

Zamoligus cavernularius n. sp. (Copepoda, Poecilostomatoida, Rhynchomolgidae) Associated with a Pennatulacean in the Yellow Sea

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Zamoligus cavernularius n. sp. is described from the pennatulacean cnidarian *Cavernularia obesa* Milne Edwards and Hailme in the Yellow Sea. The new species is readily distinguished from its congeners by the genital double-somite, mandible, female maxilliped, and other structures. This is the first report on association of a member of *Zamoligus* with the pennatulacean and the second report on a copepod from the Korean pennatulacean.

The pennatulaceans have been reported as hosts of some copepods of the families Rhynchomolgidae, Macrochironidae and Lamippidae. In Korea, only a single species, *Critomolgus nudus*, was reported by Kim (2000) as a new species from the pennatulacean *Virgularia gustaviana* (Herklots).

In the present report a new species of the genus *Zamoligus* Humes and Stock, 1972 from a pennatulacean in the Yellow Sea is described. In the recent revision of the lichomolgoid complex, Humes and Boxshall (1996) transferred *Zamoligus* from the Lichomolgidae to the Rhynchomolgidae. Until now, this genus has been consisted of three described species, all from the alcyonaceans in the Indo-West Pacific: *Zamoligus acanthodes* Humes and Stock, 1973 from *Sinularia arborea* Verseveldt, *Z. tridens* Humes and Stock, 1973 from *Cespitularia turgia* Verseveldt, both in Madagascar, and *Z. cracens* Humes and Dojiri, 1979 from *Cespitularia multipinnata* (Quoy and Gaimard) in Banda Islands (Humes, 1990).

The pennatulacean *Cavernularia obesa* Milne Edwards and Hailme from which the new species of *Zamoligus* was discovered is a luminous animal that permits easy discovery at low tide in the night when it comes out of mud and becomes exposed to the air. Examination of washings of these pennatulacean samples yielded a number of copepod material belonging to the genus *Zamoligus*. The present report describes this new species.

Materials and Methods

The pennatulacean hosts were caught on the mud flat at the type locality, collected in a plastic bag, and fixed with 80% ethanol. In the laboratory the fixed penntaul-

aceans were agitated and removed from the plastic bag. The remaining sediment was poured into a wide jar, and the copepod materials were sorted from the sediment.

Before measuring and dissection, the copepod specimens were soaked in lactic acid for at least ten minutes. The dissection was done using the reversed slide method described by Humes and Gooding (1964). In the description the length of body does not include the setae on the caudal rami. In the armature formula of legs 1-4, the Roman numerals represent spines and the Arabic numerals indicate setae. All figures were drawn with the aid of a camera lucida.

Description

Family Rhynchomolgidae
Zamoligus cavernularius n. sp.
(Figs. 1-3)

Material examined: Sixty ♀♀ and 20 ♂♂ discovered from the body surface of the pennatulacean *Cavernularia obesa* Milne Edwards and Hailme, in the intertidal mud flat, at Sapsi-do Island (36° 20' N, 126° 21' E) in the Yellow Sea, collected on 26 October 1999 by the author. Holotype ♀, allotype, and paratypes (50 ♀♀, 15 ♂♂) will be deposited in the U. S. National Museum of Natural History, Smithsonian Institution. Other paratypes (9 ♀♀, 4 ♂♂) are kept in the author's collection.

Female: Body (Fig. 1A) 1.63 mm long. Greatest width 0.90 mm. Prosoma broad, composed of cephalosome and 4 pedigerous somites. Suture line between cephalosome and first pedigerous somites less distinct than posterior suture lines. Urosome (Fig. 1B) 5-segmented. Fifth pedigerous somite 255 µm wide, its lateral margins

