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FRESHWATER SHRIMPS OF THE FAMILY ATYIDAE (CRUSTACEA: DECAPODA: CARIDEA) FROM PENINSULAR MALAYSIA AND SINGAPORE

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***ABSTRACT.* –** The taxonomy of the freshwater shrimps of the family Atyidae from Malaysia and Singapore is reviewed. Two genera, *Caridina* H. Milne Edwards, 1837, and *Atyopsis* Chace, 1983, are presented, with 14 species in the former genus and one in the latter, including two new records and two new species. The identity of *C. brachydactyla* var. *peninsularis* Kemp, 1918, is clarified and the taxon is redescribed in detail and regarded here as a distinct species. *Caridina bruneiana* Choy, 1992, and *C. gracilipes* De Man, 1892, are recorded for the first time from this area. Specimens previously recorded as *C. tonkinensis* Bouvier, 1904, are shown to be different from the Vietnamese species and are described to as a new species, *C. johnsoni*. Another new species, *C. malayensis*, is also described. New distribution records are also added for two poorly known species, *C. thambipilaii* Johnson, 1961, and *C. excavatoides* Johnson, 1961.

***KEY WORDS.* –** Freshwater shrimp, Atyidae, *Caridina*, taxonomy, Malaysia, Singapore.

INTRODUCTION

The freshwater shrimps of Peninsular Malaysia and Singapore have been well studied (Lanchester, 1901; Kemp, 1918; Johnson, 1960, 1961a, b, 1963, 1965, 1966, 1969; Ng, 1990, 1995a, b; Ng & Chong, 1986; Ng & Choy, 1990a, b; Choy & Ng, 1991; Yeo et al., 1999 and Wowor et al., 2004). Prior to this current study, 11 species have been reported, including one species of *Atyopsis* and 10 species of *Caridina*. As part of our efforts to better understand the diversity of the freshwater decapod fauna in Southeast Asia, intensive field surveys have been carried out in the region in the past two decades by staff and students of the Raffles Museum of Biodiversity Research (RMBR), National University of Singapore (NUS). The present study serves to review the taxonomy of the atyid shrimps for Peninsular Malaysia and Singapore based on these collections as well as the re-examination of previously recorded material. To further understand the distribution of these Malayan species, comparative material collected from other Southeast Asian countries have also been examined and documented in the present study. Specimens examined are deposited in the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC); the National Museum of Natural History, Leiden, The Netherlands (RMNH), Muséum national d'Histoire naturelle, Paris, France (MNHN); Senckenberg Museum, Frankfurt; Germany (SMF), Department of Biology at the University of Chulalongkorn, Bangkok, Thailand (CU), Museum Zoologicum Bogoriense, Bogor, Indonesia (MZB) and Natural History Museum of the University of Florence, Florence, Italy (FM). The abbreviation "cl" is used for carapace length, measured in mm from the post-orbital margin to the posterior margin of the carapace.

TAXONOMY

ATYIDAE De Haan, 1849

Atyopsis Chace, 1983

Atyopsis moluccensis (De Haan, 1849)

Atya moluccensis De Haan, 1849: 186, Pl. O. [type locality unknown, assumedly from Moluccas, Indonesia].

Atyopsis moluccensis – Chace, 1983: 27, Figs. 16–19; Ng & Chong, 1986: 30, 1 fig.; Ng & Chia, 1994: 644, Figs. 1, 3–10; Yeo et al., 1999: 213; Wowor et al., 341, Fig. 5D.

Atya armata Lanchester, 1901:559.

Atya spinipes Johnson, 1961a: 145, Figs. 38–42 (not *Atya spinipes* Newport, 1847).

***Material examined.* – Peninsular Malaysia**: 6 males, 6 females (largest cl 19.8 mm), ZRC, Sungai Baharu tributary, along Tekek-Juara trail, Pulau Tioman, Malaysia, coll. O. Chia et al., 27 Jun.1997: 5 males (largest cl 22.7 mm), ZRC, Tekek falls, Sungai Ayer Besar, along Tekek-Juara trail, Pulau Tioman, Malaysia, coll. O. Chia et al., 23 Jun.1997; 3 females, 6 juveniles (largest cl 20.6 mm), ZRC, Sungai Nipah, Pulau Tioman, Malaysia, coll. O. Chia et al., 27 Jun.1997; 6 males, 8 females, 7 juveniles (largest male cl 21.0 mm), ZRC, Sungai Keliling, Pulau Tioman, Malaysia, coll. H. H. Tan et al., 23–27 Jun.1997; 7 males, 12 females (largest male cl 26.9 mm), ZRC 1996.1776, Sungai Paya, Kampung Paya, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 16 Sep.1995: 1 male, 1 female, 1 juvenile (largest cl 21.6 mm), ZRC 1996.1777, Kampung Paya, Sungai Paya, Pulau Tioman, Malaysia, coll. H. H. Tan et al., 18 Sep.1995; 23 males, 26 females (largest male cl 28.0 mm), ZRC 1996.1778, Sungai Paya, Kampung Paya, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 25–27 Jun.1996; 9 males, 13 females (largest male cl 25.3 mm), ZRC 1996.1779, Sungai Raya, Kampung Mukut, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 26 Jun.1996; 12 males, 12 females (largest male cl 28.0 mm), ZRC 1996.1780, Sungai Asah, Pulau Tioman, coll. P. K. L. Ng et al., 26 Jun.1996; 12 males, 17 females (largest male cl 28.0 mm), ZRC 1996.1781, Sungai Keliling, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 27–28 Jun.1996; 1 male, ZRC 2007.0318, second last stream before reaching Juara along Tekek-Juara path, Pulau Tioman, Malaysia, coll. S. S. C. Chong, no date; 2 females, cl 4.8–5.6 mm, ZRC 2007.0319, Sekayu waterfall, Terengganu, Malaysia, coll. H. H. Tan, 17 Jun.1995; 2 females, cl 5.4–5.5 mm, ZRC 2007.0320, Malaysia, Stream outside Sekayu Waterfall, pH 5.3, coll. P. K. L. Ng, 18 Mar.1992.

***Comparative material examined.* –** *Atyopsis moluccensis:* **Sumatra**: 1 male, cl 19 mm, 1 ovigerous female, cl 15 mm, ZRC 2007. 0321, Sungai Seruai, near Biru Biru, Sumatra, Indonesia, coll. M. Kottelat, 2 Nov.1984. **Borneo:** 2 males, cl 15.7–16.3 mm, 1 female, cl 16 mm, Sarawak: Kubah, Raya station 4, 1977; 2 females, cl 7.5–10.3 mm, ZRC 2007.0322, Borneo: Sarawak, Austin's Place, Kampung Benut near Penrissen, coll. H. H. Tan & P. Yap, 1 Oct.1998; 1 male, cl 13.2 mm, ZRC 2007.0323, Brunei, Temburong, Sungai Dalalong at Kuala Beldeg, coll. K. Lim et. al., 14–17 Jun.1975; 1 male, cl 9.2 mm, ZRC 2007.0324, Borneo, Sarawak: Serian, Sungai Kuhas, 6.9 km left at Tebelu Tebakang turnoff, 5.8 km into right trail, 1°09'10.0"N 110°29'22.7"E, coll. H. H. Tan, 19 Feb.1997. **Thailand:** 2 females, cl 4.3–5.2 mm, CU1998.12, waterfall at Phuket, southern Thailand, no date. 6 females, cl 18.4–20, CU1998.15, Taotong waterfall, Phangnga, 27 Mar.1930; 16 specimens, CU1998.16, southern Thailand, no date; 15 males, cl 13.2–20.6 mm, 13 females, cl 11.3–17.4 mm, ZRC 2007.0325, Patong Waterfall, Phuket, southern Thailand, coll. K. Yongchindarat, 19 Aug.1980; 1 male, cl 7.5 mm, southern Thailand, coll. D. Yeo, 21 Feb.2001.

Atyopsis spinipes (Newport, 1847)*:* **Japan:** l0 males, 10–15mm, 4 females, cl 15–18 mm, 2 ovigerous females, cl 14–15 mm, ZRC 2007.0326 24°30.11'N 124°15.26'E , Gubyunmata River, Ishigaki Island, pH 7.3, coll. Y. Cai & T. Naruse, 13 Jun.2000; 1 female, cl 7.1 mm, ZRC 2007.0327, 24°22.76'N 124°14.80'E , Gubyunmata River, Ishigaki Island, pH 7.3, coll. Y. Cai & T. Naruse, 13 Jun.2000; 1 male, cl 12 mm, 1 female, cl 15 mm, 1 ovigerous female, cl 16 mm, ZRC 2007.0328, 24°26.05'N 124°14.52'E, small river in Tsuru Town, Ishigaki Island, coll. Y. Cai , N. K. Ng & T. Naruse, 17 Jun.2000. **Taiwan**: 1 female, cl 5.1 mm, ZRC 2007.0329, Tungho River, Taitung County, coll. Y. Cai et al., 24 Nov.1997. **Philippines:** 2 females, cl 6.0–7.2 mm, ZRC 2007.0330, river outside Inabacan Cave, Antequrra, Bohol, coll. Y. Cai et al., 16 Dec.2000. **Java:** 1 male, cl 7.1 mm, 2 females, cl 3.8–4.0 mm, 3 juv., RMNH N42a, Labuhan, West Java, Indonesia, no date. **Moluccas:** 1 male, cl 9.2 mm, 1 ovigerous female, cl 13.0 mm, ZRC 2007.0331, Sungai Ifis, 1°24'N 128°13'E, Halmahera, Indonesia, Sep.1994, coll. D. Robb; 1 female, cl 6.8 mm, SMF 7972, Halmahera, 1894, coll. W. Kükenthal; 1 ovigerous female, cl 12 mm, 2 males, cl 9.0–9.3 mm, SMF 7974, Halmahera, Indonesia, 1894, coll. W. Kükenthal; 1 ovigerous female, cl 15 mm, Soah, Halmahera, Indonesia, 2 males, cl 8.3–11.5 mm, SMF, Morotai, 1 Oct.1930. **New Guinea:** 2 females, cl 4.3–4.4 mm, RMNH 700, two creeks near Seroei, Yapen Island, Irian Jaya, Indonesia, 22 Feb.1955. **Sulawesi:** 1 female, cl 4.5 mm, 3 ovigerous females, cl 11.6–13.2 mm, ZRC 2007.0332, Sungai Jalange at Desa Malawa, 20 km south of Parepare on road to Ujung Pandang, Kec. Malussetassi Kab. Bara, Sulawesi, Indonesia, coll. M. Kottelat, 15 Jun.1988; 4 males, cl 9.0–9.5 mm, 7 females, cl 6.0–14 mm, 1 ovigerous female, cl 18.1 mm, ZRC 2007.0333, Sungai Terat, 19 km on road from Enrekang to Parepare, southern Sulawesi, Indonesia, coll. M. Kottelat & A. Werner, 9 Mar.1989.

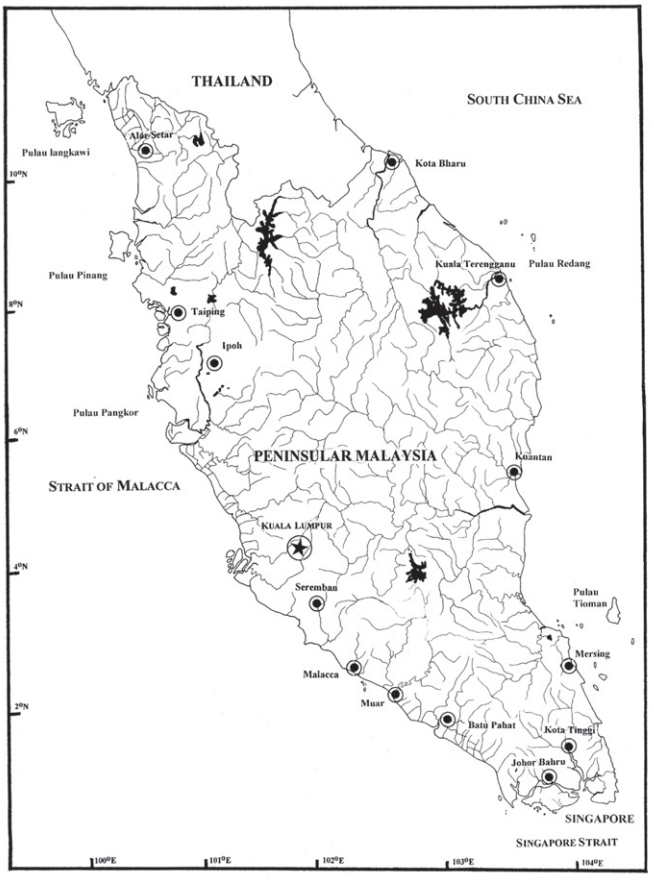

Fig. 1. Map of Peninsular Malaysia and Singapore.

***Diagnosis.* –** Body robust, pigmented, eyes well developed; rostrum not strongly compressed laterally, without lateral lobes, median dorsal carina without spines, ventral keel with 7–16, usually 10–14 teeth. Anterior margin of carapace armed with strong antennal and pterygostomian spines, latter never reduced to angle; supraorbital spine absent; ventral margin of second to fifth abdominal pleura without sclerotized spinules; telson with posterolateral angle reaching beyond setiferous posterior margin; third maxilliped not ending in a spine; pereiopods without exopods; first and second pereiopods with chelae monomorphic, without palm, little if at all longer than wide; fingers tipped with brushes of long setae apparently adapted for filter feeding, carpus of both appendages deeply excavated anteriorly, much shorter than broad, shorter than fingers; third pereiopod with a prominent meral spur in large males; branchial formula complete, with 9 pairs of gills, without mastigobranchs; epipods present on first 4 pereiopods, reduced posteriorly; endopod of first pereiopod of male rigid, rhomboidally ovate; submarginally spinose, less than 1.5 times as long from proximal articulation to base of reticulation projection as maximum width, not including margin spines; second pleopod of male with appendix masculina cylindrical, spinose over entire length distal to base of appendix interna.

***Habitat*. –** At coastal or insular freshwater habitats, with fast flowing hill and mountain streams, and similar riparian systems, living on rocks or among submerged roots.

***Remarks.* –** In Malaysia, the species was first recorded by Lanchester (1901) from the Selama River in northwest Perak and Belimbing under the name of *Atya armata*. Johnson reported it under the name *Atya spinipes* from Kuala Kenyam Kechil, Pahang, Tahan River, near Kuala Tahan and a tributary of Jahor River, near Kota Tinggi, Johor. The specimens that we examined indicate that *Atyopsis moluccensis* is restricted to the Greater Sunda Islands (including Phuket at southern Thailand). Chace (1983: 33) stated that he had "seen specimens of *A. moluccensis* only from Thailand and Java." Other distribution sites that he listed, viz. Sumatra, Bali, Sulawesi, Moluccas, Philippines, Andaman and Sri Lanka, were based only on literature. According to the present study, there is only *A. spinipes* distributed there.

***Distribution*. –** With certainty only distributed in the Greater Sunda Islands (present study).

Caridina H. Milne Edwards, 1837

Caridina typus H. Milne Edwards, 1837

Caridina typus H. Milne Edwards, 1837: 363, Pl. 25, Figs. 4, 5 [type locality: unknown].

Caridina typus – Yeo et al., 1999: 225; Wowor et al., 2004: 341, Fig. 5F.

Caridina exilirostris – Stimpson, 1860: 98 [type locality: Okinawa (Loo Choo) Island, Ryukyu Islands, Japan] (see Cai et al., 2006 for remaining synonyms).

***Material examined.* – Peninsular Malaysia**: 136 specimens, ZRC 1998.873, Sungai Salang, Pulau Tioman, Malaysia, coll. Y. Cai et al., 25 Jun.1997; 12 specimens, ZRC 1998.874, Tekek falls, Sungai Ayer Besar, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 23 Jun.1997; 41 specimens, ZRC 1998.876, Sungai Paya, coll. D. C. J. Yeo et al., 26 Jun.1997; 81 specimens, ZRC 1996.1766, Sungai Ayer Besar, stream along Tekek-Juara trail, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 24–25 Jun.1996; 4 specimens, ZRC 1996.1767, Sungai Keliling, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 27–28 Jun.1996; 1 specimen, ZRC 1996.1768, Sungai Raya, Kampung Mukut, Pulau Tioman, coll. P. K. L. Ng et al., 26 Jun.1996; 6 specimens, ZRC 1996.1770, pool between Sungai Mentawak and Sungai Keliling, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 27–28 Jun.1996; 38 specimens, ZRC 1996.1771, Sungai Nipah, Pulau Tioman, Malaysia, coll. D. C. J. Yeo et al., 28 Jun.1996; 104 specimens, ZRC 1996.1772, Sungai Paya, Kampung Paya, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 25–27 Jun.1996; 59 specimens, ZRC 1996.1773, Kampung Paya, Sungai Pasal upstream (15 min walk from start of trail to Sungai Paya), near base of Bukit Paya, Pulau Tioman, Malaysia, coll. H. H. Tan et al., 17 Sep.1995; 49 specimens, ZRC 1996.1774, Kampung Genting, Sungai Ayer Raja, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 15 Sep.1995; 25 spec, ZRC 1996.1775, Sungai Ayer Besar waterfall, on Tekek-Juara trail, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 16 Sep.1995; 6 specimens, ZRC 1990.11841–11846, ca. 100m a.s.l. waterfall stream south of Mukut waterfall, Pulau Tioman, Malaysia, S. S. C. Chong, 27 Jun.1985; 3 specimens, ZRC 2007.0334, stream along Tekek-Juara path, Pulau Tioman, Malaysia, coll. S. S. C. Chong, 26 Jun.1985; 2 specimens ZRC 2007.0335, stream behind Tanjung Said, Pulau Tioman, Malaysia, coll. A. Kamal et al., 27 Jun.1985; 2 males, cl 3.9–6.0 mm, 19 females, cl 4.8–6.2 mm, ZRC. 1998.875, Sungai Keliling, Pulau Tioman, Malaysia, coll. Y. Cai & N. K. Ng, 8–11 Sep.1998; 2 females, cl 4.6–5.7 mm, ZRC 2007.0326, Kg. Juara, Pulau Tioman, Malaysia, coll. K. L. Lim & D. K. L. Lee, Sep.1992; 1 female, cl 3.9 mm, ZRC 2007.0327, stream in Pulau Aur, Malaysia; 1 female, cl 4.8 mm, ZRC 2007.0338, Pulau Pemanggil, Malaysia, rocky stream, LMCJ 9628; 4 females, cl 2.6–3.4 mm, ZRC 2007.0339, stream on southwest slope of eastern ridge, Pulau Redang, Terengganu, Malaysia, coll. K. Lim & N. Sivasothi, 23 Dec.1991; 1 male, cl 4.9 mm, 10 females, cl 5.5–6.0 mm, ZRC 2007.0340, stream between Pasir Chayar Hutang and Teluk Kerma, Pulau Redang, Terengganu, Malaysia, coll. K. Lim et al., 23 Jun.1992; 6 males, cl 3.4–4.0 mm, 1 female, cl 4.5 mm, 2 ovigerous females, cl 4.4–4.8 mm, ZRC 2007.0341, stream south west of Telok Kerma near Dalam, Pulau Redang, Malaysia, coll. K. Lim et al., 23 Jun.1992.

***Habitat*. –** Rivers or streams on islands or coastal areas.

***Remarks.* –** Cai et al. (2006) recently designated a neotype for *C. exilirostris* Stimpson, 1860 from Okinawa, Ryukyu Islands, and regarded it as a junior synonym of *Caridina typus*. In Peninsular Malaysia, *C. typus* is only known from offshore islands (present study).

***Distribution*. –** Widely distributed in the Indo-West Pacific (Cai et al., 2006).

Caridina serratirostris De Man, 1892

Caridina serratirostris De Man, 1892: 382, Pl. 23 Figs. 28–28e [type locality: "Bangkalan" and "Bonea" rivers, Selajar, Indonesia].

Caridina serratirostris – Cai & Shokita, 2006a: 247; 2006b: 2139.

Caridina celebensis – Yeo et al., 1999: 214, Figs. 8, 9; Wowor et al., 2004: 341, Fig. 6I.

***Material examined.* – Peninsular Malaysia**: 12 specimens, ZRC1998.863, Sungai Paya, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 25 Jun.1997; 7 specimens, ZRC 1996.1752, Sungai Keliling, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 27–28 Jun.1996; 14 specimens, ZRC 1996.1753, Sungai Paya, Kampung Paya, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 25–27 Jun.1996; 1 specimen, ZRC 1996.1754, Kampung Paya, Sungai Pasal upstream (about 15 min walk from start of trail to Sungai Paya), Pulau Tioman, Malaysia, coll. H. H. Tan et al., 17 Sep.1995; 1 specimen, ZRC 1996.1755, Sungai Paya, Kampung Paya, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 25–27 Jun.1996; 2 specimens, ZRC 1996.1769, left stream at mouth of Sungai Paya, Pulau Tioman, Malaysia, coll. O. Chia & M. J. Ng, 27 Jun.1996; 3 specimens, 1990.11854–11856, Kampung Genting, Pulau Tioman, Malaysia, coll. S. S. C. Chong, 28 Jun.1986; 4 specimens, ZRC 1990.11860–11863, Kampung Mukut, Pulau Tioman, Malaysia, coll. S. S. C. Chong, 28 Jun.1986; 13 females, cl. 3.4–4.0 mm, ZRC1998.864, Sungai Keliling, coll. Y. Cai & N. K. Ng, 10 Sep.1998.

***Habitats*. –** Lower reaches of rivers or streams on islands or coastal areas.

***Remarks.* –** Cai & Shokita (2006a) separated *C. serratirostris* and *C. celebensis* on the basis of whether there was a tiny arthrobranch present at the base of third maxilliped (present in *C. serratirostris* vs. absent in *C. celebensis*), stating that "All the Tioman specimens here re-examined, though most of them with shorter rostrum, have an arthrobranch on the first pereiopod, thus, should be referred to *C. serratirostris.*" So far, in Peninsular Malaysia and Singapore, it is only reported from Pulau Tioman, an island in the South China Sea.

***Distribution*. –** Indo-West Pacific (present study; Cai & Shokita, 2006a).

Caridina peninsularis Kemp, 1918

(Figs. 2, 3)

Caridina brachydactyla peninsularis Kemp, 1918: 279, Figs.10a–g [type locality: Patani, southern Thailand and Penang Island, Malaysia]; Johnson, 1961b: 45.

Caridina brachydactyla var. *peninsularis* – Bouvier, 1925: 155, Figs. 321, 322.

Caridina nilotica var. *brachydactyla* – Johnson, 1961a: 123.

Caridina simony – Johnson, 1963: 21 (incorrect spelling).

Caridina simoni peninsularis – Johnson, 1966: 422; 1969: 110; Ng & Choy, 1990: 16.

Caridina peninsularis – Cai & Anker, 2004: 237, Fig. 2; Wowor et al., 2004: 343, Fig. 6J; Cai & Shokita, 2006a: 248.

***Material examined.* –** Lectotype: male, 3.8 mm, MNHN, *Caridina brachydactyla peninsularis* Kemp, 1918, exchange from Indian Museum, Botanical Garden, Penang, Malaysia, herein designated.

Paralectotypes: 1 male, cl 3.8 mm, 3 females, cl 3.3–5.6 mm, MNHN, data same as lectotype.

