



## One new and four newly recorded species of the genus *Macrobrachium* (Decapoda: Caridea: Palaemonidae) from Guangdong Province, southern China

ZHAO-LIANG GUO<sup>1</sup> & SHUN-LIAN HE<sup>2</sup>

<sup>1</sup>Department of Animal Science, Foshan Science and Technology College, Nanhai, 528231, Guangdong Province, People's Republic of China. E-mail: zlguo@fosu.edu.cn

<sup>2</sup>Department of Animal Science, Foshan Science and Technology College, Nanhai, 528231, Guangdong Province, People's Republic of China. E-mail: heshunlian@fosu.edu.cn

### Abstract

The present study, based on a faunistic and ecological survey of the genus *Macrobrachium* from Guangdong Province, expands the knowledge of morphology, coloration, and distribution of an undescribed species and four new records for *M. formosense* Bate, 1868, *M. inflatum* Liang & Yan, 1985, *M. maculatum* Liang & Yan, 1980 and *M. meridionalis* Liang & Yan, 1983. A more complete diagnosis of these five species is presented. *Macrobrachium heterorhynchos*, new species, can be distinguished from its congeners by a combination of characters which includes rostral sexual dimorphism, the two teeth at the proximal part of the cutting edge of the fixed finger of the second pereopod, the non-inflated palm, and the distinctly longer merus compared which is distinctly longer than the palm or the ischium.

**Key words:** Decapoda, Palaemonidae, *Macrobrachium*, China

### Introduction

The genus *Macrobrachium* is a relatively species-rich group, which contains nearly 220 species and subspecies (Liu *et al.* 1990; Chace & Bruce 1993; Wowor & Choy 2001; Cai & Ng 2002; Cai *et al.* 2004; Short 2004; Jayachandran & Raji 2005; Komai & Fujita, 2005; Li *et al.* 2007) from fresh to brackish environments. The *Macrobrachium* fauna of China is notable for its high species richness, Li *et al.* (2007) revised the local fauna and noted 33 species based on specimens they examined. So far, six species of *Macrobrachium* have been reported from Guangdong Province, occurring both in fresh and brackish waters. They are: *Macrobrachium asperulum* (Von Martens, 1868), *M. equidens* (Dana, 1852), *M. fukienense* Liang & Yan, 1980, *M. hainanense* (Parisi, 1919), *M. nipponense* (De Haan, 1849), and *M. superbum* (Heller, 1862) (see Holthuis 1950; Liu 1957; Liu *et al.* 1990; Zhang & Sun 1981; Li *et al.* 2007). Intensive field surveys have been carried out in the region in recent years by the authors, with the addition of the new species and the new records described in this study, this brings the total number of the genus *Macrobrachium* known from Guangdong Province to 11.

### Material and methods

The specimens examined in the present study were collected by hutch net with mesh size 0.8 mm and then preserved in 75% alcohol before dissection. The drawings were made with the aid of drawing tube mounted on an Olympus BX-41 compound microscope.

The following abbreviations are used throughout the text: tl, total length of body (measured from the ros-

tral tip to the posterior margin of the telson); cl, carapace length (measured from the postorbital margin to the posterior margin of the carapace); rl, rostral length (measured from the rostral tip to the postorbital margin). All measurements are in millimeters (mm). Notation for the rostral formula follows that of Chace & Bruce (1993).

Specimens are deposited in the collections of the Foshan Science and Technology College (FSTC).

## Taxonomy

### Family Palaemonidae Rafinesque, 1815

### Genus *Macrobrachium* Bate, 1868

#### *Macrobrachium heterorhynchos* sp. nov.

(Figs. 1, 2, 7A, B)

**Material examined.** Holotype: adult male (FSTC, 02–06–11–01), tl. 65.4 mm, cl. 15.4 mm, rl. 14.8 mm, Xijiang river near Jiangmen City (ca. 22°33'N, 113°08' E), 11 June 2002.

Paratypes: 3 males (FSTC, 02–06–11–02 to 04), tl. 64.8–71.0 mm, cl. 14.1–16.9 mm, rl. 14.0–16.0 mm; 1 ovigerous female (FSTC, 02–06–11–05), tl. 76.7 mm, cl. 19.8 mm, rl. 14.0 mm; 1 female (FSTC, 02–06–11–06), tl. 58.2 mm, cl. 15.3 mm, rl. 10.9 mm; data same as holotype.

**Diagnosis.** Rostrum sexually dimorphic, very long in males, about one-third distal extending beyond scaphocerite, tip strongly curved upwards, rl. about as long as cl.; rostral formula:  $3 + 8-9/4$ , dorsal teeth unequally spaced, usually with wide gaps near posterior and anterior ends of series; in females, rostrum just reaching end of scaphocerite, rl. about 0.7 cl., upper margin slightly convex above eyes, tip slightly curved upwards, rostral formula:  $3 + 8/5$ , distribution of dorsal teeth similar to of males. Cephalothorax and abdomen smooth, without microspinules. Second pereopods shorter than tl. in both sexes, equal, ischium as long as merus, carpus about 1.4 as long as merus, and shorter (0.7–0.8 times) than chela, longer (1.2–1.6 times) than palm, fingers of males about as long as palm, fingers of females shorter (0.7–0.8 times) than palm; cutting edge of both fingers with 2 teeth. All segments covered with numerous microspinules except for ischium. Egg size:  $0.50-0.59 \times 0.61-0.69$  mm in diameter.

**Description.** Rostrum (Figs. 1A, B, 7A, B) with distinct sexual dimorphism, rostrum of males very long, distal 1/3 extending beyond scaphocerite, tip strongly curved upwards, rl. about as long as cl.; dorsal margin with 11 or 12 teeth, 3 teeth behind orbit, unequally spaced, usually with wide gaps near posterior and anterior ends of series; ventral margin with 4 teeth. Females with rostrum just reaching end of scaphocerite, rl. about 0.7 cl., upper margin convex above eyes, tip slightly curved upwards with 11 dorsal teeth, ventral margin 5 teeth, teeth distribution similar to that of males.

Carapace (Figs. 1A, B, 7A, B) glabrous; antennal spine well developed; hepatic spine much smaller than antennal spine, and lies in the same line with the latter.

Antennule (Fig. 1A, C) with sharp stylocerite, reaching one-third basal segment of antennular peduncle; anterior margin of basal segment distinctly convex; second segment about 0.45–0.55 times as long as basal segment, about 1.1–1.2 time as long as distal segment. All segments with submarginal plumose setae.

