

Two Species of Copepoda (Poecilostomatoida, Siphonostomatoida) associated with Asteroida in Korea

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한국산 불가사리에 공생하는 요각류 2종

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요 약

불가사리에 공생하는 요각류가 북태평양에서는 단 4종이 기록되어 있을 뿐이다. 공생성 요각류를 채집하기 위하여 한국산 불가사리를 조사한 결과 요각류 2종이 채집되었다. 이들은 *Synstellicola* 속에 속하는 1신종과 *Scottomyzon gibberum* 으로서 이들을 기재 또는 재기재한다. *S. gibberum*은 북대서양에서만 발견되어지던 종으로서, 한국 해역에서는 여러가지 불가사리에 공생하고 있으며 한국내 분포범위가 넓은 것이 밝혀졌다.

Key words: poecilostomatoids, Siphonostomatoida, Copepoda, associations, new species, Asteroida, Korea.

INTRODUCTION

In the synopsis of copepods associated with asteroid echinoderms, Humes (1986) listed sixty species of copepods, including five new ones. These copepods have been found mainly from the tropical and sub-tropical seas. In the North Pacific only four species were known. These are *Ascomyzon asterocheres* Sars from Aleutian Islands (Wilson, 1944), and *Tisbe japonica* Ho, *Synstellicola longicauda* Ho and *S. similis* Ho from the Japanese side of the Sea of Japan (Ho, 1982). This number of North Pacific species is very

few compared to 11 species known from the North Atlantic.

The author examined more than fifteen species of Korean asteroids to collect copepod associates from them. As a result only two species of Copepoda were found. These are one new species belonging to the genus *Synstellicola* and *Scottomyzon gibberum* T. & A. Scott. Although the latter species has been frequently found from the northeastern Atlantic, the descriptions of this zoogeographically interesting species were incomplete. Moreover this copepod seems to be very common all around Korea and associates with various species of sea stars. Thus it seems necessary to redescribe it on the basis of Korean specimens.

MATERIALS AND METHODS

The copepod specimens dealt in this paper were all recovered by the author by washing the sea stars which were collected intertidally or taken from fishing nets. Diluted alcohol were used to dislodge the copepods from the hosts. Dissection and measurement were carried out on specimens soaked in lactic acid tinted with methyl blue. All figures were drawn with the aid of a camera lucida. The type specimens will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution. The dissected paratypes and other specimens are retained in the collection of the author.

DESCRIPTION

Order Poecilostomatoida Thorell, 1859

Family Lichomolgidae Kossmann, 1877

Synstellicola paracarens, n. sp.

(Figs. 1,2)

Type Specimens. Holotype female, allotype male, and paratypes (17 females and 2 males), washed from the sea star *Luidia quinaria* (von Martens), Sept. 20, 1991, from fishing net (subtidal), at Yangp'o (35°53' N, 129°31' E) in the Sea of Japan.

Other Material Examined. Five ♀♀, 7 ♂♂, washed from 10 specimens of *Luidia quinaria* (von Martens), Oct. 1, 1990, Gomso (35°35' N, 126°36' E), Yellow Sea, intertidal mud flat.

Female. Body (Fig. 1A) 0.81mm long (range, 0.71-1.01 mm based on 6 specimens). Greatest width 0.30mm. Prosome moderately wide. Ratio of length to width of prosome 1.70:1. Rostrum semi-circular, reaching base of antenna. Prosomal somites with rounded lateral margins. First pedigerous somite weakly demarcated from cephalosome. Urosome (Fig. 1B) 4-segmented, with 2 postgenital somites. Fifth pedigerous somite slightly narrower than genital somite. Genital somite 1.30 times longer than wide, convex along lateral margins of anterior half. Genital area located dorsolaterally, each area with 2 smooth setae and 1 spinule. First postgenital somite 1.27 times wider than long. Second postgenital somite 1.90 times wider than long. Caudal ramus 1.84 times longer than wide. All setae naked. Outer lateral seta 68µm long. Dorsal seta 20µ. Outermost terminal seta 65µm. Innermost terminal seta 70µm. Two median terminal setae 165µm (outer) and 277 µm (inner).

Egg sac 269 x 125 µm. Each egg about 76 µm in diameter.

Antennule (Fig. 1C) 7-segmented, with following formula of armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All setae naked.

