

A revision of the *Caridina serrata* species group, with descriptions of five new species (Crustacea: Decapoda: Caridea: Atyidae)

Y. CAI and N. K. NG

*c/o Department of Biological Sciences, National University of Singapore,
Lower Kent Ridge Road, Singapore 119260, Republic of Singapore;
e-mail: scip6145@leonis.nus.edu.sg*

(Accepted 16 November 1998)

The taxonomy of the *Caridina serrata* species group (Caridea: Atyidae) is revised. Neotypes of *C. serrata* Stimpson, 1860, and *C. cantonensis* Yu, 1938, are designated. Additional information on *Caridina sphyrapoda* Liang and Zhou, 1993 is provided. Five new species of the *Caridina serrata* species group are described, namely *Caridina nanaoensis* from Guangdong Province, *C. apodosis* from Hong Kong, and *C. yulinica*, *C. wumingensis* and *C. mutata* from Guangxi Province, all in southern China. A key to all members of the species group is included.

KEYWORDS: Crustacea, Decapoda, Atyidae, *Caridina serrata* species group, revision, new species, southern China.

Introduction

One of the first known atyid species described in East Asia is *Caridina serrata* Stimpson, 1860, first described from Hong Kong island. Since then, *C. serrata*, as well as several new species and subspecies allied to it have been reported and/or described from China and Vietnam. This is despite the fact that *C. serrata* is a poorly known species, being only very briefly described in Stimpson (1860), the figure is too small and schematic in Kemp (1918), and the type specimens are almost certainly lost.

Over the years, the first author obtained a large series of specimens of the *C. serrata* species complex from various parts of China. The study of this extensive material has permitted a much better understanding of the taxonomy of this group. The present paper serves to revise the species in this species group. The identities of *C. serrata* Stimpson, 1860, *C. cantonensis* Yu, 1938, and *C. sphyrapoda* Liang and Zhou, 1993, are clarified, and neotypes are designated for *C. serrata* and *C. cantonensis*. Five new species, *C. nanaoensis*, *C. apodosis*, *C. yulinica*, *C. wumingensis* and *C. mutata* are described.

All these species share the following common characters namely (a) a long stylocerite which distinctly extends beyond the end of the basal segment of the

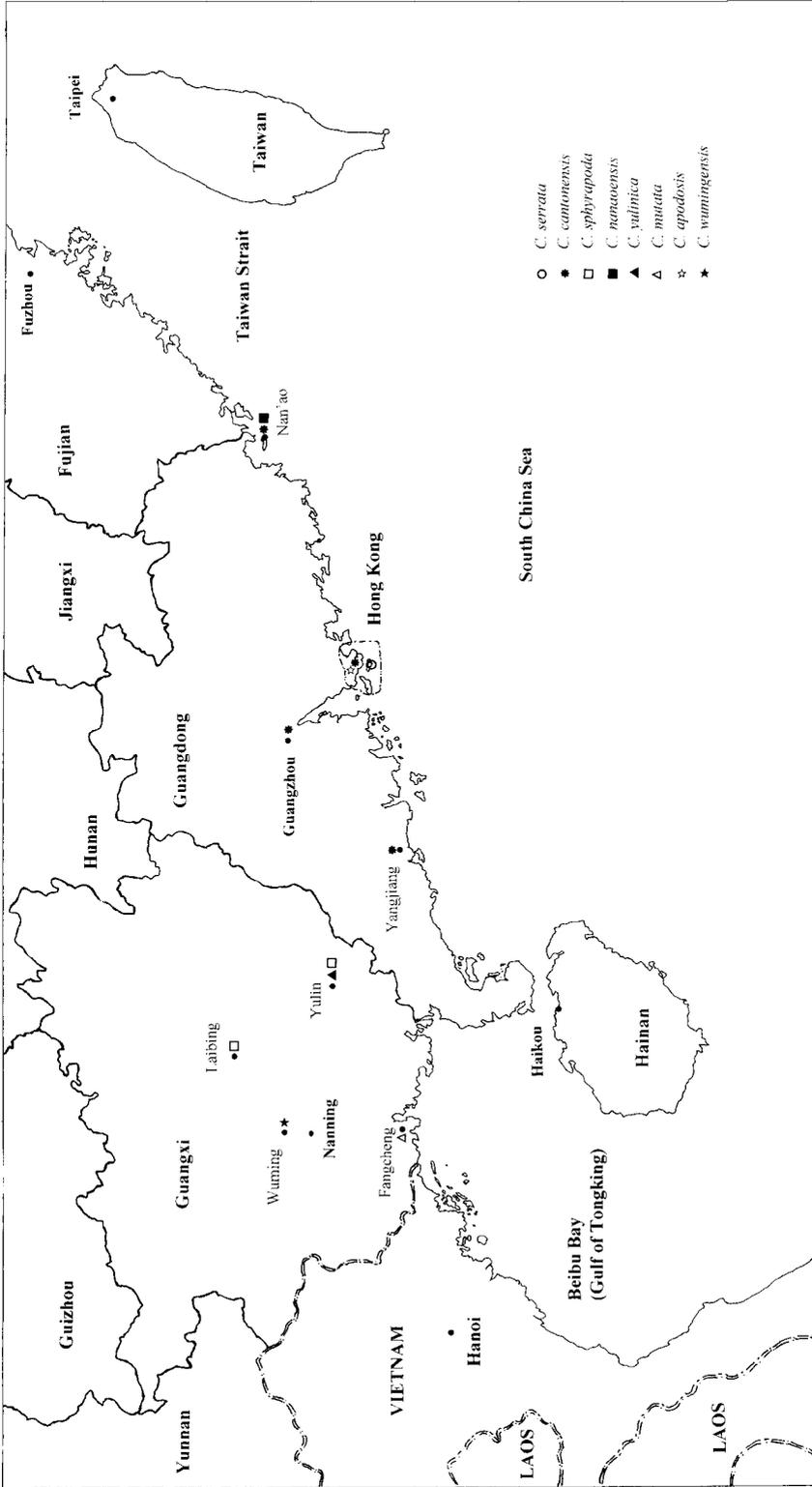


FIG. 1. Collection sites of *Caridina serrata* species group.

antennular peduncle; (b) presence of dorsal teeth on the carapace; (c) the endopod of male pleopod 1 has a distinctive appendix interna; and (d) ovigerous females have large-size eggs, and the larval development is of abbreviated type (Dudgeon, 1987).

The holotypes and paratypes of the new species are deposited in the Institute of Zoology, Academia Sinica, Beijing (IZAS). Neotypes and paratypes are kept in the Zoological Reference Collection, National University of Singapore (ZRC). Other paratypes are deposited in Beijing Natural History Museum (BNHM); Queensland Museum, Australia (QM); Rijksmuseum van Natuurlijke Historie, Leiden (RMNH), Natural History Museum, London (NHM), Museum National d'Histoire Naturelle, Paris (MNHN) and National Museum of Natural History, Smithsonian Institution, Washington DC (USNM). Materials from Shanghai Fisheries University (SFU), and National Taiwan Ocean University (NTOU), have been re-examined. The abbreviation, cl. is used for carapace length (measured from the postorbital margin to the posterior margin of the carapace). Rostral formula citation and all terminology used follow that by Chace and Bruce (1993).

Taxonomy

Family ATYIDAE De Haan, 1849

Genus *Caridina* Milne-Edwards, 1837

Caridina serrata Stimpson, 1860

(figures 2, 3, 6B, 6G)

Caridina serrata Stimpson, 1860: 29 [Type locality: Hong Kong]

Caridina serrata: Ortmann, 1894: 406; Bouvier, 1905: 76; 1925: 258, figure 593; Kemp, 1918: 289, figure 12

non *Caridina serrata serrata*: Dang, 1980: 402, figure 229

non *Caridina serrata*: Liang and Yan, 1983: 253; 1985: 198; 1986: 201.

non *Caridina serrata*: Dudgeon, 1985: 141; 1987: 339, figures 1–7

non *Caridina serrata*: Hung, Chan and Yu, 1993: 498, figures 9C, 12A–G

Material examined

NEOTYPE—♂ (cl.: 4.8 mm) (ZRC.1998.583), hill above Bekhers, Hong Kong island, Hong Kong, leg. D. Dudgeon, 28 February 1997.

Others. 21 ♂♂ (cl.: 3.3–5.1 mm), 5 ♀♀ (cl.: 3.5–5.7 mm), 1 ovigerous ♀ (cl.: 5.5 mm) (ZRC.1998.584); 4 ♂♂ (cl.: 4.2–4.5 mm), 4 ♀♀ (cl.: 4.0–5.3 mm) (IZAS); 2 ♂♂ (cl.: 4.4–4.5 mm), 2 ♀♀ (cl.: 4.7–5.2 mm) (RMNH); 2 ♂♂ (cl.: 3.9–4.0 mm), 2 ♀♀ (cl.: 5.1–5.7 mm) (USNM); 2 ♂♂ (cl.: 4.5–5.0 mm), 2 ♀♀ (cl.: 5.0–5.1 mm) (NHM); 2 ♂♂ (cl.: 3.9–4.6 mm), 2 ♀♀ (cl.: 4.6–5.0 mm) (MNHN); 2 ♂♂ (cl.: 4.2–4.5 mm), 1 ♀ (cl.: 5.0 mm) (QM), hill above Bekhers, Hong Kong island, Hong Kong, leg. D. Dudgeon, 28 February 1997.

Description

Rostrum short, straight or slightly curved downwards, nearly reaching to or slightly reaching beyond end of basal segment of antennular peduncle, tip directed slightly upwards, rostral formula: 0–5 (mode 1–3) + 5–12 (mode 7–9)/0–6 (mode 2–3), teeth larger, more widely spaced anteriorly than posteriorly; inferior orbital angle of carapace fused with antennal spine; pterygostomial angle rounded, slightly produced forwards.

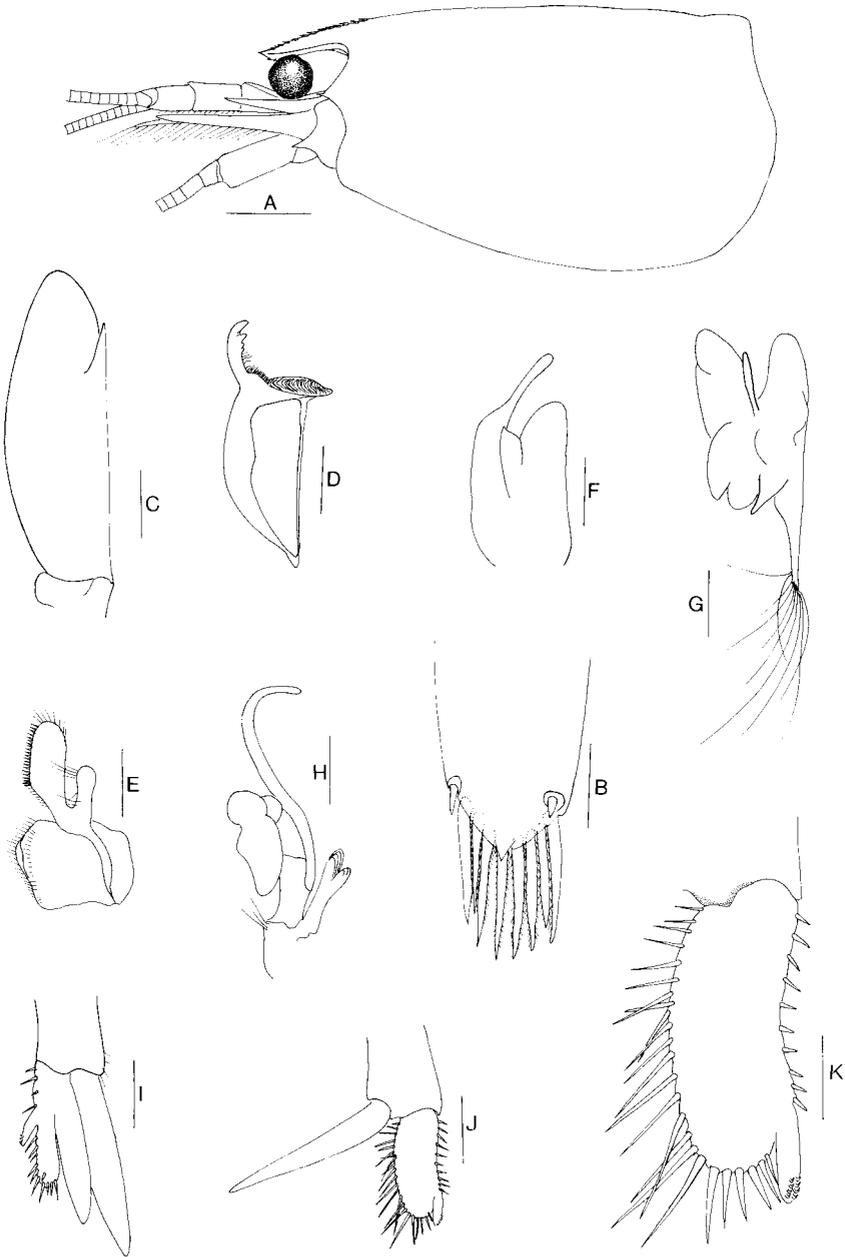


FIG. 2. *Caridina serrata* (♂, cl.: 5.0 mm, Hong Kong, ZRC.1998.584). A, cephalothorax; B, distal region of telson; C, scaphocerite; D, mandible; E, maxillule; F, maxilla; G, first maxilliped; H, second maxilliped; I, second pleopod; J, first pleopod; K, endopod of first pleopod. Scales: A = 1.0 mm; B = 0.2 mm; C–J = 0.5 mm.

Telson ending in median projection; five pairs of dorsal spinules, one pair of dorso-lateral spines near distal end, three to four pairs of spines on distal margin, lateral pair longer than sub-lateral pair, shorter than intermediate pairs; preanal carina rounded, no spine. Scaphocerite 3.0 times as long as wide.

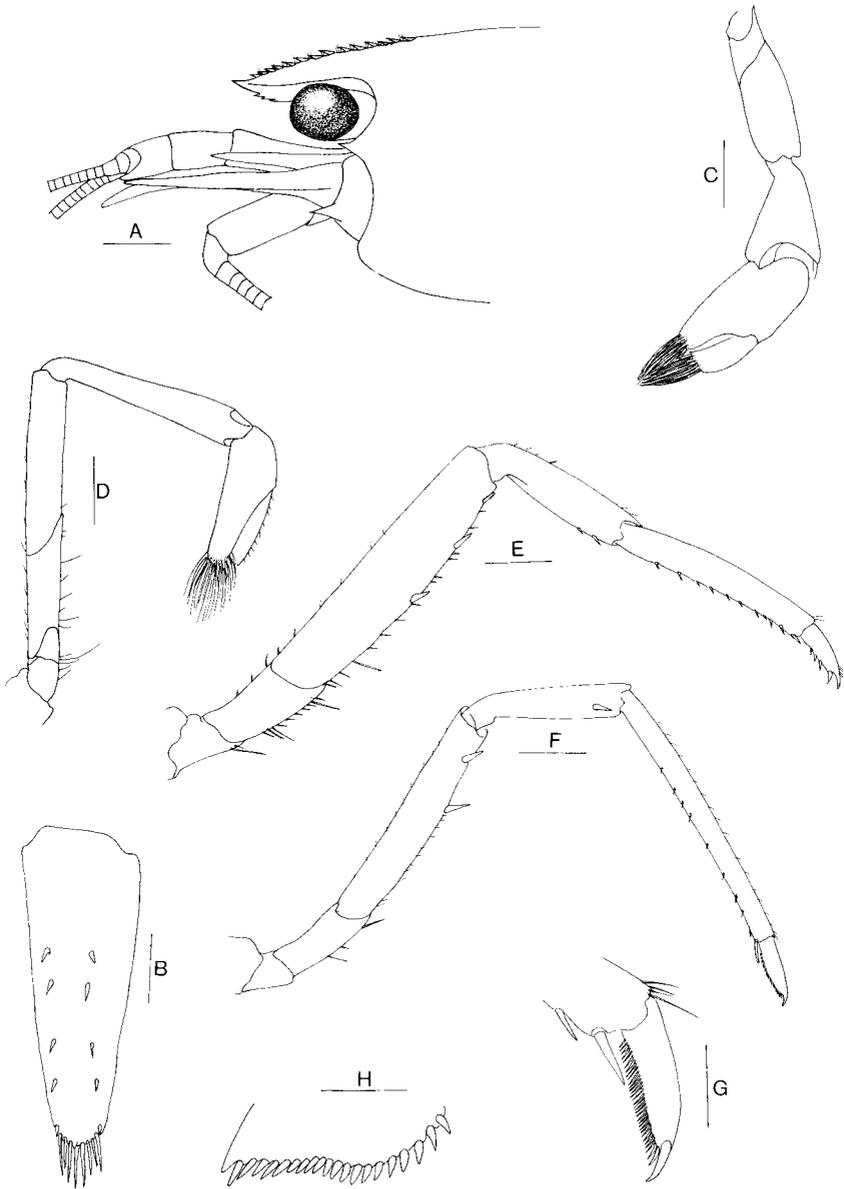


FIG. 3. *Caridina serrata* (♂, cl.: 4.8 mm, Hong Kong, ZRC.1998.584). A, anterior region of cephalothorax (Neotype, ♂, cl.: 4.8 mm, Hong Kong, ZRC.1998.583); B, telson; C, first pereiopod; D, second pereiopod; E, third pereiopod; F, fifth pereiopod; G, dactylus of fifth pereiopod; H, uropodal diaeresis. Scales: A = 1.0 mm; B–F = 0.5 mm; G, H = 0.2 mm.

