SEASONAL VARIABILITY IN ABUNDANCE AND BIOMASS OF TINTINNIDS IN THE KAšTELA BAY (MIDDLE ADRIATIC SEA)

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Abstract

Temporal variability in tintinnid abundance and biomass were investigated in the central part of the Kaštela Bay, Croatia. The highest abundance (755 ind.l^{-1}) and biomass (3.230 μgC l^{-1}) were recorded in February 1998 at the surface, and in September 1998 at 25 m depth, respectively. *Helicostomella subulata*, *Codonellopsis schabi*, *Stenosemella nivalis* and *Salpingella rotundata* represented 68% of the total tintinnid number and may have an exceptional importance in the microbial food web of the investigated coastal ecosystem.

Keywords : Adriatic Sea, Biomass, Density, Zooplankton.

Ciliated protozoa participate in the transfer of energy and carbon from bacterioplankton and phytoplankton to higher trophic levels through the microbial food web [1, 2]. Also, they can act as a link between classic herbivorous food chain and microbial food web [3]. One approach to studying trophic relations and their role in the cycling of organic matter is to analyse the temporal variability of planktonic components [4]. Therefore, the present study focuses on seasonal changes in abundance and biomass of tintinnids as one important part of ciliated protozoa community [3]. These are the first results for this part of the Bay as well as the first biomass data, which are one of very few available for the whole Adriatic Sea.

Samples were collected at a station located in the middle of Kaštela Bay (43°31.2' N; 16°22.9' E) in the central Adriatic Sea. Sampling was performed on a monthly basis from January 1998 until November 1999, at 5 m depth intervals between the surface and bottom (35 m) with 5 l Niskin bottles. The plankton material was preserved and prepared for microscopic analysis as described in reference [3]. The carbon biomass value of tintinnids was estimated by measuring linear dimensions of the lorica, which were afterwards inserted in appropriate formula [5].

Tintinnids were represented with 45 species, which is about half of the known tintinnid species from the Adriatic Sea. It is commonly known that tintinnid biodiversity is affected by the nearness of land as well as the open sea influence. The influence of both factors at investigated station was almost equal. The highest biodiversity was recorded in October 1999 (17 neritic-estuarine species and 14 open sea species) which points at very intensive exchange of water masses between the Kaštela Bay and the surrounding area.

Temporal variability in abundance of tintinnids was characterised by spring and autumn peaks, with average values of 132 ±169 ind.l^{-1} in April 1999 and 205 ±77 ind.l^{-1} in September 1998. The high mean value in winter (192 ±246 ind.l^{-1}) was recorded only in February 1998, with the highest value of 755 ind.l^{-1} at the surface (figure 1). Similar abundances were noticed in the bays of the south Adriatic [6, 7]. Very low abundances during summer could be explained by encystment of tintinnids in unfavourable living conditions, such as high sea temperature and increased light intensity [8].

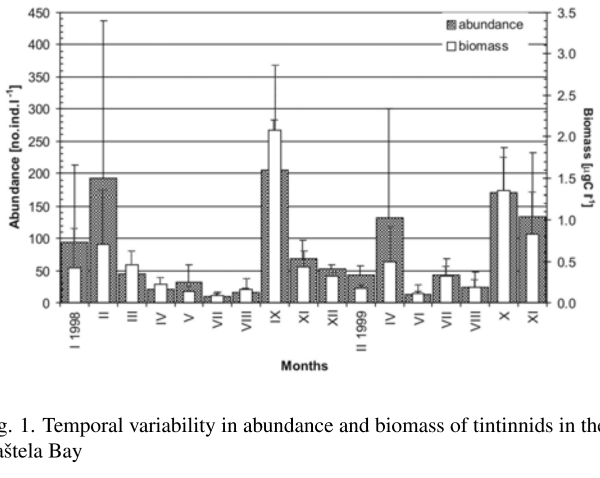

Fig. 1. Temporal variability in abundance and biomass of tintinnids in the Kaštela Bay

