

Occurrence of the freshwater bryozoan *Cristatella mucedo* Cuvier, 1798 (Bryozoa: Phylactolaemata: Cristatellidae) in the Lakes of Monticolo/Montiggel (Province of Bolzano/Bozen, Italy)

Abstract

In September 2019, thousands of colonies of the freshwater bryozoan *Cristatella mucedo* Cuvier, 1798 (Phylactolaemata: Cristatellidae) were discovered during dives in the Large and Small Lake of Monticolo/Montiggel (Province of Bolzano/Bozen, Italy) between 3 and 5 m of depth. They were attached on large stones and submerged branches. The colonies ranged from about 1 cm to over 10 cm in length. Within the framework of a study carried out in the years 2019–2020 in the two lakes aiming at documenting the colonies, also free statoblasts (spinoblasts), resistant dormant stages with diameters between 700 and 750 μm , were found. This is the first confirmed record of *C. mucedo* in South Tyrol.

Keywords: freshwater bryozoans, *Cristatella mucedo*, Phylactolaemata, statoblasts, Lakes of Monticolo/ Montiggel, scientific diving

Riassunto

Nel settembre 2019 nel Lago Grande e nel Lago Piccolo di Monticolo (Provincia di Bolzano) durante immersioni subacquee sono state avvistate per la prima volta migliaia di colonie del briozoo d'acqua dolce *Cristatella mucedo* Cuvier, 1798 (Phylactolaemata: Cristatellidae), su grandi pietre e rami sommersi tra i 3 e i 5 m di profondità. Le colonie erano lunghe da circa 1 cm a oltre 10 cm. Nei due laghi di Monticolo colonie di *C. mucedo* sono state trovate negli anni 2019–2020 da giugno a ottobre e nel mese di ottobre sono stati raccolti statoblasti, stadi dormienti resistenti, con diametro tra 700 e 750 μm . Si tratta della prima segnalazione di *C. mucedo* in Alto Adige.

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Introduction

Freshwater bryozoans are benthic, suspension-feeding colonial animals (WOOD & OKAMURA 2005). They are common in ponds, lakes and rivers, where they attach to submerged roots, branches, stones, rocks and macrophytes, but are frequently overlooked (HARTIKAINEN & OKAMURA 2015). The colonies of bryozoans are composed of genetically identical zooids produced by budding and may grow up to many centimeters in dimension, while the single zooid is small in the order of 1 mm (WOOD & OKAMURA 2005). The bryozoans of class Phylactolaemata produce numerous highly resistant dormant stages called statoblasts, that persist during unfavorable conditions (HARTIKAINEN & OKAMURA 2015). In temperate regions many species (e.g. *Cristatella mucedo*) survive only as statoblasts during winter (WOOD & OKAMURA 2005).

Worldwide, there are at least 94 freshwater bryozoan species divided into 10 families and 24 genera (MASSARD & GEIMER 2008a and 2008b). WOOD & OKAMURA (2005) reported the presence in Europe of 19 freshwater bryozoan species. In Italy 16 freshwater bryozoan species occur (VIGANÒ 1965, TATICCHI et al. 2005, TATICCHI & PIERONI 2005, TATICCHI et al. 2006, TATICCHI et al. 2008, TATICCHI 2010), in Austria 14 species (WÖSS 2017). For South Tyrol only two species have been reported thus far: *Plumatella repens* (Linnaeus, 1758) and *Plumatella fungosa* (Pallas, 1768) (HELLRIGL 1996).

In September 2019, in the Small Lake and in the Large Lake of Monticolo/Montiggel during scuba dives, aimed at the census of Unionidae bivalves within the research project of the Museum of Nature South Tyrol “Hydrozoa and Bivalvia in the lakes of Monticolo/Montiggel and Caldaro/Kaltern”, thousands of colonies of the freshwater bryozoan *Cristatella mucedo* Cuvier, 1798 (Bryozoa: Phylactolaemata) were sighted. This paper reports the first confirmed record of *C. mucedo* in South Tyrol.

