

Three Penaeid Species (Crustacea, Decapoda, Penaeidae) from the Southeastern Coast of Korea

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Three penaeid species, *Penaeus monodon*, *P. semisulcatus* and *Metapenaeopsis lata* are reported from the southeastern coast of Korea. *P. monodon* and *P. semisulcatus* have been incorrectly known so far as *P. bubulus* and *P. monodon*, respectively, in Korea. *M. lata* is the first record of this species from Korean waters. Morphological diagnoses are given with coloration and distribution for the three species.

Key words: Decapoda, Penaeidae, *Penaeus monodon*, *Penmaeus semisulcatus*,
Metapenaeopsis lata, Taxonomy, Korea, Intersex anomaly

Introduction

Penaeid shrimps are widely distributed from tropical to temperate regions, mainly in shallow inshore waters. About 226 species of penaeids are now known in the world (Pérez Farfante and Kensley, 1997). Many of them are of high economic value and also form the major basis of commercial shrimp fisheries (Holthuis, 1980). In Korean waters, 15 species of penaeid shrimps have been known (Kim, 1977; Cha et al., 2001).

Recent collections from the southeastern coastal waters of Korea revealed the presence of three penaeid species, *Penaeus monodon* Fabricius, 1798, *P. semisulcatus* De Haan, 1844, and *Metapenaeopsis lata* Kubo, 1949. Of these, the first two species were reported by Yoshida (1941) only once with brief descriptions and pictures based on actual material from Korean waters; the former was reported as *P. carinatus* Dana, 1852. Yoshida's *P. monodon* (as *P. carinatus*) and *P. semisulcatus*, however, were sy-

nonymous with *P. bubulus* and *P. monodon* by Kubo (1949), respectively. His opinion has been followed by Korean authors (e.g., Kim and Park, 1972; Kim, 1976; 1977; Kim and Kim, 1997), though it has not been accepted by foreign authors (e.g., Dall, 1957; Liu and Zhong, 1988). The last species, *M. lata*, was previously known from the Pacific coast of southern Japan, East China Sea and South China Sea (Hayashi, 1986; Liu and Zhong, 1988), but has not been recorded from Korean waters so far.

The present study confirms that *P. monodon* and *P. semisulcatus* occur in Korean waters and *M. lata* is new to the Korean carino fauna. A morphological diagnosis and illustrations with a color photograph are given for all species. Intersex anomaly in *P. monodon* and *P. semisulcatus* is also observed.

Materials and Methods

Specimens examined in this study are deposited in the Laboratory of Invertebrate Zoology, Department of Marine Biology, Pukyong National Uni-

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versity (PUIZ).

Postorbital carapace length (CL) measured from the posterior margin of orbit to the posterior mid-dorsal margin of carapace, is used as an indication of the size of the specimens. Measurements and terminology mainly followed Pérez Farfante and Kensley (1997).

Systematic Accounts

Penaeus monodon Fabricius, 1798 (Figs. 1, 4A)

Restricted synonymy

Penaeus monodon Fabricius, 1798: 408 [neotype designated by Holthuis (1949); type locality: Bay of Batavia (=Jakarta), Indonesia]; Kishinouye, 1900: 15, pl. 2, fig. 1, pl. 7, fig. 3, 3A; Holthuis, 1949: 1055; Dall, 1957: 152, fig. 5A-E; Yu and Chan, 1986: 97, 3 unnumbered figs.; Pérez Farfante and Kensley, 1997: 133 (list), figs. 80, 81.

Penaeus carinatus Dana, 1852: 602, pl. 40, fig. 2; Yoshida, 1941: 11, text-fig. 4, pl. 2, fig. 1.

Penaeus (Penaeus) monodon—Hayashi, 1986: 73, 247, unnumbered fig.; 1992: 132, figs. 68g, 69g, 71e; Liu and Zhong, 1988: 106, text-fig. 46, pl. 1, fig. 4.

Penaeus bubulus Kubo, 1949: 296, figs. 1G, 7B, 15 U-B', 24K-M, 37, 49C, 53, 58D, 67N-Q, 73F, L, 77P, 114; Kim and Park, 1972: 190; Kim, 1976: 134; 1977: 116, text-fig. 20, pl. 41, fig. 5; Kim and Kim, 1997: 212 (list).

Material examined

Neung-po, Geoje Island, 20~30 m, gill net, 21 Nov. 2001, coll. S.T. Kim, 1♂ (CL 35.3 mm), 1♀ (CL 49.2 mm), PUIZ 142.