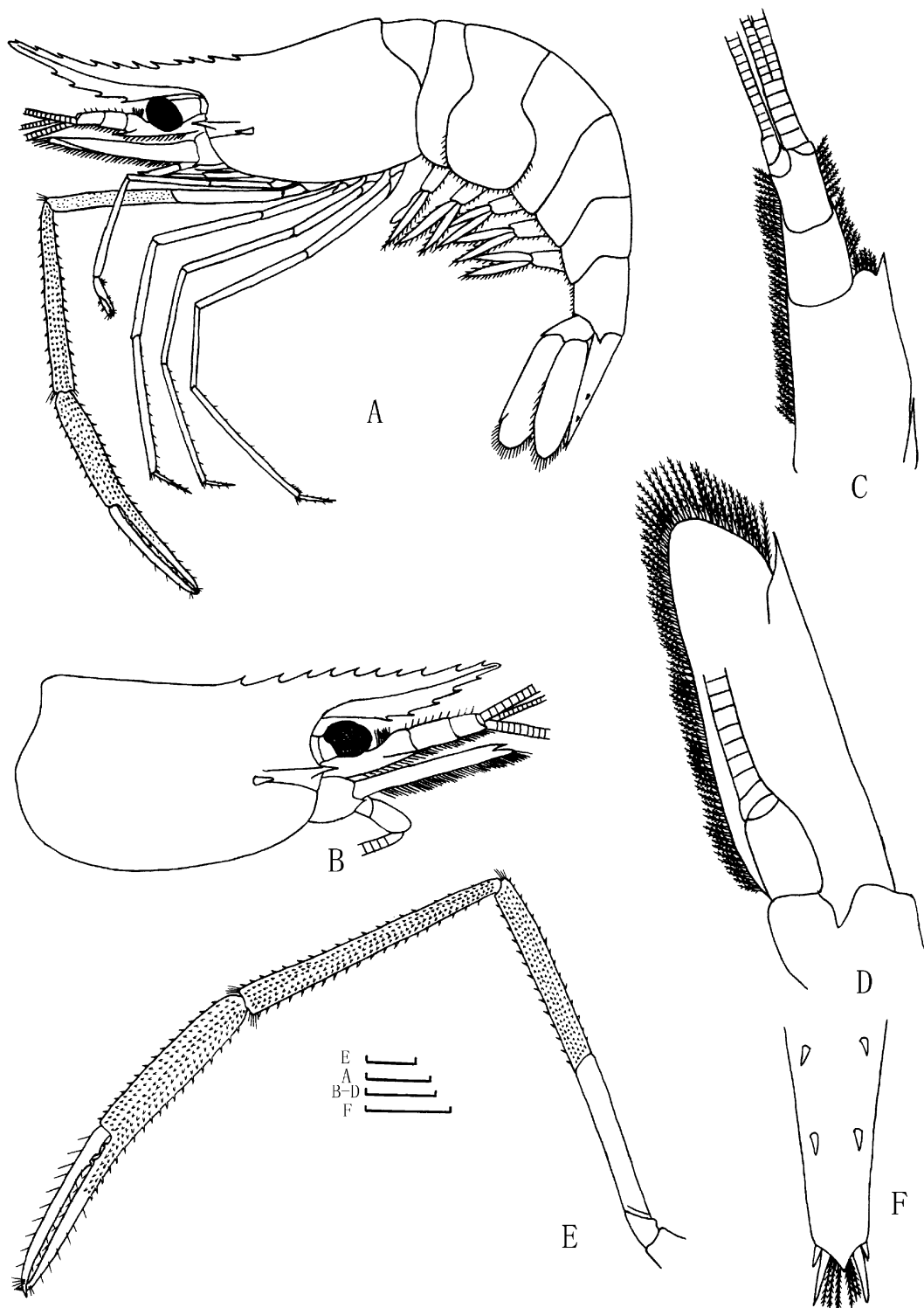
Antenna (Fig. 1A, D) with large scaphocerite, rectangular, 2.8–3.1 times as long as wide, outer margin almost straight, ended with a strong spine, overreached by lamella.

Mandible (Fig. 2A) with 3-segmented palp; incisor process with 3 sharp teeth; molar process stout, distally excavated, with blunt teeth and ridges.

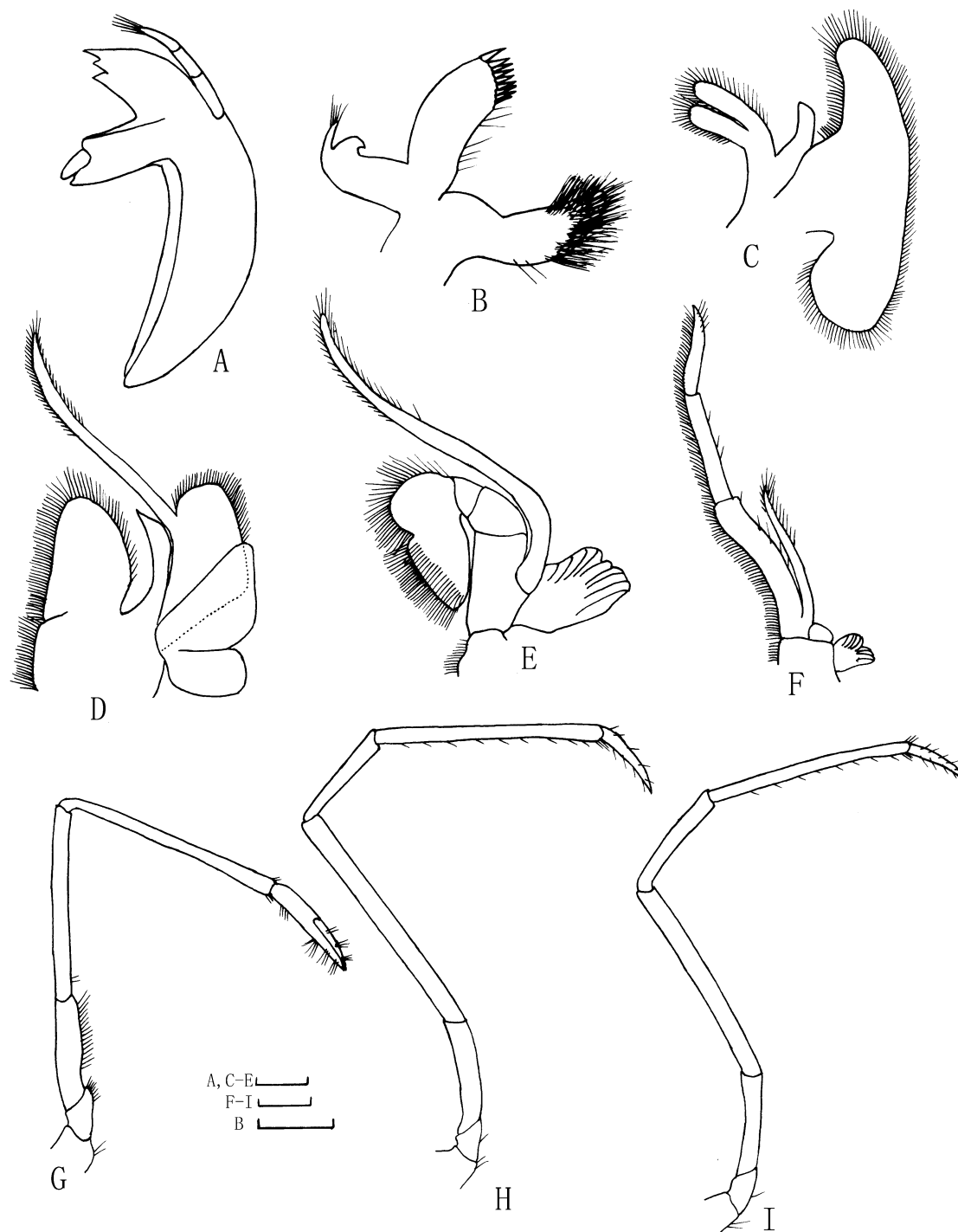
Maxillula (Fig. 2B) with bilobed palp, upper lobe slender, setose distally, lower lobe stout, hooked; upper lacinia broadly elongated, distal margin with row of strong spines, lower lacinia as long as upper lacinia,

densely setose distally.

