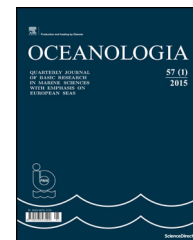




Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

ScienceDirect

journal homepage: [www.journals.elsevier.com/oceanologia/](http://www.journals.elsevier.com/oceanologia/)



ORIGINAL RESEARCH ARTICLE

# Size-selective microzooplankton grazing on the phytoplankton in the Curonian Lagoon (SE Baltic Sea)

Evelina Griniene<sup>a,b,\*</sup>, Sigitas Šulčius<sup>c</sup>, Harri Kuosa<sup>d</sup>

<sup>a</sup> Open Access Centre for Marine Research, Klaipėda University, Klaipėda, Lithuania

<sup>b</sup> Marine Science and Technology Centre, Klaipėda University, Klaipėda, Lithuania

<sup>c</sup> Laboratory of Algology and Microbial Ecology, Nature Research Centre, Vilnius, Lithuania

<sup>d</sup> Finnish Environment Institute (SYKE), Marine Research Centre, Helsinki, Finland

Received 18 August 2015; accepted 5 May 2016

Available online 19 May 2016

## KEYWORDS

Ciliates;  
Pico- and  
nanophytoplankton;  
Dilution experiments;  
Phytoplankton  
pigments;  
Predator–prey  
interactions

**Summary** Dilution experiments were performed to estimate phytoplankton growth and microzooplankton grazing rates at two sites: freshwater (Nida) and brackish water (Smiltynė) in the Curonian Lagoon (SE Baltic Sea). Using the size-fractionation approach and dilution experiments, we found that the microzooplankton community was able to remove up to 78% of nanophytoplankton (2–20 μm) standing stock and 130% of the total daily primary production in the brackish waters of the lagoon, and up to 83% of standing stock and 76% of the primary production of picophytoplankton (0.2–2 μm) in the freshwater part. The observed differences were attributed to the changes in ciliate community size and trophic structure, with larger nano-filterers (30–60 μm) dominating the brackish water assemblages and pico-nano filterers (<20 μm and 20–30 μm) prevailing in the freshwater part of the lagoon.

© 2016 Institute of Oceanology of the Polish Academy of Sciences. Production and hosting by Elsevier Sp. z o.o. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

\* Corresponding author at: Open Access Centre for Marine Research, Klaipėda University, H. Manto Str. 84, LT-92294 Klaipėda, Lithuania. Tel.: +370 63538585.

E-mail address: [evelina.griniene@apc.ku.lt](mailto:evelina.griniene@apc.ku.lt) (E. Griniene).

Peer review under the responsibility of Institute of Oceanology of the Polish Academy of Sciences.



Production and hosting by Elsevier

## 1. Introduction

Microzooplankton (size category 20–200 μm) grazers, usually dominated by protists, are considered to be one of the most important phytoplankton mortality factors in aquatic systems. They can remove up to 60–75% (about 2/3) of daily primary production (PP), with the remaining 1/3 being channelled directly through mesozooplankton or lost by viral lysis, settling and advection processes (Calbet, 2008; Landry and Calbet, 2004; Schmoker et al., 2013). Due to the high

<http://dx.doi.org/10.1016/j.oceano.2016.05.002>

0078-3234/© 2016 Institute of Oceanology of the Polish Academy of Sciences. Production and hosting by Elsevier Sp. z o.o. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

metabolic rate and short generation time, microzooplankton may play a pivotal role in determining the overall rates of grazing, nutrient regeneration and secondary production, especially during periods when they are most abundant (Weisse, 1990).

Ciliates tend to dominate microzooplankton communities in estuaries and reach very high abundances (up to 72 800 cells L<sup>-1</sup>) (Gallegos, 1989; Quinlan et al., 2009). Even though their preferred prey falls within the 5–25 µm size-class, ciliates can feed even on the smallest phytoplankton, i.e. picofraction (<2 µm) (Hansen et al., 1994). Thus ciliates may be an important link in the transfer of carbon from picophytoplankton to higher trophic levels (Quinlan et al., 2009), especially during the summer when copepod production is at its highest (Dzierzbicka-Głowacka et al., 2015). In addition, a number of nano-sized (2–20 µm) ciliates are widening the effect of microzooplankton towards smaller prey size.

Size-selective grazing by ciliates has important implications for the food-web structure and nutrient cycling, especially in coastal regions, where efficient grazing on small-sized phytoplankton, called Fast-Growing-Low-Biomass, is observed (Sun et al., 2007). Moreover, different size groups of the phytoplankton community also have specific responses to grazing by ciliates.