Others: **Peninsular Malaysia:** 1 male, cl 2.9 mm, 7 ovigerous females, cl 4.2–4.8 mm, ZRC 2007.0342, sandmine at Teok, Nibong area, Batu Ferringhi, Penang, Malaysia, coll. H. H. Tan & S. H. Tan, 8 Jun.1993; 2 females, cl 2.6–4.1 mm, ZRC 2007.0343, stream in Pulau Aur Malaysia; 1 male, cl 3.1 mm, 2 females, cl 3.6–4.2 mm, 5 ovigerous females, cl 4.2–5.3 mm, ZRC 2007.0344, Sungai Mupor, Kota Tinggi, Malaysia, 21 Aug.1994; 1 male, cl 3.6 mm, ZRC 2007.0345, Pulau Pemanggil, rocky stream, Malaysia, LMCJ 9628; 5 males, cl 2.6–3.2 mm, 6 females, cl 2.5–5.3 mm, ZRC 2007.0346, Sungai Dohol, Malaysia, coll. H. H. Tan, 24 Feb.1995; 1 male, cl 3.6 mm, ZRC 2007.0347, Terengganu, Pulau Redang, stream on south west slope of eastern ridge, Malaysia, coll. K. Lim, S. Sivasothi, 23 Dec.1992; 11 males, cl 3.5–5.5 mm, 1 female, cl 5.4 mm, ZRC 2007.0348, Gunung Panti, Kota Tinggi, Malaysia, coll. P. K. L. Ng, 1991; 8 females, cl 3.5–4.9 mm, ZRC 2007.0349, stream between Pasir Chayar Hutang and Teluk Kerma, Pulau Redang, Terengganu, Malaysia, coll. K. Lim et al., 23 Jun.1992; 3 males, cl 3.1–3.4 mm, 7 females, cl 4.1–5.2 mm, ZRC 1995.50, Malaysia, coll. K. Lim, Dec.1990; 1 male, cl 3.0 mm, 1 ovigerous female, cl 5.0 mm, ZRC 1979.4.18.75.78, slow, small tidal, stream draining into Sungai Skudai at 7 1/2 mile, Johor Bahru-Skudai road, Malaysia, coll. D. S. Johnson, 10 May 1960; 1 female, cl 3.5 mm, 5 ovigerous females, cl 4.4–5.4 mm, ZRC 1979.30–35, large slow stream, 7 miles from Kota Tinggi Lombong Road, Johor, Malaysia, no date, 1 male, cl 3.5 mm, 4 females, 3.4–4.4 mm, ZRC 1979.4.18.19–23, S. Mupor at miles 10 marker, Kota Tinggi-Mersing Road, Malaysia, 13 May 1966; 2 males, cl 3.4 mm, 1 female, cl 4.0 mm 3 ovigerous females, cl 5.1–5.4 mm, ZRC 2007.0350, 3 miles from Kota Tinggi, Lombong Kd. large slow stream, Malaysia: Johor, 19 Aug.1960. **Singapore:** 3 males, cl 3.3–3.5 mm, ZRC 1974.4.18.4–6, Sungei Seletar, station 3, Singapore, coll. P. Yeo & Kwai Ho, 23 Sep.1959; 2 males, cl 3.0–3.3 mm, 1 female, cl 3.5 mm, ZRC 1979.4.18.1–3, Sg Seletar, Singapore, coll. K. H. Yeo, 23 Sep.1959; 2 males, cl 3.3–3.4 mm, 1 female, cl 4.5 mm, 2 ovigerous females, cl 5.3–5.4 mm, ZRC 1979.4.18.8–12, 12 miles from Chua Chu Kang Road, Sg Peng Siang, Singapore, 18 Aug.1961.

***Comparative material examined.* – Southern Thailand**: 4 males, 9 females, CU 1998.01, Taotong Waterfall, Phangnga, southern Thailand, 22 May 1973; 3 females, CU 1998.04, Phangnga, southern Thailand, 8 May 1974; 4 specimens, CU 1998.06, Bangpae Waterfall, Phuket, southern Thailand, 28 Mar.1974; 10 specimens CU 1998.08, Lam Pee Waterfall, Phangnga, southern Thailand, no date. 3 specimens, CU 1998.10, Tone Na Nua, Phangnga, southern Thailand, 28 Aug.1973. 11 specimens, CU, southern Thailand, 14 Oct.1967; 14 males, cl 2.5–3.4 mm, 12 females, cl 3.3–4.9 mm, 10 ovigerous females, cl 3.6–4.8 mm, southern Thailand, coll. D. Yeo, 21 Feb.2001; 2 females, cl 2.5–2.7 mm, CU 2000.06, Thailand: Thonmayom waterfall, Amphoe Ko Chang Trat Province, 9 Dec.1973; 3 males, cl 2.8–3.0 mm, 10 ovigerous females, cl 3.3–3.5 mm, CU 2000.12, Thailand: Klong Thom, Amphoe Muang, Phang Nga Province, South Thailand, 12 May 1974; 3 females, cl 3.9–5.0 mm, CU 2000.17, Amphoe Ka Po, Ranong, southern Thailand, 9 Dec.1974. **Philippines:** 1 female, cl 2.6 mm, FM 2464, stream near Coron Town, Balisungan, Busuang Island, Philippines, coll. G. Beit, 11 Mar.1991. **Borneo:** 3 males, cl 2.1–3.0 mm, 2 females, cl 1.8–1.9 mm, RMNH, 20 km north of Sandakan, Sepilok-laut, near resthouse, Sabah, Malaysia, 5°49'N 118°06'E, coll. J. Huisman & R. de Jong, 3 Nov.1987; 2 males, cl 3.8–3.9 mm, 2 females, cl 3.2–4.3 mm, 12 ovigerous females, cl 4.8–6.0 mm, ZRC 2007.0351, 8.6 km after turning towards Sungai Cina, Matang, 1°39'2.6"N 110°10'44.7"E, after entrance to Matang Reserve, Sarawak, Malaysia, coll. H. H. Tan, 4 Sep.1995; 3 males, cl 3.3–3.8 mm, 1 female, cl 4.2 mm, 12 ovigerous females, cl 4.3–5.5 mm, ZRC 2007.0352, Borneo: Sarawak, Matang area, Kg Tenenggor, 01°37'48.0"N 110°12'51.4'E, coll. H. H. Tan, 4 Sep.1995;

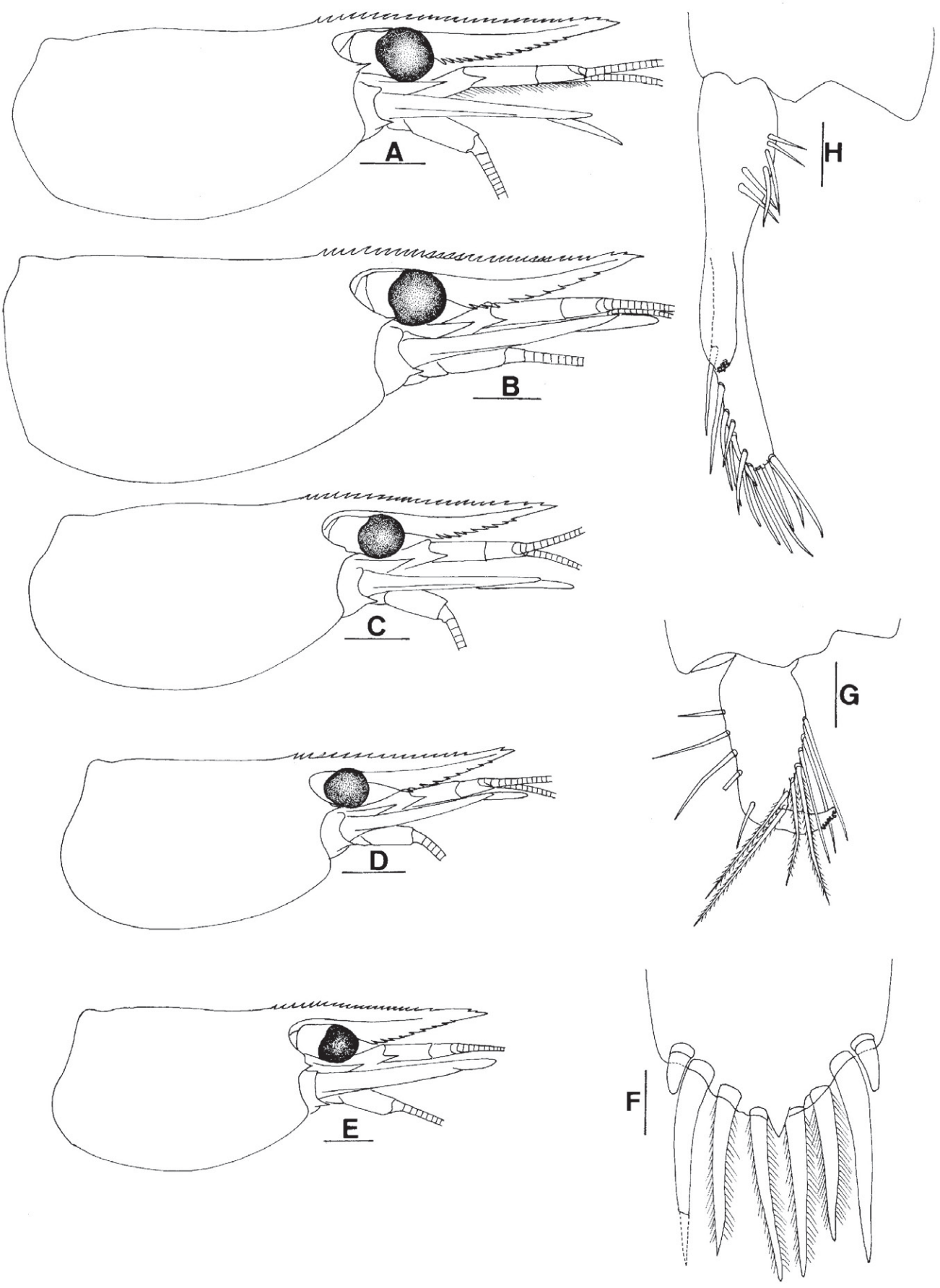

Fig. 2. *Caridina peninsularis*: A–E, cephalothorax and cephalic appendages; F, distal portion of telson; G, endopod of male first pleopod; H, appendix masculina and appendix interna of male second pleopod. Scale bars: A–F = 1 mm; G–H = 0.1 mm. (A, female, cl 4.6 mm; B, F, female, cl 5.0 mm; C, female, cl 4.3 mm; D, female, cl 3.6 mm; E, female, cl 4.0 mm; G, H, male, cl 2.9 mm; all material from Penang, Peninsular Malaysia, ZRC).

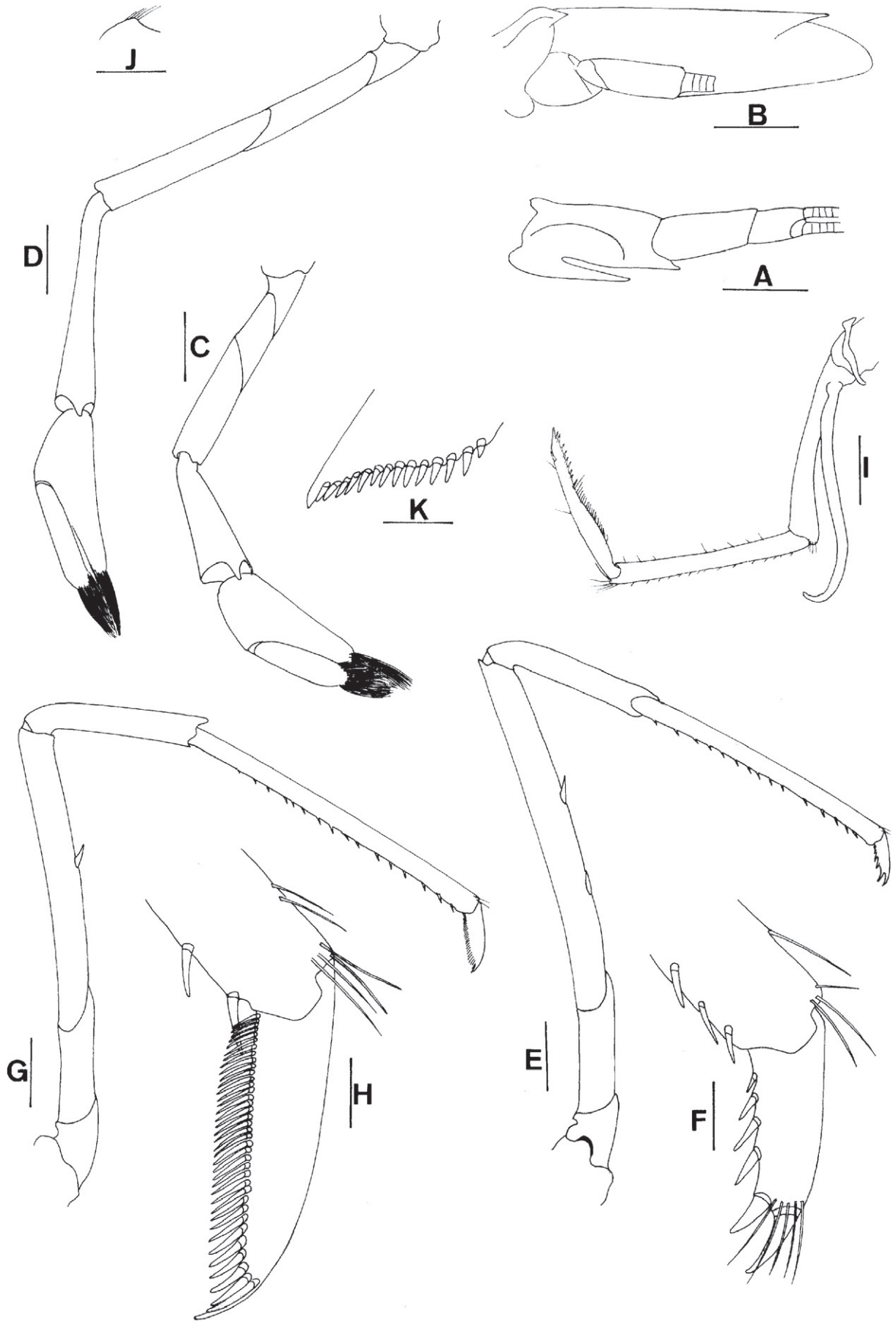

Fig. 3. *Caridina peninsularis*: A, antennular peduncle; B, scaphocerite; C, first pereiopod; D, second pereiopod; E, third pereiopod; F, dactylus of third pereiopod; G, fifth pereiopod; H, dactylus of fifth pereiopod; I, third maxilliped; J, preanal carina; K, diaeresis. Scale bars: A, B = 1 mm; C–E, G, I = 0.5 mm; F, H = 0.1 mm; K = 0.2 mm. (female, cl 5.0 mm, Penang, Peninsular Malaysia, ZRC).

9 males, cl 2.7–3.6 mm, 1 female, cl 3.6 mm, 11 ovigerous females, cl 4.0–5.0 mm, ZRC 2007.0353, Borneo, Sarawak: stream 3.0 km before turnoff to Cape Pelandok and Kg. Pandan, after Lundu Town, drains from Gg. Gading, 1°44'18.5"N 109°52'01.0"E, coll. H. H. Tan, 2 Sep.1996; 19 males, cl 2.7–3.7 mm, 5 females, cl 3.7–4.4 mm, 9 ovigerous females, 4.5–5.0 mm, ZRC 2007.0354, Borneo: Sarawak, Santubong, just before Damai resort area, ca. 100 m after turnoff from road leading from Santubong to Damai, 01°44.83'N 110°18.97'E, pH 5.0, coll. H. H. Tan & P. Yap, 2 Oct.1998; 2 ovigerous females, cl 5.3–5.8 mm, ZRC 2007.0355, Borneo: Sarawak, Lundu area, Sungai Sebiris, 8.7 km towards Sematan on Lundu-Sematan road after T-junction from Batang Kayan ferry point (4 km), 01°41.76'N 109°47.07'E, pH 6.5, coll. H. H. Tan & P. Yap, 2 Oct.1998; 1 male, cl 3.0 mm, ZRC 2007.0356, Borneo, Sarawak: stream near Sungai Tengah Lorong 1, ca. 12.6 km into turnoff towards Singai (eventually leads to Matang), from Bau-Lundu road, 1°32'35.1"N 110°12'49.3"E, coll. H. H. Tan, 2 Sep.1998; 1 female, cl 6.0 mm, ZRC 2007.0357, Borneo, Sarawak: Red Bridge at Matang, 1°36'29.6"N 110°13'25.6"E, pH 6.7, coll. H. H. Tan, 30 Aug.1996; 5 males, cl 4.1–4.6 mm, 12 ovigerous females, cl 5.7–6.3 mm, MZB CRU-1637, A small stream on the road to Beluru, nearby Pekan Bakong, Miri, Sarawak, moderate flowing river with mud-debris substrate and grasses along its bank, 03°50'N 114°10'E, coll. D. Wowor, 11 Sep.1998; 1 male, cl 4.0 mm, 5 females, cl 6.6–7.0 mm, 7 ovigerous females, cl 6.4–6.8 mm, MZB CRU-1638, Sungai Monyet at Lungmanis area, Sandakan District, Sabah, stream between Sandakan and Kota Kinabalu, 60 km from Sandakan town, moderate flowing stream with stones substrate, across forest, 05°43'23.2"N 117°41'07.2"E, pH 7.4, coll. D. Wowor, 27 Sep.1998; 1 male, cl 3.6 mm, 2 ovigerous females, cl 5.8–6.0 mm, ZRC 2007.0358, Borneo, Sarawak: stream at 17.6 km into turnoff towards Singai (eventually leads to Matang), from Bau-Lundu road, 1°33'45.7"N 110°14'19.9"E, coll. H. H. Tan, 2 Sep.1996, 4 ovigerous females, cl 4.9–5.9 mm, ZRC 2007.0359, Borneo, Sarawak: Sungai Stuum Muda, 21.1 km before Lundu ferry point at Bg. Kayan, 1°28'51.3"N 109°58'18.1"E, coll. H. H. Tan, 2 Sep.1998; 3 males, cl 2.8–3.1 mm, 18 ovigerous females, cl 4.5–5.4 mm, ZRC 2007.0360, Borneo, Sarawak: stream ca. 4.9km before end of road to Kg. Pueh, near base of Gg. Pueh, 1°48'08.9"N 109°43'41.0"E, coll. H. H,. Tan, 1 Sep.196; 4 ovigerous females, cl 4.5–4.8 mm, ZRC 2007.0361, 22 km to Senatan from Lundu, draining from Gg Pueh, 1°46'34.9"N 109°44'44.4"E, coll. H. H. Tan, 6 Sep.1995; 1 male, cl 3.5 mm, 6 ovigerous females, cl 4.4–5.6 mm, ZRC 2007.0362, Borneo: Sarawak, 1.3 km before junction to Cina Matang, Kg. Matang, 1°36'1.2"N 110°13'29"E, pH 6.3, coll. H. H. Tan, 4 Sep.1995; 2 ovigerous females, cl 4.8–5.7 mm, ZRC 2007.0363, Sungai Stok Muda, Sarawak, 1°28'51.3"N 109°58'18.1"E, coll. H. H. Tan, 6 Sep.1995; 8 males, cl 3.3–4.3 mm, 6 females, cl 3.8–4.3 mm, 4 ovigerous females, cl 4.8–5.0 mm, ZRC 2007.0364, Brunei: Kg. Lepong Naru, Temburong, 9 Jan.1992; 3 females, cl 4.7–5.4 mm, Sarawak: Matang, coll. P. K. L. Ng, 1986; 2 males, cl 3.3–3.5 mm, 2 females, cl 5.9–6.2 mm, 8 ovigerous females, cl 5.2–5.4 mm, ZRC 2007.0365, Brunei: Sungai Baru, Lamunin, coll. S. Choy & K. Lim, 14 May 1993; 7 males, cl 2.8–3.2 mm, 6 females, cl 2.7–4.0 mm, 2 ovigerous females, cl 5.3–5.4 mm, ZRC 2007.0366, Sarawak: Matang, near Park Kuching, coll. S. Choy, 26 Nov.1992. **Java:** 6 males, cl 2.6–3.3 mm, 2 females, cl 3.6–4.8 mm, 5 ovigerous females, cl 3.7–4.8 mm, MZB Cr-1068, Bantan, Java, Indonesia, coll. D. I. Hartoto, Aug.1983; 1 ovigerous female, cl 5.2 mm, RMNH, Besuki, East Java, Indonesia, coll. Semmelink, 1864; 19 males, cl 3.0–3.7 mm, 8 females, cl 3.2–4.7 mm, 24 ovigerous females, cl 4.0–5.0 mm, MZB CRU-1636, S. Cihanggasa, Banten, Java, coll. D. Wowor, 16 Aug.1982. **Sumatra:** 8 males, cl 2.4–2.8 mm, 6 females, cl 2.4–3.6 mm, 2 ovigerous females, cl 3.6–3.8 mm, RMNH, Way Pisang, Lampang Selatan, coll. Sabar, 24 Jun.1974; 10 males, cl 3.0–3.4 mm, RMNH, Ketang, east coast of Sumatra, Indonesia, 6 Nov.1941.

***Description.* –** Rostrum horizontal (Figs. 2A–E), reaching to or slightly beyond end of scaphocerite, slightly shorter or as long as carapace. Rostral formula: 2–3+15–37(25–32)/5–12, dorsal teeth along entire margin, rarely indistinctly with 1–2 subapical teeth. Antennal spine placed slightly below inferior orbital angle. Pterygostomian margin rounded.

Sixth abdominal somite 0.6 times as long as carapace, 1.9 times as long as fifth somite, slightly shorter than telson. Telson (Fig. 2F) 3.2 times as long as wide, terminating in a projection, with 4 pairs of dorsal spinules and 1 pair of dorsolateral spinules; telson with 3 or 4 pairs of distal spines, sublateral pair distinctly longer than intermediate pairs. Pre-anal (Fig. 3J) carina low, no spine.

Eyes well developed, anterior end reaching to 0.7 times length of basal segment of antennular peduncle. Antennular peduncle (Fig. 3A) 0.8–0.9 times as long as carapace; basal segment of antennular peduncle longer than combined length of second and third segments, anterolateral angle pointed, reaching to 0.3 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 (Fig. 3B) 3.7 times as long as wide.

Incisor process of mandible ending in irregular teeth, molar process truncated. Lower lacinia of maxillula broadly rounded, subtriangular; upper lacinia elongated, with a number of distinct teeth on inner margin, palp slender. Upper endites of maxilla subdivided, palp short, scaphognathite tapering posteriorly with numerous long, curved setae at posterior end. Palp of first maxilliped ending in a broad triangular projection. Second maxilliped typical, podobranch well developed. Third maxilliped (Fig. 3I) reaching to end of second segment of antennular peduncle, with ultimate segment shorter than penultimate segment.

Epipods on first 4 pereiopods. First pereiopod (Fig. 3C) reaching to distal end of eyes, merus of first pereiopod 3.3 times as long as wide, slightly shorter than carpus; carpus shorter than chela, 2.5 times as long as high; chela 2.3 times as long as broad, with fingers 1.6 times as long as palm. Second pereiopod (Fig. 3D) reaching beyond end of second segment of antennular peduncle, merus 4.9 times as long as broad; carpus of second pereiopod 4.9 times as long as high, 1.3 times as long as chela, chela 2.6 times as long as wide, fingers 1.4 times as long as palm. Third pereiopod (Figs. 3E, F) reaching beyond end of antennular peduncle, propodus 14 times as long as broad, 5.6 times as long as dactylus; dactylus 3.0 times as long as wide (spines included), terminating in 2 claws, with 4–6 accessory spines on flexor margin. Fifth pereiopod (Fig. 3G, H) reaching beyond end of scaphocerite, propodus 17 times as long as broad, 4.8 times as long as dactylus; dactylus 3.5 times as long as wide (spinules included), with 38–42 spinules on flexor margin.

Endopod (Fig. 2G) of male first pleopod subtriangular, 1/4 length of exopod, appendix interna elongated, with most of its length reaching beyond end of endopod. Appendix

masculina (Fig. 2H) of male second pleopod 2/3 times length of endopod, appendix interna stout.

Uropodal diaeresis (Fig. 3K) with 13–14 movable spinules.

Ovigerous females with eggs sized 0.40–0.42 × 0.25–0.30 mm.

Habitat. **–** Commonly found in low-salinity brackish waters and in freshwater systems subject to tidal influence.

Remarks. **–** Johnson (1963) synonymised many species allied with *C. nilotica* under *C. simoni*, including *C. brachydactyla peninsularis*. He stated that "Kemp's subspecies *peninsularis* can be recognized as valid, under the name *C. simoni peninsularis*." This was followed by Johnson (1963, 1966), Ng & Choy (1990) and Ng (1990). Tiwari & Pillai (1971), however, pointed out that "*C. brachydactyla* and *C. simoni* are distinct taxa, differing from each other in a number of important characters. The major points of difference between the two are the structure of rostrum and first pleopod" and reassigned *peninsularis* back as a subspecies of *brachydactyla*. We agree with Tiwari & Pillai (1971) in recognizing the two as separate taxa, but we believe that *peninsularis* should be accorded a full species status as the differences in the rostrum (teeth throughout the upper margin vs. with distinct apical teeth in *C. brachydactyla*) and the absence of a large distal spine in male specimen (vs. present in *C. brachydactyla*) are very distinct and cannot be accounted for by infraspecific variation.

Distribution. **–** Greater Sunda Islands and the Philippines (present study).

Caridina bruneiana Choy, 1992

Caridina bruneiana Choy, 1992: 49, Figs.1–4 [type locality: Brunei]; Wowor et al., 2004:343, Fig. 7A–C.

Material examined. **– Singapore**: 2 males, cl 3.0–3.1 mm, 1 female, cl 3.5 mm, 17 ovigerous females, cl 4.8–6.1 mm, RMNH D 16621, Jurong, Singapore, coll. E. R. Alfred, 22 Mar.1958; 3 males, cl 3.0–3.5 mm, 3 females, cl 2.3–3.2 mm, ZRC 1979.4.18.13–18, Sungai Peng Siang, 12 miles from Chua Chu Kang Road, Singapore, 18 Aug.1961.

