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## Two Copepod Species of *Nothobomolochus* (Poecilostomatoida, Bomolochidae) Parasitic on Marine Fishes from Yosu Bay, Korea

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Two species of the parasitic copepod were recovered from two Korean fishes, *Lateolabrax japonicus* (Cuvier and Valenciennes) and *Pampus argenteus* (Euphrasen) taken from Yosu Bay, Korea. The present paper contains redescription of two species of *Nothobomolochus* of Bomolochidae. Both species, *N. lateolabracis* (Yamaguti and Yamasu) and *N. tricerus* (Basset-Smith), are newly recorded from the Korean water. *N. lateolabracis* and *N. tricerus* were found on the *L. japonicus* and *P. argenteus*, respectively.

### Introduction

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; Choi *et al.*, in press; Suh *et al.*, 1993). In Korean waters, nevertheless, a few studies have been done on parasitic copepods of marine fishes.

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 specimens of the mortalities of marine fishes occurred on Yosu Bay in Korea. Having studied this material, we recovered two species of the copepod parasites from two species of Korean fishes: *Nothobomolochus lateolabracis* (Yamaguti and Yamasu) from *Lateolabrax japonicus* (Cuvier and Valenciennes) and *N. tricerus* (Basset-Smith) from *Pampus*

*argenteus* (Euphrasen). Both species were described for the first time in Korea.

### Materials and Methods

The fishes examined for the copepod parasites were taken from in Yosu Bay, Korea (34° 45'N, 127° 45'E) on 13 June, 1993. The copepod parasites were removed from the gill of fishes, and all the parasites were fixed in 5% buffered formalin-seawater. For morphological observation the copepods were 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 Vervoort (1962) and Kabata (1979).

## Results and Discussion

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

Suborder Poecilostomatoida Thorell, 1859

Family Bomolochidae Claus, 1875

*Nothobomolochus lateolabracis* (Yamaguti and Yamasu, 1959)

*Nothobomolochus tricerus* (Basset-Smith, 1898)

1. *Nothobomolochus lateolabracis* (Yamaguti and Yamasu, 1959)

Figs. 1~3

*Artacolax lateolabracis* Yamaguti and Yamasu, 1959, p. 90, pl. 1, figs. 1~2;

*Nothobomolochus lateolabracis* Vervoort, 1962, p. 71; Ho *et al.*, 1983, p. 8, figs. 61~81.

*Pseudartacolax lateolabracis* Yamaguti, 1963, p. 14, pl. 7, fig. 3.

**MATERIAL EXAMINED.** Eight females from the gills of 2 fishes, *Lateolabrax japonicus* (Cuvier and Valenciennes) were taken from Yosu Bay, 13 June 1993.

**DESCRIPTION.** Female: The body (Fig. 1A) is about 1.29~1.45 mm (mean=1.38mm, n=5) long, more or less cyclopoid, with a large transversally produced cephalothorax and with the remaining thoracic somites gradually diminishing in width. Cephalothorax (Fig. 1A) is wider than long and measuring 0.47 mm (0.45~0.51 mm) × 0.69 mm (0.65~0.73 mm), broadly rounded anteriorly and cut off squarely posteriorly. A V-shaped groove running posteriorly from the rostral plate is distinctly visible from above. The second thoracic somite is visible as a narrow band with rounded sides, broader than third thoracic somite; the third thoracic somite is well developed and backward produced and covers the major part of fourth thoracic somite.