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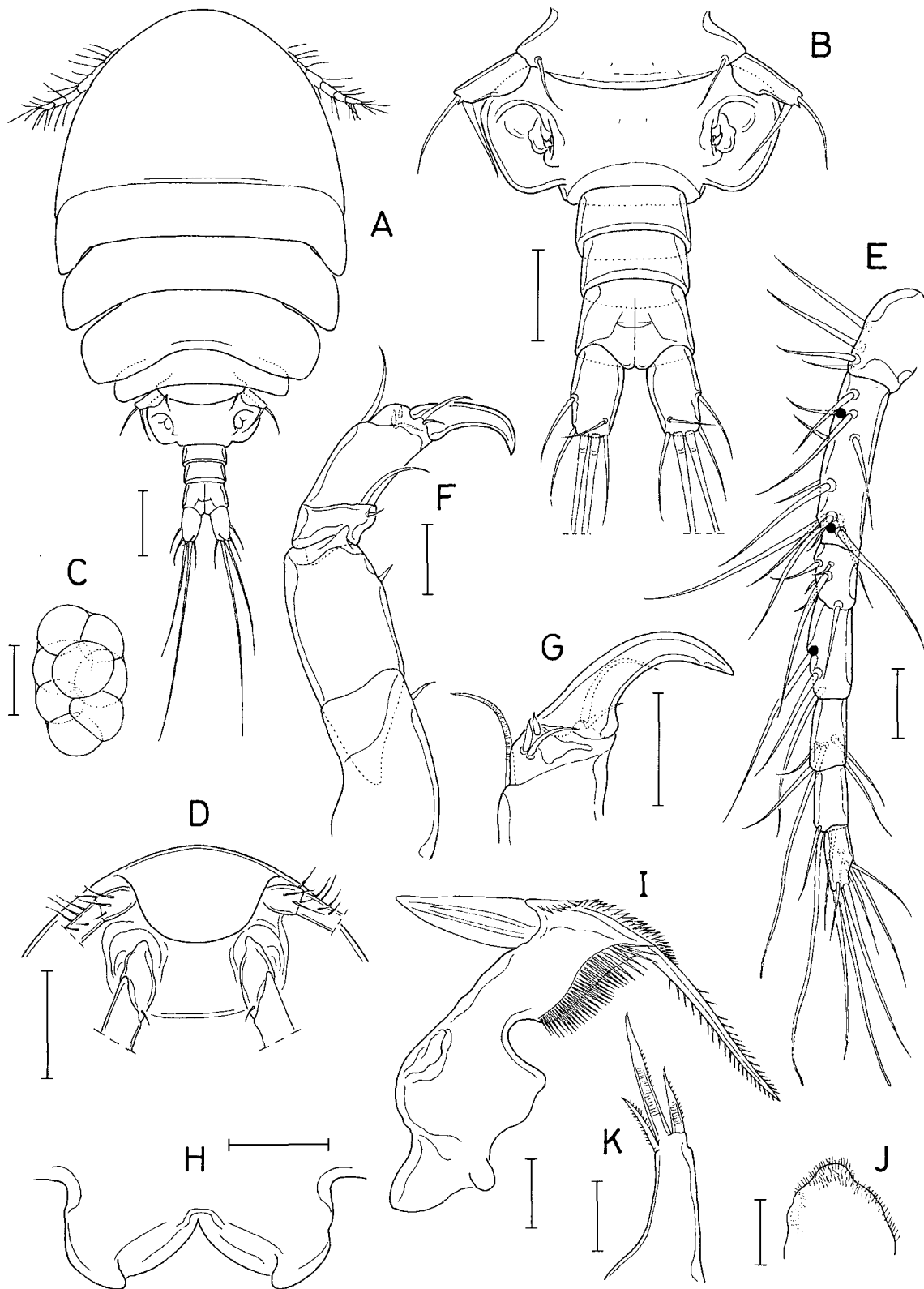


Fig. 1. *Zamolgus cavernularius* n. sp., female. A, Habitus, dorsal; B, Urosome, dorsal; C, Egg sac; D, Rostral area, ventral; E, Antennule (dots indicate insertions of added aesthetascs in male); F, Antenna; G, Terminal part of antenna; H, Labrum; I, Mandible; J, Paragnath; K, Maxillule. Scale bars=0.02 mm (I-K), 0.05 mm (E-H), 0.1 mm (B), and 0.2 mm (A, C, D).

