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A botryllophilid found at Sicily

First occurrence of the family Botryllophilidae Sars G.O., 1921 (Copepoda, Cyclopoida) in
Sicily, central Mediterranean Sea

BY

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ABSTRACT

A female copepod specimen belonging to the family Botryllophilidae Sars G.O., 1921 was retrieved for the first time in December 2023 from nautical ropes of the tourist marina in Palermo (Cala Marina), near the commercial port of the city. The individual lacks many of the distinctive morpho-anatomical characteristics of the class Copepoda, as usual in cyclopoid parasites. In this group, females typically carry paired multiseriate egg sacs, which are extruded from the genital openings and lead to taxonomic identification. The family is

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commonly associated with tunicates. There are few reports of commensal and/or parasitic copepods associated with sea squirts in the Mediterranean Sea. This record cannot be treated as a new non-indigenous species for the Italian coasts yet, as there are no extensive studies on the distribution of the taxon.

Key words. — Biodiversity assessment, tunicates associated fauna, fouling, Mediterranean Sea

RIASSUNTO

Un esemplare femmina di copepode appartenente alla famiglia Botryllophilidae Sars G.O., 1921 è stato raccolto dalle cime nautiche del porticciolo turistico di Palermo (Cala Marina), vicino al porto commerciale della città, a Dicembre 2023. Questo rappresenta il primo record della famiglia in Sicilia. L'animale presenta un piano morfo-anatomico privo di evidenti caratteri distintivi della classe Copepoda, comune nei parassiti ciclopoidi. In questo gruppo, le femmine portano tipicamente un paio di sacche con uova multiseriate, che vengono estruse dalle aperture genitali e che aiutano nell'identificazione tassonomica. La famiglia è comunemente associata ai tunicati. Esistono poche segnalazioni di copepodi commensali e/o parassiti associati a tunicati nel Mar Mediterraneo. Questo record viene qui presentato come nuova segnalazione da indagare attraverso campionamenti mirati e analisi integrative; non può ancora essere considerato specie non indigena per le coste italiane, poiché non esistono studi approfonditi sulla distribuzione del taxon.

Parole chiave. — Monitoraggio della Biodiversità, Fauna associata a tunicati, Comunità Fouling, Mar Mediterraneo

INTRODUCTION

Copepods occur in every kind of aquatic habitat, from fresh water to estuarine and open marine waters, showing benthic, demersal and planktonic habits. Additionally, many species of this ubiquitous taxon evolved to live in association with other marine invertebrates and vertebrates as ectosymbionts, endosymbionts, commensals, or parasites (Gotto, 1979; Dudley & Illg, 1991; Pastore, 2001; Özak et al., 2012). These last categories show drastic modifications of their external anatomy compared to free-living copepods, specifically adapting to attach to a host and to enhance their reproductive efficiency. Most of them lack many of the distinctive morpho-anatomic characters of the class Copepoda, especially in female individuals, whose taxonomic recognition is often not obvious to a non-specialist, which is also due to the rare conspecific males (Dudley & Illg, 1991; Ooishi, 2006; El-Rashidy & Boxshall, 2011; Özak et al., 2012).

In many cases, it is still not known whether the symbiosis with the host establishes a relationship of mutual benefit (mutualism) or not (commensalism and parasitism) (Kim et al., 2016).

The ascidian tunicates are among the marine taxa more often associated with copepod symbionts. These crustaceans can reach high abundance in a single tunicate individual and be represented by various taxa in a single host species (Pastore, 2001; Kim & Boxshall, 2020). The copepods associated with tunicates mostly belong to the order Cyclopoida (Ooishi, 2008; Boxshall & Hayes, 2019). In this group, females typically carry paired, multiseriate egg sacs, which are extruded from the paired genital apertures and carried until ready to hatch. The presence of the two sacs is a useful character in the taxonomic identification of the class rank of these morphologically modified parasitic copepods (Boxshall & Hayes, 2019).

Among Cyclopoida, the families most frequently associated with ascidians are Ascidicolidae, Archinotodelphyidae, Botryllophilidae, Enteropsidae, Lichomolgidae and

Notodelphyidae (Boxshall & Hayes, 2019).

Following the revision by Boxshall & Halsey (2004) some genera previously belonging to the subfamily Haplostominae (family Ascidicolidae) were moved into the family Botryllophilidae. The family Botryllophilidae now includes seven genera: *Botryllophilus* Hesse, 1864, *Haplosaccus* Chatton & Harant, 1924, *Haplostoma* Chatton & Harant, 1924, *Haplostomella* Chatton & Harant, 1924, *Haplostomides* Chatton & Harant, 1924, *Paulillgia* Monniot C., 1982, and *Schizoproctus* Aurivillius, 1885 (Kim & Boxshall, 2021; Walter & Boxshall, 2024).

The few records of commensal and parasitic copepods associated with ascidians along the Italian coast concern the families Ascidicolidae, Botryllophilidae Enterognathidae, and Enteropsidae, reported by Illg & Dudley (1980) in the Gulf of Naples, and by Pastore (2001) in the Gulf of Taranto. In some cases, the Italian locality of occurrence was the locus typicus of a newly described species.

Other data reported by the Italian Fauna Checklist (Bologna et al., 2022; and ref. therein) about the occurrence of the family Botryllophilidae in Italian waters lack information on the sampling localities and hosts. The checklist includes the genus *Haplostoma* with the species *H. banyulensis* (Brément, 1909) and *H. mizoulei* Monniot C., 1962.