Diagnosis

Body glabrous. Rostrum slightly sinuous, moderately upward distally, slightly reaching beyond distal margin of antennular peduncle, with 6 dorsal teeth (2 teeth on carapace) and 3 ventral teeth; epigastric tooth slightly more separated from posterior-most tooth of rostral series than distance between posterior-most tooth and its frontal tooth of rostral series; adrostral sulcus short, reaching epigastric tooth; postrostral carina long, reaching almost posterior

margin of carapace, with feeble indication of median sulcus. Carapace with antennal and hepatic spines, lacking orbital and pterygostomial spines; gastro-orbital carina short, extending anteriorly half of distance from hepatic spine to orbital margin; antennal carina well-marked; hepatic carina prominent, nearly parallel with dorsal margin of carapace; cervical carina short. Second and 3rd abdominal somites without middorsal carina, 4th somite with middorsal carina on posterior half, 5th and 6th somites with middorsal carina on whole length; 6th somite stout and short, about 2.00 times as long as posterior deep, bearing 3 cicatrices. Telson unarmed. Antennule lacking distolateral spine (parapenaeid spine) on 1st segment. Fifth pereopod with pleurobranchia, lacking exopod. Petasma symmetrical, anterior median lobe small, not projecting as far as lateral lobes. Thelycum composed of 2 lateral plates; anterior process rounded distally, posterior process large, with bluntly pointed portion inserted between lateral plates for about third of its length.

Coloration

Body dark brown and blackish-green; abdomen with mud-yellow and brownish-black transverse cross bands on posterior half; antennal flagella uniformly light brown; thoracic appendages same color as body but distal parts light brown; pleopods dark purple with bases bright yellow and blue; distal part of uropods dark blue or brown (Fig. 4A).

Distribution

Widely distributed in the Indo-West Pacific from the eastern coast of Africa to the Red Sea, Pakistan, Malay Archipelago, Philippines, Taiwan, Japan, Korea, northern Australia and Fiji (Yu and Chan, 1986; Pérez Farfante and Kensley, 1997). Found subtidally to a depth of 150 m but usually found shallower than 30 m (Chan, 1998). Commercially important in India and South East Asia (Holthuis, 1980). Rather rare in Korea and Japan (Hayashi, 1986); in Korea, occurs only around southeastern coast at autumn (Yoshida, 1941; present study).

Remarks

Holthuis (1949) extensively discussed *Penaeus monodon* based on the previous literatures and designated a neotype of this species, because the real

