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Y. Cai ^a & P. K. L. Ng ^a

^a Department of Biological Sciences , National University of Singapore , Singapore

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A revision of the *Caridina gracilirostris* De Man, 1892, species group, with descriptions of two new taxa (Decapoda; Caridea; Atyidae)

Y. CAI & P. K. L. NG

Department of Biological Sciences, National University of Singapore, Singapore

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Abstract

Re-examination of the syntypes of *Caridina gracilirostris* De Man, 1892, shows that the type series is composed of three species. These three species are similar in the form of the rostrum, but can be differentiated easily by a combination of rostral formula and sexual appendages. To stabilize the taxonomic status of these species, a lectotype for *C. gracilirostris* is selected. A lectotype for *Caridina appendiculata* Jaliha and Shenoy, 1998, is also designated from among the remaining syntypes of *C. gracilirostris*. A new species, *C. neglecta*, is described. *Caridina gracilirostris* and *C. gracilima* Lankester, 1901, are redescribed and figured, and *C. appendiculata* is transferred to the *C. nilotica* species group. A new species group is also recognized for *C. gracilirostris*, *C. neglecta*, *C. gracilima*, and a new species, *C. longifrons*. The *C. gracilirostris* species group is defined here as taxa possessing a rostrum with subapical teeth, fewer than 10 dorsal teeth, and without any postorbital teeth.

Keywords: Crustacea, Decapoda, Atyidae, Caridea, *Caridina gracilirostris*, new species, freshwater shrimp, revision, taxonomy

Introduction

When De Man (1892) described *Caridina gracilirostris*, he noted that there were two forms of pereopod carpus in his material: a short carpus form from Sulawesi, and a long carpus form from Flores. Tiwari and Pillai (1971) also reported both forms from different parts of the Andaman Islands. Jaliha and Shenoy (1998, p 128), in an abstract, stated that for *C. gracilirostris* De Man, 1892, “(I)ts syntype material is actually an assemblage of three taxonomic forms...”. This is something we have also independently observed for the material of “*Caridina gracilirostris*” that we have examined for many years. We have also noted that these three forms also differ from each other in the structure of their sexual appendages. Interestingly, a re-examination of the syntypes of *C. gracilirostris* shows the type series actually contains representatives of all three forms. In the present study, the taxonomy of *C. gracilirostris* is revised and clarified. A species group is established for these

taxa, which is defined as follows: rostrum with subapical teeth, fewer than 10 dorsal teeth, and without postorbital teeth present.

Specimens examined are deposited in the Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC); Department of Zoology, Chulalongkorn University, Bangkok, Thailand (CU); Philippines National Museum, Manila (NMCR); Museum of Zoology, Bogor, Indonesia (MZB); Zoological Museum, Amsterdam, The Netherlands (ZMA); The Naturalis, National Museum of Natural History (ex Rijksmuseum van Natuurlijke), Leiden, The Netherlands (RMNH); Muséum national d'Histoire naturelle, Paris, France (MNHN); Senckenberg Museum, Frankfurt; Germany (SMF); Basel Natural History Museum, Basel, Switzerland (BNHM), and National Museum of Natural History, Smithsonian Institution, Washington DC, USA (USNM). All drawings were either made with a stereomicroscope or a compound microscope, both with the aid of a camera lucida. Measurements were made with the aid of a stereomicroscope and an eyepiece micrometer. Dissections were performed under a stereomicroscope. All dissected parts from one specimen were kept in a single small tube, which were then kept together with the rest of the shrimp. Specimens of different sizes, both sexes, with several duplicates were used when specimens were sufficient. When there were several specimens, the holotype was normally left intact and paratypes were used for dissection in the description of new species. The abbreviation cl is used for carapace length (measured from the postorbital margin to the posterior margin of the carapace). Notation for the rostral formula (a–b + c–d + e/f–g), are: a–b, range of the number of postorbital teeth; c–d, range of the number of the dorsal rostral teeth; e: the number of apical teeth; f–g: range of the number of the ventral rostral teeth. Abbreviations for the ratio of the various segments of the pereopods follow Bouvier (1925).

Taxonomy

Family ATYIDAE De Haan, 1849

Caridina gracilirostris De Man, 1892

(Figures 1, 2)

Caridina gracilirostris De Man 1892, p 399 (part), Plate 25, Figure 31a–c [type locality: river near Maros, Sulawesi (Celebes), Indonesia].

Caridina gracilirostris: Kemp 1918, p 282; Blanco 1935, p 32, Figures 11–17; Riek 1953, p 121; Holthuis 1965, p 23 (part); 1978, p 35 (part); Johnson 1961, p 124, Figures 1, 2; Richard and Chandran 1994, p 242; Chace 1997, p 10 (part); Jaliha and Shenoy 1998, p 128; Cai and Ng 2001, p 674, Figure 7; Wowor, Cai, and Ng 2004, p 341, Figure 5Q; Cai and Shokita 2006a, p 250; 2006b, p 2135.

Caridina pseudogracilirostris Thomas, Pillai, and Pillai 1976, p 871, Figure 1 [type locality: Cochin backwater, India].

Material examined

Lectotype (here designated): male, cl 3.5 mm, ZMA DE102645, river near Maros, Sulawesi (Celebes), Indonesia, leg. M. Weber, 1888. Paralectotypes: two ovigerous females, cl 5.6–5.7 mm, same data as lectotype; one male, cl 3.7 mm, one female, cl 4.1 mm, one ovigerous female, cl 4.6 mm, eggs 0.4×0.25 mm, RMNH D1076, river near Balangnipa, leg. M. Weber, 15–21 October 1888; two males, cl 3.7–3.8 mm, one ovigerous female, cl 5.0 mm, eggs 0.40×0.25 mm, MNHN Na 723, river near Balangnipa, leg. M. Weber, 15–21 October 1888, exchanged from Amsterdam Museum, 1911.

