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**A new species of *Bonnierilla* (Copepod, Cyclopoida,
Notodelphyidae) parasitic on *Halocynthia roretzi*
(V. Drasche) from the Kamak Bay, Korea**

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Bonnierilla namhaesius n. sp. is described based on the specimens recovered from the ascidians, *Halocynthia roretzi* Von Drasche in Namhae Islands, Korea. This is distinguished from congeners by having a combination of characters: setal formula 3, 17+1 hook, 9+1 aesthete, 5, 3, 2, 2+1 aesthete, 7+1 aesthete respectively on eight segments of antennule, II, 5 on distal segment of the second leg to fourth leg exopod, and 2, 3, 1 on distal margin of caudal ramus. This is the second record of the male, and first record of the copepodid in the genus *Bonnierilla*.

Key Words : Copepoda, Notodelphyidae, Parasite, New species, Ascidians, Korea

In his reevaluation of *Bonnierilla*-group, Stock (1967) recognized eight species of Notodelphyids in the genus *Bonnierilla* Canu, 1891. However, *Bonnierilla curvicaudata* Ooishi was inadvertently overlooked by him. Ho (1984) found *Bonnierilla mollia* in the Japanese waters, therefore, there are ten species of *Bonnierilla*. *Bonnierilla* was apparently new to science, and are here dealt with. *B. namhaesius* n. sp. living in the edible simple ascidian, *Halocynthia roretzi* Von Drasche, is harmless to human beings. However, copepod parasites have been considered as enemies of

marine animals capable of causing serious economic damage [Wilson, 1938; Davey *et al.*, 1978; Kabata, 1979; Paul, 1983; Pregonzer, 1983; Choi and Suh, 1991; Suh *et al.*, 1993; Choi *et al.*, 1994]. In Korean waters, nevertheless, a few studies have been done on parasitic copepods on the edible simple ascidian.

In order to add our knowledge of the parasitic copepod fauna of Korean marine animals, this survey has been carried out since 1990. In the course of the study we had an opportunity to examine the specimens from Namhae Islands in Korea. Having studied this material, we

described the new species under the name *Bonnierilla namhaesius* n. sp.

Materials and methods

The edible simple ascidian, *Halocynthia roretzi*, examined for the copepod parasites were taken from cultured area in Namhae Islands, Korea (34° 43' N, 128° 04' E). All ascidians were collected with hands from the strings of the hanging culture facilities. We have removed the copepod parasites from the mantle cavity of ascidians. After collection, all copepod parasites were fixed and preserved in 5% buffered formalin-seawater. For morphological observation the copepods was cleared in lactic acid and dissected on wooden slides as used by Humes and Gooding (1964). Body length was measured from anterior tip of prosome to posterior margin of caudal rami. In the description of armature, Roman and Arabic numerals indicate spines and setae, respectively. Drawings were made with the aid of a drawing tube. Body structures are described according to the terminology of Kabata (1979), Ho (1984) and Gotto (1993).

Results

Taxonomy

Order Cyclopoida Burmeister, 1834

Family Notodelphyidae Dana, 1853

Bonnierilla namhaesius, new species

Type Specimens : We have removed 166 specimens (156 ♀, 5 ♂ and 5 copepodids) of copepod parasites from the gill of 3 specimens

of *Halocynthia roretzi*, were taken from in Namhae Islands, 10 December 1993. Holotype ♀ and allotype ♂ and intact paratypes (10 ♀, 1 ♂ and 1 copepodids) will be deposited in the U. S. National Museum of Natural Science, Smithsonian Institution, Washington, D. C. The remaining paratypes (143 ♀, 1 ♂) are retained in the author's collection.

Female : The body (Fig. 1A) is laterally compressed and extremely soft, 2.2 - 2.8 mm (mean=2.5, n=20) long from the anterior most of prosome to the end of urosome. Prosomic shield fused posteriorly with metasome. Metasome of 3 poorly defined leg-bearing segments, with no tergal plates. Rostrum produced into a semicircular lobe between antennular bases of both sides. Brood sac occupies entire metasome, extending from the segment of second legs to that of fourth legs. Urosome (Figs. 1A, 2C) is 5-segmented inclusive of fifth thoracic segment and perianal ring, which bears caudal rami. Genital aperture lies on anterior edge of second urosomal segment. Caudal ramus is about 1/4.7 times as long as urosome. Antennule (Fig. 1B) is 8-segmented. The armature on these segments is 3, 17+1 hook, 9+1 aesthete, 5, 3, 2, 2+1 aesthete, and 7+1 aesthete. The armature on the 3-segmented second antenna (Fig. 1C) is 0, 2, and 8+1. This appendages is the most heavily sclerotized part of the body and bears a strong, recurved terminal claw.