Habitat. **–** Similar to *C. peninsularis*, i.e. in streams or rivers with seawater influence.

Remarks. **–** With regard to the form of the rostrum, *Caridina bruneiana* is very similar to *C. peninsularis*, with which it has been found to occur together. However, it can be separated from *C. peninsularis* by the relatively higher rostrum, higher number of postorbital rostral teeth (2–3 vs. 3–5) and spinules on the dactylus of fifth pereiopod (19–22 vs. 38–42); and the absence of a spine on the preanal carina. Its presence in Singapore suggests a wider distribution in the Peninsular Malaysia, although it is not formally known there at present.

Distribution. **–** Borneo, Singapore (Choy, 1992; present study).

Caridina gracilipes De Man, 1892

Caridina Wyckii var.*gracilipes* De Man, 1892: 387, Pl. 24 Fig. 29–29e [type localities: Sulawesi (Celebes), and Selajar, Indonesia].
Caridina nilotica gracilipes – De Man, 1908b: 270, Figs.7a, b.
Caridina wyckii var. *gracilipes* – Schenkel, 1902: 498.
Caridina longirostris – Chace, 1997: 14 (part), Fig. 7 [not *Caridina longirostris* H. Milne-Edwards, 1837].
Caridina gracilipes – Wowor et al., 2004: 341, Fig. 6D; Cai & Shokita, 2006a: 250.

Material examined. **– Singapore**: 5 males, cl 1.9–2.7 mm, 11 females, cl 2.4–3.1 mm, ZRC 2007.0367, pond at West Coast Park, brackish water, Singapore, coll. K. Lim & P. G. Lee, 21 Aug.1992.

Habitat. **–** Lower reaches of rivers and streams with seawater influence.

Remarks. **–** *Caridina gracilipes* De Man, 1892 is morphologically similar to *C. elongapoda* Liang & Yan, 1977 and *C. longirostris* H. Milne-Edwards. However, it is different from *C. elongapoda* in lacking an appendix interna on the endopod of male first pleopod. *Caridina gracilipes* can be distinguished from *C. longirostris* (cf. Cai et al., 2006) in its elongated carpus of the first pereiopod and dactylus of the last pereiopods (vs. stout and short). *Caridina gracilipes* has been reported from Taiwan, southern China, Sulawesi, Philippines and Sarawak (Cai & Shokita, 2006a; Wowor, et al., 2004). This is the first record of the species for the Malay Peninsula.

Distribution. **–** Sulawesi, Taiwan, Chinese mainland, the Philippines, Borneo and Malay Peninsula (present study; Cai & Shokita, 2006a; Wowor, et al., 2004).

Caridina gracilirostris De Man, 1892

Caridina gracilirostris De Man, 1892: 399 (part), Pl. 25, Fig.31a–c [type locality: river near Maros, Sulawesi (Celebes), Indonesia]; Kemp, 1918: 282; Johnson, 1961a: 124, Figs. 1, 2; 1965: 8; Richard & Chandran, 1994: 242; Chace, 1997:10 (part); Jalihal & Shenoy, 1998: 128; Cai & Ng, 2001: 674, Fig.7; 2007 (in press); Wowor et al., 2004: 341, Fig. 5Q; Shokita, 2003: 249, Fig. 18A; Cai & Shokita, 2006a: 250.
Caridina gracilirostris gracilirostris: Johnson, 1963: 20.

Material examined. **– Peninsular Malaysia**:1 ovigerous female, cl 5.5 mm, ZRC 2007.0368, slow, small, tidal stream, draining into Sungai Skudai at mile 7 Johor Bahru, Skudai Road, Malaysia, coll. D. S. Johnson, 10 May 1960; **Singapore**: 7 females, cl 3.5–3.9 mm, ZRC 2007.0369, S. Simpungkii at Sembawang Road, Singapore, coll. 11 Jul.1961; 2 ovigerous females, cl 5.0–5.1 mm, ZRC1979.4.12.146–147, Sungei Seletar at Nee Soon, Singapore, 25 Sep.1959; 2 males, 4.0–4.3 mm, 6 ovigerous females, cl 5.2–5.5 mm, ZRC 2007.0370, Sungei Seletar, station 3, Singapore, coll. P. Yeo Kwai Ho, 23 Sep.1959.

***Remarks*. –** All the specimens examined in the present study have no appendix interna on the endopod of male first pleopod and thus should be referred to the typical form of *Caridina gracilirostris*. Cai & Ng (2007) recently revised the *C. gracilirostris* species group, referring the form with no appendix interna on the endopod of the male first pleopod to *C. gracilirostris* and the other form, with a distinct appendix interna on the endopod of male first pleopod to either *C. appendiculata* Jalihal & Shenoy, 1998, or a new species.

***Distribution*.–** Indonesia, Singapore, Malaysia, Thailand, Cambodia, Taiwan, Japan, Palau, the Philippines, Fiji, India and Madagascar (Cai & Ng, 2007)

Caridina elongapoda Liang & Yan, 1977

Caridina nilotica elongapoda Liang & Yan, 1977: 220, Figs.5–8 [type locality: Xinzai, Gulei village, Zhangpu County, Fujian, southern China].

Caridina aff. *brachydactyla* – Yeo et al., 1999: 218, Figs.10–14.[not *C. brachydactyla* De Man, 1892]

Caridina longirostris – Chace, 1997: 14 (part), Fig. 6 [not *C. longirostris* H. Milne Edwards, 1837]

Caridina elongapoda – Cai & Shokita, 2006a: 249.

***Material examined*. – Peninsular Malaysia**: 28 specimens, ZRC 1998.865, Sungai Asah, coll. P. K. L. Ng et al., 24 Jun.1997; 1 specimen, Monkey Bay, Pulau Tioman, coll. H. H. Tan et al., 25 Jun.1997; 4 specimens, ZRC 1998.866, Sungai Raya, Pulau Tioman, coll. D. C. J. Yeo et al., 26 Jun.1997; 120 specimens, ZRC 1998.867, Sungai Mentawak, Pulau Tioman, coll. Y. Cai, 24 Jun.1997; 105 specimens, ZRC 1998.868, Sungai Keliling, coll. Y. Cai et al., 27 Jun.1997; 53 specimens, ZRC 1998.869, Sungai Paya, Pulau Tioman, coll. P. K. L. Ng et al., 25 Jun.1997; 50 specimens, ZRC 1998.870, Sungai Nipah, Pulau Tioman, coll. Y. Cai, 24 Jun.1997; 65 specimens, ZRC 1998.871, Sungai Salang, Pulau Tioman, Malaysia, coll. Y. Cai et al., 25 Jun.1997; 23 specimens, ZRC 1996.1756, Sungai Keliling, Pulau Tioman, Malaysia, coll. P. K. L. Ng et al., 27–28 Jun.1996; 51 specimens, ZRC 1996.1757, Sungai Raya, Kampung Mukut, Pulau Tioman, coll. P. K. L. Ng et al., 26 Jun.1996; 2 specimens, ZRC 1996.1758, Sungai Ayer Besar, stream along Tekek-Juara trail, Pulau Tioman, coll. P. K. L. Ng et al., 24–25 Jun.1996; 10 specimens, ZRC 1996.1759, left stream at mouth of Sungai Paya, Pulau Tioman, coll. O. Chia & M. J. Ng, 27 Jun.1996; 66 specimens, ZRC 1996.1760, Sungai Nipah, Pulau Tioman, coll. D. C. J. Yeo et al., 28 Jun.1996; 125 specimens, ZRC 1996.1761, Sungai Paya, Kampung Paya, Pulau Tioman, coll. P. K. L. Ng et al., 25–27 Jun.1996; 16 specimens (ZRC 1996.1762), Kampung Paya, Sungai Pasal upstream (about 15 min walk from start of trail to Sungai Paya), Pulau Tioman, coll. H. H. Tan et al., 17 Sep.1995; 19 specimens, ZRC 1996.1763, Kampung Genting, Sungai Ayer Raja, Pulau Tioman, coll. P. K. L. Ng et al., 15 Sep.1995; 10 specimens, ZRC 1996.1764, Sungai Paya upstream, near base of Bukit Paya, coll. H. H. Tan et al., 17 Sep.1995; 3 specimens, ZRC 1996.1765, Sungai Ayer Besar waterfall, on Tekek-Juara trail, Pulau Tioman, coll. P. K. L. Ng et al., 16 Sep.1995; 4 specimens, ZRC 1990.11847–11850, Genting, Pulau Tioman, Pahang, coll. S. S. C. Chong, 28 Jun.1986; 3 specimens, ZRC 1990.11857–11859, last stream enroute to Juara, Pulau Tioman, Pahang, coll. S. S. C. Chong, 30 Jun.1986; 6 specimens, ZRC 1990.11864–11869, Kampung Mukut, Pulau Tioman, coll. S. S. C. Chong, 28 Jun.1986; 2 specimens, ZRC 1990.11870–11871, ca. 100 m a.s.l. Waterfall at south of Mukut waterfall, Pulau Tioman, coll. S. S. C. Chong, 27 Jun.1986. 10 males, cl.2.8–3.2mm, 27 females, cl.3.5–5.0, ZRC 1998.872, Sungai Keliling, Pulau Tioman, coll. Y. Cai & N. K. Ng, 8–11 Sep.1998; 1 female, cl 3.6 mm, 2 ovigerous females, cl 3.7–3.8 mm, ZRC 1990.11847–11853, Sungai Genting, Pulau Tioman, 28 Jul.1986; 19 males, cl 2.7–3.8 mm, 5 females, cl 3.5–4.7 mm, 29 ovigerous females, cl 3.5–4.7 mm, ZRC 2007.0371, Kg. Mukut, Pulau Tioman, 28 Jun.1986; 2 ovigerous females, cl 5.1–5.2 mm, ZRC 2007.0372, ca. 100m above see level, waterfall in stream south of Mukut waterfall, Pulau Tioman, coll. S. S. C. Chong, 27 Jun.1985; 8 males, cl 3.0–3.2 mm, 11 females, cl 3.2–4.1 mm, ZRC 2007.0373, stream on east ridge Pulau Redang, 24 Jun.1992.

***Remarks*. –** Cai & Shokita (2006a) recently reported *C. elongapoda* from the Philippines and referred the Pulau Tioman material reported by Yeo et al. (1999) to this species.

***Distribution*. –** China, Malaysia, the Philippines (Cai & Shokita, 2006a)

Caridina propinqua De Man, 1908
(Figs. 4–6)

Caridina propinqua De Man, 1908a: 227, Pl. 19, Fig. 6 [type locality: Dhappa, near Calcutta, India]; Kemp, 1915: 309; 1918: 274; Bouvier, 1925: 181, Figs. 375, 381; Johnson, 1961:131, Figs. 12–15; 1965 : 8 ; De Silva, 1982: 127, Fig.5; Ng & Choy, 1990: 17; Wowor et al., 2004: 343, Fig. 7J–L; Cai & Shokita, 2006a: 249 ; 200b : 2150.

Caridina blanco Chace, 1997:7, Fig. 2 [type locality: Tayabus River, Luzon Island, the Philippines].

Caridina hainanensis Liang & Yan, 1983: 211, Fig. 1 [type locality: Wenchang County, Hainan Island, China]; Liang, 2004: 302.

***Material examined*. – Peninsular Malaysia:** 9 males, cl 2.5–3.0 mm, 2 females, cl 2.3–3.0 mm, 2 ovigerous females, cl 3.6–4.0 mm, ZRC.1979.4.17.28–40, Malaysia: Johor Bahru, non-brackish stream, low tide, flowing into Sungai Skudai at mile 2, Skudai Rd, coll. E. R. Alfred, 9 Feb.1957; 3 males, cl 2.8–3.0 mm, 2 females, cl 3.1 mm, 3 ovigerous females, cl 3.3–3.5 mm, ZRC 2007.0374, mangrove creek at Tanjong Sedili, Johor, Malaysia, coll. Y. Cai & N. K. Ng, 20 Sep.1999. **Singapore**: 22 males, cl 2.3–3.1 mm, 18 females, cl 2.7–3.4 mm, 11 ovigerous females, cl 3.1–3.8 mm, ZRC 2007.0375, creek in Sungei Buloh mangroves, Singapore, coll. Y. Cai, 18 Nov.1999; 7 males, cl 2.0–3.0 mm, 12 females, cl 2.6–3.6 mm, 8 ovigerous females, cl 2.9–3.4 mm, ZRC 2007.0376, Mandai Kechil mangroves, Singapore, coll. REST lab, 8 Apr.1992; 1 male, cl 2.8 mm, 2 females, 2.6–3.0 mm, 1 ovigerous female, cl 3.4 mm, ZRC.1979.4.17.14–19, Singapore: Mile 12, Jurong Road, peaty ditches, through coconut plantation, coll. D. S. Johnson, 16 Jan.1957; 1 male, cl 2.5 mm, 1 female, cl 4.0 mm, 1 juv., ZRC 2007.0377, Singapore: Sungai Buloh, coll. P. K. L. Ng, 23 Apr.1991; 5 males, cl 2.0–2.5 mm, 6 females, cl 2.2–3.3 mm, ZRC 2007.0378, Singapore: Sungai Buloh; coll. P. Ng, Dec.1992; 2 males, cl 2.5–2.6 mm, 1 female, cl 4.2 mm, 1 ovigerous female, cl 4.0 mm, ZRC 1990.11823–11826, Singapore: Sungai Seletar, coll. P. Yeoh, 23 Sep.1995.

***Diagnosis*. –** Rostrum (Fig. 4A, B, 5A, 6A) straight or sloping down anteriorly, reaching near middle of second segment of antennular peduncle, to end of third segment. Rostral formula: 2–4+8–16/0–4 (mostly 3), no apical teeth. Suborbital angle acute, distinctly separated from antennal spines; pterygostomian margin rounded. Preanal carina

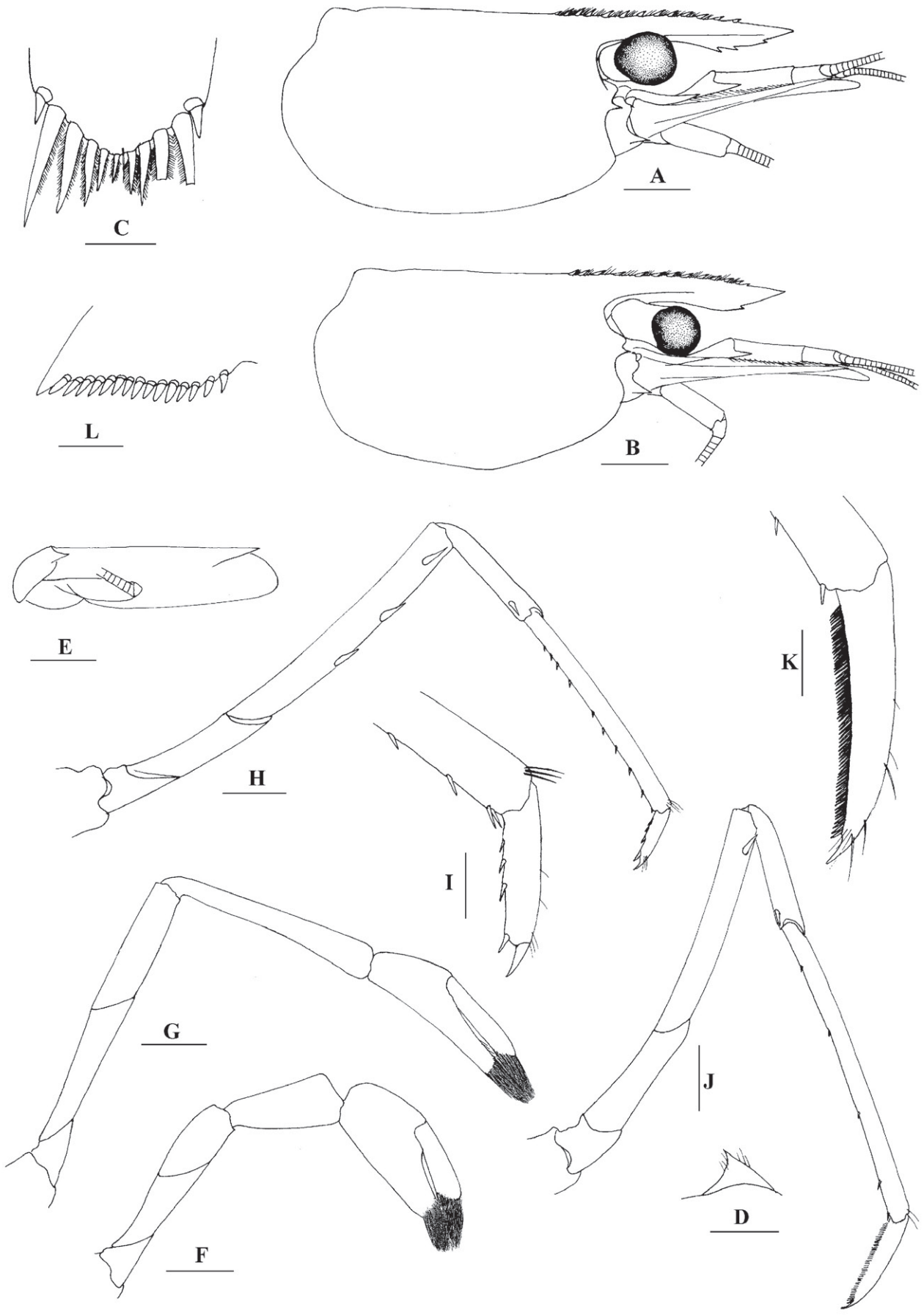

Fig. 4. *Caridina propinqua*:A, B, cephalothorax and cephalic appendages; C, distal portion of telson; D, pre-anal carina; E, scaphocerite; F, first pereiopod; G, second pereiopod; H, third pereiopod; I, dactylus of third pereiopod; J, fifth pereiopod; K, dactylus of fifth pereiopod; L, diaeresis Scale bars: A, B, E = 1 mm; C, I, K, L = 0.2 mm; D, F–H, J = 0.5 mm. (A, female, cl 4.2 mm; B–K, female, cl 4.1 mm; all material from Sungei Buloh, Singapore, ZRC).

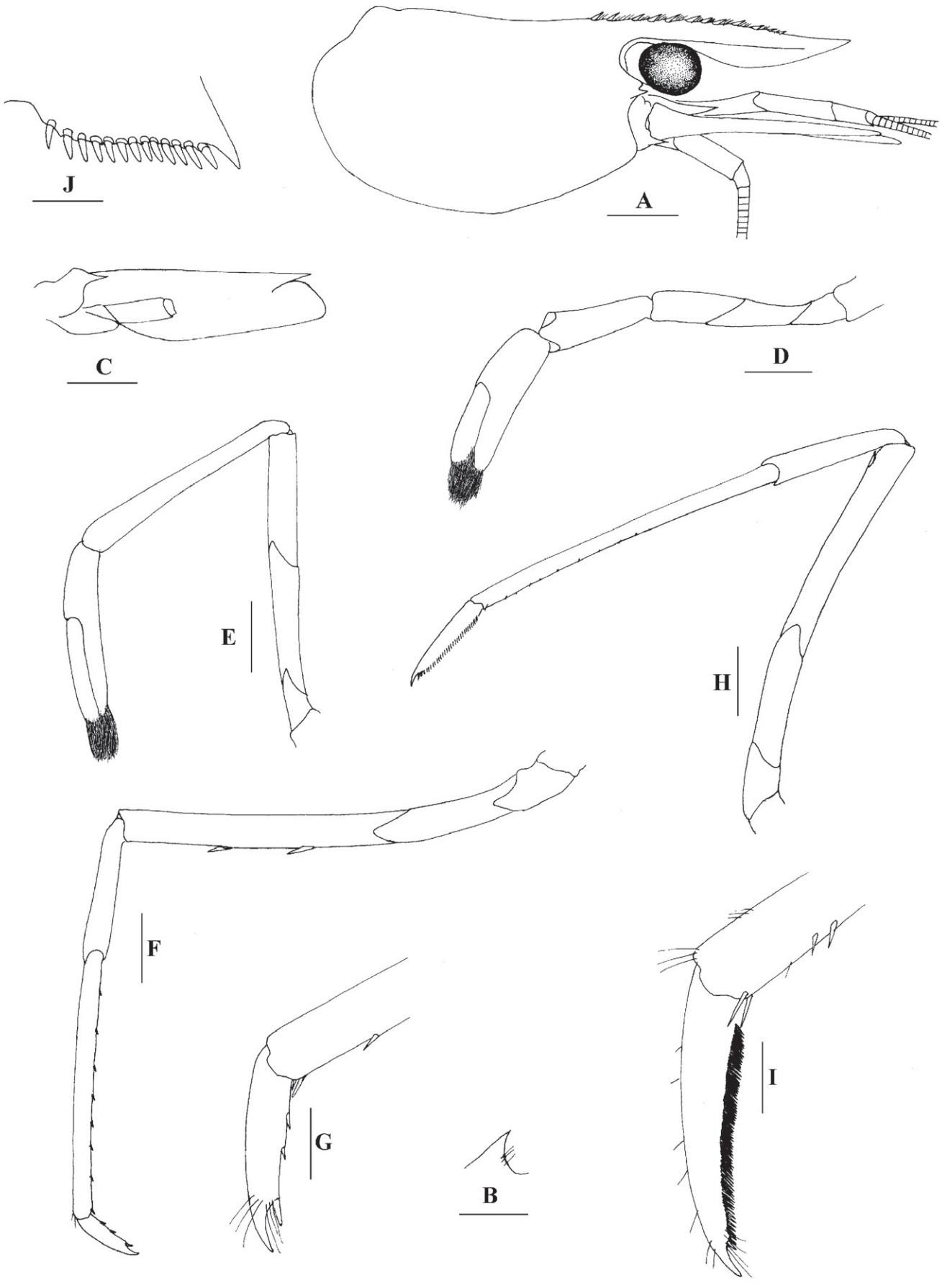

Fig. 5. *Caridina propinqua*: A, cephalothorax and cephalic appendages; B, pre-anal carina; C, scaphocerite; D, first pereiopod; E, second pereiopod; F, third pereiopod; G, dactylus of third pereiopod; H, fifth pereiopod; I, dactylus of fifth pereiopod; J, diaeresis. Scale bars: A, C = 1 mm; B, D–F, H = 0.5 mm; G, I, J = 0.2 mm. (female, cl. 3.7 mm, Sungei Mandai, Singapore, ZRC).

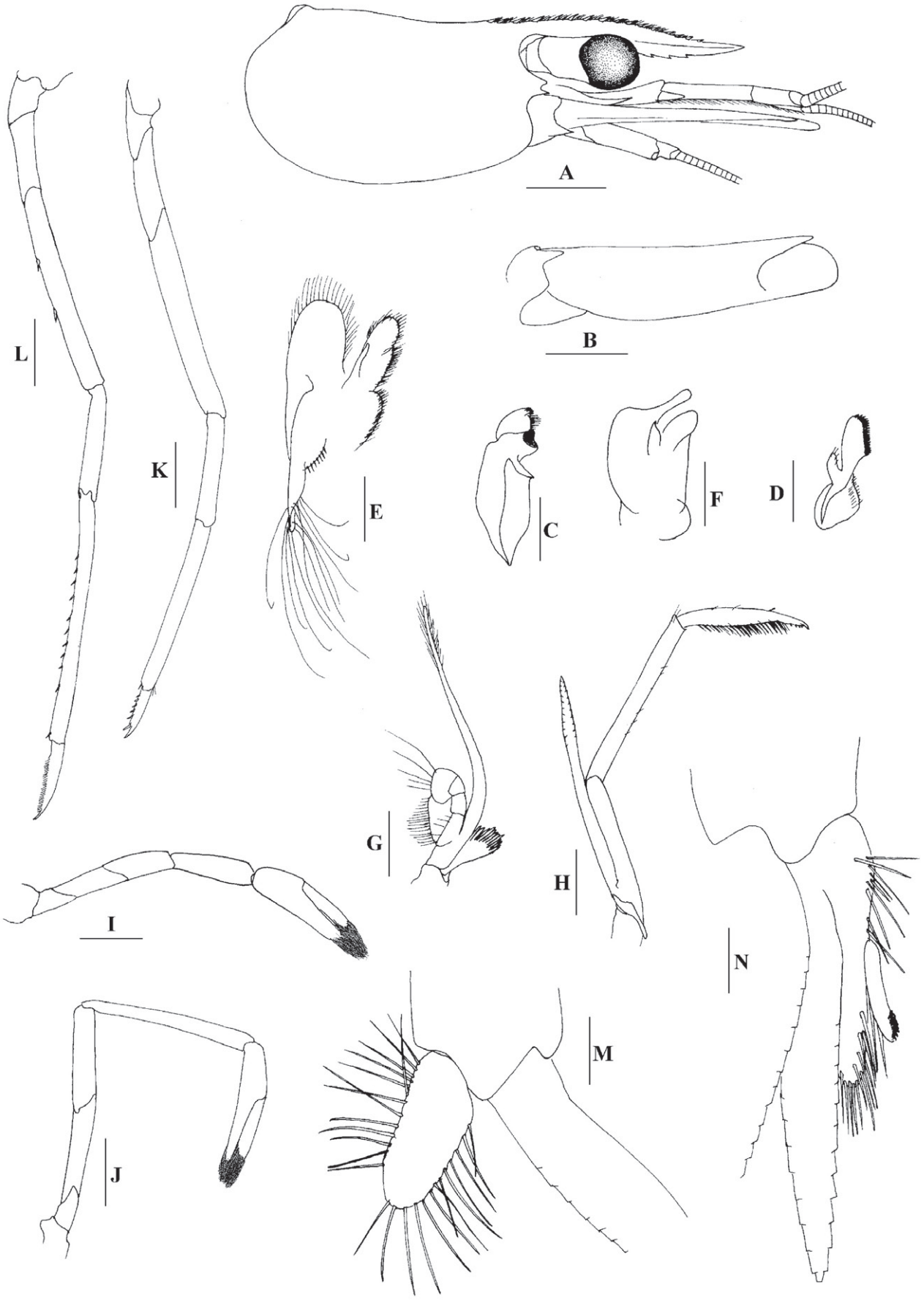

Fig. 6. *Caridina propinqua*: A, cephalothorax and cephalic appendages ; B, scaphocerite ; C, mandible ; D, maxillula ; E, maxilla ; F, first maxilliped ; G, second maxilliped ; H, third maxilliped ; I, first pereiopod ; J, second pereiopod ; K, third pereiopod ; L, fifth pereiopod ; M, endopod of male first pleopod ; N, appendix masculina and appendix interna of male second pleopod. Scale bars: A, B = 1 mm; C–L = 0.5 mm; M, N = 0.2 mm. (male, cl 2.9 mm, Sungai Sedili, Johor, Peninsular Malaysia, ZRC).