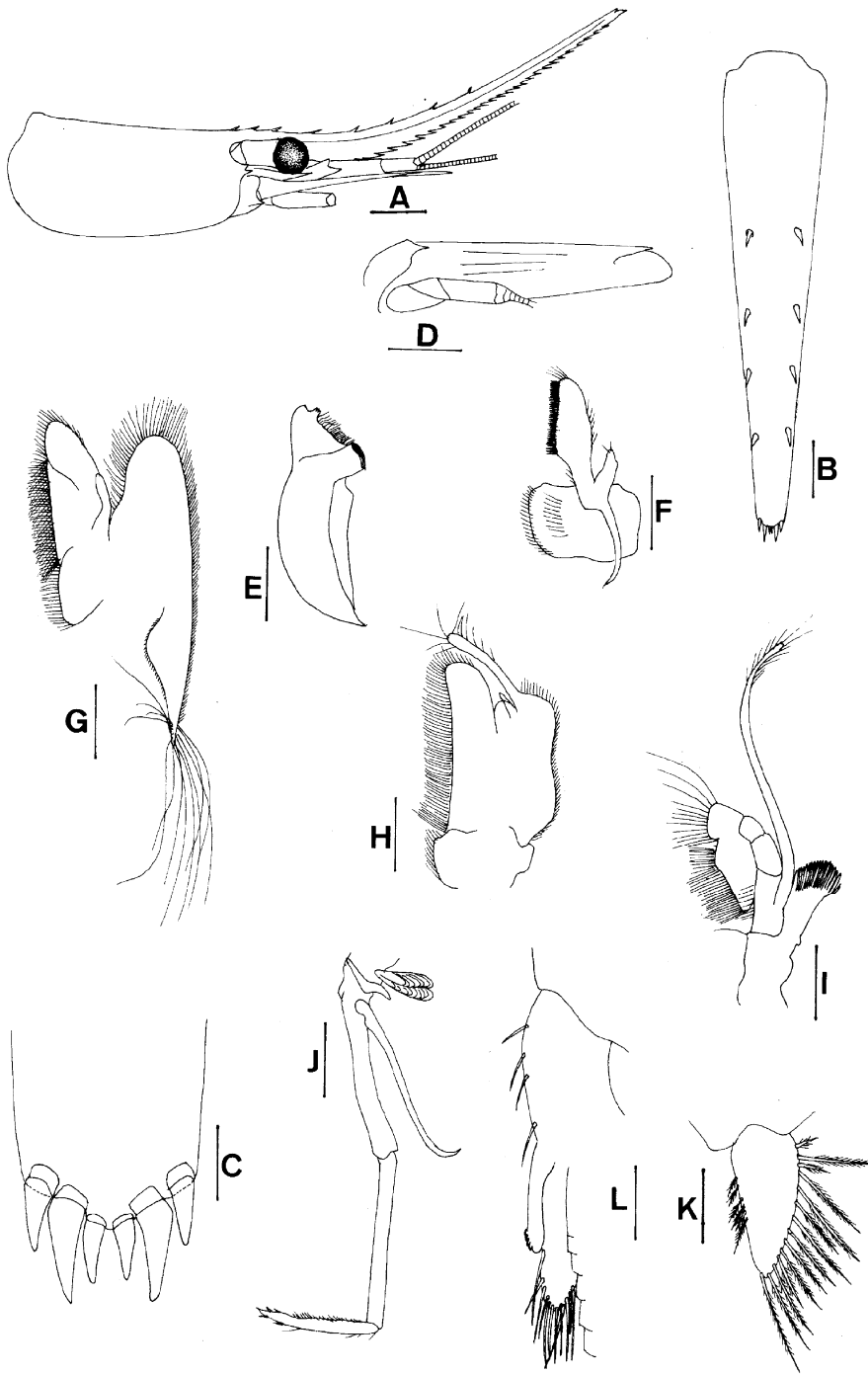


Figure 1. *Caridina gracilirostris*. (A) Cephalothorax and cephalic appendages; (B) telson; (C) distal portion of telson; (D) scaphocerite; (E) mandible; (F) maxillula; (G) maxilla; (H) first maxilliped; (I) second maxilliped; (J) third maxilliped; (K) endopod of male first pleopod; (L) appendix masculina and appendix interna of male second pleopod. (A, K, L) Syntype, male, 3.5 mm, ZMA DE 102645; (B–J) female, cl 5.2 mm, USNM 280305, Malaga River, Hinunangan Bay, Leyte, Philippines. Scale bars: 1 mm (A); 0.5 mm (B, D–J); 0.1 mm (C); 0.2 mm (K, L).

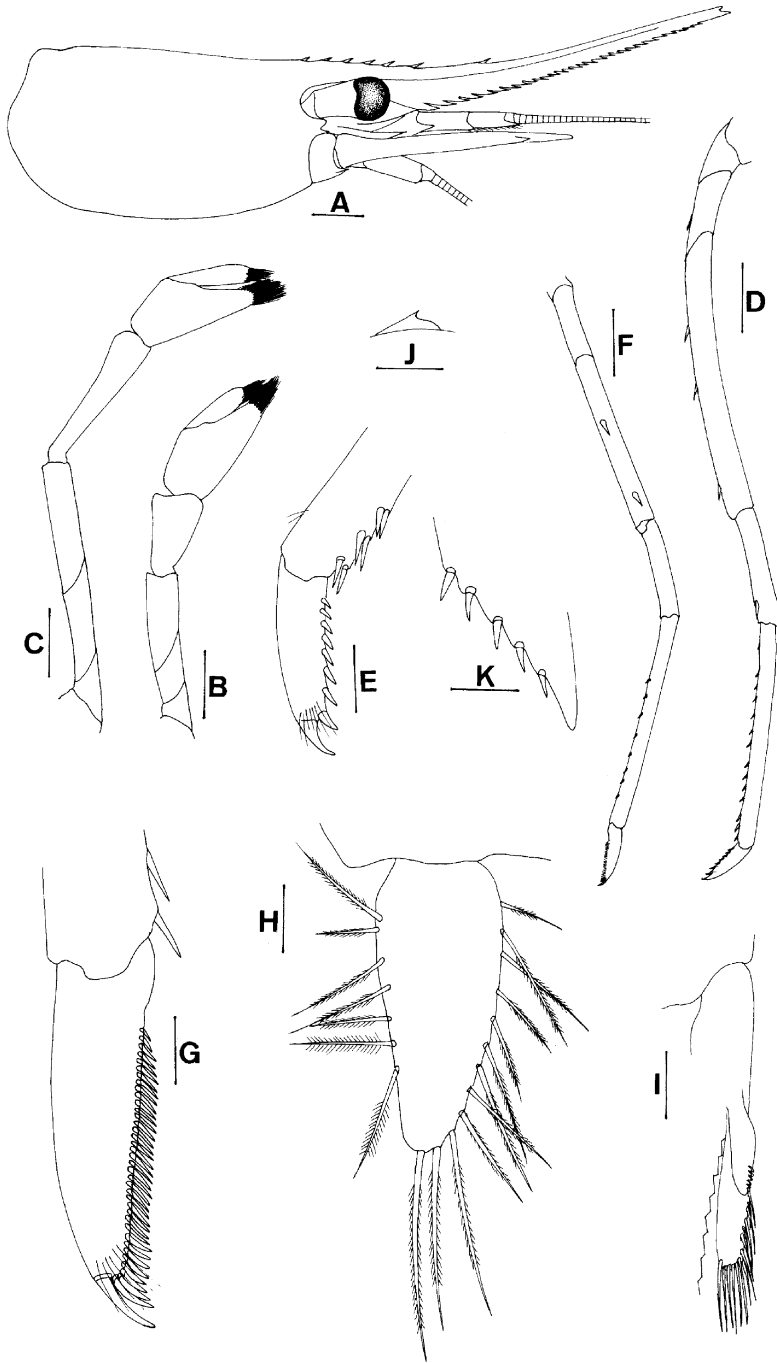


Figure 2. *Caridina gracilirostris*. (A) Cephalothorax and cephalic appendages; (B) first pereopod; (C) second pereopod; (D) third pereopod; (E) dactylus of third pereopod; (F) fifth pereopod; (G) dactylus of fifth pereopod; (H) endopod of male first pleopod; (I) appendix masculina and appendix interna of male second pleopod; (J) preanal carina; (K) diaeresis. (A–G, J) Female, cl 5.2 mm; (H, I) male, cl 5.2 mm, USNM 280305, Malaga River, Hinunangan Bay, Leyte, Philippines. Scale bars: 1 mm (A); 0.5 mm (B–D, F, J); 0.2 mm (E, I); 0.1 mm (G, H, K).

