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A new species of *Cymbasoma* Thompson, 1888 (Copepoda: Monstrilloida) from the Fujian coast, China*

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Abstract A new monstrilloid copepod species, *Cymbasoma cheni* sp. nov., from Meizhou Bay (an embayment in Fujian Province, southeastern China) is described and illustrated. The diagnostic character of the new species is the structure and armature of the fifth leg, which is represented by a single lobe armed with three naked setae subequal in length. The new species closely resembles *Cymbasoma bowmani* Suárez-Morales and Gasca, 1998 in the structure of the fifth legs, and the body proportions, including total body length, and relative lengths of the cephalothorax and the genital double somite. However, *Cymbasoma cheni* sp. nov. is distinguished by lack of cuticular ornamentation on the cephalothorax, the position of the oral papilla, and the structure of the fifth leg with three naked setae. Although the structure of the fifth legs is similar in *Cymbasoma cheni* sp. nov. and *Cymbasoma quintanarooense* (Suárez-Morales, 1994), the new species can be easily distinguished from *Cymbasoma quintanarooense* by the relative length of the antennule, differences in the genital double-somite and the ovigerous spines, and the shape of ocelli. This is the sixth record of this genus from China seas.

Keyword: copepoda; Monstrilloida; *Cymbasoma*; new species; Fujian Coast

1 INTRODUCTION

The order Monstrilloida Sars, 1901 represents one of the most intriguing taxa among the copepoda (Suárez-Morales, 2011). During preadult stages, they parasitized on marine benthic polychaetes and molluscs (Isaac, 1975; Davis, 1984). Adults are planktonic and usually found in coastal zooplankton samples. Monstrilloid copepods appear to be the most diverse in coral reef areas (Sale et al., 1976; Suárez-Morales, 2000, 2011; Suárez-Morales et al., 2017). The current taxonomy, morphology, and relevance of this group of copepods were summarized by Suárez-Morales (2011). The order is currently represented by more than 166 accepted species contained in six valid genera: *Monstrilla* Dana, 1849; *Cymbasoma* Thompson I.C., 1888; *Monstrillopsis* Sars G.O., 1921; *Maemonstrilla* Grygier and Ohtsuka, 2008; *Australomonstrillopsis* Suárez-Morales and McKinnon, 2014; *Caromiobenella* Jeon et al., 2018 (Huys and Boxshall, 1991; Grygier, 1993; Suárez-Morales and Escamilla, 2001; Grygier and Ohtsuka, 2008; Suárez-Morales and Mckinnon, 2014; Jeon et al., 2018; Walter and Boxshall, 2018a). Their taxonomy and diversity is still being explored in different regions of the world, including some previously poorly known geographic areas, such as Australia (Suárez-Morales and Mckinnon, 2014, 2016; Suárez-Morales et al., 2017) and the Korean Sea (Chang, 2012, 2014; Lee and Chang, 2016; Lee et al., 2016; Jeon et al., 2018). In China, there are only two genera, and 16 nominal species with distributions in the East and South China Seas (Chen and Huang, 2008; Chen and Li, 2008).

Cymbasoma is a diverse genus with more than 90 nominal species (Walter and Boxshall, 2018b); they

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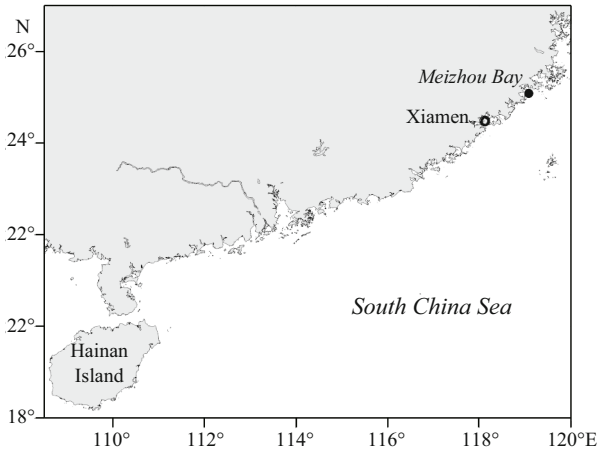