(Figs. 4D, 5B) with a spine. Sixth abdominal somite 0.8 times as long as carapace, 1.9 times as long as fifth somite. Telson (Fig. 4C) with 3 or 4 pairs of dorsal spines and small posteromedial projection, lateral pair of spines longer than intermedial pairs. Antennular peduncle long, subequal to carapace length. Stylocerite reaching to 0.8 times length of basal segment of antennular peduncle. Scaphocerite (Figs. 4E, 5C, 6B) 3.5–4.0 times as long as wide. First pereiopod (Figs. 4F, 5E, 6I) with carpus 2.1–3.3 times as long as high, chela 2.5 times as long as broad, finger longer than palm. Second pereiopod (Figs. 4G, 5D, 6J) with carpus 6.3–9.6 times as long as high, chela 3.4–5.0 times as long as broad, fingers twice as long as palm. Third pereiopod (Figs. 4H, I, 5F, G, 6K) with propodus 3.3–3.8 times as long as dactylus, propodus not enlarged. Dactylus ending in 2 claws, with 2–5 spines on flexor margin. Fifth pereiopod (Figs. 4J, K, 5H, I, 6L) with propodus 2.8–3.1 times as long as dactylus; dactylus ending in a claw, with 66–74 spinules on flexor margin. Endopod of male first pleopod (Fig. 6M) with no appendix interna. Uropodal diaeresis (Figs. 4L, 5J) with 13–15 spinules. Eggs sized 0.32–0.36 × 0.20–0.22 mm.

***Remarks.* –** Cai & Shokita (2006b) recently reviewed the taxonomy of this species and regarded *C. hainanensis* Liang & Yan, 1983 and *C. blancoi* Chace, 1997 as its junior synonyms.

The forms of the first two pereiopods vary with both location and sex. In the female specimens from Sungei Buloh, Singapore, the carpus of the first and the second pereiopods are 2.2 and 6.3 times as long as high, respectively, those of the female specimens from Sungei Mandai, Singapore, are 2.9 and 7.4 times, respectively, while those of male from Sungai Sedili, Malaysia are 3.4 times and 9.6 times, respectively. The eggs that we measured are also relatively smaller than what has been reported (0.32–0.36 × 0.20–0.22 mm in current study vs. 0.39–0.45 × 0.24–0.27 mm in Hainan (Liang & Yan, 1983) and 0.38–0.48 × 0.25–0.30 mm in the Ryukyu Islands (Cai & Shokita, 2006a)). Johnson (1961) reported the egg size of the present species as 0.54 × 0.36 mm from Malaysia. However, as pointed out in the remarks section under *C. johnsoni*, new species, Johnson's (1961) material is probably a mixture of *C. propinqua* and *C. johnsoni* (see below).

***Distribution*.** – Sri Lanka, India, Malay Peninsula, the Philippines, Japan and China (present study; Cai & Shokita, 2006b).

Caridina sumatrensis De Man, 1892
(Fig. 7)

Caridina weberi var. *sumatrensis* De Man, 1892: 375, pl. 22, Fig. 23g [type locality: Deli, Sumatra, Indonesia].

Caridina weberi sumatrensis – Bouvier, 1925: 247, Fig. 567 ; Johnson, 1963: 26.

Caridina sumatrensis – Wowor et al., 2004: 343, Fig. 6P, Q; Cai & Shokita, 2006a: 246.

***Material examined.* – Peninsular Malaysia:** 1 male, cl 3.7 mm, ZRC, Sungai Telor, Malaysia, coll. Ng et al., 7 Sep.1998; 2 males, cl 3.1–3.3 mm, 6 ovigerous females, cl 4.2–5.3 mm, ZRC 2007.0379, Sungai Mupor, Kota Tinggi, Malaysia, 21 Aug.1994; 1 male, cl 3.2 mm, 10 females, cl 2.8–3.1 mm, ZRC 2007.0380, Maxwell Hill, Malaysia, coll. H. H. Tan, 1995; 2 ovigerous females, cl 5.4–6.7 mm, ZRC 2007.0381, Sekayu Waterfall, Malaysia, coll. H. H. Tan, 17 Jun.1995; 1 male, cl 3.8 mm, 2 females, cl 4.8–5.0 mm, ZRC 2007.0382, stream outside Kota Tinggi Waterfall, coll N. K. Ng et al., 20 Sep.1998; 3 females, cl 5.2–5.7 mm, ZRC 2007.0383, Sungai Dohol, Malaysia, coll. H. H. Tan, 24 Feb.1995; 10 males, cl 3.2–3.4 mm, 2 females, cl 3.7–4.8 mm, ZRC 2007.0384, Mersing, Malaysia, coll. H. H. Tan, 9 May 1995; 3 males, cl 2.7–4.0 mm, 8 females, cl 2.2–4.7 mm, ZRC 2007.0385, Malaysia, stream outside Sekayu Waterfall, pH 5.3, coll. P. K. L. Ng, 18 Mar.1992; 5 males, cl 3.6–3.7 mm, 5 ovigerous females, cl 5.3–5.5 mm, ZRC 2007.0386, Malaysia: Gunung Panti, Kota Tinggi, coll. P. K. L. Ng, 1991. **Singapore:** 1 male, cl 2.3 mm, 4 females, cl 2.2–2.4 mm, ZRC 2007.0387, Lombong Stream, Singapore, 31 Aug.1990; 2 females, cl 5.8–6.3 mm, RMNH D 16621, Jurong, Singapore, coll. E. R. Alfred, 22 Mar.1958.

***Habitat*. –** Rivers and streams.

***Remarks*. –** With 4–6 postorbital teeth, *C. sumatrensis* is easily separated from other subspecies of *C. weberi* and is recognized as a distinct species. It was recently reported from the Philippines by Cai & Shokita (2006a).

***Distribution*. –** Sumatra, Malay Peninsula and the Philippines (present study; Cai & Shokita, 2006a).

Caridina thambipilaii Johnson, 1961
(Figs. 8–10)

Caridina thambipillaii Johnson, 1961:138, Figs.25–27 [type locality: Sungai Putat near the pumping station, Malacca, Peninsular Malaysia]; Johnson, 1965: 8; Ng & Choy, 1990:16; Wowor et al., 2004: 343, Fig. 7P–S.

***Material examined.* –** Holotype: male, cl 3.9 mm, ZRC 1979.4.18.41, Sungai Putat near the pumping station, Malacca, Peninsular Malaysia, coll. D. J. Johnson, 6 Jan.1956.
Allotype: 1 ovigerous female, cl 6.5 mm, eggs 0.30 × 0.25mm, ZRC 1979.4.18.42, data same as holotype.
Paratypes: 2 males, cl 3.6–4.1 mm, ZRC 1979.4.18–19, data same as holotype.

Others: **Peninsular Malaysia**: 2 females, cl 3.2–3.3 mm, ZRC 2007.0388, Malaysia, Johor Mawai, Tg. Sedili Road, Sungai Selangi, 22 Apr.1992; 5 males, cl 3.6–3.9 mm, 9 females, cl 4.1–5.6 mm, ZRC 2007.0389, about 112 km, market on Johor Bahru to Kuantan road, north of K. Rompin, Pahang, Malaysia, 19 Oct.1991; 1 male, cl 3.6 mm, 1 ovigerous female, cl 6.0 mm, ZRC.1979.4.18.51–52, Malaysia: Johor, Kota Tinggi, Mawai road, tidal stream above mangrove limit, among weeds, 18 Jul.1961.

***Comparative material examined.* – Borneo**: 2 males, cl 3.2–3.3 mm, 1 female, cl 4.9 mm, 1 ovigerous female, cl 4.8 mm, ZRC 2007.0390, 8.6 km after turning towards Sungai Cina, Matang, 1°39'2.6"N 110°10'44.7"E, after entrance to Matang Reserve, Sarawak, Malaysia, coll. H. H. Tan, 4 Sep.1995; 3 females, cl 5.1–5.9 mm, 1 ovigerous female, cl 5.7 mm, eggs 0.47 × 0.30 mm, ZRC

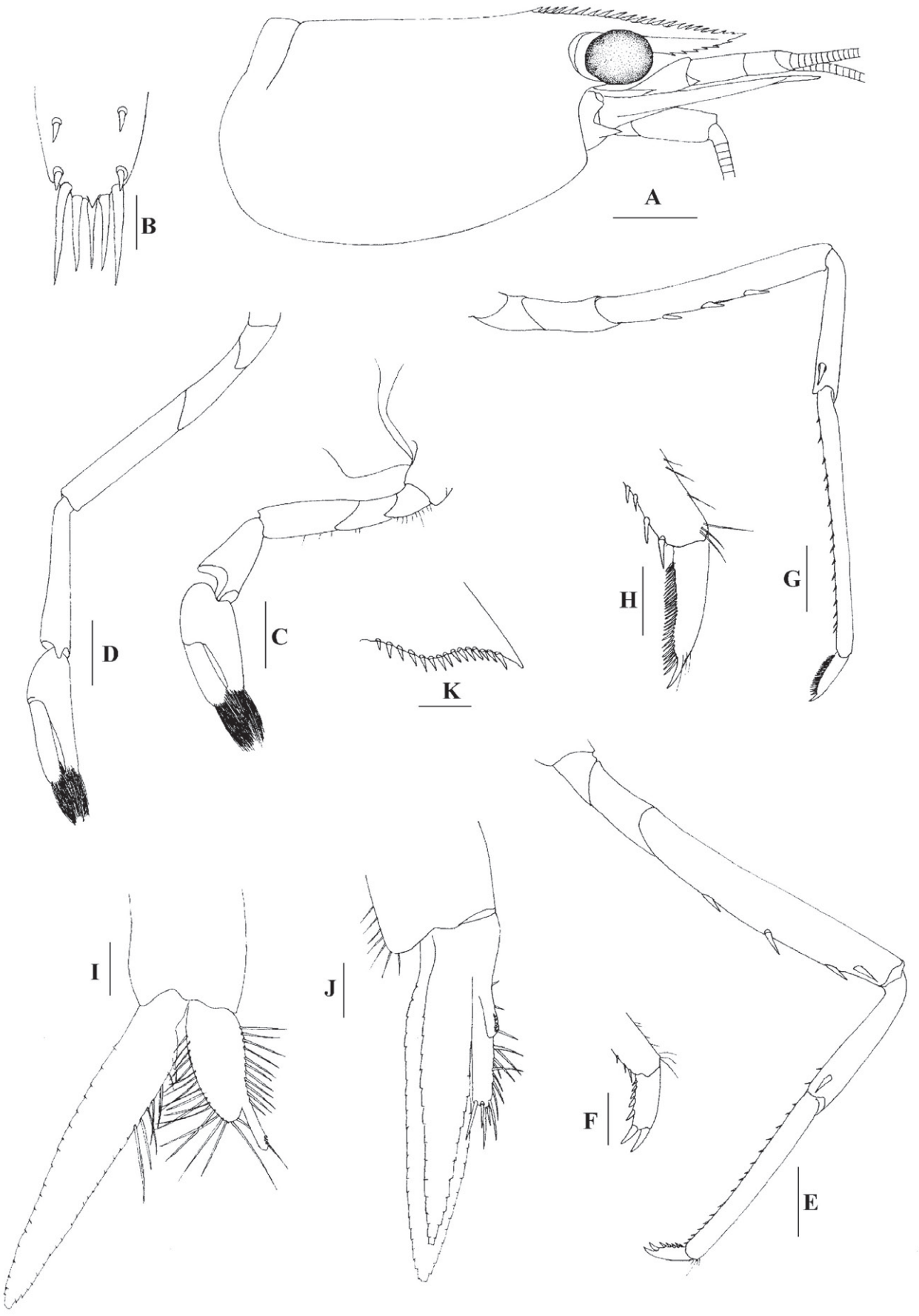

Fig. 7. *Caridina sumatrensis*: A, cephalothorax and cephalic appendages; B, distal portion of telson; C, first pereiopod; D, second pereiopod; E, third pereiopod; F, dactylus of third pereiopod; G, fifth pereiopod; H, dactylus of fifth pereiopod; I, male first pleopod; J, male second pleopod. Scale bars: A = 1 mm; C–E, G = 0.5 mm; B, F, H, I, J = 0.2 mm. (male, cl 3.7 mm, Sungai Telor, Peninsular Malaysia, ZRC).

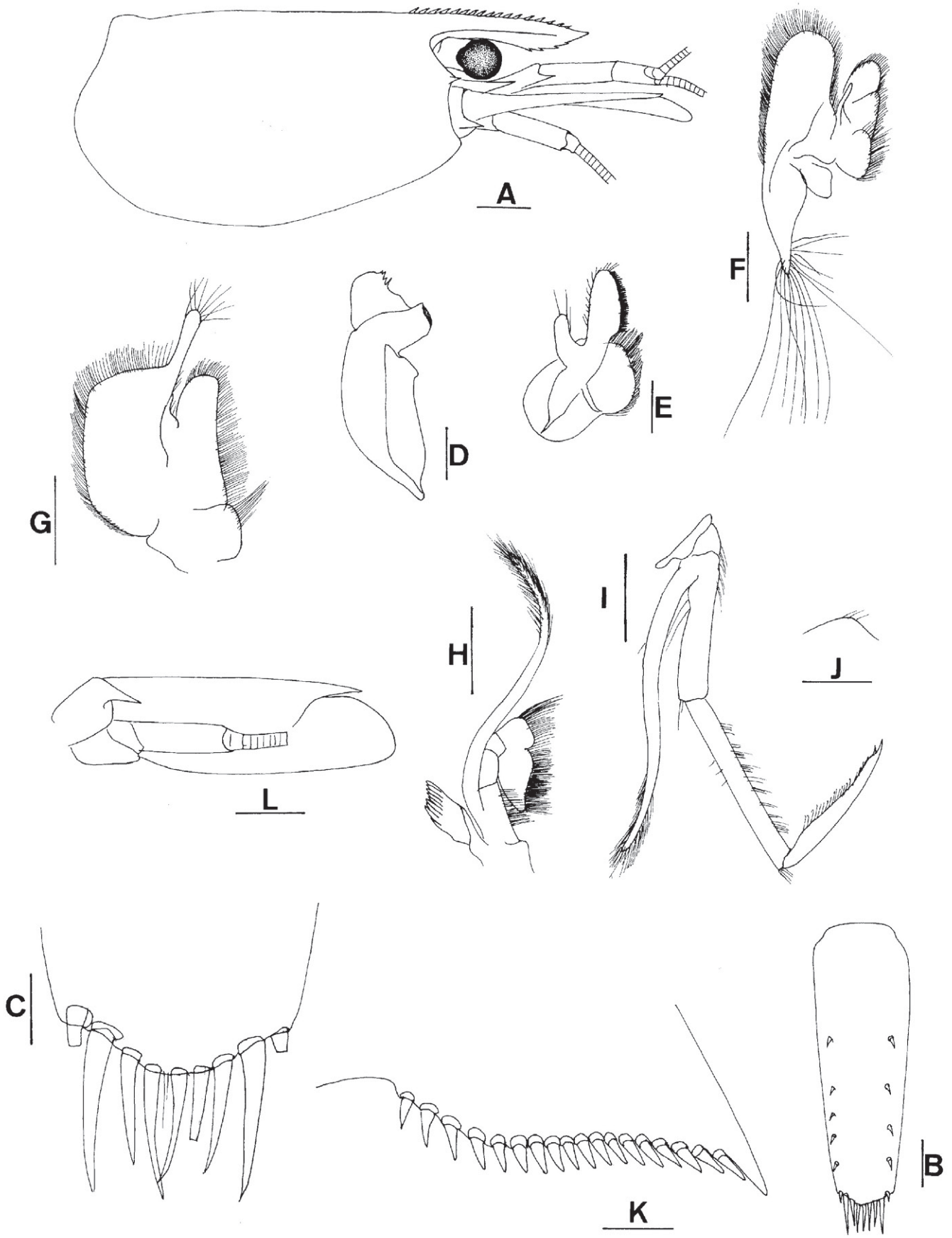

Fig. 8. *Caridina thambipillaii*: A, cephalothorax and cephalic appendages; B, telson; C, distal portion of telson; D, mandible; E, maxillula; F, maxilla; G, first maxilliped; H, second maxilliped; I, third maxilliped; J, preanal carina; K, diaeresis; L, scaphocerite. Scale bars: A = 1 mm, B, D–J = 0.5 mm; C, K = 0.2 mm. (A–C, female, cl 5.9 mm, D–K, ovigerous female, cl 5.7 mm; all material from Sungai Stunggang, Sarawak, East Malaysia, ZRC).

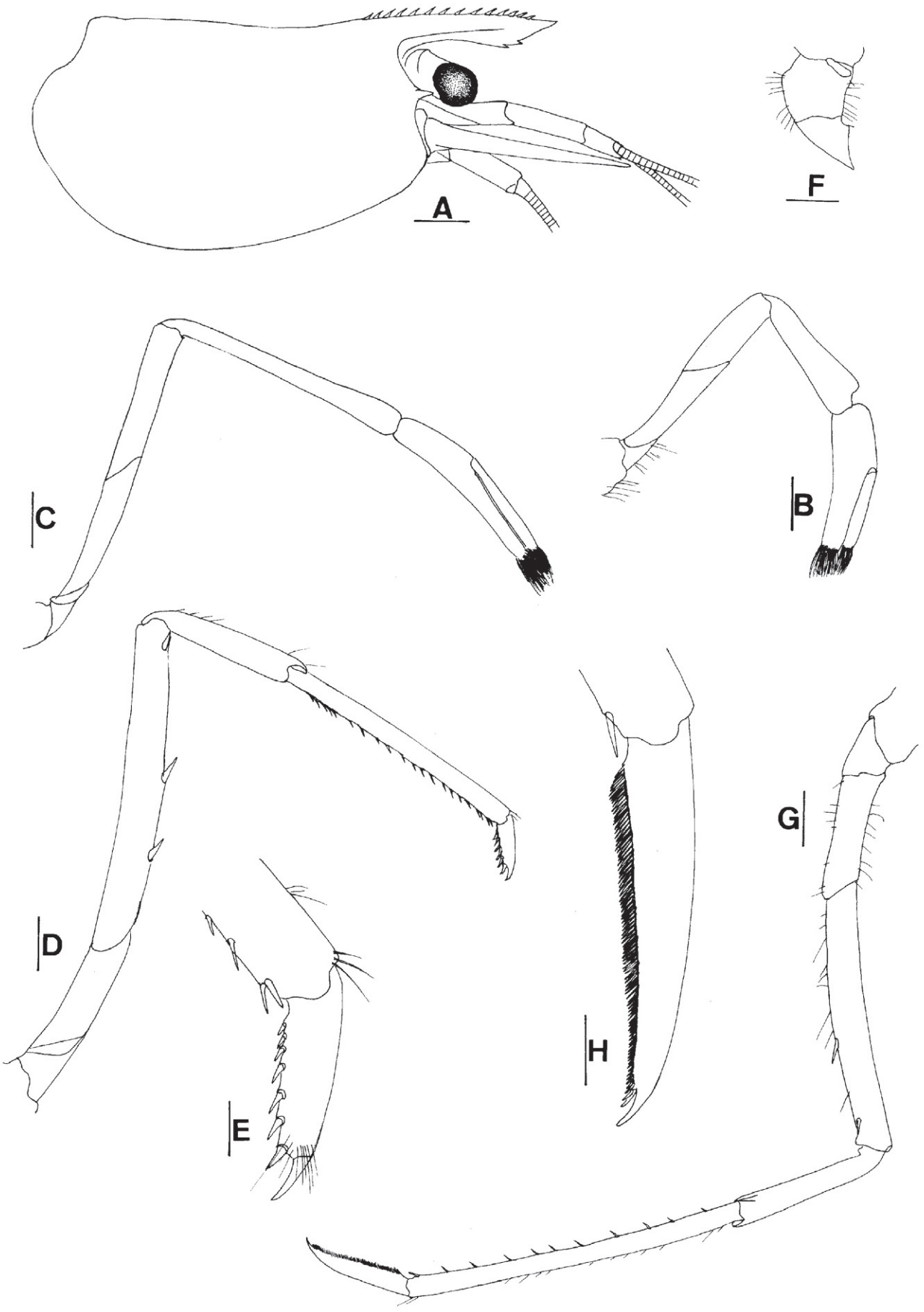

Fig. 9. *Caridina thambipillaii*:A, cephalothorax and cephalic appendages; B, first pereiopod; C, second pereiopod; D, third pereiopod; E, dactylus of third pereiopod; F, basis of fourth pereiopod, showing the epipod; G, fifth pereiopod; H, dactylus of fifth pereiopod. Scale bars: A = 1 mm; B–D, F, G = 0.5 mm; E, H = 0.2 mm. (ovigerous female, cl 5.7 mm, Sungai Stunggang, Sarawak, East Malaysia, ZRC).

