

Copepod Associated with Ascidians from Korea I. A New Record of Notodelphyid (Copepoda, Cyclopoida) Species from Ascidians in the East Sea, Korea

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***Paranotodelphys villosus* Ooishi, 1963, a symbiotic Copepoda, recovered from the ascidian, *Ascidia sydneiensis samea* (Oka) is reported from the East Sea, Korea.**

KEY WORDS: *Paranotodelphys villosus*, Notodelphyidae, Copepoda, Redescription

The Notodelphyidae is a family of cyclopoid copepods usually associated with Tunicata (Jones, 1979). Most species of this group are considered as commensals in the branchial sac of the solitary ascidians. Some members of the family are parasites encysted in the tunic or ventral blood vessel of the solitary ascidians and in the matrix of the compound ascidians. The subadult forms and maels are free swimming, and are in many cases undescribed (Jones, 1974).

In this paper, we deal with one species that were recovered from the materials of ascidian, *Ascidia sydneiensis samea* (Oka) which were collected from Imwon and Changho located in the East Sea of South Korea. The specimens were dissected and measured in lactic acid. All figures were drawn with the aid of drawing tube. We prepared illustration and description about the female and male of *Paranotodelphys villosus* Ooishi, 1963 from Korea for a comparison with the Japanese specimen. This paper is the first report of cyclopoid copepoda associated with ascidians from Korea.

Order Cyclopoida Burmeister, 1835

Family Notodelphyidae Dana, 1853

Paranotodelphys villosus Ooishi, 1963, p.419, figs. 1-2.

Materials examined: 16 ♀♀, 1 ♂

(appendages of 4 ♀♀, 1 ♂ dissected and mounted on 5 microslides) recovered from washing of *Ascidia sydneiensis samea* (Oka) collected at Imwon in Kangwon-do (located in the coast of East Sea, Korea), on Dec. 27, 1986, by I.-H. Kim; 3 ♀♀, recovered from washing of *Ascidia sydneiensis samea* (Oka) collected at Changho in Kangwon-do on Nov. 16, 1986, by I.-H. Kim.

Body (Fig. 1A, B) 2.87 mm long, (from tip of prosome to end of caudal rami). Body straight without showing ventral flexure and covered dorsolaterally with scatteredly minute spinules. Body divisible into prosome, 4-segmented metasome and 5-segmented urosome. Last metasomal somite with brood pouch. Urosome relatively slender, 1.7 times longer than prosome. Genital apparatus located near posterior margin of first urosomal somite. Caudal rami (Fig. 1E) elongate and slender, about 3.8 times as long as anal somite and about 8.3 times as long as wide, with single plumose seta on near middle and subterminal dorsal plumose seta, 2 equal terminal plumose setae and 2 terminal long simple setae. Inner margin of rami densely fringed by hairs and scattered setules dorsolaterally.

Antennule (Fig. 2A) 9-segmented, segments gradually narrowing toward terminal end. Setae mixed plumose and simple. Setal formula: 3 (all plumose), 17 (7 plumose+1 spine-like), 6 (3