Eyes well developed. Antennular peduncle stout, half as long as carapace; stylocerite distinctly reaching beyond end of basal segment of peduncle.

Mouthparts as figured (figure 2), palp of first maxilliped broadly triangular, ending in small projection.

First pereiopod reaching to end of basal segment of antennular peduncle; chela

2.0 times as long as broad, fingers shorter than palm; carpus short, as long as palm, 1.3 times as long as high; merus stout, slightly longer than carpus, 2.0 times as long as wide. Second pereopod slender, reaching beyond end of scaphocerite, chela 2.7 times as long as broad; fingers 1.5 times as long as palm; carpus 1.3 times longer than chela, 5.5 times as long as high; merus as long as chela. Third pereopod reaching end of scaphocerite, dactylus terminating in two claws, three to five accessory spines on flexor margin; propodus 4.0 times as long as dactylus (terminal spine included), 7.0 times as long as broad, numerous spinules on posterior margin; merus stout, 4.5 times as long as wide. Fifth pereopod reaching to end of basal segment of antennular peduncle; dactylus stout, 30–35 denticulate spines on flexor margin; propodus slender, 3.5 times as long as dactylus, 10.0 times as long as broad, strong spine present on distal end, measuring 0.3 times as long as dactylus.

Endopod of the male first pleopod extending to 0.7 times exopod length, rectangular in shape, 2.5 times as long as broad, inner margin concave, outer margin slightly convex, usually curved inwards, simple setae longer on exterior margin, longest along anterior margin. Appendix interna on distal quarter, extending outwards, reaching to or slightly reaching beyond distal margin of endopod. Appendix masculina of male second pleopod reaching to 0.6 times endopod length, inner distal surface densely lined with long spinules; appendix interna at middle of appendix masculina, extending to distal quarter of appendix masculina.

Uropodal diaeresis with 18–21 spinules.

Eggs $0.9\text{--}1.0 \times 0.6\text{--}0.7$ mm in diameter.

Habitat

Fresh collections of this species were made by David Dudgeon from a small mountain stream at a hill above Bekhers, Hong Kong island. Kemp (1918: 291) recorded his specimens from ‘...pools in very small streamlets of clear water, devoid of weeds, on the Peak at Hong Kong, at an altitude of 1200–1500 ft...’.

Distribution

Hong Kong island only.

Remarks

This species was regarded by Ortmann (1894) as of doubtful validity but no discussion was given (Ortmann, 1894: 406). Bouvier (1925: 285) subsequently questioned the validity of *C. serrata* when he treated it as one of his two doubtful species in his monograph on the Atyidae. The type specimens are almost certainly lost (Evans, 1967; Deiss and Manning, 1981; Manning, 1993; R. B. Manning, pers. comm.). Based on the specimens collected from the peak of Hong Kong island (two lots from the same locality), Kemp (1918: 289) gave a more detailed description, stressing the unusual character of the stylocerite: ‘...the large process is long, much as on *C. serratirotris* de Man, 1892, reaching a little beyond the end of the segment to which it is attached’, but did not mention the pleopods. The present specimens agree well with the description of Kemp (1918).

Caridina serrata, as presently defined, differs distinctly from *C. serratirotris* and *C. celebensis* de Man, 1892 (*fide* Holthuis, 1965, 1978; Chace, 1997), in that it has a well-developed appendix interna at the endopod of the male first pleopod (vs absent). *Caridina serrata* can also be easily separated from South-East Asian taxa like *Caridina weberi sumatrensis* de Man, 1892, *C. laevis* Heller, 1862, *C. propinqua*

de Man, 1908, *C. thambipillai* Johnson, 1961. The long stylocerite in the *C. serrata* species group, which distinctly extends beyond the end of antennular peduncle is absent in these South-East Asian taxa.

Dang (1980) recognized two subspecies of *C. serrata*, namely *C. serrata serrata* and *C. serrata cucphuongensis* Dang, 1980, from northern Vietnam. According to his description and figures, the rostrum of *C. serrata serrata* reaches to the end of the second segment of the antennular peduncle, and the stylocerite does not reach beyond the end of the basal segment of the antennular peduncle. As such, it should not be referred to as *C. serrata*, or even to this species group. It is most probably an undescribed species. *Caridina serrata cucphuongensis* seems to be a member of this species group with regards to its long stylocerite and form of the pleopods. Its unusually stout rostrum, with only a few large teeth, however, easily distinguishes it from *Caridina serrata* and other members of the species group. According to Prof. Dang Ngoc Thanh, National Centre for Natural Science and Technology in Vietnam, specimens of both taxa (including types of *C. serrata cucphuongensis*) may be lost. Examination of some fresh *Caridina* material collected from Cucphuong, northern Vietnam (the type locality of *Caridina serrata cucphuongensis*), did not reveal any specimens of *C. serrata cucphuongensis*, but one new species (Cai, Nguyen and Ng, submitted).

Dudgeon (1985, 1987) used the name '*Neocaridina serrata*' for a population from Lam Tsuen river in New Territories, Hong Kong. Examination of the specimens from Lam Tsuen river showed that they are *Caridina cantonensis* Yu, 1938, instead. It differs from *C. serrata* by its longer rostrum which has a different rostral formula, and by the structures of the first two pereopods and the pleopods. According to Kubo (1938, 1940) and Cai (1996), neither *C. serrata* nor *C. cantonensis* can be referred to the genus *Neocaridina* Kubo, 1938, since the distal half of the male first pleopod is not dilated.

Liang and Yan (1983, 1985, 1986) highlighted some characters of *C. serrata* for comparison when they described several new species from China, but did not state the provenance of this material. Prof. Liang Xiangqiu, kindly allowed the first author to examine two lots of *C. serrata* from Guangdong Province, when he visited Shanghai Fisheries University in February, 1997. Results showed that both lots are not *C. serrata*. One lot of specimens, from Zhijing County, have stylocerites which do not reach beyond the end of the first segment of the antennular peduncle. It is probably an undescribed species which should not be referred to the *Caridina serrata* species group. The other lot, from Baiyunshan, a hill near Guangzhou city, belongs to *Caridina cantonensis*.

Hung *et al.* (1993) reported *C. serrata* from Taiwan. Re-examination of their specimens has shown that the Taiwanese species is different from the Hong Kong species in the form of the stylocerite, which never reaches the end of the basal segment of the antennular peduncle, and the appendix interna of the endopod of the male first pleopod, which distinctly reaches beyond the distal margin of the endopod. The Taiwanese *C. serrata* is actually *C. formosae* Hung *et al.*, 1993. So far, no material from Taiwan resembles *Caridina serrata* Stimpson, 1860.

According to the present study, *C. serrata* only occurs on Hong Kong island. Due to urbanization of the island, this endemic species is seriously threatened and should be regarded as an endangered species.

Since the type specimen of *C. serrata* was lost in the Great Chicago Fire in 1871 (Evans, 1967; Deiss and Manning, 1981; Manning, 1993; R. B. Manning, pers.

comm.), and because of the taxonomic problems with this species group, one specimen from the type locality is herein designated as the neotype of *Caridina serrata* Stimpson, 1860. The neotype, a male (cl.: 48 mm) from Hong Kong island is deposited in the ZRC (ZRC.1998.583).

***Caridina cantonensis* Yu, 1938**

(figures 4, 5, 6C–E, 6H–N)

Caridina cantonensis Yu, 1938: 290, figures 7, 8 [type locality: Guangdong (Canton), southern China]

?*Caridina cantonensis*: Dang, 1980: 414, figure 236

Material examined

NEOTYPE—♂ (cl.: 4.8 mm) (ZRC.1998.561), Qing'ao village, Nan'ao County, Guangdong Province, China, leg. J. Lin, April 1994.

Others. 3 ♂♂ (cl.: 3.9–4.2 mm), 3 ♀♀ (cl.: 3.6–4.9 mm), 1 juvenile (cl.: 2.0 mm) (IZAS), a stream 1 km to seashore, near Zapu town, Yangjiang County, Guangdong Province, leg. S. Yang, August 1978; 5 ♂♂ (cl.: 3.0–3.7 mm), 3 ♀♀ (cl.: 3.6–5.0 mm) (JG88164), Sheng'ao town, Nan'ao County, Guangdong Province, leg. S. Yang, 11 November 1988; 1 ♂♂ (cl.: 4.7 mm), 5 ♀♀ (cl.: 3.2–5.2 mm), 1 ovigerous ♀ (cl.: 5.2 mm) (IZAS), Yun'ao, Nan'ao County, Guangdong Province, S. Yang, November 1988; 7 ♂♂ (cl.: 3.8–5.3 mm), 3 ♀♀ (cl.: 5.0–6.1 mm), 4 ovigerous ♀♀ (cl.: 5.9–6.5 mm) (IZAS), Qing'ao town, Nan'ao County, Guangdong Province, leg. J. Lin, April 1994; 2 ♂♂ (cl.: 4.1–4.4 mm), 3 ♀♀ (cl.: 4.7–5.5 mm) (IZAS), stream near Qingao town, Nan'ao County, Guangdong Province, leg. J. Lin, April 1994; 1 ♂ (cl.: 3.9 mm), 9 ♀♀ (cl.: 3.9–4.8 mm), 2 ovigerous ♀♀ (cl.: 5.0–5.2 mm) (IZAS), Qing'ao, Nan'ao County, Guangdong Province, J. Lin, April 1994; 1 ♂ (cl.: 4.9 mm), 1 ♀ (cl.: 4.0 mm) (IZAS), 300 m to seashore near Bainiu village, Nan'ao County, Guangdong Province, leg. Y. Cai, February 1994; 2 ♂♂, 1 ♀ (RNHM), Qing'ao, Nan'ao County, Guangdong Province, leg. J. Lin, April 1994; 1 ♂ (cl.: 4.2 mm), 1 ovigerous ♀ (cl.: 6.5 mm) (ZRC.1998.562), same data as neotype; 9 ♂♂ (cl.: 3.9–4.6 mm), 15 ♀♀ (cl.: 3.5–5.8 mm) (IZAS, XG.0183), stream at campus of Hong Kong Chinese University, leg. S. Huang, 5 February 1980; 6 ♂♂ (cl.: 2.0–4.0 mm), 2 ♀♀ (cl.: 4.0–4.1 mm) (IZAS), small mountain stream, Kodoorie, New Territories, Hong Kong; leg. Y. Cai and S. S. Shea, 22 October 1994; 4 ♂♂, 1 ♀, (IZAS) stream on Mo An Hill, New Territories, leg. Y. Cai and S. Y. Lee, 24 October 1994; 19 ♂♂ (cl.: 3.8–4.2 mm), 18 ♀♀ (cl.: 3.6–5.1 mm) (one ovigerous) (IZAS), Lam Tsuen river, New Territories, Hong Kong, leg. Y. Cai and S. S. Shea, 30 October 1994; 7 ♂♂, 1 ovigerous ♀ (ZRC.1998.581), Lam Tsuen river at Pak Ngau Shek, leg. D. Dudgeon, 25 April 1997; 14 ♂♂, 2 ovigerous ♀♀ (ZRC.1998.582), stream in forest at Tai Po Kau, leg. D. Dudgeon, 25 April 1997; 16 ♂♂, 3 ♀♀, 3 ovigerous ♀♀ (ZRC.1998.567), Shine Mun reservoir, 25 April 1997; 9 ♂♂, 2 ♀♀, 3 ovigerous ♀♀ (ZRC.1998.580), Wu Kau Tang, Hong Kong, leg. D. Dudgeon, 28 April 1997.

Description

Rostrum straight, slightly bent downwards, extending to middle of second segment of antennular peduncle or to end of antennular peduncle but not reaching beyond it, rostral formula: 2–7 (mode: 3–5) + 6–15 (mode: 8–12)/2–6 (mode: 3–5), teeth more widely spaced anteriorly than posteriorly. Antennal spine placed at inferior angle of carapace, pterygostomial angle rounded, slightly produced forwards.

Telson ending in median projection; one pair of dorso-lateral spines near distal end, three to four pairs of spines on distal margin, lateral pair subequal to intermediate pairs; preanal carina rounded, no spine. Scaphocerite 3.0 times as long as wide.

Eyes well developed. Antennular peduncle slender, 0.7 times as long as carapace. Stylocerite very long, reaching to middle of second segment of antennular peduncle, occasionally near end of this segment. Scaphocerite 3.3 times as long as wide. Mouth parts similar to *C. serrata*. First maxilliped with terminal triangular palp.

First pereiopod reaching to middle of basal segment of antennular peduncle; chela 2.2 times as long as broad; fingers as long as palm; carpus 1.4 times as long as high, 0.6 times as long as chela, slightly shorter than merus; merus 2.7 times as long as wide. Second pereiopod reaching end of second segment of antennular peduncle; chela twice as long as broad, finger twice as long as palm; carpus slender, 5.5 times as long as high, slightly longer than merus. Third pereiopod just reaching end of scaphocerite, dactylus terminating in two spines, three to five accessory spines on flexor margin; propodus 4.0 times as long as dactylus, 10.0 times as long as broad; carpus 0.6 times as long as propodus; merus longer than previous segments, 5.5 times as long as wide. Fifth pereiopod reaching end of antennular peduncle, propodus 4.2 times as long as dactylus; dactylus 5.0 times as long as broad, 32–40 denticulate spines on flexor margin.

Endopod of male first pleopod rectangular, anterior region curving backwards, 0.7 of exopod length, inner margin concave, short setae present, outer margin straight or convex, distal margin rounded, setae of inner margin longer, spines of

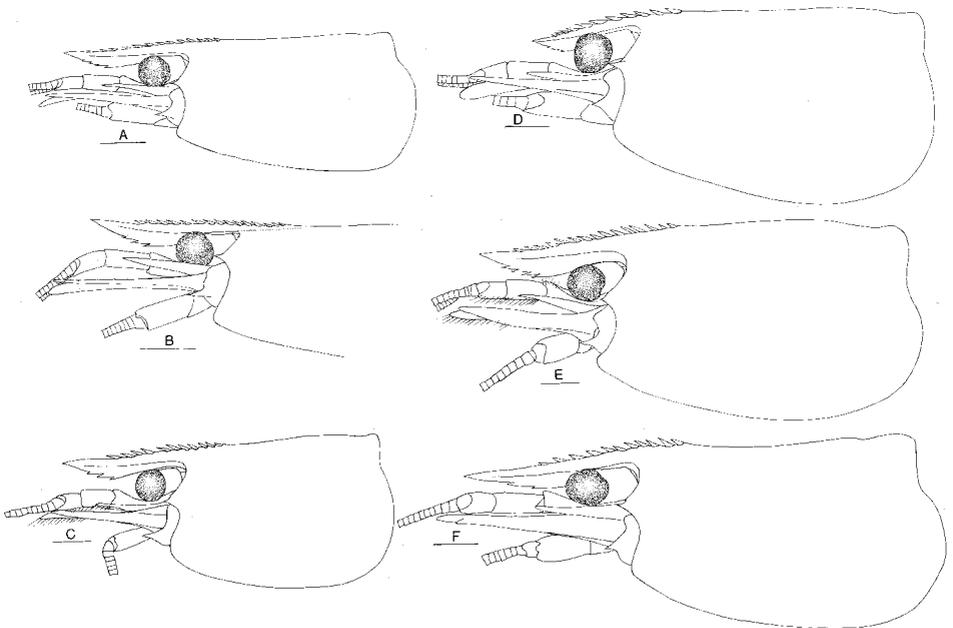


FIG. 4. *Caridina cantonensis*, cephalothorax, A, ♂, cl.: 5.7 mm, Nan'ao, Guangdong Province (IZAS); B, ♂, cl.: 5.8 mm, Nan'ao, Guangdong Province (IZAS); C, ♂, cl.: 3.8 mm; Lam Tsuen, Hong Kong (IZAS); D, ♂, cl.: 3.9 mm, Kodoorie, Hong Kong (IZAS); E, ♂, cl.: 5.0 mm, Lam Tsuen, Hong Kong (IZAS); F, ♂, cl.: 4.1 mm, Yangjiang, Guangdong Province (IZAS). Scales: A–F=1.0 mm.