Fig.1 Map of the sampling sites of *Cymbasoma cheni* sp. nov. in Meizhou Bay, Fujian, South China

are distributed worldwide (Suárez-Morales, 2011). Most of these species are reported from the eastern Atlantic, Australian waters, and the Korea seas (Razouls, 1996; Chang, 2012; Suárez-Morales and Mckinnon, 2016; Suárez-Morales et al., 2017). Studies on the taxonomy of the genus *Cymbasoma* are rare in China, and there have been only five records of this genus in China seas (Chen and Huang, 2012; Chen and Li, 2008). Recently, we re-examined samples of zooplankton deposited in the South China Sea marine biodiversity collections, Chinese Academy of Sciences. In one of these samples, an adult female specimen of a previously undescribed *Cymbasoma* species was found; it is described as a new species of *Cymbasoma* below.

2 MATERIAL AND METHOD

Zooplankton was collected in Meizhou Bay (25.09°N, 119.08°E) on 10 December 2008 by vertical tow net (0.505-mm mesh, 0.8-m diameter at pulling speed of 0.5 m/s) (Fig.1). The biological material was preserved immediately in 5% formaldehyde. Observation and measurements were carried out under a microscope (Leica M205 C, manufacturer: Leica, Country: Germany), and drawings were made with the aid of a camera lucida (Leica MC 190HD). Standard terminology for copepod morphology follows Huys and Boxshall (1991). The monstrilloid antennulary armature is described on Grygier and Ohtsuka (1995). The type specimen has been deposited in the South China Sea marine biodiversity collections, Chinese Academy of Sciences.

3 SYSTEMATICS

Class MAXILLOPODA Dahl, 1956

Subclass COPEPODA H. Milne Edwards, 1840

Order MONSTRILLOIDA G. O. Sars, 1901

Family Monstrillidae Dana, 1849

Genus *Cymbasoma* Thompson I.C., 1888

Cymbasoma cheni sp. nov.

(Figs.2–3)

Holotype: Unique specimen, an adult female from Meizhou Bay, undissected, formaldehyde-preserved. Date of collection: 10 December 2008. Vial deposited in the South China Sea marine biodiversity collections (SCSMBC), Chinese Academy of Sciences (SCSMBC048020).

Type locality: Meizhou Bay (25.09°N, 119.08°E), Fujian Province, China; salinity 32.73, temperature 25.8°C, depth of water 16 m, the vertical haul from 15 to 0 m, with 0.505 mm mesh net.

Etymology: This species is named in honor of CHEN Qingchao, a marine biologist with the South China Sea Institute of Oceanology, Chinese Academy of Sciences.

Description: Adult female. Total body length of holotype 1.90 mm measured from anterior end of cephalic somite to posterior margin of abdominal somite (Fig.2A, B, C). Cephalothorax relatively long, accounting for 66% of whole body length (Fig.2a). Anterior part of the surface of the cephalic segment nearly smooth. Forehead medially flat in dorsal view (Fig.2b). Oral papilla lying midventrally 0.28 mm of the way back along cephalothorax (Fig.2c). Pair of relatively large ocelli present, rounded, pigment cups moderately developed, medially conjoined, intensely pigmented at inner margins only (Fig.2a). No cuticular ornamentation observed on the remaining surface of the cephalothorax (Fig.2a).

Antennule relatively long, measuring 0.33 mm, about 26.3% of the cephalothorax, and about 17.3% of total body length (Fig.3a, b). Antennule four-segmented, length ratio of antennule segments, from basal to distal one: 11.4:18.2:20.5:49.9 (=100), armed with 1, 0; 1, I; 1, I; 4, III, setae (Roman numerals) and spines (Arabic numerals) (Fig.3b). Armature: element 1 present on segment 1:1d_1; segment 2 with 2d_1 and IId. Segment 3 with elements 3: 3d_1 and IIId. Segment 4 bearing element 4d_1, 4$v_{1–3}$ and IV$d_{1–3}$. Element 5 absent. Last segment with one small aesthetasc on distal margin. 6_1 and 6_2 present (Fig.3b).