Study area

The Large Lake of Monticolo/Montiggel (from 46°25'16" to 46°25'37"N and from 11°17'16" to 11°17'41"E) is located at 492 m a.s.l. in the Bolzano/Bozen Province, Italy. It has a surface area of 178,400 m² and a volume of about 1,490,000 m³. Its maximum length is 757 m, its average width 236 m and its maximum water depth about 12.5 m (THALER & TAIT 1981a). The Small Lake of Monticolo/Montiggel (from 46°25'41" to 46°25'50"N and from 11°17'38" to 11°17'50"E) is located at 514 m a.s.l.. It has a surface area of 52,100 m² and a volume of about 517,000 m³ with a maximum length of 316 m, an average width of 165 m and a maximum water depth of 14.8 m (THALER & TAIT 1981b). The two lakes are natural water bodies of glacial origin.

Both lakes are classic dimictic lakes (THALER & TAIT 1987). Normally, they are covered with ice from the end of December until the end of February or beginning of March. In summer, there is thermal stratification of the water with a thermocline at a depth of about 5 m and the temperature of the epilimnion reaches 25–26°C. Chemical data classify the lakes as meso-eutrophic water bodies. The main chemical and physical mean water parameters of the first 5 m of depth in Large Lake of Monticolo/Montiggel in the years 2015 – 2019 were: conductivity 305 µS cm⁻¹ at 20°C, maximum pH 8.6, total phosphorus (TP) 20 µg L⁻¹, nitrate nitrogen (NNO₃) 18.8 µg L⁻¹, ammonium nitrate (NNH₄) 115 µg L⁻¹, total nitrogen (TN) 533 µg L⁻¹, total organic carbon (TOC) 5.9 mg L⁻¹, chlorophyll a (Chl a) 3 µg L⁻¹, oxygen minimum (min O₂) 6.5 mg L⁻¹, oxygen maximum (max O₂) 10.3 mg L⁻¹ (MORPURGO et al. 2021).

Materials and methods

This study was carried out between September 2019 and October 2020. In this timeframe, 6 scuba dives were performed in the two Lakes of Monticolo/Montiggel in order to photograph and sample colonies of bryozoans. During the scuba dives, water temperature in Celsius degrees (±1 °C) and depth in meter (±0.1 m) were measured by a



Fig. 1: Underwater macro photograph of a colony of *Cristatella mucedo* (about 3 cm in length) at 4 m depth in the Large Lake of Monticolo / Montiggli on September 26th, 2019 (Photo by Massimo Morpurgo).

scuba dive computer Uwaterc Aladin Prime. Underwater macro photographs of bryozoans were taken with digital SLR camera Nikon D80 with 60 mm macro lens in underwater housing Sealux CD80 and one flash Sea & Sea YS-110 alpha in manual mode. Underwater wide-angle images and video were taken with an action cam GoPro CU-SPC05 with natural light. Colonies of bryozoans were measured underwater with a steel Vernier caliper in mm (± 1 mm).

Colonies of *Cristatella mucedo* were collected on September 26th and on October 3th, 2019 in the Large Lake of Monticolo/Montiggli from submerged tree branches at a depth between 3 and 4 m. The first sample was fixed in ethanol 70% and the second in formalin 4%. The samples were deposited in the zoological collection of the Museum of Nature South Tyrol, Bolzano/Bozen, Italy (*C. mucedo* collection number NMS EVV8 and NMS EVV9).

A second sampling took place on October 10th, 2020 at the same lake and at the same depth. The colonies were gently placed underwater into a 10 L transparent plastic bag filled to approximately 30% of capacity with lake water and transported to the laboratory alive. In the laboratory, the samples were kept in a small tank with lake water at room temperature (22–23°C). Over the next three days, the colonies degenerated releasing floating statoblasts, floatoblasts in form of spinoblasts (Wöss 2005b), which were collected, photographed and then fixed in ethanol 70% (*C. mucedo* collection number NMS EVV10). The microscopic photographs of the floatoblasts were taken under a stereomicroscope Leica M205A.

