

Three Species of Gammaridean Amphipods (Crustacea) Associated with Cultured Abalones (Gastropoda) in Korea

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ABSTRACT

Three species of gammaridean amphipods are reported from four cultured abalones in Jeju Island, Korea. These amphipods are *Ampithoe valida* Smith, *Elasmopus rapax* Costa, and *Melita rylovae* Bulycheva which were found from the abalones *Haliotis discus hannai* Ino, *H. discus discus* Reeve, *H. diversicolor aquatilis* Reeve, and *H. sieboldii* Reeve. *Elasmopus rapax*, a new record to Korean fauna, is described in detail. Other two gammaridean species are briefly described with diagnostic characters. These amphipods and abalones revealed no species-specific relationship and are considered to be simple and accidental associates.

Key words: Amphipoda, Ampithoidae, Melitidae, association, abalones, *Haliotis*

INTRODUCTION

Association between the gammaridean amphipods and the gastropods has been very rarely recorded. Lowry and Stoddart (1998) found a new species of gammaridean *Haliogeneia crosnieri* living in the abalone *Haliotis rubra* Leach in southeastern Australia. As far as we are aware, no other amphipods has been recorded as associate of the gastropods.

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Recently we found three species of gammarideans living in the mantle cavity of abalones cultured in the Shellfish Genetic and Breeding Research Institute located at Hallim in Jeju Island. These gammarideans were identified as *Ampithoe valida* Smith, *Elasmopus rapax* costa, and *Melita rylovae* Bulycheva. One of them, *Elasmopus rapax* is found to be a new record in Korea and is fully described. Other two species are briefly described with diagnostic characters.

The studies gammaridean materials were collected from the culture panels in aquaria at the above Institute. While taking out the submerged culture panels attached by the abalones from water, the gammarideans came out from the abalones. These gammarideans were brushed and moved to bottles containing 80% ethanol.

DESCRIPTIONS

Family Ampithoidae Stebbing, 1899

****Ampithoe valida* Smith, 1873 (Fig. 1)**

Ampithoe valida: Barnard, 1954, p. 34, pl. 31; Nagata, 1960, p. 176, pl. XVI, figs. 97 & 98; Nagata, 1965, p. 314, fig. 38A-B; Hirayama, 1983, p. 117, fig. 25; Kim & Kim, 1987, p. 4, fig. 3.

Ampithoe valida valida: Kim & Kim, 1988, p. 109, fig. 2B.

Material examined. 1 ♀ from the abalone *Haliotis discus hannai* Ino, 9 Aug. 2004, collected by I.-H. Kim from the culture aquarium of the Shellfish Genetic and Breeding Research Center, at Hallim in Cheju Island.

Female. Body (Fig. 1A) 11.7 mm long (from rostrum to posterior end of urosomite 3). Eye black.

Gnathopod 1 (Fig. 1B) subchelate, slightly smaller than gnathopod 2; basis nearly 3 times as long as ischium, with quadrate anterodistal lobe; ischium slightly shorter than merus; carpus slightly shorter than propodus, widened in middle, with setiferous posterior margin; propodus with roundly convex posterior margin and oblique palm.

Gnathopod 2 (Fig. 1C) subchelate; basis more expanded than gnathopod 1, with round anterodistal lobe, widened distally; merus slightly shorter than carpus; carpus with slightly pointed posterior edge; propodus 2 times as long as ischium, more expanded than in gnathopod 1, with oblique palm.

Pereopod 5 (Fig. 1D) with basis slightly widened and rounded; merus longer than carpus; propodus nearly 2 times as long as ischium, with 4 spines on posterior margin. Pereopod 6 (Fig. 1E) with basis longer than broad, bearing small posterodistal projection; merus 2.4 times as long as ischium, longer than carpus, but shorter than propodus; propodus slender and long, with 6 spines on anterior margin.

Peduncle of uropod 3 (Fig. 1F) 2 times as long as rami, with plumose setae on ventral margin, and 4 distal and 2 dorsal spines; inner ramus with spines and setae apically, 4 subterminal spines and 1 lateral short spine; outer and inner rami nearly similar in length, with 2 hook-like apical spines on outer ramus.