Cephalothorax incorporating first thoracic pedigerous somite. First thoracic pedigerous somite and three free succeeding pedigerous somites each bearing pair of well-developed legs (Fig.3d, e), with endopodites and exopodites three segmented. Size of

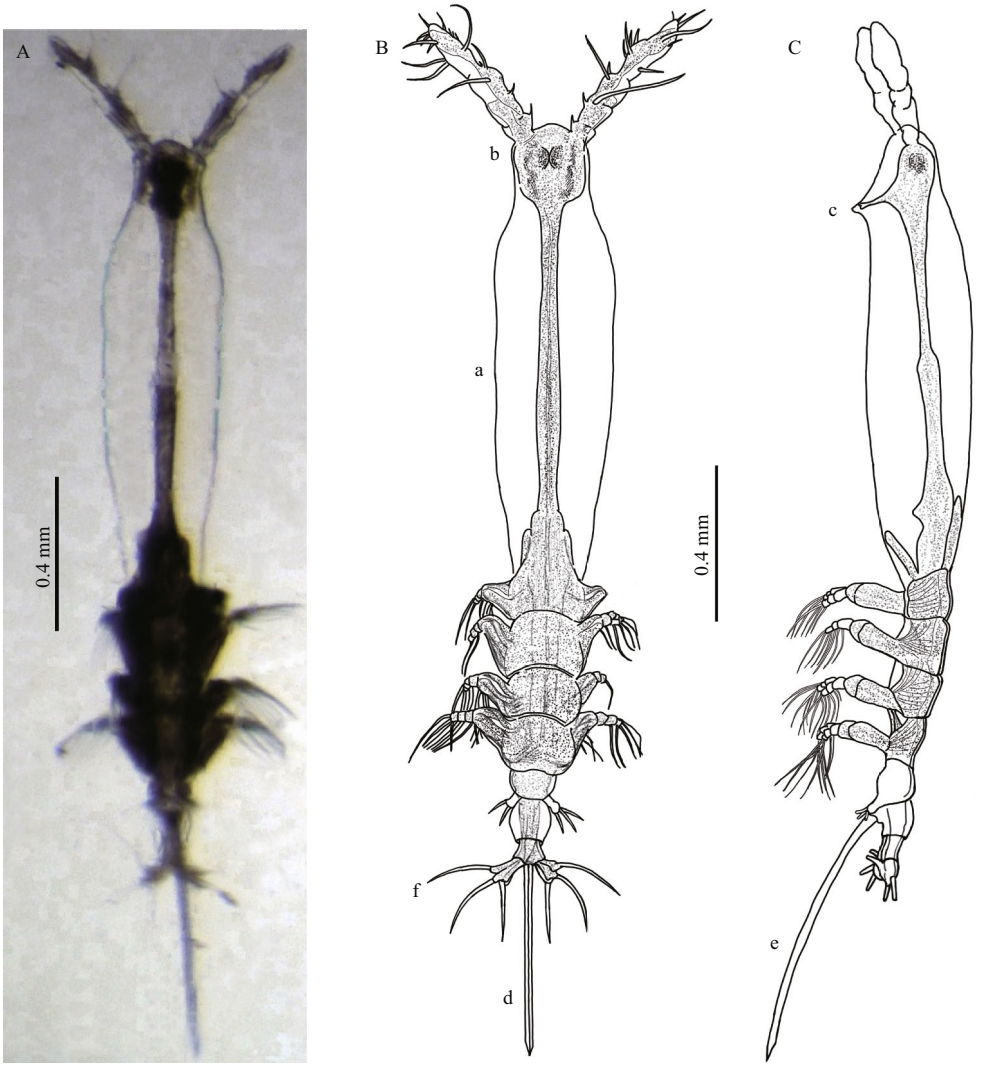


Fig.2 *Cymbasoma cheni* sp. nov., holotype, Meizhou Bay, China; adult female

A. photograph of *Cymbasoma cheni* sp. nov.; B. habitus, dorsal view; C. habitus, lateral. a. cephalothorax, dorsal view; b. forehead, dorsal view; c. oral papilla, lateral; d. ovigerous spines, dorsal view; e. ovigerous spines, lateral; f. caudal rami, dorsal view.