Maxilla (Fig. 2C) with simple palp; basal endite deeply bilobed, upper and lower lobes with numerous simple setae distally; scaphognathite broad, about 3.4 times as long as wide.



**FIGURE 1.** *Macrobrachium heterorhynchus*, new species. A, entire animal, lateral view, holotype, male (FSTC, 02-06-11-01), cl. 15.4 mm. B, cephalothorax and cephalic appendages, lateral view, paratype, female (FSTC, 02-06-11-05), cl. 19.8 mm. C, antennular peduncle. D, scaphocerite. E, second pereiopod. F, posterior portion of telson. C-F, paratype, male (FSTC, 02-06-11-02), cl. 14.1 mm. Scale: A-B = 5 mm, C-D = 2 mm, E-F = 2.5 mm.



**FIGURE 2.** *Macrobrachium heterorhynchos*, new species, paratype, male (FSTC, 02-06-11-02), cl. 14.1 mm. A, mandible. B, maxillula. C, maxilla. D, first maxilliped. E, second maxilliped. F, third maxilliped. G, first pereopod. H, third pereopod. I, fifth pereopod. Scale: A-E = 1 mm, F-I = 2 mm.

First maxilliped (Fig. 2D) with subcylindrical, distally tapering palp, basipodal and coxal endites distinct; exopod with large caridean lobe, flagellum with numerous plumose setae distally, epipod deeply bilobed, upper lobe triangle, lower lobe oval.

Second maxilliped (Fig. 2E) with normal endopod, last segment fused with entire length of penultimate; exopod well developed, flagellum with plumose setae distally, epipod simple, with well-developed podobranch.

Third maxilliped (Fig. 2F) with robust endopod, ischiomerus slightly bow-shaped, with rows of long simple setae on distal inner and outer margins; carpus about 0.76 times length of ischiomerus, with row of long, simple setae on inner margin and sparse row of simple setae on outer margin; distal segment about 0.78 times penultimate segment, with long, simple setae on inner margin; exopod reach distal end of ischiomerus, with plumose setae distally; basal with well developed oval lateral plate, two arthrobranchs, one rudimentary, obscured by the larger.

Branchial formula typical for genus.

First pereopods (Figs. 1A, 2G) slender, base of fingers extending beyond scaphocerite, carpus 1.8–2.1 times as long as chela; palm shorter than fingers.

Second pereopods (Fig. 1A, E) slightly shorter than the tl. in both sexes, similar in shape and size, distal merus extending beyond scaphocerite; the finger 0.71–0.97 times as long as palm, fixed finger with 2 teeth at proximal, basal tooth is formed of 2–3 denticles, moveable finger with 2 proximal teeth, palm not inflated, 4.0–4.6 times as long as width; carpus is 6.6–8.8 times as long as width, 1.2–1.6 times as long as palm, and is 1.4–1.6 times as long as merus; merus of males slight longer than palm, 1.0–1.2 times as long as palm, in females merus shorter than palm, 0.8–0.9 times as long as palm; merus 1.1 times as long as ischium; all segments covered with numerous microspinules except for ischium.

Third pereopods (Figs. 1A, 2H) extending beyond scaphocerite by one-fifth distal propodus; propodus 2.2–2.6 times as long as dactylus, dactylus about 6.0 times as long as width, terminating in a small claw.

Fifth pereopods (Figs. 1A, 2I) extending beyond tip of scaphocerite; propodus 3.0–3.3 times as long as dactylus, dactylus about 5.4 times as long as width, terminating in a small claw.

First pleopods of male with endopod of about half of exopod, slightly concave at inner margin, top rounded, without appendix interna.

Second pleopods with well developed appendix masculina, reaching middle of endopod, about twice as long as appendix interna with numerous stiff setae.

Abdomen (Figs. 1A, 7A, B) glabrous; pleura of first three somites broadly rounded, pleura of somites 4 and 5 also rounded, but with almost rectangular posterolateral angle; sixth somite 1.2–1.6 times as long as fifth somite, about 0.6–0.7 times as long as telson.

Telson (Fig. 1A, F) smooth, about 0.6 times cl., longer than sixth abdominal segment; dorsal surface furnished with 2 pairs of stout movable spines; posterior margin tapers regularly to a sharp point with 2 pairs of posterior spines; numerous setae present between inner spines.

Uropodal diaeresis with a spine, shorter than outer angle.

Eggs small, 0.50–0.59 X 0.61–0.69 mm in diameter.

**Live coloration.** All specimens light green with numerous small reddish spots on carapace, abdomen and uropods. Third abdominal somite with a white broad transverse band near posterior margin. Endopod of third maxilliped transparent, distal segment entirely reddish, penultimate segment with 3 red rings, basal segment with 1 red ring; ischium, merus and fingers of second pereopods translucent, with 3, 4 and 2 red rings respectively, outer surface of carpus and palm yellowish, with 2 longitudinal dark stripes near margins (these dark stripes persist in preservation, Fig. 7A, B). First, third, fourth and fifth pereopods transparent, ischium, merus and carpus with 2, 4 and 2 red rings respectively, half proximally of fingers reddish; a large dark spot on uropods; eggs reddish brown.

**Etymology.** Species name is derived from *heteros* (Greek), meaning different and *rhynchus* (Greek), meaning nose in reference to the rostral morphology of the male being different from the female.

**Remarks.** *Macrobrachium heterorhynchus* superficially resembles *M. inflatum* Liang & Yan, 1985, in having similar ratios of various segments of the second pereopods. However, it can be distinguished from *M. inflatum* by its sexually dimorphic rostrum (versus non-sexually dimorphic); the palm of the male second pereopods is not inflated (versus inflated) and 4.0–4.6 times (versus 3.5–3.6 times) as long as broad, the merus is distinctly longer than the palm or the ischium (versus shorter than the palm or the ischium), the cut-

ting edge of the fixed finger bears two teeth (versus one tooth), without a gape present when closed (versus with a distinct gape present); the scaphocerite is broader (the length is 2.8–3.1 times as long as width versus 3.4 times); and they have entirely different body coloration.

*Macrobrachium heterorhynchos* is also close to *M. nipponense* (De Haan, 1849). Comparison of adult specimens of equivalent size to *M. heterorhynchos* and specimens of *M. nipponense* from Guangdong province shows that it can be distinguished from latter by characters of rostrum and second pereopods. The rostrum of *M. heterorhynchos* is sexual dimorphic (versus non-sexual dimorphic) and with more ventral teeth (4 or 5 versus 2 or 3). The second pereopods of *M. heterorhynchos* are distinctly shorter than those of *M. nipponense*; the merus is distinctly longer than the palm (versus shorter than the palm), the finger is proportionally longer in *M. heterorhynchos* than in *M. nipponense* (ratio of finger to palm length 0.71–1.0 versus 0.6–0.7), and without setae on cutting edge (versus covered with long dense setae).

**Habitat:**

The type specimens were collected from near Jiangmen City (ca. 22°33'N, 113°08' E). The locality is approximately 50 km away from the northern coast of Nanhai Sea. The water is brackish with temperature 26°C and pH 7.5. It is found together with *M. nipponense* and *M. hainanense*.