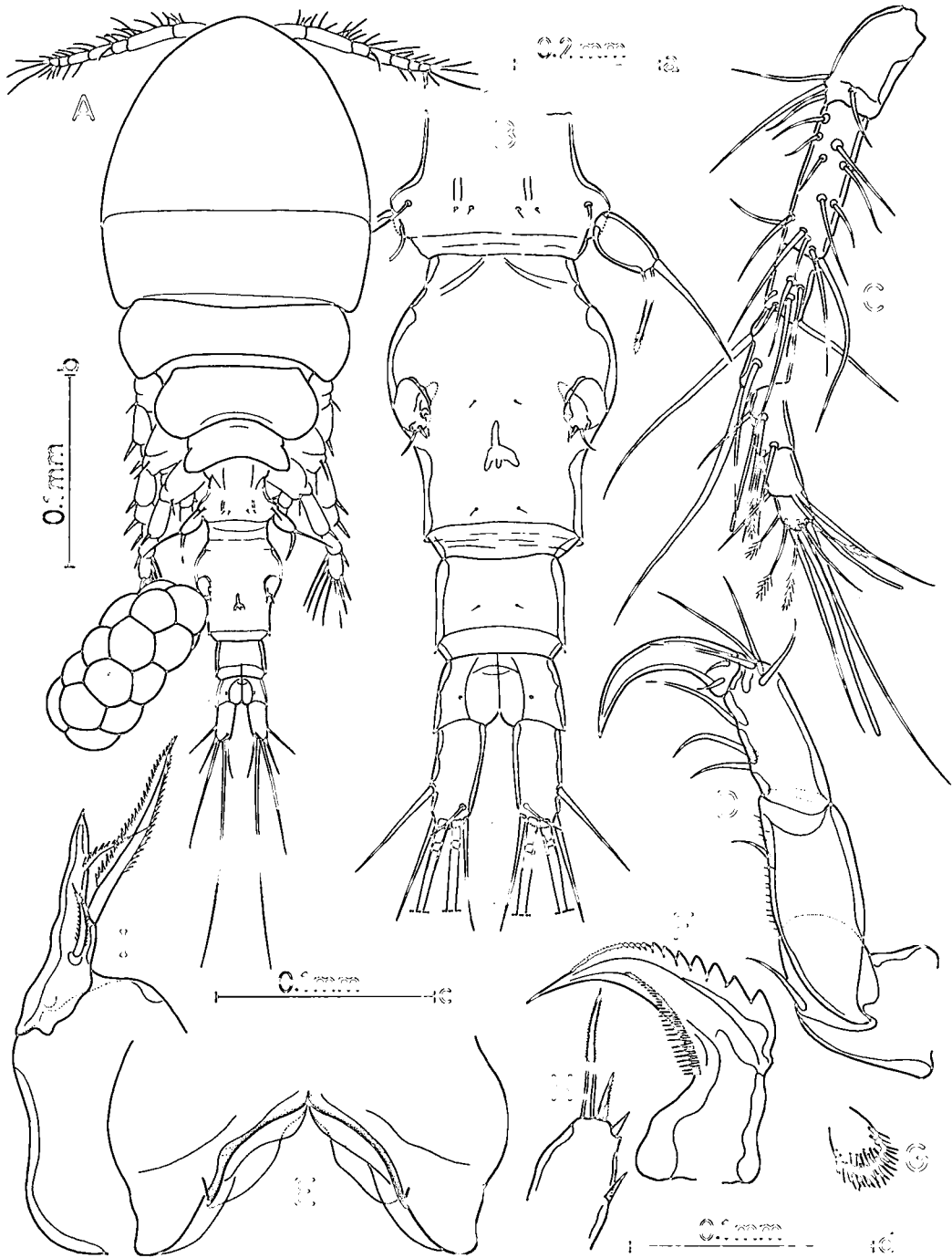


Fig. 1. *Synstellicola paracarens*, n. sp. Female. A, habitus, dorsal; B, urosome, dorsal; C, antennule; D, antenna; E, labrum; F, mandible; G, palp; H, maxillule; I, maxilla. Scales: A=a; B=b; C=d; D=f; E-I=i.

