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Copepod Parasites of Commercial Bivalves in Korea

II. Copepods from Cultured Bivalves

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한국산 식용 이매패류에 기생하는 요각류

II. 양식 이매패류에 기생하는 요각류

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Nine species of copepod parasites are recorded from nine Korean cultured bivalves. One new species, *Lichomolgus similis* n. sp. is included, and other eight species are: *Conchyliurus quintus, Pseudomyicola spinosus, Myicola ostreae, Ostrincola koe, O. japonica, Herrmannella longicaudata, Modiolicola bifidus, M. gracilicaudus.* The relationship between the copepod parasites and their host bivalves is discussed.

Introduction

Mollusca is one of the four major phyla of marine invertebrates that serves as host of symbiotic copepods (Humes, 1985). Although more than two hundred species of copepods have been reported as symbionts of molluscs, only five of them have so far been recorded from Korea. They are known from three species of bivalves: *Psudomyicola spinosus* (Raffaele & Monticelli) and *Modiolicola bifidus* Tanaka from the mussel, *Mytilus galloprovincialis* Lamarck, *Leptinogaster digita* Kim & Ho and *Herrmannella soleni* Kim & Ho from *Solen grandis* Dunker, and *Anthessius atrinae* Suh & Choi from *Atrina pectinata* (Linné) (Suh & Choi, 1990, 1991; Kim & Ho, 1991).

In Korea several species of bivalves are regarded as important food from the sea, and 9 species are currently recorded as cultured items (Ministry of Agriculture, Forestry and Fisheries, Republic of Korea, 1990). In addition to these 9 species, recently, one more species, *Patinopecten yessoensis* (Jay) has been added to the cultured bivalves on the coast of the Sea of Japan. We examined these 10 species of commercial bivalves for parasitic copepods and found 9 species of copepods (see Table 2 in the "DISCUSSION" section). *Clinocardium californense* (Deshayes) was found to carry no copepod. One of the copepods turned out to be a new species and 6 of the remaining 8 species are recorded for the first time in Korea. The new species is thoroughly described, and most of the remainders are briefly described with illustrations.

Materials and Methods

The bivalves examined for the copepod parasites were taken from the following localities. They were mostly bought from the local fish markets at each

locality: 1) from the Yellow Sea- Inchon (37°30'N 126°38'E), Puan(35°46'N 126°41'E), and Mokpo (34°48'N 126°22'E). 2) from the Sea of Japan- Sokcho(38°13'N 128°29'E), Kangnung(37°46'N 128°56'E), Mukho(37°31'N 129°10'E), and Imwon(37°20'N 129°20'E). 3) from the Korea Strait- Pusan (35°07'N 129°03'E), Chungmu(34°50'N 128°25'E), and Wando Island(34°19'N 126°46'E). Each bivalve was openned and washed in diluted alcohol solution. The washings from the same species of host were then filtered through fine mesh plankton net and the copepods were picked from the sediments under a dissecting microscope at a low magnification. In studying the morphology, copepods were dissected in lactic acid following the technique reported by Humes and Gooding(1964). The drawings were made with the aid of a camera lucida.

Results

Below is the list of the 9 species of copepods to be described and their classification:

Family Clausidiidae

Conchyliurus quintus Tanaka, 1961

Family Lichomolgidae

Lichomolgus similis, new species

Family Myicolidae

Pseudomyicola spinosus(Raffaele & Monticelli, 1885)

Myicola ostreae Hoshina & Sugiura, 1953

Ostrincola koe Tanaka, 1961

Ostrincola japonica Tanaka, 1961

Family Sabelliphilidae

Herrmannella longicaudata Avdeev, 1975

Modiolicola bifidus Tanaka, 1961

Modiolicola gracilicaudus Avdeev, 1977

1. *Conchyliurus quintus* Tanaka, 1961 (Figs. 1~3)

Conchyliurus quintus Tanaka, 1961, p. 258, pl. 27, figs. 8~10, pls. 28, 29; Ko et al., 1962, p. 113.

MATERIAL EXAMINED. 1) from *Tapes philippinarum* (Adams & Reeve): 4 ♀♀, 2 ♂♂ discovered from about 150 hosts, Wando Island, 8 Jul. 1986; 3 ♀♀, 3 copepodids, Puan, 7 Dec. 1986; 2 ♀♀, 2 ♂♂ from more than 200 hosts, Pusan (fish market), 22 Nov. 1987; 5 ♀♀, 15 copepodids from about 150 hosts, Inchon, 13 Oct. 1989; 3 ♀♀, 3 ♂♂, 5 copepodids from more than 200 hosts, Mokpo (fish market), 4 Nov. 1989; 2 copepodids from about 150 hosts, Pusan (fish market), 1 Dec. 1989. 2) from *Cyclina sinensis* (Gmelin): 3 copepodids from about 60 hosts, Inchon (fish market), 13 Oct. 1989. 3) from *Scapharca subcrenata* (Lischke): 3 copepodids from 30 hosts, Kangreung (fish market: host bivalves were transported to Kangreung from elsewhere in Korea), 15 Nov. 1990. 4) from *Mactra veneriformis* Reeve: 1 copepodid from 60 hosts, Inchon (fish market), 13 Oct. 1989. 5) from *Meretrix lusoria* (Röding): 1 copepodid from 20 hosts, Puan, 28 Jun. 1990.

FEMALE. Body (Fig. 1A, B) flattened dorsoventrally. Body size (excluding setae on caudal rami) for 4 selected specimens 1.058 (length of body)× 0.279(maximum width of cephalothorax) *mm*, 1.375 ×0.365*mm*, 1.565×0.395*mm*, and 1.741×0.424*mm*. Body 3.8(smaller specimens) to 4.2(larger specimens) times longer than wide. Rostrum produced forward, quadrate in dorsal view. Prosome elliptical, about 1.8 times longer than wide. Each prosomal somite fringed with membrane along posterior dorsal margin. Urosome 5-segmented. Genital complex (Fig. 1C) 318 *μm* long; maximum width 252 *μm* measured dorsally across lateral corners at midlength; ratio of length to width 1.26:1; posterior part of almost all adult females covered on their back with dark sticky material which holds 1 pair of spermatophores near the posterodorsal corner; complex structures beneath this material and spermatophores (Fig. 1C); spermatophore from female 145×45*μm*, with ratio of length to width 3.2:1. First and second abdominal somites 105×128 *μm* and 76×116 *μm* in size, respectively. Anal somite 120 *μm* long and 105 *μm* wide (1.14 times longer than wide) with transversely arranged, 4 patches of spinules on proximoventral surface (Fig. 1D).

Caudal ramus (Fig. 1E) shorter (0.9) than anal somite, 2.56 times longer than maximum width, with fine spinules on distoventral edge. Lateral seta located about midlength of caudal ramus. Innermost terminal seta plumose only on inner side. Other 3 terminal setae pinnate distally. Inner median ter-

minal seta longest, about 3 times longer than outer median terminal seta.

Egg sac elongate (Fig. 1A), as long as urosome, 786×156 *μm* in size.

Antennule (Fig. 1E) rather short, 6-segmented, with formula of armature: 4, 15, 10, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. First segment with minute spinules along anterior margin. Aesthete on fourth segment small. Plumose setae: 1, 1, 2, 1 and 4 on each second, third, fourth, fifth, and sixth segments, respectively.

Antenna (Fig. 1F) 4-segmented, with setal formula 1, 1, 2, and 7. Second and third segments armed with thick spinules on inner margin. Third segment without any process on inner distal angle; one of 2 setae strong and curved.

Labrum (Fig. 2A) with 1 pair of rosette-like structures, 2 smaller and 2 larger lobular processes near mid-posterior margin, and fine spinules on both posterior edges. Mandible (Fig. 2B) with 3 foliaceous elements. Palp (Fig. 2C) bifurcate as 2 spinular lobes; anterior lobe slender and longer. First maxilla (Fig. 2D) armed with 8 setae (3+2+2+1); outer surface near base of proximalmost seta armed with setules. Second maxilla (Fig. 2E) 2-segmented. First segment with minute spinules on distal and inner surfaces. Second segment variable in structure (Figs. 2F, G), usually armed with 1 strong claw which is accompanied by 1 subsidiary spine on side, 2 spines each on ventral and dorsal corners (dorsal spine usually bifurcate and ventral one usually with 2 minute spinules as in Fig. 2F), and 1 lateral seta. Maxilliped (Fig. 2H), 2-segmented. First segment with 1 long seta near inner corner and spinules on ventral surface. Second segment being a strong hook and accompanied by 1 small denticle.

Legs 1~4 (Figs. 2I~K, 3A) with 3-segmented exopods and endopods. Leg 1 with seta on inner corner of coxa, but legs 2~4 with spine on this corner. Inner spine on basis of leg 1 strong, nearly as long as combined length of 2 basal segments of endopod.

Formula of armatures in legs 1~4 as following:

P1: Prp 0-1; 1-I Exp I-0; I-1; III, I, 4
Enp 0-1; 0-1; II, 4

P2: Prp 0-I; 1-0 Exp I-1; I-1; III, I, 5
Enp 0-1; 0-2; III, 3

P3: Prp 0-I; 1-0 Exp I-0; I-1; III, I, 5
Enp 0-1; 0-2; IV, 2

P4: Prp 0-I; 1-0 Exp I-0; I-1; III, I, 5
Enp 0-1; 0-2; IV, 1

Leg 5 (Fig. 3B) 2-segmented. Seta of basal segment separated dorsally and based on small protuberance on dorsolateral area of fifth pediger. Free segment about 3 (2.8~3.3) times longer than wide, with 3 spines and 1 seta. Inner distal corner armed with 1 process.

Leg 6 represented by 2 setae (inner one of which based on long projection) on posterodorsal surface of genital complex (Fig. 1C).

MALE. Body (Fig. 3C) resembles that of female. Body length in largest specimen 1.345 *mm*. Urosome (Fig. 3D) 6-segmented. Genital complex 1.25 times wider than long, with pointed posterolateral process. Third abdominal somite distincly shorter than other abdominal somites.

Antennule, antenna, mandible and maxillae as those in female. Maxilliped (Fig. 3E) 4-segmented; inner distal corner of first segment protruded and bearing spinules; second segment with 1 long seta and several thick spinules near inner distal corner, 1 annular row of spinules on inner distal surface, and several spinules near base of seta; third segment short and unarmed; fourth segment extended into 1 long claw which is bifurcate at tip, with 2 setae of extremely unequal size and 1 process near base of larger seta.

Legs 1~5 as in female.

Leg 6 represented by 1 seta on ventral flap of genital complex (Fig. 3D).

REMARKS. This species shows a wide range of host preference. Half of the bivalves examined were infested with this copoepod. The infesting rate in each host species is, however, not high.

Conchyliurus mactrae reported by Avdeev(1977) from *Mactra sinensis* in the Possiet Bay of the Sea of Japan is the only other species of *Conchyliurus* known from the Far East. Avdeev's species has the antenna bearing a distinct process on the inner distal corner of third segment (no such process in

C. quintus) and the female leg 6 is located on the posterolateral corner of genital complex(posterodorsally in *C. quintus*). Moreover, its quadrate spermatophores and the armature of anal somite bearing ventrally both proximal and distal rows of spinules (only proximal row in *C. quintus*) are the features by which *C. quintus* can be distinguished.

2. *Lichomolgus similis*, new species
(Figs. 4, 5, 6A~E)

TYPE SPECIMENS. 18 ♀♀, 11 ♂♂ recovered from 10 specimens of *Meretrix lusoria* (Röding), Puan (fish market: host bivalves came from the Yellow Sea coast near Puan), 14 Aug. 1988. 1 ♀, holotype, 1 ♀ allotype, and 20 undissected paratypes(13 ♀♀, 7 ♂♂) will be deposited in the U. S. National Museum of Natural History, Smithsonian Institution, Washington D. C. Other dissected paratypes are kept in the collection of the junior author.

OTHER MATERIAL EXAMINED. 52 ♀♀, 8 ♂♂, 4 copepodids recovered from about 60 specimens of *Cyclina sinensis* (Gmelin), Inchon (fish market), 13 Oct. 1989.

FEMALE. Body (Fig. 4A) 1.23 *mm* (1.09~1.38 *mm* long, based on 10 specimens), excluding setae on caudal rami. Maximum width 0.54 *mm*. Ratio of length to width of body 2.28:1. Ratio of length of prosome to that of urosome 1.49:1. Urosome (Fig. 4B) 5-segmented. Genital complex slightly wider than long. Genital area (Fig. 4D) located dorsolaterally, with 3 spinules. Genital complex and first abdominal somite with crenulated posteroventral margin. Anal somite armed proximally with 1 outer group of smaller spinules and 1 inner group of larger spinules on each side of ventral surface. Caudal ramus (Fig. 4C) 5.07 times longer than wide. Setae on caudal ramus naked except for innermost terminal seta which is plumose on inner side. Lateral seta located at midlength of caudal ramus. Longest inner median terminal seta about twice as long as outer median terminal one. Antennule (Fig. 4E) as in most *Lichomolgus* species, with setal formula of 4, 13, 6, 3, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. Antenna (Fig. 4F) 4-segmented. Each of first 3 segments with 1 denticulate spine (2-4 denticles on each side) near inner distal corner. Third segment with 3 additional setae. Fourth segment about 3 times longer than wide, with small spinules on proximal outer margin, 4 terminal claws (one of which distinctly stronger), and 3 subterminal setae.