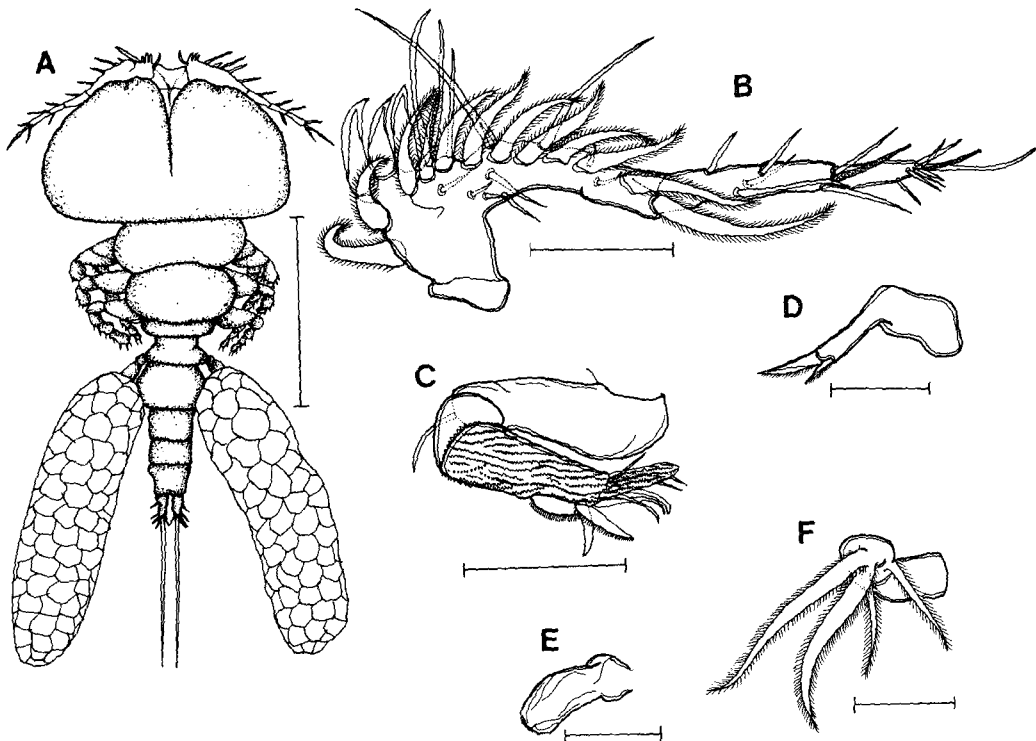


Fig. 1. *Nothobomolochus lateolabracis* (Yamaguti and Yamasu), female: A, habitus, dorsal; B, antennule; C, antenna; D, mandible; E, paragnath; F, maxillule. Scale bar: A=0.5 mm; B, C=0.1 mm; D~F=0.05 mm.

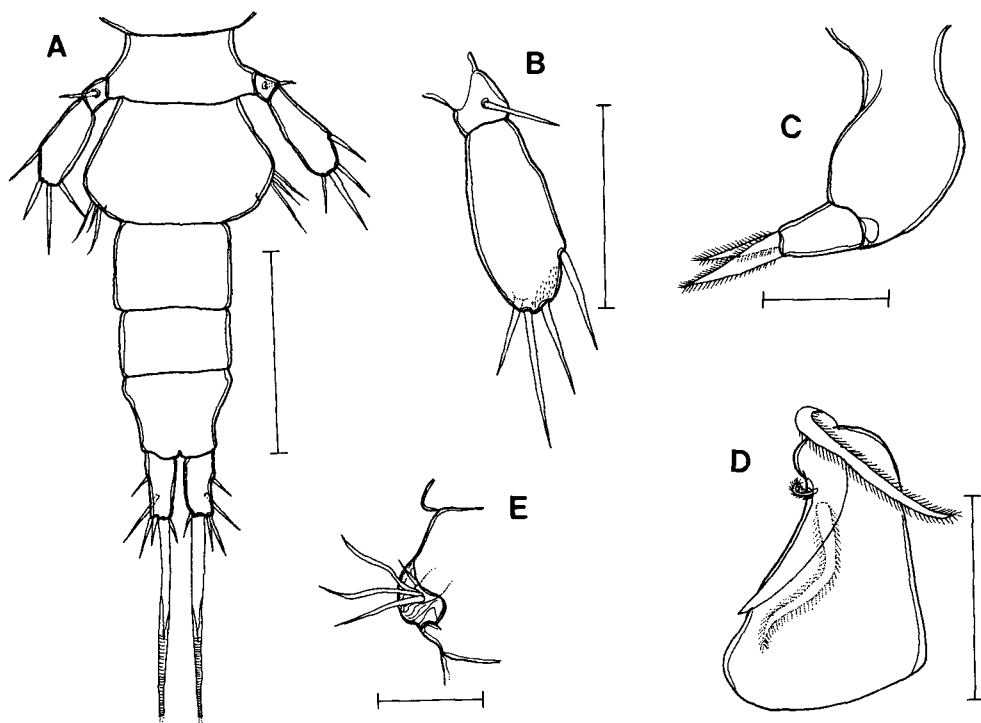


Fig. 2. *Nothobomolochus lateolabracis* (Yamaguti and Yamasu), female: A, urosome; B, fifth leg; C, maxilla; D, maxilliped; E, egg sac attachment. Scale bar: A=0.2 mm; B, D, E=0.1 mm; C=0.05 mm.