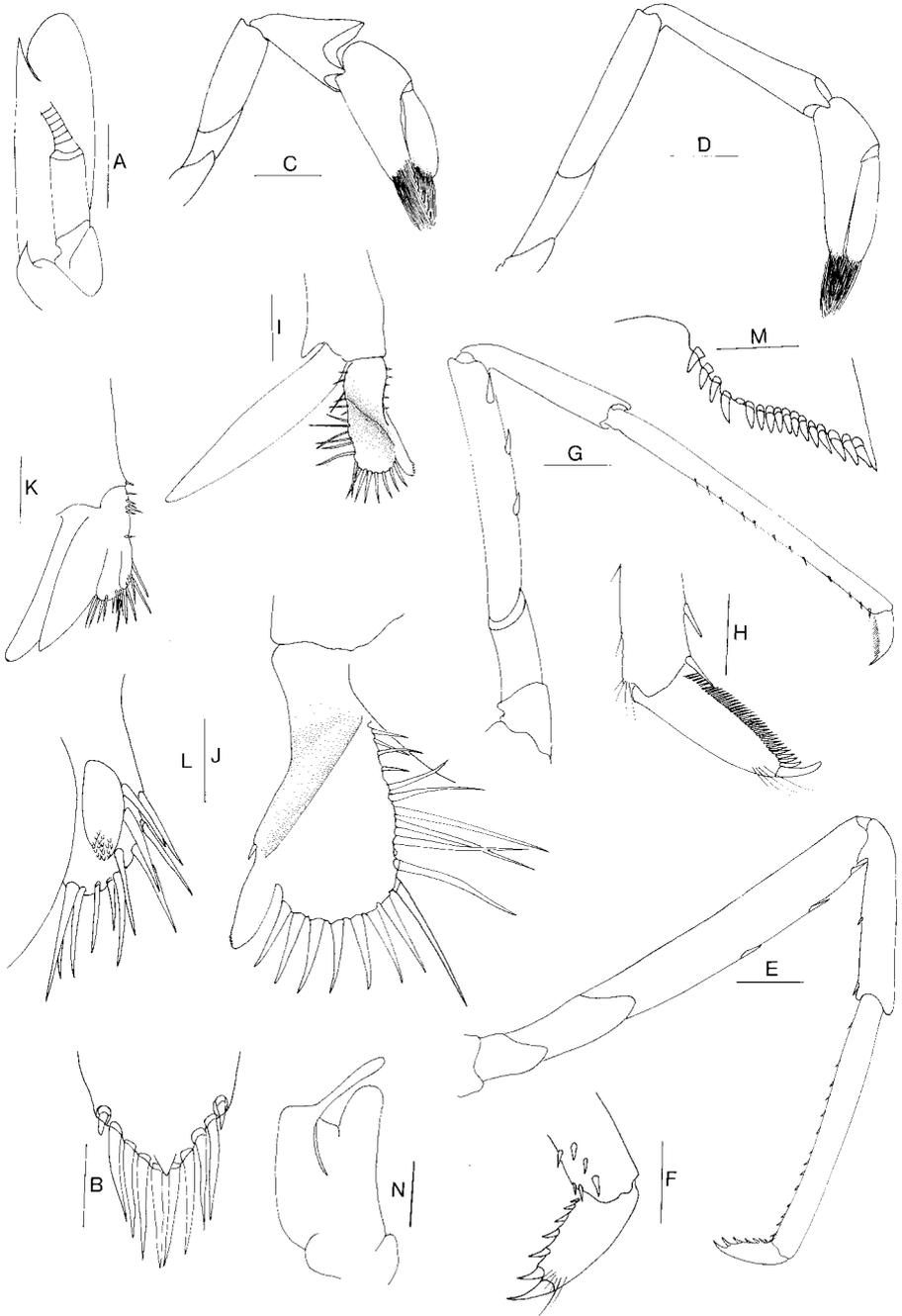


FIG. 5. *Caridina cantonensis* (♂, cl.: 5.7 mm, Nan'ao County, Guangdong Province, IZAS). A, scaphocerite; B, distal region of telson; C, first pereiopod; D, second pereiopod; E, third pereiopod; F, dactylus of third pereiopod; G, fifth pereiopod; H, dactylus of fifth pereiopod; I, first pleopod; J, endopod of first pleopod; K, second pleopod; L, masculina and appendix interna of second pleopod; M, uropodal diaeresis; N, palp of first maxilliped. Scales: A = 1.0 mm; B, F, H, J, L, M = 0.2 mm; C–E, G, I, K, N = 0.5 mm.

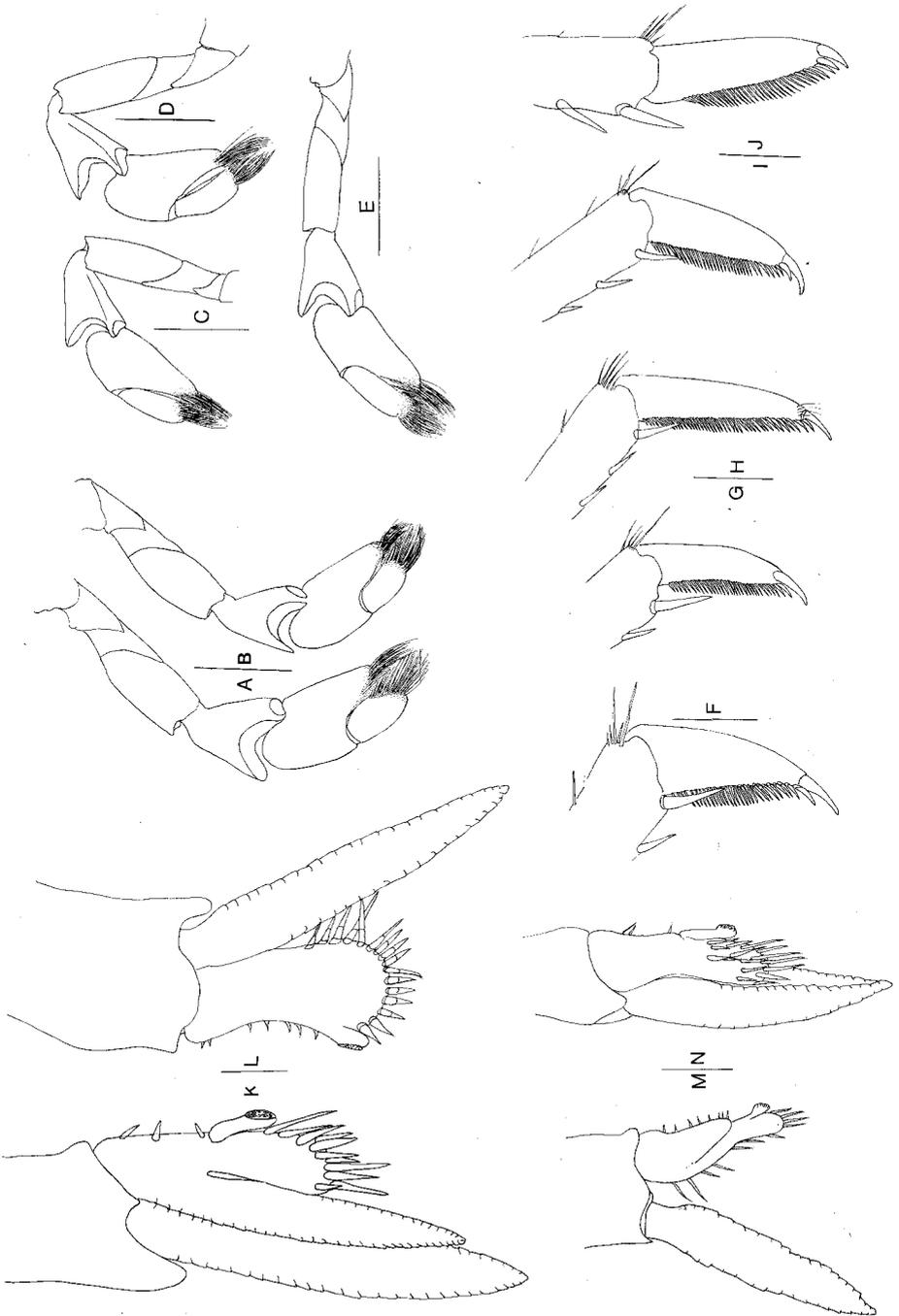


FIG. 6. A-E, female first pereiopod, F-J, dactylus of female third pereiopod; A, F: *Caridina nanaoensis*, sp. nov. Nan'ao, Guangdong Province, ♀, cl.: 6.3 mm (IZAS); B, G: *C. serrata*, Hong Kong island; ♀, cl.: 5.7 mm (IZAS); C, I: *C. cantonensis*; Nan'ao, Guangdong Province, cl.: 5.0 mm (IAZS); D, H: *C. cantonensis*, Yangjiang, Guangdong Province, ♀, cl.: 5.2 mm (IZAS); E, J: *C. cantonensis*, Shing Mun reservoir, Hong Kong, ♀, cl.: 6.0 mm (IZAS); K, male second pleopod, *C. cantonensis*, Lam Tsuen River, Hong Kong, ♂, cl.: 5.0 mm (IZAS); L, first pleopod, same specimen as in K; M, male first pleopod, *C. cantonensis*, Yangjing, Guangdong Province, ♂, cl.: 4.1 mm (IZAS); N, second pleopod, same specimen as in K. Scales: A-E=1.0 mm; F-J=0.2 mm; K-N=0.5 mm.

distal margin longer than those of inner margin, shorter than those of outer margin. Appendix interna extending slightly inwards reaching to anterior margin of endopod. Appendix masculina of endopod of male second pleopod 0.5 times endopod length, glabrous, densely lined spines on distal surface. Appendix interna narrow, small, 0.5 times appendix masculina length.

Uropodal diaeresis with 15–20 spinules.

Eggs $0.9\text{--}1.2 \times 0.6\text{--}0.8$ mm in diameter.

Habitat

Specimens examined were collected from mountain streams and rivulets in several locations of Guangdong Province (S. Yang, J. Lin, pers. comm.; Y. Cai pers. observ.), and Hong Kong (D. Dudgeon, pers. comm.; Y. Cai pers. observ.).

Distribution

Nan'ao island, Guangzhou, Yangjiang of Guangdong Province, Hong Kong and probably northern Vietnam (Dang, 1980).

Remarks

Yu (1938) described the rostral formula of *C. cantonensis* as 5–6+8–14/4–6. None of the present specimens have exactly this formula. Yu (1938) unfortunately, did not mention the form of the stylocerite, which is the most important character in this species group. The type material was collected from a mountain stream from somewhere in Canton (Guangdong). According to Yu (1938), his material was kept in the Fan Memorial Institute of Biology, the forerunner of the Institute of Zoology, Academia Sinica. His material is no longer extant in the Institute of Zoology (Y. Cai, pers. observ.; A. Dai, pers. comm.) and other associated Institutions (S. Yang, pers. comm.; X. Li, pers. comm.), and should be regarded as lost.

The form and rostral formula of *C. cantonensis* do vary in different localities and even within the same lot of specimens. In the specimens collected from Nan'ao County (IZAS), the rostral formula is 3–6+7–13/1–5, and their rostral forms are similar to those of the type specimens, which are slender, reaching to the base of the third segment of antennular peduncle or to the end of the peduncle. Specimens from the Yangjiang County (IZAS) population have a rostral formula of 4–6+6–9/2–4, and the rostra have a large anterior toothless region. Hong Kong specimens (IZAS, ZRC) have stouter and shorter rostral forms, with the majority of them reaching slightly beyond the base of the third segment of the antennular peduncle while some reach slightly behind it. These variations are present even within a single population. Other characters like the pereopods, male pleopod, telson, etc. all share a common form and agree well with the original description. Such differences between populations should be regarded as infra-specific variations.

The Nan'ao population is more similar to the types when compared with other populations. Since this species seems to have a wide distribution range, and in order to stabilize the taxonomic status of *C. serrata* species group, a male specimen from Qing'ao village of Nan'ao County (cl: 48 mm, rostral formula 4+9/4) is herein designated as neotype and deposited in the ZRC (ZRC.1998.561).

Caridina cantonensis Yu, 1938 is similar to *C. serrata* Stimpson, 1860, in the structure of the male pleopods, the telson and the long stylocerite. The differences are mainly in the form and armature of the rostrum, and the shape of the pereopods. *Caridina cantonensis* has a relatively longer rostrum, reaching to the middle of the

second segment of the antennular peduncle, or to the end of the third segment, but that of *C. serrata* only reaches to or slightly beyond the end of the basal segment. The number of teeth on the post-orbital region and ventral margin of the rostrum is also quite different. There are 0–5 (mode 1–3) and 0–6 (mode 2–3) in *C. serrata*, and 2–7 (mode 5–6) and 2–6 (mode 3–5) in *C. cantonensis*, respectively. The form of the first two pereopods can also be used to separate *C. cantonensis* from *C. serrata*. The finger of the male first pereopod is longer than the palm in *C. cantonensis* but shorter in *C. serrata*. The second pereopod of *C. cantonensis* never reaches beyond the scaphocerite, while that of *C. serrata* always distinctly extends beyond the scaphocerite; and the carpus of this leg is only slightly longer than the chela in *C. cantonensis* but much longer in *C. serrata*.

Specimens from Lam Tsun river in New Territories, Hong Kong, reported as *Neocaridina serrata* by Dudgeon (1985, 1987) are *Caridina cantonensis* (see remarks on *C. serrata*). Dang (1980) recorded *C. cantonensis* from northern Vietnam and on the basis of his description and figures, this identification seems to be correct. These specimens, however, should be re-examined to be certain.

***Caridina sphyrapoda* Liang and Zhou, 1993**

(figure 7)

Caridina sphyrapoda Liang and Zhou, 1993: 236, figure 4

Material examined

HOLOTYPE—♂ (cl.: 5.5 mm) (SFU, 85a-8-1), Longdong river, Laibing County, Guangxi Province, China, leg. J. Zhou, 24 May 1985.

PARATYPES—1 ♀ (cl.: 3.8 mm), 1 ovigerous ♀ (cl.: 5.8 mm) (SFU, 85a-8-2), data same as holotype.

Others. 3 ♂♂ (cl.: 4.5–6.3 mm), 6 ♀♀ (cl.: 4.7–6.6 mm) (IZAS), stream near Kuyang town, Yinlin County, Guangxi Province, leg. Y. Cai, H. Tang and H. Zhen, November 1993; 2 ♂♂ (cl.: 4.5–5.0 mm) (IZAS), stream near Bo'ai Town, Yulin County, Guangxi Province, leg. H. Tang, May 1994.

Description

Rostrum reaching beyond end of antennular peduncle, rostral formula: 4–8 + 8–11/9–13; antennal spine fused with inferior orbital angle of carapace, or placed slightly lower than inferior orbital angle; pterygostomial angle broadly rounded.

Telson ending in a median projection, four pairs of spines along distal margin of telson, lateral pair distinctly longer than intermediate pairs.

Eyes well developed. Antennular peduncle 0.8 times as long as carapace, stylocerite slightly reaching beyond end of basal segment of antennular peduncle. Scaphocerite of antennal peduncle 3.0 times as long as broad. Palp of first maxilliped broadly triangular.