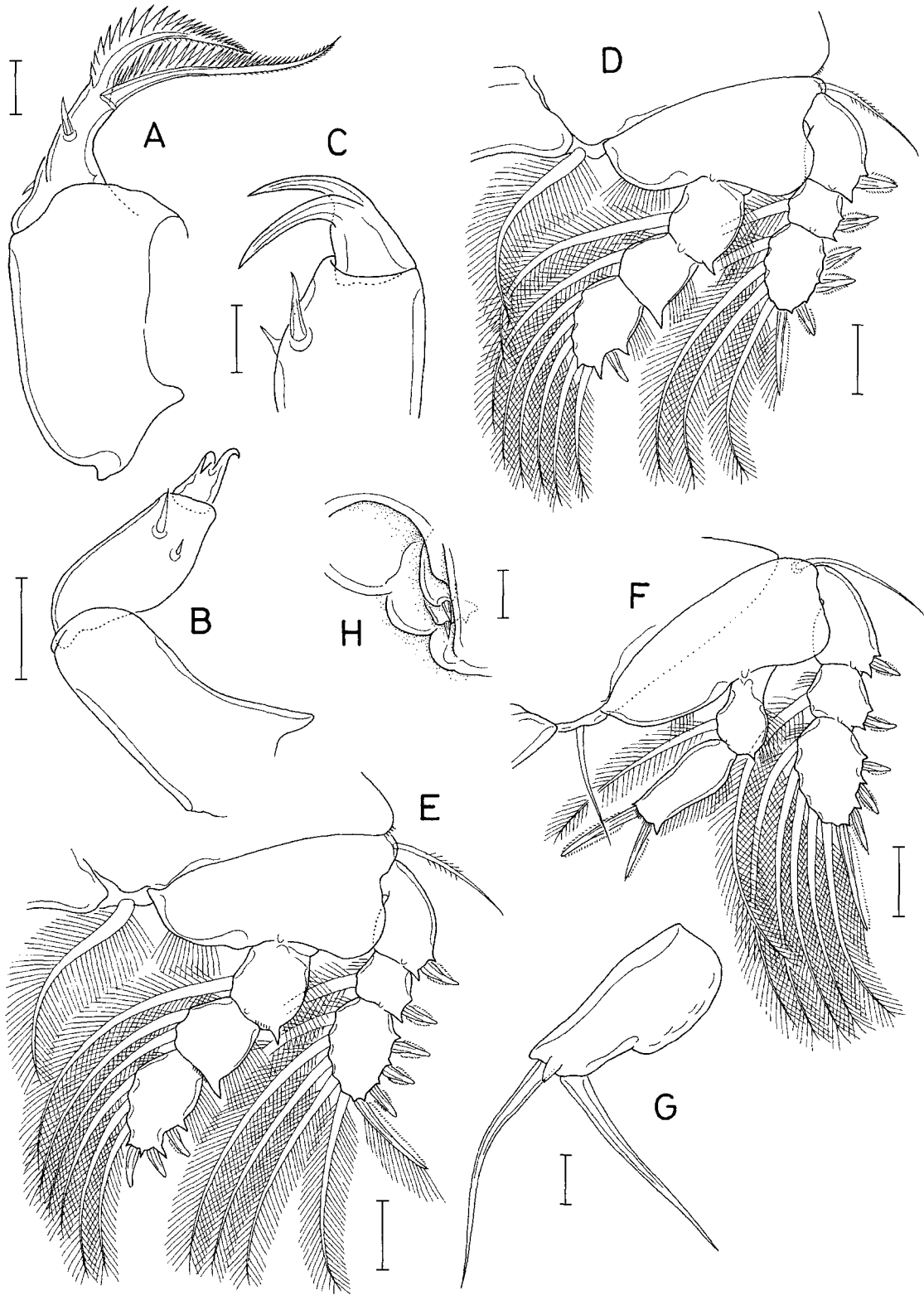


Fig. 2. *Zamoligus cavernularius* n. sp., female. A, Maxilla; B, Maxilliped; C, Terminal part of maxilliped; D, Leg 1; E, Leg 2; F, Leg 4; G, Leg 5; H, Leg 6. Scale bars=0.02 mm (A, C, G, H) and 0.05 mm (B, D-F).