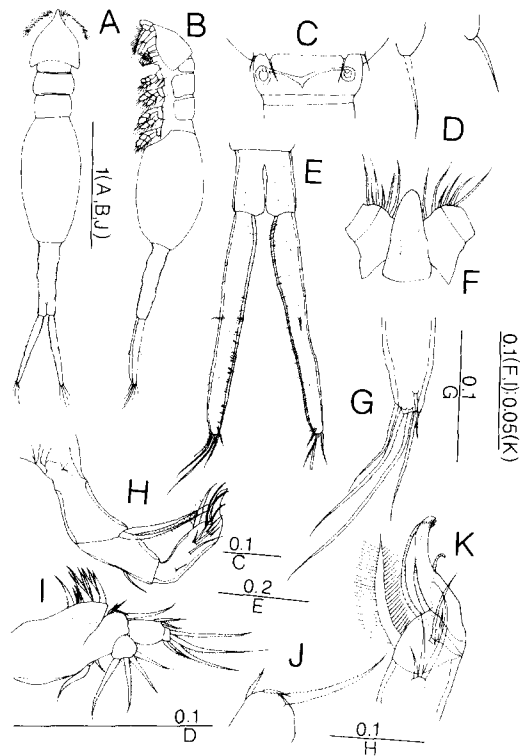


Fig. 1. *Paranotodelphys villosus* Ooishi, 1963, female. A. habitus, dorsal; B. habitus, lateral; C. leg 5 and genital somite; D. leg 5; E. anal somite and caudal rami; F. rostrum; G. distal portion of caudal ramus; H. antenna; I. maxillule; J. distal portion of basis of maxillule; K. distal portion of antenna. Unit of scales: mm.

plumose), 5 (2 plumose), 4 (2 plumose), 3, 2, 2+1 aesthete, and 7+1 aesthete.

Antenna (Fig. 1H) 3-segmented. First segment with 2 plumose setae on outer distal corner; second segment with 1 short simple seta on inner ventral margin; third segment with 2 short isolated setae and a group of 3 setae on inner ventral margin. Claw slender, with 3 stiff curved setae, 2 flexible shorted simple setae and 1 long stout plumose seta at base.

Labrum (Fig. 3D) broad, with long hairs ventrally and short hairs on each side of distal margin.

Paragnath (Fig. 3D) bilobed, located between mandible and maxillule, located on lower margin of labrum, with short hairs on both inner ventral margin of both lobes.

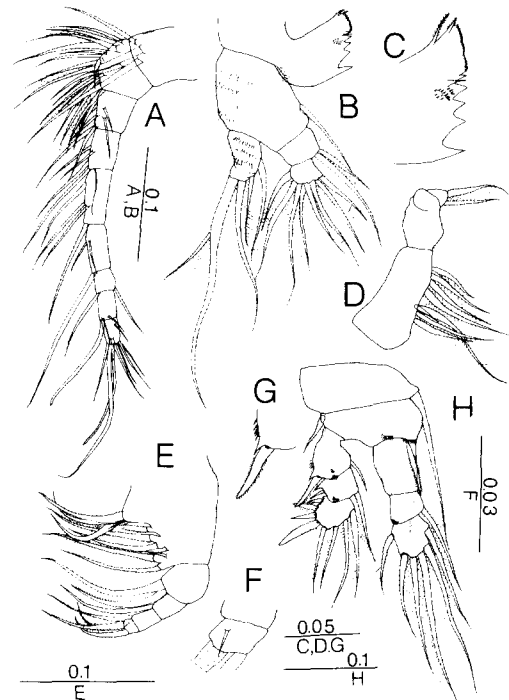


Fig. 2. *Paranotodelphys villosus* Ooishi, 1963, female. A. antennule; B. mandible; C. masticatory lamella of coxa of mandible; D. maxilliped; E. maxilla; F. 5th segment of maxilla; G. distal portion of 1st exopodal segment of leg 1; H. leg 1. Unit of scales: mm.

Mandible (Fig. 2B) consisted of 2-segmented protopodite, 2-segmented endopod and 1-segmented exopod. Masticatory lamella of coxa with 5 heavy teeth and 1 simple seta between fourth and fifth tooth, and a row of closely set denticles and 2 plumose setules. Basis with 1 distal plumose seta on inner margin and hairs dorsolaterally. Endopod 2-segmented, first segment with 2 plumose setae on inner distal corner; second segment with 8 plumose apical setae. Exopod elongate, outer and inner margins with hairs, and 5 plumose setae on inner and distal margins.

Maxillule (Fig. 1I, J) with 2-segmented protopodite and 1-segmented rami. Basal endite of coxa with 7 long plumose setae and 2 short plumose setae on inner margin. Second endite terminated by 1 setiform elongation. Epipodite with 1 long stout plumose seta and 1 short

plumose setule. Basis with 2 short proximal plumose setae and 1 long distal plumose seta on inner margin. Endopod with 2 short plumose setae on inner margin, 3 long plumose setae at apex and 1 short plumose seta on outer margin. Exopod with 4 long marginal plumose setae.