Mandible (Fig. 1D) has 5 plumose setae in the exopod and 4 and 9 setae respectively in the 2-segmented endopod, a plumose seta in the sympod. The armature on masticatory

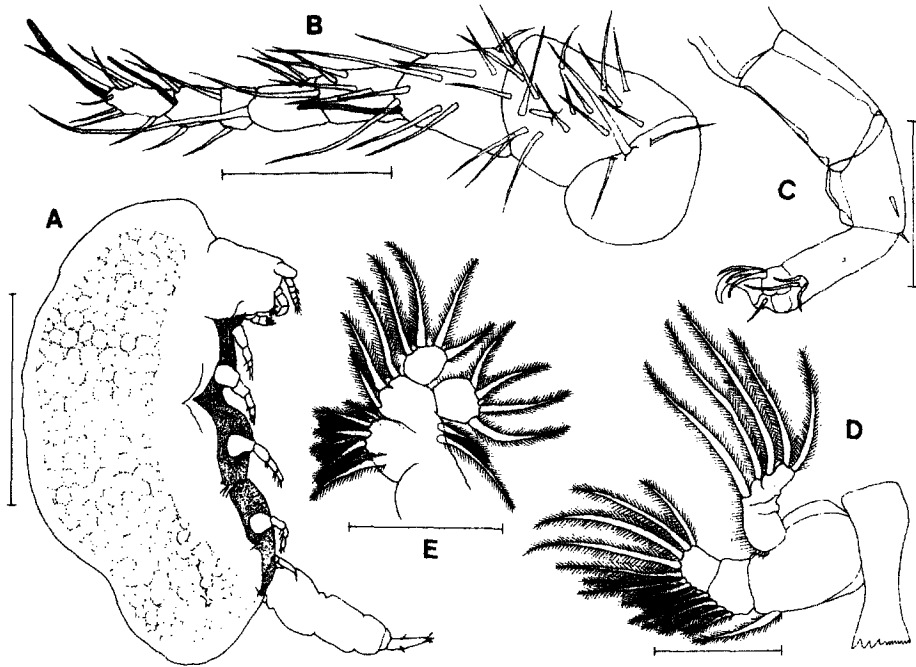


Fig. 1. *Bonnierilla namhaesius*, n. sp., Female : A, habitus, lateral; B, first antenna; C, second antenna; D, mandible; E, first maxilla. Scale bar : A = 1.0 mm; B-E = 0.1 mm