Results

On September 3th, 2019, in the Small Lake of Monticolo/Montiggli during a scuba dive, hundreds of gelatinous and elongate colonies of bryozoans, about 10 to 50 mm long, were sighted for the first time and photographed on large stones between 4 and 5 m of depth on the north shore about 50 meters from the bathing facility (46°25'49.7"N 11°17'41.2"E), water temperature 24°C. On the basis of the underwater photographs and literature (WOOD & OKAMURA 2005), the colonies were identified as *Cristatella mucedo* Cuvier, 1798; Phylum Bryozoa, Class Phylactolaemata, Family Cristatellidae (Fig. 1).



Fig. 2: Colonies of *C. mucedo* on a submerged branch at 3 m depth in the Large Lake of Monticolo / Montiggli on September 26th, 2019 (Photo by Massimo Morpurgo).



Fig. 3: Underwater picture of colonies of *C. mucedo* on submerged branches in the Large Lake of Monticolo / Montiggli at a depth of 4 m on October 3rd, 2019. Numerous long colonies twisted between them forming cords up to about 40 cm long hung from the thinnest branches of the submerged tree. The cordons of colonies are arranged diagonally because they were moved by a light water current at the time of the shot (Photo by Massimo Morpurgo).

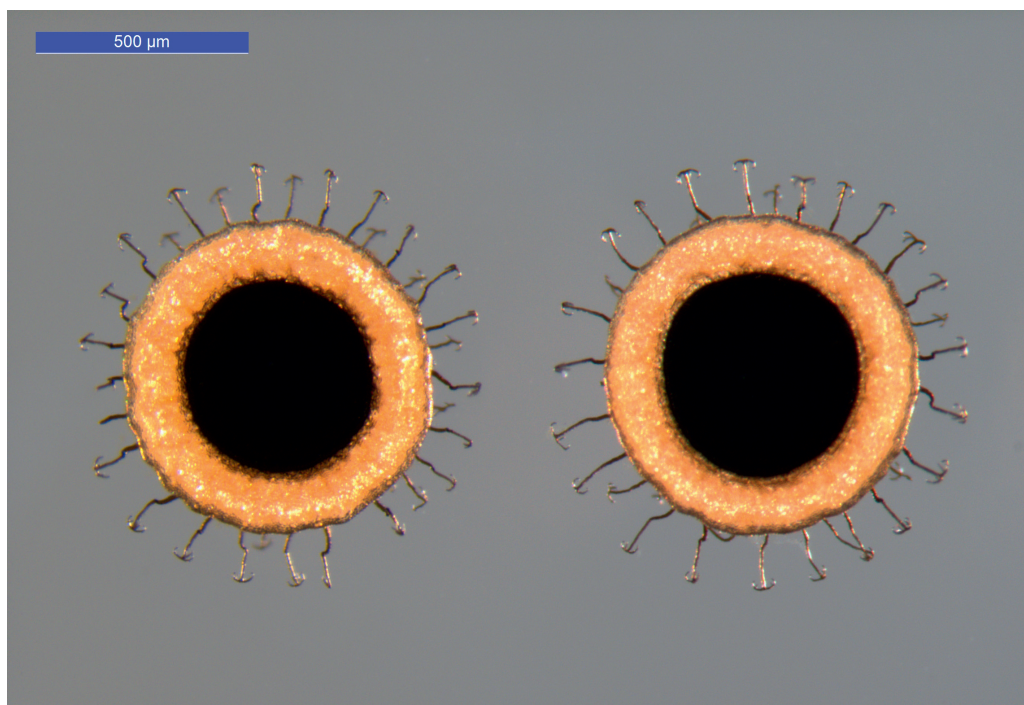


Fig. 4: Spinoblasts (ventral view) of *C. mucedo* (between 710 and 750 μm in diameter) from the Large Lake of Monticolo/Montiggel (Photo by Benno Baumgarten and Massimo Morpurgo).