Urosome (Figs. 1A, 2A) is gradually narrowing and distinctly five-segmented, 0.55 mm (0.52~0.59 mm). Genital complex (Figs. 1A, 2E) is lateral swelling rounded, wider than long, 0.15 mm (0.13~0.16 mm) × 0.22 mm (0.21~0.23 mm). Area of egg sac attachment (Figs. 1A, 2E) is located dorso-laterally of genital complex, bordered by a strongly chitinized margin. From the opening protrude 3 fine setae, a small seta present on a distinctly visible but small genital flap (leg 6). Egg sacs (Fig. 1A) are very long, 0.77 mm (0.54~0.86 mm) long, about half the length of the body. Caudal ramus (Figs. 1A, 2A) is slightly conical, longer than wide, 0.07 mm (0.06~0.08 mm) × 0.03 mm (0.03~0.04 mm), with 6 setae; one of the setae on each side is lengthened.

Antennule (Fig. 1B) consists of 3 fused basal segments and a 3-segmented flagellum. The basal segments are armed with 12 plumose setae on the basal portion of anterior margin, 8 short setae

and 5 long setae on the rest margin; the dorsal chitinized plate is divided into 3 fairly broad and bluntly pointed finger-shaped processes of about the same length as the plumose setae. The formula for the 3-segmented flagellum is 4, 2+1 aesthete, and 7+1 aesthete respectively. Antenna (Fig. 1C) is 2-segmented sympod; first segment is long, subcylindrical, with long slender seta near distal end; second segment is short. First segment of endopod is long and armed with several rows of fine spinules; the tubercle and the lamellar process are armed with a pectinate row of bigger spinules, in addition with 4 hooked spines and 3 setae. Second segment is robust, with several rows of fine spinules continuing over its surface from the first segment.

Mandible (Fig. 1D) is flat with rounded base and cylindrical shaft; large subtriangular process is sharp ventral edge and smaller but similar process. Paragnath (Fig. 1E) is rounded, apparently with a