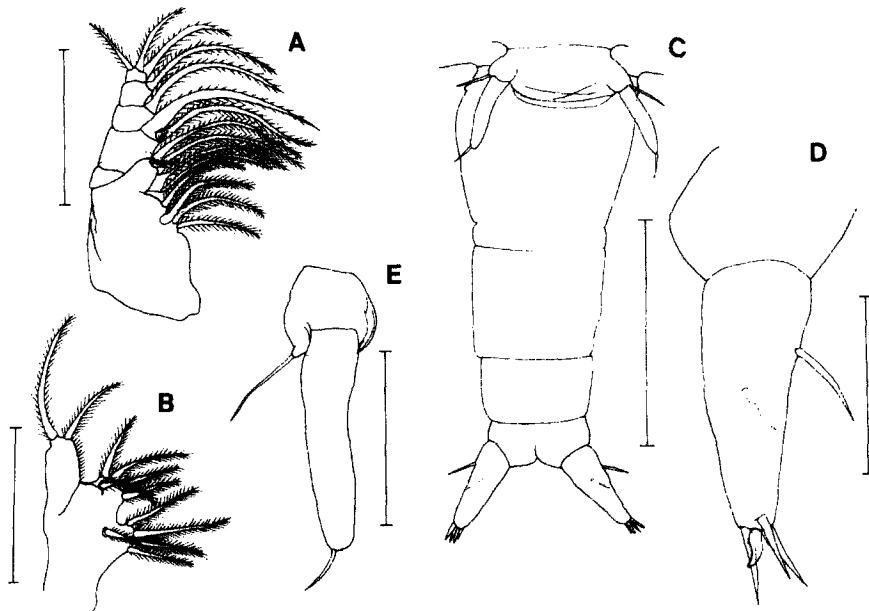


Fig. 2. *Bonnierilla namhaesius*, n. sp., Female : A, second maxilla; B, maxilliped; C, urosome; D, caudal ramus; E, fifth leg. Scale bar : A, B = 0.1 mm; C = 0.4 mm; D, E = 0.1 mm

lamella is 11~13 setules, 4 strong terminal teeth. Maxillule (Fig. 1E) has 2-jointed protopodite and 1-jointed rami. Outer distal angle of coxa carries an epipodite in the form of a stout seta and a setule, and inner margin bears 2 expansions representing endites. Proximal endite is rimmed with 11 setae of varying size along inner margin; distal endite has a smaller outgrowth resembling a seta. Basis is furnished with 3 subequal setae on distal margin. Both endopod and exopod bear 4 subequal setae. Maxilla (Fig. 2A) has 5-jointed, broad at the base, attenuating toward the tip. The armature in these segments 9, 3, 1, 1, 3 plumose setae. Two seta between the seventh and the eleventh is very short. Maxilliped (Fig. 2B) is indistinctly 3-parted, the armature in these parts are 5, 5, 2 plumose

setae. Both first and second part bear a separated seta.

The setal and spinal formulae of the legs are as follows (Roman numerals indicating spines, Arabic numerals representing setae).

	Sympod	Endopod	Exopod
Leg 1	0; I-1	0-1; 0-1; 0-6	I-1; I-1; IV-4
Leg 2	0; 0-1	0-1; 0-2; 0-6	I-1; I-1; II-5
Leg 3	0; 0-1	0-1; 0-2; 0-6	I-1; I-1; II-5
Leg 4	0; 0-1	0-1; 0-2; 0-5	I-1; I-1; II-5

The first four pairs of legs (Figs. 3A-D) are biramous with three-segmented rami. The endopods are characteristically shorter than the exopods in all legs. All setae on the endopod and exopod of first leg are strongly plumose, but those of fourth leg are non-hairy setae. Fifth leg (Figs. 2C, E) is two-segmented, both segments bear one naked, slender seta. Caudal

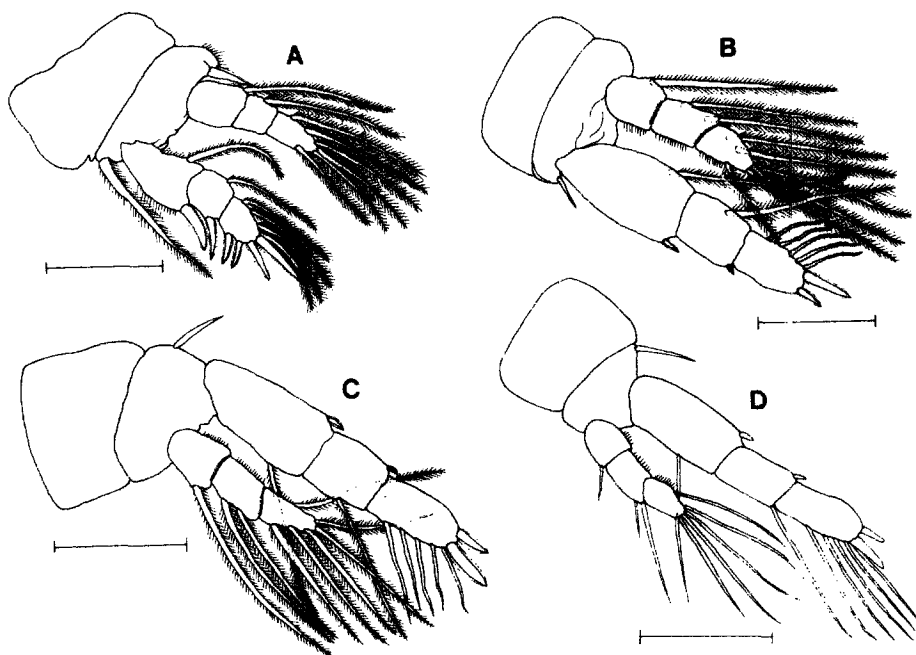


Fig. 3. *Bonnierilla namhaesius*, n. sp., Female: A, first leg; B, second leg; C, third leg; D, fourth leg. Scale bar: A-D = 0.1 mm