During a recent survey, a female specimen of a symbiotic copepod of the family Botryllophilidae was sampled at the Cala Marina, close to the commercial and touristic port of Palermo (Sicily, Italy). In this paper, we report this record as new for the central Mediterranean area.

MATERIAL AND METHODS

The sampling site is the recreational marina of Palermo near the commercial harbour of the city (38°07'14.04"N 13°22'12.84"E; fig. 1), where a rich fouling community mostly

represented by sessile suspension feeders thrives, attached to artificial substrates of the infrastructures. A long-term survey has been conducted for ten years to monitor biodiversity changes in this site due to its vulnerability to bioinvasions.

The fouling community is sampled periodically and specimens found on the ropes or hawsers of the boats are collected. The site is not wave-exposed and is characterized by a high upload of nutrients.

The fouling community was collected in December 2023 from nautical ropes at a depth between 0 and 2 m. The sorting was carried out under a stereomicroscope to observe and collect small-sized organisms alive. The copepod here reported was photographed when still alive and subsequently preserved in absolute ethyl alcohol and identified.

RESULTS AND DISCUSSION

The island of Sicily is considered a hotspot for the early detection of exotic species in the Mediterranean Sea, in particular also due to its extensive port system (Servello et al., 2019; Katsanevakis et al., 2023).

The commercial and tourist harbour of Palermo has become the fourth largest in Italy in terms of the number of cruise passengers. The sea travel sector in this area is expected to grow in the next years. The traffic of the harbour of Palermo is growing as one of the most important Italian ports – alongside Civitavecchia, Naples, and Genoa – and will exceed one million passengers per year in the near future (information from the annual reference report "Italian Cruise Watch", 2023). As a consequence, the records of non-indigenous species (NIS) are expected to increase, as demonstrated by interesting records of NIS fauna associated with the fouling communities that have already been reported (e.g., Lo Brutto et al., 2018).

The copepod specimen collected shows the typical oligomerization of parasitic copepods, i.e., the fusion of body somites and loss of appendage segments.

Following the taxonomic key to subfamilies of Ascidicolidae by Gotto (1993), the female copepod collected belongs to the subfamily Haplostominae Chatton & Harant, 1924, synonymized with the family Botryllophilidae Sars G.O., 1921. It was found on nautical ropes colonized by polychaetes, molluscs, peracarids, ascidian tunicates (*Phallusia mammillata* (Cuvier, 1815) and botryllids). It was sorted alive (fig. 2), free, and probably detached from an ascidian host. In fact, the family comprises species that are exclusively associated with ascidians (Tovar-Hernández et al., 2010; Kim & Boxshall, 2021). The body colour was yellowish. The eggs in the two attached egg sacs appeared light purple.

Botryllophilid females have an elongated and cylindrical body. In some genera the females have no integumental folds indicating segmentation, and there are no distinct lateral cones representing the fifth leg areas. The regional delimitations for the cephalosome, metasome and urosome are the only indications of bodily segmentation that can be perceivable. Terminally, the urosome is pointed. The majority of species seems to carry the eggs in paired egg sacs.

Copepods are very commonly associated with both solitary and colonial tunicates, and can be found in all parts of the zooids as well as in the matrix of colonial forms (Kim & Boxshall, 2021). Among these, the Notodelphyidae and Botryllophilidae are widely distributed and are the most frequently reported, probably as their relatively large body size allows easier detection. Within a single family, such as the Notodelphyidae, morphology can vary from cyclopiform to either vermiform, lobate, or stellate body shapes. In the family Notodelphyidae the eggs are retained inside a dorsal or dorsolateral incubatory pouch formed by modification of the fourth pedigerous somite (Kim & Boxshall, 2020). The presence of a single structure for carrying the eggs, including a single egg sac, is also characteristic in some botryllophilid genera (e.g., genus *Botryllophilus*; cf. Ooishi, 2006).

After a few days in absolute ethyl alcohol, the sample was again observed, but it

resulted to be deformed due to dehydration, as can be seen in fig. 3. The specimen was not dissected or used for SEM analysis as it was the only specimen sampled. At present, therefore, it would not seem possible to identify the specimen described herein to a taxonomic level below that of the family.

The present record cannot be treated as a new non-indigenous taxon for the Italian coast yet. The literature reports previous Mediterranean records of botryllophilids detected in the western basin (López-González et al., 1997; Ooishi, 2004, 2006). Nonetheless, the present observation suggests that fouling species of harbours, such as many ascidians, could host small-sized symbiont species, thereby favouring their diffusion (Tovar-Hernández et al., 2010).

Unfortunately, there are no extensive studies on the species-specific association between commensals and hosts in Mediterranean tunicates and, further, specialists lack, thus it is still not possible to hypothesize any route of dispersal or compare the sample with reference collections or databases.

ACKNOWLEDGEMENTS

Project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.4 - Call for tender No. 3138 of 16 December 2021, rectified by Decree n.3175 of 18 December 2021 of the Italian Ministry of University and Research funded by the European Union – NextGenerationEU; Project code CN_00000033, Concession Decree No. 1034 of 17 June 2022 adopted by the Italian Ministry of University and Research, CUP D33C22000960007 and CUP B73C22000790001, Project title “National Biodiversity Future Center – NBFC”. The authors are grateful to Sergio Bonomo for supporting in taking images.

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First received 27 February 2024.

Final version accepted 10 March 2024.

[CAPTIONS]

Fig. 1. Sampling site in Cala Marina of Palermo, Sicily, southern Italy.

Fig. 2. Habitus of the adult female copepod, which was collected and photographed alive.

Fig. 3. The female copepod specimen after having been stored for a few days in absolute ethyl alcohol: A, dorsal view; B, ventral view.