On September 26th and on October 3th, 2019 in the Large Lake of Monticolo/Montiggel, thousands of colonies of *C. mucedo* were found, photographed and filmed by diving between 3 and 5 m of depth on the branches of a large submerged tree on the eastern shore of the lake in front of the Hotel Sparer (46°25'18.5"N 11°17'23.3"E, water temperature 20°C). The fallen tree was positioned perpendicularly to the shoreline with the branches sunk to a depth of over 5 m. The colonies of *C. mucedo* completely covered the wider branches (Fig. 2). Numerous long colonies twisted between them forming cords up to about 40 cm long hung from the thinnest branches of the submerged tree (Fig. 3).

In June 2020, the colonies could be reconfirmed in the two lakes in the same two dive sites as the previous year, but they were smaller in number. The largest colonies measured between 30 and 100 mm in length. The width of the colonies has not been measured, but should be about 5–8 mm (E. Wöss, pers. comm.).

The free statoblasts (floatoblasts) collected from colonies of *Cristatella mucedo* sampled on the submerged tree on October 10th, 2020 in the Large Lake of Monticolo/Montiggel (water temperature 17°C) had diameters between 700 and 750 μm (Fig. 4).

Discussion

HELLRIGL (1996) lists two species of Bryozoa in his checklist of animal species of South Tyrol: *Plumatella repens* (Linnaeus, 1758) in the Lakes of Monticolo/Montiggel on the underside of water lily leaves and *Plumatella fungosa* (Pallas, 1768) in the Lake of Varna/Vahrn on reed stalks and on freshwater snails. Furthermore, he hypothesized the presence of other five species in South Tyrol: *Plumatella fruticosa* Allman, 1844, *Fredericella sultana* Blumenbach, 1779, *Lophopus crystallinus* (Pallas, 1768), *Paludicella articulata* (Ehrenberg, 1831) and *Cristatella mucedo* Cuvier, 1798. Several limnological studies have been carried out in the two Lakes of Monticolo/Montiggel since 1906 (HUBER 1906, THALER & TAIT 1981a, 1981b, 1987), but until 2019 neither colonies nor statoblasts of *C. mucedo* were found. To the author's knowledge, the occurrence of *C. mucedo* in the Bolzano/Bozen Province had never been confirmed before and therefore the present record is to be considered as the first definite one in South Tyrol.

Cristatella mucedo shows a holarctic distribution (MASSARD & GEIMER 2008a), occurring in Europe, Asia and North America (WOOD & OKAMURA 2005). From Italy there are only few published data (VIGANÒ 1965, ELIA et al. 2006). In Norway, *C. mucedo* has been shown to occur at 227 localities out of 601 investigated lakes preferring lakes of medium sea level, high water temperature, small wave action and medium water color. Also, *C. mucedo* proved to be indifferent to the trophic level and avoided the most acidic lakes (absent below pH 5.4) (ØKLAND & ØKLAND 2000). Substantially, the environmental characteristics of the Lakes of Monticolo /Montiggl fall within these parameters: medium sea level (492 and 514 m a.s.l., respectively), high water temperature in summer (25–26°C), small wave action and meso-eutrophic conditions. The Large Lake of Monticolo /Montiggl is a slightly alkaline lake with a maximum mean pH of 8.6 and a mean conductivity of 305 $\mu\text{S cm}^{-1}$ 20°C (MORPURGO et al. 2021).

Generally, colonies of *Cristatella mucedo* cannot be found all year round. During the winter months, only resting stages statoblasts can survive in the water bodies (WÖSS 2005a). In the Lakes of Monticolo /Montiggl colonies of *C. mucedo* were recorded from June to October and free statoblasts (floatoblasts) were found in October. Unlike other bryozoans, colonies of *C. mucedo* are not permanently attached to the substratum, but are capable of gliding slowly (OKAMURA 1996). They actively divide by fission (WOOD & OKAMURA 2005).