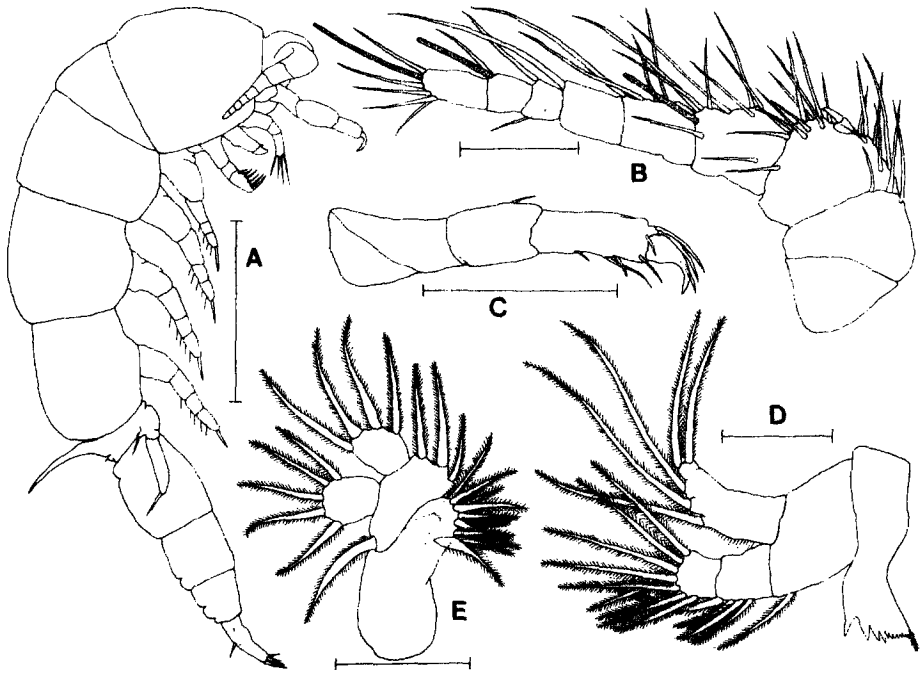


Fig. 4. *Bonnierilla namhaesius*, n. sp., Male : A, habitus, lateral; B, first antenna; C, second antenna; D, mandible; E, first maxilla. Scale bar : A = 0.3 mm; B-E = 0.05 mm