First pereopod extending to level of eye; chela 2.0 times as long as broad, palm subequal to length of fingers; carpus 0.8 times as long as chela, 1.8 times as long as high. Second pereopod reaching to end of second segment of antennular peduncle; chela 3.5 times as long as broad, slightly shorter than carpus, palm 0.8 times as long as fingers; carpus 5.0 times as long as high. Third pereopod reaching end of scaphocerite; dactylus 0.2 times as long as propodus, eight teeth on posterior margin; carpus 10.0 times as long as broad. Fifth pereopod reaching middle of second

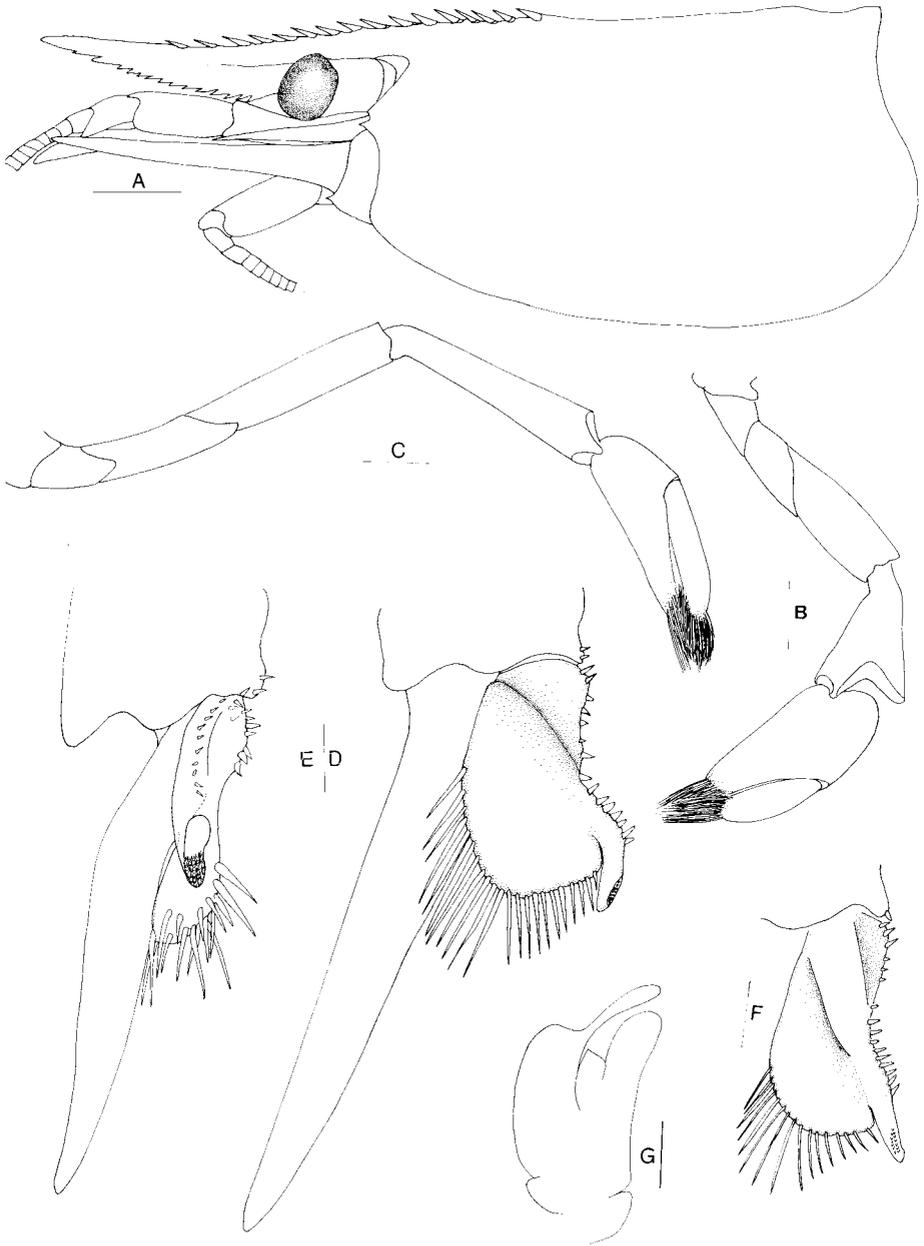


FIG. 7. *Caridina sphyrapoda* (♂, cl.: 6.3 mm, Yulin County, Guangxi Province, IZAS). A, cephalothorax; B, first pereiopod; C, second pereiopod; D, first pleopod; E, second pleopod; F, first pleopod; G, palp of first maxilliped (F, G: ♂, cl.: 6.2 mm, Yulin County, Guangxi Province, IZAS). Scales: A = 2.0 mm; B–G = 0.5 mm.

segment of antennular peduncle; dactylus 0.3 times as long as propodus, 51–65 denticulate teeth on posterior margin.

Endopod of male first pleopod curved backwards, 0.4 times as long as exopod, 2.0 times as long as broad; inner margin deeply concave, small protrusion at proximal

region, appendix interna reaching or reaching beyond distal margin of endopod. Appendix masculina of male second pleopod 0.5 times as long as exopod, appendix interna small, 0.3 times as long as appendix masculina.

Uropodal diaeresis with 12–15 spinules.

Eggs about 1.25×0.85 mm in diameter.

Habitat

Found in very clear water from subterranean streams (Y. Cai, pers. observ.) or in rivers (Liang and Zhou, 1993).

Distribution

Laibing County, Yulin County of Guangxi Province, southern China.

Remarks

Caridina sphyrapoda has only been previously recorded from the type locality, Laibin County of Guangxi Province. Re-examination of the types showed that the Yulin specimens are identical to the types, although there is some variation in the structure of the endopod of the male first pleopod. The form of the process at the proximal inner region is not easy to discern in some specimens, and the appendix interna is straight in some specimens but curved inwards in others, even within one population. This should be regarded as infra-specific variation. This species is presently referred to the present *C. serrata* species group because of its relatively long stylocerite, the rostral formula and the form of sexual pleopods. When compared to congeners in the group, the stylocerite of *C. sphyrapoda* is comparatively shorter, reaching just slightly beyond the end of the basal segment of the antennular peduncle and the rostrum is comparatively longer, distinctly reaching beyond the end of the antennular peduncle. The broad endopod of the male first pleopod, with a process at its proximal region and the form of appendix masculina of male second pleopod can be used to distinguish it from *C. serrata* and *C. cantonensis*.

***Caridina nanaoensis* sp. nov.**

(figures 6A, 6F, 8)

Material examined

HOLOTYPE—♀ (cl.: 5.0 mm) (IZAS), Xialiao stream near Xishan Town, Nan'ao County, Guangdong Province, China, leg. Y. Cai, 18 February 1994.

PARATYPES—4 ♂♂ (cl.: 4.7–5.4 mm), 4 ♀♀ (cl.: 5.5–6.0 mm) (IZAS), data same as holotype; 2 ♂♂ (cl.: 4.4–4.8 mm), 2 ♀♀ (cl.: 5.2–6.0 mm) (ZRC.1998.568–571), same data as holotype; 2 ♂♂ (cl.: 4.5–4.8 mm), 2 ♀♀ (cl.: 5.1–5.7 mm) (RMNH), same data as holotype.

Others. 41 ♂♂, 27 ♀♀ (IZAS), data same as holotype; 19 ♂♂ (cl.: 4.4–6.2 mm), 13 ♀♀ (cl.: 4.2–6.2 mm), Biantuo stream near Gongqian village, Nan'ao County, Guangdong Province, leg. Y. Cai, 17 February 1994.

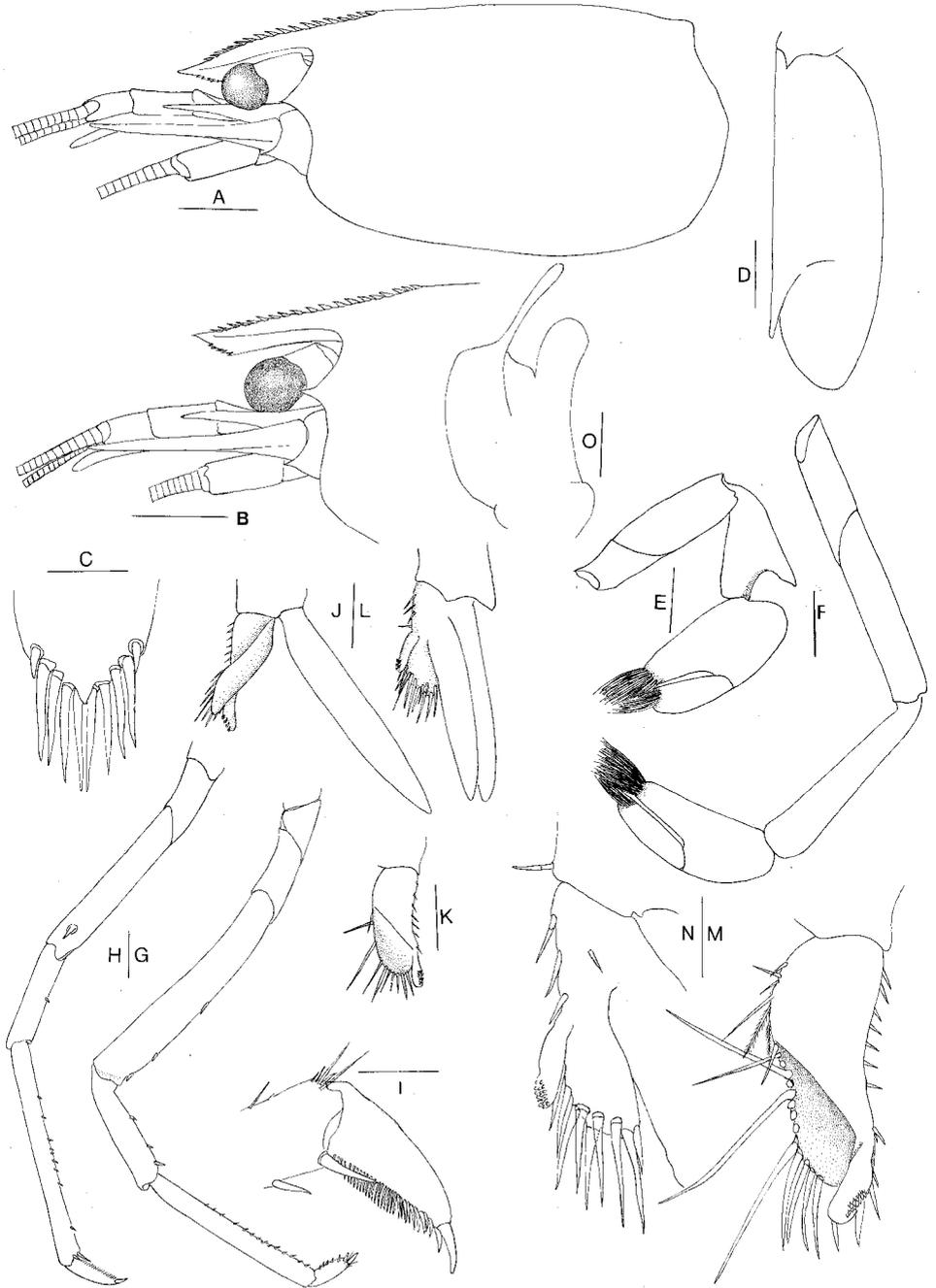


FIG. 8. *Caridina nanaoensis* sp. nov. (paratype, ♂, cl.: 5.0 mm, Nan'ao County, Guangxi Province, IZAS). A, cephalothorax; B, anterior region of cephalothorax (holotype, ♀, cl.: 5.0 mm, Nan'ao County, Guangdong Province, IZAS); C, distal region of telson; D, scaphocerite; E, first pereiopod; F, second pereiopod; G, third pereiopod; H, fifth pereiopod; I, dactylus of fifth pereiopod; J, first pleopod; K, same as J; L, second pleopod; M, endopod of first pleopod; N, appendix masculina and appendix interna of second pleopod; O, palp of first maxilliped. Scales: A, B = 1.0 mm; C, I, M, N = 0.2 mm; D–H, J–L, O = 0.5 mm.

Description

Rostrum bent downwards, reaching middle of second segment of antennular peduncle, rostral formula: 5–8 (mode 5–6) + 8–15 (10–13)/3–6 (mode 4–5). Antennal spine fused with inferior orbital angle of carapace, pterygostomial angle rounded.

Telson ending in median projection, four to five pairs of distal spines, lateral pair subequal to intermediate pairs.

Eyes well developed. Antennular peduncle 0.6 times as long as carapace, stylocerite reaching to middle of second segment of antennular peduncle. Scaphocerite 3.0 times as long as broad. Palp of first maxilliped ending in a small projection.

First pereopod reaching to level of eyes, chela about 2.0 times as long as wide, fingers slightly shorter than palm; carpus shorter than chela, 1.4 times as long as wide; merus slightly longer than carpus, 2.2 times as long as wide. Second pereopod slender, nearly reaching to end of scaphocerite, chela 2.5 times as long as wide, fingers longer than palm. Carpus 4.7 times as long as high; 1.2 times as long as chela. Merus as long as carpus. Third pereopod reaching end of antennular peduncle, propodus 3.4 times as long as dactylus, six teeth on posterior margin, merus 6.0 times as long as wide. Fifth pereopod reaching to end of second segment of antennular peduncle, propodus 3.5 times as long as dactylus, 29–34 spinules on posterior dactylus margin.

Endopod of male first pleopod 2.7 times as long as wide, reaching to 0.5 times exopod length, anterior region folding backwards, appendix interna distinctively reaching beyond distal end of endopod. Appendix masculina of male second pleopod stout, reaching to 0.5 times of endopod length.

Uropodal diaeresis with 17–18 spinules.

Etymology

The new species is named after its type locality, Nan'ao island, Nan'ao County.

Habitat

Caridina nanaoensis sp. nov., was found at two streams on Nan'ao island. They were collected from under leaf debris, in large numbers. The water is very clear, with a temperature of about 13°C and pH 6.0.

Remarks

Caridina nanaoensis, sp. nov., most closely resembles *C. serrata*, both species having a short rostrum, short antennular peduncle, stout first pereopod (figure 6A, B), slender second pereopod, and the distal region of fifth pereopod with a very strong spine (figure 6F, G). *C. nanaoensis* differs from *C. serrata* by the form of rostrum which distinctively reaches beyond the end of the basal segment of the antennular peduncle (vs near to or just reaches beyond in *C. serrata*); tip straight (vs upturned in *C. serrata*), the folded male first pleopod (vs unfolded in *C. serrata*); and the stout appendix masculina of the male second pleopod (vs slender in *C. serrata*).

Caridina nanaoensis can be distinguished from *C. cantonensis* by its proportionately shorter rostrum; its stout first pereopod which has fingers distinctly shorter than the palm (vs as long as palm in *C. cantonensis*), merus 2.2 times as long as wide (vs 2.7 times in *C. cantonensis*), the short antennular peduncle which is 0.6 times as long as carapace (vs 0.7 times in *C. cantonensis*) and the scaphocerite 3.0 times as long as wide (vs 3.3 times in *C. cantonensis*).

***Caridina yulinica* sp. nov.**

(figures 9–11)

Material examined

HOLOTYPE—♂ (cl.: 6.4 mm) (IZAS), Niuwo cave near Kuiyang Town, Yulin County, Guangxi Province, China, leg. Y. Cai, H. Zheng and H. Tan, 1 November 1993.

PARATYPES—8 ♂♂ (cl.: 4.8–5.8 mm), 8 ♀♀ (cl.: 4.0–6.3 mm), 1 ovigerous ♀ (cl.: 6.5 mm) (IZAS), data same as holotype; 2 ♂♂ (cl.: 5.2–5.4 mm), 2 ♀♀ (cl.: 5.6–6.2 mm) (ZRC.1998.563–566), same data as holotype; 2 ♂♂ (cl.: 5.0–5.6 mm), 1 ♀ (cl.: 5.4 mm) (RMHN), same data as holotype.

Description

Rostrum straight, bent downwards, reaching to base of second segment of antennular peduncle or nearly to end of this segment, rostral formula: 5–8 + 6–9/1–3 (mostly 2); antennal spine fused with inferior orbital angle of carapace; pterygostomial angle rounded.

Telson ending in median projection; four to five pairs of spines on distal margin, lateral pair subequal to intermediate pairs; preanal carina rounded, no spine.

Eyes well developed. Antennular peduncle 0.6 times as long as carapace. Stylocerite reaching beyond end of basal segment of antennular peduncle. Scaphocerite 3.0 times as long as wide. Palp of first maxilliped broadly triangular.