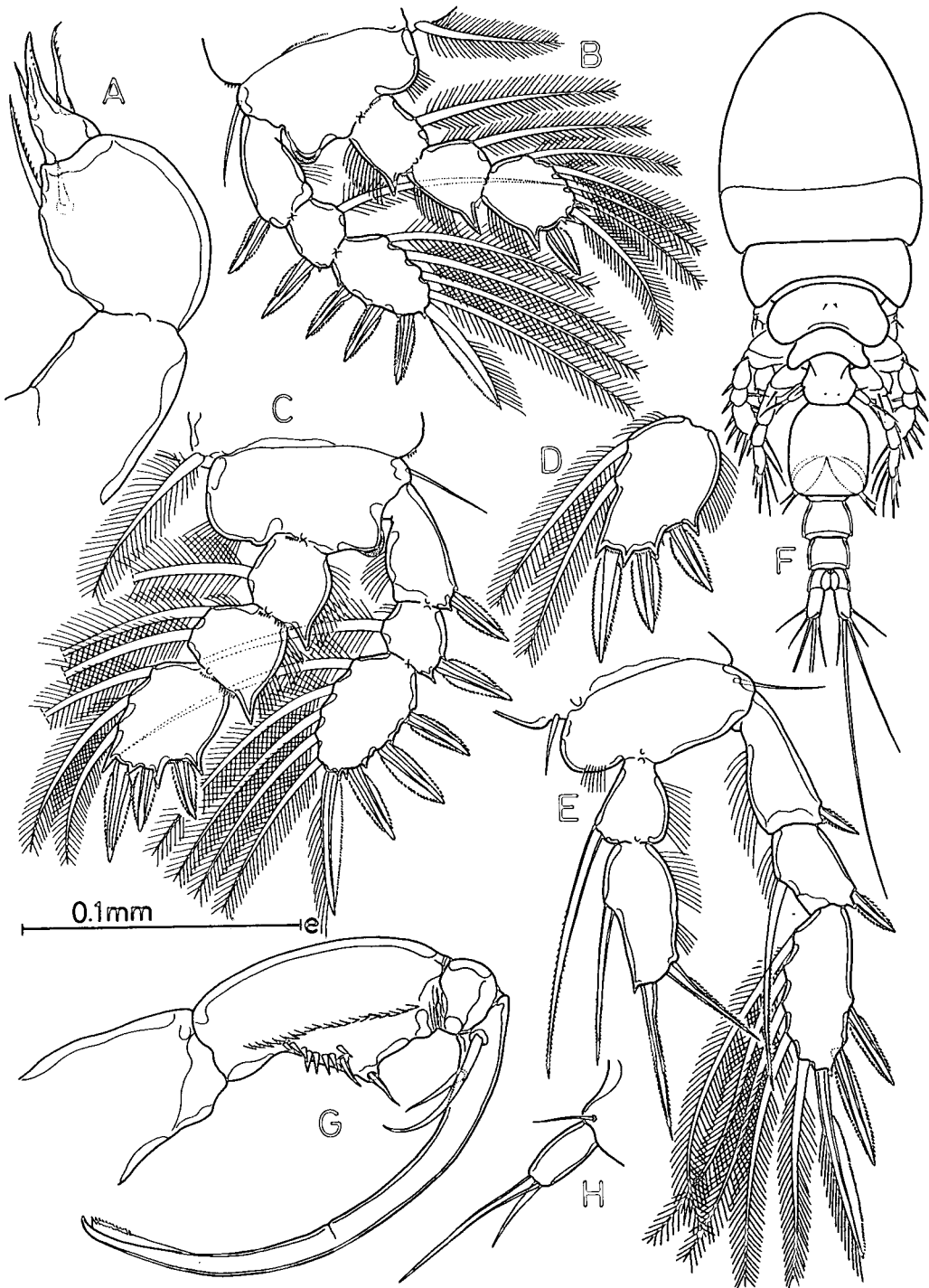


Fig. 2. *Synstellicola paracarens*, n. sp. Female. A, maxilliped; B, leg 1; C, leg 2; D, third endopod segment of leg 3; E, leg 4. Male. F, habitus, dorsal; G, maxilliped; H, leg 5. Scales: A, G=i, B-E=d, F=j; H=g.

Antenna (Fig. 1D) 3-segmented, with formula of armature: 1, 1, and 7 + 1 claw. First segment wide at base. Second segment with fine setules on inner margin in addition to seta. Third segment with 3 inner setae, 4 outer distal setae, and 2 smaller setae at base of claw. Claw strong and arched.

