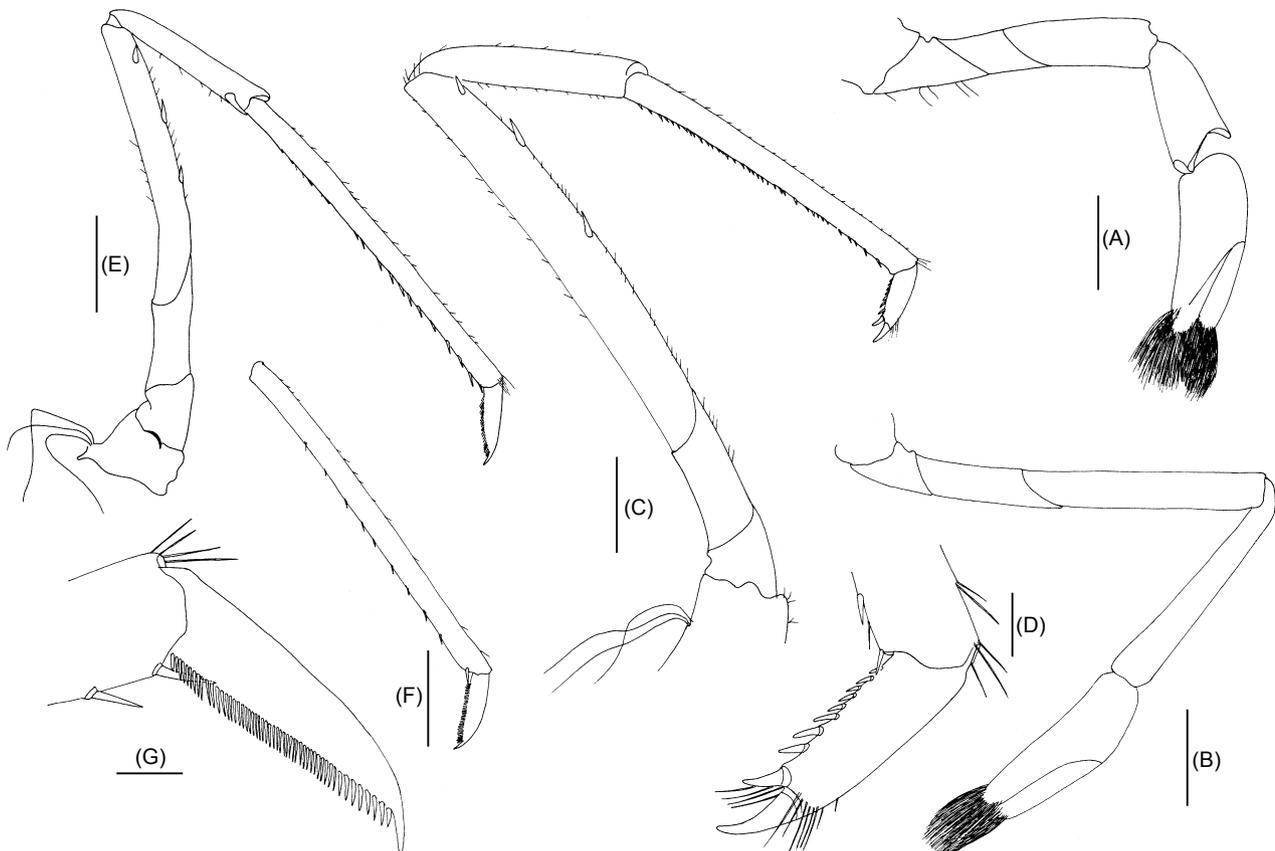


Fig. 3. *Caridina longshan* sp. nov. (A) first pereopod, (B) second pereopod, (C) third pereopod, (D) dactylus of third pereopod, (E) fifth pereopod, (F) propodus and dactylus of fifth pereopod, (G) dactylus of fifth pereopod. Scale bars: A-C, E, F = 1.0 mm; D, G = 0.2 mm. (A-E, G, female, female, cl 6.5 mm, Panon Cave, Huaoyan Village, Longshan County, Hunan Province, paratype, ZRC 2018.0480; F, wanting leg of another specimen, same location).

in *C. cavaleriei cavaleriei*; cf. Bouvier, 1925: figure 544) and degenerated eyes (Fig. 1A-D) (vs. clearly developed in *C. cavaleriei cavaleriei*; cf. Bouvier, 1925: fig. 544). With the long and upturned rostrum, *Caridina longshan* sp. nov. morphology resembles that of *C. dentifrons* NK Ng and Cai, 2000, from Guizhou. It could be easily separated by its larger number of ventral rostral teeth (12-17 vs. 4-8 in *C. dentifrons*; cf. NK Ng and Cai, 2000: fig. 1A-C), degenerated eyes (Fig. 1A-D) (vs. clearly developed in *C. dentifrons*; cf. NK Ng and Cai, 2000: fig. 1A-C) and dactylus of third pereopod with 7 or 8 accessory spines on flexor margin (Fig. 3D) (vs. 6 spines in *C. dentifrons*; cf. NK Ng and Cai, 2000: fig. 3E)

Two characters of this species are unusual: the pigmentation in the cornea of eyes and the presence of spinules on the surface of distal spines (serrated setae in Garms and Watling 2013) of telson (Fig. 2K, L). The condition of the eye cornea pigmentation ranges from totally absent to just a black spot (Fig. 1A-D). The adaptive significance of the serrated setae of the telson is not known.

Distribution: Hunan Province (Longshan), China.

***Caridina alu* sp. nov.**

(Figs. 4-6)

urn:lsid:zoobank.org:act:F7760EDF-36A2-48DD-9B49-409B6B51A1CD

Material examined: Holotype: male, cl 6.5 mm, IZCAS DE 5029, caught by fish traps in subterranean river, Alu Cave, behind a hotel at Alufa Village, Luxi County, Yunnan Province, southern China, coll. Kos, B. Sket & Velkovrh. 24 Nov 1995. Paratypes: 1 female, cl 4.0 mm, IZCAS DE 5030, same data as holotype; 1 male, cl 6.0 mm, 1 female, cl 4.8 mm, RMNH.CRUS. D.57290; 1 male, cl 6.2 mm, 1 female, cl 5.6 mm, UL, same data as holotype; 2 males, cl 5.8-6.3 mm, 4 females, 3.0-4.7 mm, cl 4.2-6.2 mm, ZRC 2018.0481, same data as holotype.

Comparative material examined: *Caridina sphyrapoda* Liang and Zhou, 1993-holotype: male, cl 5.5 mm, SFU 85a-8-1, Longdong river, Laibing County, Guangxi Province, China, coll. J. Zhou, 24 May 1985. Paratype: 1 female, cl 3.8 mm, 1 ovigerous female, cl 5.8 mm, SFU 85a-8-2, same data as holotype. Others: 3 males, cl 4.5-6.3 mm, 6 females, cl 4.7-6.6 mm, IZCAS, stream near Kuyang Town, Yinlin County, Guangxi Province, coll. Y. Cai, H. Tang and H. Zhen, Nov 1993.

Description: Rostrum long (Fig. 4A, B),

straight, reaching slightly beyond distal end of scaphocerite, armed dorsally with 16-24 teeth, of which 5-8 are situated on carapace behind posterior margin of orbital margin, occupying about half carapace length, armed ventrally with 4-12 (mode 7-10) teeth. Orbit narrow; antennal spine sharp, completely fused with suborbital angle. Pterygostomian angle broadly rounded.

Sixth abdominal somite twice as long as fifth abdominal somite, about half carapace length, slightly shorter than telson. Telson (Fig. 5G) without posteromedian projection, posterior margin rounded, lateral pair of spines longer than sub-lateral pairs, subequal to intermediate pairs of spines.

Eyes degenerated (Fig. 4A, B), small, pigment at centre of cornea. Antennular peduncle (Fig. 5A) 0.54 times as long as carapace. Antennular flagellum extraordinary long, more than twice total length. Stylocerite reaching 0.74 basal segment length of antennular peduncle or to end of segment. Scaphocerite (Fig. 5B) 3 times as long as wide, outer margin slightly concave.

Mouthparts as figured. Mandible (Fig. 4C) with blunt teeth at extremity of incisor process. Maxillula (Fig. 4D) with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight, with dense setae and teeth. Maxilla (Fig. 4E) with slender palp, upper endite subdivided, scaphognathite tapering with numerous long hooked setae posteriorly. Palp of first maxilliped stout (Fig. 4F), terminating in projection. Endopod of second maxilliped (Fig. 5C) with fused dactylus and propodal segments. Third maxilliped (Fig. 5D) reaching to distal end of antennular peduncle, ending in single terminal claw; exopod reaching posterior 0.25 penultimate segment length, ultimate segment shorter than penultimate segment. Epipods on first 4 pereopods.

First pereopod (Fig. 5E) short, stout, reaching slightly beyond end of basal segment of antennular peduncle, merus 2.5 times as long as broad; carpus strong concave anteriorly, 1.3 times as long as high, chela 1.7 times as long as broad, fingers slightly longer than palm. Second pereopod (Fig. 5F) reaching to end of antennular peduncle, carpus 2.6 times as long as high, chela slightly shorter than carpus, 2.6 times as long as broad, fingers 1.5 times as long as palm. Third pereopod (Fig. 6A, B) long, reaching slightly beyond distal end of scaphocerite, propodus 10 times as long as broad, 4.3 times as long as dactylus (claw included); dactylus ending in 2 claws, with 2-4 accessory spines on flexor margin. Fifth pereopod

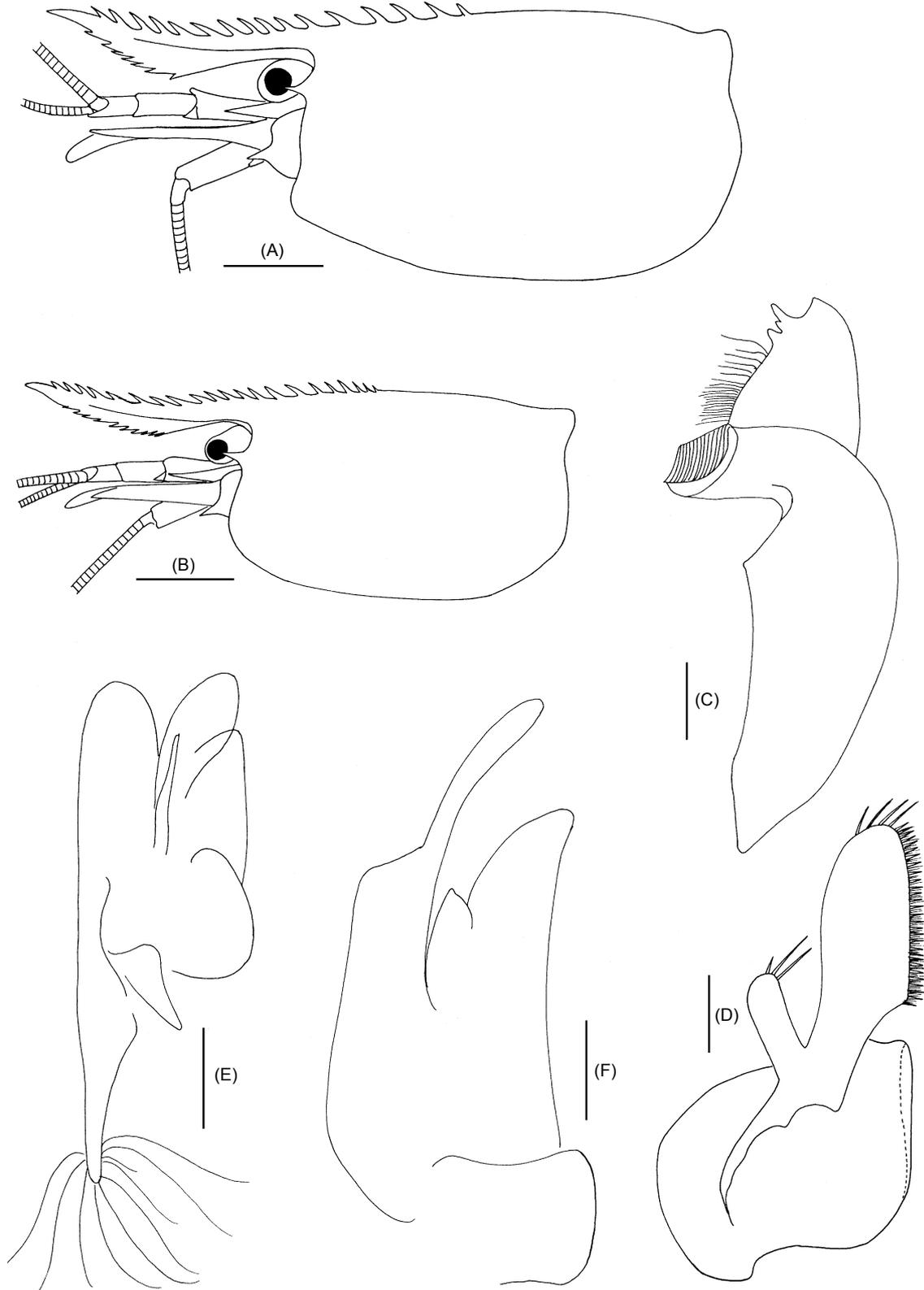


Fig. 4. *Caridina alu* sp. nov. (A, B) cephalothorax and cephalic appendages, lateral view, (C) mandible, (D) maxillula, (E) maxilla, (F) first maxilliped. Scale bars: A, B = 2.0 mm; C, D = 0.5 mm; E, F = 1.0 mm; G, H = 0.2 mm. (A, C-F, female, cl 5.0 mm, paratype, ZRC 2018.0481; B, holotype, cl 6.5 mm, IZCAS DE 5029).

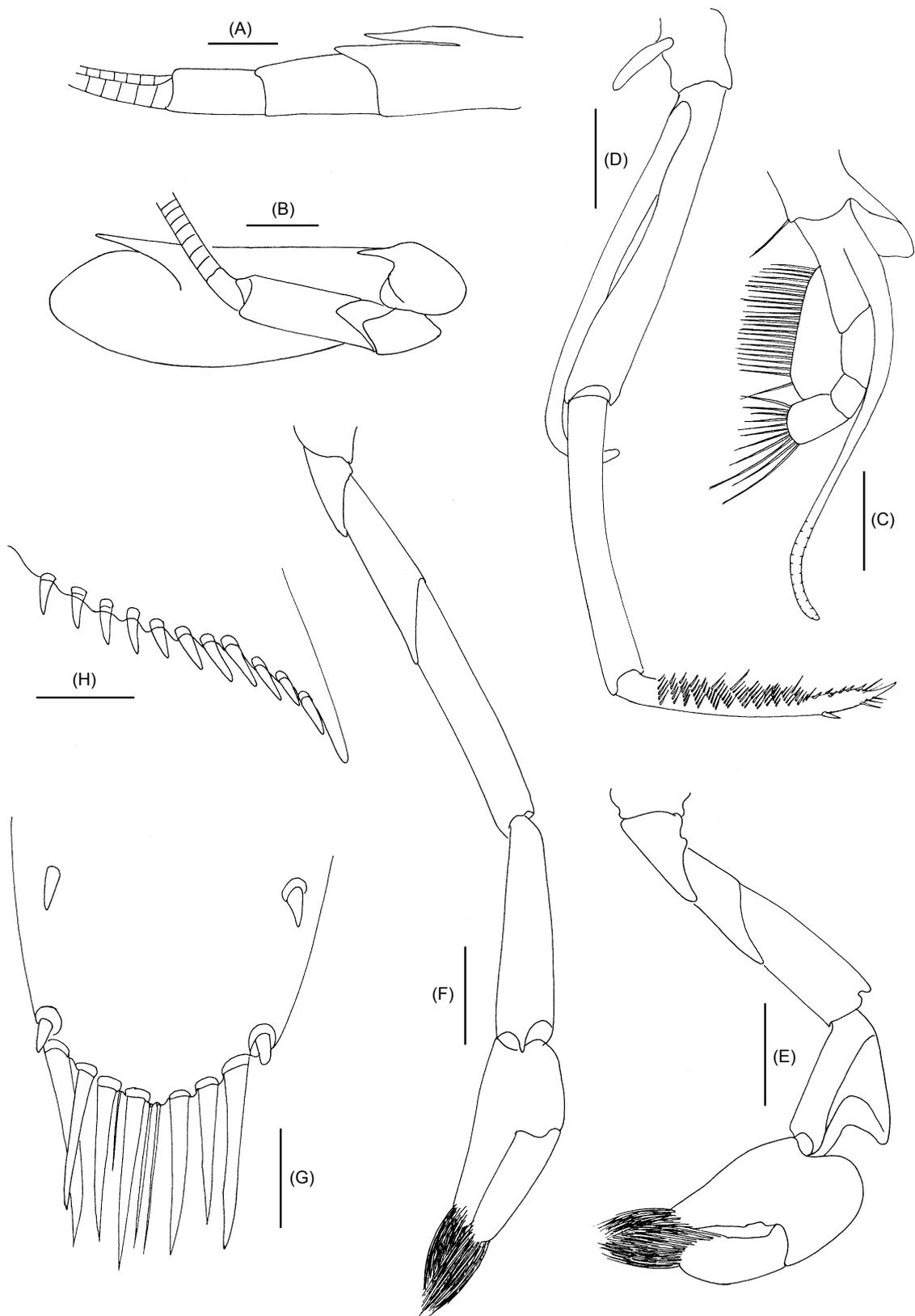


Fig. 5. *Caridina alu* sp. nov. (A) antennular peduncle, (B) scaphocerite, (C) second maxilliped, (D) third maxilliped, (E) first pereiopod, (F) second pereiopod, (G) distal portion of telson. Scale bars: A-F = 1.0 mm; G, H = 0.3 mm. (female, cl 5.0 mm, paratype, ZRC 2018.0481).