Labrum (Fig. 4G) deeply incised. Medial edges nearly parallel, each with sclerotized projection near entrance of parallel edge. Posterior margin convex, covered with translucent substance. Mandible (Fig. 4H) slender and bipectinate. Maxillule (Fig. 5A) with 2 terminal and 1 small, subterminal elements. Maxilla (Fig. 5B) with unormanented first segment; second segment with 1 seta and 1 barbed spine, and terminated in rectangularly curved lash. Maxilliped (Fig. 5C) 3-segmented; first segment globose; second segment long, with 2 subterminal setae; third segment armed with 1 terminal and 1 median, spinulated papillae, in addition to a seta.

Legs 1~3 (Fig. 5D~F) with strongly projected outer distal corner on first and second segments of endopod. Leg 4 (Fig. 5G) with 3-segmented exopod and 2-segmented endopod; endopod second segment with 2 terminal spines (inner spine more than twice as long as outer one) and 2 large, sharp projections on outer margin; exopod third segment with 3 (more common) or 2 outer spines.

Formula of armature of legs 1~4 as follows:

P1: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 4
Enp 0-1; 0-2; III, 2

P2: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 5
Enp 0-1; 0-2; III, 3

P3: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 5
Enp 0-1; 0-2; III, 2

P4: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 5 (or II, I, 5)
Enp 0-1; II

Free segment of leg 5 (Fig. 5I) 116 *μm* long and 51 *μm* in maximum width, with prominent projection on inner margin and terminally with 1 outer, naked seta and 1 inner, longer spine.

MALE. Body (Fig. 6A) resembles that of female. Length 0.97 *mm* (0.84~1.05 *mm*), based on 9 spec-

imens. Urosome 6-segmented. Genital complex (Fig. 6B) 1.16 times wider than long, its distal corners each with 2 setae and 1 spinule.

Caudal ramus slightly wider (ratio 4.87:1) than that of female.

Antennule (Fig. 6C) with formula of armature: 4, 13+1 aesthetes, 6, 3+1 aesthete, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. Aesthete on second segment long, nearly reaching distal end of fifth segment.

Antenna, labrum, mandible, maxillule, and maxilla as in female. Maxilliped (Fig. 6D) with unarmed first segment. Second segment with prominently protruded inner margin; dorsal surface with 1 patch of spinules proximally, 1 longitudinal row of spinules and 1 short median seta; inner protrusion armed distally with 1 modified thick seta bearing lateral setule. Third segment smallest and unarmed. Terminal segment long and curved, bearing 2 unequal setae at base.

Legs 1~4 as in female. Leg 5 (Fig. 6E) narrow and long, 4.5 times longer than wide, with a pair of pointed projections at inner distal corner.

ETYMOLOGY. The specific name *similis* (=resembling in Latin) refers to the resemblance of the new species to *L. bidentipes* Ho.

REMARKS. This specis is close to *Lichomolgus bidentipes* Ho found in *Septifer virgatus* on the Pacific side of Japan (Ho, 1980). The form and size of the body, the ornamentation of urosome, and the structure of legs 4 and 5 are quite alike between the two species. They, however, are easily distinguished by the armature of their antenna. This appendage in *L. similis* is unique for the genus in having the denticulate spine on each inner subterminal area of the basal 3 segments. Do and Kajihara's (1986) redescription of *L. bidentipes*, based on the female specimens obtained from *Mytilus edulis*, also shows no such spines. Besides this armature, the general shape of the appendage also shows difference. The antenna of *L. similis* is stockier and bears terminally 4 hooks and 3 setae, instead of 4 hooks and 2 setae as in *L. bidentipes*. Other minor differences are found in the terminal segment of leg 4 endopod and the free segment of leg 5. The two denticulate projections on the terminal segment of leg 4 are better developed in *L. similis*. The two terminal elements on the free segment of leg 5 are setae in *L. bidentipes*, while they are composed of 1 spine and 1 seta in *L. similis*.

3. *Pseudomyicola spinosus*
(Raffaele & Monticelli, 1885)
(Fig. 6F~I)

Pseudomyicola spinosus Raffaele & Monticelli, 1885, p. 302; Humes, 1968, p. 205, figs. 1~34; 1984, p. 589; Ho, 1980, p. 296, fig. 1; Do & Kajihara, 1986, p. 23, figs. 9, 10; Suh & Choi, 1990, p. 137.

MATERIAL EXAMINED. 1) from *Crassostrea gigas* (Thunberg): 2 ♀♀ from 3 hosts, Mukho, 25 Sept. 1989; 1 ♀, 1 ♂ from 20 hosts, Chungmu (fish market), 17 Jun. 1990. 2) from *Scapharca broughtoni* (Schrenck): 8 ♀♀, 2 ♂♂, 2 copepodids from 10 hosts, Puan, 13 Sept. 1989. 3) from *Scapharca subcrenata* (Lischke): 20 ♀♀, 11 ♂♂ from about 150 hosts, Kangnung (fish market: host bivalves were transported to Kangnung from elsewhere in Korea), 8 Oct. 1986; 46 ♀♀, 15 ♂♂ from more than 100 hosts, Puan, 7 Dec. 1986; 43 ♀♀, 28 ♂♂ 32 copepodids from 30 hosts, Kangnung (fish market: host bivalves were transported to Kangnung from elsewhere in Korea), 15 Nov. 1990.

REMAKRS. This species is easily identified by the body shape (Fig. 6F), the small and tapered caudal ramus (Fig. 6G), the presence of a basal hook on the first segment of antennule (Fig. 4H), and the large, foliaceous leg 5 (Fig. 6I). *P. spinosus* is the most widely distributed species of bivalve-parasitizing copepod. It has been reported from many parts of the world in about 50 species of bivalves.

4. *Myicola ostreae* Hoshina & Sugiura, 1953
(Figs. 7, 8)

Myicola ostreae Hoshina & Sugiura, 1953, p. 27, pl. 2; Tanaka, 1961, p. 251, pls. 22, 23.

MATERIAL EXAMINED. All from *Crassostrea gigas* (Thunberg). 7 ♀♀, 1 ♂ from 30 hosts, Puan, 7 Dec. 1986; 18 ♀♀, 15 copepodids from more than 50 hosts, Puan, 26 Oct. 1987; 9 ♀♀, 3 ♂♂ from more than 200 small host specimens, Puan, 14 Jan. 1988; 12 ♀♀ from more than 100 hosts, Puan, 13 Sept. 1989; 3 ♀♀, 1 ♂ from more than 150 hosts, Mokpo (fish market), 4 Nov. 1989; 1 ♀, 1 ♂ from 20 hosts, Chungmu, 17 Jun. 1990.

FEMALE. Body of fully grown adult (Fig. 7A, B) with inflated cylindrical prosome and obscuring body segmentation. Length (excluding setae on caudal rami) 1.77 *mm* (1.65~2.04 *mm*), maximum width 0.57 *mm* (0.42~0.58 *mm*), based on 4 specimens. Ratio of length to width of prosome 3.09:1. Ratio of length of prosome to that of urosome 2.35:1. Body of late copepodid (Fig. 7C) and young adult (Fig. 7D) uninflated, with clear body segmentation. Prosome usually with conspicuous constriction between pedigers 3 and 4. Urosome (Fig. 7E) with ventral spinulation as in species of *Ostrincola*. Genital area (Fig. 7F) located dorsoventrally, with 2 spinules. Caudal ramus (Fig. 7E) tapered, 4.95 times longer than wide, with 6 naked setae. Longest termal median seta 0.41 times as long as the ramus. Egg sac (Fig. 7G) multiseriate, 1.05× 0.46 *mm* in size.

Antennule (Fig. 7H) 7-segmented, with formula of armature: 4, 13, 5, 3, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. Antenna (Fig. 7I) 3-segmented. First segment wider than long, with 1 small inner distal seta and several lateral spinules. Second segment with 1 small inner distal seta. Terminal segment about 2.7 times as long as wide, with spinules on outer proximal surface, 1 small inner seta, 1 small outer distal seta, and 2, unequal, inner distal setae. Claw recurved near tip.

Labrum of *Ostrincola*-type. Mandible (Fig. 7J) with 4 barbed elements. Maxillule (Fig. 7K) with 4 setae. Maxilla (Fig. 7L) 2-segmented. First segment large, with 2 groups of spinules. Second segment with 2 barbed setae of unequal size and 1 small naked seta. Maxilliped rudimentary, appears as a small sclerote behind maxilla.

Legs 1~4 (Fig. 8A~D) with 3-segmented rami. Formula for armature as follows:

P1:	Prp 0-1; 1-I	Exp I-0;	I-1;	III, I, 4
		Enp 0-1;	0-1;	I, 5
P2:	Prp 0-1; 1-0	Exp I-0;	I-1;	III, I, 5
		Enp 0-1;	0-2;	III, 3
P3:	Prp 0-1; 1-0	Exp I-0;	I-1;	II, I, 5
		Enp 0-1;	0-2;	IV, 2
P4:	Prp 0-1; 1-0	Exp I-0;	I-1;	II, I, 5
		Enp 0-1;	0-2;	IV, 1

All legs with spinules on each outer margin of segments of both rami. Setae on both rami in inflated adult usually deformed, especially in anterior legs. Leg 5 (Fig. 8E) with proximal segment armed on outer margin with spinules and 1 seta. Second segment 1.65 times longer than wide, with 2 spines, 2 setae, and spinules on both outer proximal and inner distal margins.

MALE. Body (Fig. 8F) uniflated, with distinct body segmentation. Length of largest specimen 0.96 *mm*. Maximum width of this specimen 0.25 *mm*. Ratio of length to width of body 3.9:1. Ratio of length of prosome to that of urosome 1.11:1. First pediger weakly demarcated from cephalon. Urosome 6-segmented. Genital complex (Fig. 8G) with 2 setae on each distal corner. First 3 postgenital somite each with 1 transverse row of spinules on posteroventral border (Fig. 8G). Caudal ramus 6.6 times longer than wide, with 6 setae.

Antennule same as in female. Antenna (Fig. 8H) slender than in female. First segment longer than wide. Third segment 4.8 times longer than wide.

Labrum, mandible, maxillule, and maxilla same as those of female. Maxilliped (Fig. 8I) 4-segmented. First segment with spinules on blunt inner distal bulge. Second segment with a pair of setae and spinules on inner and lateral surfaces. Third segment short and unarmed. Fourth segment clearly demarcated from claw, with 1 spinule and 1 long seta. Claw strong, as long as basal 3 segments combined.

Legs 1~4 same as those of female. Leg 5 (Fig. 8J) more slender. Second segment 2.47 times longer than wide, with 2 naked setae and 2 barbed setae. Spinules only on inner distal margin.

REMARKS. Distinction between *Myicola* Wright, 1885 and *Ostrincola* Wilson, 1944 has not been

clear in the past. Tanaka (1961) pointed out the close resemblance between the two genera, and Humes (1986) suggested to remove *M. ostreae* to *Ostrincola,* based on the fact that, unlike the genotype *Myicola metisiensis* Wright, 1885, *M. ostreae* has small body and relatively broader leg 5. Humes also indicated that the magnitude of the inflation of prosome is not a reliable generic character in the taxonomy of the Myicolidae. As indicated above, the swollen cylindrical prosome in *M. ostreae* is confined to the fully grown female adult. Its copepodid, young female adult and fully grown male show no significant difference in general apperance from the species of *Ostrincola.* However, recently, Ho and Kim (in Press) has redefined the genera of Myicolidae. They considered the nature of the egg sac to be a key character in the classification of the family. According to them, the most important difference between the two genera is that the egg is uniseriate in *Ostrincola* but multiseriate in *Myicola.*

5. *Ostrincola koe* Tanaka, 1961
(Figs. 9, 10)

Ostrincola koe Tanaka, 1961, p. 254, pls. 24, 25; Ko et al., 1962, p. 113; Ko & Yoshikoshi, 1974, p. 95.

MATERIAL EXAMINED. 1) from *Tapes philippinarum* (Adams & Reeve): 4 ♀♀ from about 120 hosts, Puan, 7 Dec. 1986; 13 ♀♀, 1 ♂ from about 150 hosts, Puan, 13 Sept. 1989; 4 ♀♀, 7 ♂♂ from about 100 hosts, Inchon (fish market), 13 Oct. 1989. 2) from *Cyclina sinensis* (Gmelin): 1 ♀ from 36 hosts, Puan, 14 Jan. 1988. 3) from *Mactra veneriformis* Reeve: 13 ♀♀, 8 ♂♂, 4 copepodids from about 60 hosts, Inchon (fish market), 13 Oct. 1989.