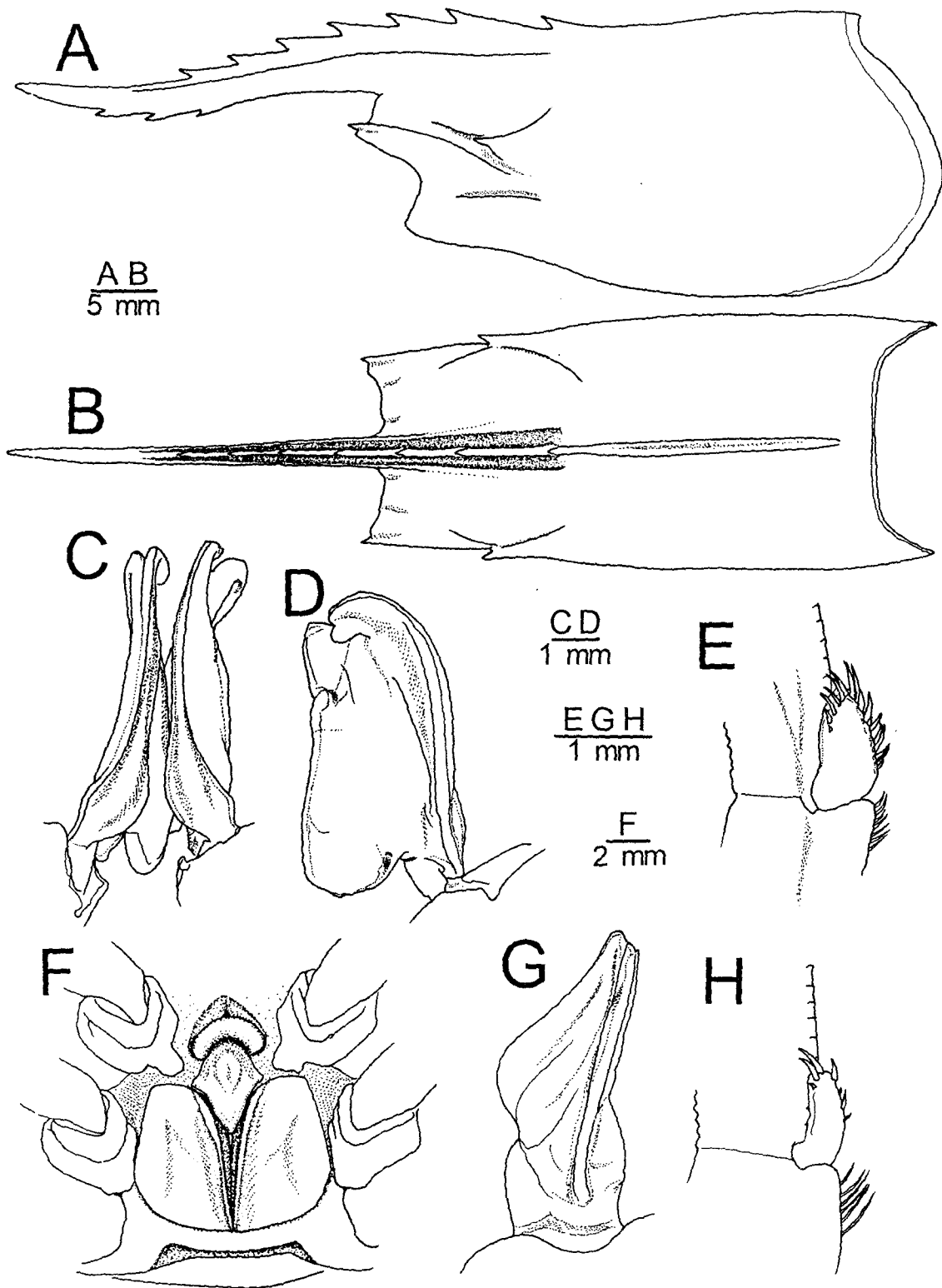


Fig. 1. *Penaeus monodon* Fabricius, 1798. A~E, male (CL 35.3 mm; PUIZ 142) from Neung-po, Geoje Island; F~H, female (CL 49.2 mm; same lot) from same locality. A, carapace, lateral; B, same, dorsal; C, petasma, ventral; D, same, mesial; E, left appendix masculina, ventral; F, thelycum, ventral; G, left petasma, ventral; H, left appendix masculina, ventral.

type of Fabricius (1789) was lost and its taxonomic status was confused with *P. semisulcatus* De Haan, 1849. The present material agrees well with Holthuis' (1949) description of this species in having the 5th pereopod without an exopod, the median sulcus of the rostral carina more or less distinct (Fig. 1B), and the cervical carina feebly indicated (Fig. 1A).

In Korea, Yoshida (1941) reported the present species (as *P. carinatus* Dana, 1852) on the basis of actual material. However, Kubo (1949) considered that Yoshida's *P. carinatus* (= *P. monodon*) was identified as his new species, *P. bubulus* Kubo, 1949. His opinion has been followed by the Korean authors (e.g., Kim and Park, 1972; Kim, 1976; 1977; Kim and Kim, 1997) without any actual examination of the specimens. Dall (1957) pointed out that Kubo (1949) erroneously assigned *P. monodon* to his new species, *P. bubulus*, which has partly been responsible for the confusion between *P. monodon* and *P. semisulcatus*, as indicated by Holthuis (1949). Consequently, Dall's (1957) conclusion, in which Kubo's (1949) *P. bubulus* was synonymized with *P. monodon*, was accepted by many foreign authors (e.g., Holthuis, 1980; Liu and Zhong, 1988; Hayashi, 1992; Chan, 1998). We also follow Dall's (1957) conclusion because *P. bubulus* has the following characters identified with those of *P. monodon*: the adrostral carina reaches two-fifths of the carapace, the gastro-orbital carina occupies the posterior about half the distance between the orbital margin and hepatic spine, the hepatic carina horizontally straight, and the 5th pereopod without an exopod.

The female specimen (CL 49.2 mm) has a fully developed thelycum (Fig. 1F), but the first pleopod has a small petasma (Fig. 1G) and the second pleopod bears a moderately developed appendix masculina (Fig. 1H). This may be the first example of intersex anomaly in *P. monodon*, though it is known in some penaeid species: *Metapenaeus monoceros* by George (1963), *Penaeus setiferus* (= *Litopenaeus setiferus*) by Rigdon et al. (1975), *Penaeopsis rectacuta* by Pérez Farfante (1978), and *Penaeus vannamei* (= *Litopenaeus vannamei*) by Pérez Farfante and Robertson (1992).

Penaeus semisulcatus De Haan, 1844
(Figs. 2, 4B)

Restricted synonymy

Penaeus semisulcatus De Haan, 1844: 191, pl. XLVI, fig. 1 [type locality: Japan]; Yoshida, 1941: 10, text-fig. 3, pl. 1, fig. 2; Holthuis, 1949: 1056; Dall, 1957: 154, fig. 6A-E; Yu and Chan, 1986: 94, unnumbered fig.; Pérez Farfante and Kensley, 1997: 133 (list).

Penaeus ashiaka Kishinouye, 1900: 14, pls. 3, 7, fig. 4, 4A, 4B.