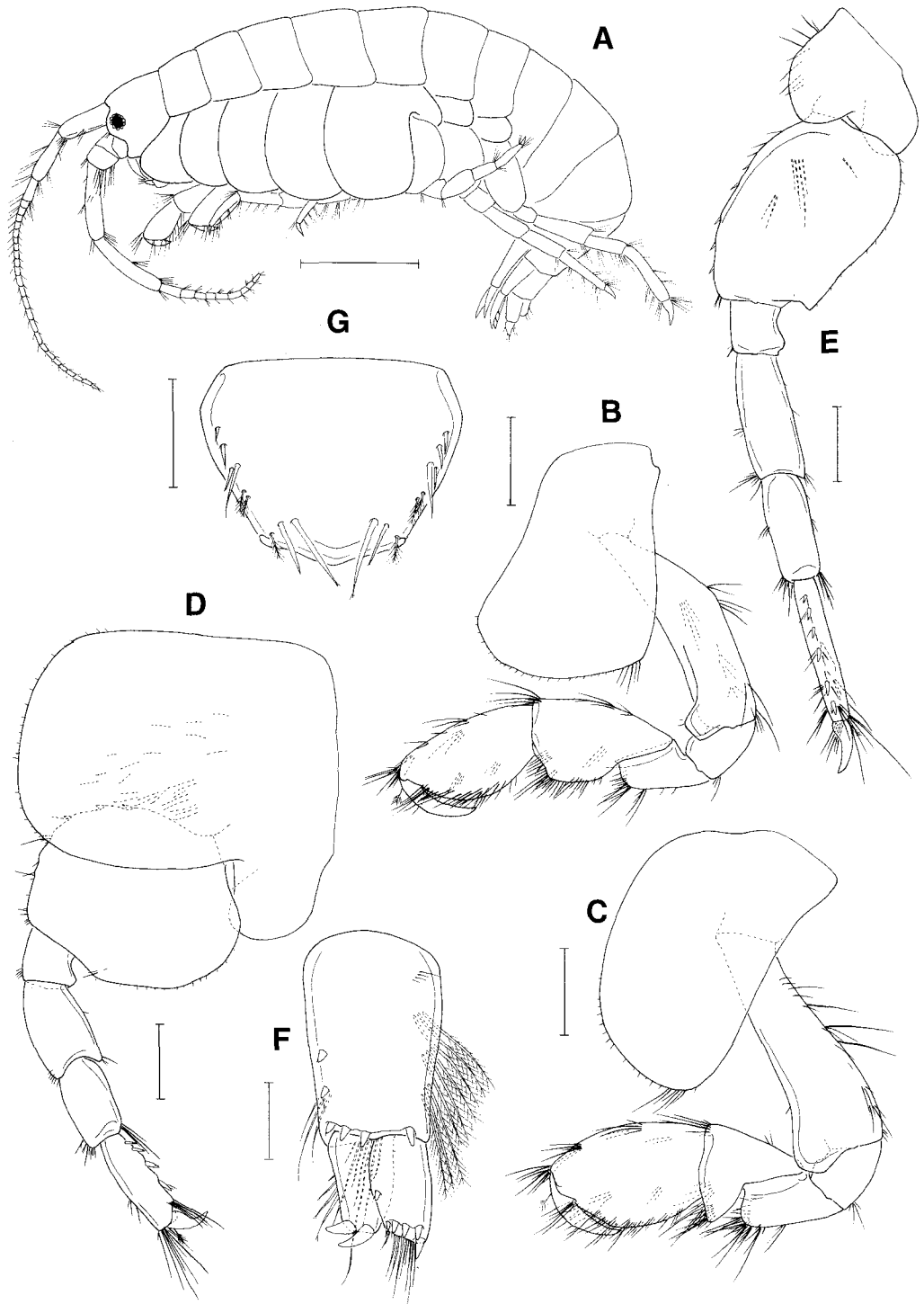


Fig. 1. *Ampithoe valida* Smith, female. A, body; B, gnathopod 1; C, gnathopod 2; D, pereopod 5; E, pereopod 6; F, uropod 3; G, telson. Scales: A, 2 mm; B-E, 0.5 mm; F, 0.2 mm; G, 0.1 mm.

Telson (Fig. 1G) entire, broader than long, gradually narrowed distally, nearly truncated, with 4 subapical setae, 4 smooth and 3 small plumose setae on both sides, and slightly convex posterior margin.

Male. Not found.

Distribution. Cosmopolitan (in temperate region).

Remarks. Barnard (1954) recognized *Ampithoe shimizuensis* Stephensen as a synonym of *A. valida* because of negligible differences between them. Nagata (1960, 1965) followed Barnard's view. Kim and Kim (1987) described *A. valida* from Cheju Island. Then, they (Kim and Kim, 1988) recorded *A. shimizuensis* Stephensen as a distinctive subspecies of *A. valida* and differentiated them on the basis of six morphological differences. Our specimen is identified as *A. valida* s. str., because it coincide more with *A. valida* than *A. valida shimizuensis*.

This species can be characterized by the features that the basis of pereopod 5 is rounded, the basis of pereopod 6 carries a small projection, and the telson is gradually narrowed posteriorly and almost truncated at end, with slightly convex posterior margin.

Family Melitidae Bousfield, 1973

****Elasmopus rapax* Costa, 1853 (Figs. 2-4)**

Elasmopus rapax: Barnard, 1969, p. 118; 1971, p. 76, figs. 33R, 34R, 35R.