Labrum (Fig. 1E) deeply incised. Each lobe with tooth near postero-median border of inner side. Mandible (Fig. 1F) with 1 row of teeth on inner basal margin and 1 row of spinules on outer basal margin. Palp (Fig. 1G) as a setiferous lobe. Maxillule (Fig. 1H) with 4 elements. Maxilla (Fig. 1I) 2-segmented; second segment terminated in spiniform process, with 3 elements, of which larger median one bipectinate and as long as the segment. Maxilliped (Fig. 2A) 3-segmented; first segment unarmed; second segment as long as the first, swollen, with 2 setae of unequal size; terminal segment pointed distally with 2 smooth, unequal setae.

Legs 1-4 (Figs. 2B-E) 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; III, 2

P4: Prp 0-1; 1-0 Exp I-0; I-1; II, I, 5
 Enp 0-1; II, 1

Outer distal corners of endopodal segments of legs 1-3 acutely pointed. Inner seta on coxa of legs 1-3 plumose, whereas outer seta on basis of these legs naked.

Leg 4 (Fig. 2E) with 2-segmented endopod. Inner seta on coxa short and naked. Setae on endopod weakly pectinate.

Leg 5 1.68 times longer than wide; inner margin swollen. Two distal setae unequal in shape and length; inner seta 78 μm long, bent inward proximally and weakly pectinate distally; outer one straight, longer and 156 μm long.

Leg 6 represented by 2 short, smooth setae and a spiniform process in genital area.

Male. Body (Fig. 2F) smaller and slender than that of female. Length 0.62mm (range, 0.59-0.68mm, based on 7 specimens). Greatest width 0.19mm. Urosome 5-segmented including 3 postgenital somites. Genital somite 1.20 times longer than wide. Caudal ramus with same ratio of length to width as in female.

Antennule, antennae, labrum, mandible, maxillule, and maxilla resemble those of female. Maxilliped (Fig. 2G) 4-segmented; first segment unarmed; second segment protuberant at distal third of inner margin, with 1 pair of inner setae (one of which mounted on protuberance), several spinules below protuberance and 1 lateral row of spinules; third segment short and unarmed; terminal segment with a pair of unequal sized naked setae and terminated in long claw. Claw arched, slightly longer than combined 3 basal segments.

Legs 1-4 as in female, with identical armature.

Leg 5 (Fig. 2H) with small free segment bearing parallel margins. One of distal setae twice as long as another one, both nearly straight and unarmed.

Leg 6 consisting of posteroventral flap on genital somite bearing 2 naked setae, 27 μm and 40 μm long, respectively.

Etymology. *Systellicola paracarens*, n. sp. (par, in Latin means "like") is named for its similarity in the

body length and genital somite to *S. carens* (Humes, 1986).

Remarks. The genus *Synstellicola* contains currently 10 species including *S. carens* (Humes, 1986), which was erroneously included in the genus *Astericola* in the original description. This species has 4-segmented urosome in female and agrees well in every respects to the definitions of the genus *Synstellicola* given by Humes & Stock (1972, 1973). Therefore it should be included in the genus *Synstellicola*.

The members of the genus *Synstellicola* are quite homogeneous, with very few appendages showing interspecific differences, and the characteristics distinguishing the species of the genus seem to be restricted to the caudal rami, the genital somite and the leg 5.

S. paracarens, n. sp. is comparable to *S. carens*, *S. kossmanni*, *S. lankensis* and *S. pichoni*, all of which have caudal rami ranging from 1 to 2 in the ratio of length to width. In other species this ratio is less than 1 (in *S. acanthasteris* and *S. longiseta*) or more than 2 (in *S. affinis*, *S. gracilis*, *S. longicauda* and *S. similis*).

In 5 species (*S. kossmanni*, *S. lankensis*, *S. longiseta*, *S. pichoni* and *S. similis*), the lateral margins of the genital somite are more or less straight unlike the new species which has lateral margins convexed. Only one species, *S. carens* remains to be compared to the new species. This South Pacific species and the new species have similar body length, male maxilliped and some other characteristics. However the shape of leg 5 differs between the two. In *S. carens* the outer and inner margins of the free segment of leg 5 are parallel, whereas in *S. paracarens* inner margin of the segment is swollen. In the females of *S. carens* inner one of the two terminal setae on this segment is rather straight but in the new species this seta is curved proximally. Moreover, *S. carens* has more slender genital somite and no tooth on posterior border of labrum.

Order Siphonostomatoida Thorell, 1859

Family Asterocheridae Giesbrecht 1899

Scottomyzon gibberum (T. & A. Scott, 1894)

(Figs. 3,4)

Dermatomyzon gibberum T. & A. Scott, 1894, (p. 144, pl. 9, figs. 10-14).