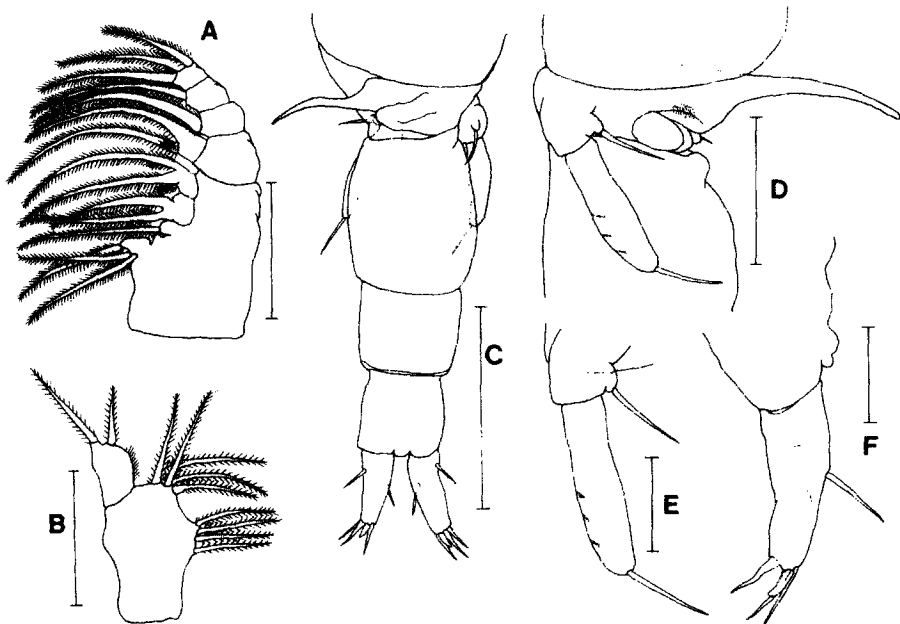


Fig. 5. *Bonnierilla namhaesius*, n. sp., Male : A, second maxilla; B, maxilliped; C, urosome; D, sixth leg, lateral; E, fifth leg; F, caudal ramus. Scale bar : A, B = 0.05 mm; C = 0.2 mm; D-F = 0.05 mm

ramus [Fig. 2D] are only slightly curved, conical, with truncate end, and 2.7 times as long as the greatest width. It bears 3 stout terminal setae of varying size, 1 blunt spine with several apical rows of fine tubercles. Besides these, there are 2 short setae.

Male : The body [Fig. 4A] tapering posteriorly and distinctly differentiated into prosome, metasome and urosome, 1.0 - 1.3 mm (mean=1.2, n=5) long from the anteriormost of prosome to the end of urosome. Metasome 4-segmented, with segment of first legs indicated only on dorsal side. Rostrum produced into a semicircular lobe between antennular bases of both sides. Urosome [Figs. 4A, 5C] is 6-segmented inclusive of fifth thoracic

segment and perianal ring, which bears caudal rami. Antennule [Fig. 4B] is 8-segmented as female. The armature on these segments is 3, 18+1 hook, 9+1 aesthete, 5+1 aesthete, 1, 1+1 aesthete, 2+1 aesthete, and 7+1 aesthete. Antenna [Fig. 4C] is similar to that of female in contour and ornaments, except that setal number on first segment is larger by one. Mandible [Fig. 4D] is largely in accord with that of female in structure. Maxillule [Fig. 4E], Maxilla [Fig. 5A] and Maxilliped [Fig. 5B] are substantially conforming to the corresponding limbs of female.

The setal and spinal formulae of the legs are as follows (Roman numerals indicating spines, Arabic numerals representing setae).

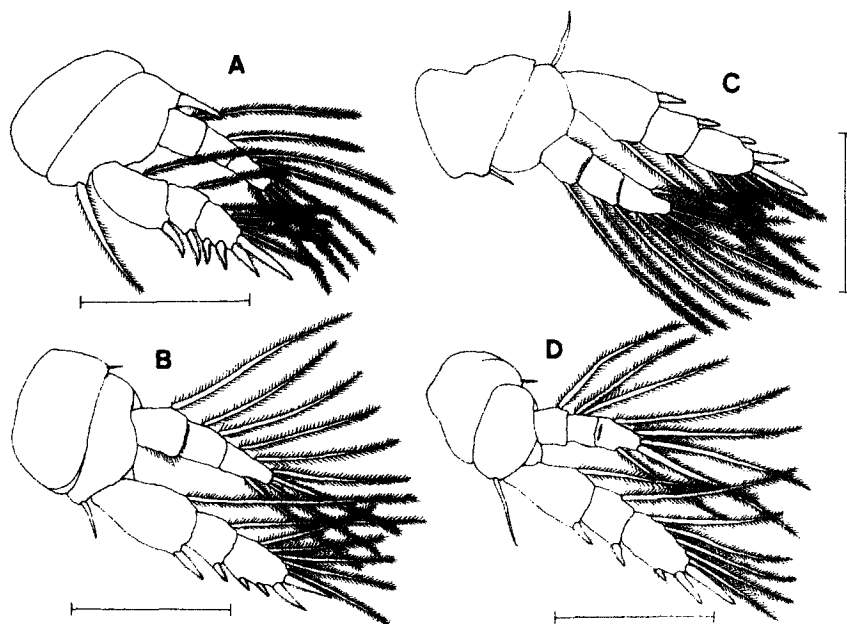


Fig. 6. *Bonnierilla namhaesius*, n. sp., Male : A, first leg; B, second leg; C, third leg; D, fourth leg. Scale bar : A-D = 0.05 mm