Material examined. 17 ♀♀, 6 ♂♂ from *H. discus hannai* Ino, 22 May 2005; 8 ♀♀, 2 juveniles from *H. discus discus* Reeve, 22 May 2005. All specimens were collected by I.-H. Kim from the culture aquaria of the Shellfish Genetic and Breeding Research Center, at Hallim in Cheju Island.

Male. Body (Fig. 2A) 16.1 mm long. Eye black. Antenna 1 (Fig. 2B) 0.7 times as long as body, about 2 times as long as antenna 2, its three peduncular articles with ratio of length 1.5 : 1.7 : 1; peduncle 1 with 4 spines on posterior margin; accessory flagellum 5-articled. Peduncular articles 4 and 5 of antenna 2 (Fig. 2C) slender and similar in length.

Upper lip with rounded ventral margin. Right incisor of mandible (Fig. 2E) with 6 teeth, left incisor (Fig. 2D) with 3 teeth; right lacinia mobilis with large proximal tooth and 6 terminal denticles with 3 raker spines; left lacinia mobilis with 5 distinct denticles and 4 raker spines; molar triturative, with long serrate seta; article 2 of palp (Fig. 2F) 2.5 times as long as article 1, nearly identical to article 3 in length; article 3 falcate with stiff setae on inner margin. Inner lobe of lower lip (Fig. 2G) separate; outer lobe with small projection on inner distal angle.

Maxilla 1 (Fig. 2H) with inner plate of setiferous and finger shape, with 2 apical plumose setae; outer plate with 7 apical spines; articles 1 and 3 of palp identical in length; article 2 slightly shorter than article 1 or 3; article 3 with 9 apical spines and 6 setae. Maxilla 2 (Fig. 2I) with inner plate slightly narrower than outer one, bearing apical setules, 1 plumose and 1 serrate seta on medial side; outer plate with apical setules.

Maxilliped (Fig. 2J) with inner plate bearing 18 plumose setae; outer plate with 19 setae or spines and 3 plumose setae; article 1 and dactylus of palp (Fig. 2K) nearly identical in length; article 2 1.8 times as long as article 1; article 3 with small distal lobe and short setae on surface; dactylus

