Zoological Studies **50**(5): 605-610 (2011)

Zoological Studies

A New Siphonostomatoid Copepod Associated with the Ahermatypic coral *Tubastraea aurea* from Taiwan

Yu-Rong Cheng[1], Chang-Feng Dai[1], and Wen-Been Chang[2,3,*]

[1]*Institute of Oceanography, National Taiwan Univ., 1 Roosevelt Road, Section 4, Taipei 106, Taiwan*

[2]*National Museum of Marine Biology and Aquarium, 2 Houwan Road, Checheng, Pingtung 944, Taiwan*

[3]*Institute of Marine Biodiversity and Evolution, National Dong Hwa University, 1 Da Hsueh Road, Section 2, Shou-Feng, Hualien 974, Taiwan*

(Accepted April 14, 2011)

Yu-Rong Cheng, Chang-Feng Dai, and Wen-Been Chang (2011) A new siphonostomatoid copepod associated with the ahermatypic coral *Tubastraea aurea* from Taiwan. *Zoological Studies* **50**(5): 605-610. A new species of siphonostomatoid copepod *Cholomyzon tubastraeae* sp. nov. is described. It was found from an ahermatypic coral *Tubastraea aurea* (Quoy and Gaimard, 1833), collected from shallow-water reefs in northern and southern Taiwan. The new species can easily be distinguished from its 2 congeners, *Cho. palpiferum* Stock and Humes, 1969 and *Cho. brevisetigerum* Humes, 1997, by the endopod of leg 3 and the armature formula as 0-1; 0-1; I-2. http://zoolstud.sinica.edu.tw/Journals/50.5/605.pdf

Key words: Siphonostomatoid, Associated copepod, Scleractinian coral.

Copepods are a major group of associates and even parasites of a wide variety of scleractinian corals (Humes 1985). So far, at least 8 species of copepods were reported occurring in symbiosis with corals of the family Dendrophylliidae (including the genera *Dendrophyllia*, *Tubastraea*, and *Tubinaria*). They are *Xarifia hamata* Humes and Ho, 1968 from *Turbinaria* sp.; *Cholomyzon palpiferum* Stock and Humes, 1969 from *Tubastraea micracantha* (Ehrenberg 1834) and *Dendrophyllia nigrescens* Dana, 1846; *X. lacerans* Humes, 1985 and *X. uncinata* Humes, 1985 from *Tur. danae* Bernard, 1897; *X. insolita* Cheng et al., 2007 from *Tub. aurea* (Quoy and Gaimard 1833); *Coralliomyzon tenens* Humes and Stock, 1991 from *Tur. peltata* (Esper 1794); *Cor. latitergum* Humes, 1997 from *Tur. peltata*; and *Cho. brevisetigerum* Humes, 1997 from *Tub. micracantha* (Ehrenberg 1834).

Siphonostomatoid copepods belonging to the family Asterocheridae are frequently associated with shallow-water scleractinian corals (Stock 1987 1988). We report a new species of siphonostomatoid copepod associated with *Tub. aurea* from shallow reefs in northern and southern Taiwan.

MATERIALS AND METHODS

Fragments of a scleractinian coral were collected by scuba diving, placed in a bag while in the water, and transported to the laboratory for examination of copepod parasites. To collect the parasitic copepods, the coral together with the seawater in the bag was emptied into a bucket to which sufficient 95% ethyl alcohol was added to make an approximately 5% solution. The coral remained in this solution at ambient temperature for several hours. Then the coral was thoroughly rinsed by shaking well, and the wash water was

*To whom correspondence and reprint requests should be addressed. E-mail:wenbeen@nmmba.gov.tw

poured through a fine net (with a mesh size of approximately 100 μm). Copepods were picked from the sediment retained in the net and preserved in 70% ethanol (Humes and Dojiri 1982). They were later cleared in 85% lactic acid for 1-2 h and dissected on a wooden slide under a dissecting microscope (Humes and Gooding 1964). The removed body parts and appendages were examined under a compound microscope at magnifications of up to 1000×. All drawings were made with the aid of a drawing tube.