Maxilla (Fig. 2E) 5-segmented. Basal segment with 4 setiferous endites; first endite with 3 long plumose setae and 1 tiny plumose setule; second endite with 1 long plumose seta; third endite with 2 long plumose setae; fourth endite with 2 long plumose setae and 1 tiny plumose setule. Second segment with 1 long plumose seta and 1 long spine. Each of third and fourth segments with 1 long plumose seta. Fifth segment with 3 feeble plumose setae and 1 tiny simple setule.

Maxilliped (Fig. 2D) 3-segmented. First segment longest and with 9 plumose setae forming distal group of 5 and proximal group of 4; second segment with short hairs on inner margin; third

segment with 2 subequal apical plumose setae.

Four pairs of swimming legs (Figs. 2H, 3A-C) gradually increasing in length from anterior to posterior and with distinctly 3-segmented rami. Endopod of leg 1 longer than exopod. Inner processes on first and second segments of endopod of leg 1 and first segments of endopod of legs 2-4 weakly developed. Coxa of leg 4 with reduce seta; exopod longer than endopod. Their formula of spines (Roman numerals) and setae (Arabic numerals) are as follows:

Leg 1	prp 0-1; 1-1	Exp I-1; I-1; IV-4 Enp 0-1; 0-1; 6
Leg 2	prp 0-1; 1-0	Exp I-1; I-1; IV-5 Enp 0-1; 0-2; 6
Leg 3	prp 0-1; 1-0	Exp I-1; I-1; IV-5 Enp 0-1; 0-2; 6

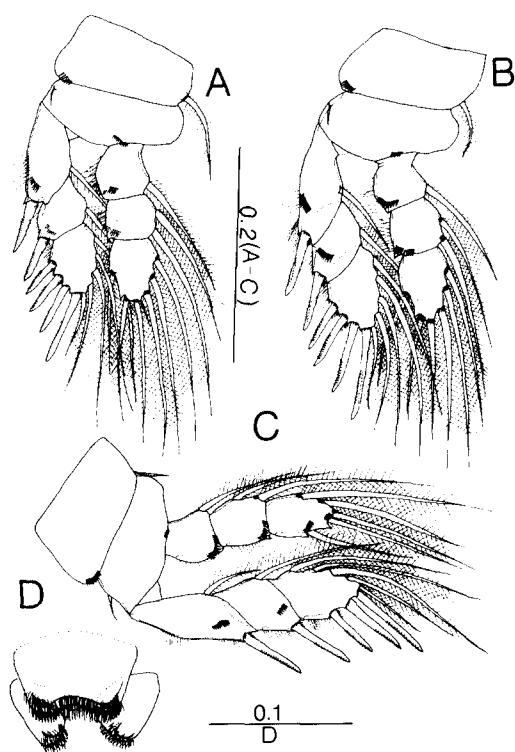


Fig. 3. *Paranotodelphys villosus* Ooishi, 1963, female. A. leg 2; B. leg 3; C. leg 4; D. labrum and caudal rami. Unit of scales: mm.

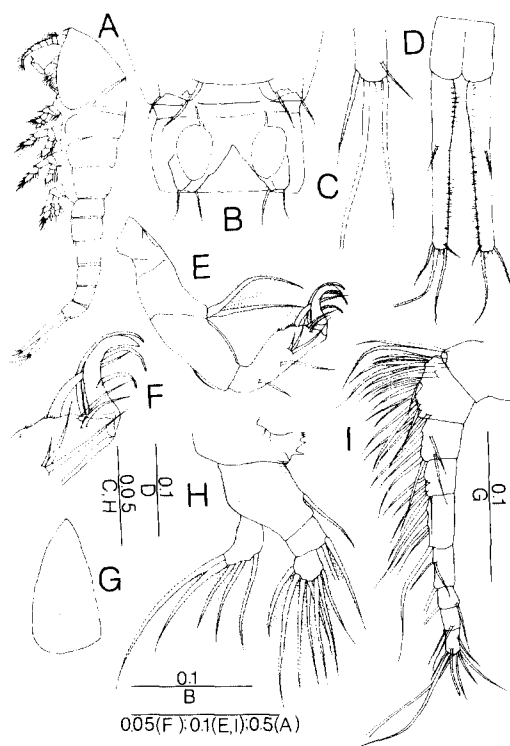


Fig. 4. *Paranotodelphys villosus* Ooishi, 1963, male. A. habitus, lateral; B. leg 5, leg 6, and genital segment; C. distal portion of caudal ramus; D. anal somite and caudal rami; E. antenna; F. distal portion of antenna; G. rostrum; H. mandible; I. antennule. Unit of scales: mm.

