Four Species of Copepoda (Poecilostomatoida) Parasitic on Marine Fishes of Korea

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Four known species of the copepod parasite were recovered from three marine fishes of Korea. It contains redescription of three species of *Acanthochondria*(*A. brevicorpa* Yü, *A. tchangi* Yü and *A. yui* Shiino) and *Anchistrotos kojimensis* Do & Ho. All of these species are newly recorded from the Korean waters.

Introduction

Copepod parasites have been considered as enemies of fishes capable of causing serious economic damage(Kabata, 1979). In Korean waters, nevertheless, few studies have been done on copepod parasites of fishes, although copepod associates of invertebrate hosts have received the attention of carcinologists(Suh and Choi, 1990, 1991; Kim, 1992; Kim and Ho, 1991; Ho and Kim, 1991, 1992).

Recently, we had an opportunity to examine specimens of the two genera, *Acanthochondria* in Chondracanthidae and *Anchistrotos* in Taeniacanthidae, collected from marine fishes in Korean waters. Having studied this material, we have found three species of *Acanthochondria*(*A. brevicorpa* Yü, 1935, *A. tchangi* Yü, 1935, *A. yui* Shiino, 1964) and one species of *Anchistrotos*(*A. kojimensis* Do & Ho, 1983) from three species of demersal fishes, *Acanthogobius hasta*(Temminck & Schlegel), *Acanthogobius flavimanus*(Temminck & Schlegel) and *Amblychaeturichthys hexanema*(Bleeker).

Anchistrotos kojimensis is briefly described here, since a detailed original description was made by Do and Ho(1983). On the other hand, the remaining three species of *Acanthochondria* have not been described in detail since their discovery. Thus, these are described with illustrations, mainly based on the important taxonomic characters suggested by Kabata(1984). All of four species of copepod parasites treated herein are reported for the first time to the Korean fauna.

Materials and Methods

The fishes examined for the copepod parasites were taken from Kogum-do, Wando Islands(34° 45′ N, 126° 50′E) and Yongkwang(35° 25′N, 126° 25′ E). All fishes were collected with the bottom trawls. We have removed more than 700 specimens of copepod parasites from the gill filaments, gill arches and buccal cavity of fishes. The copeopds were preserved in 5% buffered formalin seawater immediately after collection, cleared in lactic acid and dissected on wooden slides(Humes and Gooding, 1964). Drawings were made with the aid of a drawing tube.

The characters of male of *Acanthochondria* are not described, because we would follow Kabata(1984) in suggesting that morphological characters of male are hardly useful for identifying *Acanthochondria* in specific level. However, the male of *Anchistrotos kojimensis* was not found.

This study was supported by the NON DIRECTED RESEARCH FUND, Korea Research Foundation, 1991.

Results and Discussion

The classification of these four species of copepods is listed as follows:

Family Chondracanthidae Milne Edwards, 1840
Acanthochondria brevicorpa Yü, 1935
Acanthochondria tchangi Yü, 1935
Acanthochondria yui Shiino, 1964
Family Taeniacanthidae Wilson, 1911
Anchistrotos kojimensis Do & Ho, 1983

1. *Acanthochondria brevicorpa* Yü, 1935(Fig. 1)

Acanthochondria brevicorpa Yü, 1935, p. 9, pl. 4, figs. 1~8.

MATERIAL EXAMINED. 1) from *Acanthogobius hasta*: 96 females(94 with attached males), 4 copepodids discovered from 9 hosts, Kogum-do, 14 May 1990; 28 females(all with attached males) from 22 hosts, Yongkwang, 24 October 1990; 1 female with attached male from 2 hosts, Kogum-do, 29 November 1990; 2 females(all with attached males) from 9 hosts, Kogum-do, 19 December 1990; 1 female with attached male from 10 hosts, Kogum-do, 19 January 1991; 9 females(all with attached males) from 14 hosts, Kogum-do, 28 February 1991; 17 females(16 with attached males), 2 copepodids from 16 hosts, Kogum-do, 26 March 1991. 2) from *Amblychaeturichthys hexanema*: 13 females(10 with attached males) discovered from 3 hosts, Kogum-do, 15 June 1990.