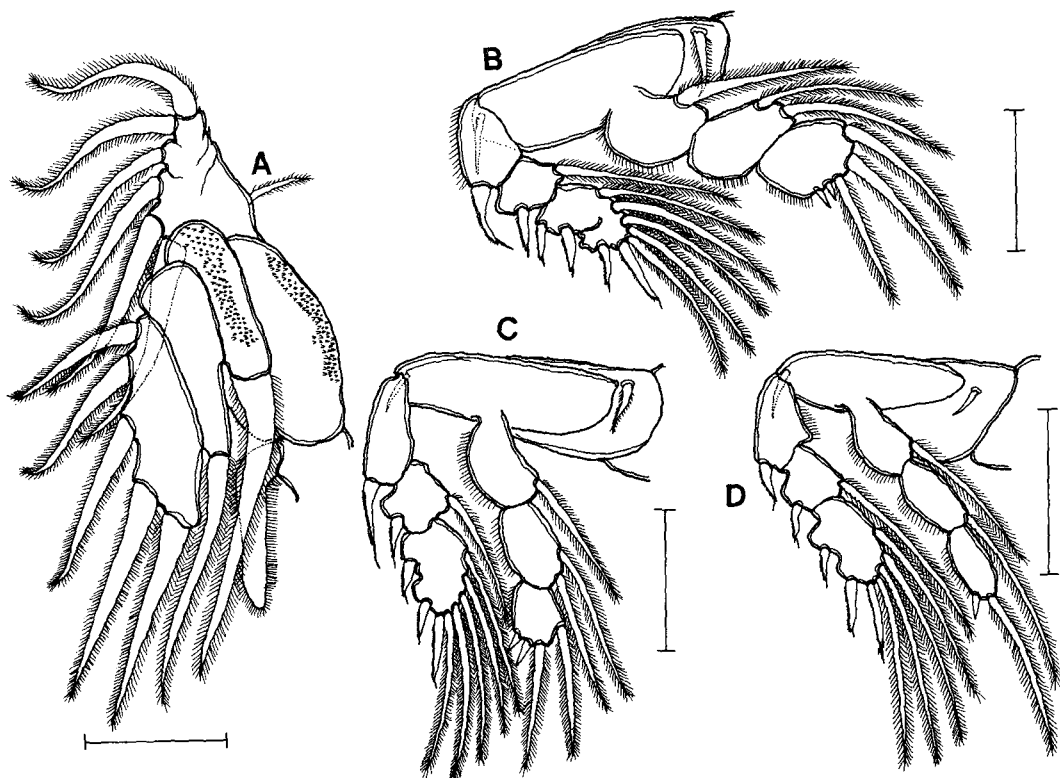


Fig. 3. *Nothobomolochus lateolabracis* (Yamaguti and Yamasu), female: A, first leg; B, second leg; C, third leg; D, fourth leg. Scale bar: A, D=0.1 mm; B, C=0.2 mm.

small spiniform membrane.

Maxillule (Fig. 1F) is small, rounded, with 2 long and 2 shorter setae, all plumose. Maxilla (Fig. 2C) consists of 2 haired teeth at the apex. Maxilliped (Fig. 2D) is armed with 2 strong, plumose setae and a much smaller seta; claw is strong, curved without auxiliary tooth. The setal and spinal formulae of the legs are as follows:

	Endopod	Exopod
Leg 1	0-1; 0-1; 5	I -0; III, 6
Leg 2	0-1; 0-2; II, 3	I -0; I -1; III, I, 5
Leg 3	0-1; 0-2; II, 2	I -0; I -1; II, I, 5
Leg 4	0-1; 0-1; I, 1	I -0; I -1; II, I, 4

The endopod and exopod of the first leg are strongly flattened; the segments of the exopod almost fused. Both rami of the second to fourth legs are 3-segmented. All setae of 4 legs are strongly plumose. The external marginal spines of the exo-

pods of the second to fourth legs consist of a fine flagellum and a spur, but the internal margin of these spines is smooth.

The fifth leg (Fig. 2B) has a short intermediate segment, bearing a fine seta, and a spatulate distal segment, bearing an external spiniform seta and 3 apical spiniform setae, of which the median seta is lengthened.

REMARKS. *Nothobomolochus lateolabracis* is easily identified by body shape, antennule, and the reduction of armature in the terminal segment of fourth leg; for instance, the present species is very similar to *N. denticulatus* in the structure of the antennule and *N. fradei* in the reduction of armature (I, 1 instead of I, 1, I) in the terminal segment of the endopod of the fourth leg. *N. fradei* is distinguishable in having the heavily serrated outer spines in the external marginal spines of the exopods of the second to fourth legs. *N. lateolabracis*

has not yet been reported outside Japanese waters since Yamaguti and Yamasu (1959), Ho *et al.* (1983) described from Inland Sea of Japan. We found it again from the same host, *Lateolabrax japonicus* (Cuvier and Valenciennes) from Yosu Bay in Korea; but the present species has not been found in Kamak Bay, Yoja Bay, Tungnyang Bay and Wando Islands.

Male has not yet been found Korean and Japanese waters.

2. *Nothobomolochus tricerus* (Basset-Smith, 1898)

Figs. 4~6

*Bomolochus tricerus* Basset-Smit, 1898, p. 2, pl. 1, figs. 1a~g; Pillai, 1965, p. 39, figs. 15A~O.

*Nothobomolochus tricerus* Vervoort, 1962, p. 64; Pillai, 1969, p. 149, figs. 1~4; Ho *et al.*, 1983, p. 9, figs. 82~94.

*Pseudobomolochus tricerus* Yamaguti, 1963, p. 16.

*Bomolochus (Pseudobomolochus) managatuwo* Yamaguti, 1939, p. 396, pl. 3, figs. 28~29, pl. 4, figs. 30~36; Sewell and Seymour, 1949, p. 163; Shen, 1957, p. 303, pl. 5.

*Nothobomolochus managatuwo*, Vervoort, 1962, p. 66.

*Pseudobomolochus managatuwo* Yamaguti, 1963, p. 15, pl. 10, fig. 1.

**MATERIAL EXAMINED.** Nine females from the gill of 7 fishes, *Pampus argenteus* (Euphrasen) were taken from Yosu Bay, 13 June 1993.