Cristatella mucedo colonies were detected in the two Lakes of Monticolo /Montiggl only below 3 meters depth, where low light levels prevent the species from being overgrown by algae (cf. WOOD & OKAMURA 2005). Probably, the absence of the species in the upper three meters was the reason that it was overlooked until now. The present study confirms that scuba diving represents a good method for monitoring the biodiversity in lakes. In the recent years, three other animal species have also been newly discovered for South Tyrol in this way in the Large Lake of Monticolo /Montiggl: the zebra mussel *Dreissena polymorpha* (MORPURGO & THALER 2002), the freshwater jellyfish *Craspedacusta sowerbii* (MORPURGO & ALBER 2015) and the brown hydra *Hydra oligactis* (MORPURGO 2017). *Cristatella mucedo* colonies were found in large numbers, particularly in the Large Lake of Monticolo /Montiggl. This bryozoan biomass is likely to have a certain importance in the trophic network of the lake. In fact, freshwater bryozoans are an important link between plankton and benthos. Bryozoans ingest a wide variety of suspended food particles, including green algae, cyanobacteria, protozoans, rotifers, and detritus (WOOD 2019). Their fecal pellets deliver a concentrated package of quality nutrients to benthic organisms: oligochaetes, microcrustaceans, water mites and immature insects (WOOD 2019).

Cristatella mucedo is host of the myxozoan parasite *Buddenbrockia plumatellae* Schöder, 1910 (syn. *Tetracapsula bryozoides*) (OKAMURA 1996). The freshwater bryozoan *Fredericella sultana* hosts the myxozoan parasite *Tetracapsuloides bryosalmonae* that causes the devastating Proliferative Kidney Disease (PKD) of salmonid fish (HARTIKAINEN & OKAMURA 2015). The discovery of these two myxozoan parasites resulted in the description of a new class and order (WOOD & OKAMURA 2005): Phylum Cnidaria, Subphylum Myxozoa, Class Malacosporea, order Malacovalvulida, family Saccosporidae (CANNING et al. 2000). Malacosporeans alternate between two hosts: fish as intermediate hosts (Salmonid, Cyprinid and Percid) and freshwater bryozoans Phylactolaemata as definitive hosts (HARTIKAINEN & OKAMURA 2015). The malacosporeans *Buddenbrockia* spp. are able to infect cyprinid fish showing stages in kidney similar to those of *T. bryosalmonae* (GRABNER & MATBOULI 2010). The knowledge of the distribution of freshwater bryozoans is of fundamental importance for the monitoring of myxozoan parasites of fish.

Colonies of another bryozoan of the genus *Plumatella* were recently found in the Large Lake of Monticolo /Montiggl on the shells of zebra mussels *Dreissena polymorpha* (MORPURGO 2017) (Fig. 5). Species of *Plumatella* cannot be determined from photographs of the colonies alone, and to confirm that it is *P. repens*, as indicated by HELLRIGL (1996), the statoblasts must be examined closely (WOOD & OKAMURA 2005). Further sampling is needed to collect statoblasts for the purpose of species identification. *P. repens* was recently reported in the alpine Lake Tovel in the neighboring Province of Trento and confirmed by examination of statoblasts (TATICCHI et al. 2016).



Fig. 5: Underwater macro photograph of *Plumatella* sp. on a zebra mussel *Dreissena polymorpha* at 2 m depth in the Large Lake of Monticolo / Montiggl on May 31st, 2015 (Photo by Andrea Falcomatà).

It may be assumed that *Cristatella mucedo* is also present in other water bodies in South Tyrol. Further studies are required to be able to assess the actual distribution in the Province of Bolzano/Bozen.

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