RESULTS

Siphonostomatoida Thorell, 1859
Coralliomyzontidae Humes and Stock, 1991
Cholomyzon Stock and Humes, 1969
Cholomyzon tubastraeae sp. nov.
(Figs. 1-3)

Material examined: All specimens were collected from the scleractinian coral *Tub. aurea* (Quoy and Gaimard, 1833) off Taiwan. Ten ♀♀ and 8 ♂♂ obtained from a coral colony collected

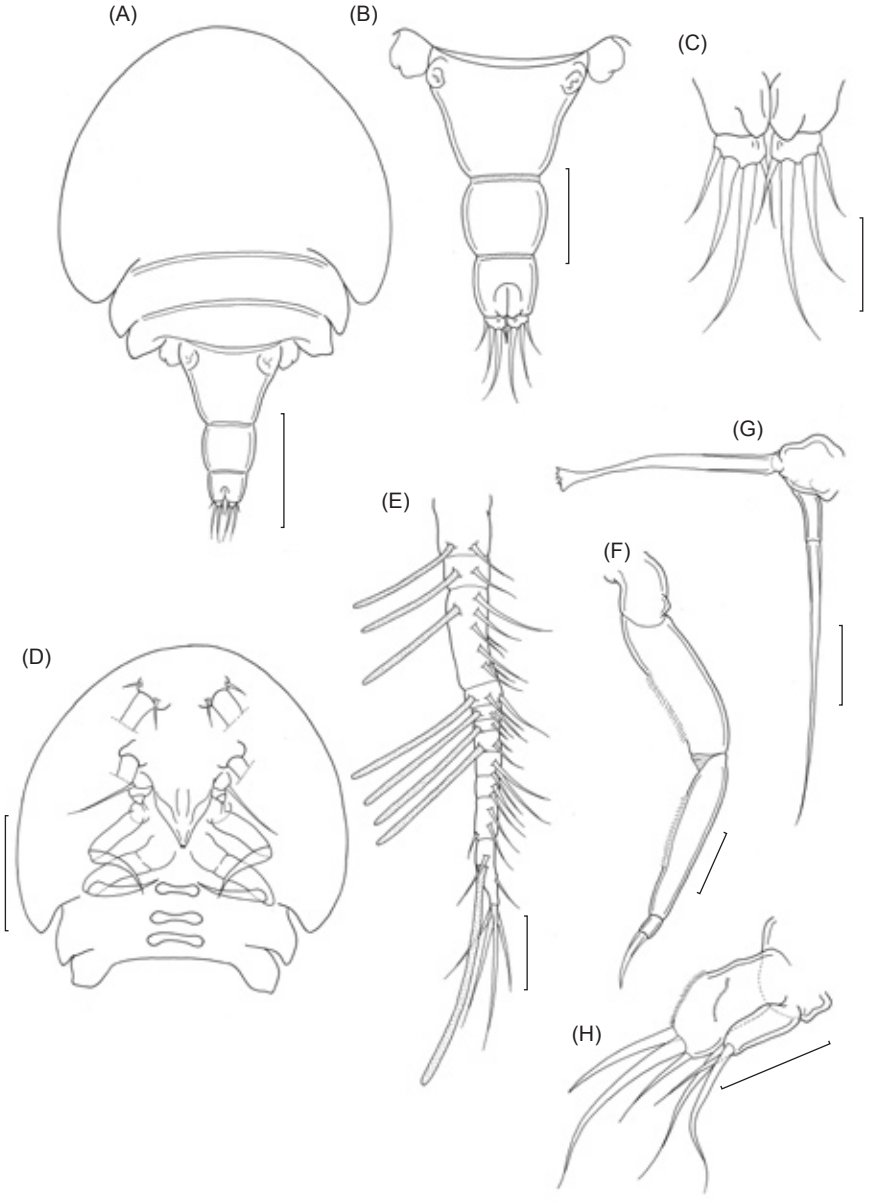

Fig. 1. *Cholomyzon tubastraeae* sp. nov., female. (A) Dorsal; (B) urosome; (C) caudal ramus; (D) cephalosome; (E) antennule; (F) antenna; (G) mandible; (H) maxillule. Scale bars: A, D = 0.2 mm; B = 0.1 mm; C, E, F, G, and H = 0.04 mm.

at 2 m in depth, at Yaliu on 21 July 2006; 5 ♀♀ and 20 ♂♂ from a coral colony taken at 3 m in depth, at Houbihu on 16 Aug. 2006; 12 ♀♀ and 15 ♂♂ from a coral colony taken at 5 m in depth, at Tiao-shi on 25 Nov. 2006; and 2 ♀♀ and 5 ♂♂ from a coral colony taken at 2 m in depth, at Yaliu on 10 May 2007. Holotype (NTUIO-COPEPOD 0010), allotype (NTUIO-COPEPOD 0011), and paratypes (NTUIO-COPEPOD s0002) deposited in the Institute of Oceanography, National Taiwan Univ., Taipei, Taiwan.