FEMALE. Body (Fig. 9A) 1.24 *mm* long and 0.34 *mm* wide, with distinct suture line between cephalosome and first pediger. Genital complex (Fig. 9B, C) with 3 transverse rows of spinules on ventral surface. Each abdominal somite with a transverse row of spinules on ventral surface near posterior border. Anal somite as long as wide, narrower distally. Caudal ramus (Fig. 9D) 8.48 times longer than wide, with 2 proximal, 1 subterminal and 3 terminal setae. proximalmost seta located at about first quater (0.28) of the ramus and accompanied by 1 small setule at base. Outer subterminal seta positioned at distal 0.23. The longest, median terminal seta 0.31 (0.30~0.35) times as long as caudal ramus. Egg sac as long as abdomen, containing 4~7 eggs.

Antennule (Fig. 9E) with formula of armature: 4, 15, 6, 3, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. Antenna (Fig. 9F) 3-segmented, with formula of armature: 1, 1, and 6+1 claw. First segment with 1 transverse row of spinules. Third segment 2.45 times longer than wide, with spinules on outer margin.

Labrum (Fig. 9G) with 1 row of spinules on lateral surface. Posterior border finely spinulated. Mandible (Fig. 9H) with 4 elements. Maxillule (Fig. 9I) with 3 unequal setae. Maxilla (Fig. 9J) 2-segmented. First segment with 2 proximal groups of spinules. Second segment with 1 smooth seta and 2 barbed elements.

Legs 1~4 (Figs. 9K, 10A~C) with spinules on outer margin of rami. Fromula of armature as follows:

P1:	Prp 0-1; 1-I	Exp I-0; I-1; III, I, 4
		Enp 0-1; 0-1; I, 5
P2:	Prp 0-1; 1-0	Exp I-0; I-1; III, I, 5
		Enp 0-1; 0-2; III, 3
P3:	Prp 0-1; 1-0	Exp I-0; I-1; II, I, 5
		Enp 0-1; 0-2; IV, 2
P4:	Prp 0-1; 1-0	Exp I-0; I-1; II, I, 5
		Enp 0-1; 0-2; IV, 1

Leg 5 (Fig. 10D) 2-segmented. First segment bearing 1 plumose seta, but without spinules. Second segment broad, nearly circular, 1.18 times as long as wide, with spinules on both margins, 3 spines and 1 plumose seta. Second outer spine longest, 0.88 times as long as the segment.

MALE. Body (Fig. 10E) 1.02 *mm* long, and 0.28 *mm* wide, with 6-segmented urosome. Posteroventral corner of genital complex (Fig. 10F) with 2 subequal plumose setae. Formula of armature as in female, except for additions of 1 aesthete on second segment and 2 aesthetes on fourth segment. Antenna, labrum, mandible, maxillule, and maxilla as in female. Maxilliped (Fig. 10G) 4-segmented,

with formula of armature: 0, 2, 0, and 2+1 claw.

Second segment of leg 5 (Fig. 10H) 1.89 times as long as wide, with spinules only on inner distal margin. Both terminal spines longer than this segment.

REMARKS. The description given above is intended to supplement Tanaka's (1961) original description, which lacks details in fine structures. Distinctions between *O. koe* and the other Far Eastern species, *O. japonica,* will be dealt with after redescription of the latter species.

6. *Ostrincola japonica* Tanaka, 1961
(Figs. 11, 12)

Ostrincola japonica Tanaka, 1961, p. 256, pl. 26, pl. 27, figs. 1~7; Ko et al., 1962, p. 114.

MATERIAL EXAMINED. 9 ♀♀, 6 ♂♂ from 2 large specimens of *Crassostrea gigas* (Thunberg), Puan, 14 Jan. 1988; 2 ♀♀ from more than 100 specimens of same host species, Puan, 13 Sept. 1989.

FEMALE. Body (Fig. 11A) 1.30 *mm* long and 0.33 *mm* wide, with general appearance as in preceding species. First 2 abdominsal somites distinctly longer than anal somite (Fig. 11B). Caudal ramus (Fig. 11C) 10 times longer than wide. Proximal seta positioned at basal 0.18 of ramus. Second proximal seta longest. Of three short terminal setae, longest median seta about 0.1 times as long as caudal ramus.

Labrum (Fig. 11F), mandible (Fig. 11G) and maxilla (Fig. 11I) not much different from preceding species. Maxillule (Fig. 11H) with 4 setae. Maxilliped not discernible.

Legs 2~4 (Figs. 11J, 12A~C) with same formula of armature as *O. koe,* but spinules on distal margin of basis not as well developed. Leg 5 (Fig. 12D) 2-segmented. First segment with 1 plumose seta and 3 or 4 spinules on distal outer surface. Second segment nearly oval, 1.68 times as long as wide, with fine denticles on all margins; ventral margin nearly straight. Four elements on this segment: 1 naked dorsal seta, 2 unequal terminal spines and 1 plumose terminal seta.

MALE. Body (Fig. 12E) 1.20 *mm* long and 0.31 *mm* wide, with 6-segmented urosome. Genital complex (Fig. 12F) 1.23 times as long as wide. Caudal ramus, labrum and oral appendages except for maxilliped, same as those of female. Maxilliped (Fig. 12H) as in *O. koe* except for shorter claw.

Legs 1~4 same as in female. Leg 5 (Fig. 12G) with second segment about 2.9 times as long as wide.

REMARKS. *Ostrincola japonica* is so far found only from the oyster *Crassostrea gigas* in Korea. Although it resembles closely the other Far Eastern species, *O. Koe,* These two species can be separated by the distinctions given in Table 1.

Table 1. Some differeces between *Ostrincola koe* and *O. japonica.*

Characters	*O. Koe*	*O. japonica*
Female.		
Length to width of 3rd segment of antenna	about 2.5:1	about 4.3:1
Terminal median seta on caudal ramus	more than 1/4 of caudal ramus	about 1/10 of caudal ramus
Anal somite	as long as 2nd abdominal somite	1/2 as long as 2nd abdominal somite
Free segment of leg 5	about 1.20 times as long as wide	about 1.68 times as long as wide
Male.		
Length to width of leg 5	about 1.9:1	about 2.9:1

7. *Herrmanella longicaudata* Avdeev, 1975
(Fig. 13)

Herrmannella longicaudata Avdeev, 1975, p. 223, pls. 1~3.

MATERIAL EXAMINED. 3 ♀♀, 2♂♂ from 2 specimens of *Patinopecten yessoensis* (Jay), Imwon in Kangwon-do, 27 Dec. 1986.

FEMALE. Body (Fig. 13A) 2.42 *mm* long and 0.81 *mm* wide (ratio 3.0:1). Rostrum well-developed, 116 *μm* long, with pointed tip, and protruded base. urosome slender. Genital area located midway in genital complex. Each abdominal somite longer than wide. Anal somite with fine denticles on ventrodistal border (Fig. 13C). Caudal ramus (Fig. 13 B) 9.8 times as long as wide. Innermost terminal seta plumose proximally on inner side (Fig. 13D). Other setae naked. Longest inner terminal seta longer than caudal ramus. Egg sac (Fig. 13) 1.35 (length)×0.33(width) *mm* in size, slightly longer than urosome, with numerous eggs.

Antennule (Fig. 13E) peculiar in having foliaceous setae on first and second segments (3 and 4 in number, respectively). Formula of armature: 4, 13, 6, 3, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. First, fifth and sixth segments with 1 plumose seta and terminal segment with 4. Antenna (Fig. 13F) 4-segmented. Formula of armature: 1, 1, 3, and 6+claw. Second segment with fine spinules on inner margin. Third segment very short. One of outer distal setae on fourth segment typically bifurcated at tip (Fig. 13G).

Labrum consisting of 2 unarmed, divergent lobes. Mandible long and slender. Maxillule (Fig. 13H) with 2 unequal, terminal setae and 1 small subterminal seta. Maxilla with numerous minute spinules on first segment. Maxilliped (Fig. 13I) 3-segmented; second segment with 2 subequal setae; third segment pointed at tip, with 1 seta and 1 minute setule.

Legs 1~3 as in original description. Second endopod segment of leg 4 (Fig. 13J) with 2 spinular processes near outer distal margin. Leg 5 (Fig. 13 K) 3.3 times as long as its maximum width (expanded at base). Two terminal subequal setae each longer than leg segment.

MALE. Body as in female. Genital complex 1.3 times longer than wide. Maxilliped (Fig. 13L) 4-segmented. First and third segments unarmed. Second segment with thick denticles and 2 setae, one of which is transformed as shown in Fig. 13L insertion. Fouth segment fused with claw, with 1 small and 1 large setae. Claw long and curved.

Antennule with same armature as in female, except addition of 1 aesthete on fourth segment (shown with a dot in Fig. 13E). Antenna with spinules on both inner and outer margins of second segment.

Leg 1 armed with fine spinules in outer distal area of third segment of endopod (Fig. 13M). Leg 5 (Fig. 13N) without proximal inflation, two terminal setae much unequal.

REMARKS. This is the second report of *H. longicaudata* since Avdeev's (1975) first report from the Soviet Far East. It is interesting to point out that we found it again from the same host (recorded as *Mizuchopecten yessoensis* (Jay) by Avdeev) and only from Imwon in Kangwon-do on the east coast of Korea. One wonders if this species of parasite is confined to the Sea of Japan.

8. *Modiolicola bifidus* Tanaka, 1961
(Fig. 14A~H)

Modiolicola bifidus Tanaka, 1961, p. 266, pl. 32, figs. 6~11, pls. 33, 34; Do & Kajihara, 1986, p. 15, figs. 16A~J; Ko, Murakami & Daiku, 1962, p. 114; Suh & Choi, 1990, p. 138.

MATERIAL EXAMINED. 1) from *Tapes philippinarum* (Adams & Reeve): 1 ♀, 2 ♂♂ from about 150 hosts, Puan, 13 Sept. 1989; 1 ♀ from about 100 hosts, Inchon (fish market), 13 Oct. 1989; 4 ♀, 1 copepodids from more than 150 hosts, Mokpo (fish market), 4 Nov. 1989; 11 ♀♀, 3 ♂♂ from about 120 hosts, Pusan(fish market), 1 Dec. 1989; 4 ♀♀, 3 ♂♂ from about 100 hosts, Chungmu, 17 Jun. 1990. 2) from *Scapharca broughtoni*(Schrenck): 4 ♀♀, 4 ♂♂ from 22 hosts, Kangreung(fish mar-

ket: host bivalves were transported to Kangreung from elsewhere in Korea), 22 Feb. 1988. 3) from *Scapharca subcrenata*(Lischke): 2 ♀♀ from about 200 hosts, Kangnung(Fish market: host bivalves were transported to Kangnung from elsewhere in Korea), 17 Sept. 1987.

FEMALE. Body (Fig. 14A) 1.13~1.96×0.39~0.75 *mm* (based on 4 selected specimens. Rostrum weak, triangular, 50 *μm* long, not reaching bases of antennae, and with blunt tip. Genital complex 1.25 times longer than wide, with constriction at midway (Fig. 14B). Genital area dorsal, with 1 spinule and 2 setae. Genital complex and first 2 postgenital somites with membrane on posteroventral margin. Anal somite 0.95 times longer than wide, with fine spinules on posteroventral margin. Caudal ramus (Fig. 14C) about 4 times longer than wide. Outer lateral seta on caudal ramus at about midway of ramus. Egg sac 470×185 *μm*.

Antennule as in other species of the genus. Antenna (Fig. 14D) 4-segmented, with formula of armature: 1, 1, 3, and 4+3 claws. Terminal segment about 2.7 times longer than wide.

Labrum, mandible, maxillule and maxilla as in other species of *Modiolicola*. Maxilliped (Fig. 12E) 3-segmented. First segment unarmed. Second segment with 2 equal size setae. Third segment pointed at tip, with 1 small seta. Legs 1-4 with following formula of armature:

P1: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 4
Enp 0-1; 0-1; I, 5
P2: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 5
Enp 0-1; 0-2; III, 3
P3: Prp 0-1; 1-0 Exp I-0; I-1; III, I, 5
Enp 0-1; 0-2; IV, 2
P4: Prp 0-1; 1-0 Exp I-0; I-1; II, I, 5
Enp 0-1; 0-1; II

Leg 5(Fig. 14F) with free segment bearing 2 weak proximal expansions, 1.36 times longer than wide. Two terminal setae very unequal; outer one naked, inner one 112 *μm* long, with crenate outer margin.

MALE. Body shape as in female. Length 1.02 *mm*. Maximum width 0.31 *mm*. Genital complex 0.8 times longer than wide, with 2 setae and 2 denticles on posteroventral corenr.

antennule with addition of 1 more aesthete on fourth segment, otherwise as in female. Antenna with third segment armed with spinules on inner margin.

Labrum, mandible, maxillule and maxilla as in female. maxilliped (Fig. 14H) 4-segmented. Second segment with 2 setae and 3 rows of spinules on inner surface. Fourth segment fused with claw, with 2 extremely unequal setae. Claw long and slender.

Legs 1-4 same as in female. Leg 5(Fig. 14G) with smaller free segment. Two terminal setae subequal.