FEMALE. Body(Fig. 1A, B) stout. Total length 4.64*mm*(3.78~5.78*mm*) (including posterior process) based on 20 specimens. Cephalothorax(Fig. 1 A, B) wider than long and measuring 1.36*mm* (1.18~1.55*mm*)×1.22*mm*(1.05~1.50*mm*), subrectangular or anteriorly narrower; lateral margins often concave; buccal cavity close to bases of leg 1. Trunk(including neck and posterior process) very stout, 3.43*mm*(2.70~4.33*mm*)×2.95*mm*(2.38~3.83 *mm*); its constrictions distinctly present in lateral margins. Posterior process long and cylindrical, projecting further than posterior margin of abdomen. Genito-abdomen(Fig. 1C) measuring 0.63*mm* (0.53~0.80*mm*) long, with hemispherical genital part separated from abdomen by constriction. Abdomen ovoid, with uropods near base. Egg sac(Fig. 1D) 4.48*mm*(2.98~6.03*mm*) long.

First antenna(Fig. 1E), type A(see Kabata, 1984); basal part with 2 papillae and distal part with armature of 7 setae and 2 papillae. Second antenna (Fig. 1F) with abruptly narrowing tip armed with narrow flange. Labrum(Fig. 1G) with a patch of dorsal spinules. Mandible(Fig. 1H) with 36 denticles on outer and 28~30 on inner margin. Paragnath(Fig. 1I) bluntly rounded and sparsely denticulated. First maxilla(Fig. 1J) with medial and lateral margins convex and spinules in ventrolateral corner. Claw of second maxilla(Fig. 1K) with about 12 lateral denticles on outer margin, auxiliary process with unarmed, attenuated tip and very short seta on posterior margin. Maxilliped(Fig. 1L) with scattered spinules on anterior margin near base of claw; latter with one secondary tooth.

Leg 1(Fig. 1M) bilobed, smaller than similar leg 2(Fig. 1N), both with patches of fine spinules on distal parts; exopods bulbous and endopods slightly conical. Uropod(Fig. 1θ) with inflated base, tapering tip covered with minute setules; armature comprising 3 long setae.

REMARKS. Original description(Yü, 1935) lacked sufficient details and no redescription followed. It was necessary, therefore, to described this species in detail. The most distinct features of *Acanthochondria brevicorpa* are the short stout neck and long posterior processes of trunk. The difference between sizes of legs 1 and 2 is also typical.

The present species was first reported from *Acanthogobius hasta* at the Chinese coast in the Yellow Sea. This is the second report of this species from *A. hasta*. In Korea, *Acanthochondria brevicorpa* is quite common on its host, *A. hasta*, although we report the additional host record of *Amblychaeturichthys hexanema*.

2. *Acanthochondria tchangi* Yü, 1935(Fig. 2)

Acanthochondria tchangi Yü, 1935, p. 1, pl. 1, figs. 1~7.

MATERIAL EXAMINED. 18 females(16 with attached males) discovered from 15 specimens of *Acanthogobius hasta*, Yongkwang, 6 December 1991.

FEMALE. Body(Fig. 2A, B) with relatively slender head and neck, but stout trunk. Total length 6.94*mm*(6.40~8.18*mm*) (including posterior pro-