**Distribution.** Known only from the type locality in Guangdong Province, southern China.

### ***Macrobrachium formosense* Bate, 1868**

(Figs.3, 7C)

*Macrobrachium formosense* Bate, 1868: 364, fig. 1, pl. 31 [type locality: Tansui, northern Taiwan]; Holthuis, 1950: 156; Shokita, 1979: 207; Suzuki *et al.*, 1993: 58; Shy & Yu, 1998: 25; Li *et al.*, 2007:93.

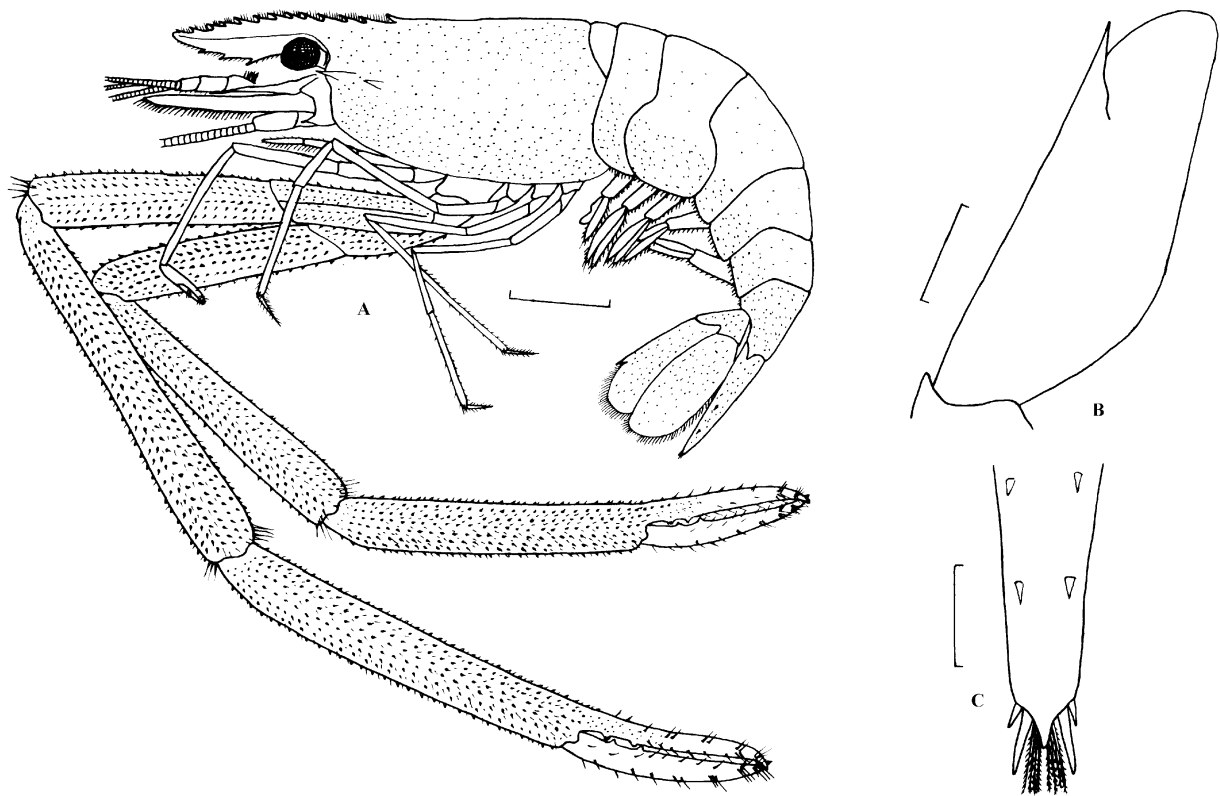
*Palaemon similis* Yu, 1931: 281, fig. 2.

*Macrobrachium hainanense* Holthuis, 1950: 158, fig. 35; Liu *et al.*, 1990: 118, fig. 15; Chace & Bruce, 1993: 27.

**Material examined.** 3 females, tl. 61.0–71.6 mm, cl. 18.2–26.0 mm, 4 males, tl. 61.8–93.0 mm, cl. 21.3–29.8 mm, near Dongan Town, Zhuhai City, 12 July 2002; 2 females, tl. 35.1–55.5 mm, cl. 9.5–19.6 mm, 3 males, tl. 45.2–65.3 mm, cl. 11.8–27.0 mm, Dingjia Bay, Jinwan District, Zhuhai City, 13 July 2002; 4 females, tl. 45.4–51.1 mm, cl. 11.0–19.6 mm, 5 males, tl. 38.5–78.3 mm, cl. 8.7–29.1 mm, near Shantou City, 16 April 2003; 2 females, tl. 45.3–56.1 mm, cl. 12.0–23.2 mm, 3 males, tl. 48.0–67.4 mm, cl. 12.8–23.2 mm, near Yangjiang City, 18 May 2003; 2 females, tl. 75.0–73.5 mm, cl. 25.5–27.2 mm, 8 males, tl. 80.1–97.6 mm, cl. 24.5–32.2 mm, near Guangning County, 10 July 2004. 1 female, tl. 55 mm, cl. 12.5, 4 males, tl. 70.5–89.0 mm, cl. 21.2–30.5 mm, Xiachuan Island, Taishan City, 18 July 2008.

**Diagnosis.** Rostrum reaching to end of antennular peduncle, upper margin slightly convex above eyes, rostral formula: 3–4 + 9–10/2–4, rl. about 0.55–0.66 times cl. Cephalothorax, abdomen and telson roughened, with numerous microspinules, densest laterally. Second pereopods of adult male stout, equal or subequal in size, all segments rough, covered with microspinules, finger about 0.50–0.60 times as long as palm, cutting edges of both fingers with 2 or 3 teeth, basal tooth of fixed finger formed of 2 or 3 denticles; carpus longer or as long as palm, palm 4.9–6.8 times as long as width; carpus about 1.4–1.6 times as long as merus; merus about 1.3–1.6 times as long as ischium (Fig. 3). Egg size: 0.42–0.55 X 0.52–0.69 mm in diameter.

**Description.** Rostrum (Fig. 3A) exceeding the end of antennular peduncle, not reaching beyond the end of scaphocerite; rl. is about 0.55–0.66 times of cl.; upper margin slightly convex over eyes; 12–14 dorsal rostral teeth, of which 3 or 4 teeth placed behind the orbit. Distance between first dorsal tooth and orbital margin 0.29 cl. The distance between the first and second tooth is about 1.5 times of the second and third tooth. There are 3 ventral rostral teeth. The scaphocerite (Fig. 3B) is large, is about 3.0 times as long as broad, with a distinct spine near the outer part of the base.



**FIGURE 3.** *Macrobrachium formosense*. A, entire animal in lateral view, male, cl. 28.0 mm. B, scaphocerite. C, posterior portion of the telson. Scale: A = 10 mm, B = 2.5 mm, C = 2.0 mm.

First pereiopod (Fig. 3A) slender, reaching  $1/3$  of carpus length beyond scaphocerite. Carpus about 2.6 times length of chela; palm longer than the fingers. Second pereiopod (Fig. 3A) very strong in adult male, subequal in size, shape and segment ratios of left and right similar. Merus about 1.3–1.6 times as long as ischium; carpus about 1.4–1.6 times as long as merus and almost same length as palm; palm 4.9–6.8 times as long as wide; dactylus about 0.5–0.6 times as long as palm. Cutting edge of both fingers with 2 teeth, situated at proximal one-third. All segments covered with numerous spines and scattered setae. Last three pereiopods (Fig. 3A) slender. Dactylus of fifth leg reaching about  $1/3$  of scaphocerite, propodus about 2.8 times as long as dactylus.