Penaeus (*Penaeus*) *semisulcatus*—Hayashi, 1986: 75, 248, unnumbered fig.; 1992: 133, figs. 4d, 6, 7a, 68h, 69h, 71f; Liu and Zhong, 1988: 108, pl. 1, fig. 1.

Penaeus monodon—Kubo, 1949: 291, figs. 1F, 7D, 15M-T, 20A, 24H-J, 38, 49B, 54, 58C, 67E-G, 73 E, 73K, 77N, 113; Kim and Park, 1972: 190; Kim, 1976: 134; 1977: 114, text-fig. 19, pl. 41, fig. 4; Kim and Kim, 1997: 212 (list). [Not Fabricius, 1798].

Material examined

Neung-po, Geoje Island, 20~30 m, gill net, 21 Nov. 2001, coll. S.T. Kim, 2♂ (CL 33.0, 34.0 mm), 2♀ (CL 31.5, 33.9 mm), PUIZ 143.

Diagnosis

Body glabrous. Rostrum nearly straight, slightly upward distally, reaching distal margin of antennular peduncle, with 6~7 dorsal teeth (2 teeth on carapace) and 3 ventral teeth; epigastric tooth slightly more separated from posterior-most tooth of rostral series than distance between posterior-most tooth and its frontal tooth of rostral series; adrostral sulcus relatively long, reaching beyond epigastric tooth; postrostral carina long, reaching almost posterior margin of carapace, with distinct median sulcus. Carapace with antennal and hepatic spines, lacking orbital and pterygostomian spines; gastro-orbital carina relatively long, extending anteriorly two-thirds of distance from hepatic spine to orbital margin; antennal carina well-marked; hepatic carina prominent, inclined at about 30° with respect to dorsal margin of carapace; cervical carina long but not reaching dorsal margin of carapace. Second and 3rd abdominal somites without middorsal carina, 4th somite with middorsal carina on posterior half, 5th and 6th somites with middorsal carina on whole length; 6th somite stout and short, about 1.60 times