	Sympod	Endopod	Exopod
Leg 1	0; I-1	0-1; 0-1; 0-6	I-1; I-1; IV-5
Leg 2	0; 0-1	0-1; 0-2; I-6	I-1; I-1; IV-5
Leg 3	0; 0-1	0-1; 0-2; I-6	I-1; I-1; III-5
Leg 4	0; 0-1	0-0; 0-1; I-5	I-1; I-1; III-5

The first four pairs of legs (Figs. 6A-D) are biramous with three-segmented rami. The endopods are characteristically shorter than the exopods in all legs. All setae on the endo- and exopod of first leg are strongly plumose, but those of fourth leg are non-hairy setae. Fifth leg (Figs. 5C-E) is similar to that of female. Sixth leg (Fig. 5D) present on second urosomal segment carrying spermatophore, and triangular in outline. It bears 2 slender setae, one on outer margin and the other at the apex. Limb

bases of two sides meet each other on the mid-ventral line. Caudal ramus (Fig. 5F) are about 2.6 times as long as wide, 1.6 times as long as anal segment, and resembling that of female in essential characters. It is provided with a well-developed seta on dorsal side, with another similar seta on outer side and with 4 setae and 1 spine at the end.

Copepodid larvae: The body (Fig. 7A) tapering posteriorly and distinctly differentiated into prosome, metasome and urosome, 9.8 - 1.2 mm (mean=1.1, n=3) long from the anteriormost of prosome to the end of urosome. Metasome 4-segmented, with segment of first legs indicated only on dorsal side. Rostrum is similar to that of female. Urosome (Figs. 7A, 8C) is 4-segmented inclusive of fifth thoracic

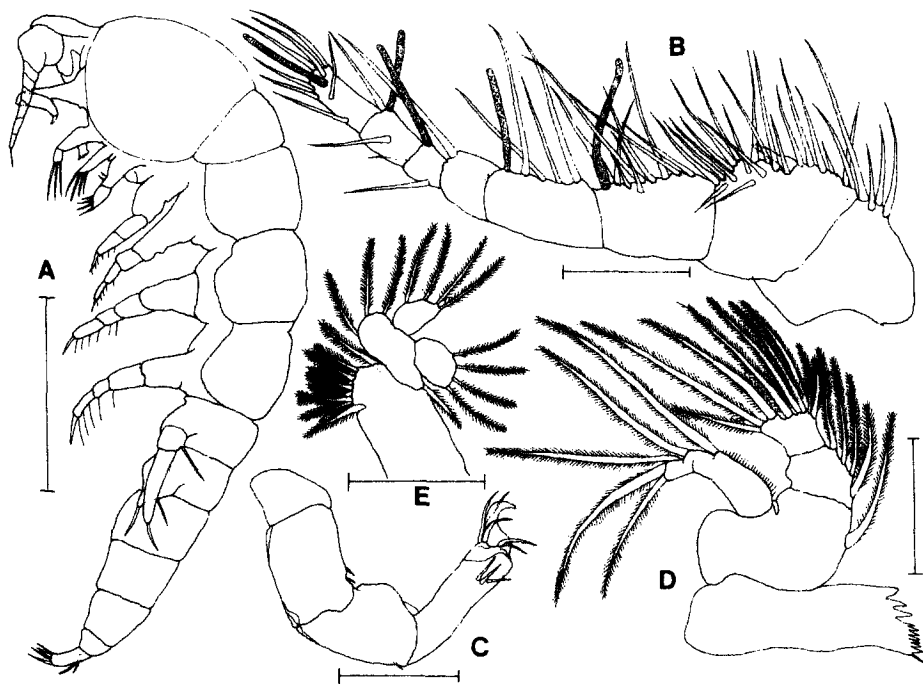


Fig. 7. *Bonnierilla namhaesius*, n. sp., Copepodid: A, habitus, latera; B, first antenna; C, second antenna; D, mandible; E, first maxilla. Scale bar: A = 0.3 mm; B = 0.05 mm; C = 0.1 mm; D, E = 0.05 mm

segment and perianal ring, which bears caudal rami. Genital process, a papilla-shaped or finger-shaped outgrowth, lies on the centre of the posterior margin of first urosomal segment; that is the site of attachment for the male. Antennule [Fig. 7A] is 8-segmented as female. The armature on these segments is 3, 16+1 hook, 9+1 aesthete, 4, 1, 2, 1+1 aesthete, and 5+1 aesthete. Antenna [Fig. 7C] is similar to that of female in contour and ornaments, except that setal number on second segment is smaller by one.