REMARKS. This species has been excellently redescribed by Do and Kajihara(1984) from Japan. The Korean specimens show no significant difference from their redescription.

9. *Modiolicola gracilicaudus* Avdeev, 1977
(Fig. 14I~M)

Modiolicola gracilicaudus Avdeev, 1977, p. 34, figs. 20~37; Ho, 1980, p. 298, figs. 2, 3; Do & Kajihara, 1986, p. 15, fig. 5F~K.

MATERIAL EXAMINED. All from *Mytilus coruscus* Gould. 11 ♀♀, 5♂♂ from 51 hosts, Kangreung, 27 Dec. 1986; 1 ♀, 1♂ from 40 hosts, Kangreung, 13 Aug. 1987; 7 ♀♀, 2 ♂♂ from 25 hosts, Kangreung, 2 May 1988; 21, 14 from 20 hosts, Sokcho, 26, Nov. 1989.

FEMALE. Body(Fig. 14I) 1.71 *mm* long and 0.71 *mm* wide, with broad cephalothorax. Somite of leg 5 much narrower than genital complex, which is 1.07 times longer than wide and with crenulated posteroventral border. Genital area located dorsolaterally, with 1 spinule and 2 setae. Caudal rami crossed distally. Each ramus tapered(Fig. 14J), 3.82 times longer than wide. Rostrum semi-circular, broad and short.

Antennule 7-segmented, with fromula of armature: 4, 13, 6, 3, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. Antenna(Fig. 14K) 4-segmented. Segments narrowed distally. Terminal three segments subequal in length. Formula of armature: 1,

1, 2, and 4+3 claws.

Maxilliped(Fig. 14L) with small third segement tipped subterminally with nipple-shaped projection.

Leg 1 exopod with a patch of small spinules near bases of outer spines on sencond and third segments. Formula of armature of legs 1-4 as preceding species. Free segment of leg 5(Fig. 14M) 1.74 times as long as wide, with weak basal expansion and 2, extremely unequal terminal elements.

MALE. Body 1.48 *mm* long. Maximum width 0.54 *mm*. Body form generally as in female. Genital complex globular, 1.27 times as wide as long. First abdominal somite with crenulated posteroventral border.

Antennule and antenna same as those of female.

Maxilliped with 1 longitudinal row of teeth on medial surface of second segment. Claw as long as remaining segments combined.

Legs 1-4 as in female. Free segment of leg 5 without basal expansion.

REMARKS. This species was first reported by Avdeev(1977) from Possiet Bay and later by Ho (1980) from Sado Island. It was found again by Do and Kajihara(1986) from Obama Bay(Fukui-ken) and Iwami(Tottori-ken). Therfore, as in *Hermannella longicaudata, M. gracilicaudus* may be confined to the bivalves living in the Sea of Japan.

Discussion

The culture of edible bivalves has considerable commercial importance. However, in the past, the industry has been unstable in production due to the frequent mass mortalities of the cultured bivalves. The mass mortalities of the hard clam, *Meretrix lusoria*(Röding), occurred on the coast of Yellow Sea since the early 1970s are well known in this country. The annual production of this species of clam peaked at 2,284 tons in 1968, but since then it droped down steadily and in 1973 only 810 tons were recorded(Yoo et al., 1975). Farming of this species of clam has not recovered since then. But, regrettably, inspite of the great loss to the mariculture industry, no study has been successful in Korea in finding out the cause(s) or the control measures of such mass mortalities. In as much as parasitic copepod is being considered a causative agent in the mass mortalities of cultured had clam [*Meretrix meretrix*(Linnaeus)] on the southern shores of Jiangsu, China(Ho and Zheng, in preparation), we shall discuss here some relationships that we found between the copepod parasites and their bivalve hosts cultured in Korea.

As shown in Table 2, *Conchyliurus quintus* invades the highest variety of host bivalves in Korea. This species of copepod also uses large number of bivalve hosts in Japan. From the works of Tanaka

Table 2. The copepod parasites and their examined hosts.

Hosts \ Copepod parasites*	1	2	3	4	5	6	7	8	9
Tapes philippinarum	+				+			+	
Crassostrea gigas			+	+		+			
Scapharca broughtoni			+					+	
Scapharca subcrenata	+		+					+	
Meretrix lusoria	+	+							
Cyclina sinensis	+	+			+				
Mactra veneriformis	+				+				
Mytilus coruscus									+
Patinopecten yessoensis							+		

* 1. *Conchyliurus quintus*; 2. *Lichomolgus similis*; 3. *Pseudomyicola spinosus*; 4. *Myicola ostreae*; 5. *Ostrincola koe*; 6. *Ostrincola japonica*; 7. *Herrmannella longicaudata*; 8. *Modiolicola bifidus*; 9. *Modiolicola gracilicaudus*.

(1961), Ko et al.(1962) and Ko and Yoshikoshi (1974) 10 host species were recorded. Our report adds one new host(*Scapharca subcrenata*) to this list of 10 species.

Next prevalent copepod parasite is *Ostrincola koe*. It has been found from 10 species of bivalves (Tanaka, 1961; Ko et al., 1962; Ko and Yoshikoshi, 1974; Yoosukh, 1991). This species has a rather wide distribution, its range extended from Yellow Sea to the Gulf of Thailand. In Thailand this copepod infests the cultured rock oyster, *Saccostrea cucullata*(Bohn) (Yoosukh, 1991) and in China it causes mass mortality of cultured hard clam, *Meretrix meretrix*(Linnaeus) (Ho and Zheng, in preparation).

Pseudomyicola spinosus is another species of copepod commonly found in bivalves. It has been recorded from nearly 50 species of bivalves from various parts of the world(Do and Kajihara, 1986). In Korean seas, the hosts of this parasite are mainly found in the wild, non-cultured bivalves.

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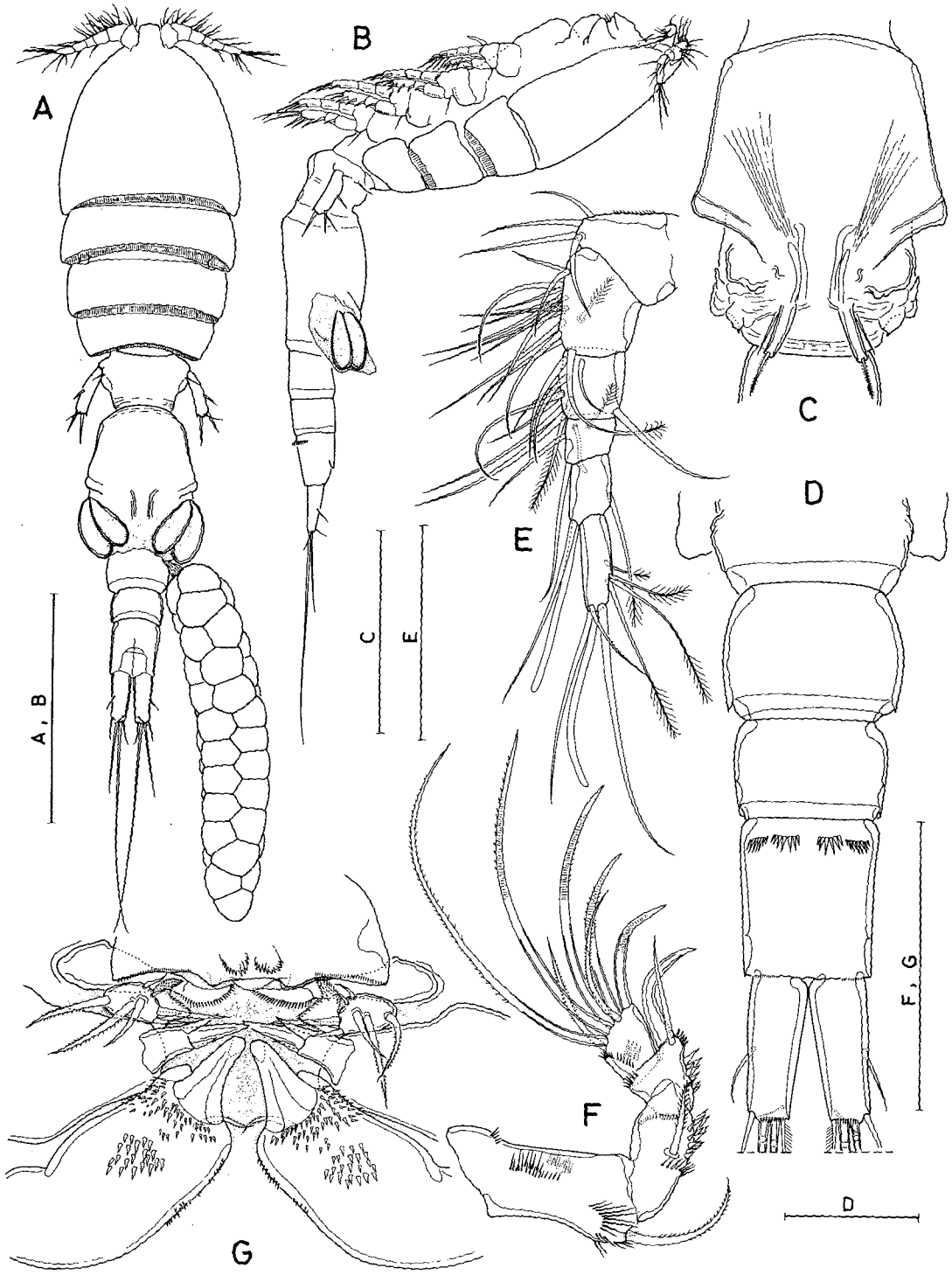

Fig. 1. *Conchyliurus quintus* Tanaka.
Female: A, habitus, dorsal; B, same, lateral; C, genital complex, dorsal; D, abdomen, ventral; E, antennule; F, antenna; G, mouth area. Scale bar: A, B=0.5 *mm*; C=0.2 *mm*, D~G=0.1 *mm*.

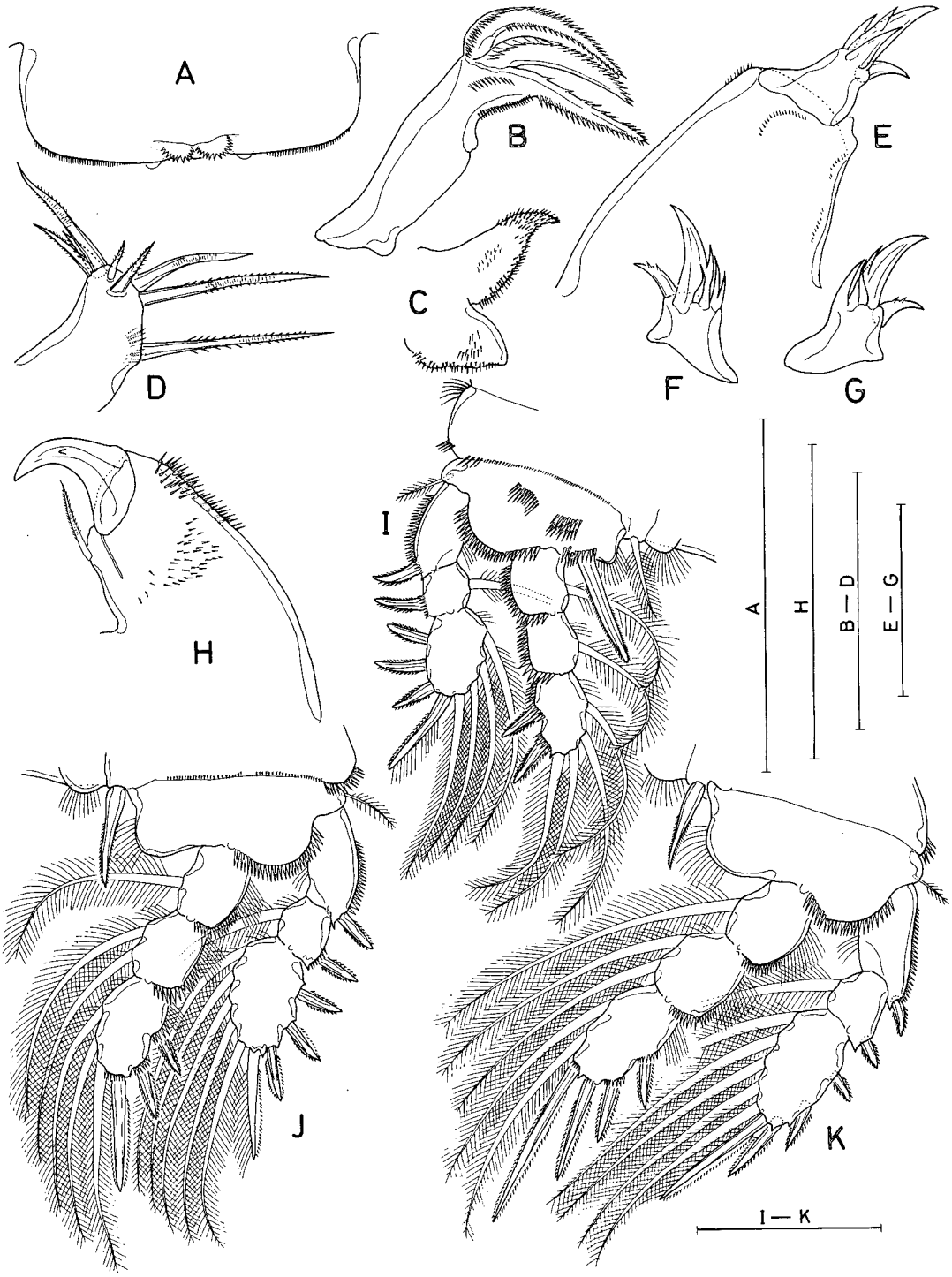

Fig. 2. *Conchyliurus quintus* Tanaka.
Female: A, labrum; B, mandible; C, palp; D, maxillule; E, maxilla; F, G, second segment of second maxilla; H, maxilliped; I, leg 1; J, leg 2; K, leg 3. Scale bar: A, H~K=0.1 *mm*; B~G=0.05 *mm*.