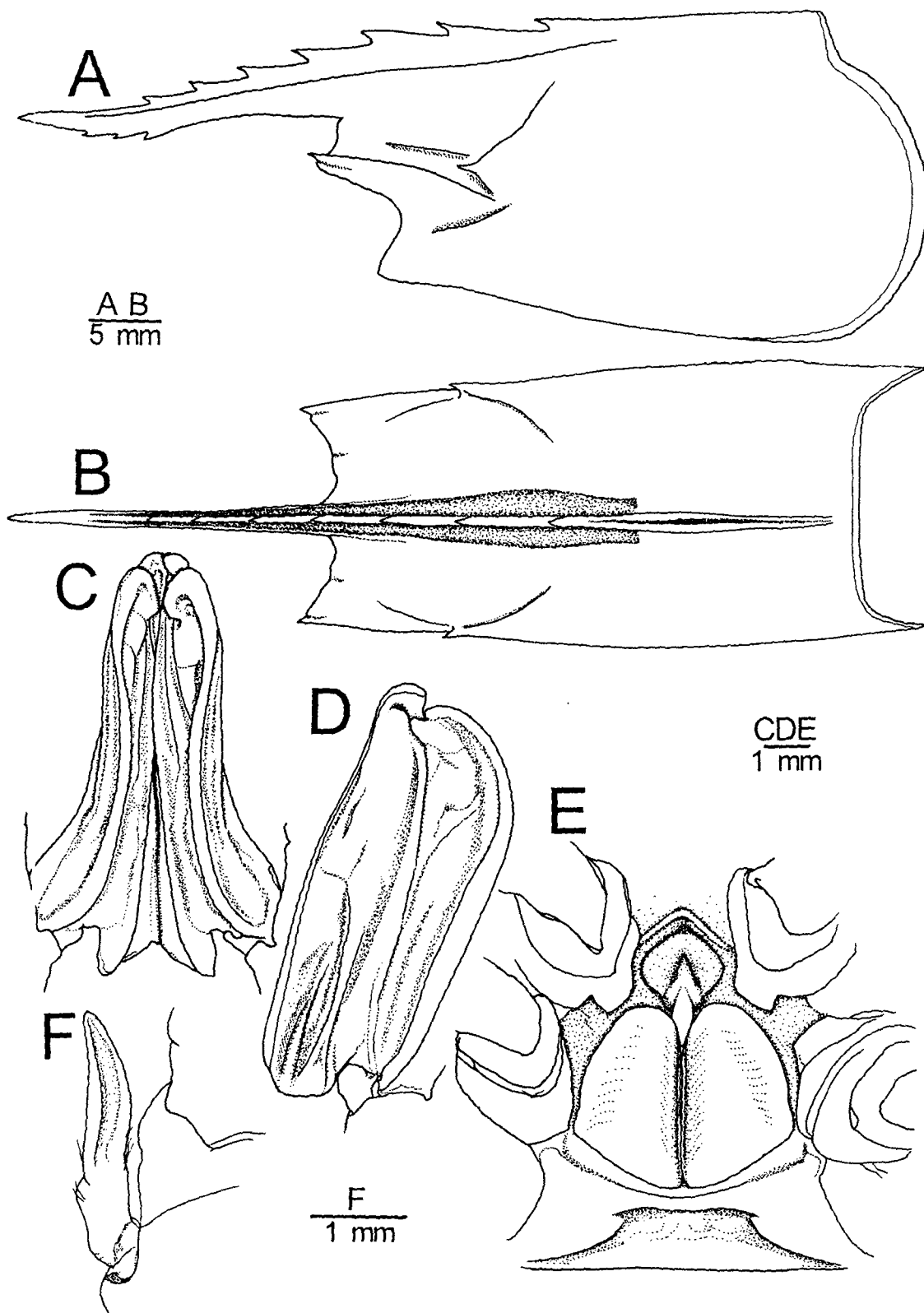


Fig. 2. *Penaeus semisulcatus* De Haan, 1844. A, B, male (CL 34.0 mm; PUIZ 143) from Neung-po, Geoje Island; C, D, male (CL 33.0 mm; same lot) from same locality; E, F, female (CL 31.5 mm; same lot) from same locality. A, carapace, lateral; B, same, dorsal; C, petasma, ventral; D, same, mesial; E, thelycum, ventral; F, left petasma, ventral.

as long as posterior deep, bearing 3 cicatrices. Telson unarmed. Antennule lacking distolateral spine (parapenaeid spine) on 1st segment. Fifth pereopod with pleurobranchia and exopod. Petasma symmetrical, anterior median lobe slightly overhanging lateral lobes. Thelycum composed of 2 lateral plates; anterior process broadened distally, posterior process small, with bluntly pointed portion inserted between lateral plates for about one-fourth of its length.

Coloration

Body red-brown or dark green with greenish brown transverse bands, especially that of anterior part of sixth abdominal somite obliquely inclined; antennal flagella alternated with white and brown bands; thoracic appendages and pleopods dull red, spotted with white markings; distal part of uropods dark reddish-brown (Fig. 4B).

Distribution

Indo-West Pacific region from the eastern coast of Africa and the Red Sea to Japan, Korea, Malay Archipelago and northern Australia, and also penetrating into the eastern Mediterranean through the Suez Canal (Yu and Chan, 1986; Pérez Farfante and Kensley, 1997). Found subtidally to a depth of 130 m but usually found shallower than 60 m (Chan, 1998). Abundant in the seas around Southeast Asian countries and Japan (Holthuis, 1980), but rare in Korea where it is found only around the southeastern coast during autumn (Yoshida, 1941; present study).

Remarks

The specific status of *P. semisulcatus* which has been confused with that of *P. monodon* was rectified by the designation of a neotype by Holthuis (1949). The present specimens agree with Holthuis' (1949) diagnosis of *P. semisulcatus* in having the following characters: the 5th pereopod with an exopod, the median sulcus of the rostral carina always distinct (Fig. 2B), and the cervical carina much stronger and sharper than in *P. monodon* (Fig. 2A).

The present species was first reported in Korean waters by Yoshida (1941) based on actual material. After that, Yoshida's (1941) *P. semisulcatus* was

synonymous with *P. monodon* by Kubo (1949) and his opinion was followed by the Korean authors (e.g., Kim and Park, 1972; Kim, 1976; 1977; Kim and Kim, 1997). Kubo's (1949) *P. monodon* has the following features: the adrostral carina reaches three-fifths of the carapace, the gastro-orbital carina occupies the posterior about two-thirds the distance between the orbital margin and the hepatic spine, the hepatic carina straight but anteriorly inclined downwards, and the 5th pereopod with an exopod. These features surely represent those of *P. semisulcatus*. Therefore, Kubo's (1949) *P. monodon* is synonymized with *P. semisulcatus* as indicated by foreign authors (e.g., Dall, 1957; Liu and Zhong, 1988).