Female (Figs. 1, 2): Body (Fig. 1A) with broad flattened prosome. Mean length (10 specimens measured) 0.82 (0.78-0.87) mm (without furcal setae) and greatest width 0.58 (0.56-0.61) mm (based on cephalosome). Prosome comprising cephalothorax, incorporating 1st pedigerous somite and 3 free pedigerous somites, but 4th pedigerous somites very small, nearly entirely covered by tergum of preceding somite. Urosome (Fig. 1B) 4-segmented, length from anterior to posterior 264 μm; genital areas located anteriorly and dorsolaterally. Caudal ramus (Fig. 1C) very small, wider than long; bearing 2 min setae on proximal

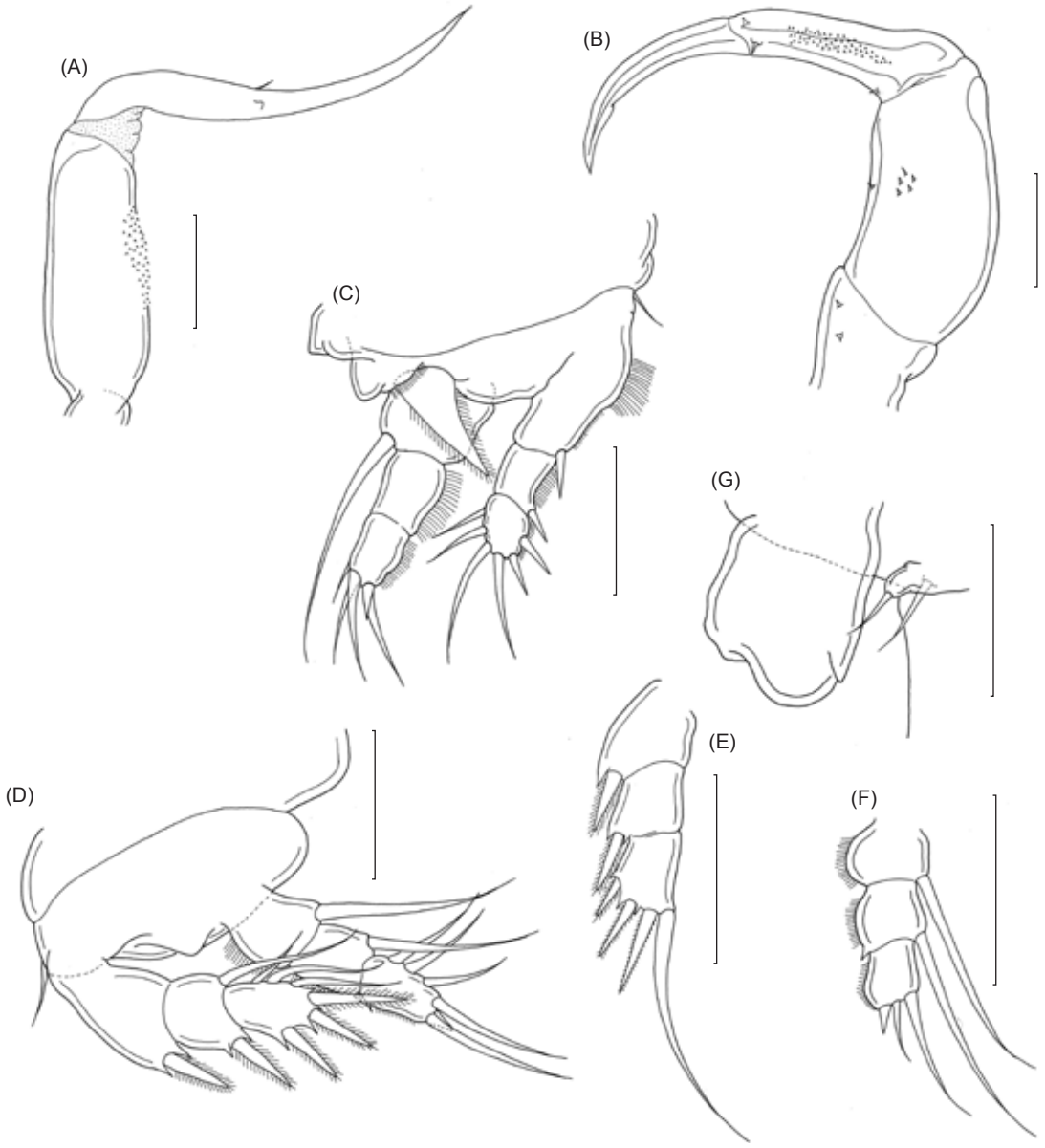

Fig. 2. *Cholomyzon tubastraeae* sp. nov., female. (A) Maxilla; (B) maxilliped; (C) leg 1; (D) leg 2; (E) exopod of leg 3; (F) endopod of leg 3; (G) leg 5. Scale bars: A-G = 0.04 mm.