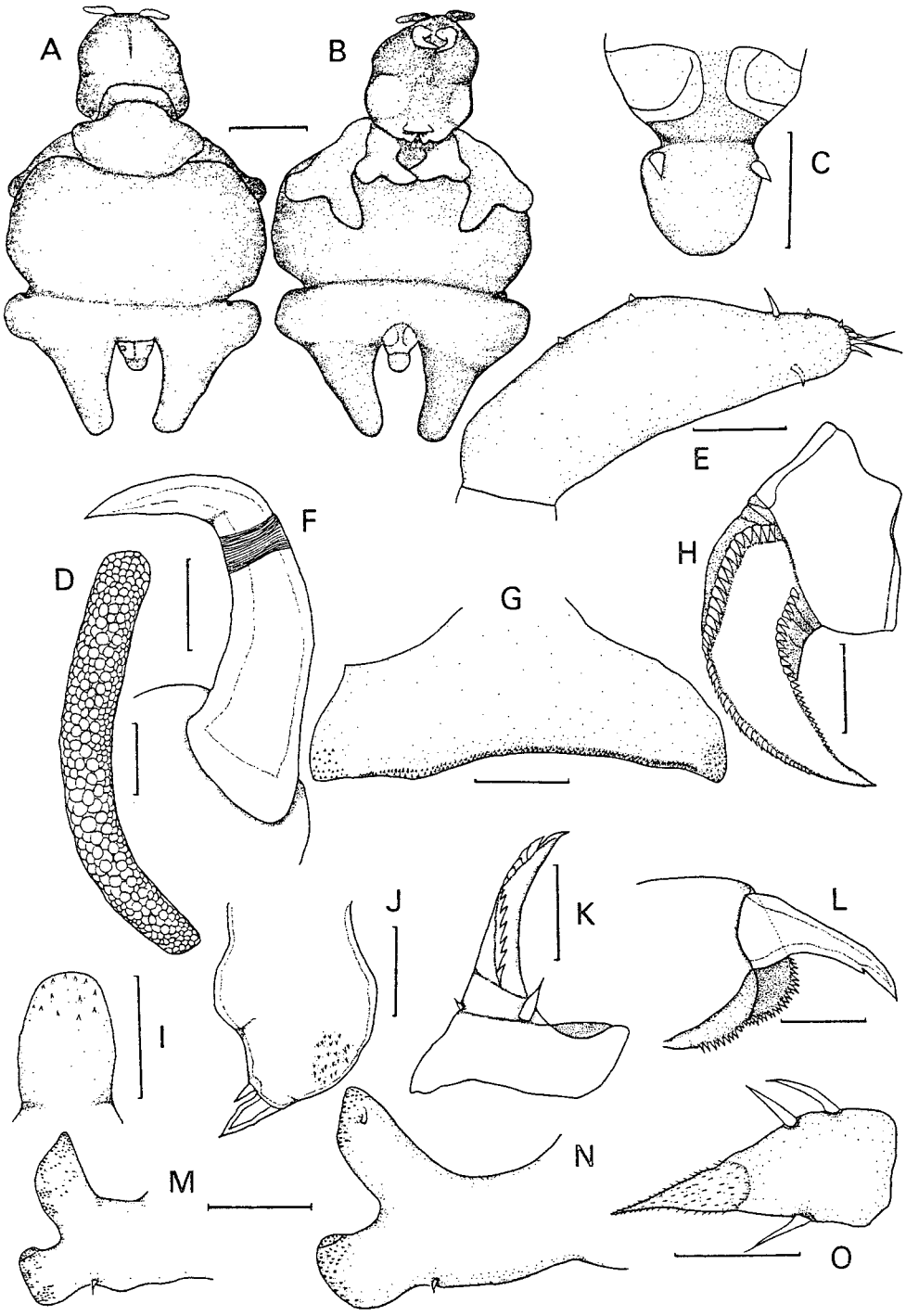

Fig. 1. *Acanthochondria brevicorpa* Yü. Female: A, habitus, dorsal; B, same, ventral; C, genito-abdomen; D, egg sac; E, first antenna; F, second antenna; G, labrum; H, mandible; I, paragnath; J, first maxilla; K, second maxilla; L, maxilliped; M, leg 1; N, leg 2; O, uropod. Scale bar: A, B, D=1*mm*; C=0.3*mm*; E–G=0.1*mm*; H–L, O=0.05*mm*; M, N=0.5*mm*.