Abdomen (Fig. 3A) rough, with numerous small spinules on pleura; uropods with numerous small spinules on surface. Sixth somite about 1.6 times as long as the fifth and 0.65 times as long as telson. Telson (Fig. 3A,C) rough, covered with numerous small spinules on dorsal surface, about 0.5 cl., distinctly longer than sixth abdominal segment; dorsal surface with 2 pairs of stout movable spines; posterior margin tapering regularly to a sharp point and with 2 pairs of posterior spines; numerous setae present between inner spines.

**Remarks.** This species is very easily confused with *M. hainanense* (Parisi, 1919). Holthuis (1950) showed that *Palaemon similis* Yu, 1931, is a synonym of *M. hainanense*. Since then, *M. formosense* is only known from Taiwan, while on the mainland, *M. hainanense* was the name used by local carcinologists (Liu 1957; Dai 1984; Liu *et al.* 1990). In the present study, we examined large numbers of specimens from Guangdong Province. The results show that *M. formosense* can be differentiated from *M. hainanense* by the structure and proportions of the segments of the male second pereiopods and the tooth arrangement on the cutting edge of the fingers. In *M. formosense*, the second pereiopods are equal or subequal, the carpus is longer or sometimes as long as the palm, and the basal tooth of the fixed finger is formed of 2 or 3 denticles, while in *M. hainanense* the second pereiopods are equal in length, the carpus is distinctly shorter than the palm, and the basal tooth of the fixed finger is formed of 4 or 5, rarely 3 denticles. Since the differences are so obvious and

consistent, we hereby treat them as two species. Li *et al.* (2007) noted that among material which they examined from Fujian, Guangdong, Hainan and Guangxi, were specimens clearly referable to both *M. formosense* as well as *M. hainanense*, and commented that the latter appears to be a good species.

This species is commercially important in Guangdong Province where it is sold live together with *M. nipponense* at local fish markets. It is fished for home and restaurant consumption as a special dish. Local commercial fishermen call it He xia (meaning river prawn) since it is usually found in rivers.

**Distribution and habitat.** Southeastern China (Fujian, Guangdong Provinces and Taiwan), Japan (Ryukyu Islands and Kyushu), and Indonesia (Java). The species seems to be restricted to shallow, sandy rivers and streams in fresh to brackish waters. It seeks shelter among in aquatic vegetation or under stone.

### ***Macrobrachium meridionalis* Liang & Yan, 1983**

(Figs. 4–6)

*Macrobrachium meridionalis* Liang & Yan, 1983: 213, fig. 2 [type locality: Jingjiang river, Chengmai County, Hainan Island, southern China]; Liu *et al.*, 1990: 115, fig. 13; Yeo *et al.*, 1999: 227, figs. 15, 16.

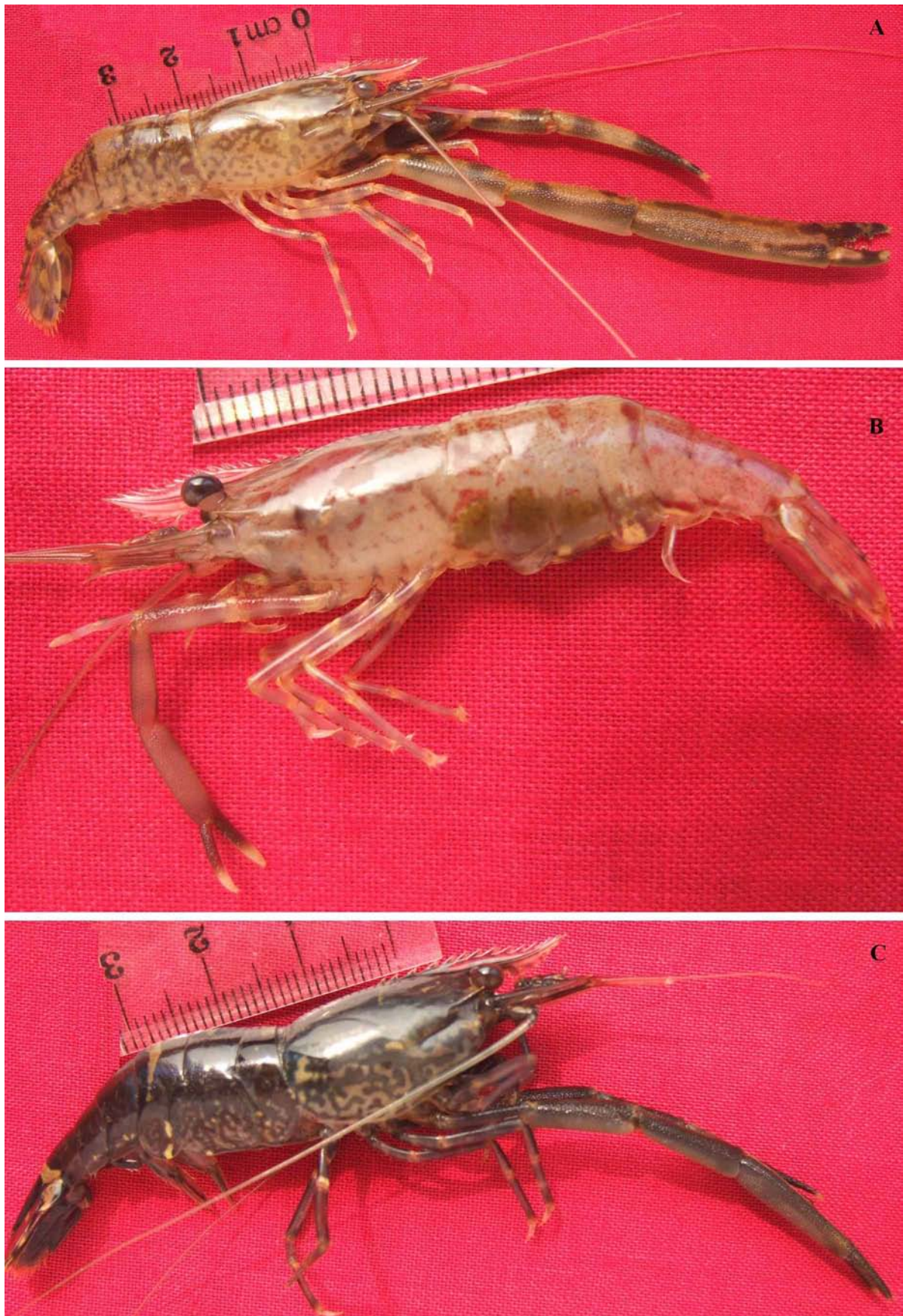
**Material examined.** 1 male, tl. 85.0 mm, cl. 27.0 mm, Dali Town, Foshan City, 15 March 2003; 4 females, tl. 50.0–65.5 mm, cl. 14.5–17.5 mm, 3 males, tl. 83.0–86.5 mm, cl. 26.9–27.5 mm, Dongping river, near Foshan City, 18 May 2004; 2 males, tl. 65.0–74.5 mm, cl. 15.2–28.0 mm, Shatoujia Town, Foshan City, 21 October 2004; 1 ovigerous female, tl. 56.5 mm, cl. 15.4 mm, Xijiang River near Shunde, Foshan City, 24 March 2004; 1 male, tl. 77.8 mm, cl. 23.8 mm, Xijiang River near Deqin City, 17 May 2005; 1 male, tl. 71.7 mm, cl. 22.3 mm, Xijiang River near Zhaoqin City, 18 May 2005; 12 females, tl. 46.0–75.5 mm, cl. 13.2–23.1 mm, 24 males, tl. 48.0–87.5 mm, cl. 15.2–26.0 mm, Huangqi fish market, 18 June 2005.