**DESCRIPTION.** Female: The body (Fig. 4A) is about 2.65~3.14 mm (mean=2.87mm, n=5), more or less cyclopoid, with a large transversally produced cephalothorax and with the remaining thoracic somites gradually diminished in width. Cephalothorax (Fig. 4A) is wider than long and measuring

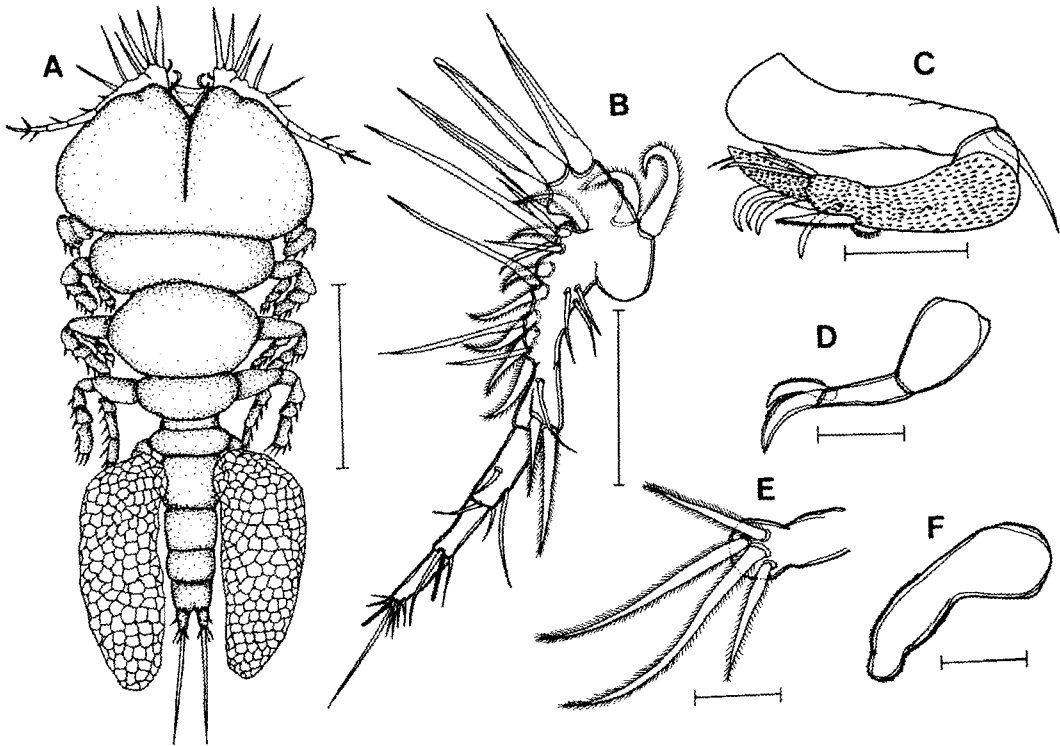


Fig. 4. *Nothobomolochus tricerus* (Basset-Smith), female: A, habitus, dorsal; B, antennule; C, antenna; D, mandible; E, maxillule; F, paragnath. Scale bar: A=1 mm; B=0.3 mm; C=0.2 mm; D~F=0.05 mm.