Table 1. Differences between Korean specimens and Ooishi's (1963) description of *Paranotodelphys villosus* Ooishi, 1963.

Characters	Ooishi's (1963) description	Korean specimens
Number of setae of from 1st to 9th segments of antennule	3, 14, 6, 4, 4, 3, 2, 2 and 8	3 (all plumose), 17 (7 plumose + 1 spine-like), 6 (3 plumose), 5 (2 plumose), 4 (2 plumose), 3, 2, 2+1 aesthete, and 7+1 aesthete.
Mode of setae of antennule	all simple setae	mixing simple, aesthete and plumose
Number of setae of basis of maxillule	2	3
Number of setae of 1st endite of maxilla	3	3+1 (tiny plumose)
Number of setae of 5th segment of maxilla	3	3+1 (tiny simple seta)
Mode of apical setae of caudal rami	4 (all plumose)	4 (2 plumose)
Number of setae of 3rd segment of endopod of leg 4	4	5

segmented exopod. Masticatory lamella of coxa with 2 heavy teeth, 2 small teeth and 1 simple seta. Number of setae of endopod and exopod as those of female.

Maxilliped (Fig. 5D) 3-segmented. First segment longest and with 8 inner plumose setae forming distal group of 5 and proximal group of 3. Second segment with short hairs on inner margin. Third segment with 2 subequal apical plumose setae.

Leg 1 (Fig. 5C) as that of female, but inner processes on first and second segments of endopod more developed than in female.

Legs 2-3 (Fig. 6A, B) as those of the female in morphology and armature.

Leg 4 (Fig. 6C) as that of female, but inner seta of coxa more developed and plumose.

Leg 5 (Fig. 6D) located near posterior margin of first urosomal somite, being 2 pairs of small bulge tipped with 1 inner longer apical plumose seta and 1 outer shorter apical plumose seta.

Leg 6 (Fig. 6E) located near posterior margin of second urosomal somite, consist of a trapezoidal flap, apically with 1 lateral plumose seta, 1 medial plumose seta and 1 distal setule near inner margin.

Remarks: So far, 10 species are known in the genus of *Paranotodelphys* Shellenberg, 1922 (Shellenberg, 1922; Ooishi, 1963; Stock, 1967;

Stock and Humes, 1970; Illg, 1970). *Paranotodelphys villosus* Ooishi, 1963 is easily distinguished from other species of the genus by its slender body and the length of the caudal rami which are the most distinctive characters of the species. The present specimens of *P. villosus* from Korea resemble those of Japan reported by Ooishi in the following characters: 1) slender body 2) long caudal rami 3) hairy inner margin of caudal rami 4) identical number of setae of A2 5) identical number of setae of maxilliped and legs 1-3. However, some morphological differences between Korean specimens and Japanese one are found and shown in Table 1.

As a result of observation of four dissected specimens, seven characters marked in Table 1. are turned out to be constant in Korean materials. Until more male and female specimens from various parts of Korea are examined for this species, we refrain from designating the specimens from East Sea of Korea as a subspecies of *P. villosus*.

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- (Accepted February 23, 1995)

한국산 해초류(Ascidians)에 공생하는 요각류 1. 동해의 해초류(Ascidians)에 공생하는
요각류 1 미기록종
서인순 · 이경숙(단국대학교 생물학과)

강원도 동해 연안에서 잡힌 해초류인 *Ascidia sydneiensis samea*(Oka)에 공생하는
요각류. *Paranotodelphys villosus* Ooishi, 1963을 보고한다.