**Diagnosis.** Rostrum reaching as far as or extending beyond end of antennular peduncle, upper margin slightly convex above eyes; rostral formula: 4–7 + 6–8/2–4, rl. about 0.40–0.50 cl. Cephalothorax, abdomen and telson smooth, without microspinules. Second pereopods subequal in both sexes, all segments rough, covered with appressed scales, those on inner margin spiniform, finger about 0.44–0.71 times as long as palm, cutting edges of fixed finger with 2–4 teeth, basal tooth formed of 4–12 (usually 4 or 5) denticles, movable finger with 3–6 tooth in proximal half to two-thirds; carpus shorter than palm, about 0.62–0.91 times as long as palm, palm slightly compressed, subcylindrical, 3.3–4.9 times as long as width; carpus cylindrical, about 1.1–1.3 times as long as merus; merus about 1.1–1.6 times as long as ischium. Egg size: 0.42–0.47 X 0.51–0.65 mm in diameter.

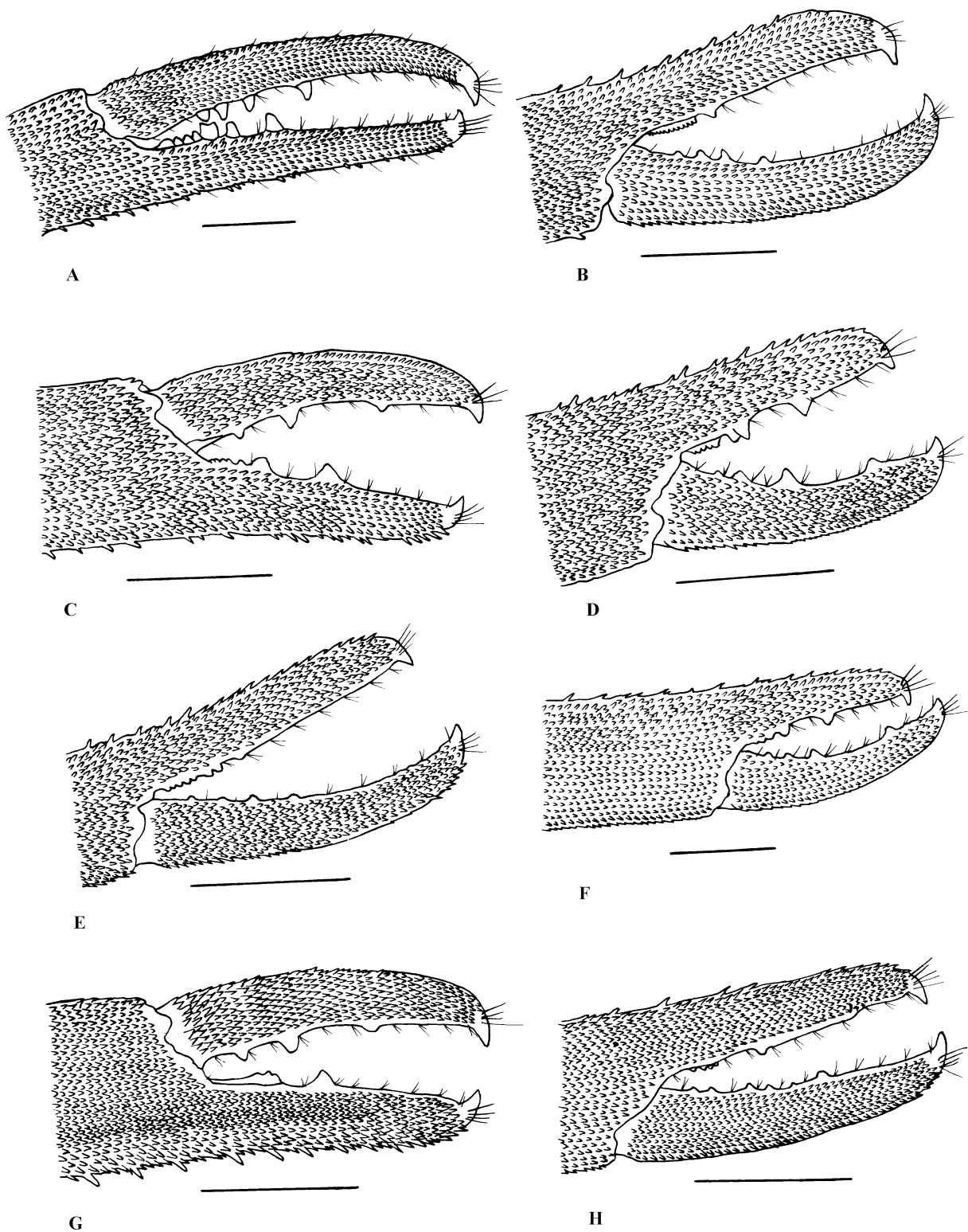
**Live coloration.** This prawn seems to be quite variable in color, with at least three color variations. In specimens collected from rocky beds, under pebbles and stones, the body and appendages are buff with irregular dark brown or red spots (Fig. 4). In specimens collected from sandy substrates, the body is very dark brown, the cephalothorax has yellow spots, and the abdomen and telson have irregular yellow stripes and spots. Those from localities with a much aquatic vegetation have a bluish-green body with irregular dark brown spots. The eggs are grass green.

**Remarks.** The first record of *Macrobrachium meridionalis* Liang & Yan, 1983 was from Chengmai County, Hainan Island, southern China. The description was based on three small specimens (Liang & Yan, 1983). Recently, Yeo *et al.* (1999), after reexamining the paratype and observing the specimens from Peninsular Malaysia, provided additional details of the morphology of *M. meridionalis* and expanded its distribution in Peninsular Malaysia. The present specimens essentially match the definition of the present species as given by Liang & Yan (1983), Liu *et al.* (1990) and Yeo *et al.* (1999). There are some minor differences compared to the type specimens. The rostral formula of the Guangdong specimens is 4–7 + 6–8/2–4 versus 5–6 + 7–8/2–3 in the types. The tooth arrangement of the cutting edges of the fingers of the major male second pereopod is





**FIGURE 4.** Photographs of living specimen of *Macrobrachium meridionalis*. A, C, male. B, ovigerous female.



**FIGURE 5.** Fingers of male second pereiopod of *Macrobrachium meridionalis*, showing morphological variation of the arrangement of the teeth on the cutting edges. Scale = 5 mm.

quite variable; the fixed finger has 2–4 teeth, the basal tooth is formed of 4–12 (usually 4 or 5) denticles, movable finger with 3–6 tooth in proximal half to two-thirds (Fig. 5). There is a distinct longitudinal groove along the each surface of the palm of second pereiopods of the fully developed adult male (Fig. 6). Yeo *et al.* (1999: 227) also found a very distinct sulcus along the length of the carpus and the proximal half of the palm, and

noted other differences such as a relative longer and slender finger of the second pereopods. This is the first record in the Guangdong Province.