Using the dilution technique (Landry and Hassett, 1982), the estimated grazing impact on phytoplankton is frequently masked by the abundant large phytoplankton fraction, not suitable for grazers, which is frequently dominant in coastal eutrophic waters (Gallegos et al., 1996). Therefore, the size-fractioning is suggested in coastal and estuarine areas, where the less abundant small phytoplankton fraction can have high turnover rates and contribute significantly to the secondary production of microzooplankton (Gallegos et al., 1996).

The information available on the trophic role of ciliates as grazers in the transitory ecosystems with changing riverine discharges and salinity regimes is limited. The dilution method for microzooplankton grazing estimation has been used only in a few Baltic Sea studies (Aberle et al., 2007; Lignell et al., 2003; Moigis and Gocke, 2003; Reckermann, 1996). Setälä and Kivi (2003) used field data combined with experimentally derived species-specific clearance rate information to assess ciliate community grazing in the open Baltic Sea. Reckermann (1996) estimated that microzooplankton carbon consumption rates exceeded mesozooplankton grazing in the Gotland Sea by 10 times, and in the estuarine Pomeranian Bay by 25–30 times.

The Curonian Lagoon is one of the most heavily eutrophicated coastal areas of the Baltic Sea (Gasiūnaitė et al., 2008). This transitory ecosystem is characterised by high primary production and the domination of toxic cyanobacteria during summer/autumn (Gasiūnaitė et al., 2005; Krevš et al., 2007; Sulčius et al., 2015). In the estuarine part the overall phytoplankton biomass markedly decreases with increasing salinity (Gasiūnaitė et al., 2008). An important feature of this system is the heterogeneity of the pelagic communities induced by the non-stable salinity gradient. The microzooplankton community in the lagoon is dominated by the ciliates, while heterotrophic dinoflagellates comprise only a minor fraction (<1%) of the total dinoflagellate abundance (Olenina I., personal communication). The detailed ciliate taxonomical composition of the Curonian Lagoon was

described by Mažeikaitė (1978, 2003) and revised to include the brackish water ciliate assemblage by Grinienė et al. (2011). Recent observations show significant differences in the community structure of ciliated protozoan between the brackish water and freshwater parts of the lagoon (Grinienė, 2013). In this study it was demonstrated that very small nanociliates (<20 µm) compose more than 60% of total freshwater ciliate assemblage, while in the brackish water community the share of nanociliates is only 15% of the total abundance. The larger size fraction (20–60 µm) dominates the brackish water ciliate assemblage (Grinienė, 2013).

In this study we applied dilution experiments and phytoplankton size-fractionation to experimentally evaluate the differences in microzooplankton and phytoplankton community structures, grazing and growth rates between the freshwater and brackish water parts of the lagoon. The experiments were made with two communities representing the two extremes of the habitat: a high salinity sample from an area (Smiltynė) with extreme salinity variability, and a freshwater sample from an area (Nida) with constant low salinity regime. Our hypothesis is that the grazing efficiency varies according to the grazer community structure (size and grazing mode).

## 2. Material and methods

### 2.1. Study area

The Curonian Lagoon (SE Baltic Sea) is a shallow (mean depth 3.8 m) eutrophic water basin connected to the Baltic Sea by the narrow Klaipėda strait. The southern and central parts of the lagoon contain fresh water due to discharge from the Nemunas River. The salinity in the northern part varies from 0 to 7 due to seawater intrusions, which are usually restricted to the northern part of the lagoon, rarely propagating more than 40 km (Dailidienė and Davulienė, 2008). Seawater inflows with a residence time of 1–6 days are most common (Gasiūnaitė, 2000). In terms of hydraulic regime-based zonation, the northern part of the lagoon and Nemunas River avandelta are classified as transitory, while the central part is classified as stagnant and intermediate (Ferrarin et al., 2008).

According to the intensive weekly study in 2007–2008 the seasonal dynamics in the fresh water site (Nida) ciliates follows the model of temperate eutrophic lakes with four seasonal phases: winter, early spring, late spring and summer/autumn (Grinienė, 2013). Summarising, during the winter time ciliate growth is limited by low biomass of phytoplankton. In the early spring, when small sized phytoplankton prevails, ciliate assemblage is dominated by small naked oligotrichs and prostomatids. After the late spring diatom bloom, ciliate assemblage shifts to medium sized nano-filterers (tintinnids). The functional and taxonomic diversity of ciliates increases toward the summer, which points to the exploitation of a wide size range of food. Small sized naked oligotrichs (pico-nano fraction feeders) and peritrichs (mainly pico-fraction feeders) were most abundant in summer and autumn. Despite this ciliate community structure is homogenous during whole period (June–October) forming the same summer/autumn cluster (Grinienė, 2013).

The structural differences between the seasonal clusters were significant and shown by ANOSIM global *R* statistics

Download English Version:

<https://daneshyari.com/en/article/5519740>

Download Persian Version:

<https://daneshyari.com/article/5519740>

[Daneshyari.com](https://daneshyari.com)