Scottomyzon gibberum: Giesbrecht, 1897, (p. 17).

Material Examined. 1) From *Aphelasterias japonica* (Bell): 3 ♀♀, 7 ♂♂, (from 1 host taken from fishing net), Nov. 25, 1989, at Jangho (36°17'N, 129°19'E) in the Sea of Japan. 2) From *Asterias amurensis* Lutken; 47 ♀♀, 7 ♂♂ (from 1 host taken from fishing net), Oct. 10, 1987, at Taejin (38°29'N, 128°26'E) in the Sea of Japan; 3 ♀♀ (from 2 hosts collected intertidally), Jan. 12, 1990, at Gomso (35°35'N, 126°36'E) in the Yellow Sea; 12 ♀♀, 13 ♂♂, 10 copepodids (from 3 hosts taken from fishing net), Feb. 28, 1990, at Imwon (36°14'N, 129°21'E) in the Sea of Japan; 10 ♀♀, 1 ♂ (from 1 host taken from fishing net), Jun. 16, 1990, Yokjido Island (34°38'N, 127°15'E), Korea Strait. 3) From *Distolasterias nipon* (Döderlin): 23 ♀♀, 11 ♂♂ (from 1 host taken from fishing net), Nov. 26, 1989, at Taijin in the Sea of Japan. 4) From *Distolasterias stichantha* (Sladen): 2 ♀♀, 7 ♂♂, 3 copepodids (from 3 hosts taken from fishing net), Feb. 28, 1990, at Jangho in the Sea of Japan. 5) From *Lysastrosoma anthosticta* (Fisher): 15 ♀♀, (from 2 hosts taken from fishing net), Jun. 3, 1990, at Namae (37°55'N, 128°47'E) in the Sea of Japan.

Female. Body (Fig. 3A) 0.66 mm long (range, 0.51-0.74 mm, based on 10 specimens), excluding setae on caudal rami. Body length not related to growth state. Prosome usually globular. Cephalosome in fully