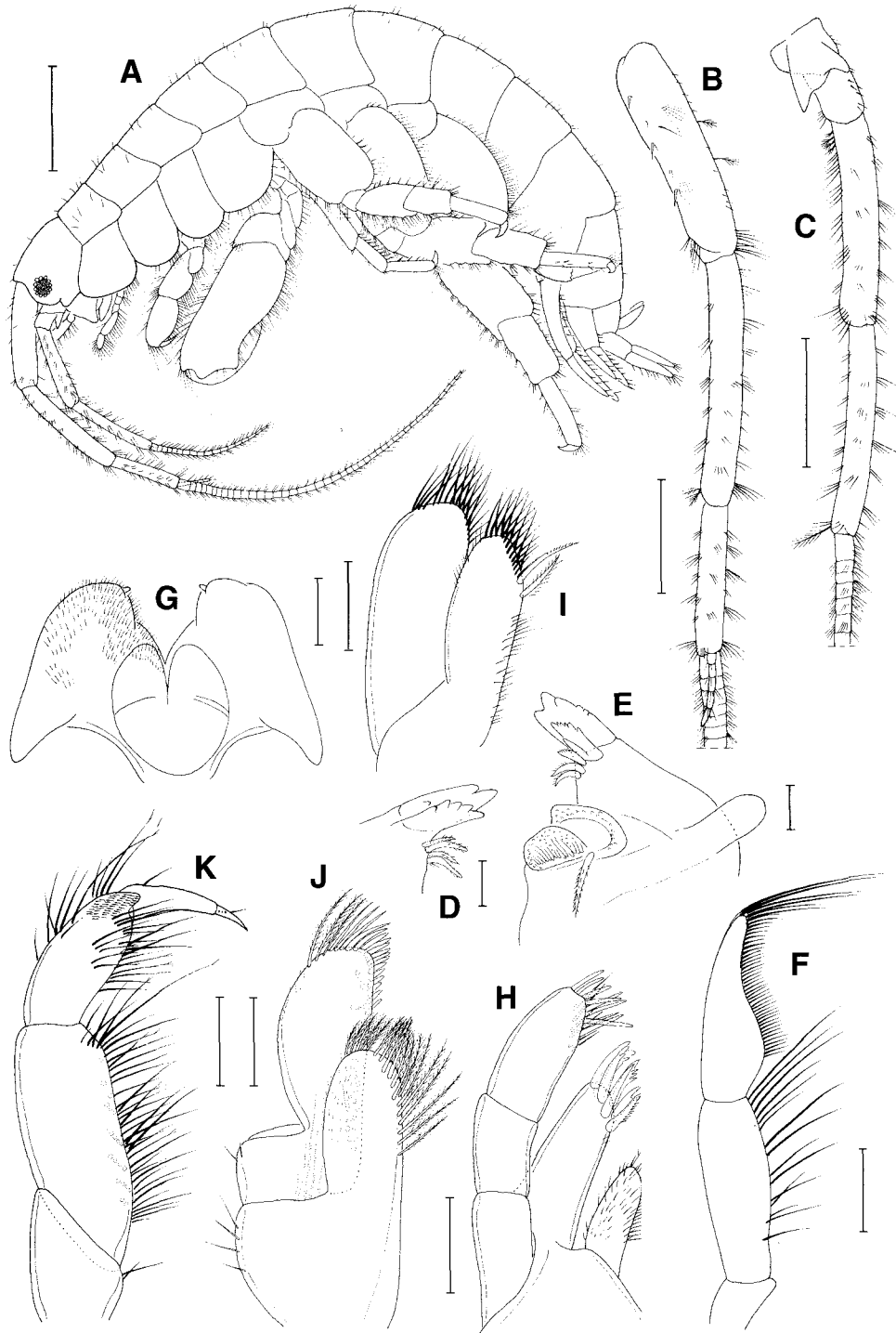


Fig. 2. *Elasmopus rapax* Costa, male. A, body; B, antenna 1; C, antenna 2; D, left of mandible; E, right of mandible; F, palp of mandible; G, lower lip; H, maxilla 1; I, maxilla 2; J, maxilliped; K, palp of maxilliped. Scales: A, 2 mm; B, C, 1 mm; D, E, 0.1 mm; F-K, 0.2 mm.

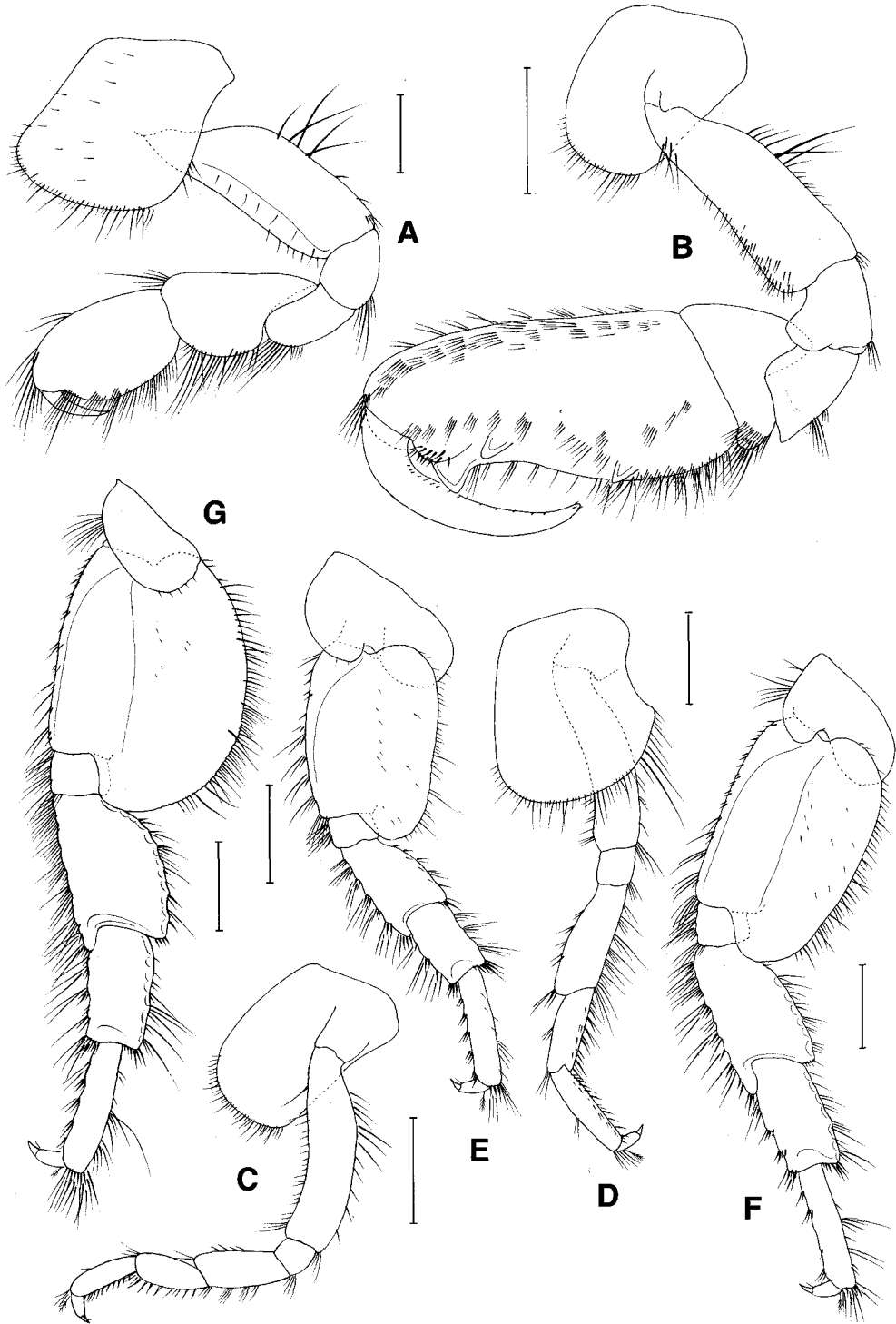


Fig. 3. *Elasmopus rapax* Costa, male. A, gnathopod 1; B, gnathopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, pereopod 7. Scales: A, 0.5 mm; B-G, 1 mm.

unguiform.