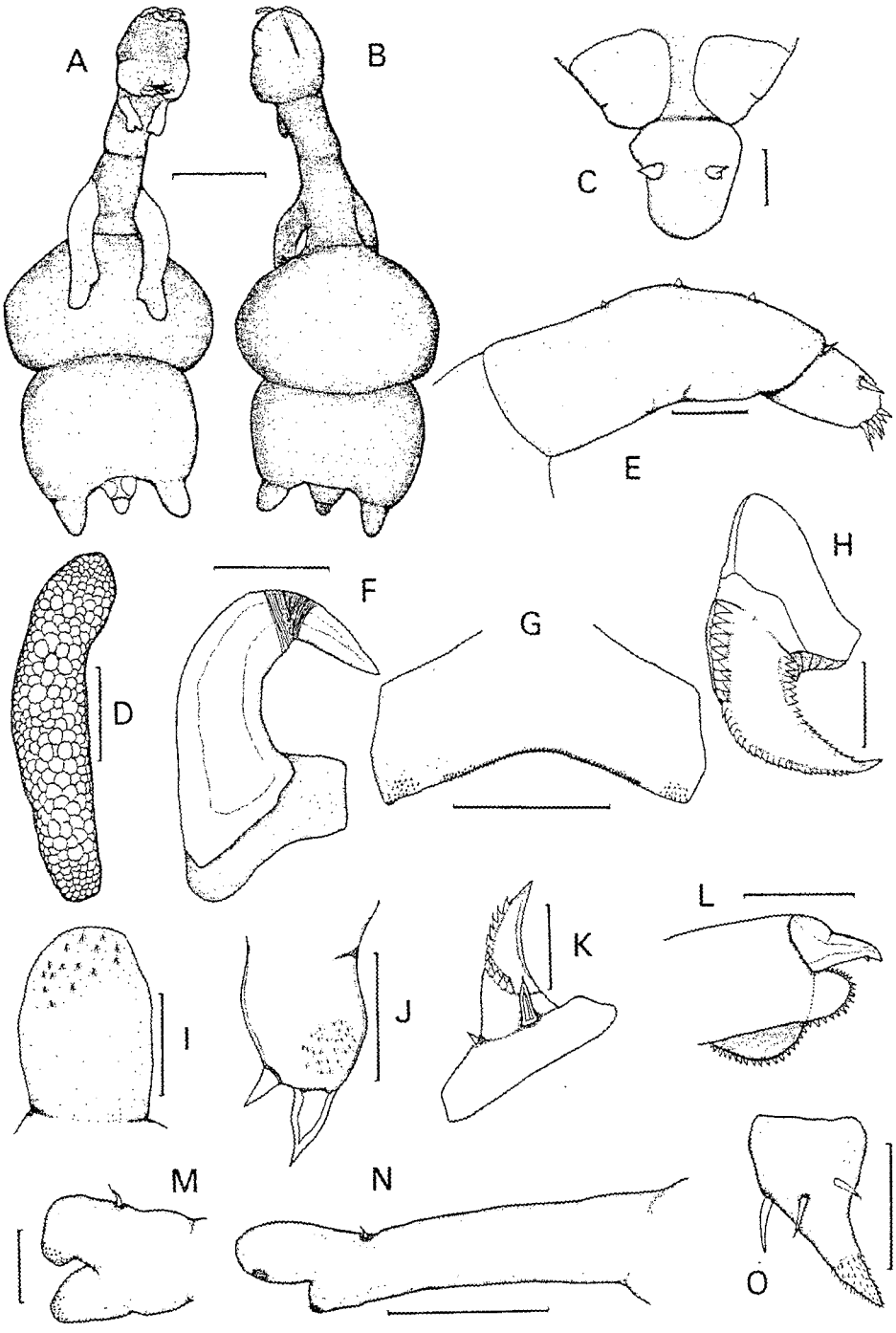

Fig. 2. *Acanthochondria tchangi* Yü. Female: A, habitus, ventral; B, same, dorsal; C, genito-adbomen; D, egg sac; E, first antenna; F, second antenna; G, labrum; H, mandible; I, paragnath; J, first maxilla; K, second maxilla; L, maxilliped; M, leg 1; N, leg 2; O, uropod. Scale bar: A, B, D=1*mm*; C, E–G=0.1*mm*; H, J–L, O=0.05*mm*; I=0.02*mm*; M=0.2*mm*; N=0.5*mm*.

cess) based on 15 specimens. Cephalothorax(Fig. 2 A, B) devoid of processes, slightly longer than wide and measuring 1.08*mm*(1.00~1.23*mm*)×0.91 *mm*(0.78~1.05*mm*), its posteroventral part with oral region slightly inflated. Neck elongate. Trunk consisting of three parts: anterior narrow, extending between bases of legs; middle and posterior broader, separated by distinct lateral constrictions; posterior process measuring 0.82*mm*(0.70~1.08 *mm*) long, slightly extending beyond posterior margin of abdomen. Neck and trunk combined measuring 3.25*mm*(2.73~3.85*mm*)×2.54*mm*(2.23~3.13 *mm*). Genito-abdomen(Fig. 2C), 0.48*mm*(0.40~0.60 *mm*) long, with subconical genital part separated from abdomen by deep constriction. Abdomen obovate, its anterior part slightly inflated, with uropods at about mid-length. Egg sac(Fig. 2D) 6.30*mm* (5.30~9.10*mm*) long.