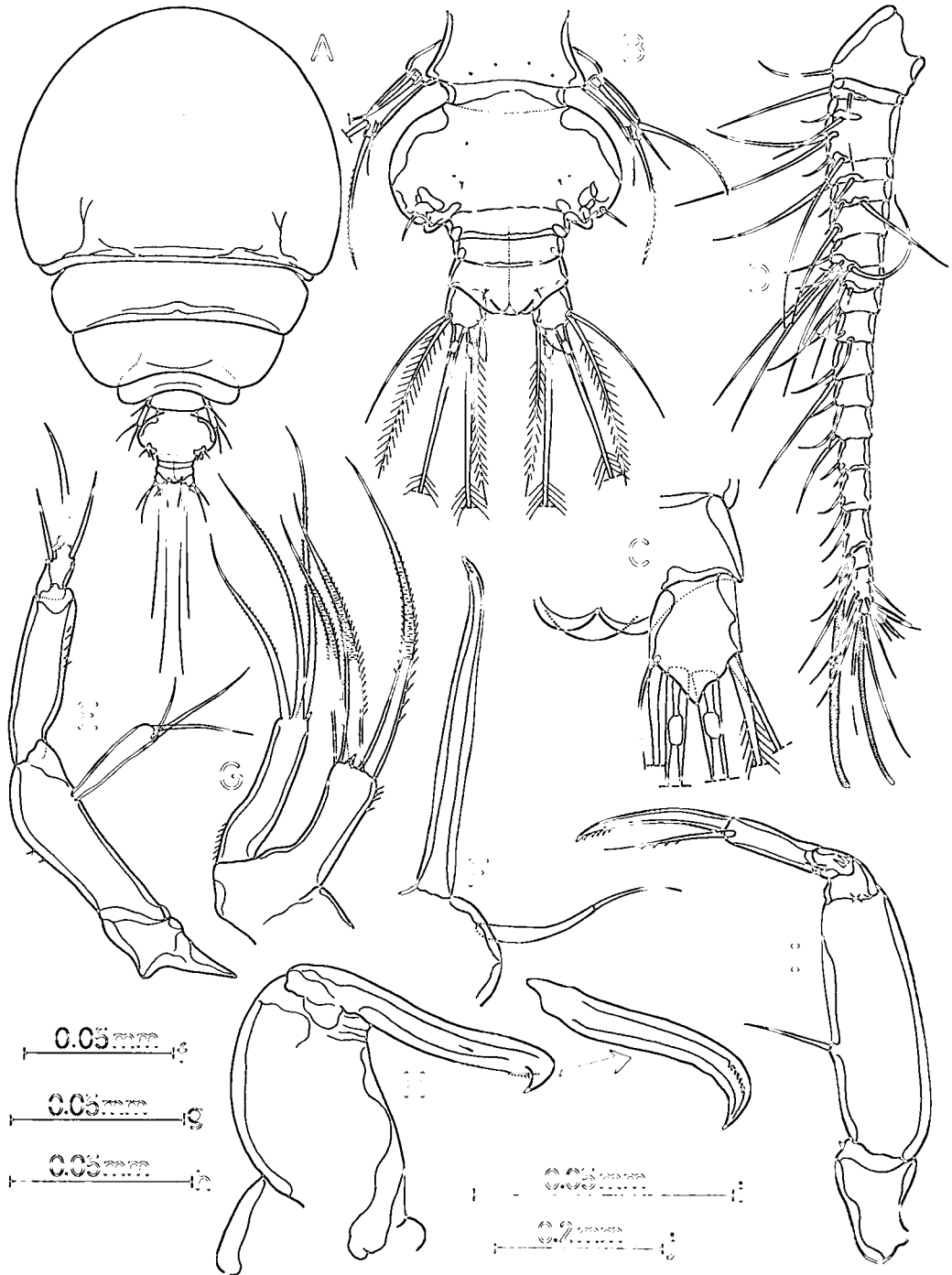


Fig. 3. *Scottomyzon gibberum* T. & A. Scott. Female. A, habitus; B, urosome, dorsal; C, caudal ramus, ventral; D, antennule; E, antenna; F, mandible; G, maxillule; H, maxilla; I, maxilliped. Scales: A = a; B = c; C = i; D, E, H, I = d; F, G = h.