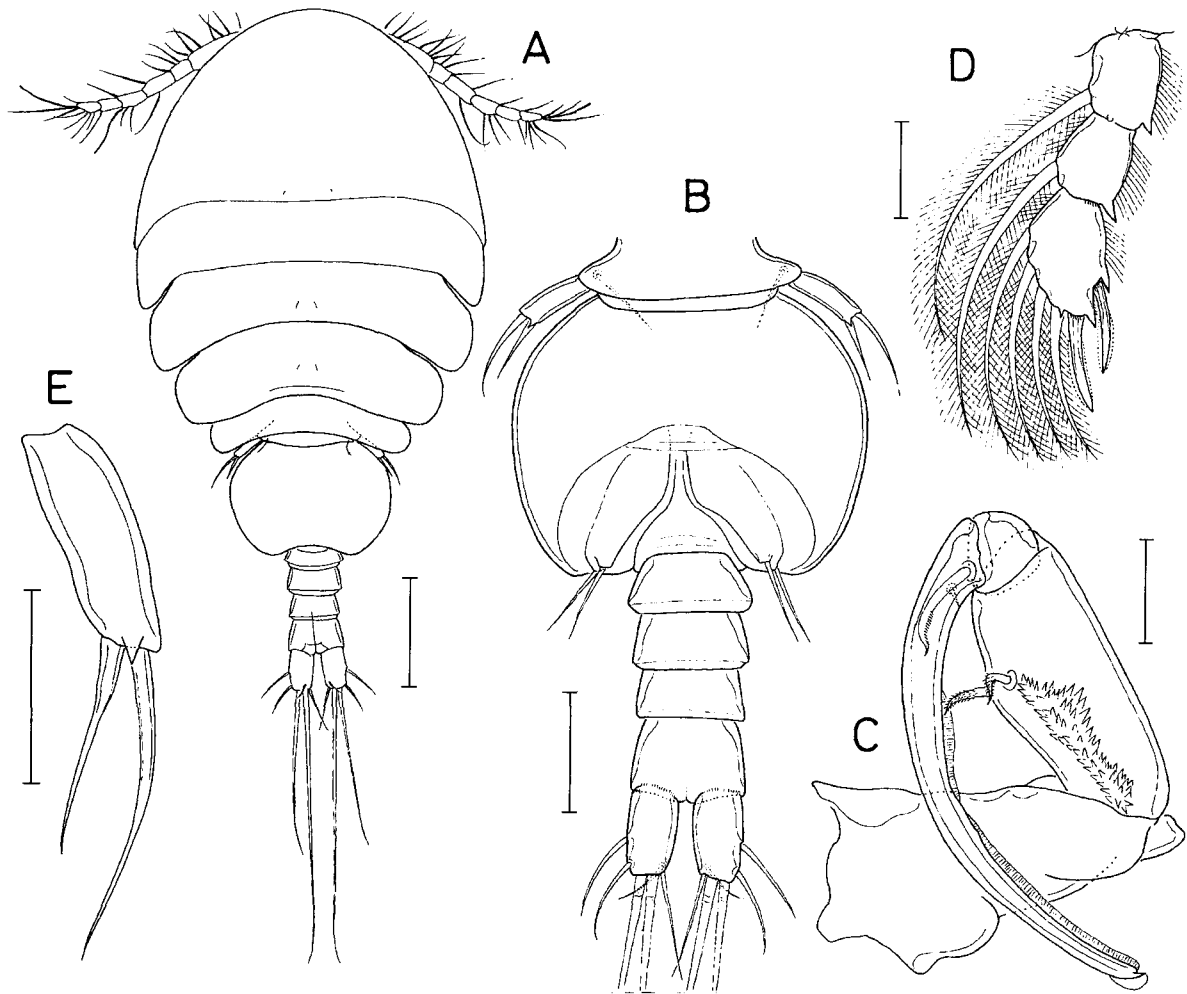


Fig. 3. *Zamolgus cavernularius* n. sp., male. A, Habitus, dorsal; B, Urosome, ventral; C, Maxilliped; D, Leg 1 endopod; E, Leg 5. Scale bars=0.05 mm (C-E), 0.1 mm (B), and 0.2 mm (A).

strongly oblique. Genital double-somite greatly expanded laterally, much wider than fifth pedigerous somite, $153 \times 330 \mu\text{m}$, more than twice wider than long. Genital areas located dorsally. Three abdominal somites 53×128 , 56×119 , and $83 \times 130 \mu\text{m}$, respectively. Caudal ramus $92 \times 56 \mu\text{m}$ (ratio 1.64:1), with 6 naked setae. Egg sac (Fig. 1C) $438 \times 276 \mu\text{m}$, containing about 10 eggs.

Rostrum broad, with round posterior margin (Fig. 1D). Antennule (Fig. 1E) 7-segmented, slender, $440 \mu\text{m}$ long, with armature formula: 4, 13, 6, 3, 4+1 aesthetasc, 2+1 aesthetasc, and 7+1 aesthetasc. All setae naked. All aesthetacs slender, with thin distal portion. Antenna (Fig. 1F) 4-segmented, with armature formula 1, 1, 2, and 6+1 claw. Setae on first and second segments small. Terminal segment about twice as long as wide. Two of 6 setae on terminal segment very small (Fig. 1G). Terminal claw massive, bent at distal third.