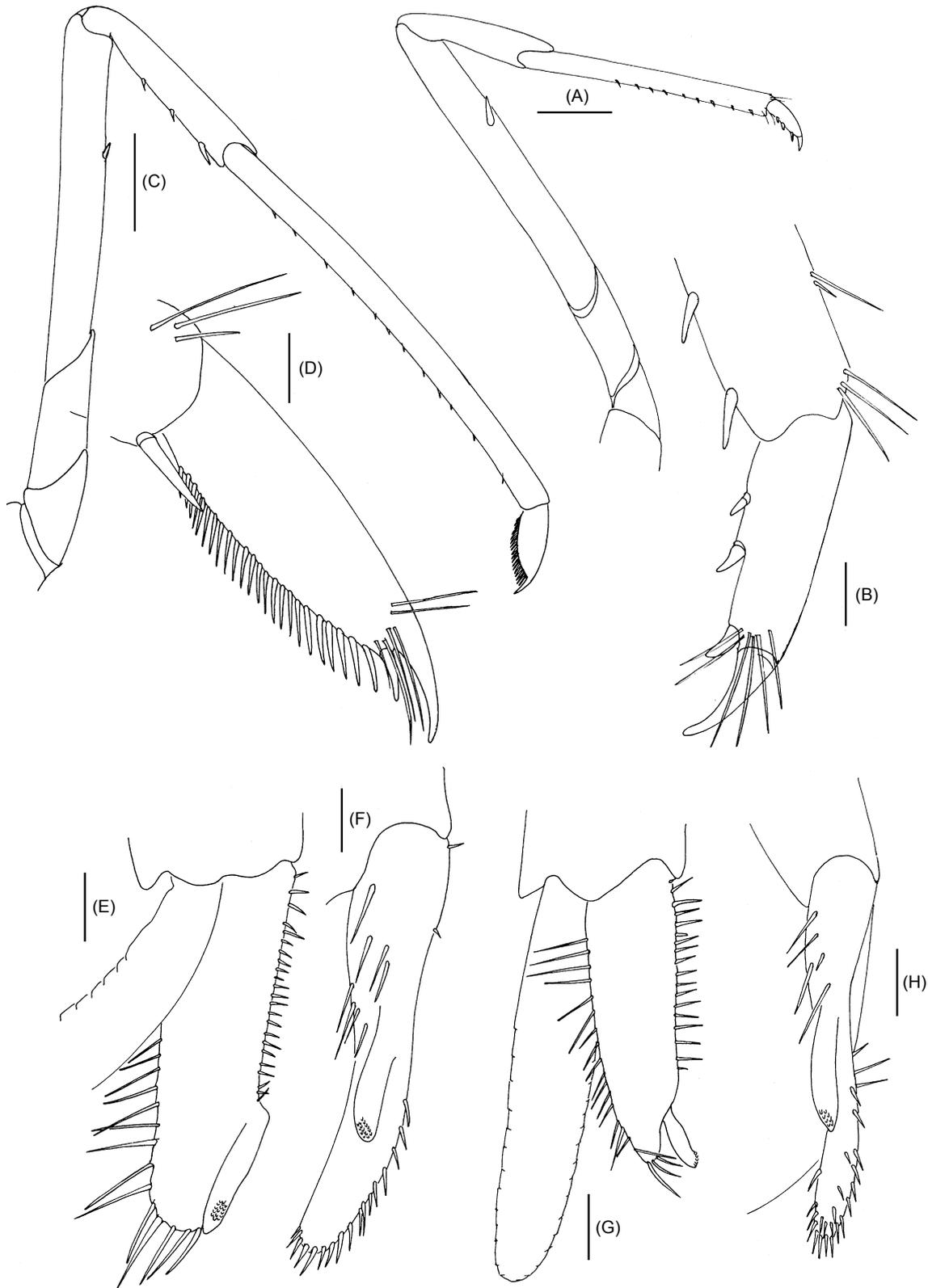


Fig. 6. *Caridina alu* sp. nov. (A) third pereiopod, (B) dactylus of third pereiopod, (C) fifth pereiopod, (D) dactylus of fifth pereiopod, (E, G) endopod of male first pleopod, (F, H) appendix masculina and appendix interna of male second pleopod. Scale bars: A, C = 1.0 mm; B, D = 0.2 mm; E-H = 0.5 mm. (A-D, female, cl 5.0 paratype, ZRC 2018.0481; E, F, male, cl 5.8 mm, holotype, IZCAS DE 5029; G, H, male, cl 6.3 mm, paratype, ZRC 2018.0481).

(Fig. 6C, D) reaching distal end of scaphocerite, propodus 13 times as long as wide, 4.9 times as long as dactylus; dactylus with 25 spinules on flexor margin.

Endopod of male first pleopod (Fig. 6E, G) short, reaching to 0.67 endopod length, subrectangular, 3.3 times as long as wide, appendix interna situated at posterior 0.25 endopod length, extending to end of endopod. Appendix masculina of male second pleopod (Fig. 6F, H) slightly curved outwards, reaching 0.75 endopod length; appendix interna of male second pleopod elongated, reaching to middle of appendix masculina.

Uropodal diaeresis (Fig. 6H) with 9-11 spinules.

Habitat: Subterranean river in a karst cave.

Etymology: The species is named after the type locality, Alu Cave. The name is used as a noun in apposition.

Remarks: *Caridina alu* sp. nov. resembles *Caridina sphyropoda* Liang and Zhou, 1993, from Guangxi Province in the form of its rostrum, but can be differentiated by the arrangement of its teeth: in *C. alu*, the postorbital teeth are widely placed, occupying half the length of the carapace (Fig. 4A, B) (vs. postorbital teeth are closely placed, occupying only a third of the carapace length; cf. Liang and Zhou, 1993: fig. 4(1)); the eyes are degenerated (Fig. 4A, B) (vs. developed; cf. Liang and Zhou, 1993: fig. 4(1)); the endopod is rectangular (Fig. 6G) (vs. sigmoid; cf. Liang and Zhou, 1993: fig. 4(8)), and the telson does not possess a posteromedian projection (Fig. 5G) (vs. projection distinctly present; cf. Liang and Zhou, 1993: fig. 4(2)).

Distribution: Yunnan Province (Alu Cave), China.

***Caridina spinicrus* sp. nov.**

(Figs. 7-9)

urn:lsid:zoobank.org:act:EF868C18-D01C-4920-A9C4-51DFACB8D42C

Material examined: Holotype: male, cl 5.5 mm, IZCAS DE 5031, artificial pond inside Goulou Cave in Beiliu County, Guangxi Province, southern China, coll. Y. Cai et al., 30 Oct 1993; Paratypes: 2 males, cl 5.5-6.0 mm, ZRC 2018.0482, same data as holotype.

Description: Rostrum (Fig. 7A) straight, reaching anterior half of second segment of antennular peduncle, dorsally with 17 teeth, of which 7 on carapace behind posterior margin of

orbital margin, occupying 0.14 carapace length, armed ventrally with only 1 small tooth. Antennular spine sharp, completely fused with suborbital angle. Pterygostomian angle rounded.

Telson (Fig. 9B) with posteromedian projection, posterior margin rounded, lateral pair of spines longer than intermediate pairs, sub-lateral pair being shortest.

Eyes well developed (Fig. 7A). Antennular peduncle 0.50 times as long as carapace. Stylocerite reaching 0.7 basal segment length of antennular peduncle. Scaphocerite (Fig. 8H) 3.0 times as long as wide, outer margin slightly concave.

Mouthparts as figured. Mandible (Fig. 7B) with blunt teeth at extremity of incisor process. Maxillula (Fig. 7C) with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight, with setae and teeth. Maxilla (Fig. 7D) with slender palp, upper endite subdivided, scaphognathite tapering with numerous long setae posteriorly. Palp of first maxilliped (Fig. 7E) ending as triangular projection. Endopod of second maxilliped (Fig. 7E) with fused dactylus and propodal segments. Third maxilliped (Fig. 7G) reaching beyond distal end of scaphocerite, ending in single terminal claw; exopod reaching 0.5 times penultimate segment length, ultimate segment as long as pentultimate segment. Epipods on first 4 pereopods.

First pereopod (Fig. 8A, B) reaching end of basal segment of antennular peduncle, merus 2.7 times as long as broad; carpus concave anteriorly, 1.7 times as long as high, chela 2.5 times as long as broad, fingers 1.3 times as long as palm. Second pereopod (Fig. 8C) reaching to end of antennular peduncle, carpus 5.2 times as long as high, chela slightly shorter than carpus, 2.7 times as long as broad, fingers 1.7 times as long as palm. Third pereopod (Fig. 8D) long, stout, reaching beyond distal end of scaphocerite. Merus 4.0 times as long as broad; carpus 2.4 times as long as broad, ventral surface armed with a row of 16 closely packed strong spines. Propodus strongly curved inwards, 9.0 times as long as broad, 4.0 times as long as dactylus (claw included), ventral surface armed with row of 23 strong spines, similar to those of at carpus, but more widely lined anteriorly; dactylus terminating as a claw, with 5 accessory spines on flexor margin. Fourth pereopod (Fig. 9C, D, E) reaching to distal end of antennular peduncle, similar to third pereopod in form, with strong spines on ventral surfaces of carpus and propodus. Fifth pereopod (Fig. 9F, G)

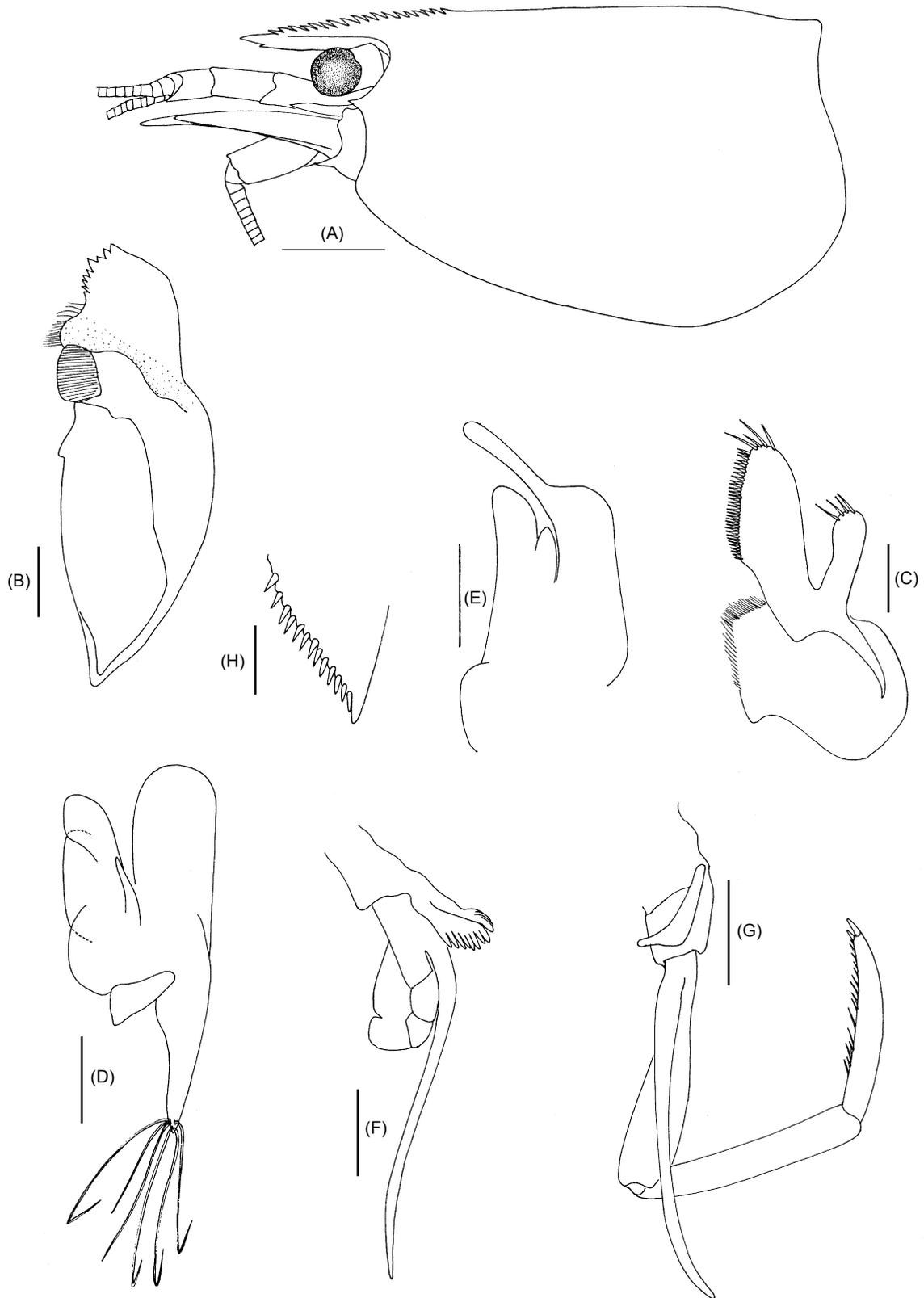


Fig. 7. *Caridina spinicrus* sp. nov. (A) cephalothorax and cephalic appendages, lateral view, (B) mandible, (C) maxillula, (D) maxilla, (E) first maxilliped, (F) second maxilliped, (G) third maxilliped, (H) uropodal diaeresis. Scale bars: A = 2.0 mm; B, C, H = 0.5 mm; D-G = 1.0 mm. (A, male, cl 5.5 mm, holotype, IZCAS DE 5031; B-H, male, cl 6.0 mm, paratype, ZRC 2018.0482).