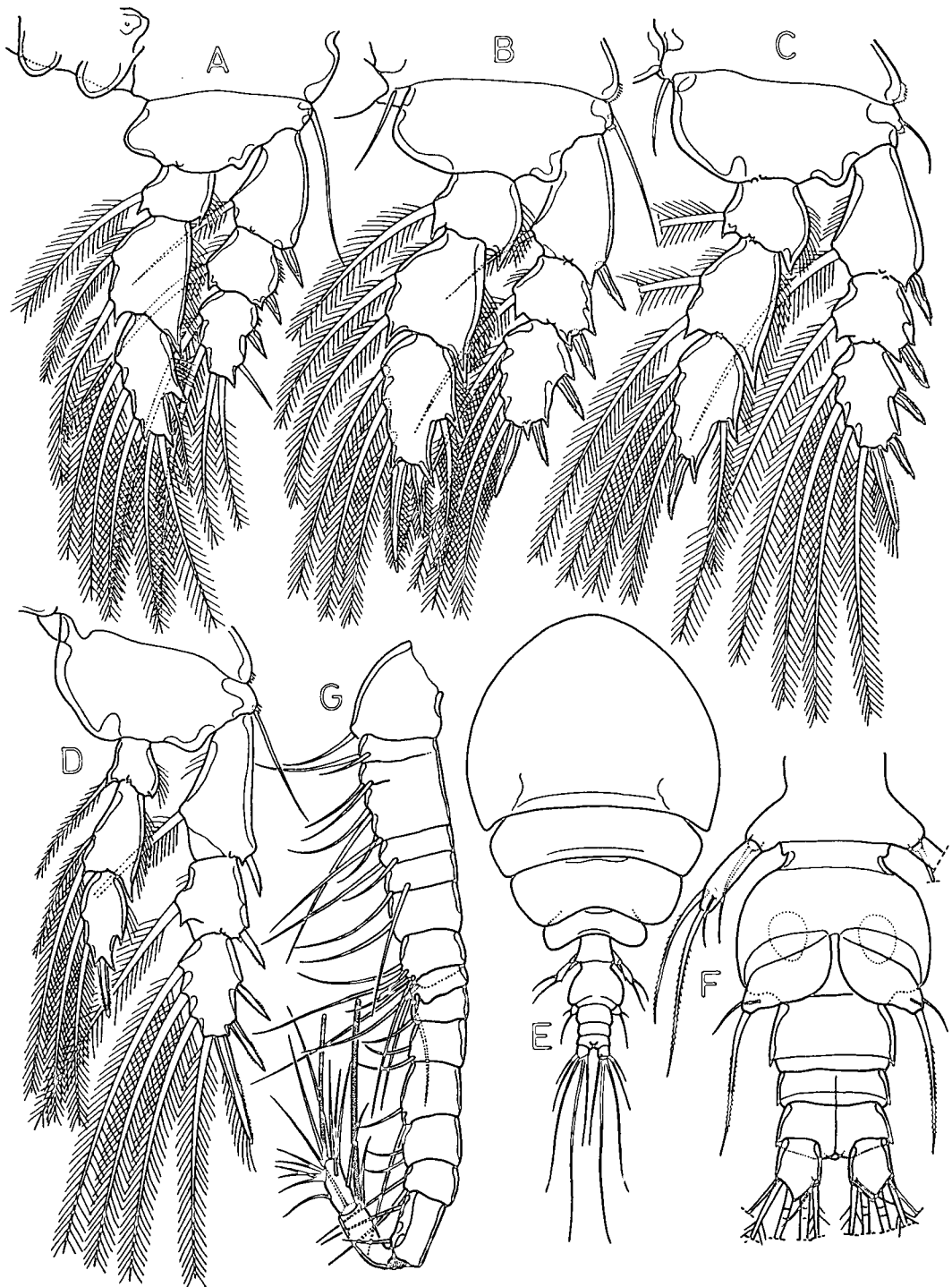


Fig. 4. *Scottomyzon gibberum* T. & A. Scott. Female. A, leg 1; B, leg 2; C, leg 3; D, leg 4. Male. E, habitus, dorsal; F, urosome, ventral; G, antennule. Sclae: A-D, F=d; E=a; G=e.

grown adults greatly expanded. First pedigerous somite fused with cephalosome. Urosome (Fig. 3B) 4-segmented, consisting of fifth pedigerous somite, genital somite and 2 postgenital somites. Fifth pedigerous somite with angular posterolateral corners. Genital somite wider than long, with round lateral margins. Genital area located posterodorsally. Distal part of genital somite of young adults weakly divided from the rest, leaving obscure segmentation. This division diminishing in fully grown adults. Two postgenital somites very short, each much wider than long. Anal somite with 2 setules on dorsal surface near base of anal operculum. Anal operculum well-developed.

Caudal ramus (Fig. 3C) $25 \times 18 \mu\text{m}$, originated from posteroventral border of anal somite. Posteroventral border of caudal ramus conically projected posteriorly. Setae on caudal ramus fragile. Outer lateral seta $107 \mu\text{m}$ long. Dorsal seta $25 \mu\text{m}$, outermost terminal seta $118 \mu\text{m}$, innermost terminal seta $249 \mu\text{m}$, and outer terminal seta $233 \mu\text{m}$. Outer lateral and dorsal setae bare. Other setae weakly plumose.

Antennule (Fig. 3D) 18-segmented, $248 \mu\text{m}$ long. Third segment apparently consisting of 3 fused segments, weakly demarcated from second. All segments armed with a pair of setae, except for following segments: 1 on first, 6 on third, 1 on sixth, 7 on seventh, $2 + 1$ aesthete on sixteenth and $12 + 1$ aesthete on terminal segment. Aesthete on terminal segment slender.

Antenna (Fig. 3E) $173 \mu\text{m}$ long excluding terminal setae and claw. First segment of protopod (coxopod) unarmed, slightly wider than long. Second segment of protopod (basipod) with minute setules on weakly convex inner edge. Exopod 1-segmented, about half as long as second segment of protopod, slightly broadened distally, tipped with 3 setae, one of which slender and half as long as other 2 setae. Endopod 2-segmented. First segment slightly shorter than second segment of protopod, with several minute setules on outer edge. Second segment with weakly curved, spiniform claw, 2 subdistal setae, and 1 small, subapical dentiform process.

Oral cone prominent in lateral view, formed by labrum and labium, enclosing mandible, without siphon. Mandible (Fig. 3F) $140 \mu\text{m}$ long, with 5 distal denticles and $88 \mu\text{m}$ long, setiform palp. Maxillule (Fig. 3G) with longer exopod and shorter endopod. Each ramus with distal 3 setae and 1 small spiniform process distally. Maxilla (Fig. 3H) robust; basal segment unarmed; second segment (= claw) slightly longer than basal segment, recurved distally, with 1 row of fine setules on one side of recurved distal region. Maxilliped (Fig. 3I) 5-segmented; first segment narrow at basal half, with 1 small spinule on inner distal corner; second segment broadest, with 1 seta at proximal 2/5 of inner margin; third segment unarmed, shorter than wide; fourth segment narrow, as long as wide, with 2 proximal and 1 distal, smaller spinules; fifth segment narrow, tipped with claw and 1 seta. This claw 1.5 times longer than the segment, with fine setules on distal inner margin.