Penaeus semisulcatus can be distinguished from *P. monodon* by the following differences: (1) the rostrum nearly straight and slightly upward distally in *P. semisulcatus* (Fig. 2A) rather than slightly sinuous and moderately upward distally in *P. monodon* (Fig. 1A); (2) the adrostral sulcus reaches beyond the epigastric spine in *P. semisulcatus* (Fig. 2B), whereas it just reaches the epigastric spine in *P. monodon* (Fig. 1B); (3) the postrostral carina is fully sulcated in *P. semisulcatus* (Fig. 2B), whereas it is feebly or partially sulcated in *P. monodon* (Fig. 1B); (4) the gastro-orbital carina extends anteriorly two-thirds of the distance from the hepatic spine to the posterior orbital margin in *P. semisulcatus* (Fig. 2A), whereas it extends half of the distance in *P. monodon* (Fig. 1A); (5) the hepatic carina is inclined at about 30° with respect to the dorsal margin of the carapace in *P. semisulcatus* (Fig. 2A) rather than nearly parallel in *P. monodon* (Fig. 1A); (6) the cervical carina in *P. semisulcatus* (Fig. 2A) is longer than in *P. monodon* (Fig. 1A); (7) the 5th pereopod bears a small exopod in *P. semisulcatus* but lacks an exopod in *P. monodon*; (8) the anterior median lobe of the petasma slightly overhangs the lateral lobes in *P. semisulcatus* (Fig. 2C, D), whereas it does not project as far as the lateral lobes in *P. monodon* (Fig. 1C, D); and (9) the posterior process of the thelycum is small with the bluntly pointed portion inserted between the lateral plates for about one-fourth of its length in *P. semisulcatus* (Fig. 2E), whereas it is large with the bluntly pointed portion inserted between the lateral plates for about one-

third of its length in *P. monodon* (Fig. 1F). In terms of colorations, in *P. semisulcatus* the pereopods and pleopods have prominent white markings (Fig. 4B), whereas in *P. monodon* such areas are always yellow or brown (Fig. 4A). The anterior part of the sixth abdominal somite in *P. semisulcatus* (Fig. 4B) bears an obliquely inclined band but lacks this band in *P. monodon* (Fig. 4A).

The two female specimens (CL 31.5, 33.9 mm), which have the fully-developed thelyca (Fig. 2E), bear a small petasma (Fig. 2F) on the first pleopod but lack an appendix masculina on the 2nd pleopod. In *P. semisulcatus*, this intersex anomaly has been reported twice, by Subrahmanyam (1966) from the Chilka Lake, India and by Raman and Gopinathan (1977) from Lake Pulicat, India.

Metapenaeopsis lata Kubo, 1949

(Figs. 3, 4C)

Korean name: Godun-pul-kal-kal-sewoo

Restricted synonymy

Metapenaeopsis latus Kubo, 1949: 434, figs. 8G, 46 G, 76N, 76T, 81B, 148H, 150 [type locality: off Nagashima, Mie Pref., Pacific coast of southern Japan].

Metapenaeopsis lata—Hayashi, 1986: 61, 241, unnumbered fig.; 1992: 89, figs. 47c, 48c, 49c, 50c; Crosnier, 1987: 437, figs. 14b, 16a, 17, 18a, 19a, 19b; Liu and Zhong, 1988: 240, fig. 146; Pérez Farfante and Kensley, 1997: 106 (list).

Metapenaeopsis dalei—Cha et al., 2001: 44 (color photograph only). [Not Rathbun, 1902].