inner dorsal surface and 4 smooth terminal setae.

Rostral area not developed (Fig. 1D).

Antennule (Fig. 1E) 11-segmented; armature formula: 1+1 aesthete, 1+1 aesthete, 7+1 aesthete, 2+1 aesthete, 2+1 aesthete, 1+1 aesthete, 2+1 aesthete, 3, 2, 3, 6+1 aesthete. Antenna (Fig. 1F) slender, 4-segmented, 2nd and 3rd segments with row of small spinules along outer margin. Oral cone (Fig. 1D) short, triangular. Mandible (Fig. 1G) with slender blade having few very small spinules at tip; palp 1-segmented with 1 long, smooth seta. Maxillule (Fig. 1H) with a small outer lobe and larger inner lobe with row of small spinules along outer and anterior margins, both bearing 3 terminal setae. Basal segment of maxilla (Fig. 2A) with row of small spinules along outer margin and a regularly curved claw. Maxilliped (Fig. 2B) consisting of 3 segments and a claw; each segment bearing many small spinules.

Legs 1-3 (Fig. 2C-F) biramous with 3-segmented rami. Leg 4 absent. Formula of spines (in Roman numerals) and setae (in Arabic numerals) shown in table.

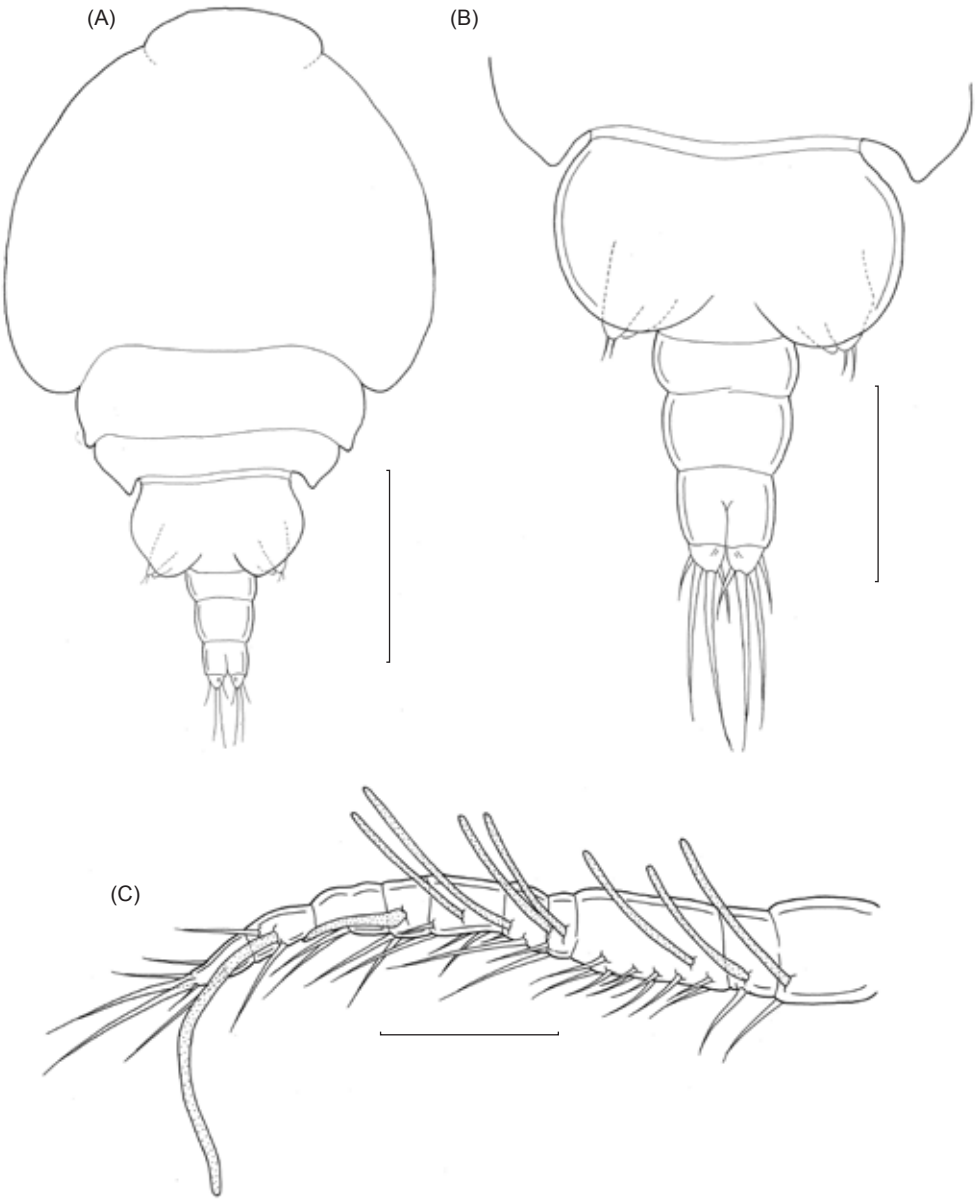

Fig. 3. *Cholomyzon tubastraeae* sp. nov., male. (A) Dorsal; (B) urosome; (C) antennule. Scale bars: A = 0.2 mm; B = 0.1 mm; C = 0.05 mm.

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-I	I-0; I-0; II+4	0-1; 0-0; I-4
Leg 2	0-0	1-0	I-0; I-1; III+3	0-1; 0-1; I-5
Leg 3	0-0	1-0	I-0; I-0; III+1	0-1; 0-1; I+2

Leg 5 (Fig. 2G) reduced to a minute process bearing a terminal seta and an adjacent dorsal seta.