When living animals are attacked, the second pereopods are easily broken off the body. Therefore, most living specimens sold in markets and most preserved specimens have lost their second pereopods.

This species is commercially important in Guangdong Province. It is fished for home and restaurant consumption as a special dish and sometimes it is sold in large quantities in fish markets. In markets, the price of this species is double that of other freshwater prawns such as *M. nipponense*, because of their size and the excellent flavour. Local commercial fishermen call it Shi xia (meaning stone prawn) due to its habitat, i. e., usually in crevices among stones.

**Distribution and habitat.** Southeastern China (Guangdong and Hainan Provinces) and Malaysia (Pulau Tioman). The species seems to be restricted to relatively slow flowing rivers above the reach of tidal influence.

### ***Macrobrachium inflatum* Liang & Yan, 1985.**

(Fig. 7D)

*Macrobrachium inflatum* Liang & Yan, 1985: 254, fig. 3 [type locality: Kunshan County, Jiangsu Province, eastern China]; Liu *et al.*, 1990: 107, fig. 5; Tan & Dong, 1996: 287; Cai & Dai, 1999: 223, fig. 8.

**Material examined.** 2 females, tl. 44.5–50.0 mm, cl. 13.0–15.2 mm, 8 males, tl. 45.5–64.3 mm, cl. 15.0–22.5 mm, Xijiang river near Foshan City, 14 August 2002; 3 females, tl. 38.2–52.0 mm, cl. 14.1–16.52 mm, 2 males, tl. 43.1–54.2 mm, cl. 16.0–23.0 mm, Xianxi reservoir near Foshan City, 1 June 2003; 4 females, tl. 38.2–55.3 mm, cl. 13.8–23.5 mm, 3 males, tl. 41.5–65.2 mm, cl. 16.2–23.7 mm, Longkou Town, Heshan City, 17 August 2003; 2 females, tl. 41.2–45.5 mm, cl. 14.2–15.7 mm, 2 males, tl. 43.0–48.2 mm, cl. 16.2–18.3 mm, Laolong Twon, Longchuan Couty, 24 April 2004; 1 ovigerous female, tl. 46.2 mm, cl. 15.7 mm, 2 males, tl. 45.2–52.3 mm, cl. 17.1–19.2 mm, Shangshuai town, Lianshan County, 14 July 2004.

**Diagnosis.** Rostrum extending beyond scaphocerite, distal part slightly curved upwards, rostral formula: 3–4 + 9–13/3–5, rl. about as long as cl. Cephalothorax, abdomen and telson smooth, without microspinules. Second pereopods equal in both sexes, carpus and outer margin of palm covered with microspinules; fingers of male about as long as palm, fingers of female shorter (about 0.83–0.92) than palm, movable finger with 2 small denticles, fixed finger with a single denticle; carpus longer than palm, about 1.3–1.5 times as long as palm, palm distinctly swollen, 3.5–3.6 times as long as width; carpus about 1.4–1.5 times as long as merus; merus about 0.91 times as long as ischium. Egg size: 0.54–0.70 X 0.84–0.92 mm in diameter.

**Live coloration.** Body translucent, light green. Rostrum transparent to almost colorless. Cephalothorax with blue-black diagonal strips, abdomen with blue-black transverse strips. Second pereopods with transversal yellow bands on merus and carpus. All joints of third to fifth pereopods with transverse yellow bands. Eggs e yellow (Fig. 7D).

**Remarks.** The present material can be confidently assigned to *M. inflatum* due to the very inflated palm, the ratio of the segments of the male second pereopods, the upturned rostrum and the rostral formula. Cai & Dai (1999) pointed out that *M. inflatum* was reported from Yunnan Province may be caused by human introduction. In recent years, we have however collected and examined numerous specimens of this species in various freshwater bodies from Hunan and Guangdong Province. It is usually found together with *M. nipponense*. Therefore this species may be naturally distributed in southeastern China. This is the first record of the species from Guangdong Province.

**Distribution and habitat.** Southeastern China (Jiangsu, Anhui, Hunan, Guangdong and Yunnan Provinces). This species is found in various freshwater bodies, such as ponds, rivers, lakes and reservoirs. It seeks shelter among aquatic vegetation.



**FIGURE 6.** Second pereiopod of *Macrobrachium meridionalis*. A, entire in outer view. B, entire in inner view. C, palm and fingers of male major second pereiopod (outer surface), showing groove on the palm.

***Macrobrachium maculatum* Liang & Yan, 1980**

(Fig. 7E)

*Macrobrachium maculatum* Liang & Yan, 1980: 31, figs. 8–14 [type locality: Yongan County, Fujian Province, eastern China]; Liu *et al.*, 1990: 114, fig. 12.



**FIGURE 7.** A, *M. heterorhynchos*, preserved specimen, paratype, female (FSTC, 02-06-11-05). B, *M. heterorhynchos*, preserved specimen, holotype, male (FSTC, 02-06-11-01). C, *M. formosense*, living specimen, male. D, *M. inflatum*, living specimen, female. E, *M. maculatum*, living specimen, male.

**Material examined.** 5 females, tl. 45.8–54.0 mm, cl. 12.0–18.3 mm, 4 males, tl. 35.6–75.8 mm, cl. 9.6–19.8 mm, Xijiang river near Foshan City, 7 July 2002; 4 females, tl. 40.8–65.0 mm, cl. 10.0–16.32 mm, 3 males, tl. 41.5–70.3 mm, cl. 8.7–22.2 mm, Xianxi reservoir near Dali Town, Nanhai District, Foshan City, 28 October 2001; 2 females, tl. 41.2–59.0 mm, cl. 13.0–19.2 mm, 1 male, tl. 87.5 mm, cl. 22.3 mm, near Shangshuai town, Lianshan County, Guangdong Province, 14 July 2004; 1 male, tl. 76.2 mm, cl. 21.5 mm, Lianzhou County, Guangdong Province, 16 July 2004.

**Diagnosis.** Rostrum reaching end of scaphocerite, the distal part slightly curved downwards, rostral formula: 3–5 + 6–9/3–5, rl. about 0.60–0.69 cl. Cephalothorax rough with microspinules, abdomen and telson smooth. Second pereopods equal in both sexes, all joints rough, covered with microspinules, finger about 0.56–0.67 times palm, cutting edge of fixed finger with 2 teeth at proximal, basal tooth formed of 2 or 3 denticles, moveable finger with 2 proximal teeth; carpus shorter than palm, about 0.75–0.89 times palm, about 1.1–1.2 times merus; merus about 1.3 times ischium. Egg size: 1.60–1.70 X 2.13–2.41 mm in diameter.

**Live coloration.** The body is very dark brown, cephalothorax with yellow diagonal stripes, and the abdomen has large spots (Fig. 7E).

**Remarks.** The present materials agree quite well with the original description and illustrations of Liang & Yan (1980) and Liu *et al.* (1990). This is the first record of the species in Guangdong Province. This species is widely distributed in southeastern China, having economic importance and usually found together with *M. nipponense*.

**Distribution and habitat.** Southeastern China (Anhui, Hunan, Fujian and Guangdong Provinces). This species inhabits freshwater and has been found in rivers, reservoirs and streams. It seeks shelter among aquatic vegetation.