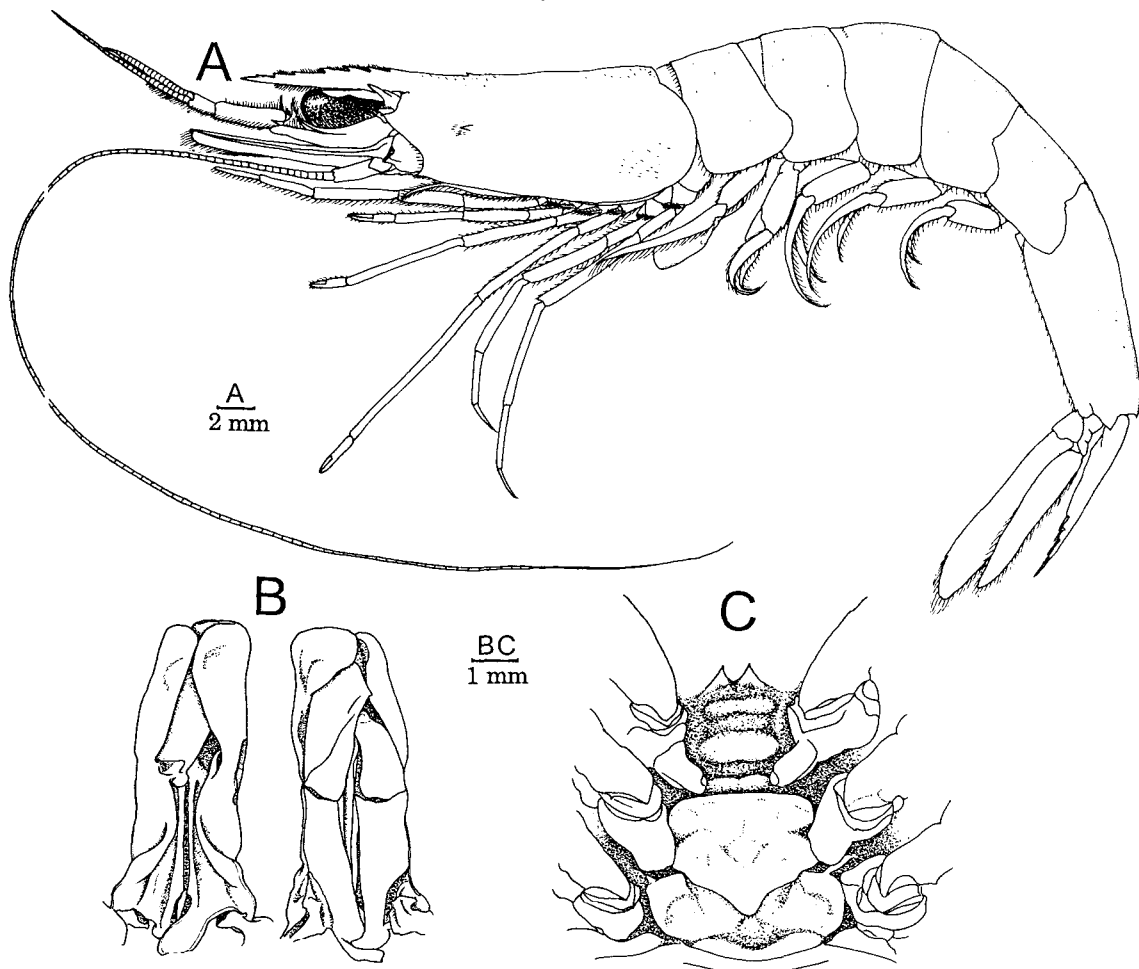


Fig. 3. *Metapenaeopsis lata* Kubo, 1949. A, B, male (CL 13.1 mm; PUIZ 141) from off Geoje Island, Korea Strait; C, female (CL 19.7 mm; PUIZ 120) from off Ulsan, Korea Strait. A, entire animal, lateral; B, petasma, ventral (left) and dorsal (right); C, thelycum.

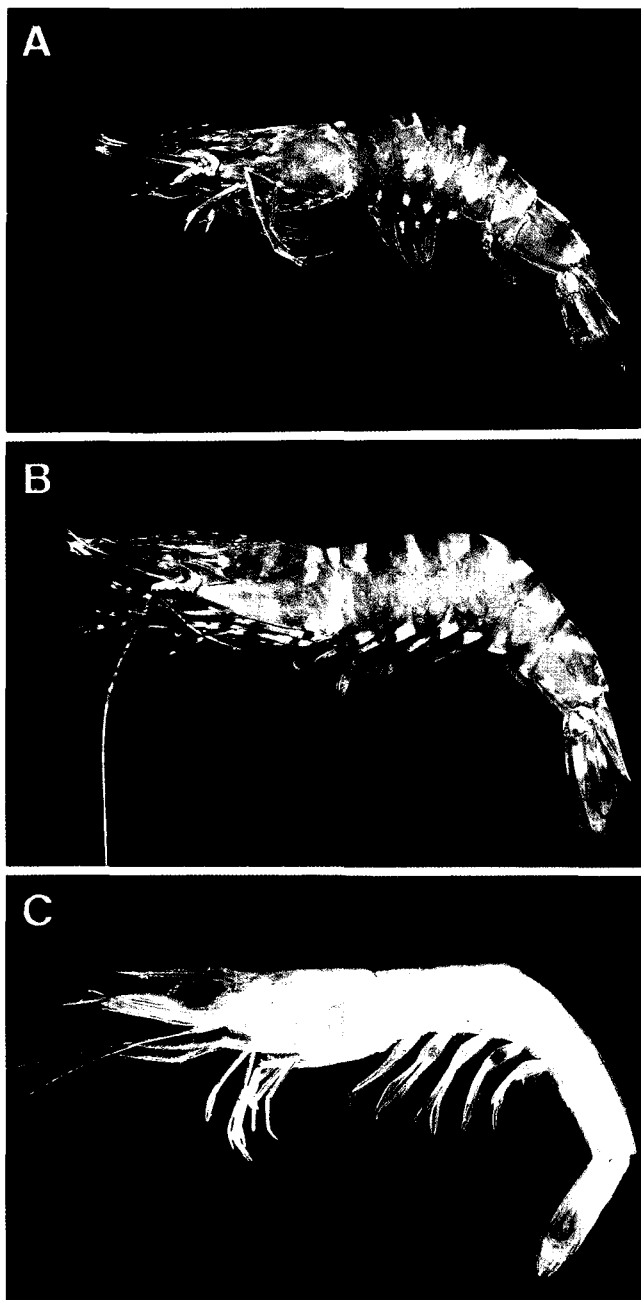


Fig. 4. Three penaeid species from the southeastern coast of Korea. A, *Penaeus monodon* Fabricius, 1798, male (CL 35.3 mm; PUIZ 142) from Neung-po, Geoje Island; B, *Penaeus semisulcatus* De Haan, 1844, male (CL 34.0 mm; PUIZ 143) from same locality; C, *Metapenaeopsis lata* Kubo, 1949, female (CL 17.5 mm; PUIZ 144) from off Gori, Korea Strait.