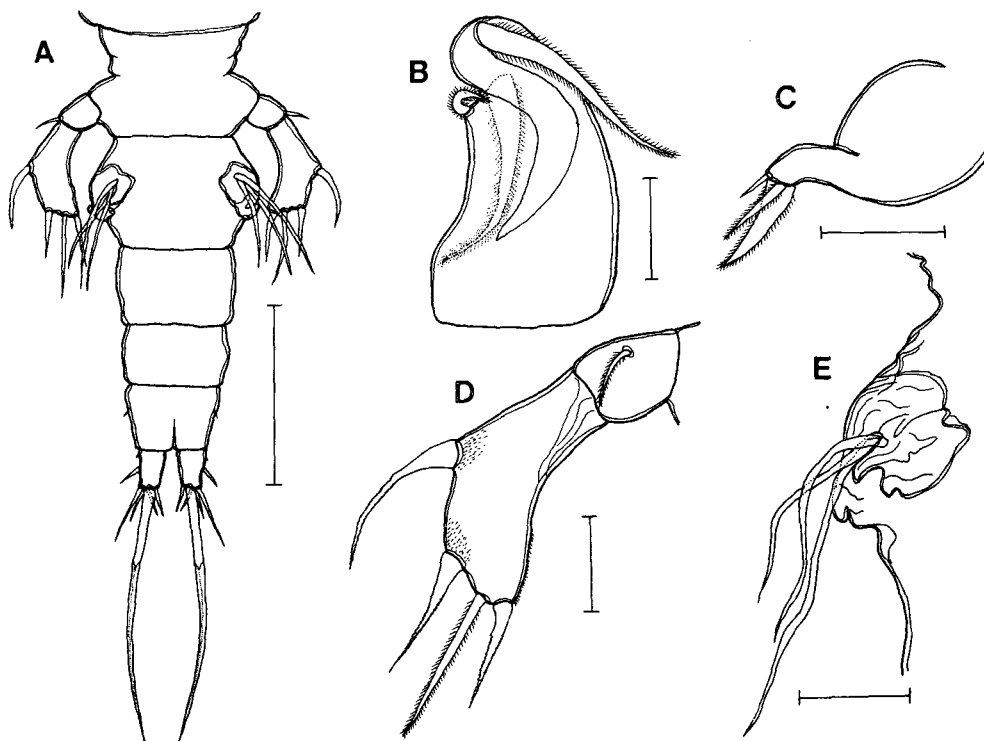


Fig. 5. *Nothobomolochus tricerus* (Basset-Smith), female: A, urosome; B, maxilliped; C, maxilla; D, fifth leg; E, egg sac attachment. Scale bar: A=0.5 mm; B~E=0.1 mm.

0.99 mm (0.94~1.06 mm) × 1.47 mm (1.45~1.51 mm), more or less trapezoid; rounded anteriorly and cut off squarely posteriorly. A V-shaped groove running posteriorly from the rostral plate is distinctly visible from above. The second thoracic somite is slightly overlaps, broader than third; the third thoracic somite is well developed and backward produced, covers about half of fourth thoracic somite.

Urosome (Figs. 4A, 5A) is gradually narrowing and distinctly 5-segmented, 1.06 mm (1.02~1.12 mm). Genital complex (Figs. 4A, 5E) is lateral swelling rounded, wider than long 0.25 mm (0.24~0.27 mm) × 0.44 mm (0.43~0.45 mm). Area of egg sac attachment (Figs. 4A, 5A, 5E) is located latero-dorsally of genital complex. From the opening protude 3 fine setae, of which the one seta is lengthened. Egg sacs (Fig. 4A) are slightly longer than the urosome. Caudal ramus (Figs. 4A, 5A) is slightly

conical, longer than wide, 0.10 mm (0.09~0.10 mm) × 0.07 mm (0.06~0.07 mm), with 6 setae; one of the setae on each side is very long, slightly longer than the abdomen.

Antennule (Fig. 4B) consists of 3 fused basal segments and a 3-segmented flagellum. The dorsal chitinized plate on each antennule is strongly developed and split into 3 forward directed, finger-shaped processes, of which the median is slightly shorter than the lateral processes and bluntly pointed. These basal segments are armed with 12 plumose setae on the basal portion of anterior margin, 7 short setae and 5 long setae on the rest margin; The setal formula of the 3-segmented flagellum is 4, 2+1 aesthete, and 7+1 aesthete. Antenna (Fig. 4C) is 2-segmented sympod; the first segment is long, subcylindrical, with long slender seta near distal end; the second segment is short. Long first segment of endopod is armed with 9 to 11 rows