Gnathopod 1 (Fig. 3A) subchelate; coxa subrectangular; basis 1.5 times as long as propodus; ischium slightly shorter than merus; merus with round posterodistal lobe; carpus slightly longer than propodus, its roundly expanded posterior margin setiferous; propodus widened in middle, nearly rounded.

Basis of gnathopod 2 (Fig. 3B) 2.2 times as long as merus, slightly expanded anterodistally, with short setae on anterior margin; ischium with broad anterodistal lobe; merus with angular posterodistal edge; carpus with round posterior margin bearing rows of setae; propodus large, 2.3 times as long as wide, with rows of setae on anterior and posterior sides; palm with rounded spiniferous process near base of dactylus followed proximally by strong tooth, 1 distinct tooth on medial surface and 1 proximal tooth; dactylus strong.

Pereopods 3–7 with setae and spines on both anterior and posterior margins; propodus with 1 pair of locking spine posterodistally; dactylus (Fig. 4F) with 1 seta posterodistally, claw weak, with 2 setae at its base.

Pereopods 3 (Fig. 3C) and 4 (Fig. 3D) nearly identical in shape. Pereopod 4 slightly larger than pereopod 3, with more setae and spines than the latter; basis very long, 4.7 times as long as ischium; merus longer than carpus, with weak lobe anterodistally; propodus slightly longer than carpus.

Pereopods 5 (Fig. 3E) and 6 (Fig. 3F) nearly identical in shape. Pereopod 6 slightly larger than pereopod 5, with more setae and spines than the latter; basis expanded, 5.3 times as long as ischium, with posteroventral lobe extended to proximal part of merus; merus longer than carpus, posteriorly expanded, with anteroventral lobe extended to proximal part of carpus; propodus slender, slightly longer than carpus.

Basis of pereopod 7 (Fig. 3G) ovoid, 6.4 times as long as ischium, posteriorly expanded, with serrate posterior margin, bearing long setae; its posteroventral lobe extended to proximal part of merus. Merus distinctly expanded, with anteroventral lobe extended to proximal part of carpus. Propodus distinctly more slender and slightly longer than carpus.

Epimera 1–3 (Fig. 4A) with setae on ventral margin; epimeron 1 subrounded ventrodistally; epimera 2 and 3 with evenly curved ventral margin, toothed posteroventral angle. Epimeron 3 with weakly serrate posterior margin.

Uropod 1 (Fig. 4B) with peduncle 1.3 times as long as rami; inner and outer rami with spines on both inner and outer margins; outer ramus slightly shorter than inner ramus, with 4 strong apical spines.

Peduncle of uropod 2 (Fig. 4C) slightly shorter than inner ramus and broadened proximally; inner ramus 1.4 times as long as outer ramus, with spines on outer margin; outer ramus with spines on inner and outer margins.

Peduncle of uropod 3 (Fig. 4D) about 0.7 times as long as rami, expanded; inner and outer rami nearly identical in length and width, with 1 row of strong apical spines; outer ramus with rows of strong spines apically and both on inner and outer margins.

Telson (Fig. 4E) cleft, length 1.4 times as long as wide, with 3 spines at subdistal part of lateral margin. Apex subrounded or weakly angular.

Female. Body 11.0 mm long, slightly smaller than that of male. Posterior margin of epimeron 3