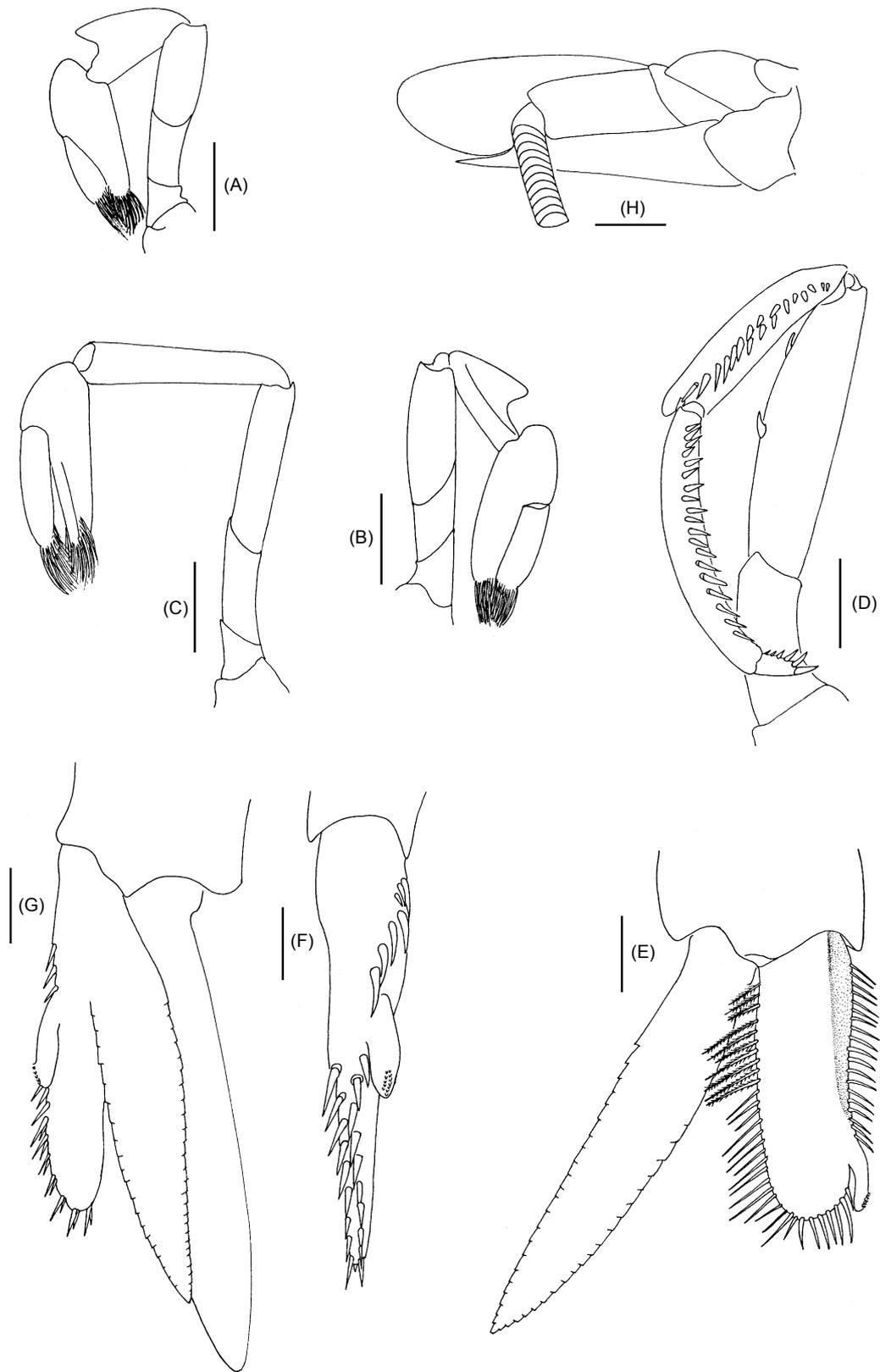


Fig. 8. *Caridina spinicrus* sp. nov. (A, B) first pereiopod, (C) second pereiopod, (D) third pereiopod, (E) male first pleopod, (F) appendix masculina and appendix interna of male second pleopod, (G) male second pleopod. Scale bars: A-D, H = 1.0 mm; E-G = 0.5 mm. (male, cl 6.0 mm, paratype, ZRC 2018.0482).

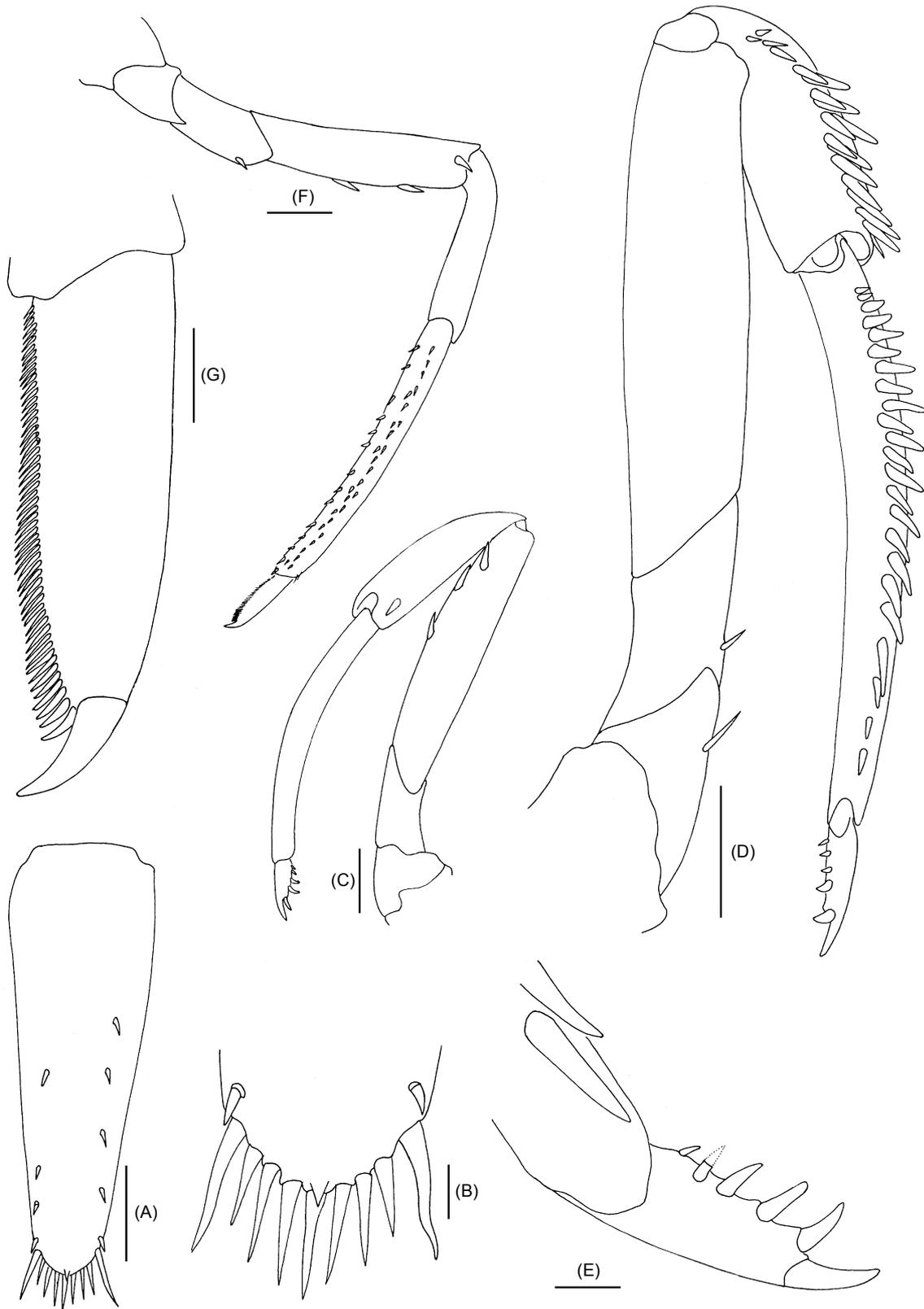


Fig. 9. *Caridina spinicrus* sp. nov. (A) telson, (B) distal portion of telson, (C, D) fourth pereiopod, (E) dactylus of fourth pereiopod, (F) fifth pereiopod, (G) dactylus of fifth pereiopod. Scale bars: A, C, D, F = 1.0 mm; B, E, G = 0.2 mm. (male, cl 6.0 mm, paratype, ZRC 2018.0482).

reaching distal end of antennular peduncle; merus 4.0 times as long as broad; carpus 4.0 times as long as broad; propodus slightly curved inwards, 10 times as long as broad, 3.8 times as long as dactylus; dactylus with 50 spinules on flexor margin.

Endopod of male first pleopod (Fig. 8E) reaching to 0.67 endopod length, subrectangular, distal end rounded, inner margin slightly curved backwards, 3.0 times as long as wide; appendix interna situated at posterior 0.2 endopod length, extending to end of endopod. Appendix masculina of male second pleopod (Fig. 8F, G) narrowing down distally, with 2 rows of spines at inner surface, reaching to 0.75 of endopod length; appendix interna of male second pleopod small, reaching to 0.4 appendix masculina length.

Uropodal diaeresis (Fig. 7H) with 13 spinules.

Habitat: *Caridina spinicrus* sp. nov. was collected together with *C. beilliu* sp. nov. from an artificial concrete pond inside Goulou Cave in Beilliu County. The water comes from a subterranean river.

Etymology: *Caridina spinicrus* is named for its distinctive spiny third and fourth pereopods, from the Latin for spiny and legs (*crura*). The name is used as a noun in apposition.

Remarks: With regard to the spiny third and fourth pereopods, only one species, *Caridina crurispinata* Gurney, 1984, described from a cave in Madagascar, shares such features. Compared with *C. crurispinata*, the spines on the third and fourth pereopods in *C. spinicrus* sp. nov. are more prominent (Fig. 8D; Fig. 9C, D, E) (vs. less prominent; cf. Gurney, 1984: fig. 6C). Apart from this, *C. spinicrus* can be distinguished from *C. crurispinata* by the straight rostrum which reaches to the anterior half of the second segment of antennular peduncle (Fig. 7A) (vs. gradually curving upwards and reaching beyond the antennal scale; cf. Gurney, 1984: fig. 4B); and the presence of an appendix interna on the endopod of the male first pleopod (Fig. 8E) (vs. absent; cf. Gurney, 1984: fig. 7B).

Compared with other Chinese species, *C. spinicrus* also superficially resembles the sympatric *C. beilliu* sp. nov. However, *C. spinicrus* can easily be separated by the rostrum not reaching beyond the end of the second segment of the antennular peduncle (Fig. 7A) (vs. beyond the end of the second segment of the antennular peduncle; Fig. 10A); the more slender first pereopod having the dactylus 2.5 times as long as broad (Fig. 8A, B) (vs. 1.5 times; Fig. 11A); and the male first pleopod

having an appendix interna that reaches to the distal end of the endopod (Fig. 8E) (vs. distinctly reaching beyond; Fig. 12D-F).

Distribution: Guangxi Province (Goulou Cave), China.

***Caridina beilliu* sp. nov.**

(Figs. 10-12)

urn:lsid:zoobank.org:act:3CCBD229-9AEF-4016-A652-F932F38FD51B

Material examined: Holotype: male, cl 5.8 mm, IZCAS DE 5032, Goulou Cave in Beilliu County, Guangxi Province, southern China, coll. Y. Cai et al., 30 Oct 1993. Paratypes: 1 male, cl 5.7 mm, IZCAS DE 5033, 1 female, cl 5.0 mm, IZCAS DE 5034, 1 female, cl 5.1 mm, IZCAS DE 5035, data same as holotype; 3 males, cl 5.7-6.7 mm, 5 females, cl 5.5-6.8 mm, ZRC 2018.0483, same data as holotype; 3 males, cl 4.2-5.5 mm, 1 female, cl 5.8 mm, RMNH.CRUS. D.57291, data same as holotype.

Comparative material examined: *Caridina cornuta* Liang and Yan, 1986 - Holotype: 1 male, cl 4.2 mm, SFU 84-53-1, 2 females, cl 3.8-6.6 mm, SFU 84-53-2, Zhijing County, Guizhou Province, China, 29 May 1984.

Description: Rostrum (Fig. 10A) straight, slightly downwards, reaching near distal end of antennular peduncle, armed dorsally with 16 teeth, of which 4 are on carapace behind posterior margin of orbital margin, armed ventrally with 1 tooth. Antennal spine fused with suborbital angle. Pterygostomial angle broadly rounded.

Sixth abdominal somite twice as long as fifth abdominal somite, slightly more than half of carapace length. Telson (Fig. 12A, B) slightly longer than sixth abdominal somite, with prominent posteromedian projection, posterior margin rounded, with lateral pair of spines longer than intermediate pairs, sub-lateral pairs being shortest.

Eyes (Fig. 10A) well developed. Antennular peduncle about half of carapace length. Stylocerite reaching to 0.8 basal segment length of antennular peduncle. Scaphocerite (Fig. 12C) 3.0 times as long as wide, outer margin straight.

Mouthparts as figured. Mandible (Fig. 10B) with blunt teeth at extremity of incisor process. Maxillula (Fig. 10C) with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight, with dense setae and teeth. Maxilla (Fig. 10D) with slender palp, upper endite subdivided, scaphognathite tapering with numerous long hooked setae posteriorly. Palp

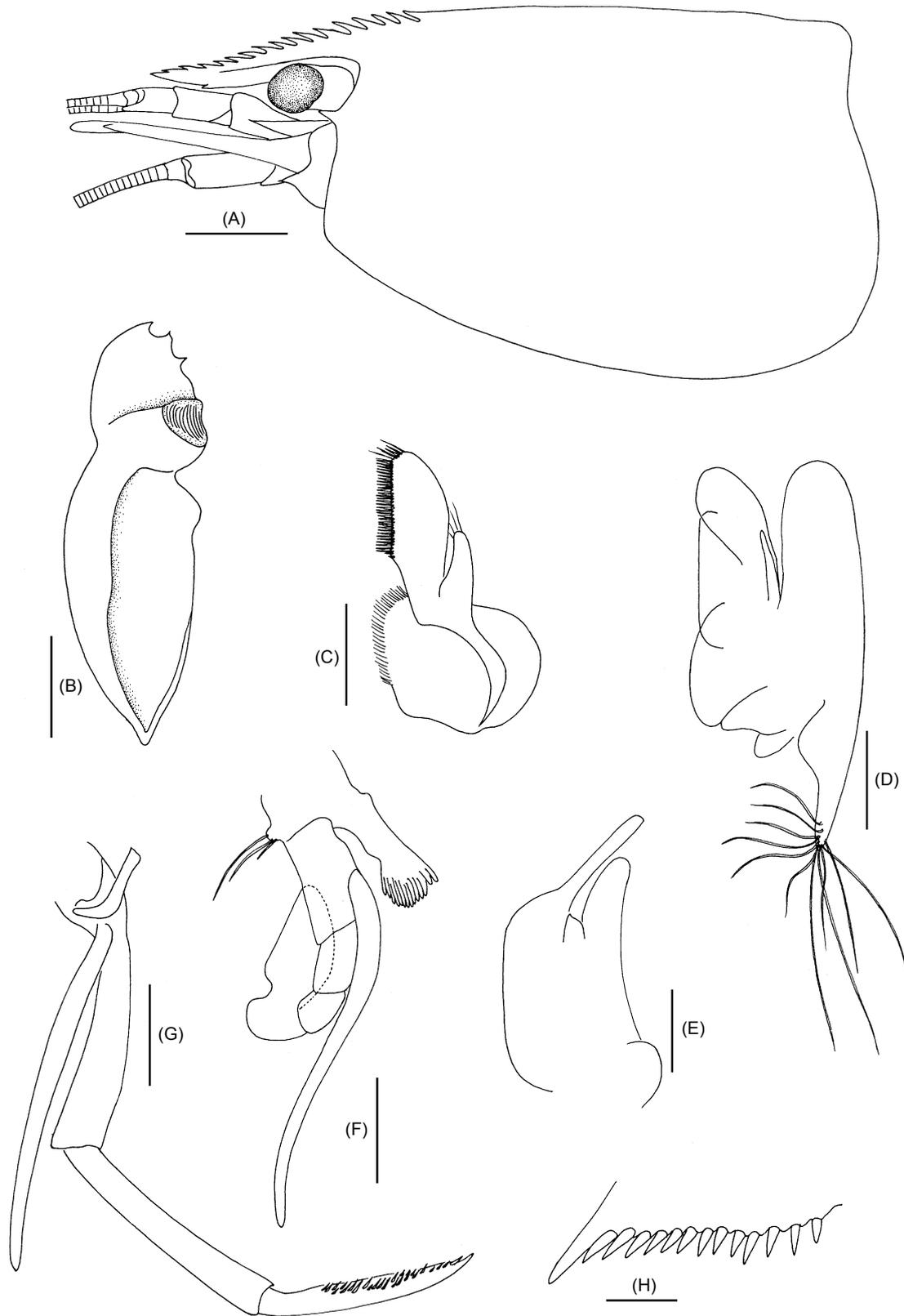


Fig. 10. *Caridina beiliu* sp. nov. (A) cephalothorax and cephalic appendages, lateral view, (B) mandible, (C) maxillula, (D) maxilla, (E) first maxilliped, (F) second maxilliped, (G) third maxilliped, (H) uropodal diaeresis. Scale bars: A = 1.5 mm, B-G = 1.0 mm, H = 0.5 mm. (male, cl 6.2 mm, paratype, ZRC 2018.0483).