Other material. Nineteen males, 15 ovigerous females, BNHM 704c, Menado, Sulawesi, Indonesia, coll. D. Wire, 1927; 56 females, four juveniles, BNMH 704c, Menado, Sulawesi, coll. D. Wire, 1927; Molucca: one male, cl 5.2 mm, one female, cl 6.3 mm, ZRC, Sungei Dodaga, Halmahera, September 1994, coll. D. Robb; New Guinea: one male, cl 4.1 mm, one female, cl 4.8 mm, ZRC, brackish water at river mouth of Ajkwa River, Irian Jaya, Indonesia, coll. D. L. Rahayu, 30 May 2000; three females, SMF 8354, Wokam, Aru Islands, Indonesia, coll. S. Merton, 16 March 1908; one male, BNHM 704b, Wakamar, Wokam, Aru Islands, Indonesia, coll. S. Merton, 16 March 1908; one female, one ovigerous female, BNMH 704a, New Guinea, Indonesia; one male, BNMH 704b, Wakamar, Wokam, Aru Islands, Indonesia, coll. H. Merton, 1919; Lesser Sunda Islands: eight males, RMNH 30485, Bondokodi River at bridge near Kodi, West Sumba, Indonesia, 31 July 1949; two females, one ovigerous female, RMNH 30486, Bondokodi River 1–2 km above the bridge near Kodi, West Sumba, Indonesia, 2 August 1949; Borneo: nine males, cl 2.3–3.0 mm, 12 females, cl 2.4–3.3 mm, five ovigerous females, cl 3.7–5.0 mm, ZRC, Kalimantan Barat, Kabupaten Sambas: Sungei Sambas, from 5 min to 2 h upstream, 01°22.76'N, 109°20.66'E, coll. H. H. Tan, 18 April 1998; six males, cl 2.9–3.8 mm, two ovigerous females, 4.2–4.3 mm, MZB, Sungei Kakap, Kabupaten Kapuas, Kalimantan Barat, 00°04'S, 109°11'E, coll. D. Wowor, 5 June 1998; one male, cl 3.8 mm, one ovigerous female, cl 5.0 mm, ZRC 1995.512, East Kalimantan: Semunad, Sungei Tulit, tidal influence as far as 300 m downriver ca 4°043.08'N, 117°00.04'E, coll. M. Kottelat, 12 February 1993; Sumatra: four females, cl 2.5–3.9 mm, one ovigerous female, cl 5.5 mm, RMNH, Kluang Bay, South Sumatra, Indonesia, collected from river, freshwater, 10 November 1941; seven females, cl 3.5–3.9 mm, ZRC, S. Simpungkii at Sembawang Road, Singapore, coll. 11 July 1961; two ovigerous females, cl 5.0–5.1 mm, ZRC1979.4.12.146–147, Sungei Seletar at Nee Soon, Singapore, 25 September 1959; two males, 4.0–4.3 mm, six ovigerous females, cl 5.2–5.5 mm, ZRC, Sungei Seletar, station 3, Singapore, coll. P. Yeo Kwai Ho, 23 September 1959; one male, cl 2.5 mm, RMNH 11693, brackish water swamp near Singapore airport, Paya Lebar district, Singapore, pH 6.8, coll. M. Laird, 1 September 1955; one ovigerous female, cl 5.5 mm, ZRC, slow, small, tidal stream, draining into Sungei Skudai at mile 7 Johor Bahru, Skudai Road, Malaysia, coll. D. S. Johnson, 10 May 1960; two males, cl 1.9–2.0 mm, five females, cl 1.9–3.5 mm, CU2000.27, Mae Nam Pasuk, Saraburi Province, Thailand, 4 July 1974; one male, cl 2.8 mm, one female, cl 3.7 mm, CU 2000.14, Amphoe Photharam, Ratchaburi Province, Thailand, 5 April 1973; three males, cl 3.2–3.8 mm, five females, cl 3.0–3.7 mm, 13 ovigerous females, cl 3.8–4.2 mm, CU 2000.12, Klong Thom, Amphoe Muang, Phang Nga Province, Thailand, 12 May 1974; three females, cl 3.0–6.5 mm, five ovigerous females, cl 3.0–3.7 mm, CU 2000.12, Klong Thom, Amphoe Muang, Phang Nga Province, Thailand, 12 May 1974; one female, cl 2.3 mm, RMNH 21008, flushing area near Peah, Cambodia, 29 August 1950; 67 males, cl 2.7–4.1 mm, 32 females, cl 3.4–5.5 mm, 28 ovigerous females, cl 4.2–5.5 mm, USNM 280305, Malaga River, Hinunangan Bay, Leyte, Philippines, coll. Albatross Philippine Expedition, 30 July 1909; two males, cl 2.5–2.6 mm, three females, cl 2.0–3.3 mm, one ovigerous female, cl 3.7 mm, ZRC, tributary of Loboc River, Loboc, Bohol, Philippines, coll. Y. Cai, 19 December 2000; five males, three females, four ovigerous females, USNM 280319, Pangauran River at Port Caltom, Busuanga Island, Mindoro Oriental, Philippines, coll. Albatross Philippines expedition, 16 December 1908; one female, cl 3.6 mm, USNM 172594, Ngerbekull River, Babelthuap Island, Palau, coll. G. Right, 1 June 1978; one male, cl 3.2 mm, one female, cl 2.4 mm, ZRC, Kangkou Hsi, Manchou village, Pingtung County, Taiwan, coll. Y. Cai

et al., 23 November 1997; four males, six females, two ovigerous females, ZRC, Veisari River, ca 4 km from W. Lawi, Lawi, Suva, Fiji, coll. A. Auspach, 1 February 1995; three males, three ovigerous females, RMNH, Fiji, coll. J. E. Parrot, 1967; seven males, one ovigerous female, MNHN Na 724, Tinnevely, southern India, no date; one male, six females, three ovigerous females, RMNH D 24205, Lake Marovovo, North of Ambato-Boéni, Pref. Ambato-Boéni, Province Majunge, Madagascar, coll. Y. Therezien, 25 June 1964.

Comparative material examined

Caridina appendiculata Jaliha and Shenoy, 1998: lectotype: male, cl 3.1 mm, *Caridina gracilirostris* De Man, 1892, syntypes, ZMA De102646, river near Bari, Flores, Indonesia, coll. M. Weber, 1888. Paralectotypes: one male, cl 2.9 mm, three females, cl 2.2–4.3 mm, same data as lectotype. One male, two females, RMNH 30488, Bondokodi River 1–2 km above the bridge near Kodi, 2 August 1949; two males, BMNH 704d, Mentawai, Sulawesi, no date; two males, cl 4.8–4.9 mm, USNM 285309, Baganga River, Mindanao, Philippines, coll. Albatross Philippines Expedition, 13 May 1908; four specimens, USNM 172592, Babelthup Island, Palau, Metengalakumer River, coll. G. Right, 17 November 1977; seven males, three females, one ovigerous female, MNHN Na722, Waterlot, Madagascar, 1924.

Description

Rostrum ending in bifid tip, reaching far beyond distal end of scaphocerite, 1.5–2.0 times as long as carapace, strongly upturned, armed with three to nine dorsal teeth on posterior half, 28–36 teeth throughout ventral margin; antennal spine short, situated below inferior orbital angle; pterygostomian margin sub-rectangular.

Sixth abdominal somite 0.8 times as long as carapace, 2.0 times as long as fifth somite, as long as telson. Telson very slender, 4.8 times as long as wide, with four pairs of dorsal spinules and one pair of dorsolateral spinules; distal spines very stout, lateral pair distinctly longer than intermediate spines; apparently lacking posteromedian projection. Preanal carina with a spine.

Eyes well developed, anterior end reaching to 0.8 times length of basal segment of antennular peduncle. Antennular peduncle 0.8 times as long as carapace; basal segment longer than sum of second and third segment lengths, anterolateral angle pointed, reaching to 0.4 times length of second segment, second segment distinctly longer than third segment. Stylocerite reaching to 0.8–0.9 times length of basal segment of antennular peduncle. Scaphocerite 4.1 times as long as wide.

Incisor process of mandible ending in a row of small teeth, molar process truncate. Lower lacinia of maxillula broadly rounded, upper lacinia elongate, with distinct teeth on inner margin, palp slender. Upper endites of maxilla subdivided, palp short, scaphognathite tapering posteriorly with some long, curved setae at posterior end. Palp of first maxilliped ending in broad triangular structure. Second maxilliped typical of genus. Third maxilliped reaching to end of second segment of antennular peduncle, with ultimate segment distinctly shorter than penultimate segment.