First pereopod reaching end of basal segment of antennular peduncle, chela 2.2 times as long as wide, finger longer than palm; carpus shorter than chela, 1.6 times as long as high, merus 2.1 times as long as wide. Second pereopod reaching to end of antennular peduncle, chela slightly shorter than carpus, fingers 1.8 times as long as palm; carpus 4.6 times as long as high. Third pereopod reaching beyond scaphocerite, dactylus stout, 3.0 times as long as wide, six spinules on posterior margin, propodus 4.4 times as long as dactylus, 8.0 times as long as wide; merus longer than propodus, 5.5 times as long as wide. Fifth pereopod reaching end of second segment of antennular peduncle, 42–52 denticulate teeth on posterior margin of dactylus, propodus 4.0 times as long as dactylus.

Endopod of male first pleopod sub-rectangular, 2.5 times as long as wide, reaching nearly to middle of exopod, appendix interna slightly reaching beyond end of endopod. Appendix masculina of male second pleopod stout, reaching nearly to middle of endopod, appendix interna stout.

Uropodal diaeresis with 16–22 spinules.

Eggs 1.2×0.75 mm in diameter.

Etymology

The new species is named after its type locality—Yulin County.

Habitat

Caridina yulinica was caught from a subterranean stream in Niuwo cave. The stream was about 60 cm wide, water depth less than 10 cm with a sandy substratum. The collection site is in total darkness, about 100 m from the entrance.

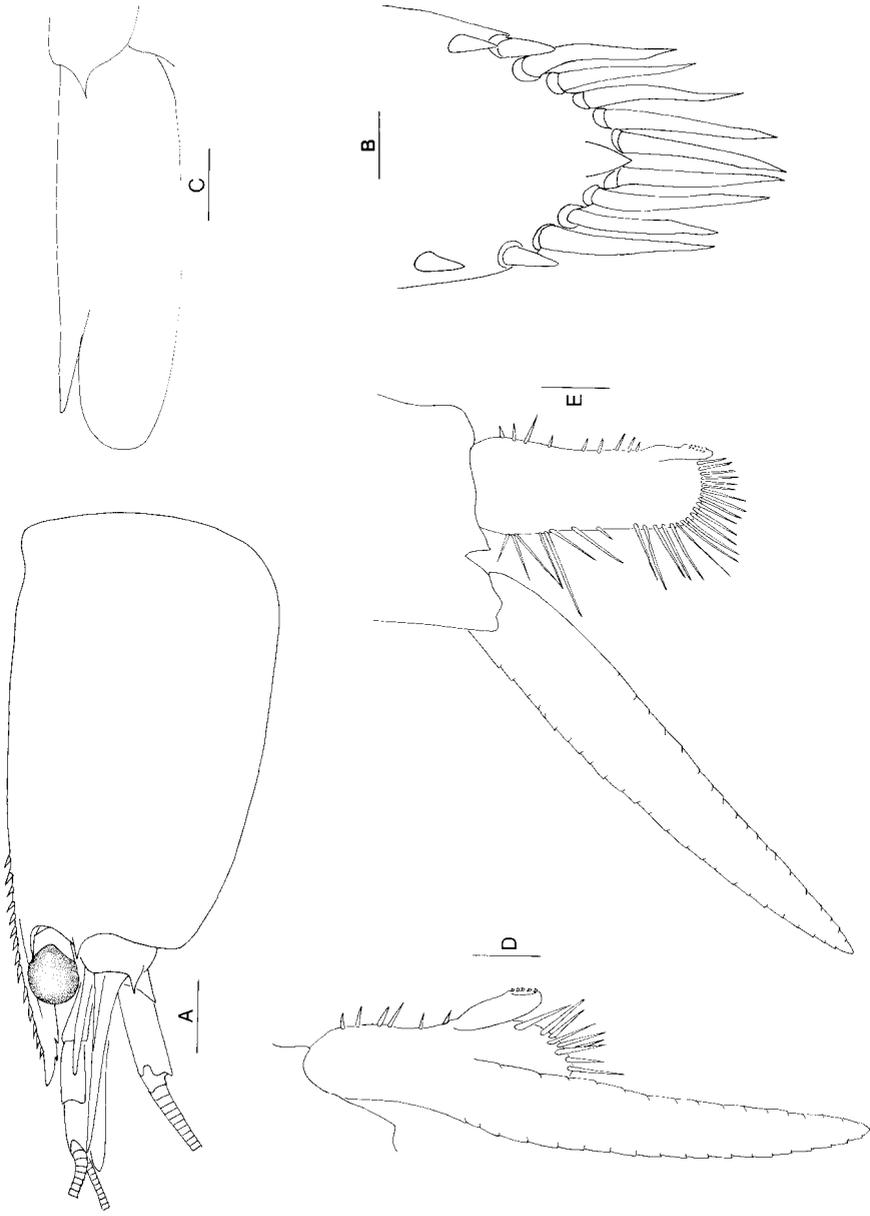


FIG. 9. *Caridina yulinica* sp. nov. (paratype, ♂, cl.: 6.0 mm, Yulin County, Guangxi Province, IZAS). A, cephalothorax; B, distal region of telson; C, scaphocerite; D, second pleopod E, first pleopod. Scales: A = 1.0 mm; B = 0.2 mm; C-E = 0.5 mm.

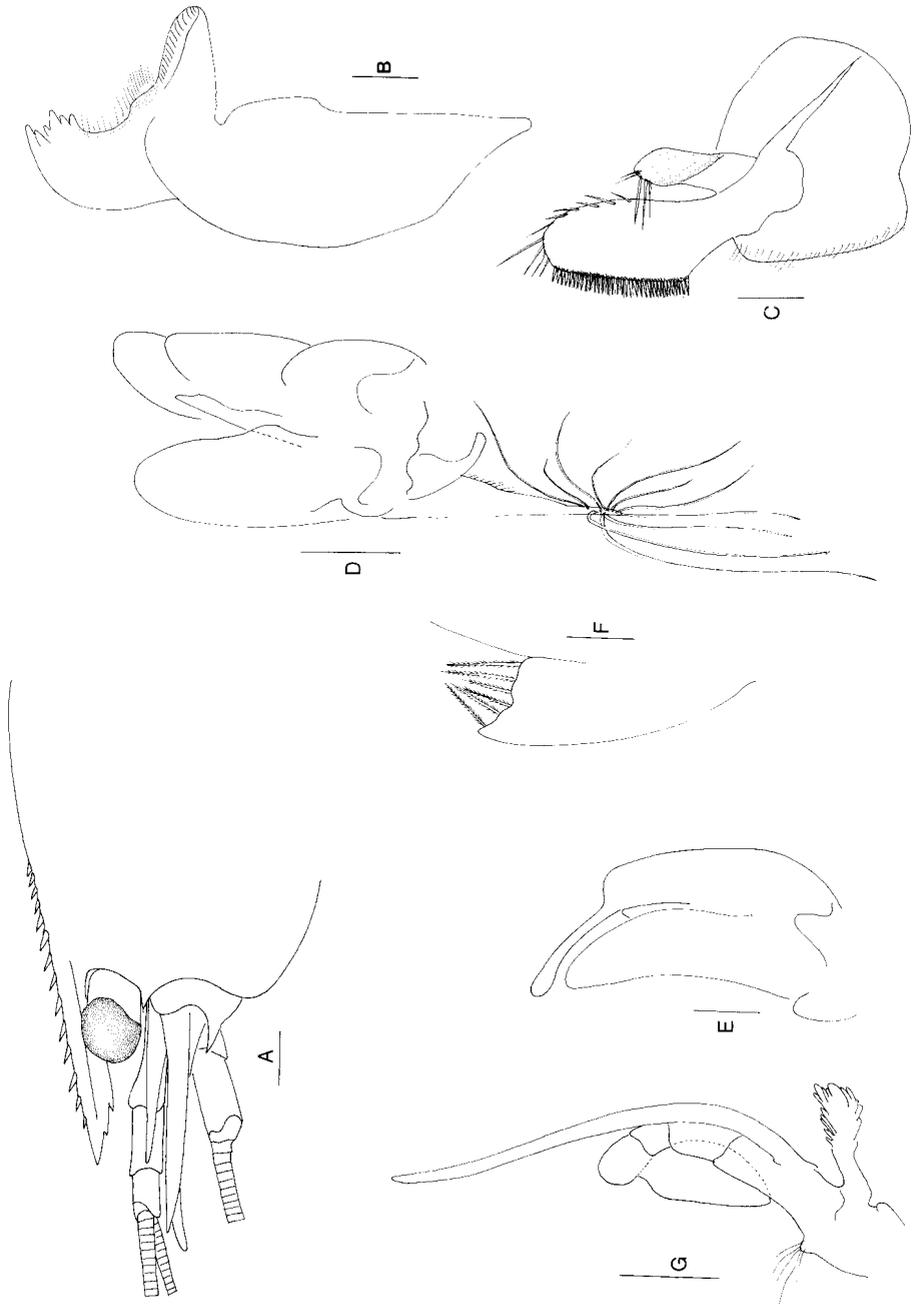


FIG. 10. *Caridina yulinica* sp. nov. (paratype, ♂, cl.: 6.0 mm, Yulin County, Guangxi Province, IZAS). A, anterior region of cephalothorax; B, mandible; C, maxilla; D, first maxilliped; E, second maxilliped; F, second maxilliped; G, mandible. Scales: A = 1.0 mm; B, C, E = 0.5 mm; D, G = 0.1 mm; F = 0.25 mm.

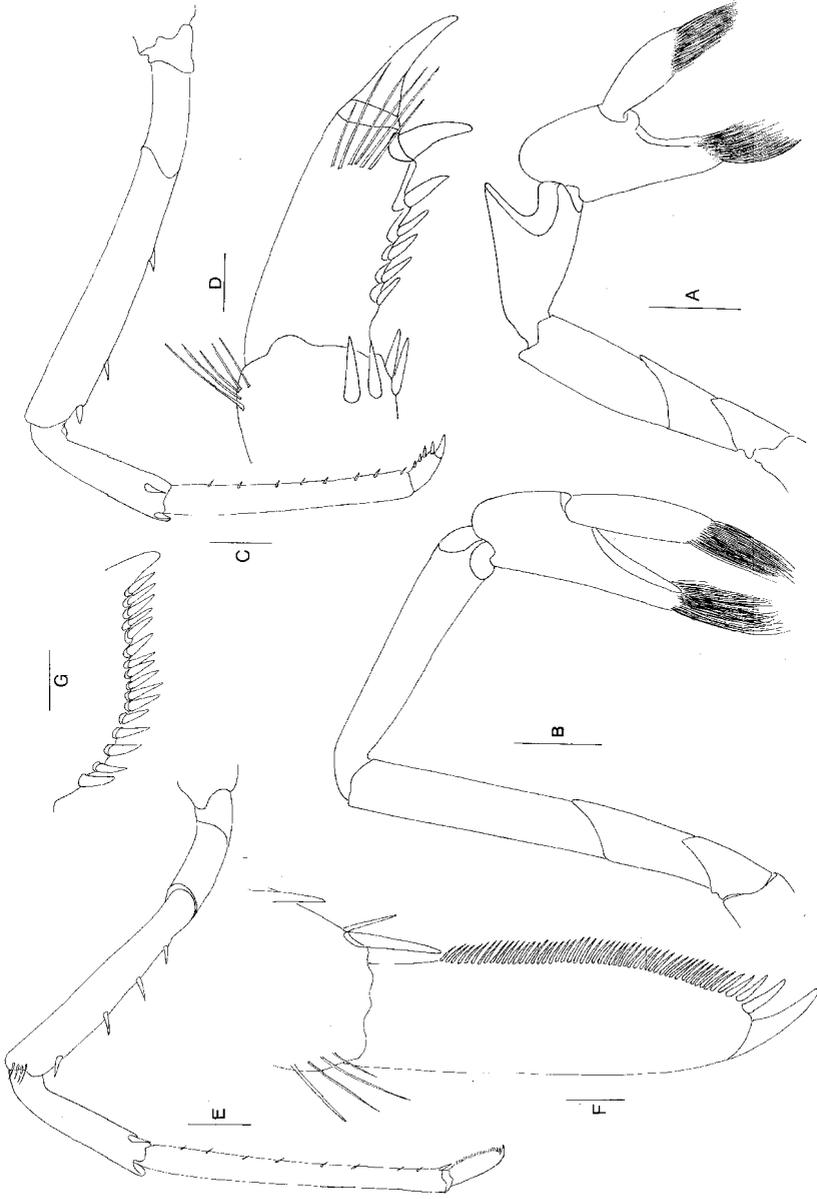


FIG. 11. *Caridina yulinica* sp. nov. (paratype, ♂, cl.: 6.0 mm, Yunlin County, Guangxi Province, IZAS). A, first pereopod; B, second pereopod; C, third pereopod; D, dactylus of third pereopod; E, fifth pereopod; F, dactylus of fifth pereopod; G, uropodal diaeresis. Scales: A, B = 1.0 mm; C, E = 0.5 mm; D, F, G = 0.1 mm.

Remarks

Caridina yulinica, new species, is most similar to *C. cantonensis*, but can be separated from the latter by its short rostrum which never reaches beyond the end of the second segment of the antennular peduncle (vs reaches beyond) and the rostrum usually with two ventral teeth [vs 2–6 (mode 3–5)]. The antennular peduncle of *C. yulinica* is short, 0.55 times as long as carapace (vs 0.7 times in *C. cantonensis*); the endopod of the male first pleopod is broad, 2.5 times as long as wide (vs 3.0 times in *C. cantonensis*), and short (reaching 0.5 times of endopod length vs 0.7 times in *C. cantonensis*); and the appendix interna of male second pleopod is stout (vs slender in *C. cantonensis*).

***Caridina mutata* sp. nov.**

(figures 12, 13)

Material examined

HOLOTYPE—♂ (cl.: 5.3 mm) (IZAS), mountain stream near Fangcheng Town, Fangcheng County, Guangxi Province, China, leg. Y. Cai and S. Yang, 12 March 1992.

PARATYPES—7 ♂♂ (cl.: 4.1–5.3 mm), 2 ♀♀ (cl.: 4.7–4.8 mm), 2 ovigerous ♀♀ (cl.: 4.7–4.8 mm) (IZAS), data same as holotype; 2 ♂♂ (cl.: 4.5–4.9 mm), 1 ovigerous ♀ (cl.: 4.9 mm) (RMHN), same data as holotype; 3 ♀♀ (cl.: 4.2–4.8 mm), 1 ovigerous ♀ (cl.: 4.5 mm) (ZRC.1998.576–579), same data as holotype.

Description

Rostrum straight, reaching to middle or nearly to end of second segment of antennular peduncle, rostral formula: 4–7 (mode 4–5) + 6–12/1–4 (mode 3); antennal spine fused with inferior orbital angle of carapace; pterygostomial margin rounded, slightly produced forwards.

Telson ending in median projection, four pairs of spines on distal margin, lateral pair longer than sub-lateral pair, subequal to intermediate pairs; preanal carina rounded, no spine.

Eyes well developed. Antennular peduncle 0.7 times as long as carapace. Stylocerite reaching beyond end of basal segment of antennular peduncle. Scaphocerite 3.3 times as long as wide. Palp of first maxilliped broadly triangular, ending in a distinctive projection.

First pereiopod reaching to end of basal segment of antennular peduncle, chela 1.6 times as long as wide, fingers longer than palm; carpus 1.5 times as long as high; merus 2.6 times as long as wide. Second pereiopod reaching to middle of third segment of antennular peduncle, fingers of chela 1.5 times as long as palm, carpus 1.4 times as long as chela, 6.0 times as long as high. Third pereiopod reaching to end of scaphocerite, dactylus 2.6 times as long as wide, with six teeth on posterior margin; propodus 9.5 times as long as wide, 4.3 times as long as dactylus; merus 6.0 times as long as wide. Fifth pereiopod reaching to middle of second segment of antennular peduncle, dactylus with 34–36 spinules on posterior margin; propodus 5.0 times as long as dactylus.

Endopod of male first pleopod reaching 0.7 times exopod length, sigmoidal, 3.0 times as long as wide, folding longitudinally medially, appendix interna sigmoidal, reaching to end of endopod. Appendix masculina of male second pleopod stout, reaching to 0.67 times length of endopod.