First antenna(Fig. 2E), type B(see Kabata, 1984); basal part with 3 papillae and distal armature comprising 8 setae. Second antenna(Fig. 2F) with uneven concave margin and transverse striation near tip. Labrum(Fig. 2G) with finely spinulated margin. Mandible(Fig. 2H) with outer denticles much larger than inner; outer row 29 teeth, inner row 26. Paragnath(Fig. 2I) lightly sclerotized, with a round tip, slender spinules on ventral surface. First maxilla(Fig. 2J) with usual apical and subapical spiniform processes. Claw of second maxilla (Fig. 2K) with 14 marginal teeth; auxiliary process unarmed; one small seta on posterior margin. Claw of maxilliped(Fig. 2L) with slightly inflated base and one secondary tooth. Legs 1 and 2(Fig. 2M, N) bilobed, second more or less than triple length of first, both with patches of spinules on tips of legs. Uropod(Fig. 4G) with 3 setae on broader proximal part; narrower distal part spinulated.

REMARKS. As in the case of *Acanthochondria brevicorpa,* the existing descriptions of *Acanthochondria tchangi* were very inadequate(Yü, 1935). Here, thus, we describe this species in detail. The present species has the two-jointed first antenna (i. e., Kabata's type B) and the female leg 1 is much smaller than leg 2. Adding to them, the similarities in the identity of the long neck, the shape of cephalothorax, and the short posterior processes of trunk also make it possible to consider this species as conspecific with *Acanthochondria tchangi.*

This species was first described by Yü(1935), probably a contracted one, discovered from the gills of *Platycephalus indicum*(Linn.) taken at the Chinese coast in the Yellow Sea. The host record of *Acanthogobius hasta* is the second report of this species.

3. *Acanthochondria yui* Shiino, 1964(Fig. 3)

Acanthochondria yui Shiino, 1964, p. 30, figs. 1, 2.

MATERIAL EXAMINED. All from *Acanthogobius flavimanus*: 37 females(29 with attached males), 1 copepodid were taken from 45 hosts, Kogum-do, 24 April 1990; 276 females(234 with attached males), 30 copepodids from 56 hosts, Kogum-do, 14 May 1990; 61 females(all with attached males) from 9 hosts, Kogum-do, 15 June 1990; 16 females(all with attached males) from 11 hosts, 14 July 1990; 9 females(all with attached males) from 22 hosts, Kogum-do, 19 August 1990; 1 female with attached male from 34 hosts, Kogum-do, 19 January 1991; 3 females(all with attached males) from 10 hosts, Kogum-do, 28 February 1991; 4 females(all with attached males) from 19 hosts, Kogum-do, 26 March 1991.

FEMALE. Body(Fig. 3A, B) with relatively short neck, but stout trunk. Total length 4.85*mm* (3.88~5.78*mm*) (including posterior process) based on 20 specimens. Cephalothorax(Fig. 3A, B) subquadrangular, slightly wider than long and measuring 1.39*mm*(1.15~1.53*mm*)×1.28*mm*(1.08~1.48 *mm*); posteroventral margins slightly concave, and bearing median longitudinal bar in anterior half of dorsal surface. Neck formed from two leg-bearing segments. Trunk subdivided into two equal parts by deep lateral constrictions at about mid-length. Posterior process 1.25*mm*(0.82~1.63*mm*) long, extending beyond distal limit of genito-abdomen. Neck and trunk combined measuring 3.60*mm* (2.78~4.30*mm*)×3.06*mm*(1.75~3.83*mm*). Genito-abdomen(Fig. 3C) 0.64*mm*(0.53~0.83*mm*) long; clearly divided into its two components by constriction; genital segment hemispherical; abdomen ovoid, with uropods at about mid-length. Egg sac (Fig. 3D) 5.71*mm*(3.88~7.55*mm*) long.

