



A New Cyst Morphotype from Recent Sediments of the Mar Piccolo of Taranto (Southern Italy, Ionian Sea)

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Abstract

A new flask-shaped cyst, similar to those produced by planktonic ciliates, has been found in March 2000, July 2002, and August 2011 in recent sediments of the Mar Piccolo of Taranto (Mediterranean Sea, Southern Italy). Flask-shaped cysts are typical of ciliates of the orders Oligotrichida and Heterotrichida inside the class Polyhymenophorea. The new morphotype here described had a peculiar morphology, showing a smooth surface and a trunc-conical shape. Eight specimens were collected, three of which were incubated, but none germinated to obtain the corresponding active stage.

Keywords: Flask-Shaped Cyst; Papulifera; Ciliophora; Marine Sediments; Mar Piccolo of Taranto; Mediterranean Sea

Introduction

The production of resting stages is a common life-cycle trait among marine plankton species [1]. This kind of strategy, in fact, has been evolved by many *phyla* of marine neritic plankton, and allows them to overcome the unfavourable periods, resting as cysts in the sediments [2].

Encystment is a regular trait of the Ciliophora life cycle. In the marine and brackish water Oligotrichida, 87 species are known as cyst producers [1].

Flask-shaped cysts are typical of Ciliophora of the orders Oligotrichida and Heterotrichida inside the class Polyhymenophorea [3]. These cysts are also known as “papulifera”, *sensu* Meunier [4], who created this series, grouping microplankton flask-shaped morpho-types

showing a hyalin plug (the *papula*) at their apex, before their identification as Ciliophora cysts [4]. The rich papulifera assemblage of Meunier [4] was subdivided in main types (*Fusopsis*, *Pterosperma*, *Piropsis*, *Radiosperma*, *Sphaerosperma*) on the basis of the external morphology, and these terms were used as genus names until the discovery of the correspondent active stage. Today many *Sphaeropsis* cysts have been associated to *Strombidium* species, *Fusopsis* has been recognized as *Cirrostrombidium*, and many Tintinnina have been described as cyst producers [5,6].

The most abundant Ciliophora of the plankton, however, are Tintinnina. In this group cysts are produced inside the lorica of the active stage and do not show the spiny surface typical of non-loricated Ciliophora.

The present paper describes a new type of papulifera cyst showing an unusual trunc-conical shape morphologically close to the *Piropsis* morpho-type of Meunier [4]. The record comes from a deeply studied area (Mar Piccolo of Taranto, Italy) where studies on cysts and plankton are a scientific tradition, and can allow comparisons and interpretation.

Materials and Methods

The studied specimens were collected in undisturbed surface sediments and by sediment traps, in March 2000, July 2002, and August 2011 in the Mar Piccolo of Taranto (Figure 1). This is a confined, eutrophic basin, divided in two inlets by two opposite promontories. The sampling site was located in the first inlet (13 m depth). Once collected, the sediment samples were stored in the dark at 4°C until their processing in the laboratory, carried out following a sieving method described in details by Rubino, et al. [7]. Cyst morphology was studied under a compound inverted microscope, analysing unstained living cysts. Finally, they were isolated, washed twice in sterile filtered sea water, and separately incubated into a multiwell plate at 20°C in a 12:12 h L/D cycle, at an irradiance of $\sim 30 \mu\text{E m}^{-2} \text{s}^{-1}$.

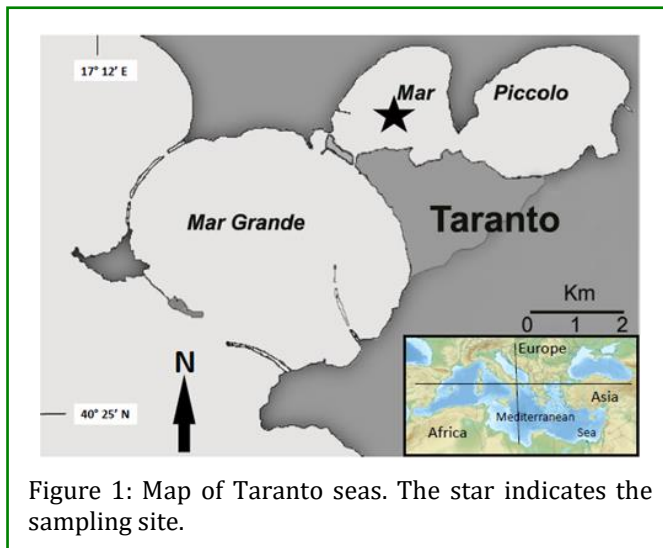


Figure 1: Map of Taranto seas. The star indicates the sampling site.

Results and Discussion

Eight specimens of a new flask-shaped cyst type were collected. They were identical in shape and size, with a diameter of $60 \pm 3 \mu\text{m}$ at the base, and a total height (basis to papula) of $50 \pm 2.5 \mu\text{m}$ (Figure 2).