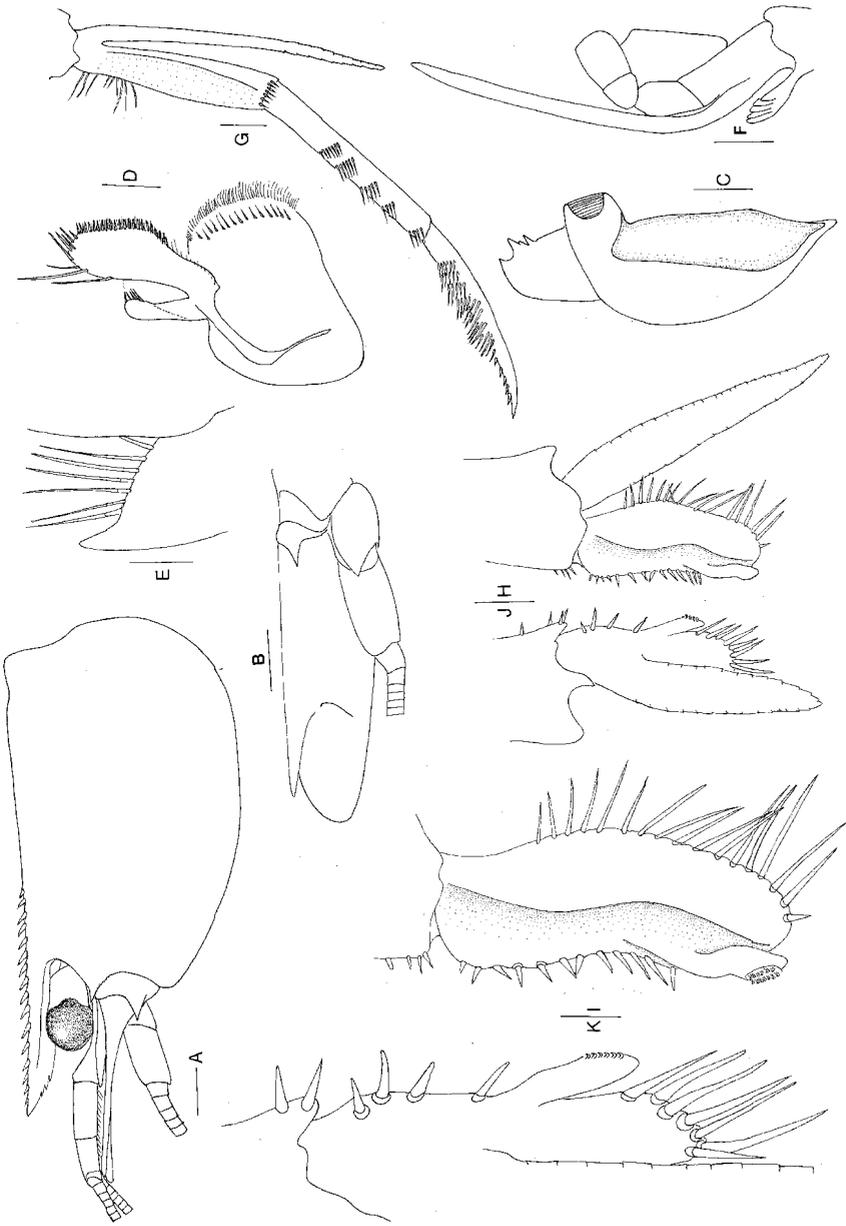


FIG. 12. *Caridina mutata* sp. nov. (paratype, ♂, cl.: 4.2 mm, Fangcheng County, Guangxi Province, IZAS). A, cephalothorax; B, scaphocerite; C, mandible; D, maxillula; E, palp of first maxilliped; F, second maxilliped; G, third maxilliped; H, first pleopod; I, endopod of first pleopod; J, second pleopod; K, appendix masculina and appendix interna of second pleopod. Scales: A, B=1.0 mm; C, D, F, G, H, J=0.5 mm; K, J=0.2 mm; E=0.1 mm.

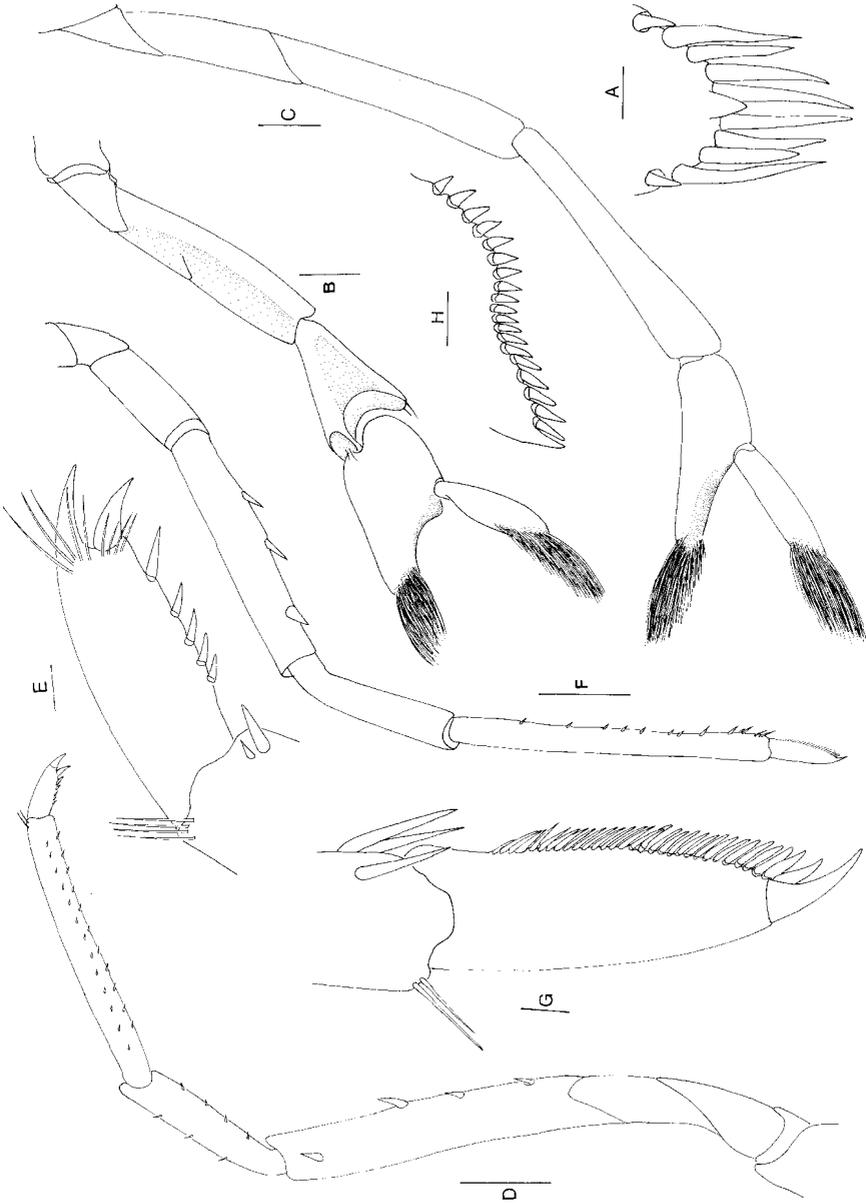


FIG. 13. *Caridina mutata* sp. nov. (paratype, ♂, cl.: 4.2 mm, Fangcheng County, Guangxi Province, IZAS). A, distal region of telson; B, first pereopod; C, second pereopod; D, third pereopod; E, dactylus of third pereopod; F, fifth pereopod; G, dactylus of fifth pereopod; H, uropodal diaeresis. Scales: A, H = 0.2 mm; B, C = 0.5 mm; D, F = 1.0 mm; E, G = 0.1 mm.

Uropodal diaeresis with 20–21 spinules.
Eggs 0.9×0.6 mm in diameter.

Colour

Body colour of female changes with age, grey when young, dark yellow when mature, and when ovigerous, totally black. Male colour ranges from pale grey to dark grey.

Etymology

The new species is named from the latin *mutata*, change, alluding to the variable coloration of female specimens, used as a noun in apposition.

Habitat

Caridina mutata was found among vegetation in a slowly flowing mountain stream.

Remarks

On the basis of the rostrum, *C. mutata* sp. nov., is most closely related to *C. cantonensis* and *C. yulinica*, but differs from *C. cantonensis* and *C. yulinica* by the stouter chela of the first pereopod (1.6 times as long as wide vs 2.0 times in *C. cantonensis* and 2.2 times in *C. yulinica*); the second pereopod, which has the carpus much longer than the chela (1.4 times vs 1.3 times in *C. cantonensis* and 1.2 times in *C. yulinica*); the telson, which has the lateral pair of distal setae longer than the sublateral ones (shorter in *C. cantonensis* and *C. yulinica*); and the sigmoid form of the endopod of the male first pleopods (vs sub-rectangular in *C. cantonensis* and *C. yulinica*).

***Caridina apodosis* sp. nov.** (figures 14–17)

Material examined

HOLOTYPE—♂ (cl.: 5.2 mm) (IZAS), mountain stream near Taitong village, New Territories, Hong Kong, leg. Y. Cai and S. Y. Lee, October 1994.

PARATYPES—4 ♂♂ (cl.: 3.5–5.8 mm), 3 ♀♀ (cl.: 4.8–5.7 mm), 3 ovigerous ♀♀ (cl.: 5.0–5.7 mm) (IZAS), same data as holotype; 2 ♂♂ (cl.: 4.8–5.8 mm), 1 ♀ (cl.: 4.8 mm), 1 ovigerous ♀ (cl.: 5.0 mm) (ZRC.1998.572–575), same data as holotype; 2 ♂♂ (cl.: 4.4–4.8 mm), 1 ♀ (cl.: 5.2 mm) (RMHN), same data as holotype.

Others. 23 ♂♂, 25 ♀♀, 7 ovigerous ♀♀, 12 juveniles (IZAS), same data as holotype.

Description

Rostrum long, extending to end of antennular peduncle or beyond, slightly curved upwards at anterior one-third, rostral formula: 4–7 + 9–15/7–10, teeth spaced wider anteriorly than posteriorly; antennal spine fused with inferior orbital angle of carapace; pterygostomial broadly margin rounded.

Telson ending in median projection, distal margin with four pairs of spines, lateral pair shorter than intermediate pairs.

Eyes well developed. Antennular peduncle slender, 0.7 times as long as carapace. Stylocerite reaching middle of second segment of antennular peduncle. Scaphocerite

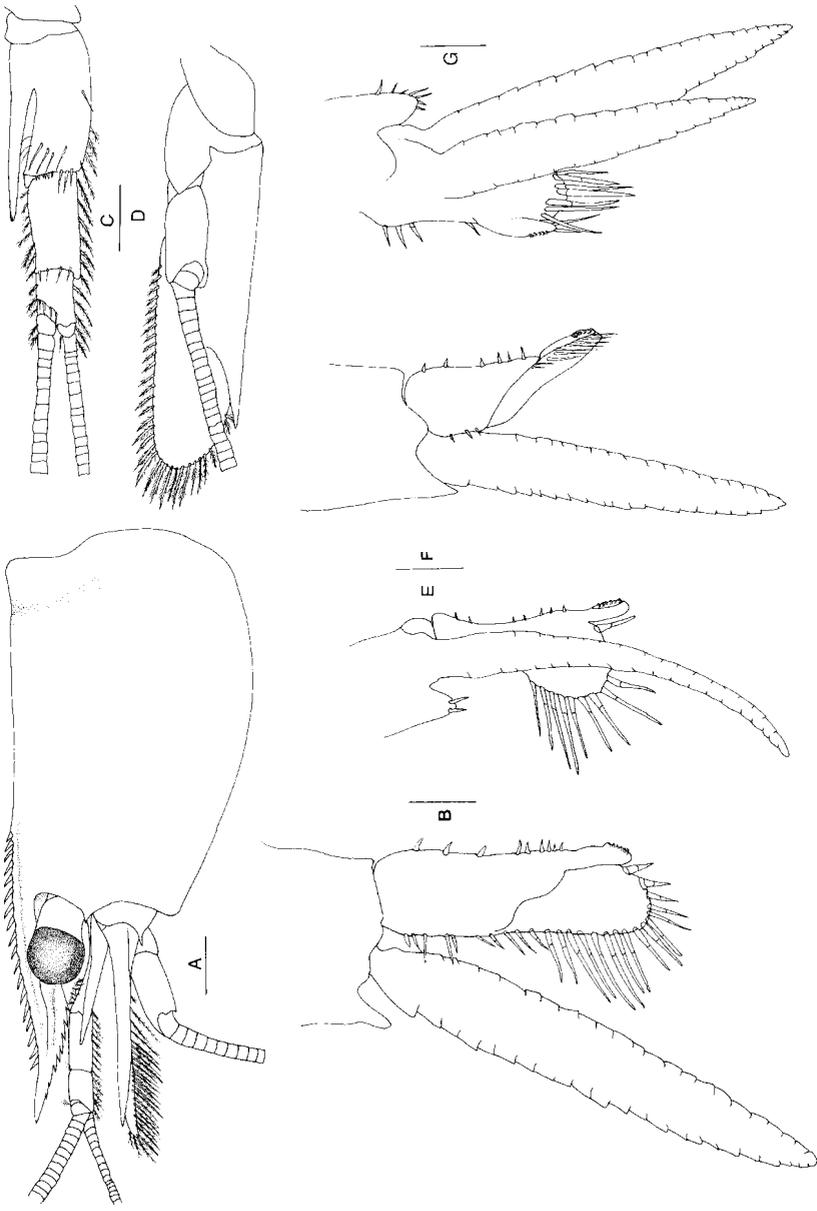


FIG. 14. *Caridina apodosis* sp. nov. (paratype, ♂, cl.: 4.5 mm, Hong Kong, IZAS). A, cephalothorax; B, male first pleopod (♂, cl.: 48 mm, Hong Kong, IZAS); C, antennula peduncle; D, scaphocerite; E, F, first pleopod; G, second pleopod. Scales: A, C, D = 1.0 mm; B, E, F, G = 0.5 mm.

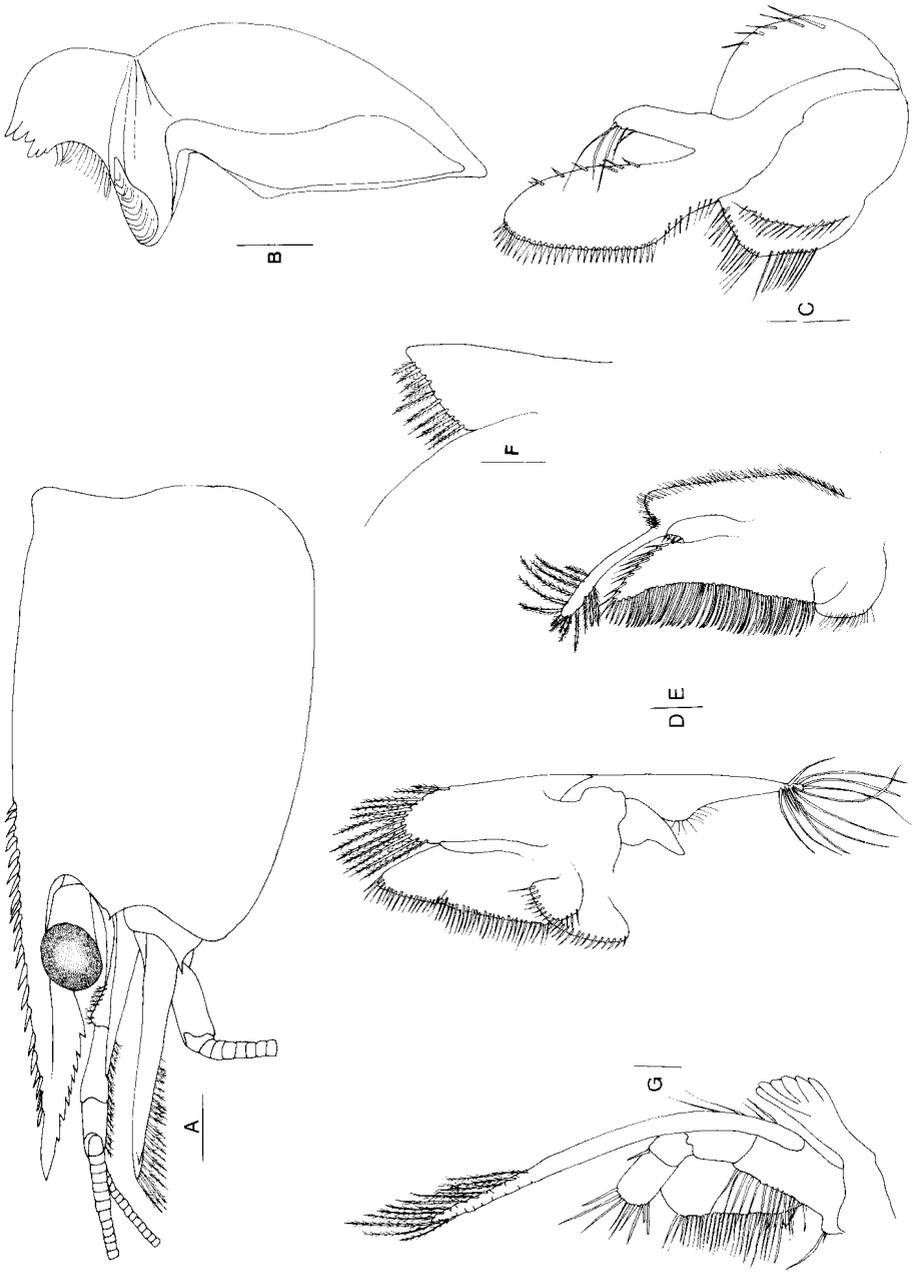


FIG. 15. *Caridina apodosis* sp. nov. (paratype, ♂, cl.: 4.5 mm, Hong Kong, IZAS). A, cephalothorax (♀, cl.: 48 mm, Hong Kong, IZAS); B, mandible; C, maxilla; D, maxilla; E, first maxilliped; F, first maxilliped; G, mandible. Scales: A = 1.0 mm; B–E = 0.5 mm; F = 0.2 mm.