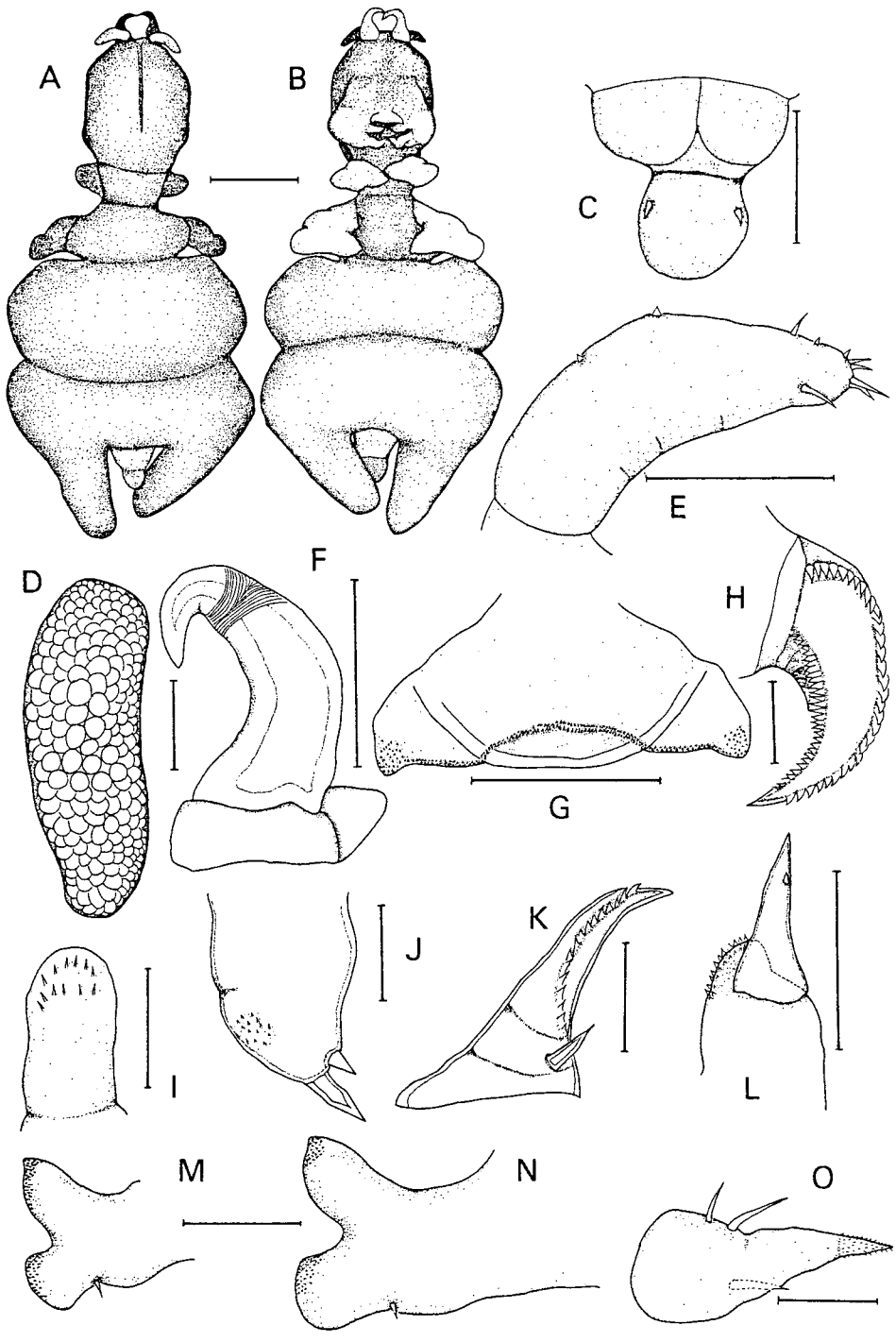

Fig. 3. *Acanthochondria yui* Shiino. Female: A, habitus, dorsal; B, same, ventral; C, genito-abdomen; D, egg sac; E, first antenna; F, second antenna; G, labrum; H, mandible; I, paragnath; J, first maxilla; K, second maxilla; L, maxilliped; M, leg 1; N, leg 2; O, uropod. Scale bar: A, B, D=1*mm*; C=0.3*mm*; E–G=0.2*mm*; H–K, O=0.05*mm*; L=0.1*mm*; M, N=0.5*mm*.

First antenna(Fig. 3E), type A(see Kabata, 1984); basal part with 2 papillae and distal armature consisting of 6 setae and 2 papillae. Second antenna (Fig. 3F) with uneven concave margin. Labrum (Fig. 3G) with denticulation on inner surface close to margin. Mandible(Fig. 3H) with about 49 denticles along outer margin of terminal falciform blade; inner margin with about 32 small denticles. Paragnath(Fig. 3I) bulbous, sparsely denticulated. First maxilla(Fig. 3J) a lobe bearing apical and subapical processes and a patch of spinules. Second maxilla (Fig. 3K) bearing one large seta and 16 teeth on terminal process. Claw of maxilliped(Fig. 3L) fairly straight, with one auxiliary tooth.

Leg 1(Fig. 3M) short and bilobed; its distal parts carrying patches of spinules; one protopodal seta present; exopod bulbous and endopod slightly conical. Leg 2(Fig. 3N) more elongate than Leg 1, otherwise similar. Uropod(Fig. 3O) irregularly tapering, with slender tip and 3 long setae on proximal part.