Epipods on first four pereopods. First pereopod not reaching beyond end of eye stalk; merus as long as carpus, 2.5 times as long as wide, carpus 1.7 times as long as high; chela twice as long as broad, finger as long as or slightly longer than palm. Second pereopod reaching beyond end of basal segment of antennular peduncle, merus shorter than carpus, 3.8 times as long as broad; carpus 1.2 times as long as chela, 4.0 times as long as high; chela

2.2 times as long as broad; fingers 1.4 times as long as palm. Third pereopod reaching to end of antennular peduncle, with propodus 13 times as long as wide, 4.0 times as long as dactylus; dactylus 3.2 times as long as wide (spines included), with eight spines on flexor margin. Fifth pereopod reaching to end of basal segment of antennular peduncle, with propodus 12 times as long as wide, 3.8 times as long as dactylus; dactylus 3.7 times as long as wide, with 37 spinules on flexor margin.

Endopod of male first pleopod subtriangular, 0.2 times as long as exopod, without appendix interna. Uropodal diaeresis with 5–11 movable spinules.

Eggs 0.4×0.25 mm in diameter.

Habitat

Lower parts of streams or rivers with seawater influence, very often from brackish water.

Distribution

Indonesia, Singapore, Malaysia, Thailand, Cambodia, Taiwan, Japan, Palau, Philippines, Fiji, India, and Madagascar.

Remarks

When De Man (1892) described *Caridina gracilirostris*, he noted that there were two forms of carpus in this species: a short carpus form from Sulawesi and a long carpus form from Flores. Tiwari and Pillai (1971) also reported both forms from different parts of the Andaman Islands.

Jalihal and Shenoy (1998, p 128), in an abstract for a meeting, commented as follows: “*C. gracilirostris* De Man, 1892. Its syntype material is actually an assemblage of three taxonomic forms, viz., a typical and two atypical forms, the ‘forma typica’ characterized by [the] absence of an appendix interna is actually *C. gracilirostris* s. s., which is predominantly Indo-Malayan species. Of the two atypical forms, the one possessing a single postorbital tooth and a straight appendix interna and being mainly an African inhabitant with occasional presence in the Malayan archipelago is described as *C. n. sp. 1*. The other one possessing two postorbital teeth and a curved appendix interna and apparently endemic to Flores is described as *C. appendiculata* n. subsp. 2.” No lectotype of *C. gracilirostris* was formally stated or designated. However, we have discovered that some Madagascan specimens, in RMNH, had been labelled by Jalihal and Shenoy as the types of “*C. appendiculata*”, although this information was not published.

Re-examination of the syntypes of *C. gracilirostris* shows that there are indeed three species. One, the typical form, from Maros and Bapanguipa, Sulawesi, has no appendix interna on the endopod of the male first pleopod; the rostrum has fewer than 10 teeth, there are no postorbital teeth; the telson does not terminate in a posteromedian projection; and the carpus of the first pereopod is short, less than twice as long as high. A second form, from Bari, Flores, has an endopod on the male first pleopod which possesses a distinct appendix interna, the dorsal margin of the rostrum is armed with more than 10 teeth, of which one or two are situated behind the postorbital margin; the telson terminates in a posteromedian projection; and the carpus of first pereopod is slender, 2.0–2.5 times as long as high. The third form, from Reo, Flores, has an endopod of male first pleopod which possesses a distinct appendix interna; the rostrum has fewer than 10 teeth, without any

postorbital teeth; the telson does not terminate in a posteromedian projection; and the carpus of the first pereopod is slender, being 2.3–2.9 times as long as high. These three forms are all superficially similar in the form of the rostrum, but can be differentiated from each other easily by the combination of rostral formula and structure of sexual appendages. To stabilize the taxonomic status of these species, we here designate a male specimen from Maros, Sulawesi, as the lectotype of *C. gracilirostris*. As Jaliha and Shenoy (1998) clearly mentioned the main characters of *C. appendiculata* in their abstract, their action makes the name available although they did not mention the types even though we know that they had in fact labelled a holotype and paratypes from a series of Madagascan specimens in the RMNH. However, Jaliha and Shenoy's (1998) abstract did not list the type material, although they did state that *C. appendiculata* was described for the population "apparently endemic to Flores" (Jaliha and Shenoy, 1998, p 128) and they referred to De Man's (1892) specimens. This action alone makes De Man's (1892) material from near Bari, Flores, which is now in RMNH, syntypes. Their labelling of the RMNH specimens from Madagascar as the types of *C. appendiculata* therefore seems odd. This action was probably done after they had decided the species was new and realized later that the material in RMNH from Madagascar was also *C. appendiculata*, and the species was not just found on Flores. We therefore here designate one of the syntypes of *C. gracilirostris* (male, cl 3.1 mm, ZMA De 102646), which was from Rive Bari, Flores, as the lectotype of *C. appendiculata* Jaliha and Shenoy, 1998. *Caridina appendiculata* is moved to the *C. nilotica* species group due to the presence of postorbital teeth on the rostrum, a diagnostic character of this group (Y. Cai and P. K. L. Ng, in preparation). The third species, although noted as different by De Man as early as a century ago, remains undescribed, for which the name *Caridina neglecta* is here proposed.

Caridina pseudogracilirostris Thomas, Pillai, and Pillai, 1976, from Cochin backwater, India, is clearly identical to *C. gracilirostris* s. str. as the description and the drawings demonstrated, especially in the absence of the appendix interna in the endopod of the male first pleopod. Richard and Chandran (1994) had synonymized *C. pseudogracilirostris* with *C. gracilirostris*, although they did not realize that there are actually three species involved in the type series of *C. gracilirostris*.

Holthuis (1965) reported *C. gracilirostris* from Madagascar. His drawing actually shows *C. appendiculata*. However, a re-examination of his material shows that one of his lots from Waterolt in Madagascar is indeed *C. gracilirostris*, the rest being *C. appendiculata*. Holthuis (1978) also reported *C. gracilirostris* from Sumba, Lesser Sunda Islands. Re-examination of part of his specimens shows that there are two species involved, *C. gracilirostris* and *C. appendiculata*, both from Bondokadi River, West Sumba.

Without detailed descriptions and/or figures of the teeth arrangement, proportions of the various segments of the pereopods and structure of male first pleopod, the actual identity of many previous records of "*C. gracilirostris*" by various authors cannot be determined for the time being.

***Caridina gracilima* Lanchester, 1901**

(Figure 3)

Caridina gracilima Lanchester 1901, p 560, Plate 34, Figure 1 [type locality: inner lake of Tale Sap, Southern Thailand].

Caridina gracilima: Bouvier 1905, p 72, Plate 39; 1913, p 463; 1925, Plate 40, Figures 301–304; Kemp 1918, p 285.

Caridina gracilirostris: Johnson 1961, p 124 (part).

Not *Caridina gracilima*: Blanco 1935, p 32, Figures 5–10.