Material examined

Off Ulsan, Korea Strait, 35°40'99"N, 129°43'80"E, 120 m, otter trawl, 20 Mar. 1996, coll. J.H. Choi, 1♀

(CL 19.7 mm), PUIZ 120. -Off Geoje Island, Korea Strait, 65 m, beam trawl, 1 June 2001, coll. J.N. Kim, 3♂ (CL 12.9~14.5 mm), 1♀ (CL 13.0 mm), PUIZ 141. -Off Gori, Korea Strait, 50~60 m, beam trawl, 24 Jan. 2002, coll. Marine Nekton Laboratory, Pukyong National University, 1♀ (CL 17.5 mm), PUIZ 144. -Off Gori, Korea Strait, 50~60 m, beam trawl, 24 Apr. 2002, coll. Marine Nekton Laboratory, Pukyong National University, 4♂ (CL 11.1~12.3 mm), 4♀ (CL 10.5~11.8 mm), PUIZ 145.

Diagnosis

Body pubescent. Rostrum straight, reaching distal margin of 3rd segment of antennular peduncle in large specimens to slightly falling short of distal margin of 2nd segment of antennular peduncle in small specimens, with 6~8 dorsal teeth and no ventral tooth; epigastic tooth considerably separated from posterior most tooth of rostral series; adrostral sulcus not defined but lateral carina of rostrum well-defined; postrostral carina short, extending about midpoint of carapace. Carapace with orbital, antennal, pterygostomian and hepatic spines; antennal carina feeble; gastro-orbital, cervical and hepatic carinae absent. Second abdominal somite with short middorsal carina on anterior part; 3rd to 6th somites with middorsal carina on whole length; 6th somite slender and long, more than 2.5 times as long as posterior deep, lacking cicatrices. Telson with 3 movable and 1 fixed teeth on lateral margin. Antennule bearing distolateral spine (parapenaeid spine) on 1st segment. Fifth pereopod with exopod but without pleurobranchia. Petasma asymmetrical, right piece rod-like with smooth apex; left piece swollen and smooth distally, longer than right piece. Thelycum composed of only central plate fused with transverse ridge, making narrow tongue-like process posteriorly; 8th thoracic sternite with short and wide sunken spaces.

Coloration

Body, including all appendages, light brown, scattered with irregular patches of reddish-brown; base of pleopods and distal half of uropods pale red (Fig. 4C).

Distribution

Known from the Pacific coast of southern Japan,

South China Sea, East China Sea, and Korea Strait (Hayashi, 1986; Liu and Zhong, 1988; present study). Found at depths between 103~472 m (Liu and Zhong, 1988) and 50~120 m (present study). The present specimens represent the first record of this species from Korean waters and have extended the bathymetric range slightly upward.

Remarks

Present specimens agree well with Kubo's (1949) original description of *Metapenaeopsis lata* except for the length of the antennular flagella. Kubo (1949) described, for only females, that the lower antennular flagellum is 0.66 times as long as the carapace. However, the length of the antennular flagella usually shows sexual dimorphism in penaeid species. In the present specimens, the lower antennular flagellum is 0.73~0.81 times as long as carapace in males (Fig. 3A) and 0.61~0.68 times in females.

In the genus *Metapenaeopsis*, the following 3 species have been reported from Korean waters (Kim, 1977; Cha et al., 2001): *M. barbata* (De Haan), *M. dalei* (Rahbun) and *M. provocaris longirostris* Crosnier. The present species sympatrically occurs with *M. provocaris longirostris* and the coloration of these two species is similar to each other. However, *M. lata* differs from the latter in females by the short posterior extension of the median plate of the thelycum (Fig. 3C). In *M. provocaris longirostris*, the posterior extension is longer than that of *M. dalei*. In males, the left piece of the petasma is rounded distally in *M. lata* (Fig. 3B) but pointed in *M. provocaris longirostris*.

The color photograph of "*M. dalei*" by Cha et al., (2001: p. 44), which takes the entire animal in lateral view, agrees quite well with the present one (Fig. 4C). Therefore, there is little doubt that Cha et al.'s (2001) photograph is of *M. lata*, not *M. dalei*, though the other figures and description are based on *M. dalei*.

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