REMARKS. The original description of this species was made by Shiino(1964). The records of *Acanthochondria yui* show only one host species, *Acanthogobius flavimanus*. It appears to be associated with its host over a large part of its geographic range. Its distribution appears to be limited to California and Australia. The range of the host extends along the North American coast in California, in Asia to Japan(from Hokkaido to Kyushu), Korea and China, and in Australia to Sydney.

4. *Anchistrotos kojimensis* Do & Ho, 1983(Fig. 4)

Anchistrotos kojimensis Do & Ho, 1983, p. 1, figs. 1~15.

MATERIAL EXAMINED. 1) from *Acanthogobius flavimanus:* 2 females discovered from 33 hosts, Kogum-do, 19 December 1990; 1 female from 34 hosts, Kogum-do, 19 January 1991. 2) from *Acanthogobius hasta*: 12 females discovered from 10 hosts, 22 October 1990; 68 females from 9 hosts, Kogum-do, 19 December 1990; 3 females from 10 hosts, 19 January 1991; 17 females from 14 hosts, Kogum-do, 28 February 1991; 12 females from 16 hosts, Kogum-do, 19 March 1991.

FEMALE. Body(Fig. 4A) with large round cephalothorax. Total length 1.35*mm*(1.17~1.48*mm*) based on four specimens. Cephalothorax(Fig. 4A) broader than long, 0.60*mm*(0.39~0.70*mm*) wide, with rounded lateral and anterior margins; dorsal surface gently convex. Second to fifth leg-bearing segments broader than long, progressively smaller, all with noticeable constrictions between them. Urosome(including genital and abdominal segments) measuring 0.47*mm*(0.37~0.53*mm*)×0.15 *mm*(0.11~0.18*mm*) long. Genital segment larger than preceding segment, with lateral margin slightly rounded. Abdomen(Fig. 4A, B) 4-segmented, and progressively narrowed posteriorly. Anal segment(Fig. 4B) with spinules on ventral surface. Caudal ramus(Fig. 4B) slightly shorter than fourth abdominal segment, two times longer than wide, and bearing unequal 6 setae. Egg sac(Fig. 4C) 0.92 *mm*(0.80~1.03*mm*) long, three times longer than urosome.

First antenna(Fig. 4D) 6-segmented, second segment larger than others, with setal formula: 5 plumose setae, 12 plumose+3 naked setae, 6 plumose+2 naked setae, 1 plumose+3naked setae, 2 naked setae+1 aesthete, and 7 naked setae+1 aesthete. Second antenna(Fig. 4E) 3-segmented; first long, with one long slender seta near distal end; second segment short, with one short seta; terminal segment with 2 rows of hooklike processes and tipped with 3 claws and 5 slender setae. Postantennary process(Fig. 4F) with sturdy base and slender curving tine. Mandible(Fig. 4G) with flat base and cylindrical shaft; a large subtriangular process and a small but similar process with both serrated concave edge. Second maxilla(Fig. 4H) 2-segmented, tapering base; distal end with 2 strong spiniform processes, one thicker than other and with serrated margin; one spinulose seta near base of thicker process. Tip of maxilliped(Fig. 4I) with serrated terminal margin on concave side and 2 long basal setae. Leg 5(Fig. 4J) 2-segmented, basal segment with one slender seta; free segment with 2 naked and 2 plumose setae.

REMARKS. This is the second report of *Anchistrotos kojimensis* collected from *Acanthogobius flavimanus*. In Japan, it was reported from the Inland Sea of Japan(Do and Ho, 1983). The range of the