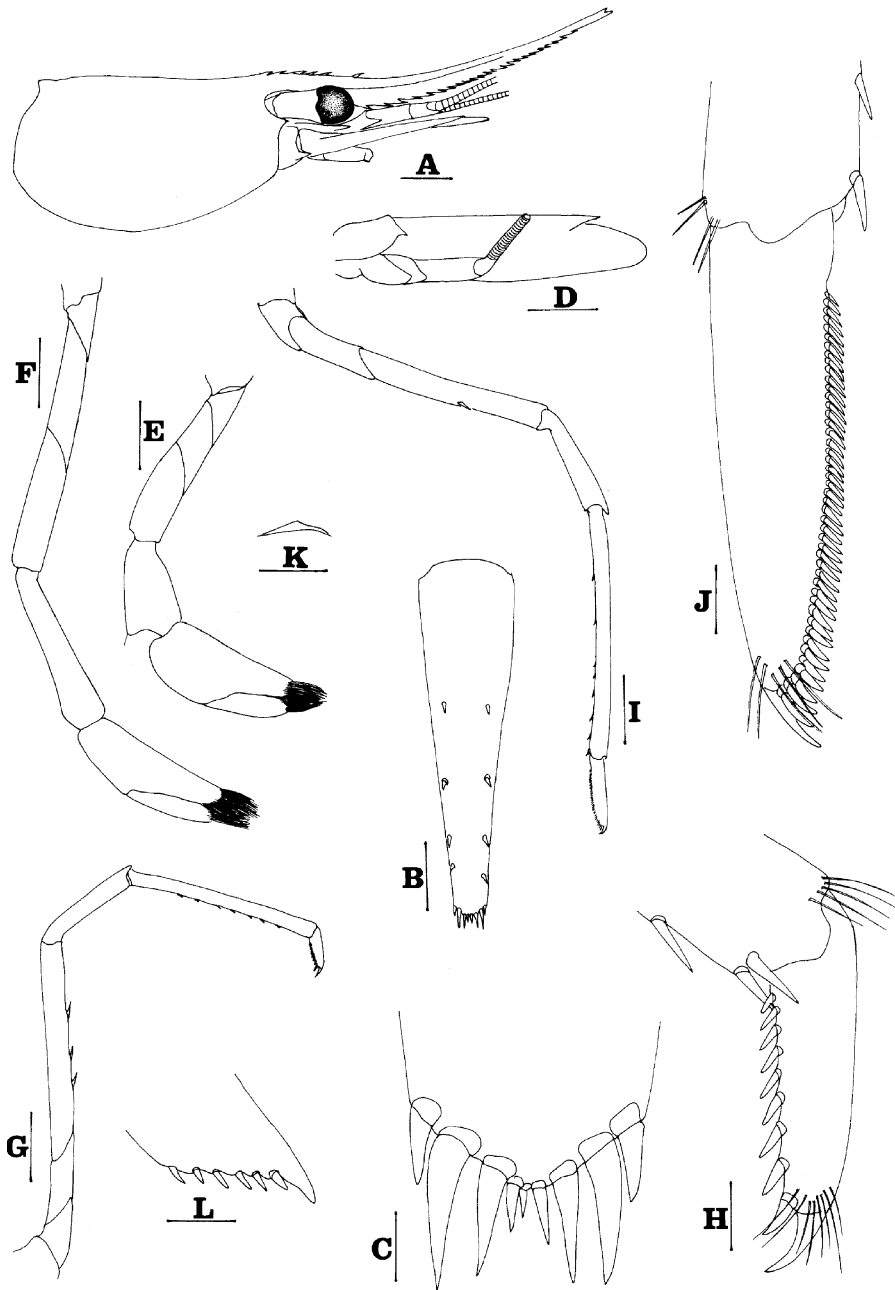


Figure 3. *Caridina gracilima*. (A) Cephalothorax and cephalic appendages; (B) telson; (C) distal portion of telson; (D) scaphocerite; (E) first pereopod; (F) second pereopod; (G) third pereopod; (H) dactylus of third pereopod; (I) fifth pereopod; (J) dactylus of fifth pereopod; (K) preanal carina; (L) diaeresis. Male, cl 4.5 mm, USNM 65554, Bangkok, Thailand. Scale bars: 1 mm (A); 0.5 mm (B, D–G, I, K); 0.1 mm (C, H, J, L).

Material examined

Lectotype (here designated): ovigerous female, cl 4.2 mm, eggs 0.58×0.42 mm, MNHN Na741, Malay Peninsula, 1899. Paralectotypes: one male, cl 3.9 mm, one male, cl 2.6 mm, same data as lectotype; one male, cl 2.8 mm, one female, cl 4.0 mm, MNHN Na740, Malay Peninsula, exchanged from the Museum of the University of Cambridge, 1912. One female, cl 3.4 mm, one ovigerous female, cl 4.0 mm, eggs 0.66×0.40 mm, MNHN Na739, among weeds at mouth of Lampam River, Tale Sap, Singgora, Thailand, coll. N. Annandale, 1899.

Other material. Two females, cl 3.8–4.5 mm, one ovigerous female, cl 4.0 mm, eggs 0.6×0.4 mm, ZRC, Mae Sot Market, Thailand, coll. H. H. Tan and H. H. Ng, 27 May 1999; one female, cl 3.1 mm, one ovigerous female, cl 3.3 mm, CU2000.29, Amphoe Muak Lek Waterfall, Saraburi Province, Thailand, 23 December 1974; two ovigerous females, cl 4.2–4.5 mm, USNM 65554, Bangkok, Thailand, coll. H. M. Smith, 4 August 1925; one male, cl 3.1 mm, one ovigerous female, cl 3.8 mm, eggs 0.6×0.4 mm, one ovigerous female, cl 3.9 mm, CU2000.04, Rayong Province, Thailand, 8 December 1973; one female, cl 4.5 mm, two ovigerous females, cl 4.3–4.6 mm, CU 2000.16, Ratchaburi Province, Thailand, 6 November 1973; one male, cl 2.8 mm, two ovigerous females, cl 3.7–3.8 mm, ZRC, Rayang, Thailand; six females, cl 3.8–4.2 mm, six ovigerous females, cl 3.5–4.0 mm, eggs 0.6×0.4 mm, CU2000.13, Ratchaburi Province, Thailand, 18 November 1973.

Description

Rostrum ending in bifid tip, reaching far beyond distal end of scaphocerite, slightly longer than carapace to 1.6 times as long as carapace, strongly upturned, armed with 5–10 dorsal teeth on posterior half, with 19–24 teeth along whole ventral margin; antennal spine short, situated lower than inferior orbital angle; pterygostomian margin broadly rounded.

Sixth abdominal somite 0.8 times as long as carapace, 1.9 times as long as fifth somite, slightly longer than telson. Telson 3.7 times as long as wide, with four pairs of dorsal spinules and one pair of dorsolateral spinules; distal spines short, stout, lateral pair slightly longer than intermediate spines; lacking posteromedian projection. Preanal carina without spines.

Eyes well developed, anterior end reaching to 0.9 times length of basal segment of antennular peduncle. Antennular peduncle 0.8 times as long as carapace; basal segment of antennular peduncle longer than sum of second and third segment lengths; second segment distinctly longer than third segment. Stylocerite reaching to 0.8 times length of basal segment of antennular peduncle. Scaphocerite very slender, 4.0 times as long as wide.

Mouthparts similar to *Caridina neglecta*. Palp of first maxilliped ending in a finger-like projection. Second maxilliped typical of genus. Third maxilliped reaching near end of antennular peduncle, with ultimate segment distinctly shorter than penultimate segment.

Epipods on first four pereopods. First pereopod not reaching to end of eye stalk; merus 2.4 times as long as broad; carpus slightly longer than merus, 1.6 times as long as high; chela 2.2 times as long as broad, fingers as long as palm. Second pereopod reaching to end of basal segment of antennular peduncle, merus shorter than carpus, 4.2 times as long as broad; carpus as long as chela, 4.2 times as long as high; chela 3.1 times as long as broad; fingers 1.2 times as long as palm. Third pereopod reaching to end of antennular peduncle, with propodus 12 times as long as wide, 4.0 times as long as dactylus; dactylus 3.5 times as long as wide (spines included) with six to nine spines on flexor margin. Fifth pereopod reaching to end of second segment of antennular peduncle, with propodus 14 times as long

as wide, 3.2 times as long as dactylus; dactylus 4.0 times as long as wide, with 30–47 spinules on flexor margin.

Endopod of male first pleopod subtriangular, 0.2 times as long as exopod, without appendix interna.

Uropodal diaeresis with 6–10 movable spinules.

Eggs $0.55\text{--}0.66 \times 0.35\text{--}0.40$ mm.

Habitat

A variety of lowland freshwater habitats.