Legs 1-4 (Figs. 4A-D) with 3-segmented rami and following formula of armature:

P1: Prp 0-0; 1-0	Exp I-1; I-1; I+1, 2,2
	Enp 0-1; 0-2; 1,2,3
P2: Prp 0-1; 1-0	Exp I-1; I-1; II, I+1, 3
	Enp 0-1; 0-2; 1, II, 3
P3: Prp 0-1; 1-0	Exp I-1; I-1; II, I+1, 3
	Enp 0-1; 0-2; 1, I, 3
P4: Prp 0-0; 1-0	Exp I-1; I-1; II, I+1, 3
	Enp 0-2; 0-2; 0, I, 2

Leg 5 2-segmented. Basal segment fused with thoracic somite, with 1 dorso-distal seta mounted on elevation. Free segment 2.5 times as long as wide, with 1 distal and 1 subdistal pectinate setae, and 1 small, subdistal naked seta.

Leg 6 represented by 2 short, unequal setae in genital area.

Male. Body (Fig. 4E) 0.60 mm (0.49-0.64 mm) long, based on 10 specimens. Greatest width 0.34 mm (0.29-0.36 mm). Prosome basically similar to that of female, not expanded so much as in female. Urosome (Fig. 4F) 5-segmented. Genital somite 1.3 times wider than long. Three postgenital somites $30 \times 52 \mu\text{m}$, $15 \times 46 \mu\text{m}$, and $23 \times 48 \mu\text{m}$ in size, respectively. Caudal ramus almost same as that of female.

Antennule (Fig. 4G) geniculate, 16-segmented. Each segment armed with a pair of setae, except for following segments: 1 on first, 6 on third, 1 on sixth, 2 + 1 aesthete on fifteenth and 12 + 1 aesthete on terminal segment.

Antenna, mandible, maxillule, maxilla and maxilliped not different from those of female.

Legs almost same as those of female but inner distal seta of endopod third segment in legs 1-4 spine-like. Leg 6 as a posteroventral flap on genital somite, bearing 2 extremely unequal setae and 1 transverse row of minute spinules.

Remarks. *Scottomyzon gibberum*, the only member of the genus, has so far been found in the area of northeastern Atlantic ranging from the southern Norway in the north to the English Channel in the South, and from the western Baltic Sea in the east to the Irish Sea in the west (Gooding, 1957; Rottger, 1969). In most case this copepod is known to be associated with the asteroid *Asterias rubens* (for complete collection records, see Humes, 1986), with one exceptional case of the discovery from another asteroid *Marthasterias glacialis* by Barel & Kramers (1977). Gooding (19567) found a single male in a jar contained an echinoid *Spatangus purpureus*, but this appearance was certainly an accidental.

As given in the collection data in the present report, a number of Korean sea stars serve as hosts of *S. gibberum*. In addition to this broad host range, its horizontal distribution in Korean seas seems remarkably wide, because the Korea Strait, one of the area where the *S. gibberum* was found, is strongly affected by the warm Kuroshio current, and thus has a quite different oceanographic condition from both the Yellow Sea and the Korean side of the Sea of Japan. Accordingly it is natural to presume that this species be found elsewhere in circumpolar seas in addition to the known distribution. Only other known case of this circumpolar distribution of copepod associate of sea stars is as to *Ascomyzon asterocheres* Sars, 1918. Like the *S. gibberum*, this species has also been found mainly from northeastern Atlantic.

Because the body shape of *S. gibberum* is variable according to the developmental stages (Rottger, 1969), careful examination were carried out on a number of specimens collected from various hosts and areas in Korean seas. The comparison of these Korean specimens to the European ones from Helgoland in North Sea revealed no significant difference between them.

ABSTRACT

Only four copepod species associated with sea stars have been known from the North Pacific. The examination of Korean sea stars for copepod associates revealed two species: *Scottomyzon gibberum* and a new species belonging to the genus *Synstellicola*. Both species are (re) described. *S. gibberum*, a sole member of the genus hitherto known only from the

northeastern Atlantic, is recorded in this report to be associated with various sea stars and distributed widely in Korean seas.

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