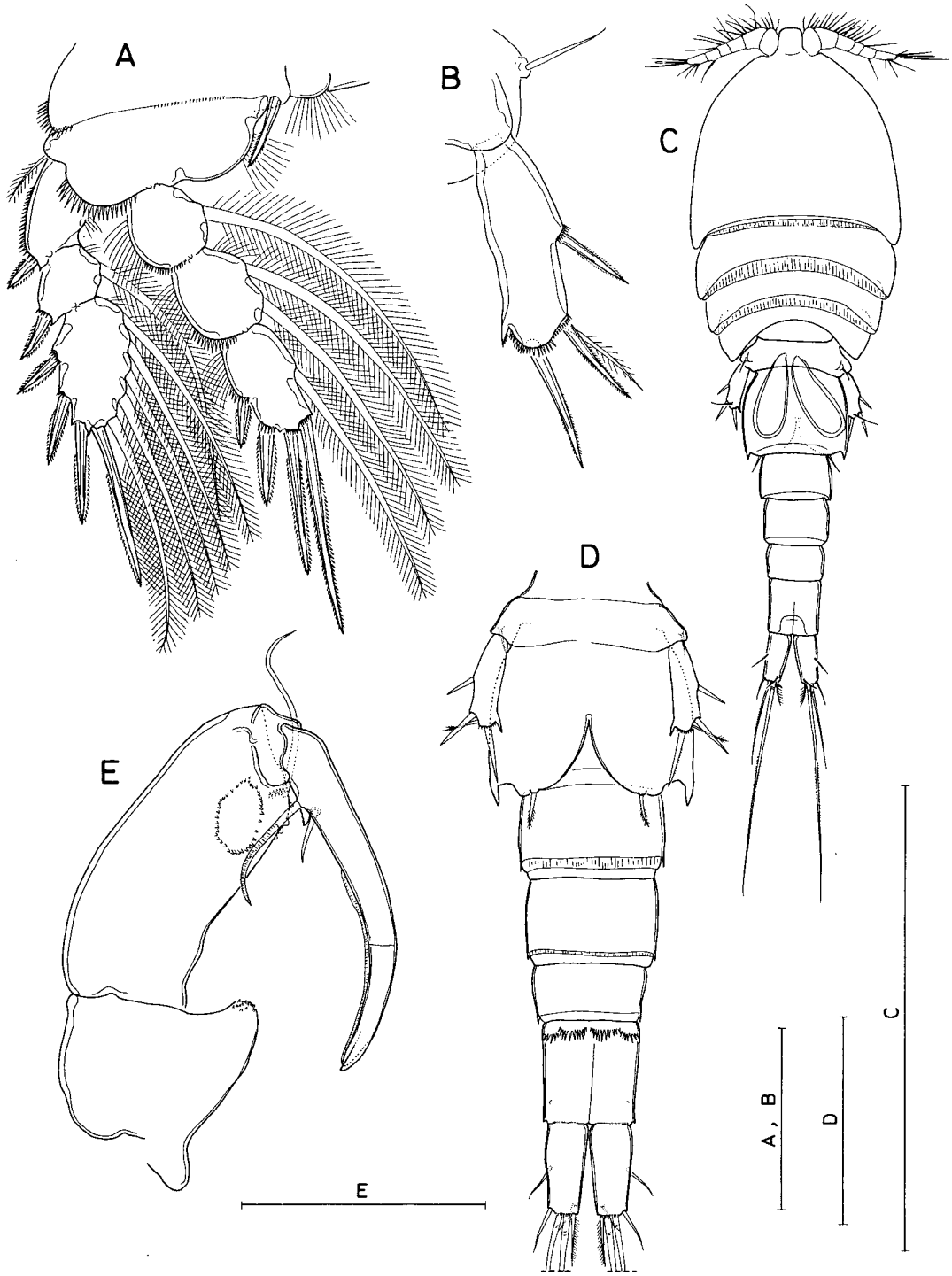

Fig. 3. *Conchyliurus quintus* Tanaka.
Female: A, leg 4; B, leg 5. Male: C, habitus, dorsal; D, urosome, ventral; E, maxilliped. Scale bar: A, B, E=0.1 *mm*; C=1 *mm*; D=0.2 *mm*.

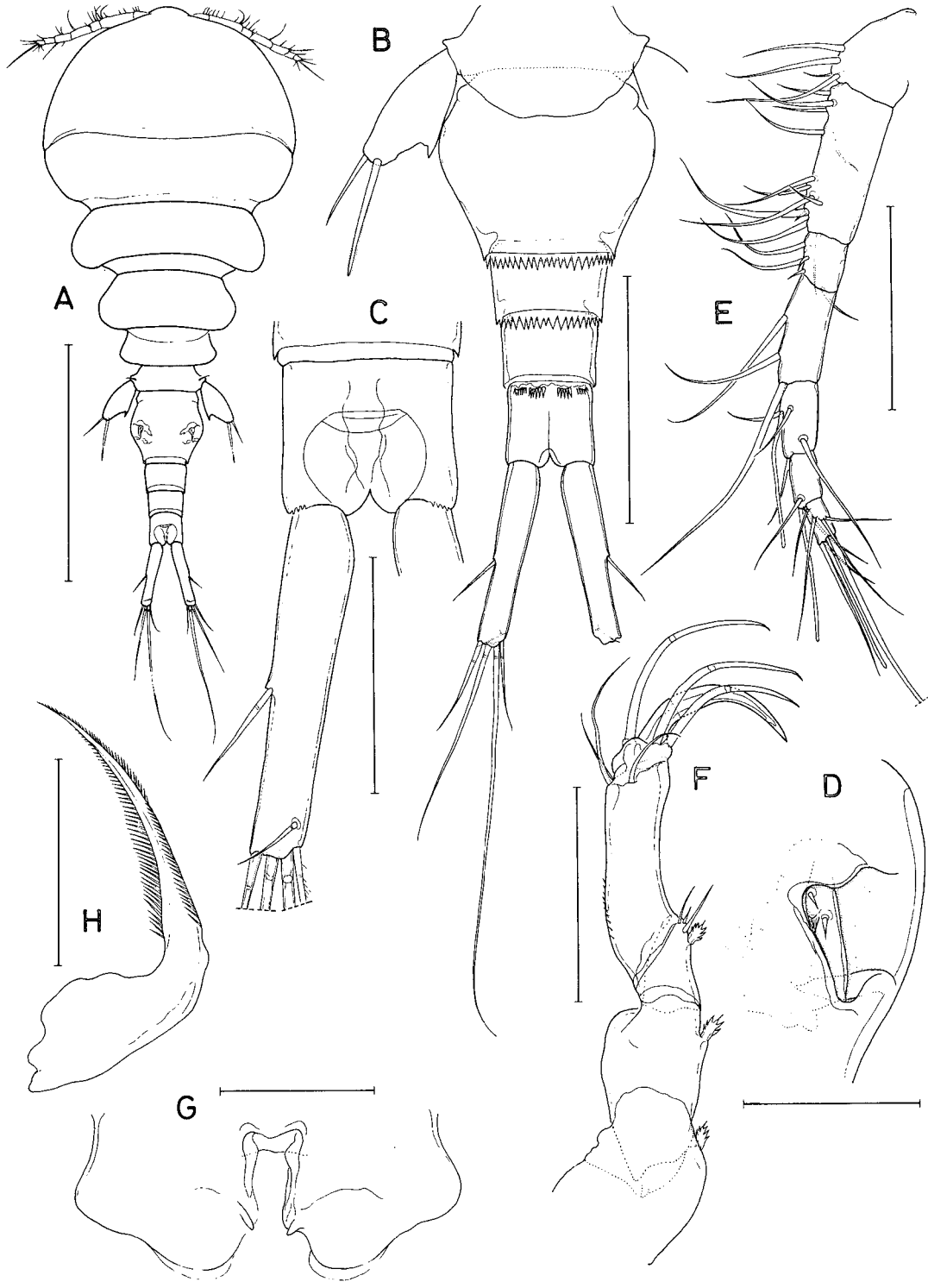

Fig. 4. *Lichomolgus similis*, new species.
Female: A, habitus, dorsal; B, urosome, ventral; C, anal somite and caudal ramus, dorsal; D, genital area; E, antennule; F, antenna; G, labrum; H, mandible. Scale bar: A, D=0.5 *mm*; B=0.2 *mm*; C, E, F=0.1 *mm*; G, H=0.05 *mm*.

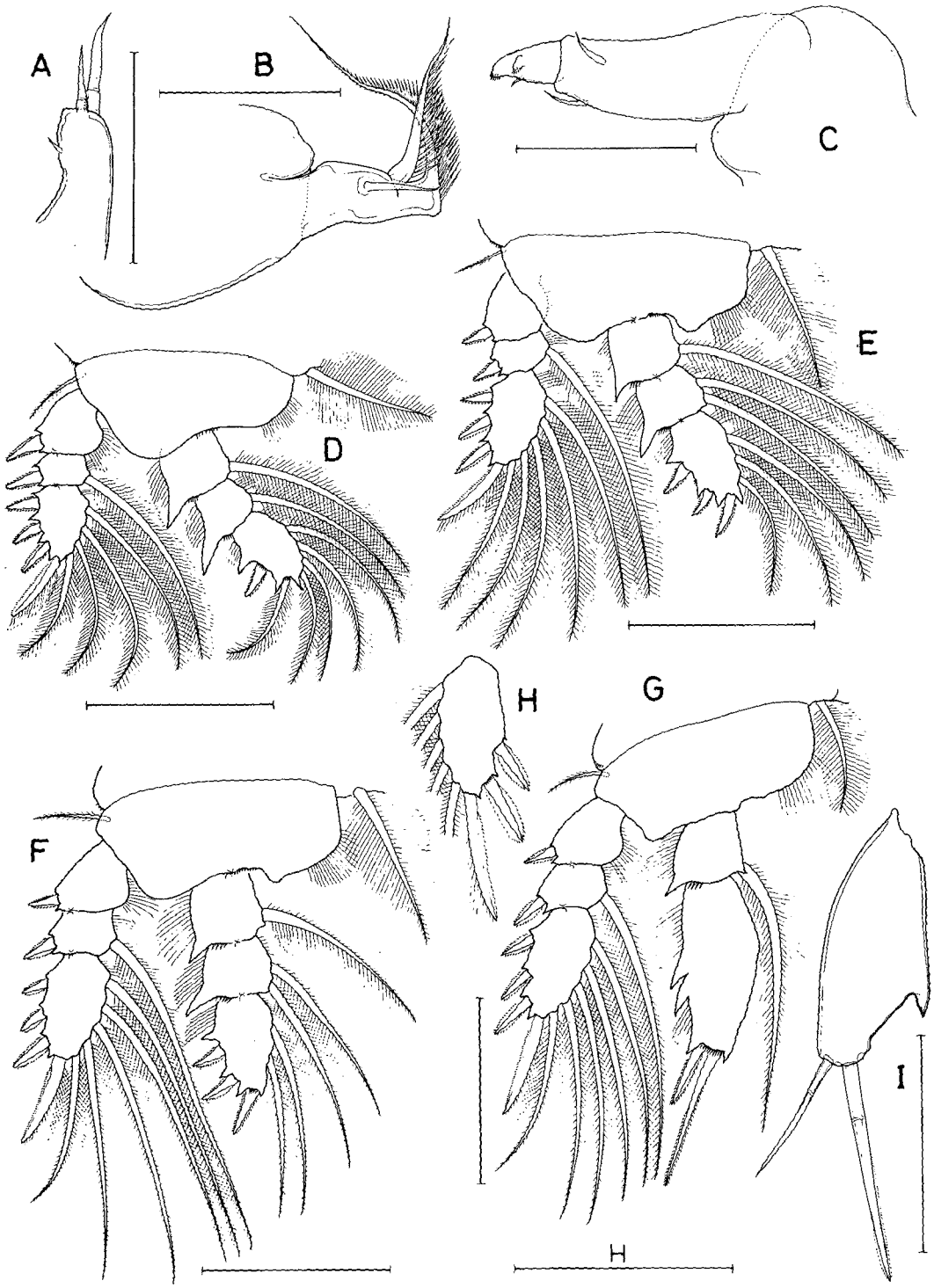

Fig. 5. *Lichomolgus similis*, new species.
Female: A, maxillule; B, maxilla; C, maxilliped; D, leg 1; E, leg 2; F, leg 3; G, letg 4, H, aberrant terminal endopod segment of leg 4; I, leg 5. Scale bar: A~C=0.05 *mm*; D~I=0.1 *mm*.