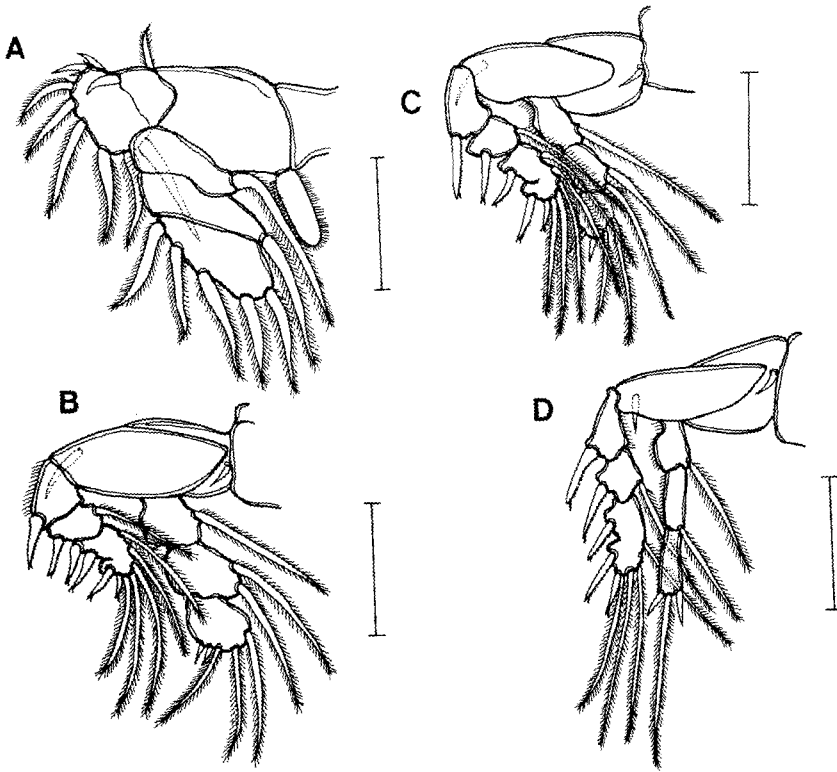


Fig. 6. *Nothobomolochus triceros* (Basset-Smith), female: A, first leg; B, second leg; C, third leg; D, fourth leg. Scale bar: A~D=0.1 mm.

of fine spinules; the tubercle and the lamellar process has a pectinate row of bigger spinules; in addition this segment has 4 hooked spines and 3 setae. Second segment is robust, with 4 to 5 rows of fine spinules continuing over its surface from the first segment.

Mandible (Fig. 4D) is flat, rounded base and cylindrical shaft; large subtriangular process has sharp ventral edge and smaller but similar process. Paragnath (Fig. 4F) is strong, oval base and digitiform process; striated ridge running along two margins of process. Maxillule (Fig. 4E) is small, rounded, with 2 long and 2 shorter setae, all plumose. Maxilla (Fig. 5C) has 2 spiniform processes with serrated margin, one thicker than other; in addition with a small spiniform process near base of thicker process. Maxilliped (Fig. 5B) has 2 strong, plumose setae and a much smaller seta. Claw is strong, curved without auxiliary tooth. The setal and spinal

formulae of the legs (Fig. 6A~D) are as follows:

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

The endopod and exopod of the first leg are strongly flattened; the segments of the exopod almost fused. Both rami of the second to fourth legs consist of 3-segmented. All setae of 4 legs are strongly plumose. The external marginal spines of the exopods of the second to fourth legs are armed with a fine flagellum and a spur, but the internal margin of these spines is smooth.

The fifth leg (Fig. 5D) is armed with a short intermediate segment, bearing a plumose seta; a spatulate distal segment carries 4 appendages; a spini-



form spine is located half-way along the external margin, 2 flagellated spines and a flank longer, plumose seta at the apex.

REMARKS. *Nothobomolochus tricerus* was known as occurred on the gills of *Pampus argenteus* (Euphrasen) and unspecified "white fish". We found this species from *P. argenteus* (Euphrasen) in Yosu Bay, Korea. It is wondered that this species is confined to Pampidae as their host. This species is easily identified by body shape, three modified elements on basal part of the antennule, the structure of the fourth leg endopod and spines on the fifth leg free segment.

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## 한국산 어류에 기생하는 *Nothobomolochus* (Poecilostomatoida, Bomolochidae)속 2종

최상덕 · 홍성윤\* · 서해립\*\*

국립수산진흥원 남해수산연구소 · \*부산수산대학교 해양생물학과

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한국산 어류 2종(농어, 병어)에서 기생성 요각류 2종이 채집되었다. 이 논문에 *Nothobomolochus* (Poecilostomatoida, Bomolochidae)속의 2종, *N. lateolabracis* (Yamaguti and Yamasu)와 *N. triceros* (Basset-Smith)을 재기재한다. 이들은 모두 한국 미기록종이며, *N. lateolabracis*와 *N. triceros*는 각각 농어와 병어에 기생한다.