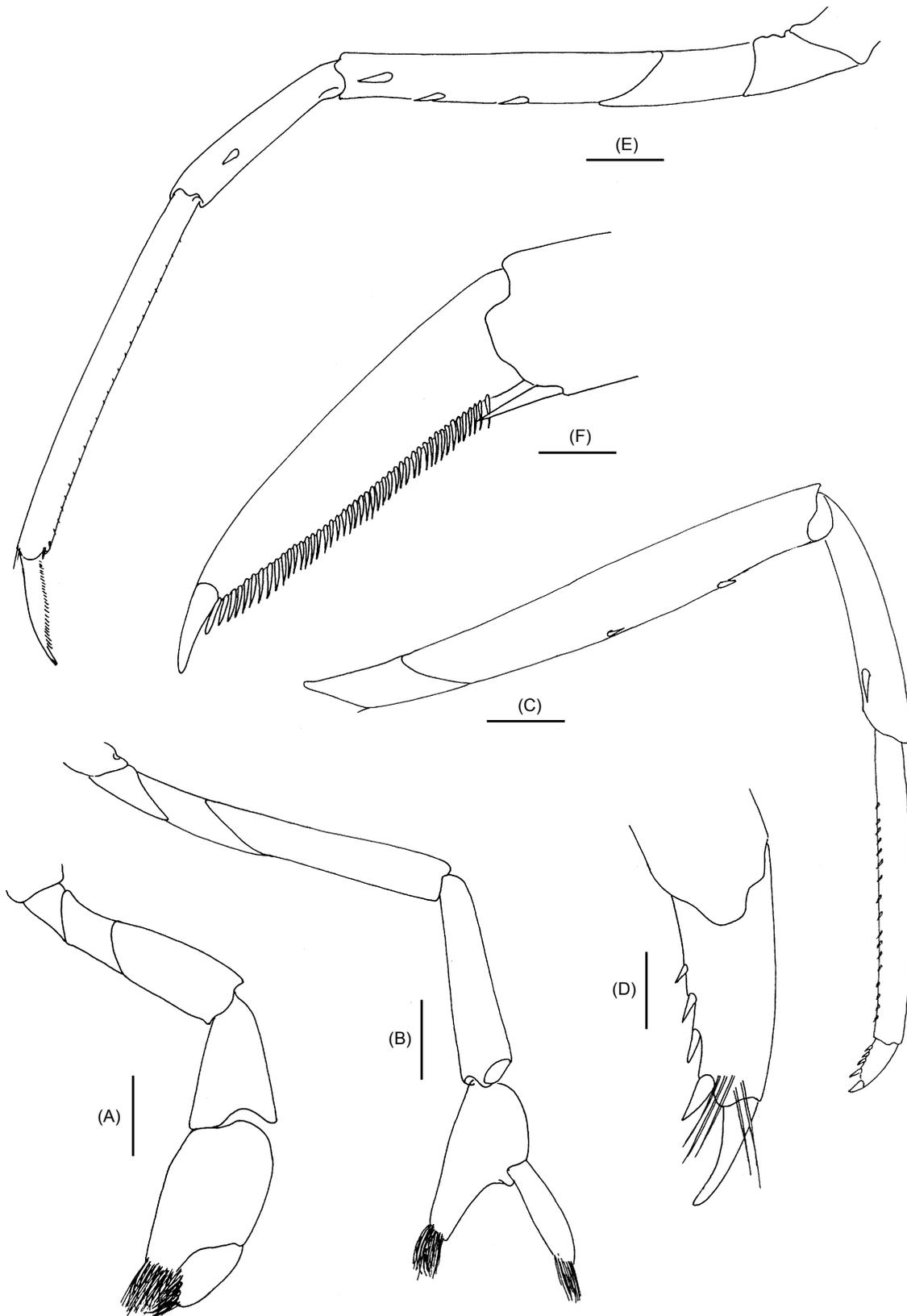


Fig. 11. *Caridina beiliu* sp. nov. (A) first pereiopod, (B) second pereiopod, (C) third pereiopod, (D) dactylus of third pereiopod, (E) fifth pereiopod, (F) dactylus of fifth pereiopod. Scale bars: A-C, E = 1.0 mm; D, F = 0.2 mm. (male, cl 6.2 mm, paratype, ZRC 2018.0483).

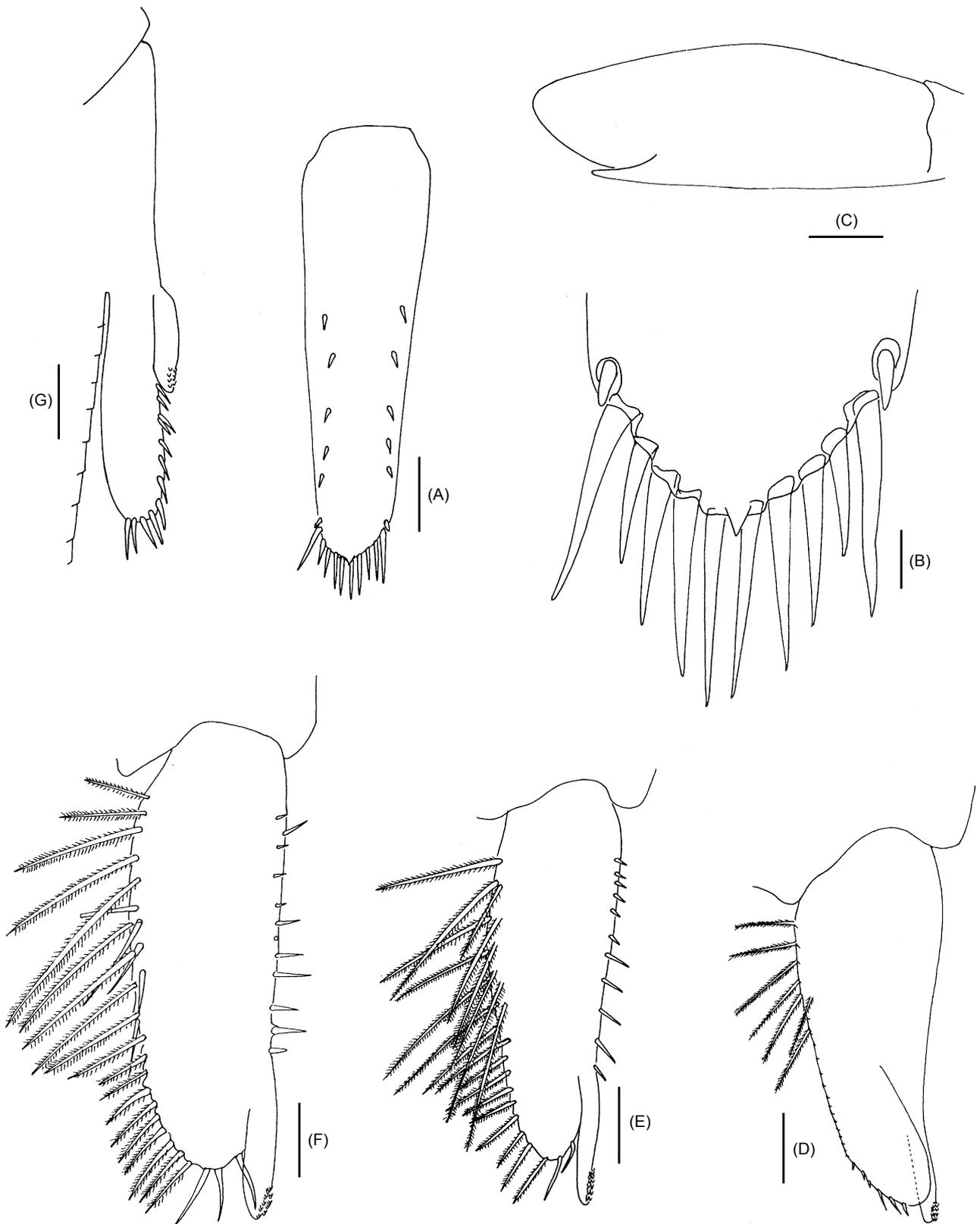


Fig. 12. *Caridina beiliu* sp. nov. (A) telson, (B) distal portion of telson, (C) scaphocerite, (D, E, F) endopod of male first pleopod, (G) appendix masculina and appendix interna of male second pleopod. Scale bars: A, C = 1.0 mm, B, D-F = 0.2 mm. (A-D, G. male, cl 6.2 mm, paratype, ZRC 2018.0483; E. F., male, cl 4.8 mm, paratype, RMNH.CRUS.D.57291).

of first maxilliped (Fig. 10E) stout, terminating in triangular. Endopod of second maxilliped (Fig. 10F) with fused dactylus and propodal segments. Third maxilliped (Fig. 10G) reaching to distal end of antennular peduncle, ending in single terminal claw; exopod reaching posterior third of penultimate segment, ultimate segment shorter than penultimate segment. Epipods on first 4 pereopods.

First pereopod (Fig. 11A) short, stout, reaching distal end of eyes, merus 2.2 times as long as broad; carpus concave anteriorly, 1.5 times as long as high, chela 1.9 times as long as broad, fingers 0.7 times as long as palm. Second pereopod (Fig. 11B) reaching slightly beyond end of basal segment of antennular peduncle, carpus 4.0 times as long as high, chela shorter than carpus, 2.1 times as long as broad, fingers 1.5 times as long as palm. Third pereopod (Fig. 11C, D) reaching beyond distal end of scaphocerite, propodus 10 times as long as broad, 4.7 times as long as dactylus (claw included); dactylus terminating as a claw, with 4 accessory spines increasing in length and size distally on flexor margin. Fifth pereopod (Fig. 11E, F) reaching beyond end of second segment of antennular peduncle, propodus 15 times as long as wide, 3.0 times as long as dactylus; dactylus with 46 spinules on flexor margin.

Endopod of male first pleopod (Fig. 12D, E, F) short, sub-elliptical, 3.0 times as long as wide, inner margin straight, outer margin rounded, appendix interna at distal part of endopod, reaching beyond distal end of endopod. Appendix interna of male second pleopod (Fig. 12G) small, slender.

Uropodal diaeresis (Fig. 10H) with 13 spinules.

Habitat: Subterranean water in karst cave.

Etymology: The species is named after the type locality, Beiliu County. The name is used as a noun in apposition.

Remarks: *Caridina beiliu* sp. nov. resembles *C. cornuta* Liang and Yan, 1986, from Guizhou Province, in the form of the rostrum. However, it can be distinguished from *C. cornuta* by the telson possessing a posteromedian projection (Fig. 12B) (vs. with no projection in *C. cornuta*; cf. Liang and Yan, 1986: fig. 3(2)); and the sub-elliptical endopod of the male pleopod does not have a projection at the base (Fig. 12F) (vs. subrectangular with a basal projection in *C. cornuta*; cf. Liang and Yan, 1986: fig. 3(7)).

Distribution: Guangxi Province (Goulou

Cave), China.

***Caridina jiangkou* sp. nov.**

(Fig. 13)

urn:lsid:zoobank.org:act:D89160FE-F0C5-4F99-80AB-2F07FEDED2CB

Material examined: Holotype: male, cl 4.8 mm, IZCAS DE 5036, Baishui Cave in Jiangkou County, Guizhou Province, China, coll. zoological survey team, 15 May 1988. Paratypes: 1 female, cl 4.0 mm, IZCAS DE 5037, 1 female, cl 6.6 mm, IZCAS DE 5038, data same as holotype; 2 males, 4.7-4.9 mm, 4 females, cl 3.5-6.2 mm, ZRC 2018.0484, same data as holotype; 1 male, cl 3.9 mm, 2 females, 4.2-5.8 mm, RMNH.CRUS. D.57292, data same as holotype.

Comparative material examined: *Caridina guizhouensis* Liang and Yan, 1986 - Holotype: male, cl 3.4 mm, SFU 84-73-1, Maopo Village, Yuping County, Guizhou Province, China, 84-73-3. Paratype: 1 ovigerous female, SFU, cl 4.6 mm, eggs 0.95 × 0.60 mm, same data as holotype.

Description: Rostrum (Fig. 13A) short, straight, reaching to distal end of basal segment of antennular peduncle rostral formula 0-5+4-7/1-5. Antennal spine fused with suborbital angle. Pterygostomian angle broadly rounded.

Sixth abdominal somite 1.8 times as long as fifth abdominal somite, about half carapace length, shorter than telson. Telson (Fig. 13B, M) with prominent posteromedian projection, posterior margin rounded, lateral pair of spines longer than intermediate pairs of spiniform setae, sub-lateral pairs shortest. Inner margin of lateral spines and surface of intermediate pairs of setae covered with spinules.

Eyes (Fig. 13A) well developed. Antennular peduncle about 0.7 times carapace length. Stylocerite reaching 0.75 basal segment length of antennular peduncle.