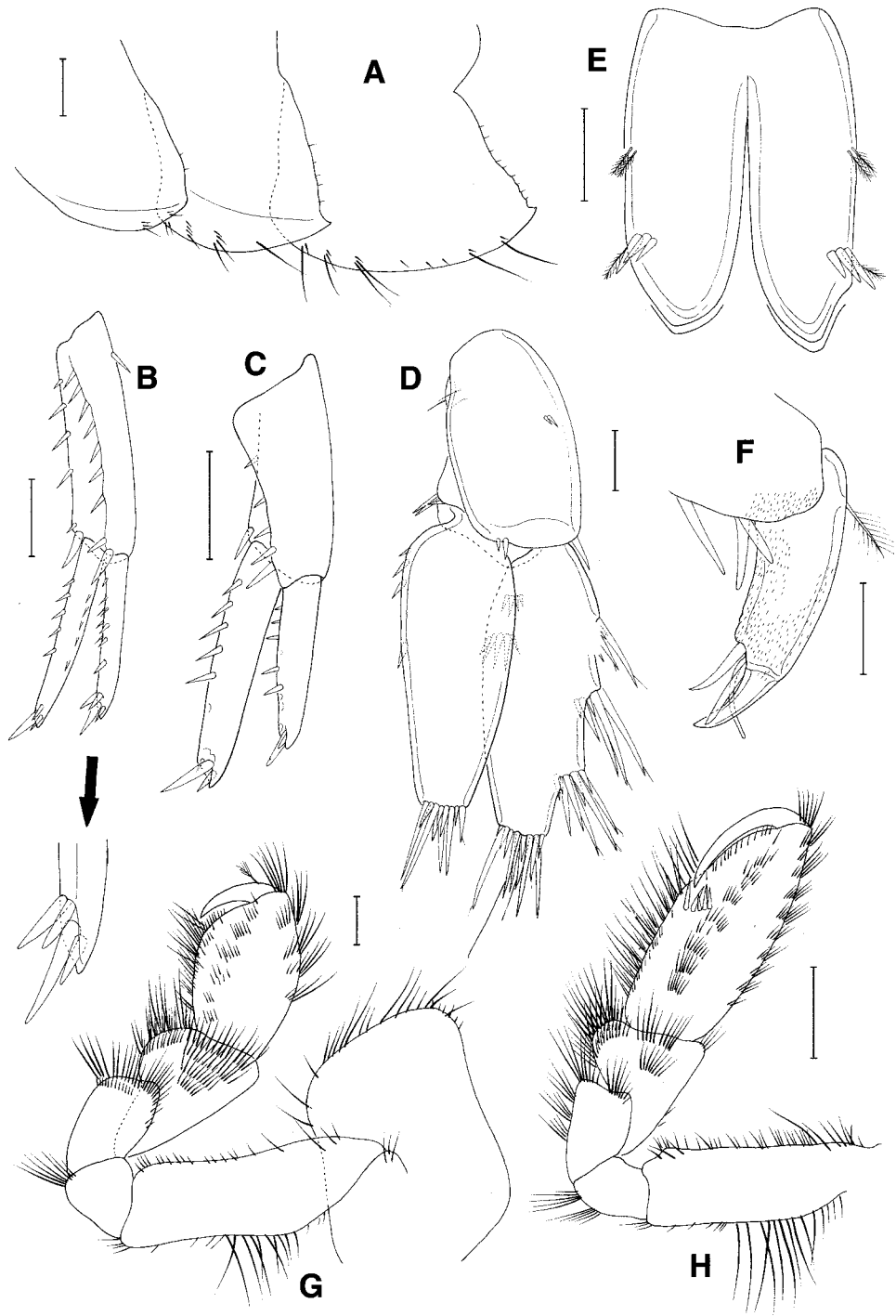


Fig. 4. *Elasmopus rapax* Costa. Male. A, epimera 1-3; B, uropod 1; C, uropod 2; D, uropod 3; E, telson; F, dactylus of pereopod 3. Female. G, gnathopod 1; H, gnathopod 2. Scales: A-C, H, 0.5 mm; D, E, G, 0.2 mm; F, 0.1 mm.

serrate more distinctly than in male. Gnathopod 1 (Fig. 4G) nearly identical to that of male; carpus and propodus slightly more expanded than in male. Gnathopod 2 (Fig. 4H) weaker than that of male; basis 3 times as long as ischium; carpus with rounded posterodistal lobe; propodus slightly longer than basis, subrectangular, with rows of setae on anterior and posterior margins and on inner surface; palm with spinules and 5 proximal spines.

Telson with subdistal spines larger than those of male and more angular apex.

Distribution. Cosmopolitan in warm and cool seas (Barnard, 1971).

Remarks. Barnard (1969) has been distinguished six different forms of *Elasmopus rapax* Costa and compared these forms with *E. antennatus* (Stout) and *E. holgurus* Barnard in the key. Uropod 3 of our specimens shows a distinctive difference from that of *E. antennatus* and *E. holgurus*. Our specimens accord with “Form I” of Barnard which was known from the Tiburon Island in the following points: gnathopod 2 is armed with three teeth on palm, the presence of a simple tooth and a medial tooth near dactylus hinge, epimeron 3 bears a serrate posterior margin and a single tooth at the posteroventral edge, the inner and outer rami of uropod 3 are nearly identical in length and width, and the telson bears the lateral spines and the smooth, distinct apical portion.

In the figure of Barnard (1971), the dactylus of pereopod 3 of *E. rapax* is illustrated as its claw is devoid of suture line, which is a minor difference from our specimens. Otherwise, our specimens coincide with his record on this species in every important points.

This species may be easily differentiated from other species of the same genus in having the following combination of characters: the presence of a spiniferous rounded process and three teeth on the palm of male gnathopod 2, the serrate posterior margin of epimeron 3, the serrate posterior margin of the basis of pereopod 7, the similar length and width of both rami of uropod 3, and subrounded or weakly angular apex of telson.