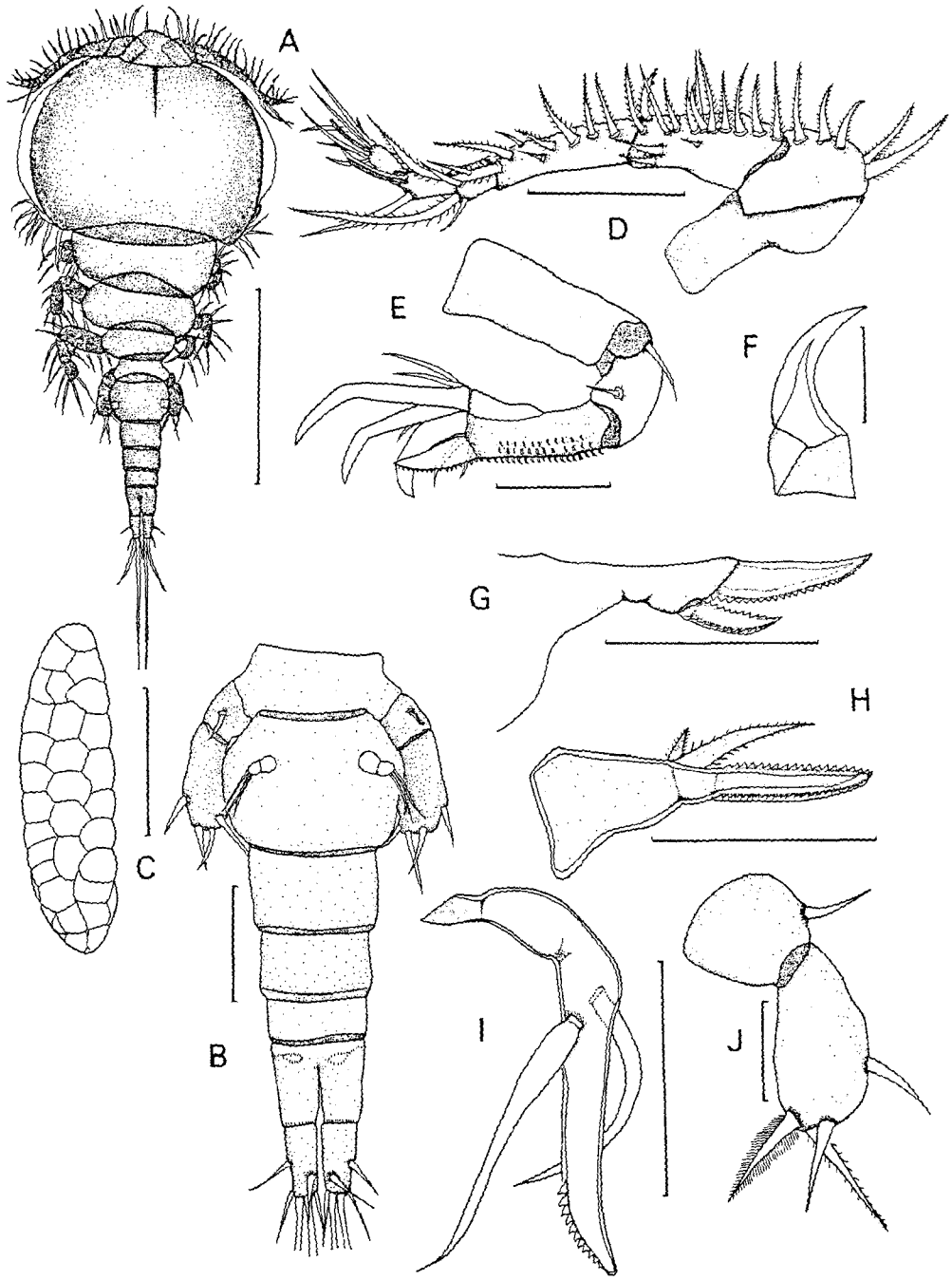

Fig. 4. *Anchistratos kojimensis* Do & Ho. Female: A, habitus, dorsal; B, Urosome, ventral; C, egg sac; D, first antenna; E, second antenna; F, postantennary process; G, mandible; H, second maxilla; I, tip of maxilliped; J, leg 5. Scale bar: A=0.5*mm*; B, D=0.1*mm*; C=0.3*mm*; E–J=0.05*mm*.

host extends from California, Japan(from Hokkaido to Kyushu), Korea, China, and to Sydney in Australia. Thus it is not unusual to find it on the same host from the southern coast of Korea. It is important to note that the host record of *Acanthogobius hasta* is the first report of *A. kojimensis*. In contrast to the case in Japan, *A. hasta* appears to be primarily a host of this species in Korea waters, instead of *A. flavimanus*.

Anchistrotos kojimensis is the third known copepod parasite recovered from *Acanthogobius hasta*. The two other copepod parasites are *Acanthochondria brevicorpa* and *A. tchangi*.

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Received June 10, 1992
Accepted July 7, 1992

한국산 해산어류에 기생하는 요각류 4종

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한국산 해산어류 3종에서 기생성 요각류 4종이 채집되었다. 이곳에 *Acanthochondria* 속의 3종(*A. brevicorpa* Yü, *A. tchangi* Yü와 *A. yui* Shiino)과 *Anchistrotos kojimensis* Do & Ho를 재기재한다. 이들은 모두 한국미기록종이다.