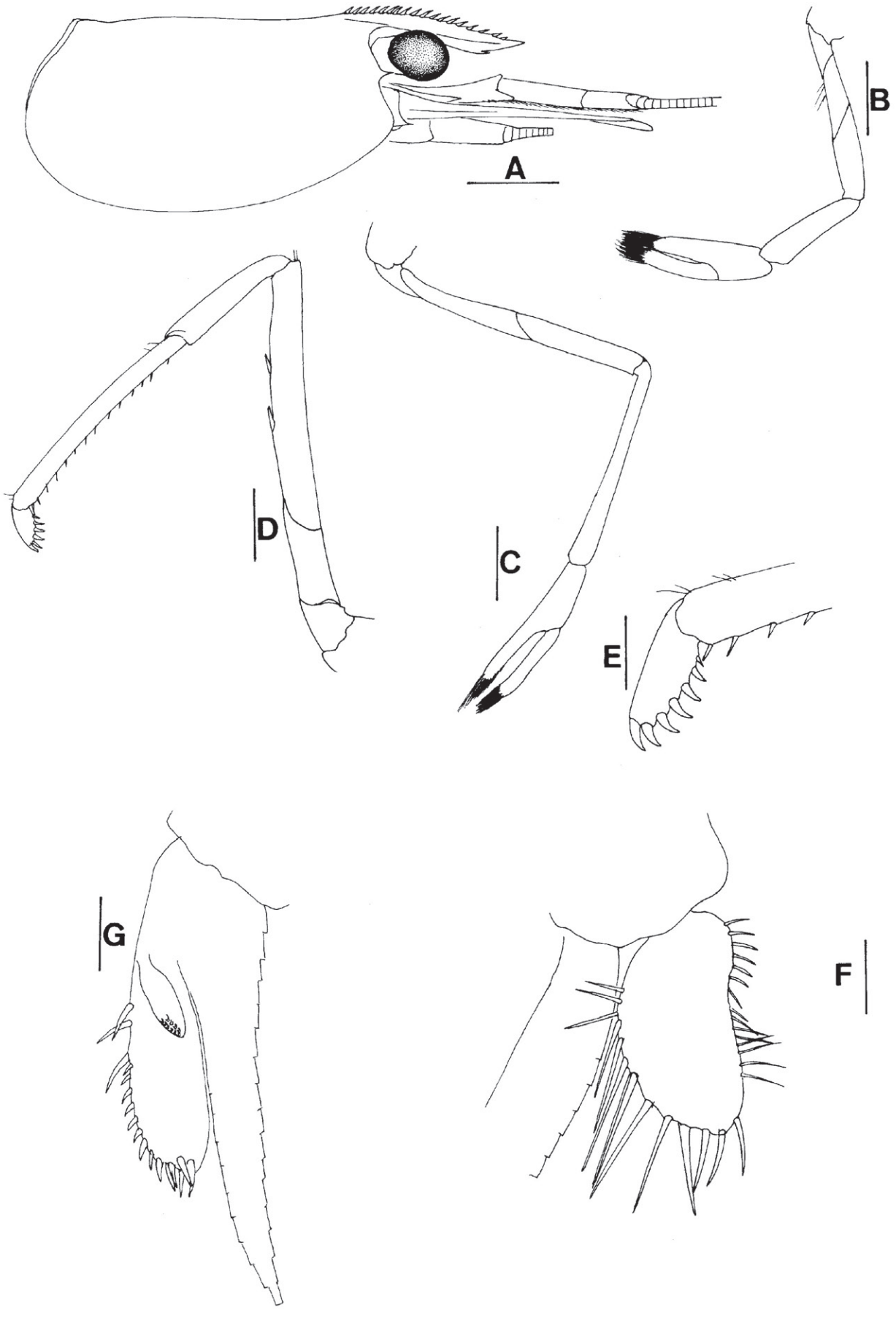

Fig. 10. *Caridina thambipillaii*: A, cephalothorax and cephalic appendages; B, first pereiopod; C, second pereiopod; D, third pereiopod; E, dactylus of third pereiopod; F, endopod of male first pleopod; G, male second pleopod. Scale bars: A = 1 mm; B–D = 0.5 mm; E – G=0.2 mm. (male, cl 3.3 mm, Sungai Stunggang, Sarawak, East Malaysia, ZRC).

2007.0391, Sungai Stunggang, 4.8 km before Lundu ferry point at Bg. Kayan, Sarawak, Malaysia, coll. H. H Tan, 2 Sep.1996; 1 ovigerous female, cl 5.9 mm, ZRC 2007.0392, Borneo: Sarawak, Bau-Lundu area, Sungai Stunggang, swamp forest, 51.0 km towards Lundu from Bau on Bau-Lundu road, 01°37.44'N 109°53.18'E, pH 4.6, coll. H. H. Tan & P. Yap, 2 Oct.1998. **Myanmar:** 3 males, cl 3.1–3.5 mm, ZRC 1979.4.17.78–80, brackish pond near railway crossing N. Okkalatia Rd., Rangoon (Yangon), coll. C. H. Fernando, no date.

Description. − Rostrum (Figs. 8A, 9A, 10A) short, straight or slightly crested basally, reaching near middle of second segment of antennular peduncle; rostral formula 3–4+11–17/1–4. Suborbital angle acute, fused with antennal spines; pterygostomian margin rounded.

Sixth abdominal somite 0.5 times of carapace, 1.6 times as long as fifth somite, as long as telson. Telson (Figs. 8B, C) 3.7 times as long as wide, distal margin broadly rounded, not terminating in a projection, with 4 or 5 pairs of dorsal spinules and a pair of dorsolateral spinules; distal end with 4 pair of spines, lateral pair longer than intermediate pairs. Preanal carina without spine.

Eyes well developed, anterior end reaching to 0.7 times length of basal segment of antennular peduncle. Antennular peduncle 0.7 times as long as carapace; basal segment of antennular peduncle subequal to combined length of second and third segments, anterolateral angle reaching to 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. Scaphocerite 3.3 times as long as wide.

Incisor process of mandible (Fig. 8D) ending in irregular teeth, molar process truncated. Lower lacinia of maxillula (Fig. 8E) broadly rounded, subrectangular, upper lacinia elongated, with a number of distinct teeth on inner margin, palp slender. Endites much small, upper endites of maxilla (Fig. 8F) subdivided, palp short, scaphognathite very broad, tapering posteriorly with numerous long, curved setae at posterior end. Palp of first maxilliped (Fig. 8G) ending in a prominent finger-like projection. Second maxilliped (Fig. 8H) with a large developed arthrobranch. Third maxilliped reaching to end of antennular peduncle, with ultimate segment shorter than penultimate segment (Fig. 8I).

Epipods well developed on first 3 pereiopods, reduced or absent on fourth pereiopod. First pereiopod (Figs. 9B, 10B) reaching beyond end of basal segment of antennular peduncle; merus 2.9–3.0 times as long as broad, shorter than carpus; carpus excavated anteriorly, shorter than chela, 3.3–3.6 times as long as high; chela 3.2–3.6 times as long as broad; fingers 1.2–1.3 times as long as palm. Second pereiopod (Figs. 9C, 10C) reaching to end of scaphocerite; merus shorter than carpus, 5.1–5.7 times as long as broad; carpus 1.4 times as long as chela, 8.0–8.6 times as long as high; chela 5.1–5.3 times as long as broad; fingers 1.4–1.6 times as long as palm. Third pereiopod (Figs. 9D, E, 10D, E) reaching to end of scaphocerite, sexually dimorphic, that of male with propodus 13 times as long as broad, 4.9 times as long as dactylus; dactylus broad, 2.2 times as long as wide (spines included), terminating in 2 claws, with 5 accessory large spines on flexor margin; that of female with propodus 12 times as long as broad, 4.4 times as long as dactylus, dactylus slender, 3.3 times as long as wide (spinules included), terminating in 2 claws, with 6 spinules on flexor margin. Fifth pereiopod (Figs. 10G, H) reaching to end of second segment of antennular peduncle, propodus 16 times as long as broad, 3.0 times as long as dactylus; dactylus slender, 5.0 times as long as wide (spinules included), terminating in a claw, with 70–106 spinules on flexor margin.

Endopod (Fig. 10F) of male first pleopod subrectangular, 1.9 times as long as wide, reaching to 1/3 length of endopod, no appendix interna. Appendix masculina of male second pleopod (Fig. 10G) stout, reaching to 3/4 length of exopod.

Uropodal diaeresis (Fig. 8K) with 16–19 movable spinules.

Ovigerous females with egg size 0.40–0.47 × 0.25–0.30 mm.

Habitat. − Streams.

Remarks. – With respect to the slender pereiopods, the form of the pleopods, and the sexual dimorphism of the third and fourth pereiopods, *C. thambipilaii* most closely resembles *C. laevis* Heller, 1862 from Java. It can be separated from *C. laevis* by the shape of the rostrum, which is straight or slightly crested basally and not sigmoid as in *C. laevis*; the smaller egg size (0.40–0.47 × 0.25–0.30 mm vs. 0.80–0.90 × 0.48–0.52 mm in *C. laevis*), and the ratio of ischium to merus in the first two pereiopods (merus almost as long as ischium vs. much longer in *C. laevis*). Three male specimens in the ZRC labeled as being collected from Rangoon (Yangon, Myanmar) by C. H. Fernando in the 1960s clearly belong to the present species.

Distribution.– Peninsular Malaysia, Sarawak and Myanmar (present study; Johnson, 1961).

Caridina excavatoides Johnson, 1961
(Figs. 11, 12)

Caridina excavatoides Johnson, 1961: 127, Figs. 3–11 [type locality: Kedah, Malaysia]; Wowor et al., 2004: 343, Figs. 7T, U.

Material examined. – Holotype: ovigerous female, cl 4.6 mm, eggs ca. 0.7 × 0.5 mm, ZRC 1979.4.11.14, stream at about 9 miles from Alor Setar, Kedah, on the Pokok Sena Road, Peninsular Malaysia, coll. D. S. Johnson, 7 Dec.1955.

Paratype: 1 ovigerous female, cl 4.3 mm, ZRC 1979.4.11.15, data same as holotype.

Others: **Malaysia:** 2 females, cl 2.2–3.0 mm, ZRC 2007.0393, Sungai Basar, Kuantan, Malaysia, 5 Sep.1998; 4 males, cl 1.8–2.3 mm, 5 females, cl 2.1–2.8 mm, 2 ovigerous females, cl 2.9–3.2 mm, eggs 0.6 × 0.4 mm, ZRC 2007.0394, Sungai Atong, Pahang near Kuantan, Malaysia, 7 Sep.1998.

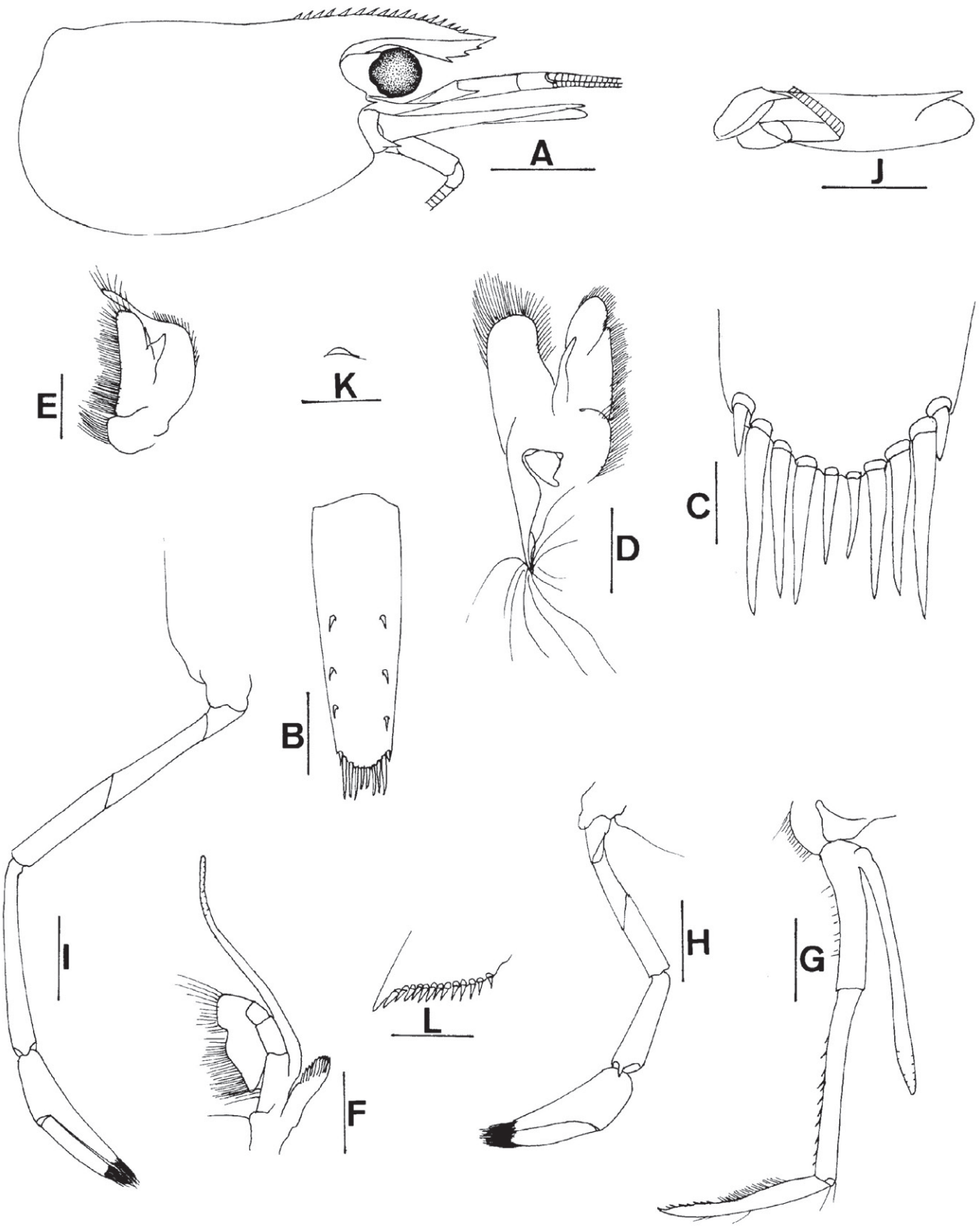

Fig. 11. *Caridina excavatoides*: A, cephalothorax and cephalic appendages; B, telson; C, distal portion of telson; D, maxilla; E, first maxilliped; F, second maxilliped; G, third maxilliped; H, first pereiopod; I, second pereiopod; J, scaphocerite; K, preanal carina; L, diaeresis. Scale bars: A, J = 1 mm; B, D–I, K = 0.5 mm; C, L = 0.2 mm. (ovigerous female, cl 2.8 mm, Sungai Besar, Kuantan, Peninsular Malaysia, ZRC).

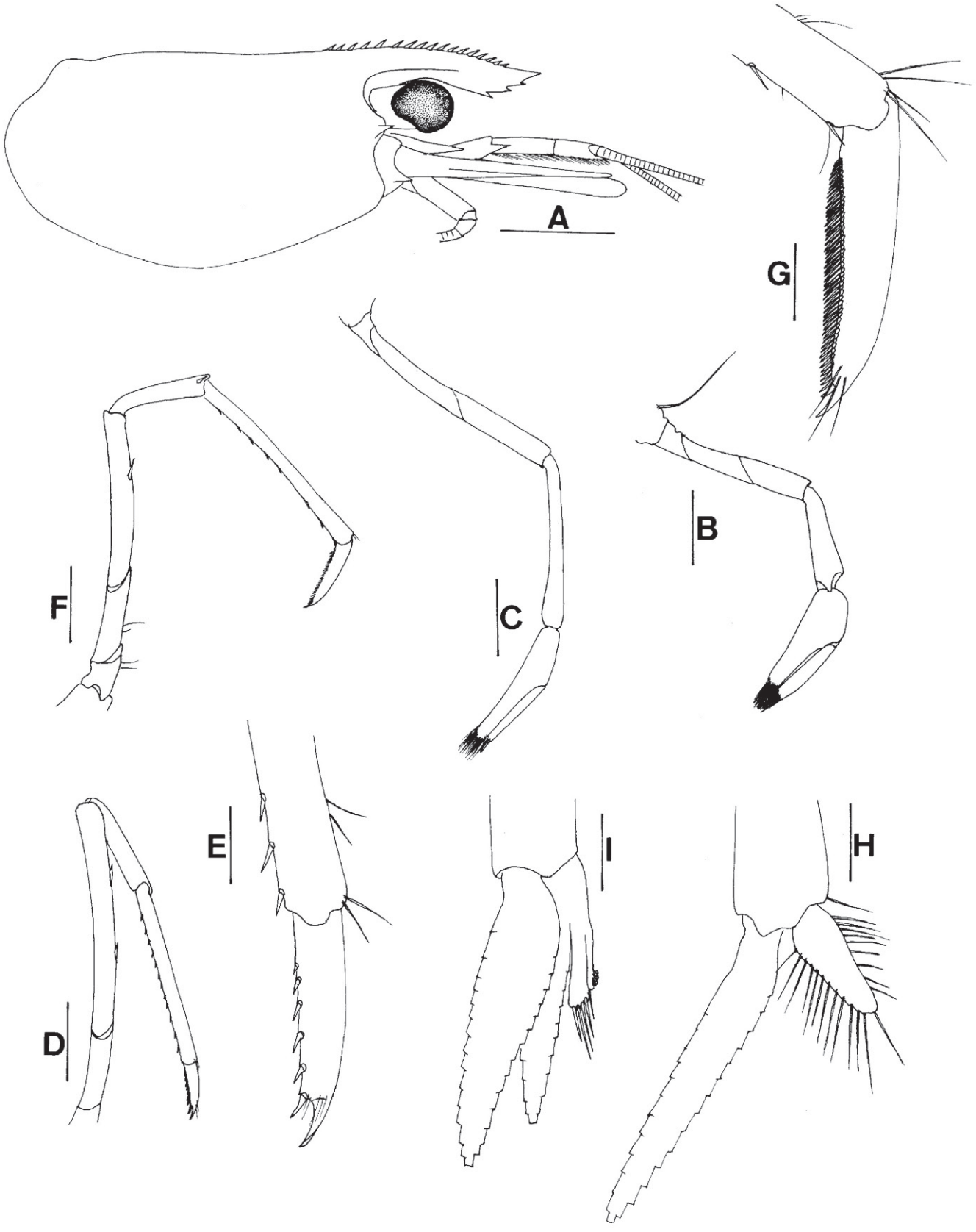

Fig. 12. *Caridina excavatoides*: A, cephalothorax and cephalic appendages; B, first pereiopod; C, second pereiopod; D, third pereiopod; E, dactylus of fifth pereiopod; F, fifth pereiopod; G, dactylus of fifth pereiopod; H, male first pleopod; I, male second pleopod. Scale bars: A = 1 mm; B–D, F = 0.5 mm; E, G = 0.1 mm, H, I = 0.2 mm. (A–C, H, I, male, cl 2.6 mm; D–G, ovigerous female, cl 2.8 mm; all material from Sungai Besar, Kuantan, Peninsular Malaysia, ZRC).

***Comparative material examined.* – Sumatra:** 3 males, cl 2.4–2.5 mm, 4 females, cl 2.9–3.5 mm, 5 ovigerous females, cl 3.2–3.4 mm, eggs 0.7 × 0.42 mm, ZRC 2007.0395, Sumatra, 250km south of Medan, Sei Rampah, Pastai Berdagai, Kg. Nagur, stagnant pools, pH 6.4, coll. H. H. Tan, 15 Jun.1996.

***Description.* –** Rostrum (Figs.11A, 12A) sigmoid, reaching near middle of second segment of antennular peduncle, or to end of third segment. Rostral formula 3–6+10–17/2–4. Suborbital angle acute, distinctly separated from antennal spines; pterygostomian margin rounded.

Sixth abdominal somite 0.6 times of carapace, 1.8 times as long as fifth somite, slightly shorter than telson. Telson (Figs. 11B, C) 3.1 times as long as wide, distal margin rounded, not terminating in a projection, with 3 pairs of dorsal spinules and one pair of dorsolateral spinules; distal end with 3 or 4 pairs of spines, lateral pair slightly longer than intermediate pairs. Preanal carina (Fig. 11K) low, without spine.

Eyes well developed, anterior end reaching to 0.7 times length of basal segment of antennular peduncle. Antennular peduncle 0.63–0.77 times as long as carapace; basal segment of antennular peduncle longer than combined length of second and third segments, anterolateral angle reaching to 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. Scaphocerite (Fig. 11J) 3.7 times as long as wide.

Incisor process of mandible ending in irregular teeth, molar process truncated. Lower lacinia of maxillula broadly rounded, subtriangular, upper lacinia elongated, with a number of distinct teeth on inner margin, palp slender. Upper endites of maxilla (Fig. 11D) subdivided, palp short, scaphognathite tapering posteriorly with numerous long, curved setae at posterior end. Palp of first maxilliped (Fig. 11E) ending in a triangular projection. Second maxilliped (Fig. 11F) typical, arthrobranch well developed. Third maxilliped (Fig. 11G) reaching beyond end of second segment of antennular peduncle, with ultimate segment shorter than penultimate segment.

Epipods well developed on first 2 pereiopods, reduced in third pereiopod, rudimentary or absent in last 2. First pereiopod (Figs. 11H, 12B) reaching near anterior end of eye; merus 2.5 times as long as broad, slightly shorter than carpus; carpus excavated anteriorly, shorter than chela, 3.5 times as long as high; chela 2.7 times as long as broad; fingers 1.7 times as long as palm. Second pereiopod (Figs. 11I, 12C) reaching to end of second segment of antennular peduncle; merus shorter than carpus, 5.1 times as long as broad; carpus 1.3 times as long as chela, 7.8 times as long as high; chela 4.0 times as long as broad; fingers 1.4 times as long as palm. Third pereiopod (Figs. 12D, E) reaching to end of antennular peduncle, propodus 10 times as long as broad, 3.2 times as long as dactylus; dactylus 4.1 times as long as wide (spines included), terminating in a claw, with 6 accessory spines on flexor margin. Fifth pereiopod (Figs. 12F, G) reaching beyond end of basal segment of antennular peduncle, propodus 11 times as long as broad, 2.7 times as long as dactylus; dactylus slender, 4.2 times as long as wide (spinules included), terminating in a claw, with 50–60 spinules on its flexor margin.

Endopod of male first pleopod (Fig. 12H) subrectangular, 2.7 times as long as wide, reaching to 1/3 length of endopod, no appendix interna. Appendix masculina (Fig. 12I) of male second pleopod slender, reaching to half length of exopod.

Uropodal diaeresis (Fig. 11L) with 12 or 13 movable spinules.

Ovigerous females with eggs sized 0.60–0.78 × 0.40–0.48 mm.

***Habitat.* –** Rivers and streams.

***Remarks.* –** In the form of the rostrum and the ratio of various segments of the pereiopods, *C. excavatoides* is most similar to *C. propinqua.* It can be distinguished from *C. propinqua* by the absence of a preanal spine, the more slender endopod of the male first pleopod and the relatively larger egg size. *Caridina excavatoides* also morphologically close to *C. tonkinensis* Bouvier, 1919. It can be separated from *C. tonkinensis* by the absence of preanal carina and the palp of first maxilliped, which terminates in a triangular (vs. finger-like projection in *C. tonkinensis*). The species was previously know only from Peninsular Malaysia; its present record from Sumatra being a new record.

***Distribution*. –** Known only from Peninsular Malaysia and Sumatra (present study; Johnson, 1961).

Caridina temasek Choy & Ng, 1991
(Figs. 13, 14)

Caridina cf. *babaulti* Johnson, 1961:136, Fig.21–24 [not *Caridina babaulti* Bouvier, 1918)

Caridina sp. Ng, 1990: 200; Ng & Tan, 1991: 120.

Caridina temasek Choy & Ng, 1991: 265, Figs.1–5 [type locality: Forest stream in Sime road, Singapore]; Wowor et al., 2004:343, Fig. 7I.

***Material examined.* –** Holotytpe: ovigerous female, cl 3.5 mm, ZRC 2007.0396, Sime Road, Singapore, coll. P. K. L. Ng & K. K. P. Lim, Aug.1990. Others: **Singapore**: 3 males, cl 2.6–2.7 mm, 1 ovigerous female, cl 3.9 mm, eggs 0.85 × 0.60 mm, Sime Road, forest stream, coll. K. Yong, & K. L. Yeo, 17 Apr.1990; 3 males, cl 2.1–2.3 mm, 2 females, cl 3.0–3.2 mm, 3 ovigerous females, cl 3.0–4.0 mm, Stream in Sime Road, Singapore, coll. Y. Y. Lim, 19 Apr.1990. **Malaysia**: 5 males, cl 2.3–2.7 mm, 7 females, cl 2.7–3.1 mm, 6 ovigerous females, 2.8–3.7 mm, Sungai Semalok, between Mawai & Tg. Sedili, Johor, Malaysia, coll. P. K. L. Ng, 22 Apr.1992; 3 males, cl 2.1–2.4 mm, 6 females, cl 2.6–3.5 mm, 14 ovigerous females, cl 3.1–3.8 mm, stream after K. Brang towards Kuala Terengganu, Malaysia, pH 5.7, 25.9 C, coll. P. K.L. Ng, 19 Mar.1992; 1 male, cl 3.5 mm, Sekayu Waterfall, Malaysia, coll. H. H. Tan, 17 Jun.1995; 2 specimens, Johor, Kota Tinggi, Sungai Mupor, along Johor Bahru-Kuantan highway, Malaysia, coll. M.