Remarks

With regard to the short carpus of the first pereopod, and the absence of an appendix interna on the endopod of male pleopod, *Caridina gracilima* resembles *C. gracilirostris*. Kemp (1918) differentiated *C. gracilima* from *C. gracilirostris* in detail, i.e. in its shorter rostrum; presence of fewer ventral rostral teeth; fewer spinules on the diaeresis of the uropod; relatively larger eggs (0.65–0.70 versus 0.33–0.52 mm) and smaller body size. Based on a larger collection from various localities in Thailand, we find that all these are good characters. Some specimens of *C. gracilima*, however, have quite a long rostrum, and the ventral rostral teeth also could be as many as 24. Other than the characters mentioned by Kemp, there is one more important character, the absence of a preanal spine, which was mentioned by Bouvier (1925). This character can be effectively used to separate *C. gracilima* from *C. gracilirostris*.

Woltereck (1937) reviewed the distribution of the genus *Caridina* and mentioned the variability of the carpus of the first pereopod in *C. gracilirostris*, and considered *C. gracilima* to be indistinguishable from *C. gracilirostris*. Johnson (1961) followed Woltereck's suggestion, provided a more detailed discussion and treated *C. gracilima* as a junior synonym of *C. gracilirostris*. The fact that both authors had not examined any specimens of *C. gracilima*, and were unaware of the taxonomic confusion within the *C. gracilirostris* species complex, probably misled them.

The only record for the species outside Thailand was that of Blanco (1935) from the Philippines. According to his description and illustration, his specimens are definitely not *C. gracilima*. They are most probably *C. gracilipes* De Man, 1892, instead.

We have examined a series of syntypes of *C. gracilima* Lanchester, 1901, in MNHN. The best female specimen is here selected as the lectotype of the species.

Distribution

Known with certainty only from Thailand.

Caridina neglecta new species (Figures 4, 5)

Material examined

Holotype: male, cl 4.2 mm, MZB, Sungai Batang, 13 km on road from Palopo to Wotu, Sulawesi, Indonesia, coll. M. Kottelat and A. Werner, March 1989. Paratype: one female, cl 4.3 mm, ZRC, same data as holotype.

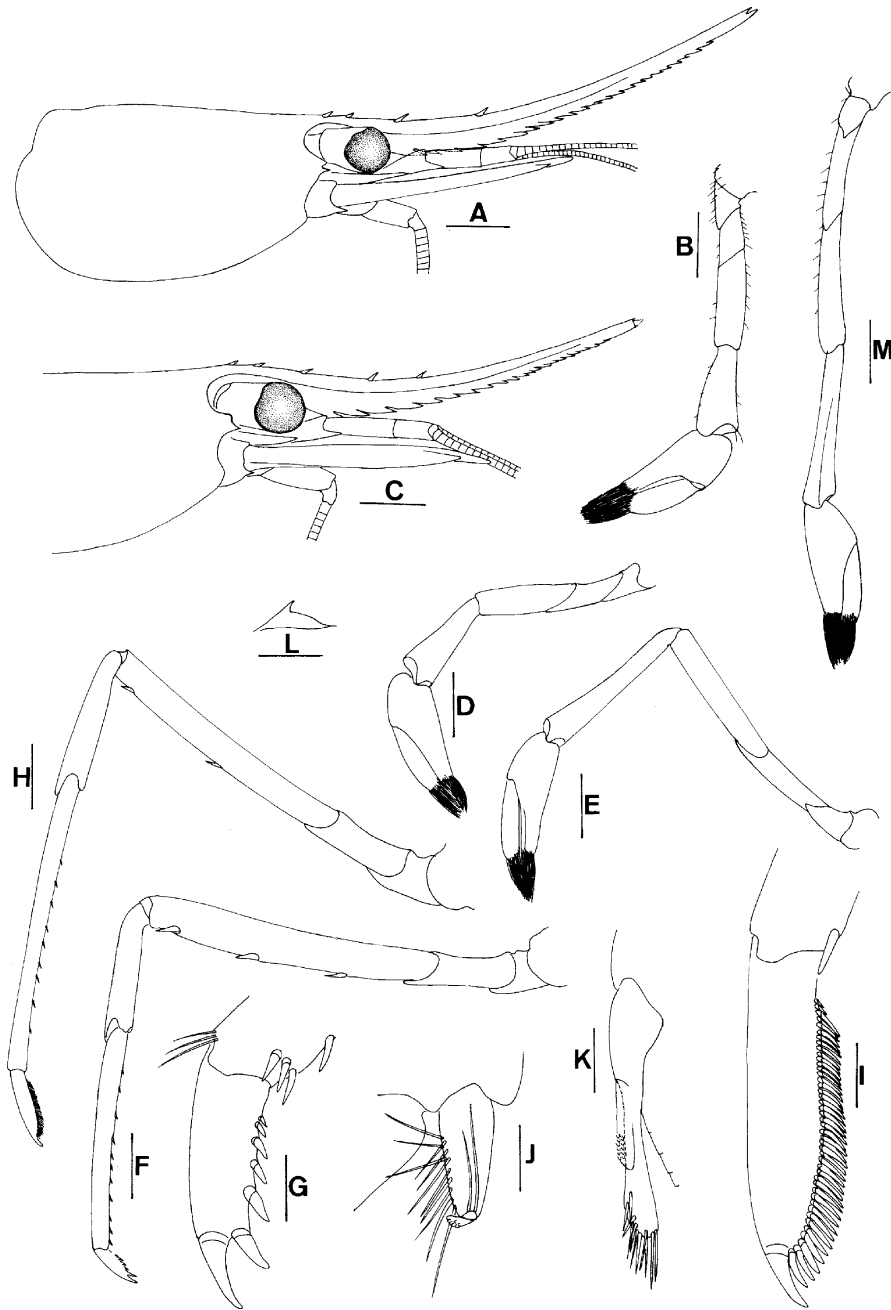


Figure 4. *Caridina neglecta*, new species. (A, C) Cephalothorax and cephalic appendages; (B) first pereiopod, female; (D) first pereiopod, male; (E) second pereiopod, male; (F) third pereiopod; (G) dactylus of third pereiopod; (H) fifth pereiopod; (I) dactylus of fifth pereiopod; (J) endopod of male first pleopod; (K) appendix masculina and appendix interna of male second pleopod; (L) preanal carina; (M) second pereiopod, female. (A, B, M) Female, paratype, cl 4.3 mm, ZRC; (C–L) male, cl 4.2 mm, holotype, MZB, Sungai Batang, 13 km on road from Palopo to Wotu, Sulawesi, Indonesia. Scale bars: 1 mm (A, C); 0.5 mm (B, D–F, H, M, L); 0.2 mm (J, K); 0.1 mm (G, I).