Male (Fig. 3): Body (Fig. 3A) resembling that of female but smaller. Mean length (10 specimens measured) 0.68 (0.65-0.72) mm and greatest width 0.44 (0.42-0.46) mm. Urosome (Fig. 3B) 5-segmented, length from anterior to posterior 201 μm. Antennule 10-segmented; each of 1st 7 segments with long aesthetasc, and 1 aesthetasc on penultimate segment; armature formula: 1+1 aesthete, 1+1 aesthete, 10+1 aesthete, 2+2 aesthete, 2+1 aesthete, 4+1 aesthete, 2+1 aesthete, 2, 2+1 aesthete, and 6. Antenna, oral cone, mandible, maxillule, maxilla, and maxilliped generally like those of female. Legs 1-3 constructed as in female. Leg 4 absent. Leg 5 as in female but much smaller. Posteroventral flap of leg 6 on genital somite bearing 2 setae (Fig. 3A, B).

Etymology: The specific name is derived from the generic name of the scleractinian host, *Tubastraea*.

DISCUSSION

The family, Coralliomyzontidae Humes and Stock, 1991, includes 4 genera: *Cholomyzon* Stock and Humes, 1969; *Coralliomyzon* Humes and Stock, 1991; *Temanus* Humes, 1997; and *Tondua* Humes, 1997. Since 1969, only 2 copepod species were reported in the genus *Cholomyzon* Stock and Humes, 1969: *Cho. palpiferum* Stock and Humes, 1969 discovered from the ahermatypic corals, *Tubastraea micracantha* (Ehrenberg, 1834) and *Dendrophyllia nigrescens* Dana, 1846 in Madagascar; and *Cho. brevisetigerum* Humes, 1997 found from *Tub. micracantha* in the Moluccas. The new species, *Cho. tubastraeae* sp. nov., can easily be distinguished from its 2 congeners by the armature formula of the endopod of leg 3 (0-1; 0-1; I-2). Moreover, all differences from its 2 congeners are summarized in table 1.