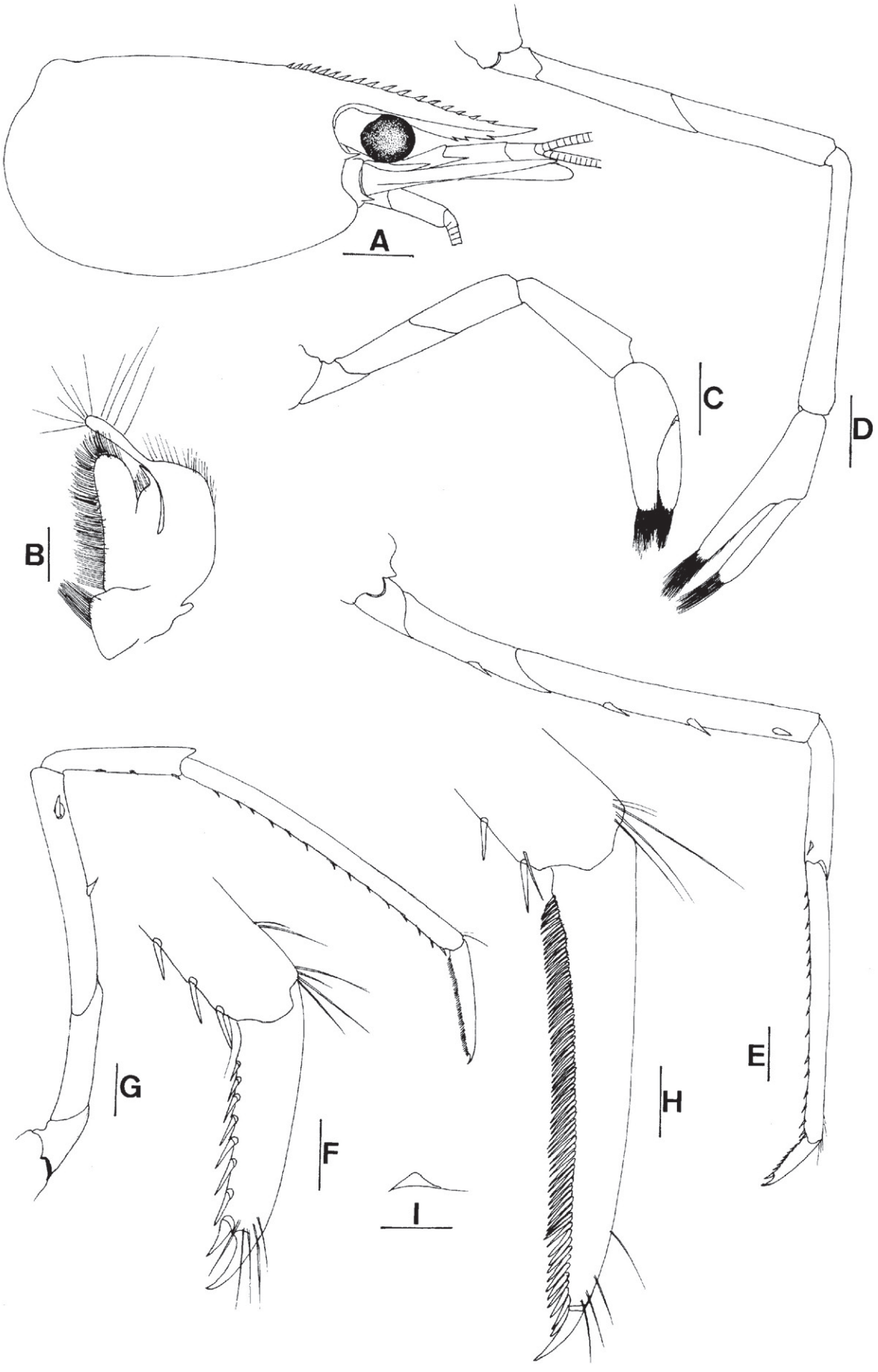

Fig. 13. *Caridina temasek* : A, cephalothorax and cephalic appendages ; B, first pereiopod ; C, first pereiopod ; D, second pereiopod ; E, third pereiopod ; F, dactylus of third pereiopod ; G, fifth pereiopod ; H, dactylus of fifth pereiopod ; I, preanal carina. Scale bars: A = 1 mm; B–E, F, I = 0.5 mm; F, H = 0.1 mm. (ovigerous female, cl 3.9 mm, Sime Road, Singapore, ZRC).

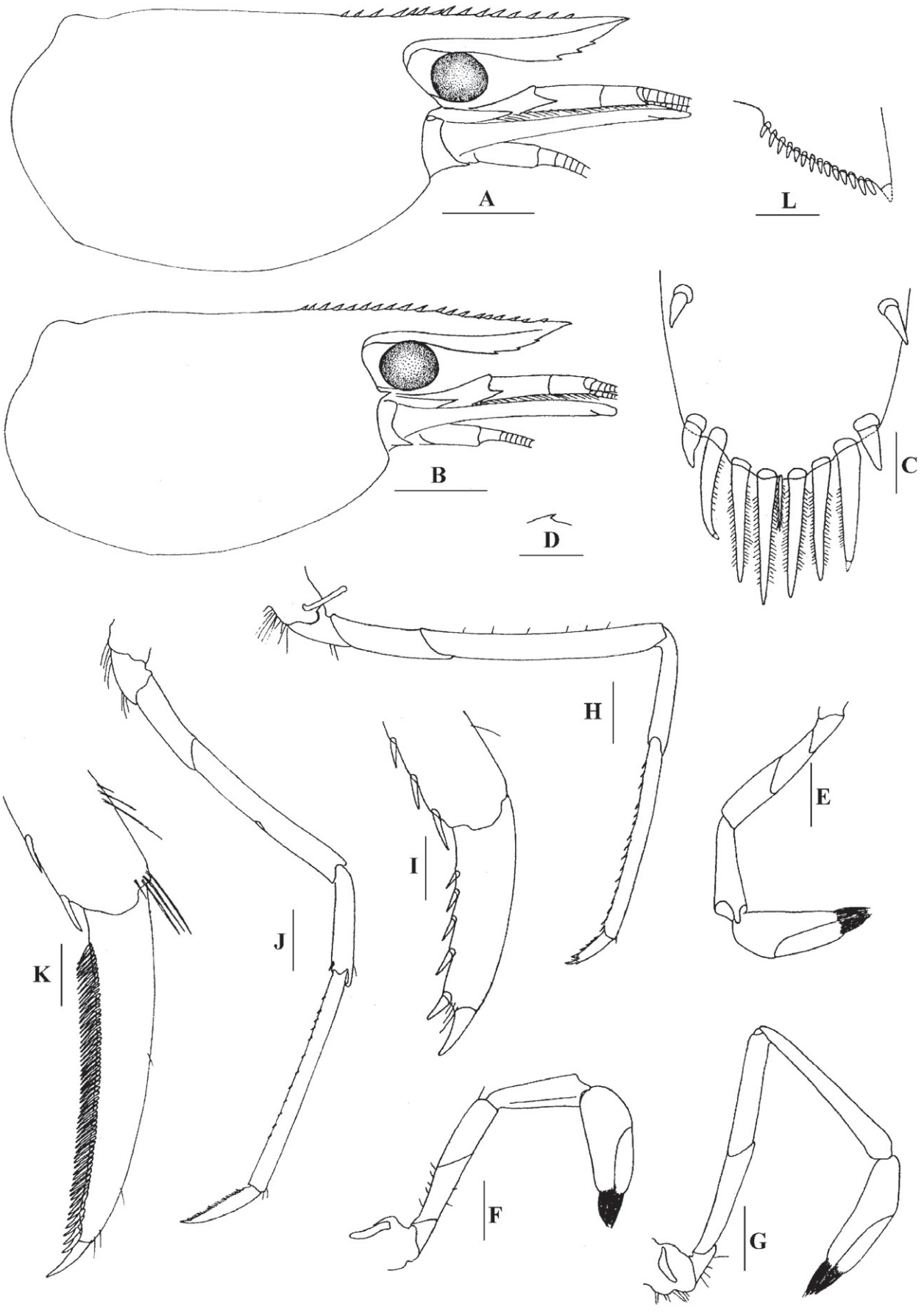

Fig. 14. *Caridina temasek* Penang: A, B, cephalothorax and cephalic appendages; C, distal portion of telson; D, preanal carina; E, F, first pereiopod; G, second pereiopod; H, third pereiopod; I, dactylus of third pereiopod; J, fifth pereiopod; K, dactylus of fifth pereiopod; L, uropodal diaeresis. Scale bars: A, B = 1 mm; E–H, J = 0.5 mm; C, I, L, K = 0.2 mm. (female, cl 3.4 mm, Penang, Peninsular Malaysia, ZRC).

Kottelat & K. Lim, 22 Jan.1991; 1 male, cl 2.4 mm, 1 ovigerous female, cl 3.5 mm, Sungai Ambat, 61 km from Kota Tinggi on road to Mersing, Johor, Malaysia, coll. M. Kottelat & P. K. L. Ng, 24 Jul.1992; 2 females, cl 2.8–3.3 mm, 1 ovigerous female, cl 3.2 mm, ZRC.1979.4.17.67–69, Mawai, Malaysia, 9 Oct.1959; 2 females, cl 3.2–3.8 mm, 4 ovigerous females, cl 3.7–4.0 mm, Sungai Machap, under bridge between Air Hitam and Simpang, Johor, Malaysia, coll. Renggam, 18 Aug.1991; 4 females, cl 2.5–2.8 mm, 3 ovigerous females, cl 2.7–3.1 mm, Gunung Panti, Kota Tinggi, Malaysia, coll. P. K. L. Ng, 1991; 5 males, cl 2.0–2.2, 12 females, cl 2.4–3.4 mm, 12 ovigerous females, cl 2.7–3.4 mm, stream on logging track, Gunung Panti, Johor, Malaysia, no date; 8 specimens, blackwater stream, Batu Arang, Kuala Lumpur, Malaysia, coll. S. Choy et al., 6 Nov.1991; 1 ovigerous female, cl 4.7 mm, ZRC 1995.507, Johor, Sungai Semberong, Malaysia, coll. C. Yong, 13 Apr.1990; 2 females, cl 3.0–3.2 mm, 1 ovigerous female, cl 2.8 mm, slow out flow stream of Lake Chin Chin, Malacca, Malaysia, coll. D. S, Johnson, 29 Oct.1963; 1 female, cl 3.5 mm, Mawai, Johor, Malaysia, 18 Jul.1961; 1 female, cl 3.1 mm, ZRC 1979.4.11.1, S. Semalok, 9 miles from Kota Tinggi, Mawai Road, Malaysia, coll. D. S. Johnson, 1 Apr.1961; 4 females, cl 2.5–3.0 mm, ZRC 1979.4.11.7–10, slow outflow stream of Lake Chin Chin, Malacca, Malaysia, 29 Oct.1963; 1 ovigerous female, cl 3.5 mm, one female, in poor condition, ZRC 1979.4.11.12, outflow stream of Ayer Keroh Reservoir, Malacca, Malaysia, coll. D. S. Johnson, 6 Jan.1956; 2 males, cl 2.7–2.8 mm, 4 females, cl 3.3–3.9 mm, 5 ovigerous females, cl 3.0–3.7 mm, Malaysia, 2 males, cl 2.7–2.8 mm, 4 female, cl 3.3–3.9 mm, 5 ovigerous females, cl 3.0–3.7 mm, Perak, Malaysia, H. H. Ng, 16 Jun.1997.

***Comparative material examined.* – Southern Thailand**: 8 males, cl 20–25 mm, 18 females, cl 2.4–3.3 mm, ZRC 2007.0408, Narathiwat Province, stream at bridge about 1 km south of bridge on Mae Nam Road Tod Deng, about 5 km north of Narathiwat, coll. M. Kottelat, 3 Nov.1995; 1 female, cl 3.4 mm, ZRC 2007.0409, Narathiwat Province, 10 km north of Bocho on Road Narathiwat-Sai Buri, coll. M. Kottelat, 1 Nov.1995; 1 male, cl 2.0 mm, 6 females, cl 1.8–3.0 mm, 3 ovigerous females, cl 2.9–3.9 mm, CU2000.03; 1 ovigerous female, cl 3.0 mm, CU2000.07; 1 ovigerous female, cl 2.7 mm, CU2000.08; 12 females, cl 2.9–3.7 mm, ZRC 2007.0410; Thailand: Mae Sot, Mae Nam Moi, border with Myanmar, Karen State, 16°41.22'N 98°30.90'E, coll. H. H. Tan, 26 May 1999; 16 females, cl 2.6–3.7 mm, 1 ovigerous female, cl 3.2 mm, ZRC 2007.0411, Thailand: south Thailand, Songkhla Province, Nam Tok Khao Chong, km 25 on road to Trang from Phattalung, 07°39.71'N 100°02.33'E, coll. H. H. Tan et al., 26 Oct.1998. **Borneo:** 19 males, cl 2.0–2.4 mm, 15 females, cl 2.3–3.4 mm, 9 ovigerous females, cl 3.0–3.6 mm, ZRC 2007.0412, Kalimantan Barat, Kabupaten Pontianak: Sungai Belado, clear water hill stream, at base of Gg Kloncet, at km 67 on Pontianak on Patiana-Anjungan road, Kg. Anjungan, 00°21.02'N 109°11.08'E, coll. H. H. Tan et al., 28 Apr.1998; 3 ovigerous females, cl 3.1–3.5 mm, ZRC 2007.0413, Kalimantan Barat, Kabupaten Sanggau: clear fast flowing stream at km 249 Pontianak on Sosok-Sanggau road, 00°09.64'N 110°29.46'E, H. H. Tan et al., 26 Apr.1998; 1 male, cl 2.6 mm, ZRC 2007.0414, Kalimantan Barat, Kabupaten Sanggau: blackwater stream at km 352 Pontianak on Sekadau-Sintang road, 00°00.44'N 111°14.38'E, coll. H. H. Tan et al., 25 Apr.1998; 1 male, cl 2.1 mm, 25 females, cl 2.0–3.4 mm, 12 ovigerous females, cl 3.1–4.0 mm, eggs 0.8–9.3 × 0.6 mm, ZRC 2007.0415, Kalimantan Barat, Kabupaten Pontianak: clear water hill stream and paddy ditch at base of Gg. Semahung, ca. 13.8 km into side road from Pahuman, 00°14.79'N 109°11.08'E, pH 6.6, coll. H. H. Tan, 27 Apr.1998; 2 females, cl 2.8–4.2 mm, ZRC 2007.0416, Kalimantan Barat, Kabupaten Pontianak: Sungai Belado, clear water hill stream ar base of Gg. Kloncet at km 67 Pontianak on Pontianak-Anjungan road, Kg. Anjungan, 00°21.02'N 109°11.08'E, pH 6.6, coll. H. H. Tan et al., 28 Apr.1998; 1 ovigerous female, cl 3.5 mm, ZRC 2007.0417, Kapuas, Kalimantan Barat, Desa Tekalong, rocky stream 37.8 km (39km milestone to Putussibau) from Putussibau, rubber plantation, 8–10m in width, 0.5–1 m in depth, hard bank with patches of grasses, sand to big gravel substrat, fast flowing clear mountain stream, cool water, 00°34'22.1"N 112°50'36.8"E, coll. Y. Y. Goh, 8 May 1998; 12 females, cl 3.0–3.7 mm, 7 ovigerous females, cl 3.8–4.1 mm, eggs 0.9 × 0.6 mm, ZRC 2007.0418, Sungai Kubas, Sarawak, Borneo, coll. P. K. L. Ng, 25 Jun.1999; 23 females, cl 2.4–4.1 mm, 34 ovigerous females, cl 3.3–3.7 mm, ZRC 2007.0419, Kalimantan Barat, Kabupaten Sintang: clear flowing stream ca. 2–3 km before Nanga sayan on Nanga Pinoh-Nanga Sayan road, 00°42.15'S 111°41.50'E, coll. H. H. Tan et al., 24 Apr.1998; 11 females, cl 2.7–3.7 mm, 2 ovigerous females, cl 3.0–4.0 mm, ZRC 2007.0420, Sungai Temunyuk, small sandy-rocky stream 67.8km (69 km milestone) from Putussibau, rubber plantation, sand and mud bank with grass, fast flowing at some places, 1–5 m in width, 0.5–1 m in depth, clear water, 00°27'42.2"N 112°38'45.7"E, pH 6.8, coll. Y. Y. Goh, 8 May 1998; 1 male, cl 2.8 mm, 6 females, cl 2.7–3.7 mm, 11 ovigerous females, cl 3.3–3.8 mm, ZRC 2007.0421, Kalimantan Barat, Kabupaten Sanggau, clear water stream at km 325 Pontianak on Sekadau-Sintang road, at Gonis Butun, Kec. Sekadau Ilir, 00°01.97'N 111°06.91'E, pH 6.0, coll. H. H. Tan, 25 Apr.1998; 9 females, cl 3.0–4.0 mm, 6 ovigerous female, cl 3.3–3.6 mm, Borneo, Sarawak: Bau, stream next to Fairy Caves, coll. P. K. L. Ng, 24 Jun.1996; 6 females, cl 3.6–4.1 mm, 4 ovigerous females, cl 3.4–4.0 mm, ZRC 2007.0422, Borneo, Sarawak: Sungai Kuhas tributary (feeder stream) 0.5km towards Kg. Lanchang, 6.9 km left at Tebelu Tebakang turnoff, 5.8 km into right trail, 1°09'23.1"N 110°29'29.9"E, coll. H. H. Tan, 31 Aug.1996; 2 females, cl 3.2–3.7 mm, ZRC 2007.0423, Sarawak, no date; 6 females, cl 2.9–3.2 mm, 13 ovigerous females, cl 3.4–3.8 mm, ZRC 2007.0424, Kalimantan Timur, Sungai Semayang at Desa Semayang, coll. H. H. Tan & D. Wowor, 8 Nov.1999.

***Description.* –** Rostrum (Figs. 13A, 14A, B) straight, or slightly sigmoid, reaching near end of basal segment of antennilar peduncle or slightly beyond end of second segment. Rostral formula: 4–6+10–14/2–6. Suborbital angle acute, distinctly separated from antennal spines; pterygostomian margin rounded.

Sixth abdominal somite 1.5 times as long as high, 0.6 times length of carapace, 1.6 times as long as fifth somite, slightly shorter than telson. Telson (Fig. 14C) 3.0 times as long as wide, distal margin rounded, not terminating in a projection, with 3 to 4 pairs of dorsal spinules and one pair of dorsolateral spinules; distal end with 3 or 4 pairs of spines, lateral pair slightly longer than intermediate pairs. Preanal carina (Fig. 13I) triangular, no spine or with a very tiny 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 combined length of second and third segments, anterolateral angle reaching to 0.3 times length of the second segment, second segment distinctly longer than third segment. Stylocerite reaching to 0.8 times length of basal segment of antennular peduncle. Scaphocerite 3.6 times as long as wide.

Incisor process of mandible ending in irregular teeth, molar process truncated. Lower lacinia of maxillula broadly rounded,

subtriangular, upper lacinia elongated, with a number of distinct teeth on inner margin, palp slender. Upper endites of maxilla subdivided, palp short, scaphognathite tapering posteriorly with numerous long, curved setae at posterior end. Palp of first maxilliped (Fig. 13B) ending in a finger-like projection. Second maxilliped typical, podobranch well developed. Third maxilliped reaching to end of scaphocerite, with ultimate segment shorter than penultimate segment.

Epipods well developed on first 2 pereiopods, reduced in third and fourth. First pereiopod (Figs. 13C, 14E, F) reaching to end of basal segment of antennular peduncle; merus 2.6 times as long as broad, slightly shorter than carpus; carpus excavated anteriorly, shorter than chela, 3.1 times as long as high; chela 2.9 times as long as broad; fingers 1.4 times as long as palm. Second pereiopod (Figs. 13D, 14G) reaching beyond end of second segment of antennular peduncle; merus shorter than carpus, 5.4 times as long as broad; carpus 1.4 times as long as chela, 7.2 times as long as high; chela 3.8 times as long as broad; fingers 1.3 times as long as palm. Third pereiopod (Figs. 13E, F, 14H, I) reaching to end of scaphocerite, propodus 13 times as long as broad, 4.1 times as long as dactylus; dactylus 4.3 times as long as wide (spines included), terminating in a claw, with 8 accessory spines on flexor margin. Fifth pereiopod (Figs. 13G, H, 14J, K) reaching to end of second segment of antennular peduncle, propodus 14 times as long as broad, 2.8 times as long as dactylus; dactylus slender, 5.2 times as long as wide (spinules included), terminating in a claw, with 55–72 spinules on flexor margin.

Endopod of male first pleopod subtriangular, twice as long as wide, reaching to 1/4 length of endopod, appendix interna reaching beyond end of endopod by most of its length. Appendix masculina of male second pleopod slender, reaching to half length of exopod.

Uropodal diaeresis (Fig. 14L) with 12–16 movable spinules.

Ovigerous females with egg size 0.70–0.85 × 0.44–0.54 mm.

Habitat. – Streams and lakes.

Remarks. – In the form of the rostrum, slender pereiopods and egg size, *C. temasek* can easily be confused with *C. excavatoides* and *C. tonkinensis*. But it can readily be differentiated from the latter two species by the structure of the endopod of the male first pleopod, which has a distinct appendix interna (vs. absent).

Johnson (1961) doubtfully referred one ovigerous female and one non-ovigerous female "from a rather fast stream flowing out of Ayer Keroh Reservoir, Malacca" to *C. babaulti*. According to his description, they seem to belong to the present species; and a re-examination of the specimens (ZRC 1979.4.11.12) confirms this. *Caridina temasek* can readily be distinguished from *C. babaulti* by the absence of a pterygostomian spine. The present study shows that *C. temasek* has a wider distribution than previously recorded from southern Thailand at the north to the West Kalimantan, Indonesia in the south.

Distribution. – The Malay Peninsula, Sarawak and West Kalimantan (present study).

Caridina johnsoni, new species

(Figs. 15, 16)

Caridina tonkinensis Johnson, 1961:133; Figs. 16-20; 1965: 8; Ng, 1990: 200; Ng & Choy, 1990a:16 (not *C. tonkinensis* Bouvier, 1919)

Caridina propinqua – Ng, 1990: 200 (part) (not *C. propinqua* De Man, 1908a)

Caridina aff. *tonkinensis* – Wowor et al., 2004: 343, 7M–O (not *C. tonkinensis* Bouvier, 1919)

Material examined. – Holotype: ovigerous female, ZRC 1995.505, Lower Peirce Reservoir, north arm, coll. P. K. L. Ng, Jun.1990.

Paratypes: 4 males, cl 2.5–2.7 mm, 4 females, cl 3.0–3.2 mm, 3 ovigerous females, cl 3.3–3.5 mm, ZRC 1995.505, Lower Peirce Reservoir, north arm, coll. P. K. L. Ng, Jun.1990.

Others: **Peninsular Malaysia:** 1 ovigerous female, cl 3.4 mm, ZRC 2007.0425, Sungai Dohol, coll. H. H. Tan, 24 Feb.1995; 25 specimens (8 ovigerous), ZRC.1979.4.17.41–66, ditch at Jason Bay, Mawai-Sedili Road, 18 Feb.1960; 5 males, cl 2.1–2.8 mm, 16 females, cl 2.4–4.3 mm, 4 ovigerous females, cl 3.1–3.5 mm, Johor Ayer Ham, stream along Ayer Ham-Kluang road through grassy field, coll. K. Lim, 23 May 1991; 4 females, 3.0–4.2 mm, ZRC 1979.4.18.75.78, slow, small tidal, stream draining into Sungai Skudai at 71/2 mile, Johor Bahru-Skudai road, Johor, coll. D. S. Johnson, 10 May 1960. **Singapore:** 2 females, cl 3.2–3.5 mm, 9 ovigerous females, cl 3.0–3.4 mm, eggs 0.6 × 0.4 mm, Nee Soon Swamp forest, coll. H. K. Lua, 29 Sep.1990; 1 male, cl 1.9 mm, 3 females, cl 2.5–3.0 mm, 3 ovigerous females, cl 3.0–3.4 mm, ZRC 1990.11891–11898, Pasir Laba, Tengeh Reservoir, coll. K. Lim, no date, 2 males, cl 2.3–2.7 mm, 1 female, cl 3.3 mm, 3 ovigerous females, cl 3.2–3.5 mm, ZRC. 190.11835–11840, Lower Peirce Reservoir, north arm, coll. P. K. L. Ng, 21 Jul.190; 1 male, cl 2.4 mm, 1 female, cl 3.0 mm, 2 ovigerous females, cl 3.2–3.4 mm, ZRC.1979.4.17.2–5, Sungai Seletar, coll. K. H. Yeo, 23 Apr.1959; 2 females, cl 2.5–3.4 mm, 4 ovigerous females, cl 2.9–3.8 mm, Lower Peirce Reserve, from flowing water, 28 Jul.1990; 5 males, cl 2.2–2.8 mm, 2 females, cl 3.3–3.4 mm, 8 ovigerous females, cl 3.6–3.8 mm, Lower Pierce Reservoir, coll. H. K. Lau, 1 Oct.1990; 5 males, cl 2.0–2.2 mm, 5 females, cl 2.1–3.1 mm, 2 ovigerous females, 3.3–3.5 mm, Seletar Reservoir, coll. C. M. Yang & K. L. Yeo, no date; 1 female, cl 2.5 mm, Lower Pierce Rd., coll. H. K. Lau, 1 Oct.1990; 6 females, cl 2.2–2.9 mm, 9 ovigerous females, cl 2.5–3.4 mm, Sungai Tengeh reservoir, Pasir Laba, coll. K. Lim, 16 Nov.1990.