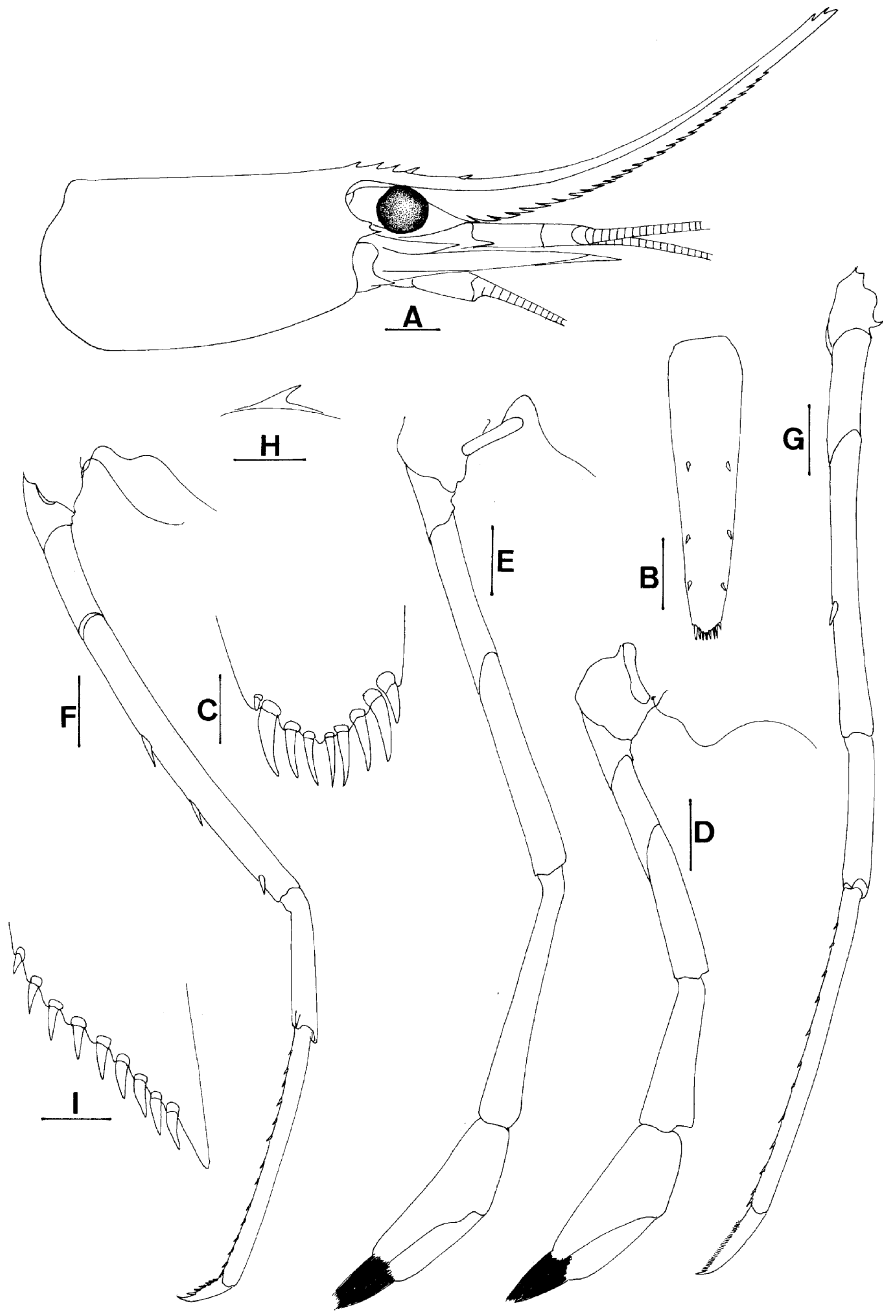


Figure 5. *Caridina neglecta*, new species. (A) Cephalothorax and cephalic appendages; (B) telson; (C) distal portion of telson; (D) first pereopod; (E) second pereopod; (F) third pereopod; (G) fifth pereopod; (H) preanal carina; (I) diaeresis. Male, cl 5.3 mm, USUM 285309, Baganga River, Mindanao, Philippines. Scale bars: 1 mm (A), 0.5 mm (B, D–G), 0.2 mm (C, I).

Other material. Two males, cl 2.2–4.3 mm, ZMA De102647, paralectotypes of *Caridina gracilirostris* De Man, 1892, river near Reo, Flores, Indonesia, coll. M. Weber, 1888; one male, cl 5.3 mm, one female, cl 4.2 mm, USNM 285309, Baganga River, Mindanao, Philippines, coll. Albatross Philippines Expedition, 13 May 1908.

Description

Rostrum ending in bifid top, reaching far beyond distal end of scaphocerite, about 1.5–2.0 times as long as carapace, strongly upturned, armed with four to eight dorsal teeth on posterior half and 21–30 teeth along whole ventral margin; antennal spine short, situated below inferior orbital angle; pterygostomial margin sub-rectangular.

Sixth abdominal somite 0.6 times as long as carapace, 1.8 times as long as fifth somite, slightly shorter than telson. Telson 3.8 times as long as wide, with three or four pairs of dorsal spinules and one pair of dorsolateral spinules; distal spines short, stout, lateral pair slightly longer than intermediate spines; not ending in a posteromedian projection. Preanal carina with spine.

Eyes well developed, anterior end reaching to 0.7 times length of basal segment of antennular peduncle. Antennular peduncle 0.8 times as long as carapace; basal segment of antennular peduncle longer than sum of second and third segment lengths; second segment distinctly longer than third segment. Stylocerite reaching to 0.8 times length of basal segment of antennular peduncle or near end of this segment. Scaphocerite very slender, 4.2 times as long as wide.

Incisor process of mandible ending in irregular teeth, molar process truncate. Lower lacinia of maxillula broadly rounded, upper lacinia elongate, with numerous distinct teeth on inner margin, palp slender. Upper endites of maxilla subdivided, palp short, scaphognathite tapering posteriorly with some long, curved setae at posterior end. Palp of first maxilliped ending in finger-like projection. Second maxilliped typical of genus. Third maxilliped reaching near end of antennular peduncle, with ultimate segment distinctly shorter than penultimate segment.

Epipods on first four pereopods. First pereopod reaching beyond end of eye stalk; merus 3.2–4.0 times as long as broad; carpus slightly longer than merus, 2.3–2.9 times as long as high; chela 2.6 as long as broad, fingers 1.2–1.4 times as long as palm. Second pereopod reaching beyond end of basal segment of antennular peduncle, merus shorter than carpus, 5.8–6.1 times as long as broad; carpus 1.3–1.4 times as long as chela, 6.2–6.7 times as long as high; chela 2.8–3.0 times as long as broad; fingers 1.3 times as long as palm. Third pereopod reaching to end of antennular peduncle, propodus 11 times as long as wide, 4.1–5.1 times as long as dactylus; dactylus 2.6 times as long as wide, with six teeth on flexor margin. Fifth pereopod reaching to end of third segment of antennular peduncle, propodus 15 times as long as wide, 3.7–3.8 times as long as dactylus; dactylus 3.7 times as long as wide, with 37–44 spinules on flexor margin.

Endopod of male first pleopod subtriangular, about 0.25 times as long as exopod, with appendix interna.

Uropodal diaeresis with nine movable spinules.

Eggs 0.4×0.25 mm in diameter.

Habitat

Rivers.

Etymology

The species name *neglecta* alludes to the fact that it has long been neglected as a valid taxon.

Distribution

Known only from Indonesia and Philippines so far, but considering these records, it probably has a wider range.

Remarks

The presence of an appendix interna on the endopod of the male first pleopod easily separates *C. neglecta* from *C. gracilirostris* and *C. gracilima*.

***Caridina longifrons* new species**
(Figure 6)

Material examined

Holotype: male, cl 4.5 mm, MZB, Kabupaten Maros, stream above Bantimurung waterfall, Sulawesi, Indonesia, coll. M. Kottelat, 7 July 1988. Paratypes: seven males, cl 3.8–4.3 mm, three females, cl 4.6–5.0 mm, eight ovigerous females, cl 4.7–5.2 mm, ZRC, data same as holotype.

Description

Rostrum ending in bifid tip, reaching far beyond distal end of scaphocerite, about twice as long as carapace, strongly upturned, armed with 8–11 dorsal teeth on posterior half, including none to two postorbital teeth, with 26–33 teeth along whole ventral margin; antennal spine short, situated below inferior orbital angle; pterygostomian margin broadly rounded.

Sixth abdominal somite 0.8 times as long as carapace, 2.1 times as long as fifth somite, slightly longer than telson. Telson 3.1 times as long as wide, with four or five pairs of dorsal spinules and one pair of dorsolateral spinules; distal spines short, stout, lateral pair slightly longer than intermediate spines; lacking posteromedian projection. Preanal carina with spine.