Mandible [Fig. 7D] is largely in accord with that of female in structure. Maxillule [Fig. 7E], Maxilla [Fig. 8A] and Maxilliped [Fig. 8B] are substantially conforming to the corresponding limbs of female. The setal and spinal formulae of the legs are as follows

(Roman numerals indicating spines, Arabic numerals representing setae).

	Symphod	Endopod	Exopod
Leg 1	0; I - 1	0 - 1; 0 - 1; 0 - 6	I - 1; I - 1; IV-4
Leg 2	1; 0 - 1	0 - 1; 0 - 2; 0 - 6	I - 1; I - 1; IV-5
Leg 3	1; 0 - 1	0 - 1; 0 - 2; 0 - 6	I - 1; I - 1; III-5
Leg 4	1; 0 - 1	0 - 1; 0 - 2; 0 - 5	I - 1; I - 1; III-5

The first four pairs of legs [Figs. 9A-D] are biramous with three-segmented rami. The endopods are characteristically shorter than the exopods in all legs. All setae on the endo- and exopod of the first to fourth legs are strongly plumose. Fifth leg [Figs. 8C, E] is similar to that of female, except second joint bears 3 similar rows on inner border. Caudal rami [Fig. 8D] are similar to that of female.

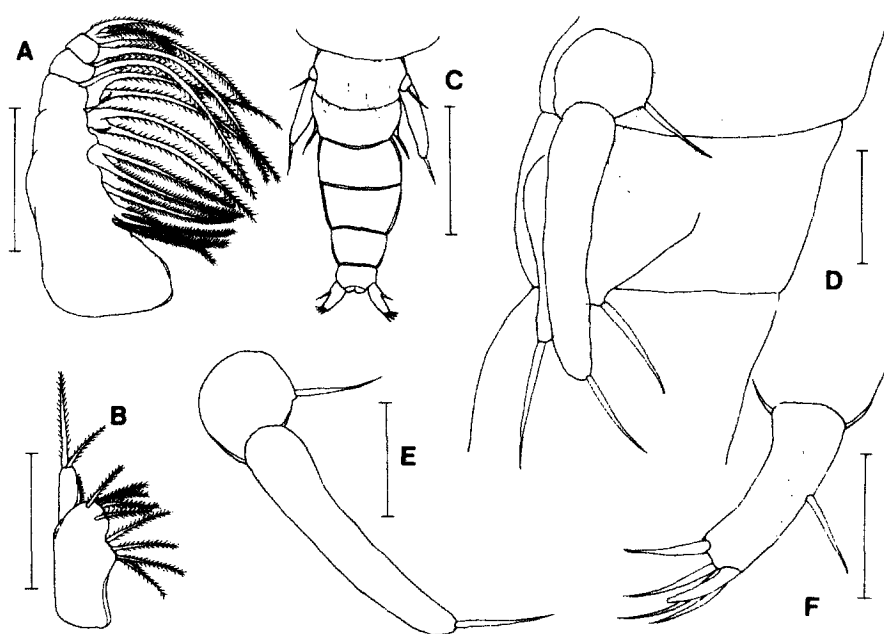


Fig. 8. *Bonnierilla namhaesius*, n. sp., Copepodid: A, second maxilla; B, maxilliped; C, urosome; D, genital process; E, fifth leg; F, caudal ramus. Scale bar: A, B = 0.05 mm; C = 0.2 mm; D = 0.1 mm; E, F = 0.05 mm