Humes and Stock (1991) established the family Coralliomyzontidae to accommodate the genera *Cholomyzon* and *Coralliomyzon* from the Asterocheridae for the following reasons: (1) the claw-like distal portion of maxilliped consisting of 2 segments; (2) antenna without an exopodite; (3) the absence of inner setae on the 1st and 2nd segment of the exopodite of leg 1; (4) the reduction or absence of leg 4; and (5) leg 5 lacking a free segment and represented by a

Table 1. Differences among the 3 species of *Cholomyzon* Stock and Humes, 1969

	Cho. palpiferum	*Cho. brevisetigerum*	*Cho. tubastraeae* sp. nov.
Antennule (female)	I+1; I+1; I+11; I+4; I+2+1 spinule; I+1 spinule; I+4; 2; 2; 3; I+7	I+1; I+1; I+7; I+2; I+2; I+1; I+5; 2; 3; I+2; 4	I+1; I+1; I+7; I+2; I+2; I+1; I+2; 3; 2; 3; I+6
Antennule (male)[a]	11-segmented	10-segmented	10-segmented
Antenna	2nd segments without row of small spinules	2nd segments without row of small spinules	2nd segments with row of small spinules
Caudal ramus	Long than wider; tipped with long setae	Wider than long; tipped with short setae	Wider than long; tipped with short setae
Maxillule	Outer lobe with 4 setae	Outer lobe with 3 setae	Outer lobe with 3 setae
Maxilliped	3rd segment with 2 spines	3rd segment with no spines or spinules	3rd segment with 2 tubercles and many small spinules
Leg 1[a]	Exp: I-0; I-0; II-4	Exp: I-0; I-0; III-3	Exp: I-0; I-0; II-4
	Enp: 0-1; 0-0; 0-4	Enp: 0-1; 0-1; I-5	Enp: 0-1; 0-0; I-4
Leg 2	Exp: I-1; I-1; III-3	Exp: I-0; I-1; III-3	Exp: I-0; I-1; III-3
	Enp: 0-1; 0-1; 1-5	Enp: 0-1; 0-1; I-5	Enp: 0-1; 0-1; I-5
Leg 3	Exp: I-0; I-1; III-1	Exp: I-0; I-1; III-1	Exp: I-0; I-0; III-1
	Enp: 0-1; 0-1; 3	Enp: 0-1; 0-1; 3	Enp: 0-1; 0-1; I-2
Leg 4	A thumb-shaped segment with 2 setae	absent	absent

[a]Roman numerals (I) refer to spines in legs 1-4 and aesthetasc in antennule. Exp, exopod; Enp, endopod.

minute protuberance bearing 2 setules. However, Boxshall and Halsey (2004) suggested the distinguishing characters listed above are all highly apomorphic, so that the reasons for establishing the Coralliomyzontidae were not justified, and species of the Coralliomyzontidae should be regarded as specialized terminal branches within the Asterocheridae. Nevertheless, they also pointed out that the antennule (with 8 aesthetascs) of both sexes of *Cho. palpiferum* Stock and Humes, 1969 may be an important plesiomorphy that indicates early separation of this lineage from the Asterocheridae. We also suggest that the 4 genera previously placed in the Coralliomyzontidae (*Coralliomyzon*, *Cholomyzon*, *Temanus*, and *Tondua*) be reconsidered as members of the family Asterocheridae, but more-powerful evidence such as molecular phylogenetic data and a comprehensive revision of morphological characters would be necessary for this.

Acknowledgments: We are especially grateful to Dr. J.s. Ho for his guidance identifying the copepods. We are also grateful to S.Y. Liu, M.J. Ho, A. Cheng, S. Horng, T.M. Lu, C.H. Huang, and Y.C. Lin for their assistance in the field. This study was partially supported by a grant from the National Science Council (NSC98-2611-M-002-001-MY3) and the Fisheries Agency, Council of Agriculture, Taipei, Taiwan.

REFERENCES

Boxshall GA, SH Halsey. 2004. An introduction to copepod diversity. London: Ray Society, 966 pp.

Humes AG. 1985. Cnidarians and copepods: a success story. Trans. Am. Microsc. Soc. **104:** 313-320.

Humes AG, M Dojiri. 1982. Xarifiidae (Copepoda) parasitic in Indo-Pacific scleractinian corals. Beaufortia **32:** 139-228.

Humes AG, RU Gooding. 1964. A method for studying the external anatomy of copepods. Crustaceana **6:** 238-240.

Humes AG, JH Stock. 1991. Coralliomyzontidae, fam. n. (Copepoda: Siphonostomatoida), associated with scleractinian corals in Madagascar. Bull. Zool. Mus. Univ. Amsterdam **13:** 17-24.

Stock JH. 1987. Copepoda Siphonostomatoida associated with West Indian hermatypic corals I: Associates of Scleractinia: Faviinae. Bull. Mar. Sci. **40:** 464-483.

Stock JH. 1988. Copepods associated with reef corals: a comparison between the Atlantic and the Pacific. Hydrobiologia: **167/168:** 545-547.