Mouthparts as figured. Mandible with blunt teeth at extremity of incisor process. Maxillula with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight. Maxilla with slender palp, upper endite subdivided, scaphognathite tapering with numerous long setae posteriorly. Palp of first maxilliped stout, terminating in triangular projection. Endopod of second maxilliped with fused dactylus and propodal segments. Third maxilliped (Fig. 13C) reaching to distal end of antennular peduncle, ending in single terminal claw; exopod reaching posterior quarter of penultimate segment, ultimate segment slightly

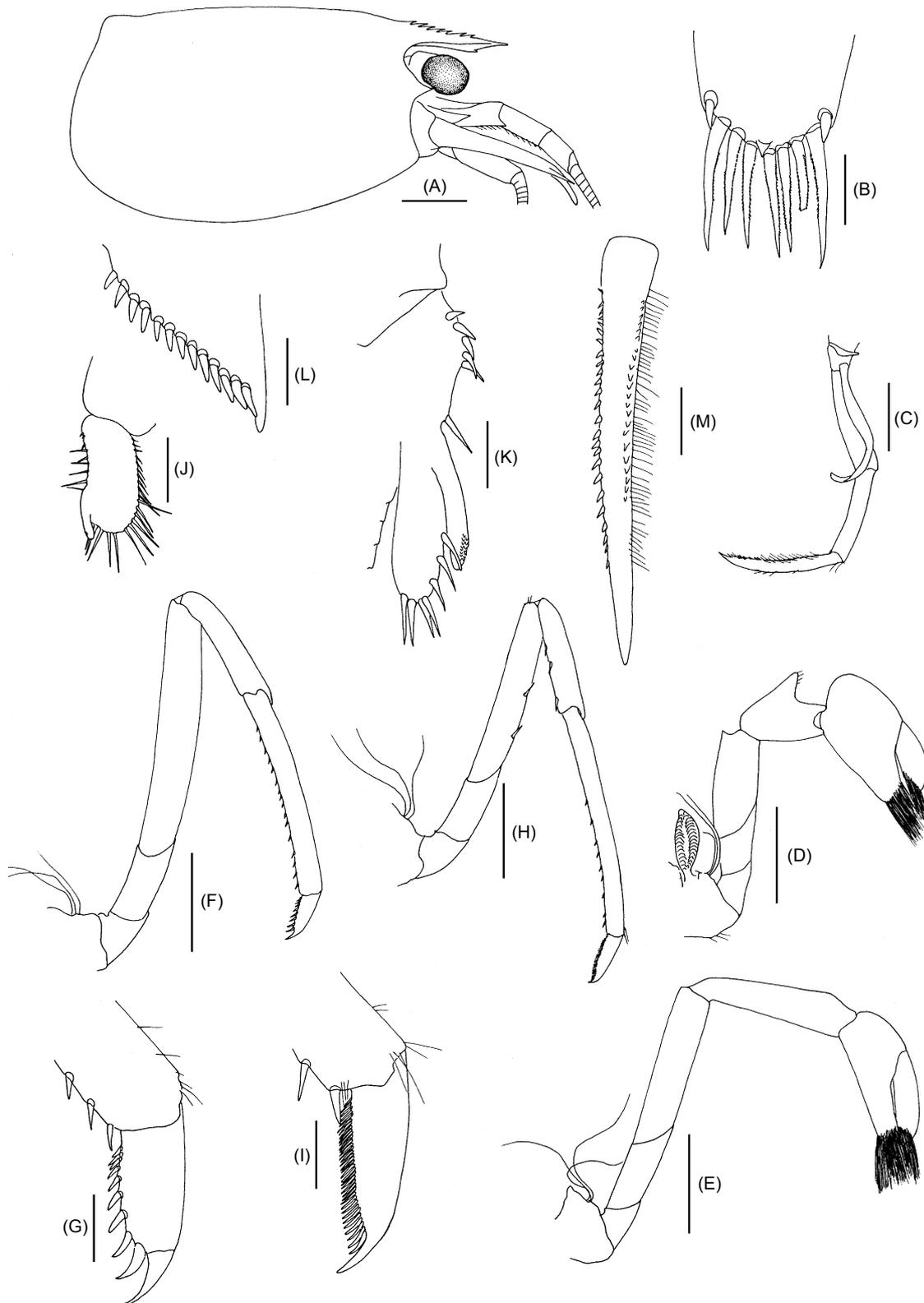


Fig. 13. *Caridina jiangkou* sp. nov., (A) cephalothorax and cephalic appendages, lateral view, (B) distal portion of telson, (C) third maxilliped, (D) first pereiopod, (E) second pereiopod, (F) third pereiopod, (G) dactylus of third pereiopod, (H) fifth pereiopod, (I) dactylus of fifth pereiopod, (J) endopod of male first pleopod, (K) appendix masculina and appendix interna of male second pleopod, (L) uropodal diaeresis, (M) posterior spine of telson. Scale bars: A, C-J = 1.0 mm; B = 0.2 mm; K = 0.1 mm. (male, cl 4.7 mm, paratype, ZRC 2018.0484).

shorter than pentultimate segment. Epipods on first 4 pereopods.

First pereopod (Fig. 13D) short, stout, reaching distal end of eyes, merus 2.1 times as long as broad; carpus strongly concave anteriorly, 1.2 times as long as high, chela 1.9 times as long as broad, fingers slightly shorter than palm. Second pereopod (Fig. 13E) reaching beyond end of basal segment of antennular peduncle, carpus 4.0 times as long as high, chela shorter than carpus, 2.7 times as long as broad, fingers slightly shorter or as long as palm. Third pereopod (Fig. 13F, G) reaching beyond distal end of antennular, propodus 10 times as long as broad, 3.7 times as long as dactylus (claw included); dactylus ending as 2 claws, with 8 spines. Fifth pereopod (Fig. 13H, I) reaching to end of antennular peduncle, propodus 11 times as long as wide, 4.0 times as long as dactylus; dactylus with 36 spinules on flexor margin.

Endopod of male first pleopod (Fig. 13J) reaching to half of endopod length, sub-elliptical, 2.4 times as long as wide, appendix interna near distal end of endopod, reaching slightly beyond distal end of endopod. Appendix masculine of male second pleopod (Fig. 13K) reaching 0.4 endopod length; appendix interna slender, reaching to 0.67 appendix masculina length.

Uropodal diaeresis (Fig. 13L) with 13 spinules.

Habitat: Stream in a karst cave.

Etymology: *Caridina jiangkou* sp. nov. is named after the type locality Jiangkou County in Guizhou Province. The name is used as a noun in apposition.

Remarks: *Caridina jiangkou* sp. nov. resembles *C. guizhouensis* Liang and Yan, 1986, in the form of the rostrum and telson. However, it can be easily separated from the latter by the form of the endopod of the male first pleopod (2.5 times as long as wide, Fig. 13J) (vs. 3.0 times; cf. Liang and Zhou, 1993: fig. 2(7)); the longer appendix interna of the male second pereopod (2/3 length of appendix masculine, Fig. 13K) (vs. 1/3; cf. Liang and Yan, 1986: fig. 2(8)); and the presence of spinules on the surface of setae of the telson (Fig. 13M) (vs. absent; cf. Liang and Yan, 1986: fig. 2(2)).

Distribution: Guizhou Province (Baishui Cave), China.

***Caridina guilin* sp. nov.**

(Figs. 14, 15)

urn:lsid:zoobank.org:act:8126B546-4886-46AC-96F7-FDCCA77549F0

Material examined: Holotype: female, cl 6.5 mm, IZCAS DE 5039, karst cave near Guilin city, Guangxi Province, southern China, coll. B. Sket, 1 Dec 1977. Paratype: 1 male, cl 4.3 mm, ZRC 2018.0485, same data as holotype.

Comparative material examined: *Caridina cavernicola* Liang and Zhou, 1993 - Holotype: female, cl 7.3 mm, SFU 82A-15-1, Lenggu Cave, Du'an County, coll. 22 May 1982. Paratype: 1 female, cl 7.0 mm, SFU, 82A-15-2, same data as holotype.

Description: Rostrum (Figs. 14A, 15A) straight, reaching to or beyond distal end of scaphocerite, rostral formula 6-8 + 20-22/7-12. Antennal spine fused with suborbital angle. Pterygostomian angle broadly rounded.

Telson sexually dimorphic. Telson in male (Fig. 14B) with prominent posteromedian projection, posterior margin rounded, lateral pair of spines longer than intermediate pairs, sub-lateral pairs being shortest; telson in female (Fig. 15B) with prominent posteromedian projection, posterior margin acutely triangular, lateral pair of spines subequal to intermedian pairs.

Eyes well developed (Figs. 14A, 15A). Antennular peduncle about 0.6 times carapace length. Stylocerite reaching to 0.8 length or to end of basal segment of antennular peduncle. Scaphocerite (Fig. 14M) 3.2 times as long as wide, outer margin straight.

Mouthparts as figured. Mandible (Fig. 14C) with blunt teeth at extremity of incisor process. Maxillula (Fig. 14D) with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight. Maxilla with slender palp, upper endite subdivided, scaphognathite tapering with numerous long setae posteriorly. Palp of first maxilliped (Fig. 14E) stout, terminating in triangular projection. Endopod of second maxilliped with fused dactylus and propodal segments. Third maxilliped (Fig. 14F) reaching to distal end of antennular peduncle, ending in single terminal claw; exopod reaching posterior quarter of penultimate segment length, ultimate segment distinctly shorter than pentultimate segment. Epipods on first 4 pereopods.

First pereopod (Figs. 14G, 15C) short, stout, reaching end of basal segment of antennular peduncle, merus 1.5 times in female and 2.0 times

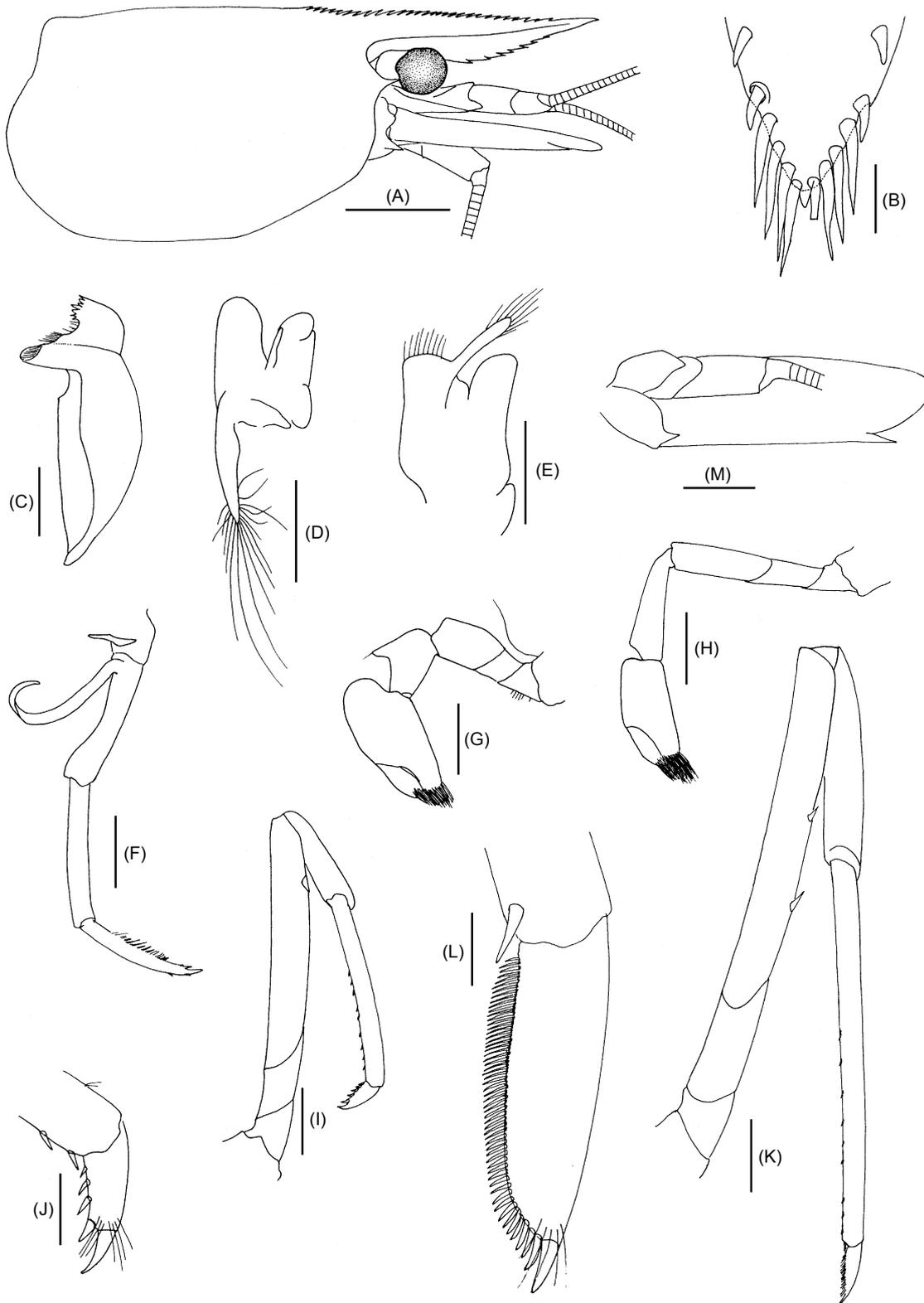


Fig. 14. *Caridina guilin* sp. nov. (A) cephalothorax and cephalic appendages, lateral view, (B) distal portion of telson, (C) mandible, (D) maxilla, (E) first maxilliped, (F) third maxilliped, (G) first pereopod, (H) second pereopod, (I) third pereopod, (J) dactylus of third pereopod, (K) fifth pereopod, (L) dactylus of fifth pereopod. Scale bars: A = 2.0 mm; B, J = 0.2 mm; C-F, M = 1.0 mm; G-I, L = 0.1 mm; K = 0.5 mm. (female, cl 6.5 mm, holotype, IZCAS DE 5039).

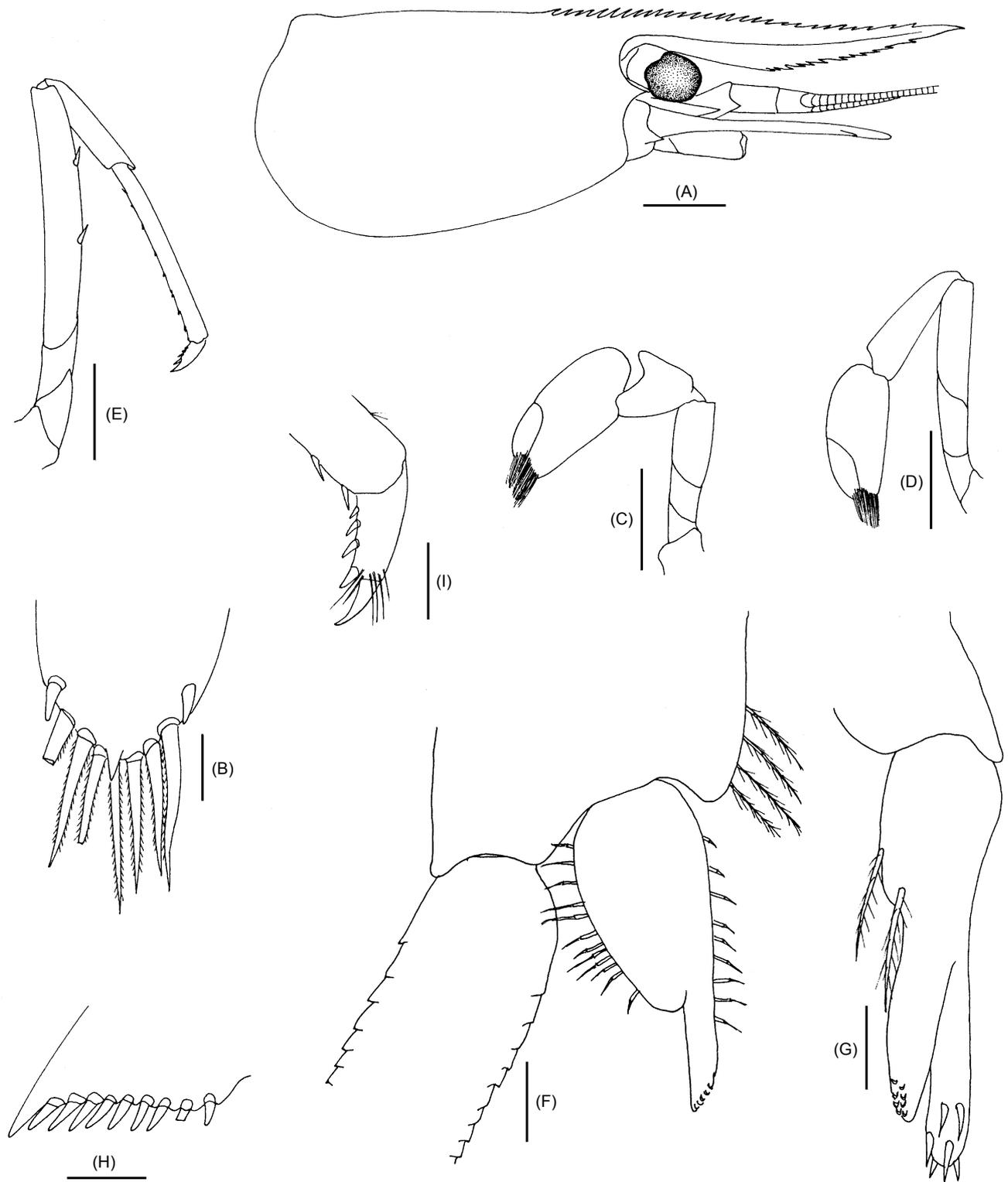


Fig. 15. *Caridina guilin* sp. nov. (A) cephalothorax and cephalic appendages, lateral view, (B) distal portion of telson, (C) first pereiopod, (D) second pereiopod, (E) third pereiopod, (F) endopod of male first pleopod, (G) appendix masculina and appendix interna of male second pleopod, (H) uropodal diaeresis, (I) dactylus of third pereiopod. Scale bars: A, C-E = 1.0 mm; B, F-I = 0.2 mm. (male, cl 4.3 mm, paratype, ZRC 2018.0485).

in male as long as broad; carpus strongly concave anteriorly, as long as high, chela 2.0 times as long as broad, fingers 0.6 times as long as palm. Second pereopod (Figs. 14H, 15D) reaching end of second segment of antennular peduncle, carpus 3.0 times as long as high, chela slightly longer than carpus, 2.1-2.4 times as long as broad, fingers 0.7 times as long as palm. Third pereopod (Figs. 14I, J, 15E, I) reaching slightly beyond distal end of second segment of antennular peduncle, propodus 10 times as long as broad, 4.5 times as long as dactylus (including claw); dactylus with terminal claw, with 5 spines. Fifth pereopod (Fig. 14K, J) reaching to end of basal segment of antennular peduncle, propodus 14 times as long as wide, 5.8 times as long as dactylus; dactylus with 56 spinules on flexor margin.