Comparative material examined. – **Thailand:** 1 ovigerous female, cl 3.0 mm, ZRC 2007.0432, Amphoe Chatturat, Chaiyaphum, coll. W. Noivangklang, 29 Oct.2000; 4 males, cl 1.7–2.1 mm, 14 females, cl 2.1–3.1 mm, 15 ovigerous females, cl 2.6–3.0 mm, eggs eyed, 0.7 × 0.4 mm, ZRC 2007.0433, Nong Pla Tao, Chaiyaphum, coll. W. Noivangklang, 28 Oct.2000; 5 females, cl 2.7–3.2 mm, 13 ovigerous females, cl 2.7–2.9 mm, ZRC 2007.0434, Nong Pla Tao, Chaiyaphum, coll. W. Noivangklang, 28 Oct.2000; 1 female, cl 2.2 mm, 1 ovigerous female, cl 3.0 mm, ZRC 2007.0435, Amphoe Wang Saphung, Loei, coll. W. Noivangklang, 15 Oct.2000; 2 males, cl 2.5–2.8 mm, 2 females, cl 2.3–2.7 mm, 2

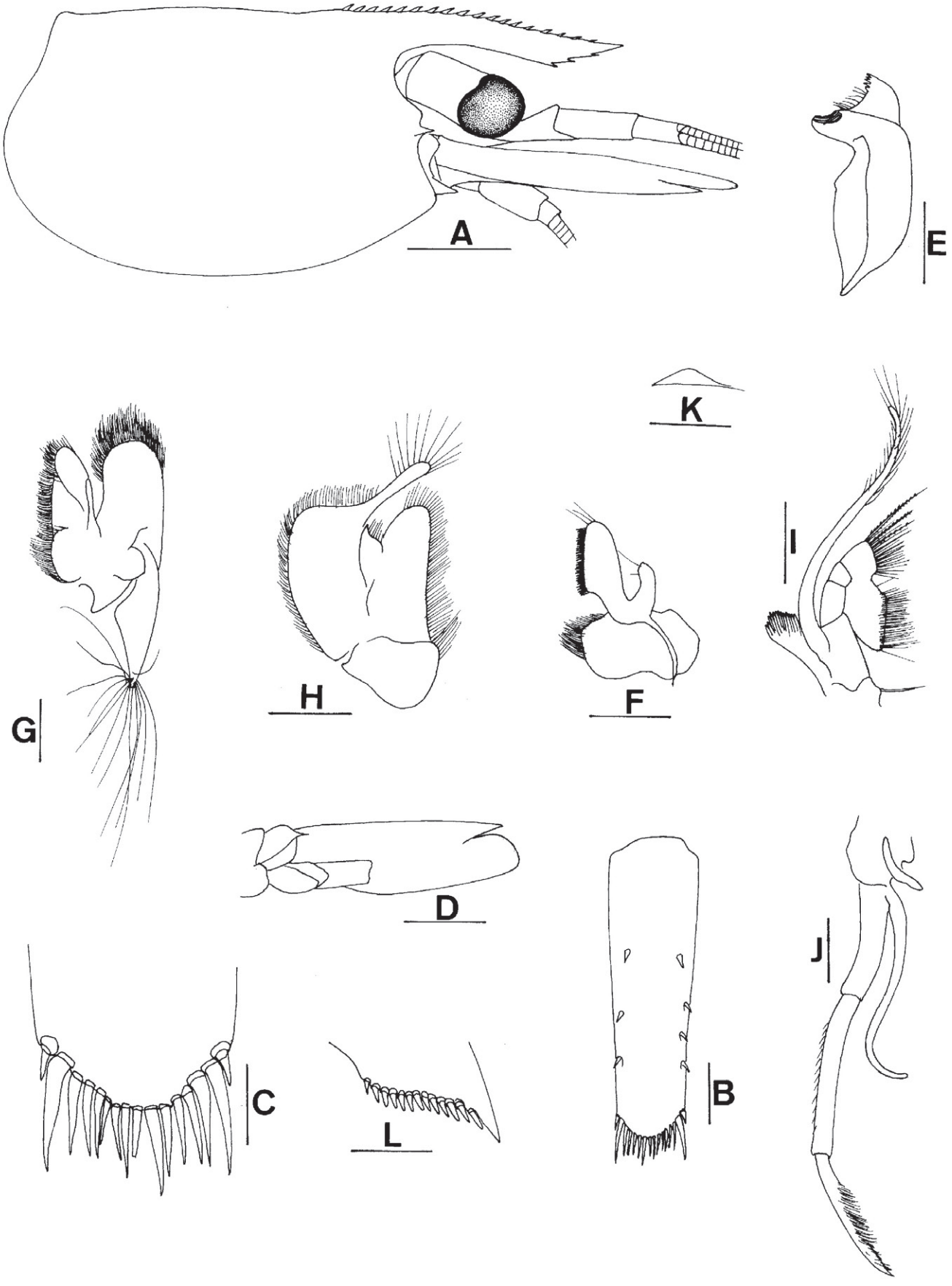

Fig. 15. *Caridina johnsoni*, new species: A, cephalothorax and cephalic appendages; B, telson; C, distal portion of telson; D, scaphocerite; E, mandible; F, maxillula; G, maxilla; H, first maxilliped; I, second maxilliped; J, third maxilliped; K, preanal carina; L, uropodal diaeresis. Scale bars: A, D = 1 mm; B, E–K = 0.5 mm; C, L = 0.2 mm. (ovigerous female, cl 3.3 mm, holotype, Lower Peirce Reservoir, ZRC).

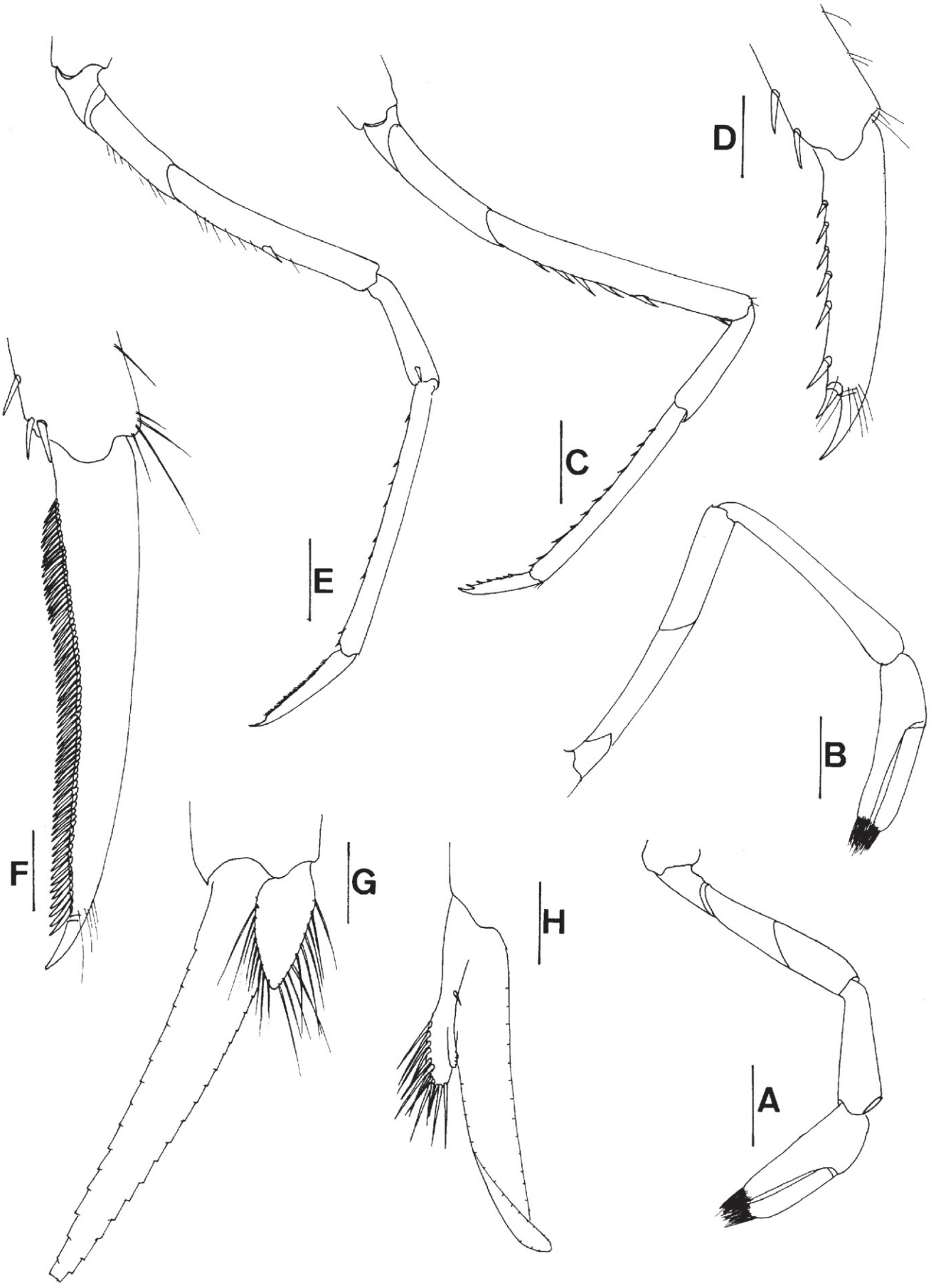

Fig. 16. *Caridina johnsoni*, new species: A, first pereiopod; B, second pereiopod; C, third pereiopod; D, dactylus of third pereiopod; E. fifth pereiopod; F, dactylus of fifth pereiopod; G, male first pleopod; H, male second pleopod. Scale bars: A–C, E = 0.5 mm; D, F = 0.1 mm; G, H = 0.2 mm. (A–F, ovigerous female, cl 3.3 mm, holotype; G, H, male, cl 2.5 mm, Lower Peirce Reservoir, ZRC).

ovigerous females, cl 3.3–4.8 mm, ZRC 2007.0436, Kaeng Sopha Waterfall, Phitsanulok, coll. W. Noivangklang, 11 Oct.2000; 1 female, cl 3.1 mm, ZRC 2007.0437, Mae Sot, Mae Nam Moi, border with Myanmar, Karen state, 16°41.22'N 98°30.90'E, coll. H. H. Tan, 26 May 1999; 4 females, cl 2.8–3.0 mm, 6 ovigerous females, cl 3.0–3.2 mm, CU 2000.04, eastern Thailand; 1 female, cl 3.2 mm, 6 ovigerous females, cl 3.5–3.6 mm, ZRC 2007.0438, Phitsanulok Province, Mae Nam Khet, east of Ban Bo, at km 42 on road from Phitsanulok to Loei, coll. M. Kottelat & K. Kubota, 29 Jan.199; 3 females, cl 1.8–2.6 mm, ZRC 2007.0439, artificial lake on the way to Chai Ya Pun, 82 km north of Khon Kean, with water lilies, 16°22'19.6"N 102°07'49.4"E, coll. Y. Cai & Y. Y. Goh, 20 Jun.1998; 2 males, cl 1.9–2.2 mm, 7 females, cl 1.8–2.7 mm, 17 ovigerous females, cl 3.0–3.3 mm, ZRC 2007.0440, artificial lake on the way to Chai Ya Pun, 82 km north of Khon Kean, with water lily, 16°22'19.6"N 102°07'49.4"E, coll. Y. Cai and Y. Y. Goh, 20 Jun.1998; 1 male, cl 2.2 mm, 1 ovigerous female, cl 3.0 mm, ZRC 2007.0441, Mae Nam Kham River on the way to Mae Sai, 20°07'31.7"N 99°39'01.7"E, coll. Y. Cai et al., 12 Jun.1998; 2 males, cl 2.5–2.6 mm, 4 females, cl 2.9–3.4 mm, 8 ovigerous females, cl 3.3–3.9 mm, ZRC 2007.0442, Mae Jio, 10 km from Chiang Mai, with water hyacinth, mud bank and substratum, warm and slightly flowing water, 18°58'25.6"N 99°14'34.1"E, pH 8.0, coll. Y. Cai, 13 Jun.1998; 8 males, cl 2.1–2.3 mm, 9 females, cl 3.0–3.6 mm, 7 ovigerous females, cl 2.8–3.4 mm, ZRC 2007.0443, Mae Lao River, 40 km from Chiang Rai, 19°58'52.6"N 99°41'46.1"E, pH 7.8, coll. Y. Cai and Y. Y. Goh, 13 Jun.1998; 1 ovigerous female, cl 4.0 mm, ZRC 2007.0444, Ban Pak Som, northern Thailand, coll. Y. Cai & Y. Y. Goh, 19 Jun.1998; 1 male, cl 2.5 mm, 5 females, cl 2.2–2.9 mm, 14 ovigerous females, cl 3.0–4.6 mm, ZRC 2007.0445, Lam Thakong, outlet of dam at upper Mae Nam Mun, on the way from Sara Buri to Ratchasima, coll. Y. Cai & Y. Y. Goh, 16 Jun.1998; 15 males, cl 1.8–2.5 mm, 3 females, cl 2.6–3.8 mm, 5 ovigerous females, cl 3.2–3.4 mm, ZRC 2007.0446, stream 15 km from Saraburi, outside a temple, coll. Y. Cai et al., 20 Jun.1998; 1 male, cl 1.9 mm, 1 female, cl 2.9 mm, 2 ovigerous females, cl 2.9–3.4 mm, ZRC 2007.0447, southern Thailand, Narathiwat Province, Nam Tok Sipo, downstream area, 06°16.06'N 101°38.65'E, coll. H. H. Tan et al., 24 Oct.198; 4 females, cl 1.9–2.5 mm, 3 ovigerous females, cl 2.8–2.9 mm, CU 2000.27, Mae Nam Pasuk, Saraburi Province, 4 Jul.1974; 1 ovigerous female, cl 2.5 mm, CU 2000.08, Mae Nam Mun between Buri Ram and Surin Province, 4 Nov.1974; 1 female, cl 3.1 mm, 1 ovigerous female, cl 3.3 mm, CU 2000.29, Thailand: Amphoe Muak Lek Waterfall, Saraburi Province, 23 Dec.1974; 5 females, cl 2.6–3.4 mm, 3 ovigerous females, cl 2.9–3.1 mm, CU 2000.33, Thailand; 1 female, cl 3.4 mm, CU 2000.15, Thailand: Phatchaburi Province, 2 Dec.1973; 1 ovigerous female, cl 2.8 mm, RMNH TH-87-87; 1 male, cl 2.0 mm, 5 females, cl 2.8–3.3 mm, 5 ovigerous females, cl 5.0–5.3 mm, 0.7 × 0.5 mm, CU 2000.04, Rayong Prov., eastern Thailand, 8 Dec.1973; 3 males, cl 1.8–2.2 mm, 7 females, cl 2.2–3.3 mm, 9 ovigerous females, cl 2.7–3.0 mm, ZRC 2007.0448, Mae Nam Ping River below Chiang Mai city, Nakhon Phing Bridge, 1–1.5 m in depth, 30 m in width, warm, turbid water, grass bank, mud bank and subst, slowing flowing, 10°58'25.6"N 99°14'34.1"E, pH 8.0, coll. Y. Cai et al., 13 Jun.1998; 3 ovigerous females, cl 2.8–3.2 mm, CU 2000.21, Thailand: Amphoe Muang, Lampang Province, 20 Aug.1973. **Borneo**: **West Kalimantan:** 16 males, cl 2.0–2.4 mm, 5 females, cl 2.0–2.7 mm, 13 ovigerous females, cl 2.7–3.2 mm, ZRC 2007.0449, Kalimantan Barat, Kabupaten Pontianak: Sungai Belado, clear water hill stream at base of Gg. Semahung, ca. 13.8 km into side road from Pahuman, coll. H. H. Tan et al., 28 Apr.1998; 11 males, cl 2.6–2.8 mm, 14 females, cl 2.3–2.8 mm, ZRC 2007.0450, Kalimantan Barat, Kabupaten Pontianak: Sungai Belado, clear water hill stream ar base of Gg. Kloncet at km 67 Pontianak on Pontianak-Anjungan road, Kg. Anjungan pH 6.6, coll. H. H. Tan et al. 28 Apr.1998.

Caridina tonkinensis Bouvier, 1919: **Vietnam**: Syntype: 1 female, cl 3.3 mm, MNHN Na 918, Tonkin, coll. Sollaud, no date. **Eastern Thailand**: 1 female, cl 3.4 mm, ZRC 2007.0451, Nong Khai Province, Mekong Basin: Bung Nong Suang, east of road from Nong Kai to Bung Kan at km 50, coll. M. Kottelat & K. Kubota, 2 Feb.1999; 1 female, cl 3.6 mm, ZRC 2007.0452, Ban Nan Khaisat, artificial lake for rice field, 50 km to Bung Kan, 18°13'26.2"N 104°02'07.1"E, coll. Y. Cai & Y. Y. Goh, 18 Jun.1998.

Description. **–** Rostrum (Fig. 15A) sigmoid, reaching slightly beyond end of basal segment of antennular peduncle, or near end of second segment, not beyond this segment, rostral formula 3–4+10–17/0–4(1–2). Suborbital angle acute, distinctly separated from antennal spines; pterygostomian margin subrectangular.

Sixth abdominal somite 1.7 times as long as high, 0.7 times of carapace, 1.8 times as long as fifth somite, slightly shorter than telson. Telson (Figs. 15B, C) 3.4 times as long as wide, distal margin rounded, not terminating in a projection, with 4 pairs of dorsal spinules and a pair of dorsolateral spinules; distal end with 4–8 pairs of spines, lateral pair longer than intermediate pairs. Preanal carina (Fig. 15K) low, without 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 of antennular peduncle longer than combined length of second and third segments, anterolateral angle reaching to 0.3 times length of the second segment, second segment distinctly longer than third segment. Stylocerite reaching to 0.8 times length of basal segment of antennular peduncle. Scaphocerite (Fig. 15D) 3.4 times as long as wide.

Incisor process of mandible (Fig. 15E) ending in irregular teeth, molar process truncated. Lower lacinia of maxillula (Fig. 15F) broadly rounded, subtriangular, upper lacinia elongated, with numerous distinct teeth on inner margin, palp slender. Upper endites of maxilla (Fig. 15G) subdivided, palp short, scaphognathite tapering posteriorly with numerous long, curved setae at posterior end. Palp of first maxilliped (Fig. 15H) ending in a triangular projection. Second maxilliped (Fig. 15I) typical, arthrobranch well developed. Third maxilliped (Fig. 15J) reaching to end of second segment of antennular peduncle, with ultimate segment shorter than penultimate segment.

Epipods well developed on first 2 pereiopods, reduced in third pereiopod, absent in last 2. First pereiopod (Fig. 16A) reaching near anterior end of basal segment of antennular peduncle; merus 2.2 times as long as broad, distinctly shorter than carpus; carpus excavated anteriorly, shorter than chela, 2.9 times as long as high; chela 2.6 times as long as broad; fingers 1.5 times as long as palm. Second pereiopod (Fig. 16B) reaching to end of second segment of antennular peduncle; merus distinctly shorter than carpus, 4.0 times as long as broad; carpus 1.3 times as long as chela, 6.0 times as long as high; chela 4.0 times as long as broad; fingers 1.6 times as long as palm. Third pereiopod (Figs. 16C, D) reaching to end of antennular peduncle, propodus 11 times as long as

broad, 2.9 times as long as dactylus; dactylus 4.6 times as long as wide (spines included), terminating in a claw, with 6 or 7 accessory spines on flexor margin. Fifth pereiopod (Figs. 16E, F) reaching beyond end of basal segment of antennular peduncle, propodus 12 times as long as broad, 2.3 times as long as dactylus; dactylus slender, 5.2 times as long as wide (spinules included), terminating in a claw, with 55–69 spinules on flexor margin.

Endopod of male first pleopod (Fig. 16 G) subtriangular, 2.3 times as long as wide, reaching to 0.25 times length of endopod, no appendix interna. Appendix masculina of male second pleopod (Fig. 16H) slender, reaching to half length of exopod.

Uropodal diaeresis (Fig. 16L) with 11–13 movable spinules.

Ovigerous females with eggs sized 0.60 × 0.40 mm.

Etymology. **–** The species is named after the late Dr D. S. Johnson, who was a major contributor to our knowledge of freshwater shrimps of the Malay Peninsula.

***Habitat.* –** Various freshwater habitats: reservoirs, lakes, rivers and streams.

***Remarks.* –** With respect to the form of the rostrum and the ratio of various joints in the pereiopods, *C. johnsoni* is most similar to *C. tonkinesis.* It can be distinguished from *C. tonkinensis* by the absence of a preanal spine and the relatively stouter first two pereiopods (carpus of the first two pereiopod 2.9 times and 4.0 times as long as high, respectively vs. 3.5 times and 4.4 times, respectively).

Johnson (1961) was the first to record *C. tonkinensis* from Singapore. This was followed by Ng (1990) and Ng & Choy (1990a). Johnson (1961: 134,135) noted a number of differences in morphological details, e.g. the relatively shorter rostrum, the shorter antennular peduncle, the stouter carpus on the first pereiopods, etc. He, however, regarded these differences as mere variation between the type [from Tonkin, Vietnam (= northern Vietnam)] and the local populations. However, close examination of specimens from various localities in Singapore and Peninsular Malaysia, including some which had been identified by Johnson (ZRC 1979.4.18.75.78), revealed that they are not *C. tonkinensis* and these are herein described as a new species, *C. johnsoni*.

Ng (1990: 200) discussed the taxonomy and ecology of what he believed to be *C. propinqua*, stating that "It is relatively easy to recognize because of its slender appearance and the sixth abdominal segment being much longer than those of related species. The author has obtained large numbers of this prawn from Lower Pierce Reservoir. It seems to prefer relatively shallow, clear, flowing water, being especially common among submerged plants by the bank, near the mouths of streams draining into the reservoir." The characters of a slender appearance and the long sixth abdominal segment are shared by *C. propinqua* and *C. johnsoni,* and a re-examination of Ng's specimens from Lower Pierce Reservoir reveals that they are *C. johnsoni* instead.

Distribution. **–** Malay Peninsula and West Kalimantan.

Caridina malayensis, new species
(Fig. 17)

***Material examined.* –** Holotype: ovigerous female, c1 3.1 mm, with eggs 0.9 × 0.55 mm, ZRC 2007.0453, stream at Nee Soon Swamp, Singapore, coll. Y. Cai, 8 Sep.1998.

Paratypes: 16 males, cl 2.1–2.4 mm, 30 ovigerous females, cl 2.8–3.6 mm, 23 female, cl 2.3–3.2 mm, ZRC 2007.0454, data same as holotype.

Others: **Peninsular Malaysia:** 1 female, cl 3.7 mm, 1 ovigerous female, cl 3.8 mm, eggs 1.0x0.6 mm, ZRC 2007.0455, Kg. Jasa Sapakap, collected from blackwater, 1°31'30.5"N 103°27'47.7"E, coll. H. H. Tan, 15 Aug.1995; 2 females, cl 3.2–3.6 mm, 1 ovigerous female, cl 3.4 mm, 2007.0456, about 50 m after 63 km to Tg. Pinang, 1°05'55.3"N 104°22'45.4"E, from brown water, pH 5.2, coll. H. H. Tan, 29 Jun.1995; 4 males, cl 2.4–2.6 mm, 2 females, cl 2.8 mm, 1 ovigerous female, cl 3.2 mm, ZRC 2007.0457, northern Selangor, peat swamp forest, small stream, along Sungai Besar to Tg. Malim road, blackwater, coll. P. K. L. Ng, 2 Jun.1992; 1 female, cl 3.0 mm, 1 ovigerous female, cl 3.5 mm, ZRC 2007.0458, northern Selangor peat swamp forest, coll. P. K.L. Ng, 27 Apr.1995. **Singapore:** 1 male, ZRC 2007.0459, Nee Soon, swamp forest, coll. K. Yong & K. L. Yeo, 30 Mar.1990; 1 male, cl 2.3 mm, 2 females, cl 3.0–3.2 mm, 1 ovigerous female, cl 3.0 mm, eggs 0.85 × 0.55 mm, ZRC. 2007.0460, Nee Soon, outside camp gate, coll. D. Yeo et al., 15 Dec.1994; 2 males, cl 2.3–2.4 mm, 3 females, cl 3.1–3.2 mm, 15 ovigerous females, cl 3.3–3.8 mm, 3 juv., ZRC 2007. 0461, edge of Nee Soon, swamp forest, flowing water, coll. P. K. L. Ng, 15 Jan.195; 4 males, cl 2.2–2.4 mm, 2 females, cl 2.5–3.2 mm, 11 ovigerous females, cl 3.1–3.5 mm, ZRC 2007.0462, Lorong Banir, 29 Dec.1994; 1 female, cl 3.5 mm, ZRC 1995.506, Nee Soon, swamp forest, Singapore, coll. P. K. L. Ng, Jun.1990.