****Melita rylovae* Bulycheva, 1955 (Fig. 5)**

Melita rylovae: Yamato, 1987, p. 278, figs. 1-6.

Melita koreana: Nagata, 1965, p. 292.

Material examined. 1 ♀, 2 ♂♂ from *Haliotis discus hannai* Ino, 9 Aug. 2004; 3 ♀♀, 4 ♂♂ from *H. diversicolor aguatilis* Reeve, 9 Aug. 2004; 4 ♀♀, 2 ♂♂ from *H. discus hannai*, 22 May 2005; 17 ♀♀, 8 ♂♂, 4 juveniles from *H. sieboldii* Reeve, 22 May 2005; 10 ♀♀, 10 ♂♂, 2 juveniles from *H. discus discus*, 22 May 2005; 13 ♀♀, 24 ♂♂, 2 juveniles from *H. diversicolor aguatilis* Reeve, 22 May 2005. All specimens were collected by I.-H. Kim from the culture aquaria of the Shellfish Genetic and Breeding Research Center, at Hallim in Jeju Island.

Male. Body (Fig. 5A) 10.1 mm long and compressed. Eye black. Urosomite 2 with 1 distinct tooth and 2 spines on both sides in dorsal view.

Pleonites 2 and 3 with tooth on each side of posterior margin in dorsal view.

Basis of gnathopod 1 (Fig. 5F) with 1 row of numerous long setae along anterior margin; ischium slightly shorter than merus; carpus 2 times as long as merus in maximum length, convex posterior margin, patches of setae on inner surface, posterior margin and on anterodistal lobe. Propodus with triangular terminal lobe, blunt posterodistal lobe, 2 small spines near base of dactylus, and