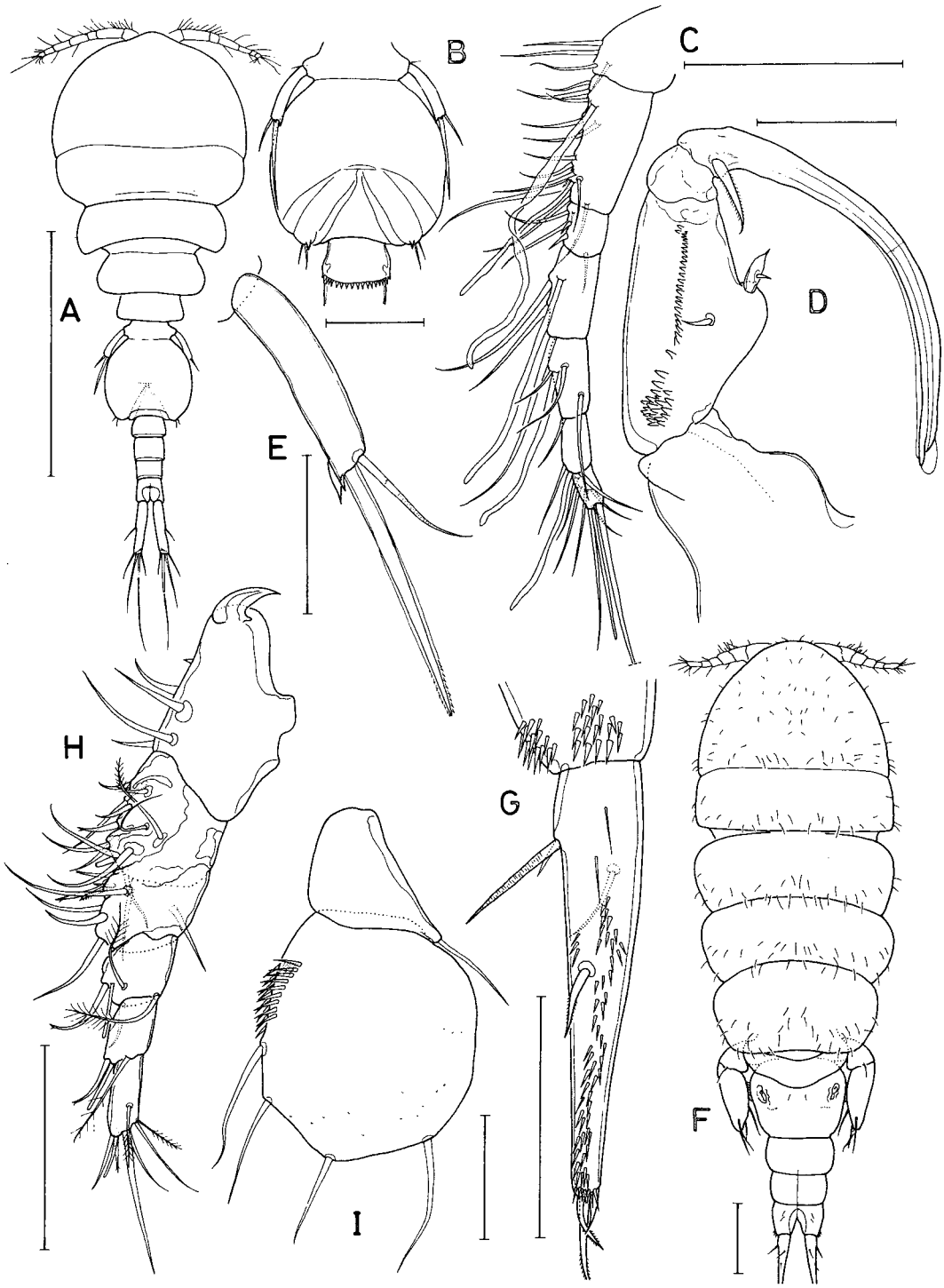

Fig. 6. *Lichomolgus similis*, new species.
Male: A, habitus, dorsal; B, anterior part of urosome, ventral; C, antennule; D, maxilliped. *Pseudomyicola spinosus*(Raffaele & Monticelli), female: F, habitus, dorsal; G, caudal rami, ventral; H, antennule; H, leg 5. Scale bar: A=0.4 *mm*; B, C, F~I=0.1 *mm*; D, E=0.05 *mm*.

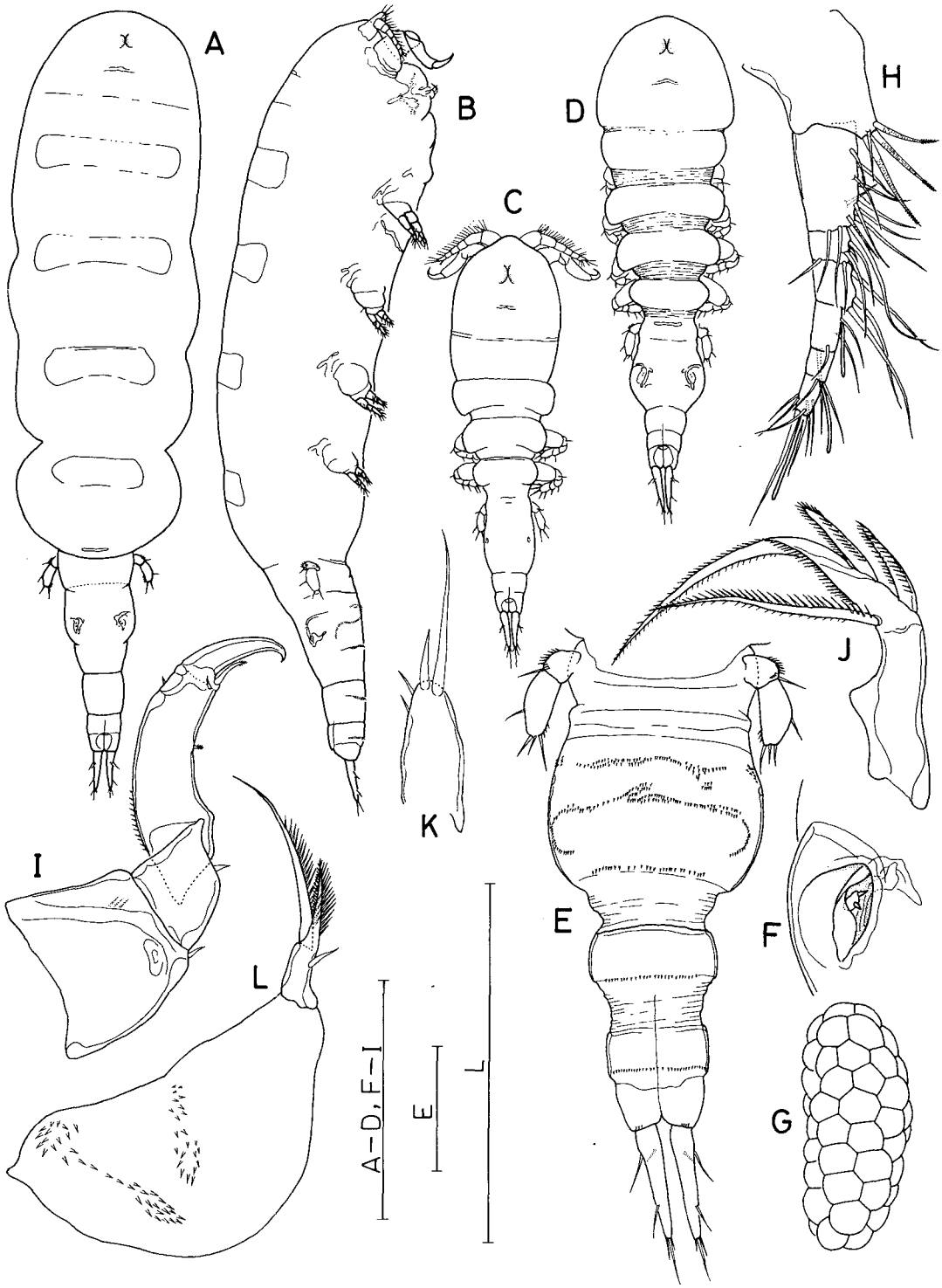

Fig. 7. *Myicola ostreae* Hoshina & sugiura.
Female: A, habitus, dorsal; B, habitus, lateral; C, D, copepodids; E, urosome, ventral; F, genital area; G, egg sac; H, antennule; I, antenna; J, mandible; K, maxillule; L, maxilla. Scale bar: A~D=0.5 *mm*; E, F, H, I, L=0.1 *mm*; G=1 *mm*; J, K=0.05 *mm*.

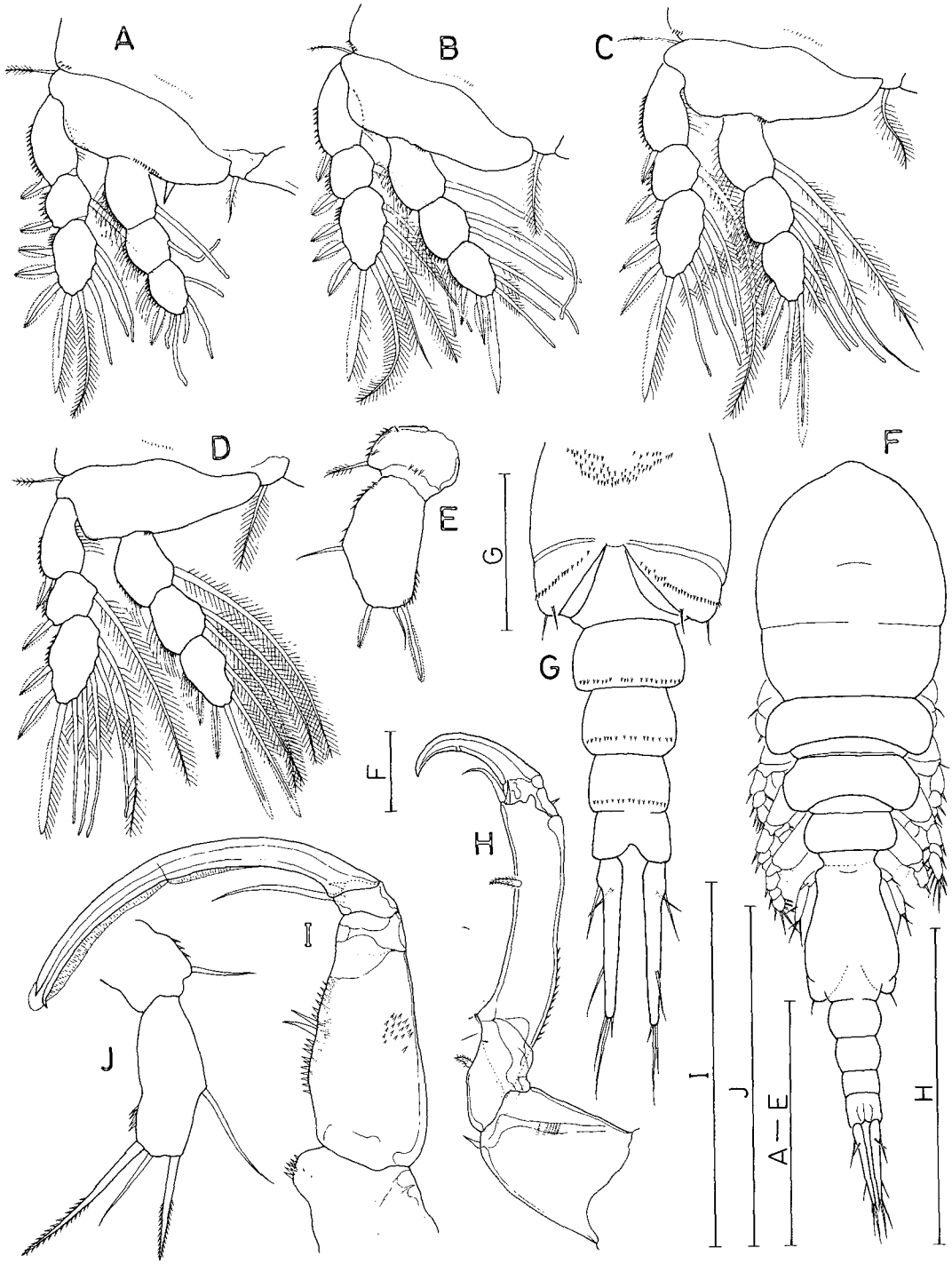

Fig. 8. *Myicola ostreae* Hoshina & Sugiura.
Female: A, leg 1; B, leg 2; C, leg 3; D, leg 4; E, leg 5. Male: F, habitus, dorsal; G, urosome, ventral; H, antenna; I, maxilliped; J, leg 5. Scale bar: 0.1 *mm*.