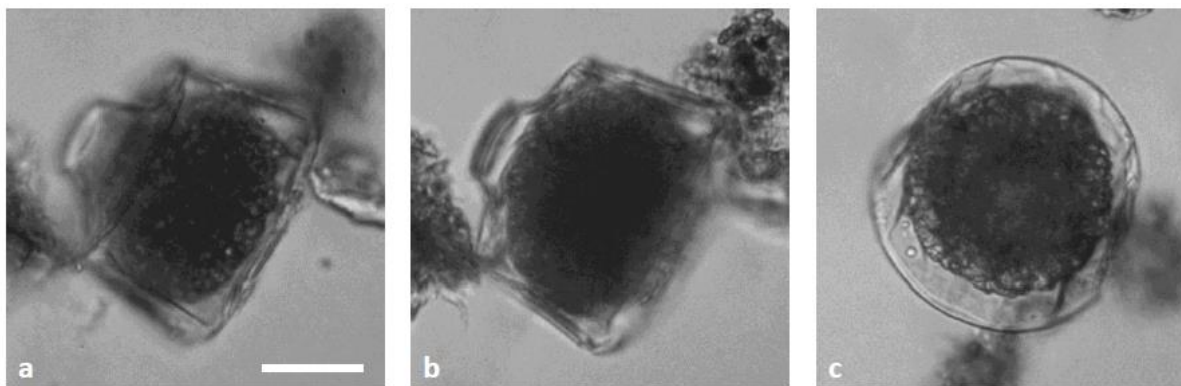


Figure 2: Light microphotographs of the isolated resting stage. Scale bar= 25 μm . a) lateral view, high focus, showing the shape of the wall and the ellipsoidal granular content; b) lateral view, median focus, showing the 'papulla'; c) basal view, showing the thickness of the wall and the nearly circular contour of the base.

The morphology was very characteristic, resembling a trunc-conical flask which remembers *Piropsis* morpho-types of Meunier [4], and it has never been reported in literature [1,4]. Differently to *Piropsis* specimens, however, the present cyst type had a profile with shoulders around the neck closed by a plug (the *papula*). Light microscopy revealed a thick double-layered and transparent wall with a smooth surface. The cytoplasm was dark-grey and granular. It appeared enclosed by the

inner layer which leaves an ellipsoidal space inside the cyst. The base of the cyst was flat, with a nearly circular contour. A short neck ($16.7 \pm 0.3 \mu\text{m}$ long) raised up from the centre of the upper face, extending the inner layer of the wall. The neck ended with a hyaline plug, the *papula*, which was lightly incurved. This plug ($\varnothing 17.5 \pm 0.4 \mu\text{m}$; thickness, 5 μm) was somewhat different from *papulae* showed by other flask-shaped cysts. In fact, commonly the

plugs are spherical and thick, while that here described is a nearly flat disk.

The *papula*, the flattened bottom, and the smooth surface (absence of spines), make the reported cysts somewhat typical.

Three of the discovered specimens were incubated to obtain the corresponding active form. Unfortunately, after 15 days none of them germinated, although no signs of degradation intervened to communicate us their unviability (as usual for well-preserved cysts, also in absence of germination).

Up to now, flask-shaped cysts have been described in marine Strombidiidae species and, from freshwater habitats, in *Pelagostrombidium fallax* and *Limnostrombidium viride* [8-11]. Reid and John [3] reported, as a result of a literature survey, many other types of cysts produced by Polyhymenophorea, some of them with the distinctive 'flask' morphology. At the present, not all the flask-shaped cysts have still been associated to a free living ciliate; this notwithstanding, only Ciliophora produce flask-shaped cysts, at present state of knowledge.

Flask-shaped cysts from Mar Piccolo are common, and Ciliophora are common too, in the plankton (42 taxa, according to Belmonte, et al.[12]). The presence of a cyst in the life cycle of Ciliophora is a rule, but the recognition of correspondence between active stage and cyst still remains as an underscribed step for the majority of species in the Mar Piccolo of Taranto.

The not orthodox papula (spherical in *papulifera*) in the present cyst, together with its smooth surface (commonly spiny in the majority of marine cysts, according to Belmonte, et al. [13]) and the space existing between the spherical content and the cyst wall, are not features proper of *papulifera* cysts. These characters suggest that the present cyst (code *TAfc5*, in the collection of the Water Res. Institute, Taranto) should be a Tintinnid species.

Tintinnina are abundant and diversified in the Mar Piccolo of Taranto, and their cysts show divergent morphology from the classic *papulifera* of Meunier [4]. As in the tintinnid *Favella* sp. [6] the cyst content appears distanced from the internal cyst wall, and this is not spiny, probably because it is formed inside the lorica (or it represents the modification of the lorica) of the active stage (for some Tintinnina cysts, see [14]).

These outcomings stress the need to further study the life cycles of Oligotrichida in order to clarify the biodiversity

of cyst populations resting in the sediments, from where the plankton populations should be affected.

The search for cysts in the sediments of marine coastal areas is a very fruitful tool to understand plankton ecology. In fact, cysts accumulate in the sediments and also a single sample collection can get information about species presence, more than a greater sampling effort in the water column [15].

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