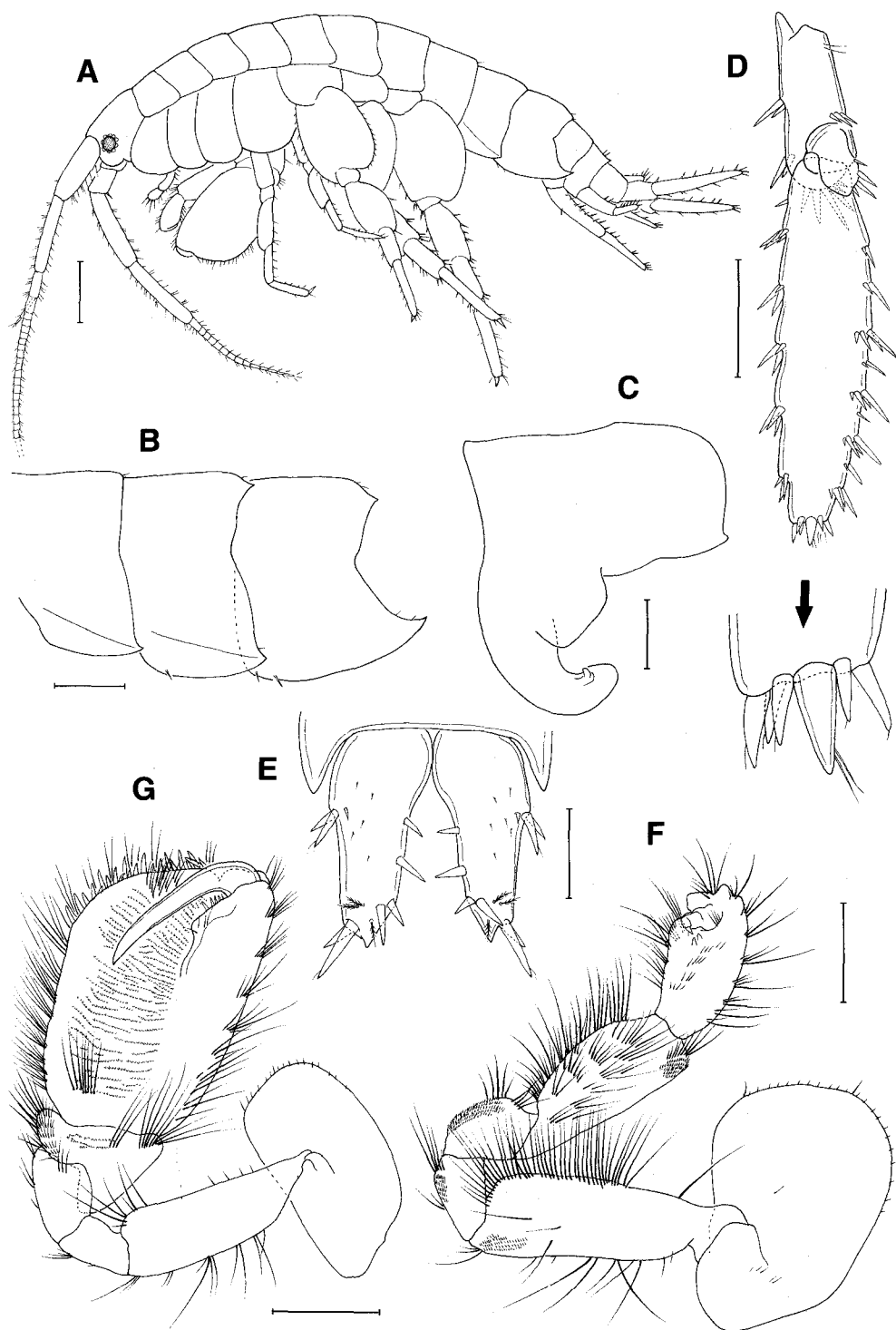


Fig. 5. *Melita rylouae* Bulycheva. A, body (♂); B, epimera 1-3 (♂); C, coxa 6 (♀); D, uropod 3 (♂); E, telson (♂); F, gnathopod 1 (♂); G, gnathopod 2 (♂). Scales: A, 1 mm; B, D, F, G, 0.5 mm; C, E, 0.2 mm.

short palm. Dactylus small, originated from sunken insertion at area proximal to terminal lobe, strongly bent, broader proximally.

Basis of gnathopod 2 (Fig. 5G) 2.7 times as long as ischium, with indistinct anterodistal lobe; carpus with rounded weak anterodistal and posterodistal lobes, and rows of setae on surface. Propodus strongly expanded and gradually broadened distally, but longer than broad, with rows of setae on anterior and posterior margins; inner surface covered with many rows of setae; palm with densely aggregated small spines; dactylus strong, recurved backward.

Epimera 1 and 2 with small ventrodistal tooth (Fig. 5B); posterodistal end of epimeron 3 extended posteriorly and forming conspicuous tooth, curved dorsally.

Outer ramus of uropod 3 (Fig. 5D) 2.2 times as long as peduncle, 2-articled; article 1 broadest in middle; article 2 very small; inner ramus scale-like, with 4 distal spines.

Telson (Fig. 5E) with 2 pairs of spines each proximally and distally on lateral margin (one of distal pair distinctly longer than the other) and 4 marginal spines medially. Distal apex of telson pointed.

Female. Anterior lobe of coxa 6 (Fig. 5C) hook-like, narrow, conspicuously extended posteriorly; its apex blunt with 1 small projection and 1 plate-like extension of exoskeleton located near base of anterior lobe. Other features as in male except for sexually dimorphic gnathopods.

Distribution. Korea, Japan, and Russian Far East.

Remarks. *Melita rylovae* is closely related to *M. koreana* Stephensen, which Nagata (1965) synonymized them for this reason. Yamato (1987), however, differentiated *M. rylovae* from *M. koreana* as a separate species. Our specimens coincide with Yamato's description for *M. rylovae* in having the following features: gnathopod 1 bears a blunt posterodistal lobe on the propodus, epimeron 3 is extended backward; uropod 3 is 2-articled; the telson carries spines on both lateral and medial margins; and the anterior lobe of female coxa 6 is more curved and elongated hook-like. These are the features of *M. rylovae* not observable in *M. koreana*.

ECOLOGICAL NOTES

Four kinds of abalones were reared at the Shellfish Genetics and Breeding Research Institute at the time of collecting. We found that almost all gammarideans came out from the abalones immediately after the culture panels were taken out of water. *Melita rylovae* was most commonly found and was collected from all four kinds of abalones. In our observation there seems no species-specific association between the gammaridean amphipods and those abalones. This observation informs that the gammarideans were loosely associated with the abalones. Each abalone was inhabited by only a single gammaridean in the anterior portion of mantle cavity. We consider that the gammarideans used the water current generated by the abalones for facilitating the respiration and collecting food particles. It is noticeable that all three species of gammarideans have in common the well developed gnathopods. *Melita rylovae* carries in particular numerous setae on the inner side of the propodus of gnathopod 2.

Although a fisheries scientist of the Institute informed us that she has not yet found any harmful effect on the abalones resulting from the association of the amphipods, it is considered that more careful observations or experiments are needed about the ecological relationship between the kinds

of animals.

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요 약

한국의 양식 전복에 공생하는 3종의 단각류가 발견되어 이들을 보고한다. 이들 단각류는 불록손참옆새우(*Ampithoe valida* Smith), 사마귀멜리타옆새우(*Elasmopus rapax* Costa), 두발가락멜리타옆새우(*Melita rylovae* Bulycheva)이며, 이 중에서 사마귀멜리타옆새우는 한국 미기록종으로서 상세히 기재하였고 다른 두 종은 주요 형질을 기재하였다. 이들 단각류가 공생한 전복은 *Haliotis discus hannai* Ino, *H. discus discus* Reeve, *H. diversicolor aquatilis* Reeve, 그리고 *H. sieboldii* Reeve이다. 관찰한 단각류와 전복들 사이에는 종 특이적 관계는 보이지 않았다.