***Description.* –** Rostrum (Figs. 17A, B) short, straight, reaching slightly beyond end of basal segment of antennular peduncle, or near middle of second segment, not beyond this segment, rostral formula 3–5+7–11/0–4, ventral teeth small or indistinct. Inferior orbital angle acute, fused well with antennal spines; pterygostomian margin broadly rounded.

Sixth abdominal somite 1.4 times as long as high, 0.6 times of carapace, 1.6 times as long as fifth somite, as long as telson. Telson (Fig. 17C) 2.6 times as long as wide, distal margin rounded, not terminating in a projection, with 3 pairs of dorsal spinules and a pair of dorsolateral spinules; distal end with 3 or 4 pairs of spines, lateral pair longer than intermediate pairs. Preanal carina (Fig. 17Q) triangular, pointed, without spine.

Eyes well developed, anterior end reaching to 0.7 times length of basal segment of antennular peduncle. Antennular peduncle (Fig. 17D) 0.7 times as long as carapace; basal segment of antennular peduncle longer than combined length of second and third segments, anterolateral angle reaching to 0.4 times length of the second segment, second segment

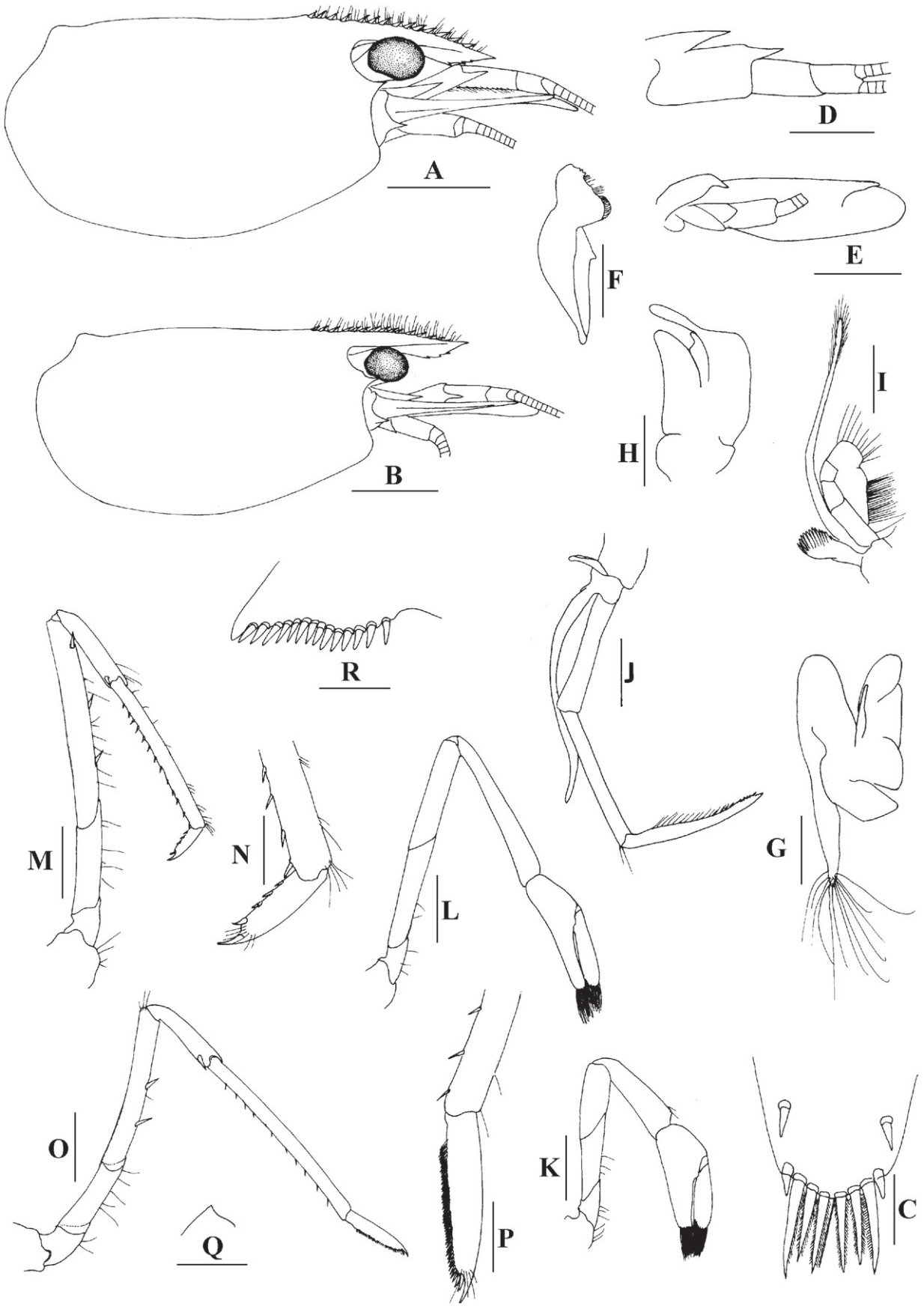

Fig. 17. *Caridina malayensis*, new species: A, B, cephalothorax and cephalic appendages; C, distal portion of telson; D, antennular peduncle; E, scaphocerite; F, mandible; G, maxilla; H, first maxilliped; I, second maxilliped; J, third maxilliped; K, first pereiopod; L, second pereiopod; M, third pereiopod; N, dactylus of third pereiopod; O, fifth pereiopod; P, dactylus of fifth pereiopod; Q, preanal carina; R, diaeresis. Scale bars: A, B, D, E = 1 mm; C, N, P, R = 0.2 mm; F–M, O, Q = 0.5 mm. (A, ovigerous female, cl 3.1 mm, holotype, Nee Soon, Singapore, ZRC; B–R, male, cl 2.9 mm, Nee Soon, Singapore, ZRC).

distinctly longer than third segment. Stylocerite reaching to 0.8 times length of basal segment of antennular peduncle. Scaphocerite (Fig. 17E) 3.3 times as long as wide.

Incisor process of mandible (Fig. 17F) ending in a row of small teeth, molar process truncated. Lower lacinia of maxillula broadly rounded, elliptical, upper lacinia elongated, with a number of distinct teeth on inner margin, palp slender. Upper endites of maxilla (Fig. 17G) subdivided, palp short, scaphognathite tapering posteriorly with numerous long, curved setae at posterior end. Palp of first maxilliped (Fig. 17H) ending in a finger-like projection. Second maxilliped (Fig. 17I) typical, arthrobranch well developed. Third maxilliped (Fig. 17J) reaching to end of second segment of antennular peduncle, with ultimate segment slightly longer than or as long as penultimate segment.

Epipods well developed on first pereiopod, absent in last 4. First pereiopod (Fig. 17K) reaching to anterior end of eye; merus 2.4 times as long as broad, distinctly shorter than carpus; carpus excavated anteriorly, shorter than chela, 2.6 times as long as high; chela 2.5 times as long as broad; fingers 1.8 times as long as palm. Second pereiopod (Fig. 12L) reaching to end of second segment of antennular peduncle; merus distinctly shorter than carpus, 4.9 times as long as broad; carpus 1.3 times as long as chela, 6.4 times as long as high; chela 3.3 times as long as broad; fingers 1.6 times as long as palm. Third pereiopod (Figs. 17M, N) reaching to end of antennular peduncle, propodus 12.5 times as long as broad, 4.0 times as long as dactylus; dactylus 3.4 times as long as wide (spines included), terminating in a claw, with 4 or 5 accessory spines on flexor margin. Fifth pereiopod (Figs. 17O, P) reaching to end of second segment of antennular peduncle, propodus 14 times as long as broad, 2.8 times as long as dactylus; dactylus slender, 4.7 times as long as wide (spinules included), terminating in one claw, with 42–45 spinules on flexor margin.

Endopod of male first pleopod subtriangular, 2.6 times as long as wide, reaching to 0.3 times length of exopod, no appendix interna. Appendix masculina of male second pleopod reaching to half length of endopod.

Uropodal diaeresis (Fig. 17 R) with 14–21 movable spinules.

Ovigerous females with eggs sized 0.90–0.96 × 0.55–0.60 mm.

***Habitat.* –** Acid-water forest rivers, streams or black water in peat swamps.

***Etymology.* –** The species is named after its currently known distribution, the Malay Peninsula.

***Remarks.* –** With regard to the form of the rostrum and pereiopods, *C. malayensis* most closely resembles *C. bakoensis* Ng, 1995. It can readily be distinguished from *C. bakoensis* by the absence of an appendix interna on the endopod of the male first pleopod. In addition, the rostrum of *C. bakoensis* is proportionately shorter in majority, reaching only to or slightly beyond the distal end of basal segment of antennular peduncle, while that of *C. malayensis* normally reaches to or beyond the middle of the second segment of the antennular peduncle; the eggs of *C. malayensis* are relatively smaller (0.90–0.96 × 0.55–0.60 vs.1.0–1.1 0.6–0.63 mm); and the anterolateral angle of the basal segment of the antennular peduncle reaches to 0.4 times the length of the second segment (vs. 0.25 times in *C. bakoensis*).

***Distribution.* –** Peninsular Malaysia and Singapore (present study).

Key to species of atyid shrimps of Peninsular Malaysia and Singapore

1. Rostrum unarmed dorsally 2
– Rostrum armed dorsally with at least 5 teeth 3

2. Carapace with acute pterygostomian angle; rostrum with 5−10 ventral teeth; second pereiopod with carpus deeply excavated, wider than long ..... *A. moluccensis*
– Carapace with rounded pterygostomian angle; rostrum with 1–2 ventral teeth or unarmed; second pereiopod with carpus not deeply excavated, longer than wide ..... *C. typus*

3. Rostrum ascendant in anterior half, slightly or distinctly extending beyond edge of scaphocerite 4
– Rostrum nearly horizontal or slightly down curved anteriorly, reaching to or slightly extending beyond edge of scaphocerite 6

4. Rostrum very long and slender, extending far beyond edge of scaphocerite, more than 1.5 times as long as carapace; armed on posterior portion of dorsal margin with 5–11 rather widely spaced teeth, including at most 1 postorbital teeth on carapace; armed ventrally with 28–36 teeth ..... *C. gracilirostris*
– Rostrum long and slender, reaching nearly to or slightly extending beyond edge of scaphocertite, less than 1.5 times as long as carapace, armed on posterior portion of dorsal margin with more than 12 teeth, including at least 1 postorbital teeth on carapace; armed ventrally less than 20 teeth 5

5. Preanal carina triangular, no spine; male first pleopod with a well-developed appendix interna on endopod .... *C. elongapoda*
– Preanal carina with a spine; male first pleopod without appendix interna, or with a vestige of it on endopod ..... *C. gracilipes*

6. Rostrum nearly horizontal, rostral teeth throughout dorsal margin 7
– Rostrum slightly down curved anteriorly or sigmoid, no teeth on anterior portion of dorsal margin 10

7. Rostrum with 7–10 postorbital teeth on carapace; stylocerite distinctly extending beyond end of basal segment of antennular peduncle; endopod of male first pleopod without appendix interna ..... *C. serratirostris*
– Rostrum with less than 7 postorbital teeth on carapace; stylocerite not reaching end of basal segment of antennular peduncle; endopod of male first pleopod with appendix interna 8

8. Rostrum long, narrow, reaching to or slightly extending beyond edge of scaphocerite, with less than 3 postorbital teeth on carapace ..... *C. peninsularis*
– Rostrum short, high, not reaching edge of scaphocerite, with 3 or more postoribal teeth on carapace 9

9. Rostrum reaching end of second segment or end of third segment of antennular peduncle; uropodal diaeresis with 18–22 spinules; dactylus of fifth periopod with more than 40 spinules on flexor margin ..... *C. sumatrensis*
– Rostrum reaching end of third segment of antennular peduncle or slightly extending beyond it; uropodal diaeresis with 12–14 spinules; dactylus of fifth pereiopod with less than 30 spinules on flexor margin ..... *C. bruneiana*

10. Endopod of male first pleopod with appendix interna 11
– Endopod of male first pleopod without appendix interna ...12

11. Rostrum short, reaching to or slightly extending beyond end of basal segment of antennular peduncle; egg 0.90–0.96 × 0.55−0.60 mm; epipod on first pereiopod only .... *C. malayensis*
– Rostrum long, reaching to middle of second segment or end of third segment of antennular peduncle; eggs 0.70–0.85 × 0.44–0.54 mm, epipods on first two pereiopods .. *C. temasek*

12. Sixth abdominal somite slender, more than 0.65 times as long as carapace length 13
– Sixth abdominal somite stout, less than 0.60 times carapace length 14

13. Palp of first maxilliped ending in finger-like projection; scaphocerite 3.6–4.0 times as long as wide; carpus of second pereiopod 6.4–7.9 times as long as high; eggs 0.38–0.54 × 0.25-0.30 mm ..... *C. propinqua*
– Palp of first maxilliped ending in triangular-like projection; scaphocerite 3.4 times as long as wide; carpus of second pereiopod 6.0 times as long as high; eggs 0.60 × 0.40 mm .. .. *C. johnsoni*

14. Third and fourth pereiopods sexually dimorphic; eggs small-sized, 0.40–0.47 × 0.25−0.30 mm ..... *C.thambipilaii*
– Third and fourth pereiopods not sexually dimorphic; eggs medium-size, 0.60–0.78 × 0.40–0.48 mm .... *C. excavatoides*

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LITERATURE CITED

Bouvier. E. L., 1904. Crevettes de la famille des Atyidés: espèces qui font partie des collections du Muséum d'histoire naturelle. *Bulletin du Muséum national d'Histoire Naturelle*, Paris, **10**:129–138.

Bouvier, E. L., 1918. Sur quelques Crustacés decapods recueillis par M. Guy Babault dans les eaux douces de l'Inde anglaise. *Bulletin du Muséum national d'Histoire naturelle*, Paris, **1918**: 386–393, Figs.1–10.

Bouvier, E. L., 1919. Quelques espéces nouvelles de Caridines. *Bulletin du Muséum national d'Histoire naturelle*, Paris, **1919**: 330–336.

Bouvier, E. L., 1925. Recherches sur la morphologie, les variations, la distribution géographique des crevettes des la famille des Atyidés. *Encyclopédie Entomologique*, series A, **4**: 1–370, Figs. 1–761.

Cai, Y. & A. Anker, 2004. On a collection of freshwater shrimps (Crustacea Decapoda Caridea) from the Philippines, with descriptions of five new species. *Tropical Zoology*, **17**: 133–166.

Cai, Y., & P. K. L., Ng, 2001. The freshwater decapod crustaceans of Halmahera, Indonesia. *Journal of Crustacean Biology*, **21**(3): 665–695, Figs. 1–19.

Cai, Y., &. P. K. L. Ng, 2007. A revision of the *Caridina gracilirostris* De Man, 1892, species group, with descriptions of two new taxa (Decapoda; Caridea; Atyidae). *Journal of Natural History*, (in press).

Cai, Y., P. K. L. Ng, S. Shokita & K. Satake, 2006. Revision of the Japanese atyid shrimps (Decapoda: Caridea) first described by William Stimpson, 1860. *Journal of Crustacean Biology*, **26**(3): 392–419.

Cai, Y. & S. Shokita, 2006a. Report on a freshwater shrimp collection (Crustacea: Decapoda: Caridea) from Philippines, with descriptions of four new species. *Raffles Bulletin of Zoology*, **54**(2): 245–247.

Cai, Y. & S, Shokita, 2006b. Atyid shrimps of the Ryukyu Islands, Southern Japan (Crustacea: Decapoda: Atyidae). *Journal of Natural History*, **40** (38–40): 2123–2172.

Chace, F. A. Jr., 1983. The *Atya*-like shrimps of the Indo-Pacific Region (Decapoda: Atyidae). *Smithsonian Contributions to Zoology*, **384**: 1–54, 24 figs.

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 to Zoology*, **587**: 1–106, Figs. 1–29.

Choy, S. C. 1992. *Caridina bruneiana*, a new species of freshwater shrimp (Decapoda, Caridea, Atyidae) from Negara Brunei Darussalam, Borneo. *Zoologica Scripta*, **21**(1): 49–55.

Choy, S. C. & P. K. L. Ng, 1991. A new species of freshwater atyid shrimp, *Caridina temasek* (Decapoda: Caridea: Atyidae) from Singapore. *Raffles Bulletin of Zoology*, **39**(2): 265–277, Figs. 1–3.

De Haan, W., 1833–1850. Crustacea, in P. F. von Siebold (ed.), *Fauna Japonica sive Descripto 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–xxxi, ix–xvi, 1–243, plates A–J, l–Q, 1–55, circ. tab. 2. Lugduni-Batavorum. [Leiden].

De Man, J. G., 1892. Decapoden des Indischen Archipels, in Max. Weber (ed.), *Zoologische Ergebnisse einer Reise in Niederlandisch Ost-Indien*, **2**: 265–527, Pls. 15–29.

De Man, J.G., 1908a. 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, Figs. 1–7.

De Man, 1908b. On the *Caridina nilotica* (Roux) and its varieties. *Records of the Indian Museum*, **2**: 255–283, Pls. 1–20.

De Silva, K. H. G. M., 1982 Studies on Atyidae (Decapoda, Caridea) of Sri Lanka. I. On a new species, a new subspecies and two species new to Sri Lanka. *Crustaceana*, **43**(2): 127–141.

Heller, C., 1862. Neue Crustaceen gesammelt wahrend der Weltumseglung der k.k. Fregatte Novara: Zweiter vorläufiger Bericht. *Verhandlungen des Kaiserlich-Königlichen Zoologisch-botanischen Gesellschaft in Wien*, **12**: 519–528.

Jalihal, D. R. & S. Shenoy. 1998. Taxonomic revision of some Indian prawn species of genus *Caridina* H. Milne Edwards, 1837 (Atyidae). *Proceedings and abstracts of the Fourth International Crustacean Congress*, Amsterdam, the Netherlands: 128–129.

Johnson, D.S., 1960. Sub-specific and infra-specific variation in some freshwater prawns of the Indo-Pacific region. *Proceedings of the Centenary and Bicentenary congress of Biology*, Singapore, **1958**: 259–267, Figs.1–5.

Johnson, D. S., 1961a. Notes on the freshwater Crustacea of Malaya I. The Atyidae. *Bulletin of the Raffles Museum, Singapore*, **26**: 120–153, Figs. 1–42.

Johnson, D. S., 1961b. A synopsis of the Decapoda Caridea and Stenopodidea of Singapore, with notes on their distribution and a key to the genera of Caridea occurring in Malayan waters. *Bulletin of the Raffles Museum, Singapore*, **30**: 44–79.

Johnson, D. S., 1963. Distribution and other notes on some freshwater prawns (Atyidae and Palaemonidae) mainly from the Indo-west Pacific region. *Bulletin of the National Museum of Singapore*, **32**: 5–30, Figs. 1–5.

Johnson, D. S., 1965. A review of the brackish water prawns of Malaya. *Bulletin of the Raffles Museum, Singapore*, **33**(2): 7–11.

Johnson, D. S., 1966. Some factors influencing the distribution of freshwater prawns in Malaya. *Proceedings of Symposium of Crustacea, Emakulam, India*, 1965, **1**: 418–433.

Johnson, D. S., 1969. Non-Penaeid prawns of inland waters, including brackish waters. In: western Malaysia and Singapore, in B. Stone (ed.), *Proceedings of the second Symposium on Scientific and Technological Research in Malaya and Singapore*, (1967) STREMS II, University of Malaya: 109–113.

Kemp, S., 1915. Crustacea Decapoda. Fauna of the Chilka Lake. *Memoirs of the Indian Museum*, **5**: 199–325.

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.

Lanchester, W. F., 1901. On the Crustacea collected during the 'Skeat' expedition to the Malay Peninsula. *Proceedings of the Zoological Society of London*, **1900** [1901]: 533–574.

Liang, X., 2004. *Fauna Sinica, Invertebrate Vol. 36, Crustacea, Decapoda, Atyidae*, Science Press, Beijing, China, 363 pp.

Liang, X. -Q. & S. -L. Yan, 1977. New species and subspecies of *Caridina* (Decapoda, Caridea) from Fukien, China. *Acta Hydrobiologia Sinica*, **6**(2): 219–225, Figs.1–13.

Liang, X. -Q. & S. -L. Yan, 1983b. New species and new records of freshwater shrimps (Crustacea Decapoda) from Hainan Island, China. *Oceanologia et Limnologia Sinica*, **14**(3): 211–216, Figs.1–3.

Milne Edwards, H., 1837. *Histoire naturelle des Crustacés, Comprenant l'Anatomie, la Physiologie et la Classification de ces Animaux*. Volume 2. (Paris: Libraire Encyclopedique de Roret): 1–532.

Newport, G., 1847. Note on the genus *Atya* of Leach, with descriptions of four apparently new species, in the cabinets of the British Museum. *Annals and Magazine of Natural History*, **19**: 158–160, Pl. 8.

Ng, P. K. L., 1990. Freshwater crabs and prawns of Singapore. In: L. M. Chou & P. K. L. Ng, (eds.), *Essays in Zoology.* Papers commemorating the 40th Anniversary of the Department of Zoology, National University of Singapore, Singapore, pp.189–210.

Ng, P. K. L. 1995a. The freshwater crabs and prawns of Bako National Park, Sarawak, Malaysia, with descriptions of one new genus and three new species. *Raffles Bulletin of Zoology*, **43**(1):181–205, Figs.1–12.

Ng, P. K. L., 1995b. Freshwater decapod crustaceans (Potamidae, Palaemonidae) of Temenggor Forest Reserve, Hulu Perak, Malaysia. *Malayan Nature Journal*, **48**: 249–257.

Ng, P. K. L. & D. G. B., Chia, 1994. Die Riesenbachgarnele. *DATZ*, **47**: 644–648.

Ng, P. K. L., & S. S. C. Chong, 1986. The freshwater crabs and shrimps of Pulau Tioman. *Nature Malaysiana*, Kuala Lumpur, **11**(3): 26–31.

Ng, P. K. L. & S. Choy, 1990a . The Caridean Prawns (Palaemonidae and Atyidae) from the Endau-Rompin area, Johore-Pahang, Peninsular Malaysia. *Malayan Nature Journal*, **43**(4): 302–312.

Ng, P. K. L. & S. Choy, 1990b. Notes on some freshwater Caridean Prawns (Palaemonidae and Atyidae) from the Endau-Rompin area, Johore-Pahang, Peninsular Malaysia. *Raffles Bulletin of Zoology*, **38**(1): 11–20.

Ng, P. K. L., & L. W. H. Tan, 1991. Invertebrates: protozoa, cnidarians, flatworms, nematodes, rotifers, segmented worms, crustaceans, mollusks; plankton. In: Ng, P. K. L. (ed.), *A guide to freshwater life in Singapore.* Singapore Science Centre, pp. 66–73, Pls. 118–131.

Richard, J., & M. R., Chandran, 1994. A systematic report on the fresh water prawns of the atyid genus *Caridina* H. Milne Edwards 1837, from Madras (Tamilnadu, India). *Journal of the Bombay Natural History Society*, **91**: 241–259.

Schenkel, E.,1902. Beitrag zur Kenntnis der Dekapodenfauna von Celebes. *Verhandlungen der naturforschenden Gesellschaft in Basel*, **13**: 485–585, Pls. 7–13.

Shokita, S. 2003. Atyidae. Pp. 249–254. In: Nishida, M., N. Shikatani and S. Shokita (eds.), *The flora and fauna of inland waters in the Ryukyu Islands*. Tokai University Press, Tokyo, Japan. 572 pp. [in Japanese].

Stimpson, W., 1860. Prodromus descriptionis animalium evertebratorum, quae in Expeditione ad Oceanum Pacificum Septemtrionalem, a Republica Federata missa, C. Ringgold et J. Rodgers, observavit et descriptist. *Proceedings of the Academy of Natural Science of Philadelphia*, **1860** (January): 22–47.

Tiwari, K. T. & R. S. Pillai, 1971. Atyid shrimps of the genus *Caridina* H. Milne Edwards, 1837, from the Andaman Islands (Decapoda, Caridea). *Crustaceana*, **21**: 79–91.

Wowor, D., Y. Cai & P. K. L. Ng, 2004. Crustacean: Decapoda: Caridea. In: Yule, C. & H. S. Yong (eds.). *The freshwater invertebrates of Malaysia and Singapore*. Malaysian Academy of Sciences, Kuala Lumpur, Pp. 337–357.

Yeo, D. C. J., Cai, Y, & P. K. L. Ng, 1999. The freshwater and terrestrial decapod Crustacea of Pulau Tioman, Peninsular Malaysia. *Raffles Bulletin of Zoology*, Supplement **6**: 190–244, Figs. 1–20.