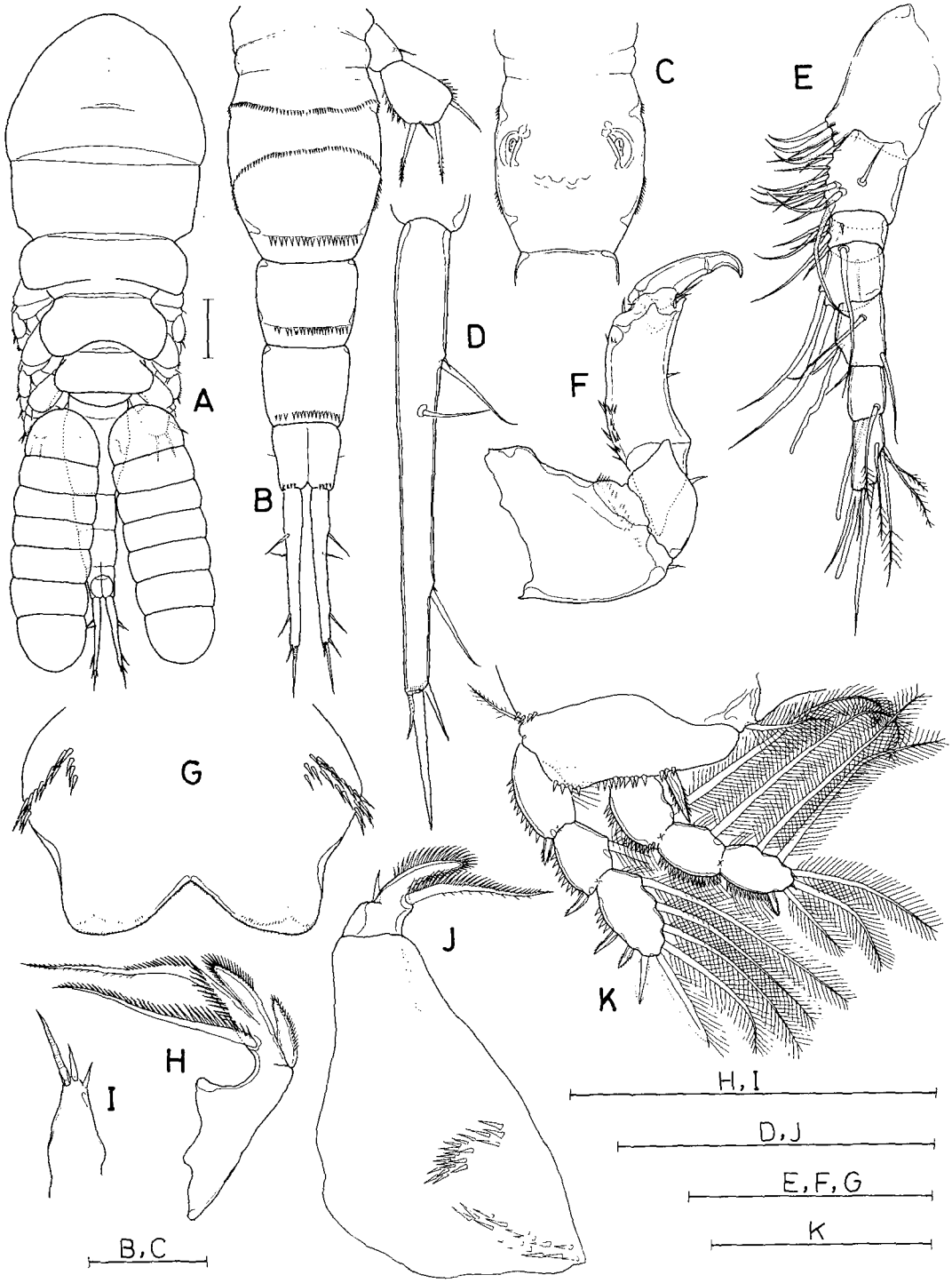

Fig. 9. *Ostrincola koe* Tanaka.
Female: A, habitus, dorsal; B, urosome, ventral; C, genital complex, dorsal; D, caudal ramus; E, antennule; F, antenna; G, labrum; H, madible; I, maxillule; J, maxilla; K, leg 1. Scale bar: 0.1 *mm*.

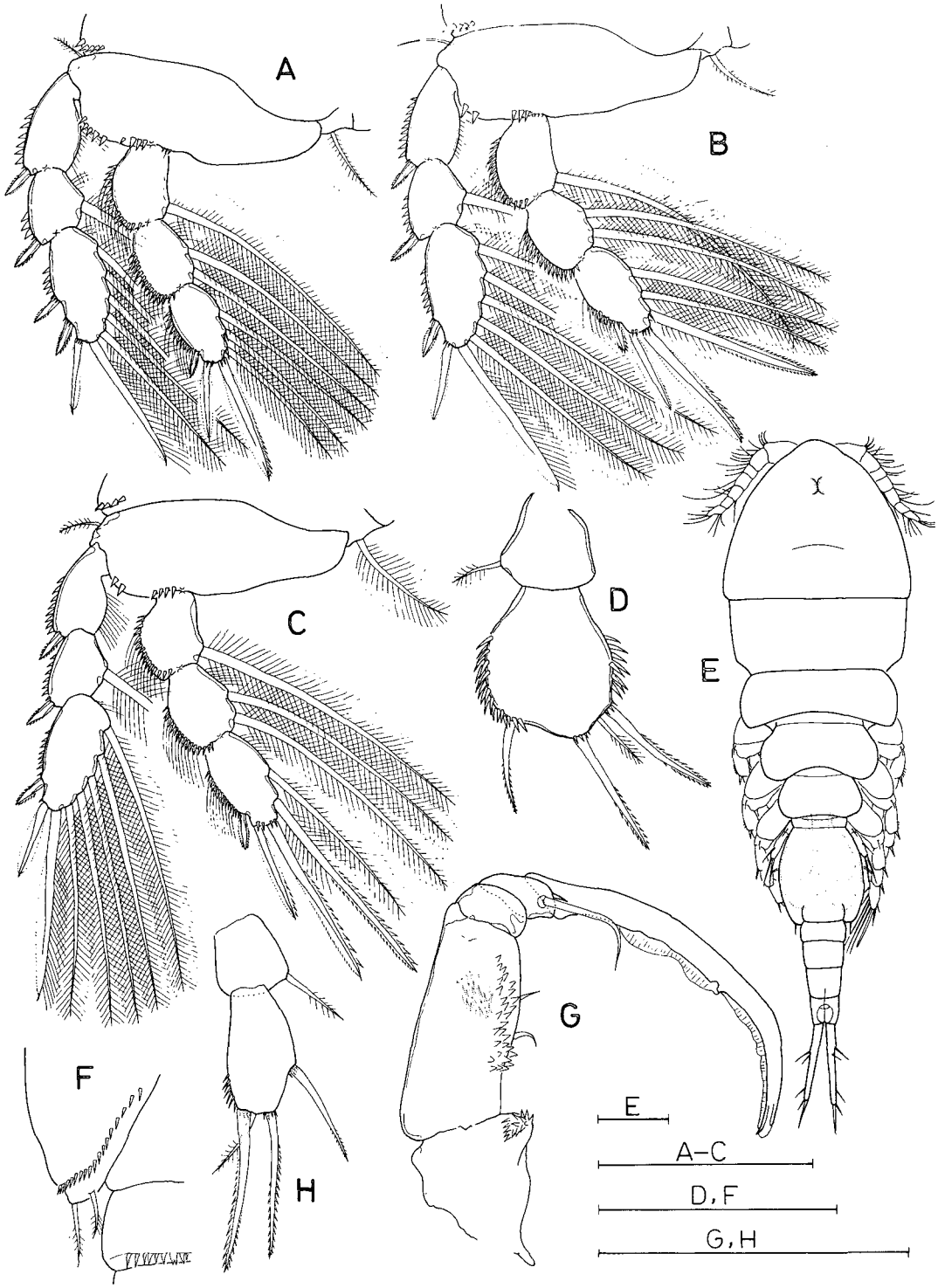

Fig. 10. *Ostrincola koe* Tanaka.
Female: A, leg 2; B, leg 3; C, leg 4; D, leg 5. Male: E, habitus, dorsal; F, posteroventral corner of genital complex; G, maxilliped; H, leg 5. Scale bar: 0.1 *mm*.

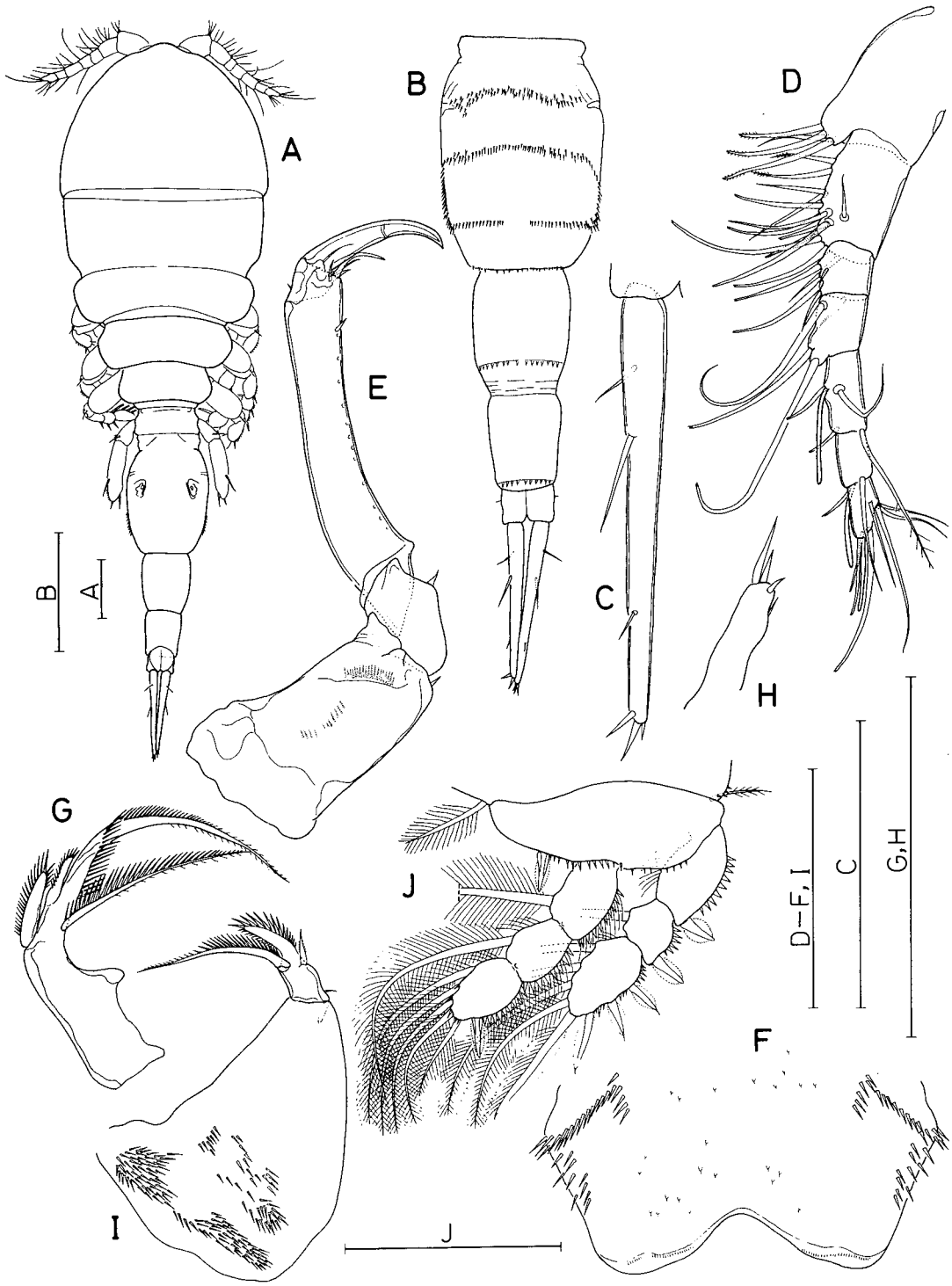

Fig. 11. *Ostrincola japonica* Tanaka.
Female: A, habitus, dorsal; B, urosome, ventral; C, caudal ramus; D, antennule; F, labrum; G, mandible; H, maxillule; I, maxilla; J, leg 1. Scale bar: 0.1 *mm*.