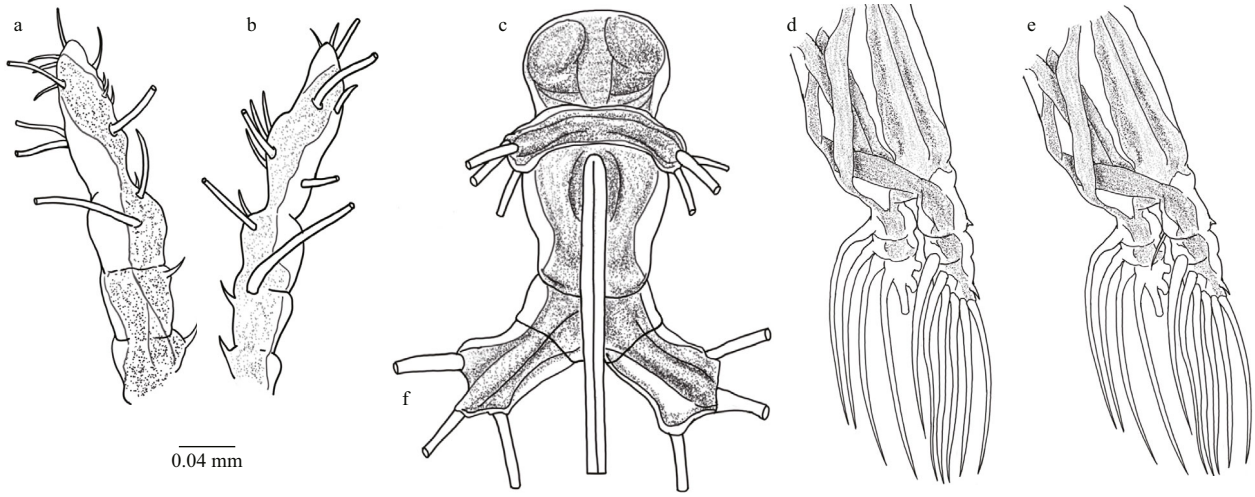


Fig.3 *Cymbasoma cheni* sp. nov., holotype, Meizhou Bay, Fujian, South China

a. left antenuule, dorsal view; b. right antenuule, dorsal view; c. the fifth legs, ventral view; d. the first swimming leg; e. the second swimming leg; f. caudal rami, ventral view.

legs 1–4 decreasing posteriorly. Pedigerous somites 2–4 accounting for 21.8% of total body length in dorsal view.

The basis of legs 1–4 lacking setae; endopodites and exopodites of legs 1–4, triarticulated. Terminal setae of exopods of legs 1–4 with inner margin bearing sparsely distributed. The first segment of leg 2–4 of exopodal armed with small innerseta (Fig.3e). The armature of swimming legs is as follows:

Leg 5 single lobed, medially separated, each lobe with one segment, 1.5 times longer than wide. Lobe armed with 3 naked setae, which are subequal in length and breadth (Fig.3c).

Urosome consisting of fifth pedigerous somite, genital double-somite, and one free abdominal (anal) somite (Fig.3c); ratio of lengths 35.6:44.7:19.7 (=100). Urosome accounting for 12.2% of total body length. Genital double-somite representing almost half-length of urosome (44.7%) (Fig.3c). The medial portion of genital double-somite moderately swollen with smooth dorsal and ventral surfaces. Genital double-somite bearing pair of long ovigerous spines. ovigerous spines insert on the middle of the ventral surface, basally separated, regular and slender (Fig.2d, e), representing 36.7% of total body length, extending well beyond setae of caudal rami. The anal somite is smooth both on dorsal and ventral surfaces, without obvious notch. Caudal rami 2.0 times longer than wide, nearly smooth both on dorsal and ventral surfaces, bearing three naked terminal setae (Figs.2f, 3f).

Male: Unknown.

Remarks: The new species, collected from Meizhou Bay, China, belongs to the genus *Cymbasoma* based on the presence of only one free somite between the genital double somite and the caudal rami in female (Isaac, 1975). There are only eight congeners sharing similar features (relatively long cephalothorax and fifth leg single lobed) with *C. cheni* sp. nov. in the genus (Table 2). The new species can be distinguished from these congeners by the shape of the fifth leg. In *C. cheni* sp. nov., C. *bowmani* Suárez-Morales and Gasca, 1998 and *C. quintanarooense* (Suárez-Morales, 1994), the three setae of the fifth leg are subequally long and thick; in the other six species, the inner seta of the fifth leg is shorter than the other two setae (Suárez-Morales, 1994; Suárez-Morales and Gasca, 1998).