Endopod of male first pleopod (Fig. 15E) short, reaching to 0.2 endopod length, sub-triangular, 1.7 times as long as wide, appendix interna at distal end of endopod, reaching remarkably beyond distal end of endopod. Appendix masculina of male second pleopod (Fig. 15G) reaching half endopod length; slightly longer than appendix interna.

Uropodal diaeresis (Fig. 15H) with 9 or 10 spinules.

Habitat: Stream in a karst cave.

Etymology: *Caridina guilin* sp. nov. is named after the type locality, Guilin city in Guangxi Province. The name is used as a noun in apposition.

Remarks: *Caridina guilin* sp. nov. bears a close resemblance to *C. cavernicola* Liang and Zhou, 1993 (described from Du'an County of Guangxi Province), in the long rostrum and the form of telson in female, which terminates in an acute triangle. The latter character is unusual and has so far not been reported in any other congener. However, the new species can easily be distinguished from *C. cavernicola* by the smaller number of ventral teeth on the rostrum (7-12, Figs. 14A, 15A) (vs. 20-24; cf. Liang and Zhou, 1993: fig. 2(1)); the shorter carpus of the first pereopod which is as long as high (Figs. 14G, 15C) (vs. 1.4-1.7 and as long as high; cf. Liang and Zhou, 1993: fig. 2(4)); and the smaller number of spines (56) on the dactylus of the fifth pereopod (Fig. 14J) (vs. 66-69; cf. Liang and Zhou, 1993: fig. 2(7)).

The adaptive significance of the unusual telson shape (Fig. 14B) is unknown, but may suggest that *C. guilin* and *C. cavernicola* are related, although they occur in two separate cave systems some distance from each other.

Distribution: Guangxi Province (Guilin), China.

***Caridina laticarpalis* sp. nov.**

(Figs. 16-18)

urn:lsid:zoobank.org:act:E0AA744D-ACC9-4929-A637-1D40D2056C25

Material examined: Holotype: male, cl 4.3 mm, IZCAS DE 5040 karst cave in Wuming County, Guangxi Province, southern China, coll. B. Sket, 22 Nov 1977. Paratypes: 2 females, cl 4.8-5.4 mm, ZRC 2018.0486, same data as holotype.

Description: Rostrum (Figs. 16A, 18A, B) straight, or slightly upturned at distal half, reaching beyond distal end of scaphocerite, as long as or slightly longer than carapace; rostral formula 6-8 + 16-21/14-15. Antennal spine fused with suborbital angle. Pterygostomian angle broadly rounded.

Telson (Figs. 16H, 18E) with prominent posteromedian projection, posterior margin rounded, lateral pair of spines longer than intermediate pairs of composite setae, sub-lateral pairs shortest.

Eyes (Figs. 16A, 18A, B) well developed. Antennular peduncle about 0.6 times carapace length. Stylocerite reaching 0.8 basal segment antennular peduncle length. Scaphocerite (Fig. 16B) 3.3 times as long as wide, outer margin straight.

Mouthparts as figured. Mandible with blunt teeth at extremity of incisor process. Maxillula (Fig. 16C) with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight. Maxilla (Fig. 16D) with slender palp, upper endite subdivided, scaphognathite tapering with numerous long setae posteriorly. Palp of first maxilliped (Fig. 16E) stout, terminating in triangular projection. Endopod of second maxilliped (Fig. 16F) with fused dactylus and propodal segments. Third maxilliped (Fig. 16G) reaching to distal end of antennular peduncle, ending in single terminal claw; exopod reaching posterior quarter of penultimate segment, ultimate segment slightly shorter than penultimate segment. Epipods on first 4 pereopods.

First pereopod (Figs. 17A, 18C) short, stout, reaching distal end of eyes, merus 1.4-1.9 times as long as broad; carpus strongly concave anteriorly, 1.0-1.2 times as long as high, chela 1.9-2.2 times as long as broad, fingers 0.8 times as long as palm. Second pereopod (Fig. 17B, 18D) reaching beyond end of basal segment of antennular peduncle, carpus 2.6-3.0 times as long as high, chela longer than carpus, 2.4 times as long as broad, fingers slightly shorter or as long as palm.

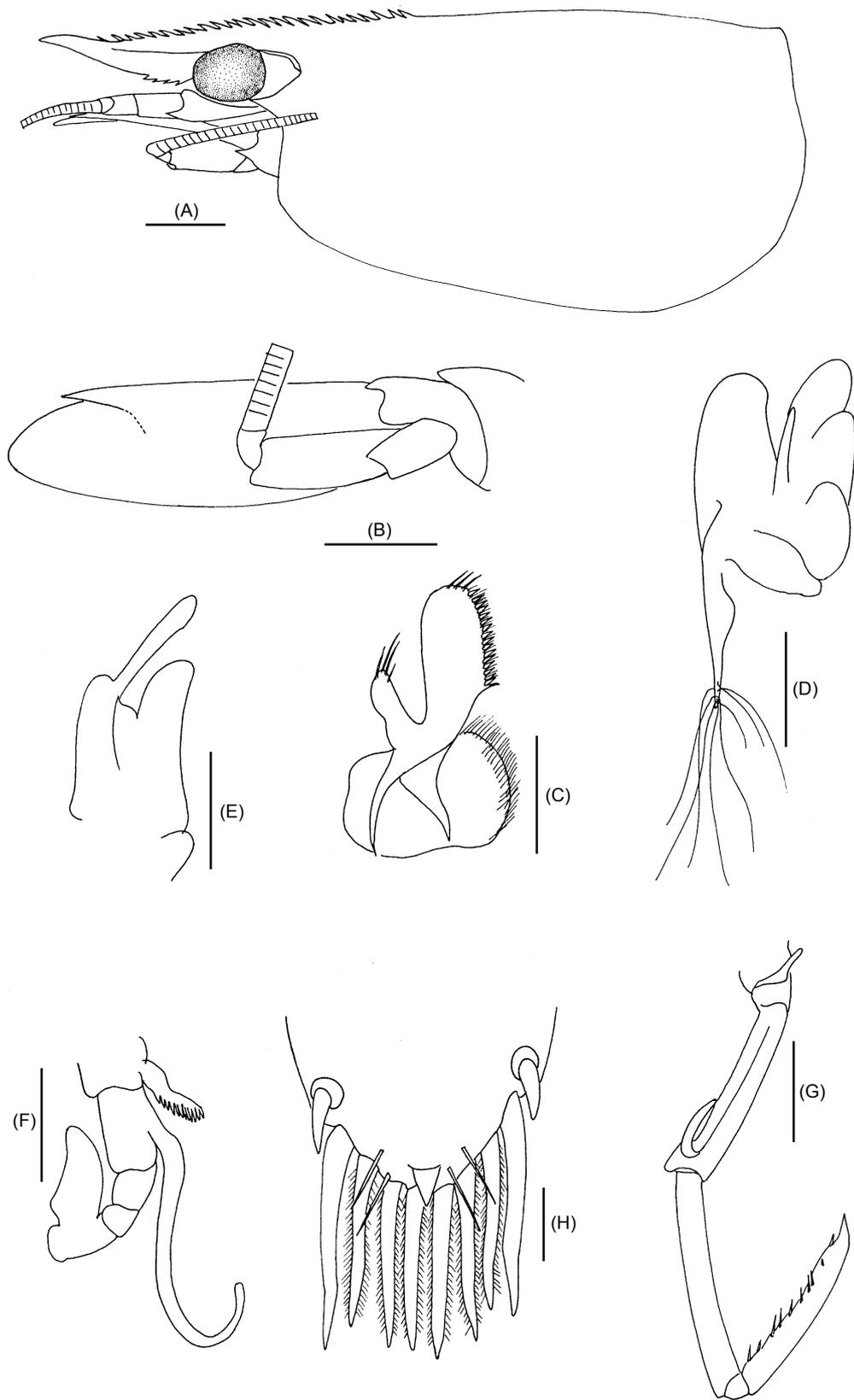


Fig. 16. *Caridina laticarpalis* sp. nov. (A) cephalothorax and cephalic appendages, lateral view, (B) scaphocerite, (C) maxillula, (D) maxilla, (E) first maxilliped, (F) second maxilliped, (G) third maxilliped, (H) distal portion of telson. Scale bars: A-G = 1.0 mm; H = 0.2 mm. (male, cl 4.3 mm, holotype, IZCAS DE 5040).

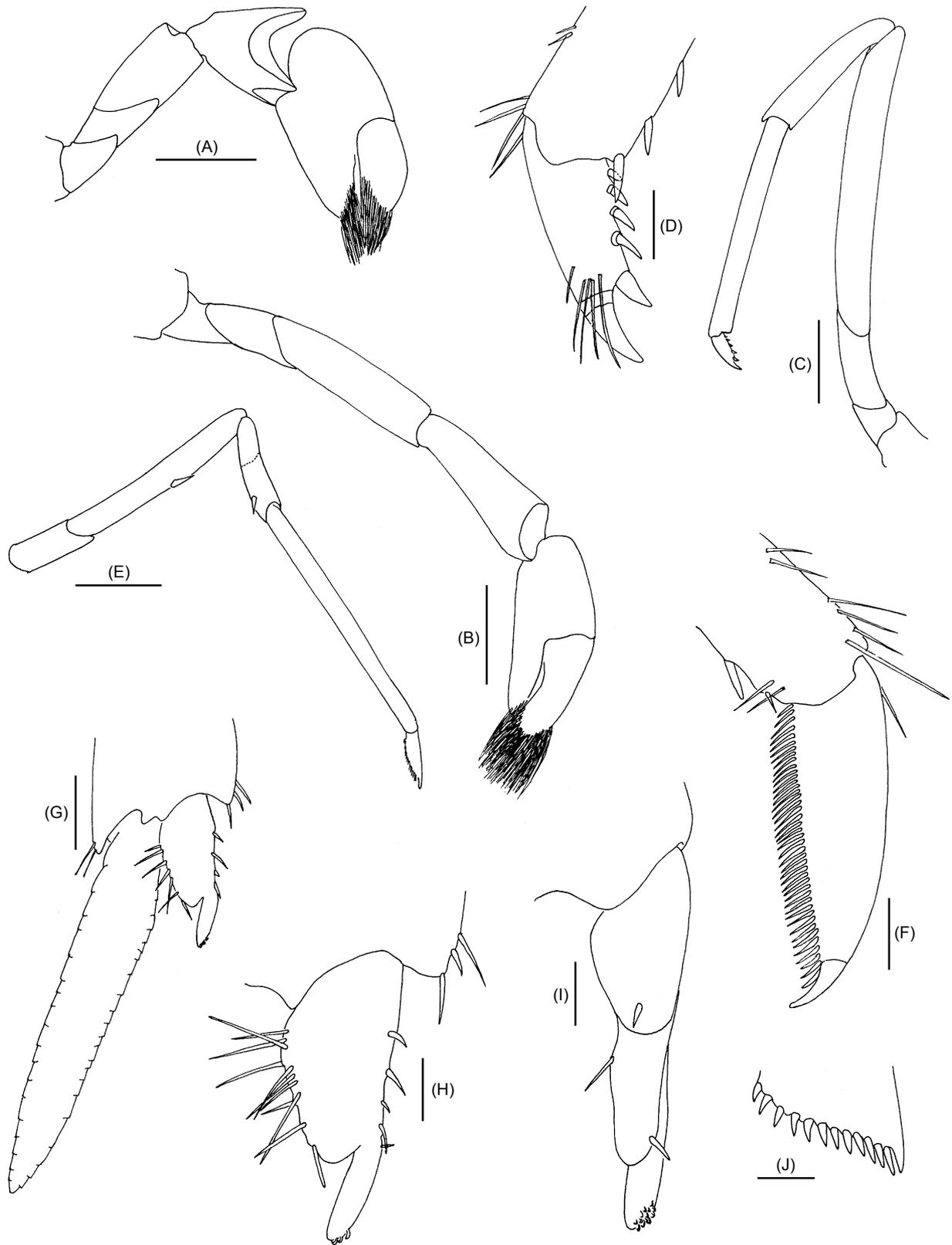


Fig. 17. *Caridina laticarpalis* sp. nov. (A) first pereiopod, (B) second pereiopod, (C) third pereiopod, (D) dactylus of third pereiopod, (E) fifth pereiopod, (F) dactylus of fifth pereiopod, (G) male first pleopod, (H) endopod of male first pleopod, (I) appendix masculina and appendix interna of male second pleopod. Scale bars: A-C, E = 1.0; D, F, H-J = 0.2 mm; G = 0.5 mm. (male, cl 4.3 mm, holotype, IZCAS DE 5040).

Third pereiopod (Fig. 17C, D) reaching beyond distal end of antennular peduncle, propodus 10 times as long as broad, 4.6 times as long as dactylus (claw included); dactylus ending in 2 claws, with 4 spines. Fifth pereiopod (Fig. 17E, F) reaching to end of antennular peduncle, propodus 13 times as long as wide, 4.3 times as long as

dactylus; dactylus with 42-45 spinules on flexor margin.