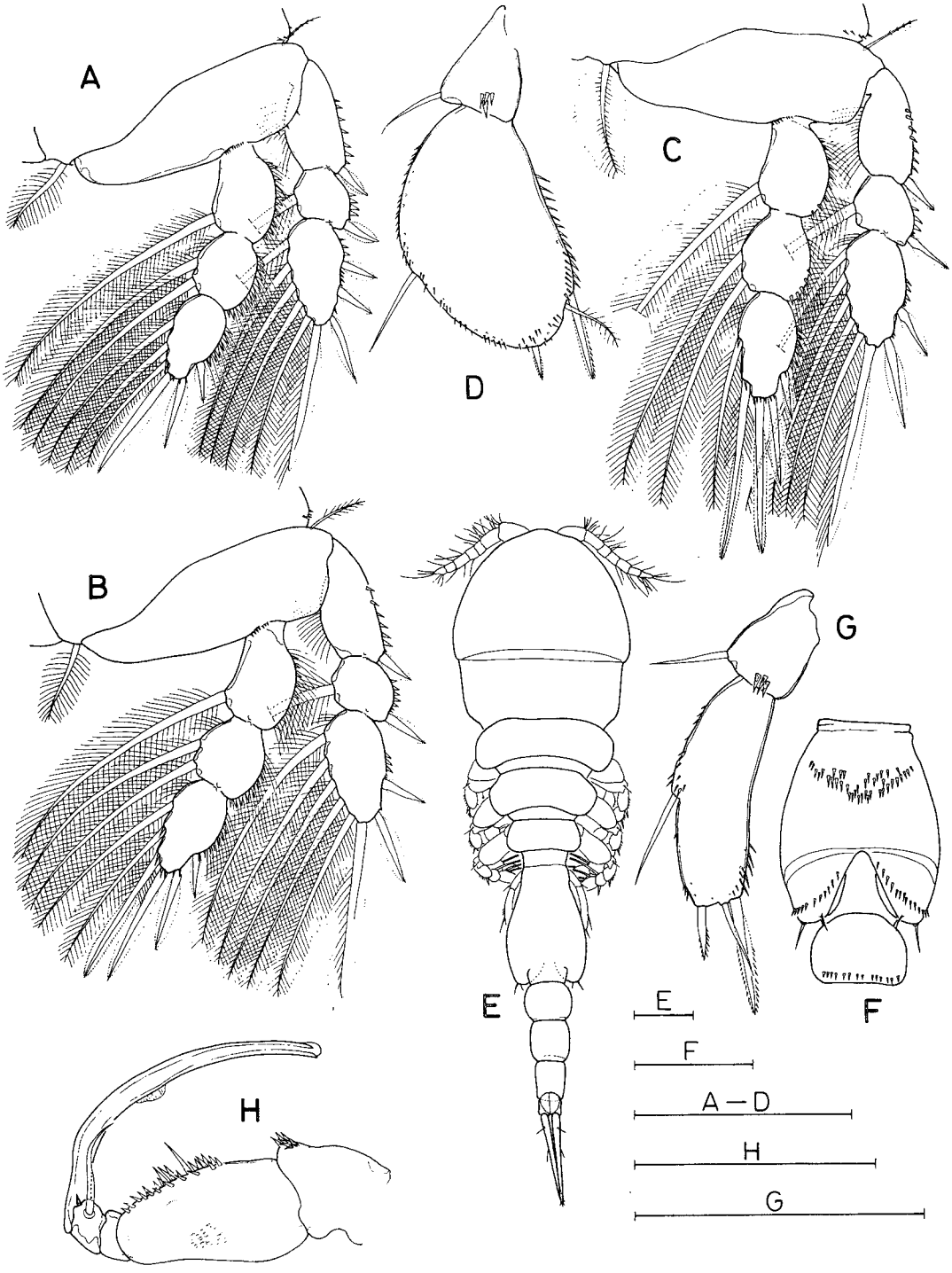

Fig. 12. *Ostrincola japonica* Tanaka.
Female: A, leg 2; B, leg 3; C, leg 4; D, leg 5. Male: E, habitus, dorsal; F, genital complex and first postgenital somite, ventral; G, leg 5; H, maxilliped. Scale bar: 0.1 *mm*.

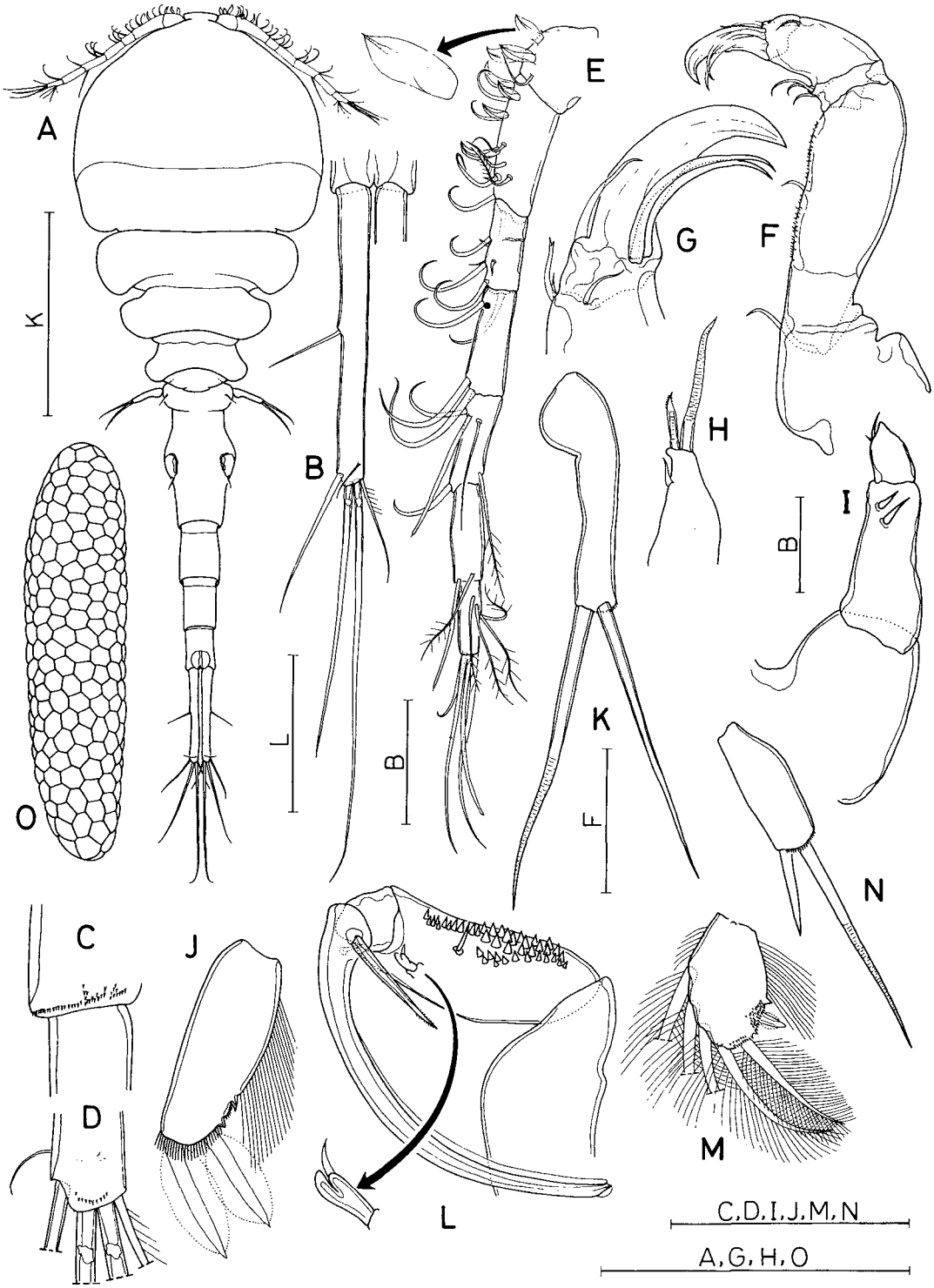

Fig. 13. *Herrmannella longicaudata* Avdeev.
Female: A, habitus, dorsal; B, caudal ramus; C, distal part of anal somite, ventral; D, distal part of caudal ramus, ventral; E, antennule; F, antenna; G, distal part of antenna, enlarged; H, first maxilla; I, maxilliped; J, terminal endopod segment of leg 4; K, leg 5. Male: L, maxilliped; M, terminal endopod segment of leg 1; N, leg 5. Scale bar: A, O=1 *mm*; B~N=0.1 *mm*.

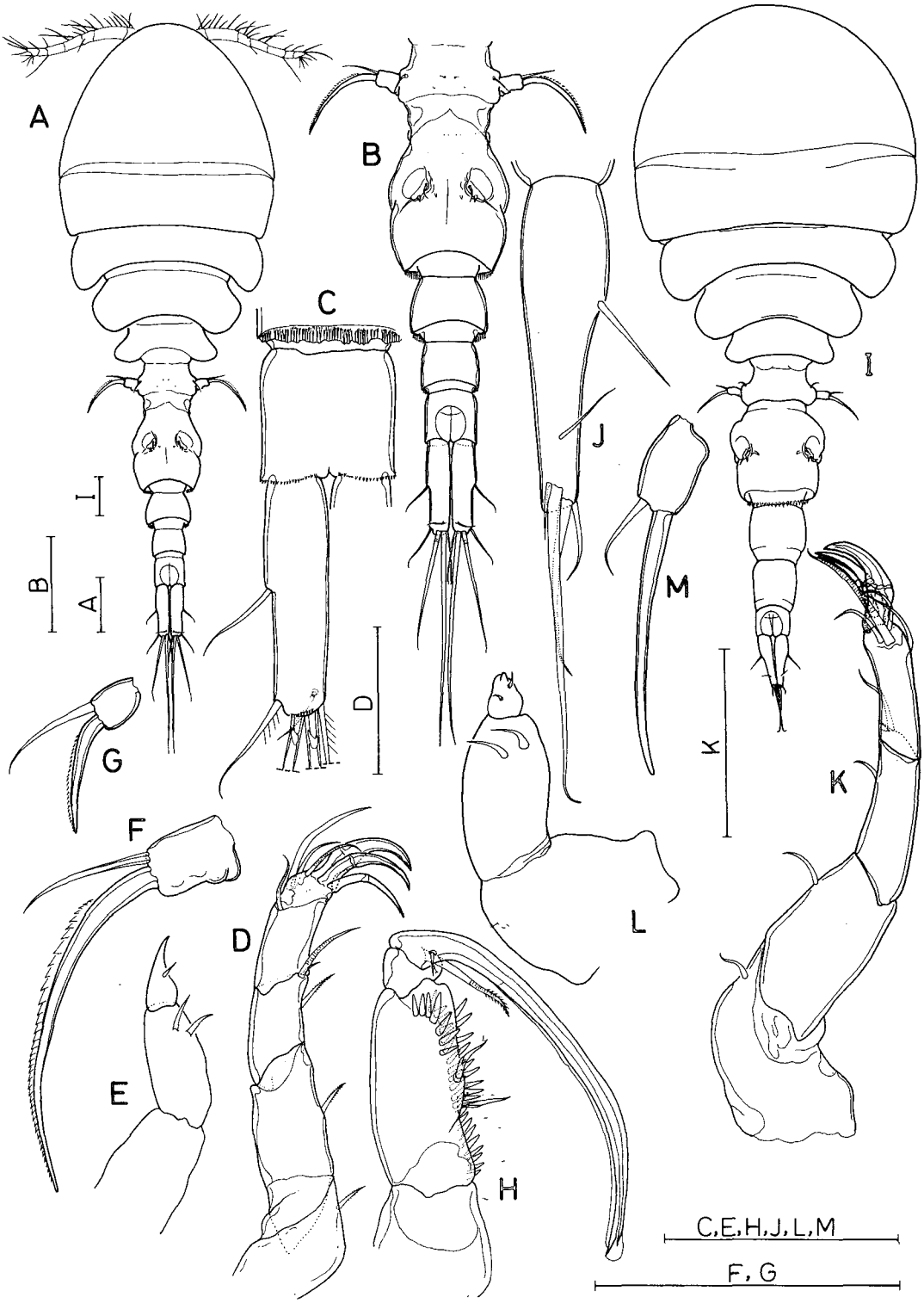

Fig. 14. *Modiolicola bifidus* Tanaka.
Female: A, habitus, dorsal; B, urosome, dorsal; C, anal somite and caudal ramus; D, antenna; E, maxilliped; F, leg 5. Male: G, leg 5; H, maxilliped. *Modiolicola gracilicaudus* Avdeev. Female: I, habitus, dorsal; J, caudal ramus; K, antenna; L, maxilliped; M, leg 5. Scale bar: 0.1 *mm*.

한국산 식용 이매패류에 기생하는 요각류

II. 양식 이매패류에 기생하는 요각류

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한국산 양식 이매패류 9종으로부터 9종의 요각류가 발견되어 이들을 기재한다. 이들 요각류 중에는 신종 *Lichomolgus simillis*도 포함되어 있다. 그 외의 다른 8종은 다음과 같다. *Conchyliurus quintus, Pseudomyicola spinosus, Myicola ostreae, Ostrincola koe, O. japonica, Herrmannella longicaudata, Modiolicola bifidus, M. gracilicaudus*. 이들 요각류와 숙주와의 관계도 기록한다.