The new species is closely related to *C. bowmani*, a species that was described by Suárez-Morales and Gasca (1998) from specimens collected in a reef area on the Yucatan Peninsula, Mexico. The body proportions, including total body length, the relative lengths of the cephalothorax and the genital double somite, are similar in the two species. Total body length of *C. cheni* sp. nov. reaches 1.90 mm, and *C. bowmani* is 2.1 mm. The cephalothorax is relatively long in both species (66% of total body length in *C. cheni* sp. nov. is, and 65% in *C. bowmani*). The relative length of the genital double somite is similar in both species (44.7% of the urosome in *C. cheni* sp. nov., and 42.8% in *C. bowmani*). Furthermore, they

Table 1 The armature of swimming legs

Leg	Basis	Endopodite	Exopodite
1	0–0	0–1; 0–1; 1, 2, 2	I–0; 0–1; I, 2, 3
2	0–0	0–1; 0–1; 1, 2, 2	I–1; 0–1; I, 2, 3
3	0–0	0–1; 0–1; 1, 2, 2	I–1; 0–1; I, 2, 3
4	0–0	0–1; 0–1; 1, 2, 2	I–1; 0–1; I, 2, 3

Table 2 Comparison of main characters in 9 similar species (elongate cephalothorax and fifth leg with 1 lobe) of *Cymbasoma*, females only

Item	A	B	C	D	E	F	G	H	I
Genital double-somite clearly globose	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Anal somite with marginal notch	No	No	Yes	No	No	No	Yes	No	No
Fifth leg single lobed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Inner seta of fifth leg smaller than other	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes
Oral papilla position along cephalothorax	21.7	20–24	21	23	28	14	28	16	12
Relatively length of AI% of total length	22.8	14–17	17	14	17.3	19	37	18.6	22.2
Genital double-somite with the ventral anterior protuberance	Yes	Yes	No	Yes	No	Yes	Yes	No	No
Ovigerous spines length considering total length	42	44–55	33	43	36.7	47	50	45.4	60

Species as followed: A: *C. bowmani* Suárez-Morales and Gasca, 1998; B: *C. boxshalli* (Suárez Morales, 1993); C: *C. cocoense* Suárez-Morales and Morales-Ramírez, 2009; D: *C. concepcionae* Suárez-Morales and Morales-Ramírez, 2003; E: *C. cheni* new species; F: *C. mediterranea* Suárez-Morales, Goruppi, de Olazabal and Tirelli, 2017; G: *C. quintanarooense* (Suárez-Morales, 1994); H: *C. striatum* (Isaac, 1974); I: *C. tumorifrons* Isaac, 1975.

bear long and slender ovigerous spines that are basally separated. The cephalothorax is relatively long in both species; however, there is no cuticular ornamentation in the new species, unlike in *C. bowmani*. The oral papilla is located in a different position in each case, at 0.28 mm of the way back of the cephalothorax in the new species (Fig.1), as compared with 0.15 mm in *C. bowmani*. In addition, the new species can be distinguished by the naked setae of the fifth leg, while *C. bowmani* has plumose ones.

Another species that merits mentioning is *C. quintanarooense* because it also has fifth legs that are represented by a single lobe armed with three setae subequal in length and breadth (Table 2). However, the new species can be distinguished from *C. quintanarooense* by several other characters. The antennule is relatively long in *C. quintanarooense* (37% of total body length) as compared with that of the new species (17% of total body length) (Table 2). In the new species, the ocelli are rounded, medially conjoined, and intensely pigmented at the inner margins only. In *C. quintanarooense*, the ocelli are triangularly shaped in dorsal aspect, separated, and intensely pigmented (Suárez-Morales, 1994). The new species has no ventral anterior protuberance in the genital double-somite, a feature that is present in *C. quintanarooense*. The three setae on the fifth leg are naked in the new species, whereas in *C. quintanarooense*, they are plumose. Additionally, *C. cheni* sp. nov. bears long and slender ovigerous spines, but *C. quintanarooense* has long ovigerous spines that are uneven terminally (Suárez-Morales and Escamilla, 2001).

4 DATA AVAILABILITY STATEMENT

The authors declare that the datasets during the current study are available from the author upon reasonable request.

5 ACKNOWLEDGMENT

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