Endopod of male first pleopod (Fig. 17G, H) short, reaching to quarter endopod length, sub-triangular, 1.7 times as long as wide, appendix interna near distal end of endopod, reaching well beyond distal end of endopod. Appendix masculina

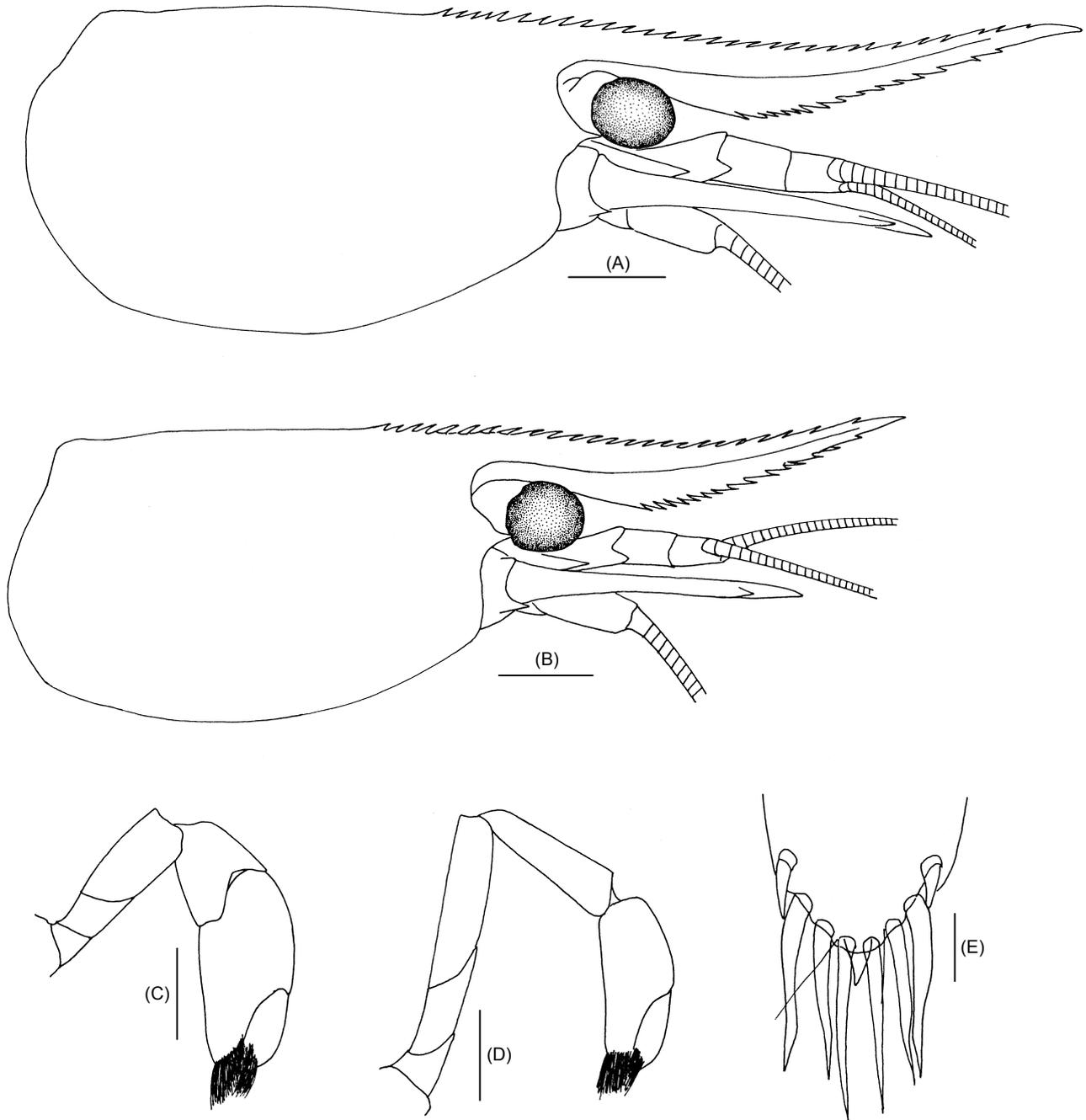


Fig. 18. *Caridina laticarpalis* sp. nov. (A, B) cephalothorax and cephalic appendages, lateral view, (C) first pereiopod, (D) second pereiopod, (E) distal portion of telson. Scale bars: A-D = 1.0 mm; E = 0.2 mm. (A, C-E, female, cl 5.4 mm, paratype, ZRC 2018.0486; B, female, cl 4.8 mm, paratype, ZRC 2018.0486).

of male second pleopod (Fig. 17I) reaching 0.8 endopod length; shorter than appendix interna.

Uropodal diaeresis (Fig. 17J) with 12 spinules.

Habitat: Stream in a karst cave.

Etymology: The new species is named for its distinctive broad carpus of first pereopod, from the Latin for broad (*latus*) and carpus.

Remarks: Taking the form of rostrum and the relatively shorter fingers of the first pereopod into account, *C. laticarpalis* sp. nov. is most similar to *C. cavernicola* Liang and Zhou, 1993 and *C. guilin* sp. nov. It can be separated from the latter two species by the rounded distal margin of the female telson (Fig. 16H) (vs. strongly acutely triangular in *C. cavernicola*, cf. Liang and Zhou, 1993 figs. 2(2); and *C. guilin*, fig. 14B). It also differs from *C. cavernicola* by the shorter carpus of the first pereopod (ratio 1.0-1.2, Fig. 17A) (vs. 1.4-1.7; cf. Liang and Zhou, 1993: fig. 2(4)); possessing fewer spinules on the dactylus of the fifth pereopod (42-45, Fig. 17F) (vs. 66-69; cf. Liang and Zhou, 1993: fig. 2(7)); and the smaller number of ventral rostral teeth (14 or 15; Figs. 16A, 18A, B) (vs. 20-24; cf. cf. Liang and Zhou, 1993: fig. 2(1)). *Caridina laticarpalis* can be further differentiated from *C. guilin* by the form of the appendix interna of the endopod of the male first pleopod, which is located near the end of the endopod (Fig. 19G, H) (vs. at the end of endopod; Fig. 17F), and by the larger number of ventral teeth on the rostrum (14 or 15, Figs. 16A, 18A, B) (vs. 7-12, Figs. 14A, 15A).

Distribution: Guangxi Province (Wuming), China.

***Caridina* aff. *heterodactyla* Liang and Yan, 1985**
(Figs. 19, 20)

Material examined: Female, cl 7.5 mm, damaged with incomplete abdomen, ZRC Tonglin Cave, near Nan Cave, Kaiyuan County, Yunnan Province, southern China, coll. B. Sket, 26 Nov 1995.

Comparative material examined: *Caridina heterodactyla* Liang and Yan, 1985- Holotype: male, cl 5.6 mm, SFU, mountain stream at Sizhong County, Yunnan Province, China, 1983. Paratype: 1 female, cl 5.6 mm, SFU, mountain stream at Sizhong County, Yunnan Province, China, 1983.

Description: Rostrum (Fig. 19A) short, sharply downturned, reaching slightly beyond end of basal segment of antennular peduncle, dorsally with 24 teeth, of which, 12 are situated at carapace behind posterior margin of orbital margin, occupying 0.3

carapace length, armed ventrally with 7 small teeth. Antennal spine fused with suborbital angle. Pterygostomian angle rounded.

Eyes well developed (Fig. 19A). Stylocerite reaching slightly beyond end of basal segment of antennular peduncle. Antennular peduncle (Fig. 20A) 0.43 times as long as carapace. Scaphocerite (Fig. 20B) 2.7 times as long as wide, outer margin straight.

Mouthparts as figured. Mandible (Fig. 19B) with blunt teeth at extremity of incisor process. Maxillula (Fig. 19C) with simple palp, lower lacinia broadly rounded, upper lacinia broadly elongated, inner edge straight, with dense setae and teeth. Maxilla (Fig. 19D) with slender palp, upper endite subdivided, scaphognathite tapering with numerous long hooked setae posteriorly. Palp of first maxilliped (Fig. 19E) stout, terminating in triangular projection. Endopod of second maxilliped (Fig. 19F) with fused dactylus and propodal segments. Third maxilliped (Fig. 20C) reaching to distal end of antennular peduncle, ending in single terminal claw; exopod reaching posterior quarter of penultimate segment, ultimate segment slightly shorter than pentultimate segment. Epipods on first 4 pereopods.

First pereopod (Fig. 20D) short, stout, reaching distal margin of eye, merus 2.1 times as long as broad; carpus strong concave anteriorly, 1.3 times as long as high, chela 2.6 times as long as broad, fingers slightly longer than palm. Second pereopod (Fig. 20E) reaching almost to end of second segment of antennular peduncle; carpus 3.9 times as long as high, chela shorter than carpus, 2.3 times as long as broad, fingers as long as palm. Third pereopod (Fig. 20F, G) reaching beyond distal end of scaphocerite, propodus 10 times as long as broad, 4.8 times as long as dactylus (claw included); dactylus ending as 2 claws, with 5 spines on flexor margin. Fifth pereopod (Fig. 20H) reaching distal end of antennular peduncle, propodus 10 times as long as wide, dactylus missing. Eggs 1.2 × 0.8 mm in diameter.

Habitat: Stream in karst cave.

Remarks: The single female specimen found from the Tonglin Cave in Kaiyuan is morphologically closest to *C. heterodactyla* Liang and Yan, 1985 in the downturned rostrum, the large number of postorbital teeth on carapace, the eggs and the long stylocerite, which reaches the end of basal segment of the antennular peduncle. It can be distinguished from *C. heterodactyla* s. str. by the much shorter length of rostrum (Fig. 19A), which

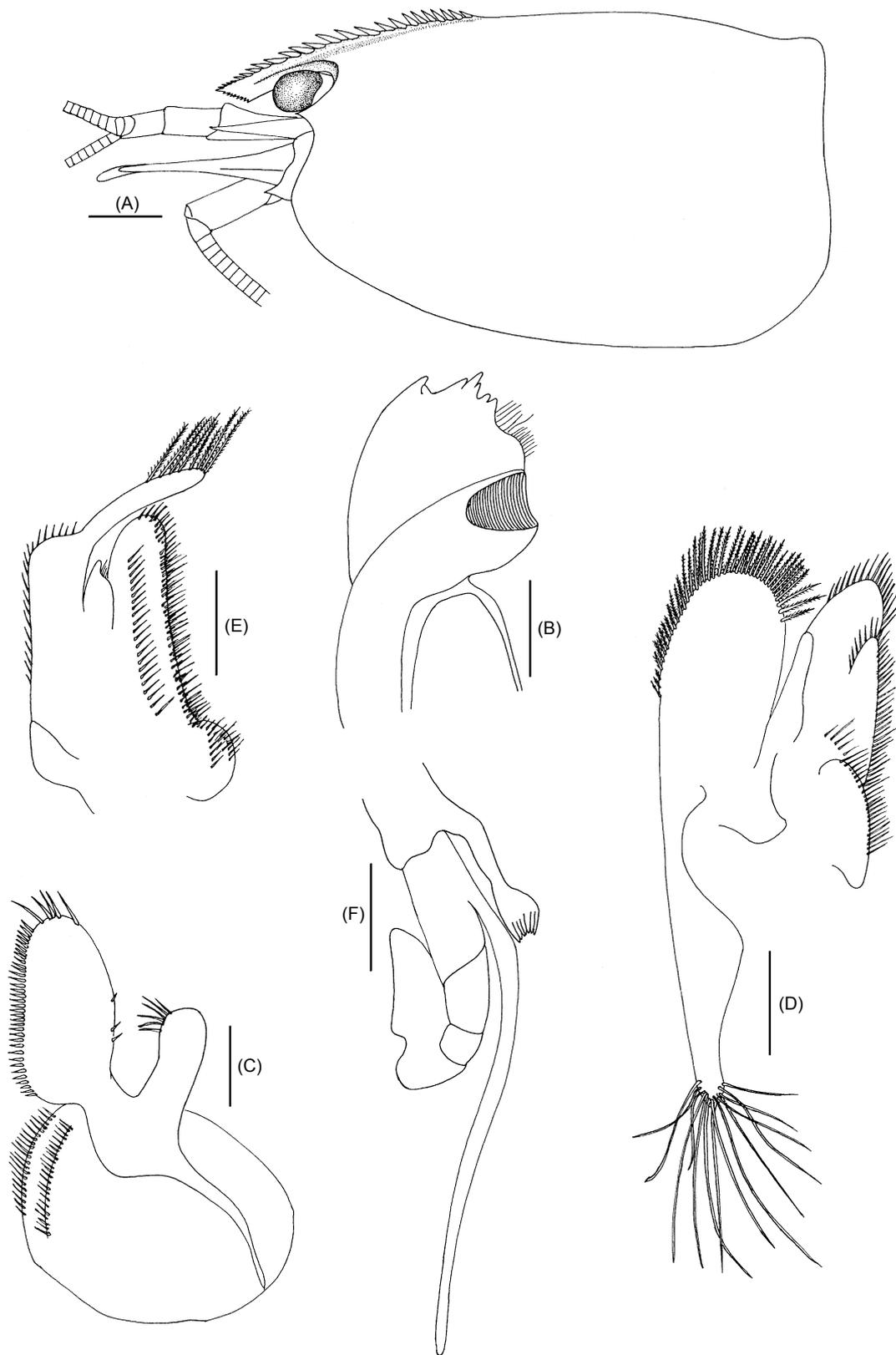


Fig. 19. *Caridina* aff. *heterodactyla* Liang and Yan, 1985. (A) cephalothorax and cephalic appendages, lateral view, (B) mandible, (C) maxillula, (D) maxilla, (E) first maxilliped, (F) second maxilliped. Scale bars: A, D-F = 1.0 mm; B, C = 0.5 mm. (ovigerous female, cl 7.5 mm, ZRC).

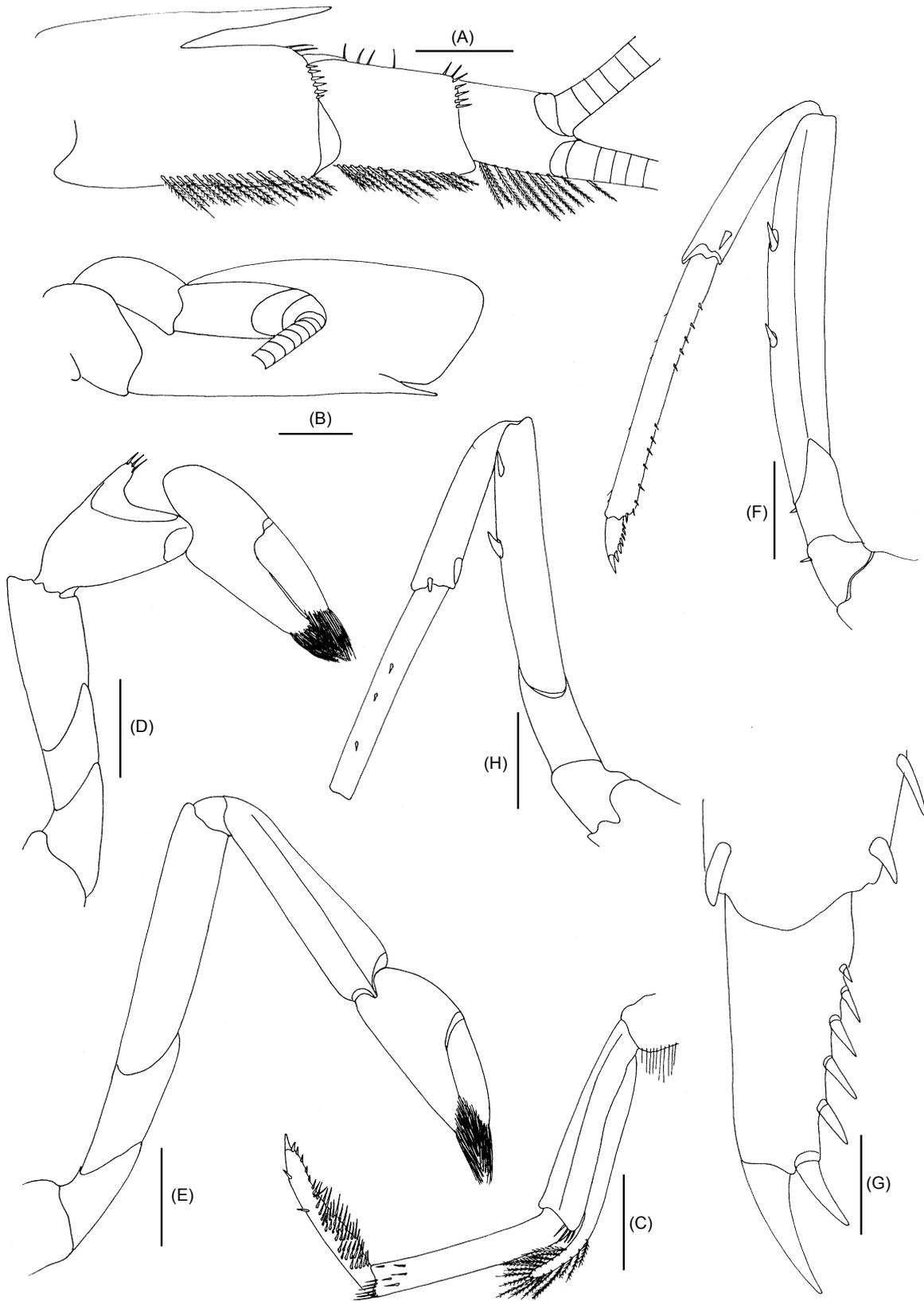


Fig. 20. *Caridina* aff. *heterodactyla* Liang and Yan, 1985. (A) antennular peduncle, (B) scaphocerite, (C) third maxilliped, (D) first pereopod, (E) second pereopod, (F) third pereopod, (G) dactylus of third pereopod, (H) fifth pereopod. Scale bars: A-F, H = 1.0 mm; G = 0.3 mm. (ovigerous female, cl 7.5 mm, ZRC).

reaches only slightly beyond the end of the basal segment of antennular peduncle; and the shorter carpus of first pereopod (1.3 times as long as high, Fig. 20D) (vs. 2.0-2.3 times as long as high; cf. Liang and Yan, 1985: fig. 2(4)). We believe that the morphological differences indicate that the present specimen is probably an undescribed species. But with only a single incomplete female specimen available, we prefer to defer the naming of new species to a later stage when more specimens are available.