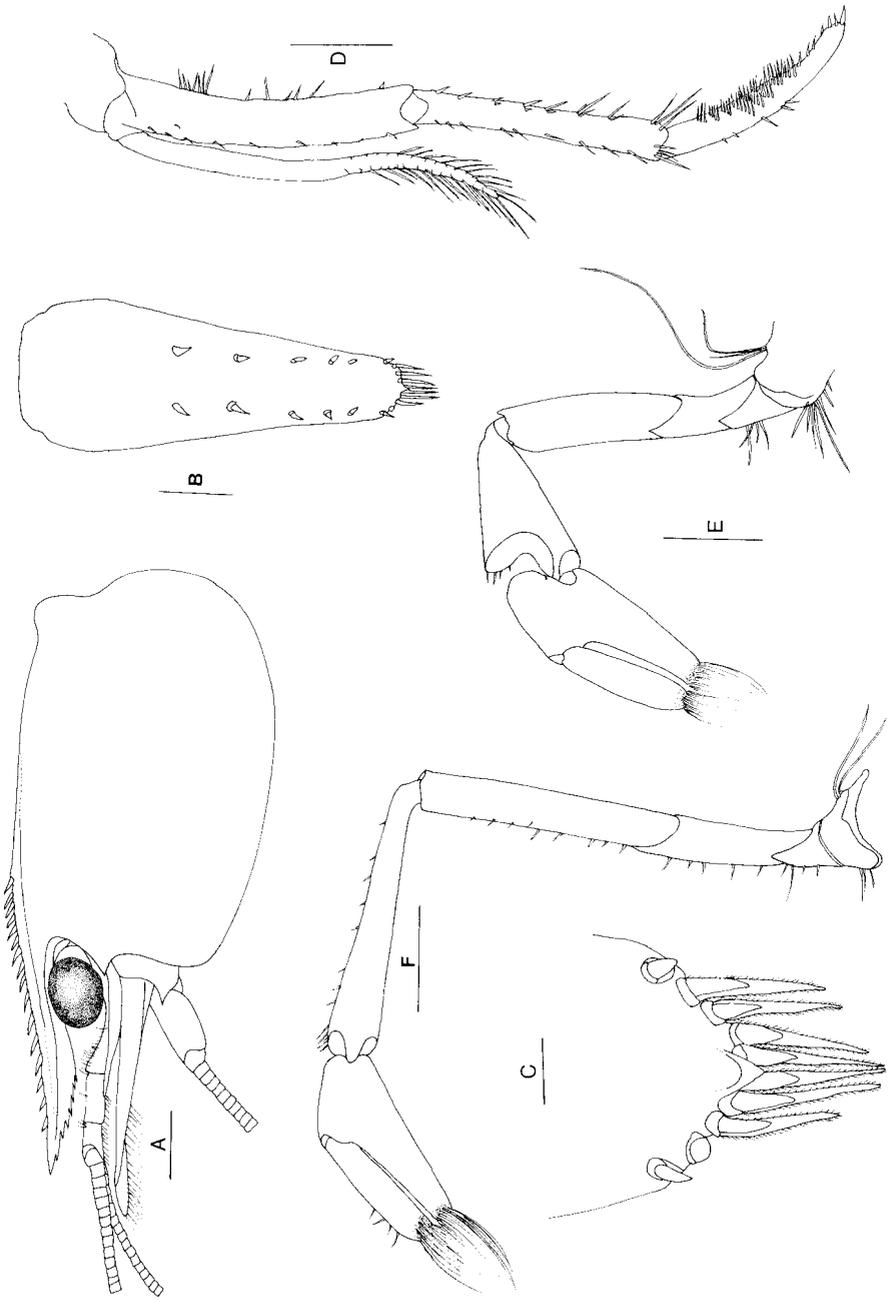


FIG. 16. *Caridina apodosis* sp. nov. (paratype, ♂, cl.: 4.5 mm, Hong Kong, IZAS). A, cephalothorax (♂, cl.: 3.5 mm, IZAS); B, telson; C, distal region of telson; D, third maxilliped; E, second pereopod; F, first pereopod. Scales: A, B, D, E, F = 1.0 mm; C = 0.2 mm.

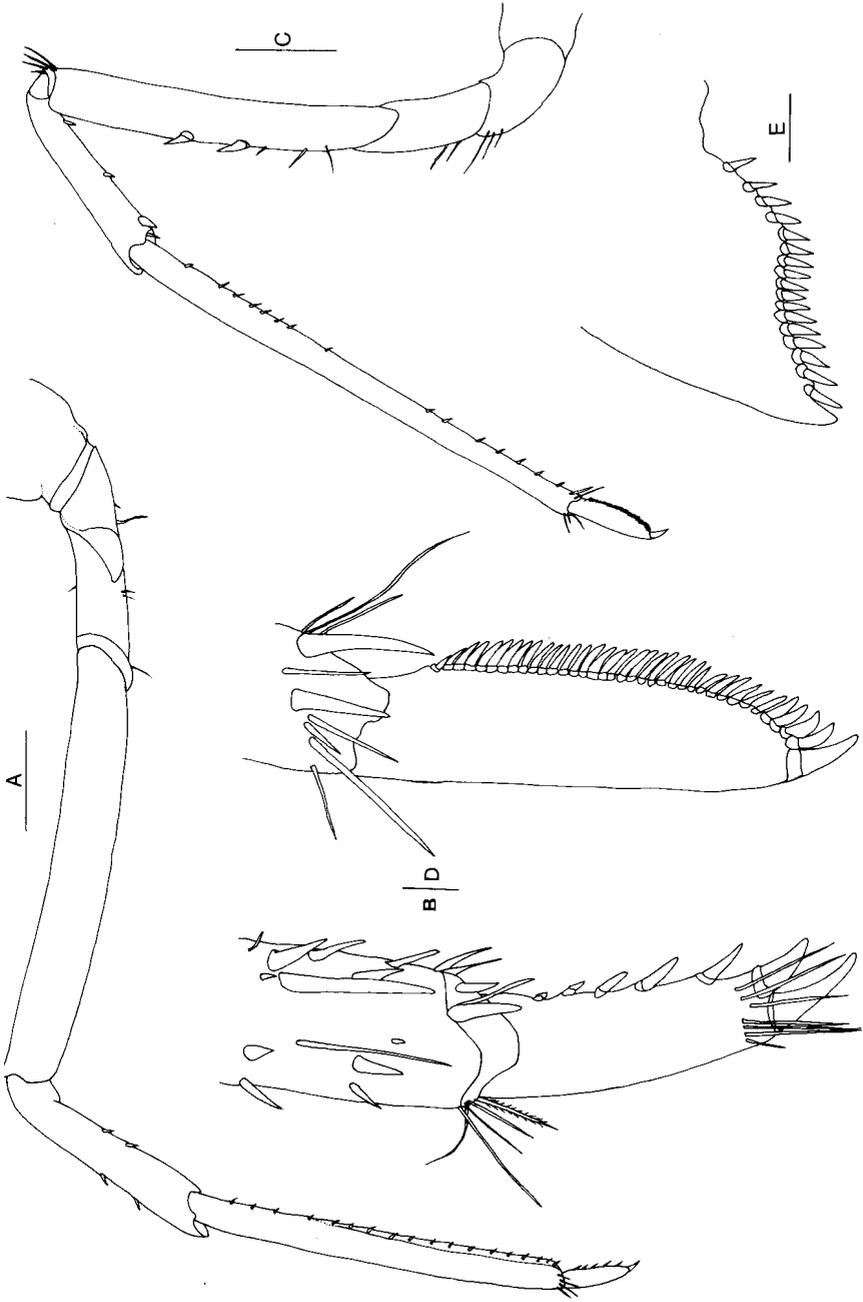


FIG. 17. *Caridina apodosis* sp. nov. (paratype, ♂, cl.: 4.5 mm, Hong Kong, IZAS). A, third pereopod; B, dactylus of third pereopod; C, fifth pereopod; D, dactylus of fifth pereopod; E, uropodal diaeresis. Scales: A, C = 1.0 mm; B, D, E = 0.2 mm.

about 3.0 times as long as broad. First maxilliped with palp ending in triangular shape without any process.

First pereopod reaching end of basal segment of antennular peduncle; chela 2.3 times as long as broad; fingers 1.5 times as long as palm. Carpus 1.6 times as long as high, 0.7 times as long as chela; merus 3.3 times as long as wide. Second pereopod reaching end of antennular peduncle, chela 2.4 times as long as broad, fingers 1.8 times as long as palm. Carpus 5.6 times as long as high, 1.4 times as long as chela. Third pereopod reaching end of scaphocerite, dactylus 4.0 times as long as broad (teeth included); terminating in two claws, five accessory teeth on posterior margin; propodus 11.0 times as long as broad, 5.0 times as long as dactylus, some small spinules on posterior margin; carpus half as long as propodus. Fifth pereopod reaching end of second segment of antennular peduncle, dactylus 3.5 times as long as broad, 33–38 denticulate spines on posterior margin; propodus slender, 1.6 times as long as broad, 5.0 times as long as dactylus, some small spinules on posterior margin; carpus 0.4 times as long as propodus.

Endopod of male first pleopod 0.5 times as long as exopod, 2.5 times as long as wide, curved backwards at distal half, long setae at outer distal margin; appendix interna reaching to about end of distal margin of endopod. Appendix masculina of male second pleopod stout, 0.5 times as long as endopod, long spines on distal region; appendix interna almost reaching tip of appendix masculina.

Uropodal diaeresis with 17–18 spinules.

Eggs 1.0–1.2 × 0.6–0.8 mm in diameter.

Habitat

The new species was found in a mountain stream near Tai Tong village, New Territories, Hong Kong.

Etymology

The new species is named *apodosis*, Greek for return, to commemorate the event on 1 July 1997, the return of Hong Kong to China. It is used as a noun in apposition.

Remarks

Caridina apodosis sp. nov., resembles *C. cantonensis* in the form of the male pleopods, and in the long stylocerite, but can be distinguished from *C. cantonensis* by its longer rostrum which reaches to the end of the antennular peduncle or beyond (vs reaches to middle of second segment or to the end of the antennular peduncle in *C. cantonensis*) and with more teeth on the ventral margin of the rostrum (7–10 vs 3–6 in *C. cantonensis*).

***Caridina wumingensis* sp. nov.**

(figures 18, 19)

Material examined

HOLOTYPE—♂ (cl.: 4.1 mm) (IZAS), cave near Wuming County, Guangxi Province, China, leg. B. Sket, 16 November 1977.

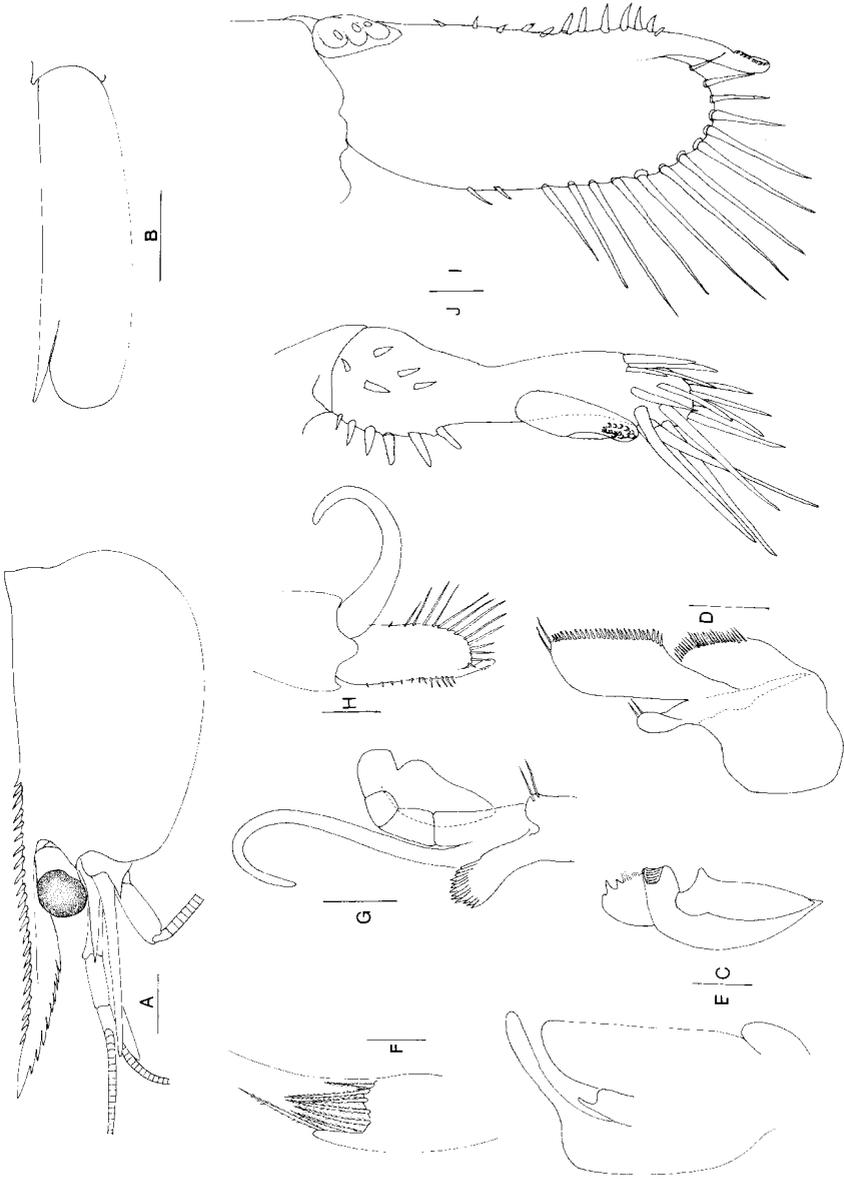


FIG. 18. *Caridina wumingensis* sp. nov. (holotype, ♂, cl.: 4.1 mm, Wuming County, Guangxi Province, IZAS). A, cephalothorax; B, scaphocerite; C, mandible; D, maxillula; E, first maxilliped; F, palp of first maxilliped; G, second maxilliped; H, first pleopod; I, endopod of first pleopod; J, appendix masculina and appendix interna of second pleopod. Scales: A, B=1.0 mm; C, D, E, G, H=0.5 mm; F, I, J=0.2 mm.

