Zootaxa 3779 (3): 301–340
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3779.3.1
http://zoobank.org/urn:lsid:zoobank.org:pub:096F0F73-2CA0-4759-9DF6-C8B4654EDB46

The Australian Monstrilloida (Crustacea: Copepoda) I. *Monstrillopsis* Sars, *Maemonstrilla* Grygier & Ohtsuka, and *Australomonstrillopsis* gen. nov.

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Abstract

Monstrilloid copepods were collected during zooplankton surveys in reef and coastal areas of Australia. Representatives of all four genera of the Monstrilloida (*Monstrilla* Dana, *Monstrillopsis* Sars, *Cymbasoma* Thompson, and *Maemonstrilla* Grygier & Ohtsuka) were recorded. In this contribution a taxonomic analysis of specimens belonging to the latter two genera is provided, and a new genus described. The genus *Monstrillopsis* was represented exclusively by male specimens, on the basis of which three new species are described: *Mon. hastata* **sp. nov.**, *Mon. boonwurrungorum* **sp. nov.**, and *Mon. nanus* **sp. nov.** These are distinguished from each other and previously described species of this genus by details of the genital complex (or genital apparatus), body size, ornamentation of the cephalic surface, number of caudal setae, and characteristic modifications of the fifth antennular segment. All have distinctive characters not associated with sexual modifications, which will ease the task of matching females collected in future studies. *Australomonstrillopsis* gen. nov. is proposed to accommodate a male specimen with a unique combination of characters including massively developed caudal rami, cephalic perioral protuberances, and absence of an inner seta on the first exopodal segment of legs 1–4, among other characters. The new genus is monotypic and contains *A. crassicaudata* **sp. nov.** Three of the four new species of *Maemonstrilla* (*Mae. ohtsukai* **sp. nov.**, *Mae. hoi* **sp. nov.**, and *Mae. protuberans* **sp. nov.**) belong to the *Mae. hyottoko* species group, and the remaining one, *Mae. crenulata* **sp. nov.**, belongs to the *Mae. turgida* group. Each of the new species of *Maemonstrilla* from Australia can be distinguished from its known congeners by a unique combination of characters

Accepted by S. Dippenaar: 8 Jan. 2014; published: 17 Mar. 2014

including the type of body reticulation, body size, antennule and body proportions, distinctive characters of the swimming legs, details of the antennular armature, and the presence/absence of a posteroventral process on the genital compound somite. With the addition of the four new species of *Monstrillopsis* and the four of *Maemonstrilla* described herein, the number of species in these genera has increased to 13 and 11 species, respectively. In no case did congeneric species co-occur, hinting that there may be a rich species diversity yet to be discovered within the Australian Monstrilloida.

Key words: marine zooplankton, taxonomy, associated Copepoda, reef crustaceans

Introduction

Monstrilloids are protelean parasites of benthic polychaetes and molluscs; most postnaupliar and preadult stages are endoparasitic (Suárez-Morales 2011; Suárez-Morales *et al.* 2010, 2014). Only the first naupliar stage, a final, transitory copepodid stage ("subimago"), and the planktonic adults are free-living. The adults are the most conspicuous stage; they are non-feeding, reproductive forms that lack second antennae and mouthparts. These copepods are part of the zooplankton community in coastal-neritic waters at all latitudes, including Arctic and Antarctic waters (Razouls, 1996; Suárez-Morales & Ivanenko 2004; Suárez-Morales 2011). Monstrilloids are frequently collected during routine plankton surveys but are rarely found in large numbers, although high densities in samples collected at night in and around coral reefs have been reported (Sale *et al*. 1976, 1978; Suárez-Morales 2001, 2011). The systematic position of the Monstrilloida is unclear: Huys *et al.* (2007) regarded the group as belonging within the Siphonostomatoida, a case considered unproven by Suárez-Morales (2011) and Suárez-Morales *et al.* (2014). For the purposes of the present work we retain the ordinal status of the Monstrilloida. Currently, the order is known to contain over 120 nominal species arranged in four valid genera: *Monstrilla* Dana, *Monstrillopsis* Sars, *Cymbasoma* Thompson, and *Maemonstrilla* Grygier and Ohtsuka (Suárez-Morales *et al.* 2006; Grygier & Ohtsuka 2008; Suárez-Morales 2011). The taxonomic status of all valid and invalid genera of the Monstrilloida was briefly reviewed by Grygier and Ohtsuka (2008). Except for *Maemonstrilla*, the valid genera can be identified following Boxshall and Halsey's (2004) key.