Labrum (Fig. 1H) bilobed. Each lobe with blunt process directed obliquely medially. Mandible (Fig. 1I) with

distinct proximal notch and long inner margin armed with spinules. Convex margin with remarkably large, tapering hyaline process. This process longer than width of mandible. Terminal lash long and slender, with spinules on margins. Paragnath (Fig. 1J) a lobe covered with minute setules. Maxillule (Fig. 1K) with 3 terminal setae, middle one of which being distinctly larger. Maxilla (Fig. 2A) 2-segmented. First segment unarmed. Second segment with small proximal anterior setae. Inner seta large, longer than terminal lash, spinulated along outer margin. Terminal lash evenly curved, with dentate outer margin. Maxilliped (Fig. 2B) 3-segmented. First segment the longest and unarmed. Second segment with 2 unequal setae on inner surface. Terminal segment without seta, characteristically bifurcated distally to 2 subequal claws (Fig. 2C).

Leg 1 (Fig. 2D), leg 2 (Fig. 2E) and leg 3 with 3-segmented rami. Leg 4 (Fig. 2F) with 3-segmented exopod and 2-segmented endopod. Armature formula of legs 1-4 as follows:

Leg 1: coxa 0-1; basis 1-0; exp I-0; I-1; III, I, 4
 enp 0-1; 0-1; I, 5
 Legs 2 & 3: coxa 0-1; basis 1-0; exp I-0; I-1; III, I, 5
 enp 0-1; 0-2; III, 3
 Leg 4: coxa 0-1; basis 1-0; exp I-0; I-1; III, I, 5
 enp 0-1; II

Distal segment of leg 4 endopod $81 \times 45 \mu\text{m}$.

Basal segment of leg 5 incorporated to somite, leaving only 1 dorsal seta. Free segment (Fig. 2G) $90 \mu\text{m}$ long, with expanded proximal half of inner margin, narrower distal half, and terminally 1 pointed process and 2 long spiniform setae. Outer seta $107 \mu\text{m}$, and inner seta $99 \mu\text{m}$. Leg 6 (Fig. 2H) represented by 2 spinules in genital area.

Male: Body (Fig. 3A) similar to that of female. Length $1.25 \mu\text{m}$. Urosome (Fig. 3B) 6-segmented. Fifth pedigerous somite $185 \mu\text{m}$ wide. Genital somite nearly circular, $237 \times 297 \mu\text{m}$. Four abdominal somites 50×105 , 48×97 , 40×90 , and $65 \times 95 \mu\text{m}$, respectively. Caudal ramus $73 \times 41 \mu\text{m}$ (ratio 1.78 : 1).

Rostrum as in female. Antennule added by 3 aesthetascs: 2 on second and 1 on fourth segments. Antenna with minute spinules on inner margin of second segment, otherwise as in female.

Labrum, mandible, paragnath, maxillule and maxilla as in female. Maxilliped (Fig. 3C) 4-segmented. First segment unarmed. Second segment with 2 identical setae on inner surface and about 3 rows of denticles on surface proximal to setae. Third segment short and unarmed. Terminal segment being a long, slender, evenly curved claw armed basally 2 extremely unequal setae, each on respective side.

Terminal endopod segment of leg 1 with 2 spines and 4 setae (II, 4), as seen in Fig. 3D. Legs 2-4 as in female. Free segment of leg 5 (Fig. 3E) $63 \times 22 \mu\text{m}$ (ratio 2.86 : 1). Inner and outer margins nearly parallel. Two terminal setae $85 \mu\text{m}$ (outer) and $58 \mu\text{m}$ (inner), respectively. Leg 6 represented by 2 setae on genital flap (Fig. 3B).

Etymology: The specific name *cavernularius* is derived from the generic name of the host pennatulacean, *Cavernularia obesa*.

Remarks: The outstanding features of *Zamolgus cavernularius* n. sp. are the possession of the two large, claw-like terminal processes of the female maxilliped and the laterally strongly expanded female genital double-somite. It can be distinguished further from its three congeners' features not applicable to the new species as follows.

Zamolgus acanthodes Humes and Stock, 1973 has three spines and five setae (III, I, 5) on the third exopod segment of leg 4, smaller body (1.02 mm in female, and 0.76 mm in male), shorter caudal rami (ratio 0.87), and longer female leg 5 (ratio about 4.5 : 1).

Zamolgus cracens Humes and Dojiri, 1979 has narrower female genital double-somite which is longer than wide, narrow rostrum, shorter but broad process on the convex margin of the mandible, four element on the maxillule, the longer female leg 5 (ratio 5.0 : 1), and shorter inner seta (shorter than the terminal lash) on the distal segment of the maxilla.

Zamolgus tridens Humes and Stock, 1973 has smaller body (1.01 mm in female, and 0.85 mm in male), narrower female genital double-somite which is longer than wide, narrower digitiform process on the convex margin of the mandible, four elements on the maxillule, and shorter inner seta on the distal segment of the maxilla (shorter than terminal the lash).

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