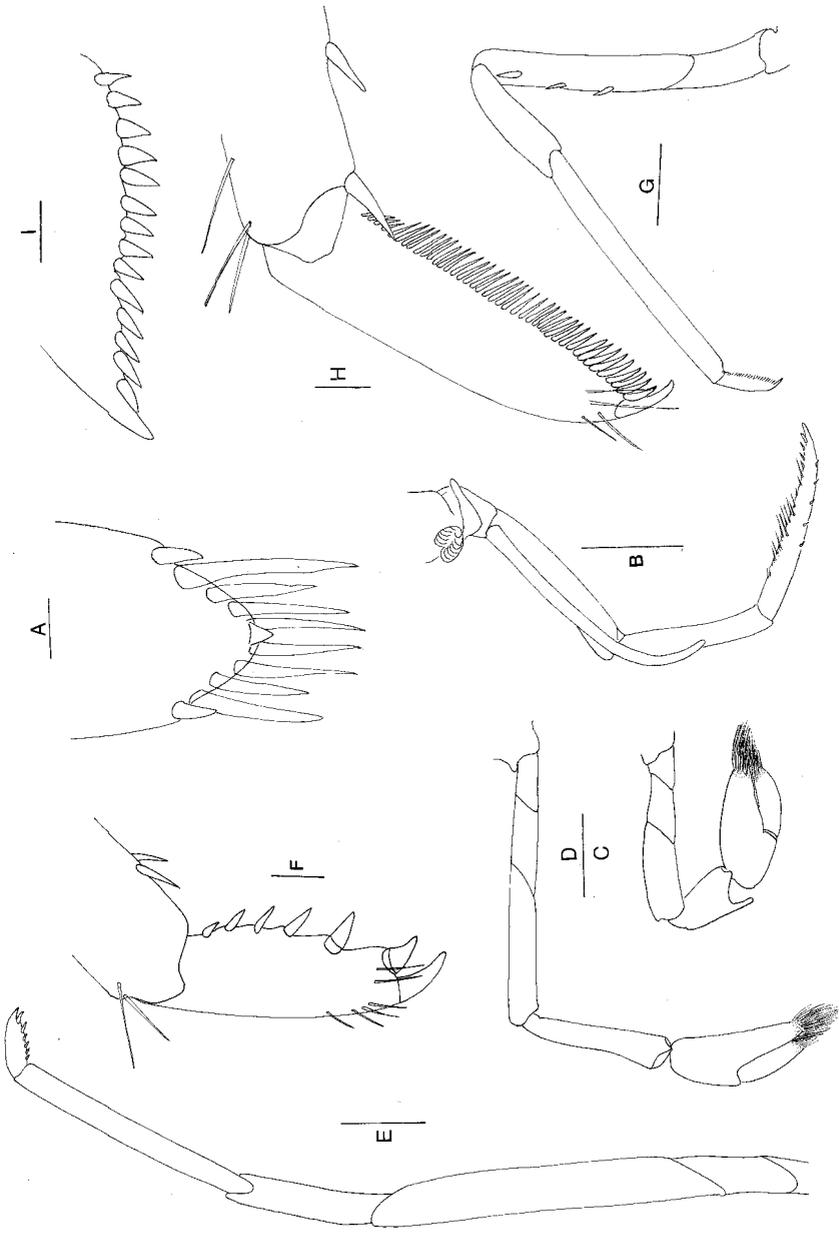


FIG. 19. *Caridina wumingensis* sp. nov. (holotype, ♂, cl.: 4.1 mm, Wuming County, Guangxi Province, IZAS). A, distal region of telson; B, third maxilliped; C, first pereopod; D, second pereopod; E, third pereopod; F, dactylus of third pereopod; G, fifth pereopod; H, dactylus of fifth pereopod; I, uropodal diaeresis. Scales: A, F, H, I = 0.2 mm; B, C, D, E, G = 1.0 mm.

Description

Rostrum long, slender, distal half slightly upturned, reaching beyond end of antennular peduncle by 0.3 length, rostral formula: 6+16/9. Antennal spine fused with inferior orbital angle of carapace; pterygostomial margin broadly rounded.

Telson ending in median projection, distal margin with four pairs of spines; lateral pair distinctly longer, but sublateral pair shorter than intermediate pairs.

Eyes well developed. Antennular peduncle slender, 0.8 times as long as carapace. Scaphocerite slender, 4.0 times as long as broad. Mouthparts as shown in figures. First maxilliped ending in a finger-like process. Third maxilliped reaching end of antennular peduncle, ultimate segment longer than penultimate segment.

First pereopod short, stout, reaching to end of basal segment of antennular peduncle, chela 2.1 times as long as broad; fingers 1.5 times as long as palm; carpus 1.5 times as long as high, 0.6 times as long as chela. Second pereopod long, slender, reaching middle of third segment of antennular peduncle; chela 2.5 times as long as wide; fingers slightly longer than palm; carpus 4.5 times as long as high, slightly longer than chela. Third pereopod very long, reaching beyond end of scaphocerite; dactylus 2.5 times as long as broad, terminating in two claws, five accessory teeth on posterior margin; propodus 10.0 times as long as broad, 4.0 times as long as dactylus. Fifth pereopod reaching middle of third segment of antennular peduncle; dactylus 3.0 times as long as broad, 43 denticulate spines on posterior margin; propodus 11.0 times as long as broad, about 4.0 times as long as dactylus; carpus longer than dactylus.

Endopod of male first pleopod with process in proximal inner region, 2.1 times as long as broad, 0.7 times length of exopod, long setae on distal half of outer margin, short setae on inner margin. Appendix interna slightly curved inwards, reaching beyond end of endopod by 0.5 times length. Appendix masculina of male second pleopod long and slender, long spines at distal region, short spinules at proximal region; appendix interna stout, measuring 0.3 times length of appendix masculina.

Uropodal diaeresis with 14 spinules.

Habitat

Found in a stream inside a cave (A. Dai, pers. comm.).

Etymology

The new species is named after its type locality—Wuming County.

Remarks

The form of the rostrum and the length of the stylocerite of *C. wumingensis* sp. nov. most closely resemble those of *C. sphyrapoda*, but the slender scaphocerite which is 4.0 times as long as wide (vs 3.0 times in *C. sphyrapoda*) and the form of male sexual pleopods can be used to separate the two species (figure 18I, J vs figure 7D, E, F).

Key to the species of the *Caridina serrata* species group

- | | | |
|---|--|--------------------------------------|
| 1 | Rostrum reaching beyond end of antennular peduncle | 2 |
| – | Rostrum not reaching beyond end of antennular peduncle | 4 |
| 2 | Rostrum distinctively reaching beyond scaphocerite, scaphocerite narrow, 4.0 times as long as wide | <i>Caridina wumingensis</i> sp. nov. |
| – | Rostrum not reaching beyond scaphocerite, scaphocerite 3.0 times as long as wide | 3 |

- 3 Seven to ten ventral teeth on carapace, 17–18 spinules on uropodal diaeresis *Caridina apodosis* sp. nov.
 – Nine to thirteen ventral teeth on carapace, 12–15 spinules on uropodal diaeresis *Caridina sphyrapoda* Liang and Zhou, 1993
- 4 Rostrum short, reaching to end of basal segment of antennular peduncle, tip slightly upturned *Caridina serrata* Stimpson, 1860.
 – Rostrum reaching to or beyond middle or end of second segment of antennular peduncle, tip straight 5
- 5 Rostrum reaching to middle of second segment of antennular peduncle, fingers of first pereopod shorter than palm *Caridina nanaoensis* sp. nov.
 – Rostrum reaching to middle of second segment or to end of antennular peduncle, fingers of first pereopod as long as or longer than palm 6
- 6 Rostrum usually reaching beyond end of second segment of antennular peduncle, fingers of first pereopod as long as palm *Caridina cantonensis* Yu, 1938.
 – Rostrum never reaching beyond end of segment of antennular peduncle, fingers of first pereopod longer than palm 7
- 7 Antennular peduncle less than 0.6 times as long as carapace, chela of first pereopod 2.2 times as long as wide *Caridina yulinica* sp. nov.
 – Antennular peduncle 0.7 times as long as carapace, chela of first pereopod 1.6 times as long as wide *Caridina mutata* sp. nov.

Acknowledgements

The authors would like to express their gratitude to Dr Peter K.L. Ng (NUS) for his invaluable guidance on the present study, his suggestions and corrections on this manuscript. Thanks are due to Prof. Dai Ai Yun and Dr Chen Guoxiao (IZAS) for the loan of their collections for this study; Prof. David Dudgeon (Hong Kong University), Prof. Yang Siliang (BNHM) and Mr J. Lin (Nan'ao County), for kindly sending us their fresh collections for this study; Dr Raymond B. Manning (USNM), for seeking the types of *C. serrata*; Prof. Dai Ai Yun (IZAS), Prof. Yang Siliang (BNHM) and Dr Li Xinzhen (Institute of Oceanography, Academia Sinica, Qingdao), for searching for the type of *C. cantonensis*; Prof. Liang Xiangqiu (SFU), for his hospitality when the first author was in Shanghai examining the SFH collections; Prof. Dang Ngoc Thanh (Vietnam National Centre for Natural Science and Technology) for searching for the type of *C. serrata cucphuongensis* (Dr P. K. L. Ng, pers. comm.); Prof. Yu Hsiang-Ping and Prof. Chan Tin-Yam, National Taiwan Ocean University, for their hospitality when the authors were in Taiwan, checking the NTOU collections; Prof. Siliang Yang (BNHM), Dr S. Y. Lee (Hong Kong University), Dr S. S. Shea (Hong Kong); Mr Tang Hong (Yulin Fisheries Department) and Mr Zhen Hui (Guangxi Fisheries Institute), for their wonderful assistance during the field trips. The authors are also indebted to the National University of Singapore for their financial support (RP950362 to Dr Peter K. L. Ng). This is contribution No. 98/16 from the Systematics and Ecology Laboratory, Department of Biological Sciences, NUS.

References

- BOUVIER, E. L., 1905, Observation nouvelles sur les crevettes de la famille des Atyides, *Bulletin scient de France et Belgium*, **39**, 55–134.
- BOUVIER, E. L., 1925, Recherches sur la morphologie, la geographique des crevettes des la famille des Atyides, *Encyclopédie Entomologique*, **4**(A), 1–370, figures 1–761.
- CAI, Y., 1996, A revision of the genus *Neocaridina* (Crustacea: Decapoda: Atyidae), *Acta Zootaxonomica Sinica*, **21**, 129–160, figures 1–16 (in Chinese with English abstract).

- CHACE, F. A. JR., 1997, The Caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine expedition 1907–1910. Part 7: Families Atyidae, Eugonatonotidae, Rhynchocinetidae, Bathypalaemonellidae, Processidae, and Hippolytidae, *Smithsonian Contributions in Zoology*, **58**, 1–106, figures 1–29.
- CHACE, F. A. JR. and BRUCE, A. J., 1993, The Caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine expedition 1907–1910. Part 6: Superfamily Palaemonoidea, *Smithsonian Contributions in Zoology*, **543**, i–vii + 1–152; figures 1–23.
- DANG, N. T., 1980, *Dinh loai dong khong xuong song nuoc noot bac Viet Nam. Decapoda* (Ha Noi, Vietnam), pp. 380–418, figures 219–236. (The identities of freshwater invertebrates of North Vietnam, in Vietnamese.)
- DE HAAN, W., 1833–1850, Crustacea, in P.F. von Siebold (ed.) *Fauna Japonica sive Descriptio Animalium, quae in Itinere per Japoniam, Jussu et Auspiciis Superiorum, qui Summum in India Batava Imperium Tenent, Suscepto, Annis 1823–1830 Collegit, Notris, Observationibus et Adumbrationibus Illustravit*, i–xxxii, ix–xvi, 1–243, plates A–J, 1–Q, 1–55, circ. tab. 2. Lugduni-Batavorum [Leiden].
- DE MAN, J. G., 1892, Decapoden des Indischen Archipels, in M. Weber (ed.), *Zoologische Ergebnisse einer Reise in Niederlandisch Ost-Indien*, **2**, 265–527, plates 15–29.
- DE MAN, J. G., 1908, The fauna of brackish ponds at port Canning, Lower Bengal. Part 10: Decapod crustacea, with an account of a small collection from brackish water near Calcutta and in the Dacca District, Eastern Bengal, *Records of the Indian Museum*, **2**, 211–231, figures 1–7.
- DEISS, W. A. and MANNING, R., 1981, The fate of the invertebrate collections of the North Pacific Exploring Expedition, 1853–1856, in A. Wheeler and J. H. Price (eds) *History in the Service of Systematics* (London: Society for the Bibliography of Natural History), pp. 79–85.
- DUDGEON, D., 1985, The population dynamics of some freshwater carideans (Crustacea: Decapoda) in Hong Kong, with special reference to *Neocaridina serrata* (Atyidae), *Hydrobiologia*, **120**, 141–149.
- DUDGEON, D., 1987, The larval development of *Neocaridina serrata* (Stimpson) (Crustacea: Decapoda: Caridea: Atyidae), *Archives of Hydrobiology*, **110**(3), 339–355, figures 1–7.
- EVANS, A. C., 1967, Syntypes of Decapoda described by William Stimpson and James Dana in the collections of the British Museum (Natural History), *Journal of Natural History*, **1**, 399–411.
- HELLER, C., 1862, Beiträge zur näheren Kenntniss der Macrouren, *Sitzungsberichte der Akademie der Wissenschaften in Wien*, **45**(1), 389–426, plates 1, 2.
- HOLTHUIS, L. B., 1953, On the dates of publications of W. de Haan's volume on the Crustacea of P. F. von Siebold's "Fauna Japonica", *The Journal of the Society for the Bibliography of Natural History*, **3**(1), 36–47, 1 portrait.
- HOLTHUIS, L. B., 1965, The Atyidae of Madagascar, *Memoires du Museum National d'Histoire Naturelle, series A (Zoologie)*, **33**(1), 1–48, figures 1–17.
- HOLTHUIS, L. B., 1978, A collection of Decapod Crustacea from Sumba, Lesser Sunda Islands, Indonesia, *Zoologische Verhandlungen Uitgegeven door het Rijksmuseum van Natuurlijke Historie te Leiden*, **53**(19), 209–224, figures 1–66.
- HUNG, M. S., CHAN, T. Y. and YU, H. P., 1993, Atyid shrimps (Decapoda: Caridea) of Taiwan, with descriptions of three new species, *Journal of Crustacean Biology*, **13**(3), 481–503, figures 1–14.
- JOHNSON, D. S., 1961, Notes on the freshwater Crustacea of Malaya. I. Atyidae, *Bulletin of National Museum, Singapore*, **26**, 120–153.
- KEMP, S., 1918, Zoological results of a tour in the Far East. Crustacea Decapoda Stomatopoda, *Memoirs of the Asiatic Society of Bengal*, **6**, 219–297.
- KUBO, I., 1938, On the Japanese atyid shrimps, *Journal of the Imperial Fisheries Institute, Tokyo*, **33**, 67–100, figures 1–24.
- KUBO, I., 1940, Studies on Japanese Palaemonoid shrimps I. *Palaemon*, *Journal of the Imperial Fisheries Institute, Tokyo*, **34**(1), 5–30, figures 1–16, plates 1, 2.
- LIANG, X. and YAN, S., 1983, A new species of *Caridina* (Crustacea: Decapoda) from Guangxi, China, *Acta Zootaxonomica Sinica*, **8**(3), 252–254, figures 1–10 (in Chinese with English abstract).
- LIANG, X. and YAN, S., 1985, Study on *Caridina* (Decapoda, Caridea) from Yunnan, China,

- Oceanologia et Limnologia Sinica*, **16**(3), 196–206, figures 1–4 (in Chinese with English abstract).
- LIANG, X. and YAN, S., 1986, Study on *Caridina* (Decapoda, Caridea) from Guizhou Province, China, *Oceanologia et Limnologia Sinica*, Suppl. 1986, 196–206; figures 1–5 (in Chinese with English abstract).
- LIANG, X. and ZHOU, J., 1993, Study on new atyid shrimps (Decapoda, Caridea) from Guangxi, China, *Acta Hydrobiologia Sinica*, **17**(3), 231–239, figures 1–4 (in Chinese with English abstract).
- MANNING, R. B., 1993, The scientific contributions of William Stimpson, an early American naturalist and taxonomist, in F. Truesdale (ed.) *Crustacean Issues 8—History of Carcinology* (Rotterdam: A. A. Balkema), pp. 109–117, figures 1, 2.
- MILNE EDWARDS, H., 1837, *Histoire naturelle des Crustacés, Comprenant l'Anatomie, la Physiologie et la Classification de ces Animaux*, Vol. 2 (Paris: Libraire Encyclopedique de Roret), pp. 1–532.
- ORTMANN, A. E., 1894, A study of the systematic and geographical distribution of the decapod Family Atyidae Kingsley, *Proceedings of the National Academy of Sciences, Philadelphia*, 397–416.
- STIMPSON, W., 1860, Prodrromus descriptionis animalium evertebratorum, quae in Expeditione ad Oceanum Pacificum Septemtrionalem, a Republica Federata missa, C. Ringgold et J. Rodgers, observavit et descripsit, *Proceedings of National Academy of Sciences, Philadelphia*, 22–47 (97–116).
- YU, S. C., 1938, Study on Chinese *Caridina* with descriptions of five species, *Bulletin of the Fan Memorial of the Institute of Biology, Zoology Series*, **8**(3), 271–310, figures 1–16.