## Acknowledgements

Gratefully acknowledged is extended to Prof. X. Q. Liang of Shanghai Fisheries University for substantial advice and encouragement. Special thanks to Dr. S. De Grave for correcting the earlier version of manuscript. We would to thank Dr. Y. X. Cai for the useful comments and suggestions that improved the manuscript. We also thank Prof. L. B. Holthuis, Dr K. I. Hayashi, Dr. S. De Grave, Mr. W. Klotz and Dr. S. Choy for providing us with essential literature.

## References

- Bate, C. S. (1868) On a new genus, with four new species of freshwater prawns. *Proceedings of the Zoological Society of London*, 1868, 363–368.
- Cai, Y. & Dai, Y. (1999) Freshwater shrimps (Crustacea: Decapoda: Caridea) from Xishuangbanna region of Yunnan Province, southern China. *Hydrobiologia*, 400, 211–241.
- Cai, Y. & Ng, P.K.L. (2002) The freshwater palaemonid prawns (Crustacea: Decapoda: Caridea) of Myanmar. *Hydrobiologia*, 487, 59–83.
- Cai, Y., Naiyaneter, P. & Ng, P. K. L. (2004) The freshwater prawns of the genus *Macrobrachium* Bate, 1868, of Thailand (Crustacea: Decapoda: Palaemonidae). *Journal of Natural History*, 38, 581–649.
- Chace, F. A. Jr. & Bruce, A. J. (1993) The caridean shrimps (Crustacea: Decapoda) of the Albatross Philippine expedition 1907–1910, Part 6: Superfamily Palaemonoidea. *Smithsonian Contributions Zoology*, 543, i–vii, 1–152.
- Dai, A.Y. (1984) A preliminary study on the freshwater prawn genus *Macrobrachium* of China (Decapoda: Caridea). *Acta Zootaxonomica Sinica*, 9 (3), 244–252.
- Dana, J. D. (1852) Conspectus Crustaceorum etc., Conspectus of the Crustacea of the Exploring Expedition under Captain C. Wilkes, U. S. N. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 6, 10–28.
- De Haan, W. (1833–1850) Crustacea. In: Von Siebold, P. F. (ed.), *Fauna Japonica sive Descriptio Animalium, quae in Itinere per Japoniam, Jussu et Auspiciis Superiorum, qui Summum in India Batava Imperium Tenent, Suscepto, Annis 1823–1830 Collegit, Notis, Observationibus et Adumbrationibus Illustravit*, (Lugduni–Batavorum: Leiden),

- De Man, J. G. (1879) On some species of the genus *Palaemon* Fabr. with description of two new forms. *Notes from the Leyden Museum*, 1 (41), 165–184.
- Heller, C. (1862) Neue Crustaceen, gesammelt während der Weltumseglung der K. K. Fregatte Novara: Zweiter Vorläufiger Bericht. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien*, 12, 519–528.
- Holthuis, L. B. (1950) The Decapoda of the Siboga expedition. Part 10. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. I. Subfamily Palaemonidae. *Siboga-Expeditie*, Leiden, 39a (9), 1–268.
- Jayachandran, K. V. & Raji, A. V. (2005) Three new species of *Macrobrachium* Bate, 1868 (Decapoda, Palaemonidae) from Western Ghats of Kerala State, India. *Crustaceana*, 77 (10), 1179–1192.
- Komai, T. & Fujita, Y. (2005) A new stygiobiont species of *Macrobrachium* (Crustacea: Decapoda: Caridea: Palaemonidae) from an anchialine cave on Miyako Island, Ryukyu Islands. *Zootaxa*, 1021, 13–27.
- Li, X. Z., Liu, R. Y., Liang, X. Q. & Chen, G. X. (2007) Crustacea, Decapoda, Palaemonoidea. Invertebrate, Vol. 44, *Fauna Sinica*, 1–381 [In Chinese with English abstract].
- Liang, X. Q. & Yan, S. L. (1980) Description of two new species of *Macrobrachium* (Decapoda Caridea) from Fujian, China. *Acta Zootaxonomica Sinica*, 5(1), 30–34 [In Chinese with English abstract].
- Liang, X. Q. & Yan, S. L. (1983) New species and new records of freshwater shrimps (Crustacea Decapoda) from Hainan Island, China. *Oceanologia et Limnologia Sinica*, 14(3), 211–216 [In Chinese with English abstract].
- Liang, X. Q. & Yan, S. L. (1985) New species and new record of Palaemoninae from China (Crustacea Decapoda). *Acta Zootaxonomica Sinica*, 10(3), 253–258 [In Chinese with English abstract].
- Liu, R. Y. (1957) *Palaemon* and *Macrobrachium*. *Bulletin Biology*, 6, 14–23 [In Chinese only].
- Liu, R. Y., Liang, X. Q. & Yan, S. L. (1990) A study of the Palaemoninae (Crustacea Decapoda) from China I. *Macrobrachium*, *Leander* and *Leandrites*. *Transactions of the Chinese Crustacean Society*, No. 2, 102–134 [In Chinese with English abstract].
- Parisi, B. (1919) Decapodi Giapponesi del Museo di Milano VII. Natantia. *Atti della Societa Italiana di Scienze Naturali*, 58, 59–99.
- Shokita, S. (1979) The distribution and speciation of the inland water shrimps and prawns from the Ryukyu Island-II. *Bulletin of Science and Engineering Division, University of the Ryukyus*, No. 28, 193–278.
- Short, J. W. (2004) A revision of Australian river prawn, *Macrobrachium* (Crustacea: Decapoda: Palaemonidae). *Hydrobiologia*, 525, 1–100.
- Shy, J. Y. & Yu, H. P. (1998) Freshwater shrimps of Taiwan. *National Museum of Biology and Aquarium*, 103 pp. [In Chinese].
- Suzuki, H., Tanigawa, N., Nagatomo, T. & Tsuda, E. (1993) Distribution of freshwater caridean shrimps and prawns (Atyidae and Palaemonidae) from Southern Kyushu and adjacent islands, Kagoshima Prefecture, Japan. *Crustacean Research*, 22, 55–64.
- Tan, Q. & Dong, X. (1996) A study on *Macrobrachium* from Anhui province, China (Decapoda: Palaemonidae). *Acta Zootaxonomica Sinica*, 21(3), 287–290 [In Chinese with English abstract].
- Von Martens, E. (1868) Über einige ostasiatische Susswasserthiere. *Archiv für Naturgeschichte, Berlin*, 34(1), 1–67.
- Wowor, D & Choy, S. C. (2001) The freshwater prawns of the genus *Macrobrachium* Bate, 1868 (Decapoda: Decapoda: Palaemonidae) from Brunei Darussalam. *The Raffles Bulletin of Zoology*, 49(2), 269–289.
- Yeo, D. C. J., Cai, Y. & Ng, P. K. L. (1999) The freshwater and terrestrial decapod crustacea of Pulau Tioman, Peninsular Malaysia. *The Raffles Bulletin of Zoology (Supplement)*, No. 6, 197–244.
- Yu, S. C. (1931) Note sur les crevettes chinoises appartenant au genre *Palaemon* Fabr. avec description de nouvelles espèces. *Bulletin de la Societ Zoologique de France*, 56(3), 269–288.
- Zhang, J. & Sun, X. (1981) A preliminary investigation on the middle and lower reaches of the Yangtze River. *Chinese Journal Zoology*, 4, 2–6 [In Chinese with English abstract].