Because of their relative rarity in plankton samples and the taxonomic complexity of the group, there are large geographic areas in which the monstrilloid copepod fauna remains practically unknown (Suárez-Morales 2011). One of these is Australia. Nicholls (1944) illustrated two specimens of *Monstrilla* sp. from Spencer Gulf, for which Davis (1949) later proposed the new species *M. nicholsii* Davis, 1949. According to Grygier (1995), Razouls (1981) stated that this species was "peu reconnaissable" because of the lack of data on many important morphological details. Its taxonomical status should be revised by checking the type specimens if they are available, or by examining collections from the type locality. There are additional Australian records of two widespread species of *Cymbasoma, C. longispinosum* (Bourne, 1890) and *C. thompsoni* (Giesbrecht, 1893) (Razouls *et al*. 2013).

In this contribution we present a taxonomic analysis of the Australian species of *Monstrillopsis* Sars, 1921 and *Maemonstrilla* Grygier & Ohtsuka, 2008, and describe three new species of the former genus and four of the latter. We also describe a new genus to which a single new species is herein assigned. Ecological and distributional comments of the species are also provided.

Materials and methods

Monstrilloid copepods were isolated from plankton samples collected in ecological studies of Australian coastal and shelf seas during the career of the second author. In all, monstrilloids occurred in 76 samples taken between November 1982 and November 2009. The source plankton samples were fixed in formaldehyde solution. Once isolated, monstrilloid copepods were transferred to 70% ethanol for taxonomic examination and long-term preservation.

The taxonomic descriptions presented here accord with the upgraded descriptive standards proposed by Grygier and Ohtsuka (1995) for monstrilloid copepods. New micro-characters were recently proposed by Grygier and Ohtsuka (2008) to further upgrade these standards, particularly in *Maemonstrilla*, but some of them require SEM analysis and others are not practical to check or evaluate with a small set of specimens or with only a single specimen available, as is the case for most of the Australian material considered here. Huys *et al.*'s (2007) nomenclature for the terminal

Arctic, Sub-Antarctic, temperate, tropical, and subtropical zones (Suárez-Morales & Ivanenko 2004; Suárez-Morales *et al*. 2006; Suárez-Morales *et al*. 2008), but the genus seems to be most diverse in temperate and cold latitudes (7 of 10 previously known species). *Maemonstrilla* has only been recorded from the Indo-West Pacific, with species known from Japan, Indonesia, India, Singapore, the South China Sea, the Red Sea, and Australia (Grygier & Ohtsuka 2008; present data).

The present collections of *Monstrillopsis*, *Maemonstrilla*, and *Australomonstrillopsis*, come from both temperate and tropical regions of Australia (Fig. 24). The habitats sampled span coastal embayments with rich seagrass communities (Western Port Bay, Shark Bay, and Exmouth Gulf), a large temperate bay (Port Phillip Bay), a platform reef within the Great Barrier Reef (Davies Reef), and an isolated Indian Ocean coral reef off the Western Australian shelf (Scott Reef). Details of the collection sites and their plankton communities can be found in the original literature cited in the Material Examined sections, although two species (the possibly endemic *Australomonstrillopsis crassicaudata* and *Maemonstrilla protuberans*) were recovered from an *ad hoc* collection made at Davies Reef in October 1985—details of the plankton community at this location can be found in McKinnon (1991). With the exception of *Maemonstrilla ohtsukai*, all the new species are described on the basis of single individuals occurring in plankton collections. The two genera co-occurred at four of the six locations. *Maemonstrilla ohtsukai* occurred both in Western Australia (Exmouth Gulf and Shark Bay) and Victoria (Western Port Bay), indicating that this species is probably widely distributed. Although the paucity of specimens compromises any conclusion regarding the distribution of the other species, the fact that in no case did congeneric species co-occur, contrary to the case in the Ryukyu Islands (Grygier & Ohtsuka 2008), hints that there may be a rich species diversity yet to be discovered within the Australian Monstrilloida.

Acknowledgements

We wish to thank Samantha Talbot (AIMS) for her help in cataloguing and maintaining these collections and for detailed editorial suggestions. The constructive comments from two reviewers and the subject editor of Zootaxa, Susan Dippenaar, greatly contributed to improve a previous version of this work.

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