Eyes well developed, anterior end reaching to 0.7 times length of basal segment of antennular peduncle. Antennular peduncle 0.8 times as long as carapace; basal segment of antennular peduncle longer than sum of second and third segment lengths; anterolateral angle pointed, reaching 0.3 times length of second segment, second segment distinctly longer than third segment. Stylocerite reaching to 0.8 times length of basal segment of antennular peduncle or near end of this segment. Scaphocerite very slender, 4.2 times as long as wide.

Incisor process of mandible ending in irregular teeth, molar process truncate. Lower lacinia of maxillula broadly rounded, upper lacinia elongate, with distinct teeth on inner margin, palp slender. Upper endites of maxilla subdivided, palp short, scaphognathite tapering posteriorly with some long, curved setae at posterior end. Palp of first maxilliped ending in finger-like projection. Second maxilliped typical of genus. Third maxilliped reaching near end of antennular peduncle, with ultimate segment distinctly shorter than penultimate segment.

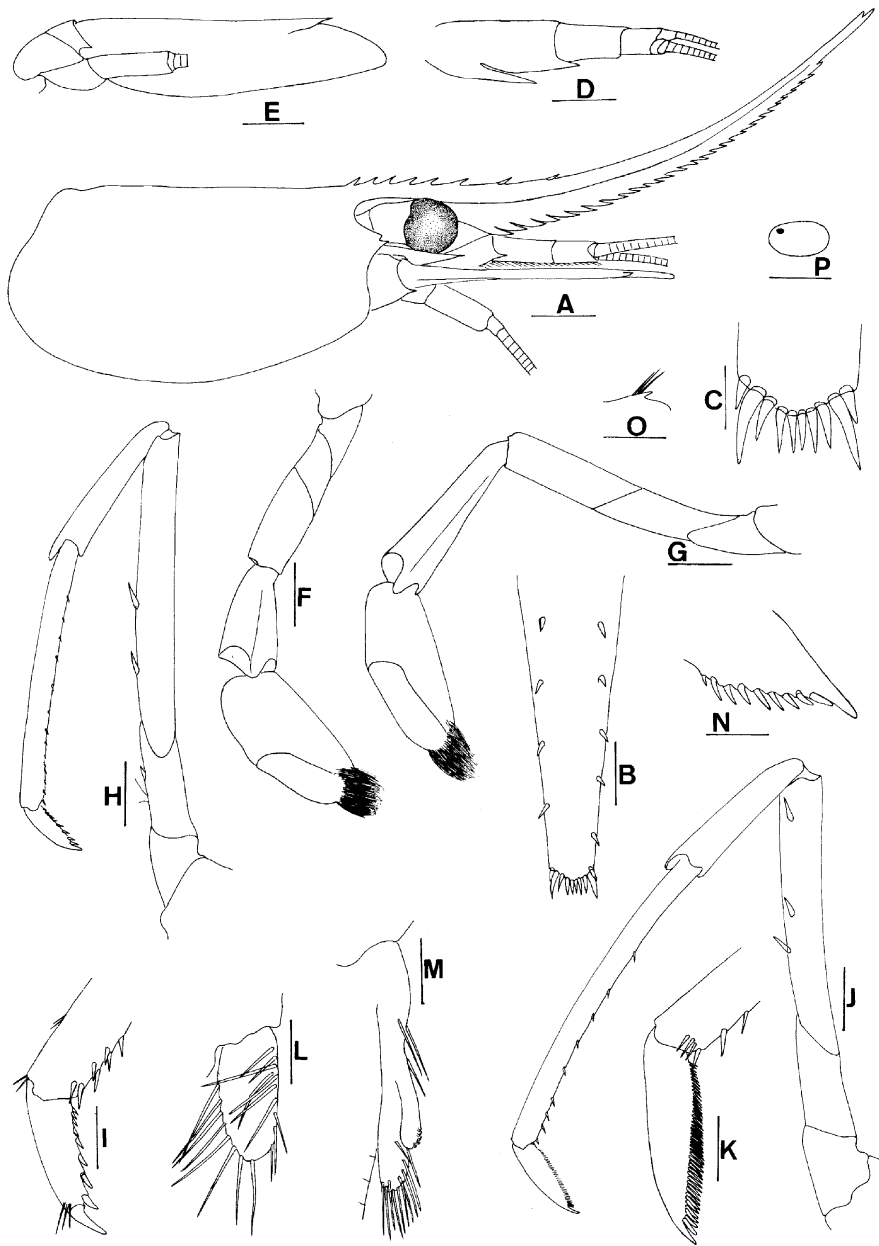


Figure 6. *Caridina longifrons*. (A) Cephalothorax and cephalic appendages; (B) telson; (C) distal portion of telson; (D) antennular peduncle; (E) scaphocerite; (F) first pereiopod; (G) second pereiopod; (H) third pereiopod; (I) dactylus of third pereiopod; (J) fifth pereiopod; (K) dactylus of fifth pereiopod; (L) endopod of male first pleopod; (M) appendix masculina and appendix interna of male second pleopod; (N) diaeresis; (O) preanal carina; (P) egg. (A–K, O, P) Female, cl 5.0 mm; (L, M) male, cl 4.0 mm, ZRC, above Bantimurung waterfall, Kabupaten Maros, Sulawesi, Indonesia. Scale bars: 1 mm (A, D, E); 0.5 mm (B, F–H, J, O, P); 0.2 mm (C, I, K, L–N).

Epipods on first four pereopods. First pereopod reaching to end of eye stalk; merus 2.0 times as long as broad; carpus slightly longer than merus, 1.8 times as long as high; chela 2.1 times as long as broad, fingers 1.2 times as long as palm. Second pereopod reaching to end of basal segment of antennular peduncle, merus shorter than carpus, 2.9 times as long as broad; carpus as long as chela, 3.6 times as long as high; chela 2.5 times as long as broad; fingers 1.4 times as long as palm. Third pereopod reaching to third segment of antennular peduncle, propodus 11 times as long as wide, 4.0 times as long as dactylus; dactylus 3.4 times as long as wide (spines included), with eight spines on flexor margin. Fifth pereopod reaching to second segment of antennular peduncle, propodus 11 times as long as wide, 3.5 times as long as dactylus; dactylus 3.6 times as long as wide, with 41 spinules on flexor margin.

Endopod of male first pleopod sub-rectangular, about 0.2 times as long as exopod, without appendix interna.

Uropodal diaeresis with nine movable spinules.

Eggs $0.9\text{--}1.0 \times 0.42\text{--}0.45$ mm.

Habitat

Caridina longifrons was found in mountain streams above Bantimurung waterfall (M. Kottelat, personal communication).

Etymology

The species name is a combination of two Latin roots, *long*, for lengthy, and *frons*, forehead, alluding to the form of the extra long rostrum. The name is used as a noun in apposition.

Distribution

Known only from the type locality, Maros of southern Sulawesi, Indonesia.

Remarks

Caridina longifrons superficially resembles *C. gracilirostris*. However, it can be easily separated from allied species by its relatively larger eggs. It can also be differentiated from *C. gracilirostris* by its relatively stouter telson (3.1 times as long as wide versus 4.8 times), the more slender merus of the first pereopod (2.5 times as long wide versus 2.0 times), the shorter carpus of the second pereopod (as long as chela versus 1.2 times longer than chela), and the stouter carpus of the second pereopod (3.6 times as long as high versus 4.0 times).

Key to species of the *Caridina gracilirostris* group

1. Appendix interna absent from endopod of male first pleopod 2
- Appendix interna present at endopod of male first pleopod *Caridina neglecta*
2. Eggs 0.7 mm in diameter or larger *C. longifrons*
- Eggs no more than 0.6 mm in diameter 3
3. Preanal carina with a spine; eggs $0.55\text{--}0.66 \times 0.35\text{--}0.40$ mm *C. gracilima*
- Preanal carina without spine; eggs 0.40×0.25 mm *C. gracilirostris*

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