In spite of isothermal conditions in winter, tintinnids were most abundant in the surface layer. In September, they concentrated in the deeper layers. For better understanding of seasonal and vertical distribution of tintinnids it is important to know the taxonomical structure. Quantitatively the most important tintinnids of the Kaštela Bay were *Helicostomella subulata*, *Codonellopsis schabi*, *Stenosemella nivalis* and *Salpingella rotundata*. These species represented 68% of the total tintinnid number and may have an exceptional importance in the microbial food web during the period of their highest abundance. *H. subulata* was most abundant from the end of winter to spring. Favourable environmental conditions and probably the trophic state of the investigated area may be relevant. *C. schabi*, *S. nivalis* and *S. rotundata* are typical autumn-winter species. Very high abundances of *H. subulata* were recorded in the surface layers, while three other species preferred the deeper layers.

Seasonal and vertical distribution of tintinnid biomass was quite similar to oscillations of their abundances (r=0.86, p<0.0001, N=17). The average biomass values ranged between 0.088 ±0.048 and 2.081 ±0.788 μgC l^{-1}, recorded in July and September 1998, respectively (figure 1). The highest biomass of 3.230 μgC $l^{-1}$was found in September 1998 at 25 m depth. Similar values were found in the Gulf of Trieste [9]. Differences in the succesion of tintinnid biomass affect the energy flow in the marine food web. Therefore, changes in the abundance or biomass of tintinnid species are important indicators of changes in the microzooplankton community, as a consequence of the changed trophic state of an area.

References

1 - Bernard C. and Rassoulzadegan F., 1993. The role of picoplankton (cyanobacteria and plastidic picoflagellates) in the diet of tintinnids. *J. Plankton Res.*, 15: 361-373.

2 - González J.M., 1999. Bacterivory rate estimates and fraction of active bacterivores in natural protist assemblages from aquatic systems. *Appl. Environ. Microbiol.*, 65: 1463-1469.

3 - Bojanić N., Šolić M., Krstulović N., Šestanović S., Marasović I. and Ninčević Ž., 2005. Temporal variability in abundance and biomass of ciliates and copepods in the eutrophicated part of Kaštela Bay (Middle Adriatic Sea). *Helgol. Mar. Res.*, 59: 107-120.

4 - Rodríguez F., Fernández E., Head R.N., Harbour D.S., Bratbak G., Heldal M. and Harris R.P., 2000. Temporal variability of viruses, bacteria, phytoplankton and zooplankton in the western English Channel off Plymouth. *J. Mar. Biol. Ass. U.K.*, 80: 575-586.

5 - Verity P.G. and Langdon C., 1984. Relationships between lorica volume, carbon, nitrogen and ATP content of tintinnids in Narragansett Bay. *J. Plankton Res.*, 6: 859-868.

6 - Kršinić F. and Mušin D., 1981. Mikrozooplankton Malostonskog zaljeva i Malog mora. *In*: Roglić J. and Meštrov M. (eds), Zbornik radova: Malostonski zaljev, prirodne pojave i društveno valoriziranje, JAVZ Hrvatska, Dubrovnik, pp. 108-119.

7 - Viličić D., Kršinić F., Carić M., Jasprica N., Bobanović-Ćolić S. and Mikuš J., 1995. Plankton and hydrography in a moderate eutroficated eastern Adriatic bay (Gruž Bay). *Hydrobiologia,* 304: 9-22.

8 - Paranjape M.A., 1980. Occurrence and significance of resting cysts in a hyaline tintinnid *Helicostomella subulata* (Ehre.) JÅŚrgensen. *J. Exp. Mar. Biol. Ecol.*, 48: 23-33.

9 - Lipej L., 1992. Mikrozooplankton v prehranjevalni verigi južnega dela Tržaškega zaliva. MS thesis, University of Zagreb, Croatia.