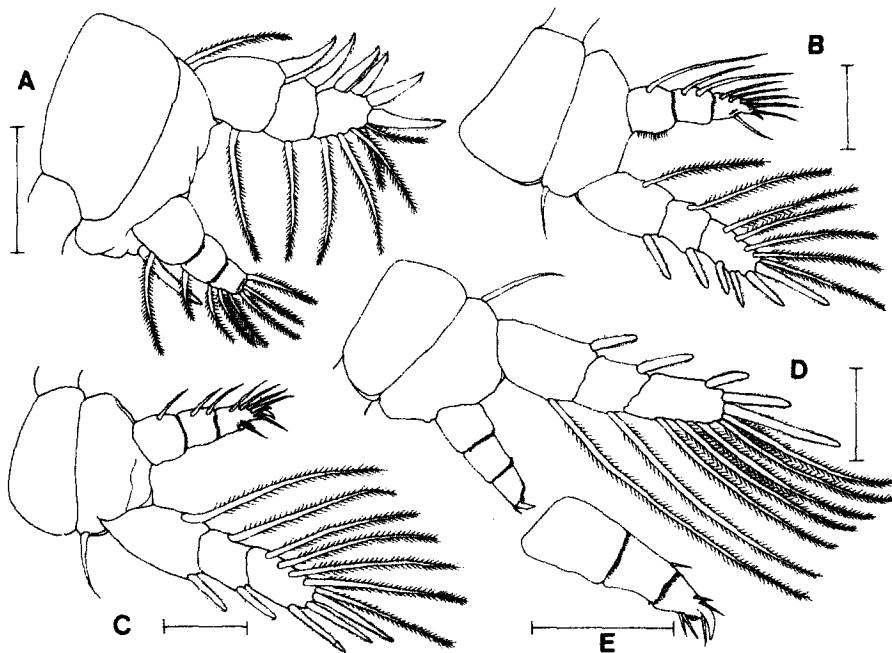


Fig. 9. *Bonnierilla namhaesius*, n. sp., Copepodid : A, first leg; B, second leg; C, third leg; D, fourth leg. Scale bar : A-D = 0.1 mm

Discussion

This species is recognizable by its unusually inflated body, with flabelliform outline in lateral aspect. In his reevaluation of *Bonnierilla*-group, Stock (1967) recognized eight species of Notodelphyids in the genus *Bonnierilla* Canu, 1891.

However, *B. curvicaudata* Ooishi was inadvertently overlooked by him. Ho (1984) found *B. mollia* in the Japanese waters, therefore, there are ten species of *Bonnierilla*.

Depending on the formula of armature of caudal rami, we found that there are two groups of species in the species in the genus *Bonnierilla*: one has 2-3- I and the other 2-4

or 2-3. Of the 10 known species, the former contains 1 species and the latter 9. The present new species belongs to the former including *B. curvicaudata* Ooishi, 1963.

It has been known that the setal and spinal formulae of the legs are an useful recognition character in several species of *Bonnierilla* (Ooishi, 1963; Stock, 1967; Ho, 1984). Although *B. namhaesius* is closely allied with *B. curvicaudata* Ooishi, it can be distinguished further from the latter by the armature of the antennule and the reduction of armature (II, 5 instead of I, II, 5) in the terminal segment of the exopod of the second to fourth legs, and from the latter by the body size.

This is the second record of the male, and

first record of the copepodid in the genus *Bonnierilla*. Morphological features of its appendages are in conformity with those of the female in the basic plan, except genital process of copepodid.

Acknowledgement

We would like to thank to Professor H. L. Suh for his continuous guidance and comments. We also wish to express our deep appreciation to Dr. D. S. Sim. Thanks are also given to S. D. Lee, Y. G. Noh and Y. C. Park, South Sea Fisheries Research Institute, for various levels of support in laboratory works.

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한국 양식산 우렁쟁이에 기생하는 *Bonnierilla* (Copepoda, Cyclopoida, Notodelphyidae) 의 1 신종

최상덕 · 홍성운*

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한국 양식산 우렁쟁이의 외투강에서 채집된 기생성 요각류 1 종이 *Bonnierilla* 속의 신종임이 확인되어 *B. namhaesius* 으로 명명하였다. 본 종은 제 1 안테나 8 개 마디의 강모식 3, 17+1 hook, 9+1 aesthete, 5, 3, 2, 2+1 aesthete, 7+1 aesthete 를 갖는 점과 제 2 외지에서 제 4 외지 마지막 마디의 II, 5 및 caudal ramu 의 끝 부분에 2, 3, 1의 형태를 갖으므로 다른 종과 구별된다. 또한 *Bonnierilla* 속 중에서 수컷은 두번째로, 유생은 처음으로 기재한다.

Key Words : Copepoda, Notodelphyidae, Parasite, New species, Ascidiens, Korea