Distribution: Yunnan Province (Tonglin Cave), China.

Family Palaemonidae Rafinesque, 1815
Genus *Macrobrachium* Spence Bate, 1868

***Macrobrachium linyunense* (Li and Luo, 2001)**

Typhlocaridina linyunensis Li and Luo, 2001: 72, fig. 1.
Macrobrachium linyunense Li, Cai and Clarke, 2006: 277, figs. 1-3.

Material examined: Paratypes of *Macrobrachium linyunense* Li, Cai and Clarke, 2006 - one female, cl 15.1 mm, ZRC, Sadong (Sand Cave), north of Linyun Town, Linyun County, Guangxi Province, China, coll. Arthur Clarke, 11 Oct 2000; one male, cl 12.8 mm, one female, cl 8.5 mm, ZRC 2005.0138, Sadong (Sand Cave), north of Linyun Town, Linyun County, Guangxi Province, China, coll. Arthur Clarke, 11 Oct 2000.

Remarks: “*Typhlocaridina linyunensis*” was described by Li and Luo (2001) on the basis of two small specimens measuring 31 and 32 mm in body length from a cave in Guangxi, but this is actually a species of *Macrobrachium* (Palaemonidae) and clearly is not an atyid shrimp at all. The type specimens were deposited in the management office of Heilongtan Reservoir in Shilin county of Yunnan Province and are not available for re-examination. The original description is rather brief and the figures are not good, but the characters of the first pereopod (Li and Luo, 2001: fig. 1 (3)), second pereopod (Li and Luo, 2001: fig. 1 (4)), third pereopod (Li and Luo, 2001: fig. 1 (5)) and the fifth pereopod (Li and Luo, 2001: fig. 1 (6)) leave no doubt that this taxon is a palaemonid.

Although the drawing of telson (cf Li and Luo, 2001: fig. 1 (7)) shows a difference in distal end of telson between *T. linyunensis* and *M. linyunense* (cf Li et al., 2006: fig. 2G); this, however, most probably is due to the poor drawing in Li and Luo (2001: fig. 1(7)), which could not differentiate the

sublateral pairs of spines from the intermediate setae. The number of movable spines on dorsal surface of telson also shows differences between *T. linyunensis* and other *Typhlocaridina* species (2 pairs in Li and Luo, 2001: fig 1(7), described as 3 pairs in table 1, vs. 5-7 pairs in that of other *Typhlocaridina* species (Liang 2004:305; 308); while the number in *M. linyunense* is 2 pairs (Li et al., 2006: 279). The length of sublateral pairs of spines in distal end of telson is subequal to intermediate pairs of setae in *M. linyunense* (Li et al., 2006: fig. 2G) and in *T. linyunensis* Li and Luo, 2001: fig. 1(7), while in *Typhlocaridina* species, sublateral pair of spines distinctly much longer than intermediate pairs of setae (Liang 2004: fig. 149b; fig. 150c).

The type specimen of “*Typhlocaridina linyunensis*” is small and subadult, but from the shape of the carapace, rostrum and pereopod proportions, it is almost certainly identical to *Macrobrachium linyunense*. Both species were from the same cave, Sand Cave (Shadong in Chinese).

Li and Luo's (2001) publication, which was published in a local university journal in Guangxi, was not known to Li et al. (2006) when they described *M. linyunense*. Nevertheless, Li and Luo (2001) has precedence over Li et al. (2006), and the species should now be considered *Macrobrachium linyunense* (Li and Luo 2001).

DISCUSSION

When they described *Macrobrachium elegantum*, Pan et al. (2010: 86) stated that “With the addition of the new species described here, there are 17 stygobiont species of Decapoda recorded in China, of which 15 belong to three genera of the family Atyidae and two to the family Palaemonidae (Table 1).” Since then, three species of cavernicolous brachyuran crabs have also been found (Chen and Chang 2002; Ng 2017; Huang et al. 2017). Checking through their list, we found at least three more shrimp species that should be added: *Mancicaris sinensis* Liang, Guo and Tang, 1999; *Caridina yulinica* Cai and NK Ng, 1999; and *C. wumingensis* Cai and NK Ng, 1999.

As noted by Holthuis (1986a: 589), “it is not difficult to classify a species which is found only in total darkness, shows no pigment, has the eyes reduced and the appendages strongly elongated, as a stygobiont; similarly a species that shows no adaptations to subterranean life, is frequent

in epigeal waters, and has once or twice been met with in a subterranean habitat, can be easily recognized as stygoxene. But all intermediates between these extremes occur. A better knowledge of a species may change our idea of whether it is or is not a stygobiont.”

Sket (2008), based on a comprehensive review, suggested to use “terrestrial and aquatic troglobionts” rather than troglobionts (for terrestrial fauna) and stygobionts (for aquatic fauna) and proposed four easily recognized categories: “(1) troglobiont is a species or population, strictly bound to a hypogean habitat; (2) eutroglophile is an essentially epigeal species, but able to maintain a permanent subterranean population; (3) subtroglophile is inclined perpetually or temporarily to inhabit a subterranean habitat but is bound to the surface for some biological functions (e.g. feeding); (4) troglone is a species only occurring sporadically underground.” Sket (2008) also commented that “it is only feasible to classify an animal species as troglobiotic if it does not ‘normally’ appear in epigeal habitats irrespective of the reasons for its absence in epigeal habitats or its morphological appearance. However, it should be recognized that any classification of each individual species may only reflect our present-day understanding and may require further revision in the future.”

In the present paper, the term cave or subterranean shrimp refers to one that is so far only known from subterranean waters. It most likely includes the stygobionts and taxa with more intermediate characters of Holthuis (1986a) and both troglobionts and eutroglophiles of Sket (2008).

If we are to apply this definition to what was listed by Pan et al. (2010), their *Caridina dianchiensis* should be excluded as it was mostly collected from surface waters (Liang and Yan 1985; Cai and Ng 2001).

Apart from the reduced eyes, which have a small pigment spot, the morphology of *C. semiblepsia* Guo, Choy and Gui, 1996 agrees closely with the description of *C. ablepsia* Guo Jiang and Zhang, 1992, a troglobiotic species living in a cave “only 25 km apart” (Guo et al. 1996: 74). This is especially in the form of the rostrum, the ratio of the pereopods, the form of the sexual appendages (Guo et al. 1996: figs. 4C-E vs. Guo et al. 1992: figs. 8, 9). As discussed under *C. longshan* sp. nov. (see remarks), the pigmentation of the cornea does vary from a large spot to a reduced small spot and, sometimes, completely absent, even among specimens from

one population. This drastic variation in eye pigmentation may be genetic and/or associated with the microhabitat the species occurs in. The other morphological differences listed by Guo et al. (1996) are relatively minor and not significant. As such, here we treat *C. semiblepsia* Guo, Choy and Gui, 1996 as a junior subjective synonym of *C. ablepsia* Guo, Jiang and Gui, 1992.

With the descriptions of the seven new and one unnamed *Caridina* species in this paper, the total number of cave shrimps now known from China is 26. This includes 19 species of *Caridina*, one species of *Neocaridina*, three species of *Typhlocaridina* and one species of *Mancicaris* (all Atyidae); and two species of *Macrobrachium* (Palaemonidae). A complete list is provided below, with a map (Fig. 21) showing their localities. Among the 26 species, only half are recognized as stygobionts or aquatic troglobionts.

Compared to those from other regions, viz. South East Asia (Holthuis 1978 1984; Cai and Ng 2005 2009; Cai and Husana 2009; Cai Choy and Ng 2009; Cai and Vidthayanon 2016), Australia (Williams 1964; Holthuis 1960 1986b; Bruce 1992; Page et al. 2007), the Americas (Hobbs et al. 1977; Alvarez et al. 2005), Europe (Sket and Zakšek 2009) and Madagascar (Holthuis 1956b; Gurney 1984; Cai 2005), the shrimp fauna in Chinese subterranean waters is comparatively high in species diversity, but most of the cave dwelling species are morphologically close to epigeal species in nearby areas.

Some interesting structures are noteworthy. The prominent spines on the third and fourth pereopods of *Caridina spinicrus*, the presence of spinules on the surface of setae, or serrated setae as defined by Garms and Watling (2013), at distal end of telson on *C. longshan* and *C. jiangkou*, and the acutely distal margin of the telson on females of *C. cavernicola* and *C. guilin* are interesting characters that have not been recorded from epigeal species and may lead to a better understanding of adaptive behavior in subterranean waters; they deserve more attention and study.

List of cave shrimps from China

1. *Caridina ablepsia* Guo, Jiang and Zhang, 1992 (Stygobiont = *C. semiblepsia* Guo, Choy and Gui, 1996; Yongshun and Baojing, Hunan)
2. *Caridina guangxiensis* Liang and Zhou, 1993 (Guilin, Guangxi)
3. *Caridina cavernicola* Liang and Zhou, 1993

- (Du'an, Guangxi)
4. *Caridina mengae* Liang 1993 (Songtao, Guizhou)
 5. *Caridina demenica* Cai and Li, 1997 (Stygobiont; Libo, Guizhou)
 6. *Caridina feixiana* Cai and Liang, 1999 (Gejiu, Yunnan)
 7. *Caridina yulinica* Cai and NK Ng, 1999 (Yulin, Guangxi)
 8. *Caridina wumingensis* Cai and NK Ng, 1999 (Wuming, Guangxi)
 9. *Caridina cavern* Liang, Chen and Li, 2005 (Stygobiont; Libo, Guizhou)
 10. *Caridina acuta* Liang, Chen and Li, 2005 (Stygobiont; Libo, Guizhou)
 11. *Caridina alba* Li and Li, 2010 (Stygobiont; Lichuan, Hubei)
 12. *Caridina longshan* sp. nov. (Stygobiont; Longshan, Hunan)
 13. *Caridina alu* sp. nov. (Stygobiont; Luxi, Yunnan)
 14. *Caridina spinicrus* sp. nov. (Beiliu, Guangxi)
 15. *Caridina beiliu* sp. nov. (Beiliu, Guangxi)
 16. *Caridina jiangkou* sp. nov. (Jiangkou, Guizhou)
 17. *Caridina guilin* sp. nov. (Guilin, Guangxi)
 18. *Caridina laticarpalis* sp. nov. (Wuming, Guangxi)
 19. *Caridina* aff. *heterodactyla* Liang and Yan, 1985 (Kaiyuan, Yunnan)
 20. *Typhlocaridina lanceifrons* Liang and Yan, 1981 (Stygobiont; Wuming, Guangxi)
 21. *Typhlocaridina liui* Liang and Zhou, 1993 (Stygobiont; Lingui, Guangxi)
 22. *Typhlocaridina semityhplata* Cai, 1995 (Stygobiont; Guilin, Guangxi)
 23. *Mancicaris sinensis* Liang, Guo, and Tang, 1999 (Stygobiont; Lanshan, Hunan)
 24. *Neocaridina brevidactyla* Liang, Chen and Li, 2005 (Libo, Guizhou)
 25. *Macrobrachium lingyunense* (Li and Luo, 2001) (Stygobiont; = *M. lingyunense* Li, Cai and Clarke, 2006; Lingyun, Guangxi)
 26. *Macrobrachium elegantum*, Pan, Hou and Li, 2010 (Stygobiont; Jingxi, Guangxi)

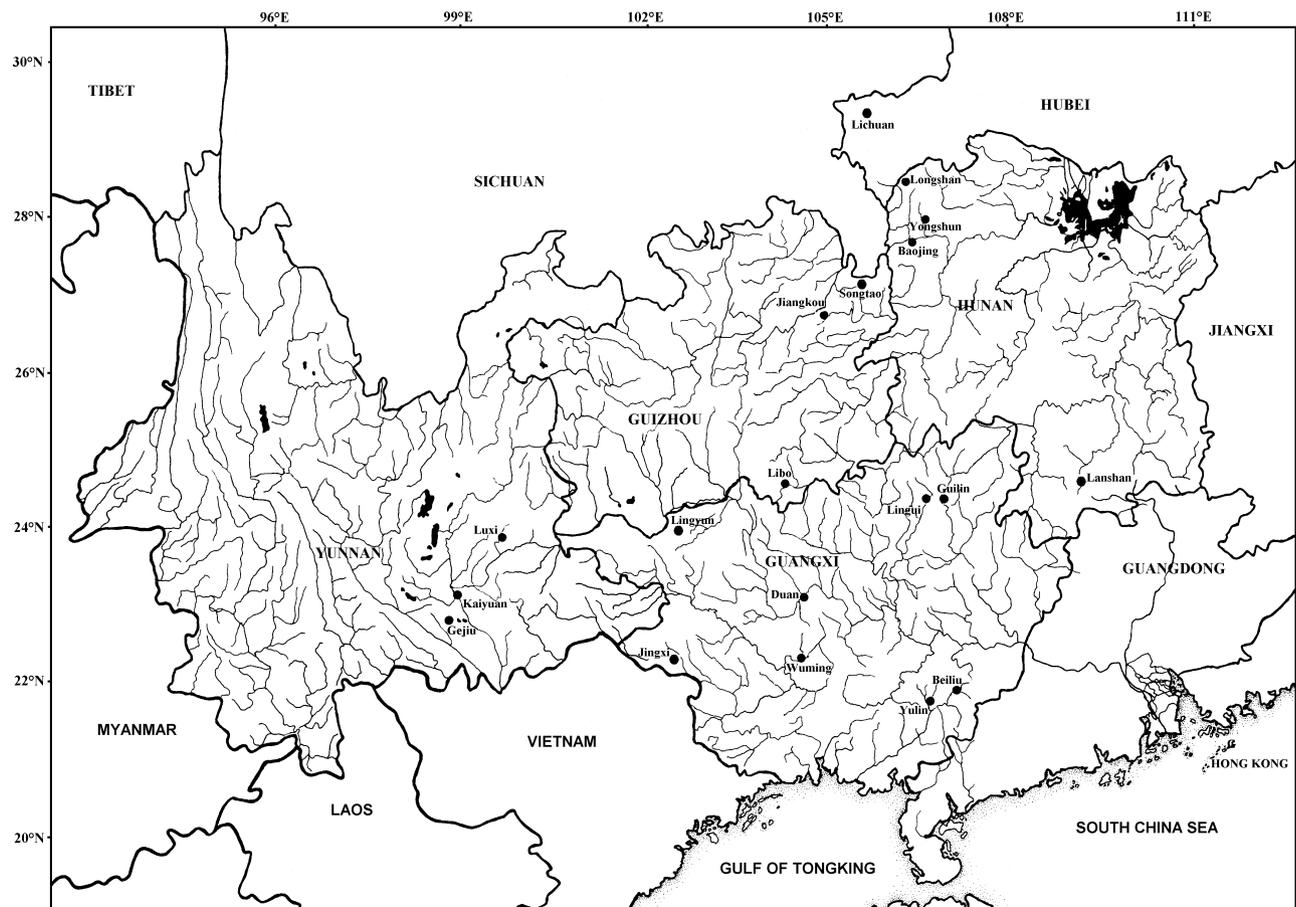


Fig. 21. Map with localities of cave shrimps found in China.

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Authors' contributions: CYX performed the morphological examination, drafted the description and discussion. PKLN drafted the discussion.

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Availability of data and materials: All materials examined are available from various museums stated in the text.

Consent for publication: Not applicable.

Ethics approval consent to participate: Not applicable.

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