CHANGES IN THE CILIATE COMMUNITY OF EUTROPHICATED VRANJIC BASIN (MIDDLE ADRIATIC SEA) DURING 2004-2005

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Abstract
Temporal variability in ciliate abundances was investigated in eutrophicated Vranjic Basin (middle Adriatic), before and after activation of new sewage system. The differences were evident in the absence of nonloricate summer peak and reduction of average nonloricate and tintinnid abundances in 2005, 2.3 and 1.9 times, respectively. The distinction in tintinnid taxonomical composition between years was not noticed.
Keywords: Adriatic Sea, Density, Eutrophication, Zooplankton

The effects of eutrophication in the Kaštela Bay, primarily in the phytoplankton community, were first observed at the end of seventies. Since the end of 1980, summer "red tide" blooms have occurred regularly [1], causing occasional mortalities to shellfish and demersal fish. These biological changes were accompanied by oxygen supersaturation in the surface and hypoxia in the bottom layers. After the activation of modern sewage system in November 2004, disappearance of nutrient and oxygen extremes, decrease in bacterial and phytoplankton abundance and production, and re-establishment of the phytoplankton regular seasonal cycle were recorded [2].

In the Vranjic Basin the ciliates are an important zooplankton fraction, characterised by high biomass and intensive population dynamics [3]. As a result of their short generation time, they respond almost instantaneously to various environmental fluctuations and can act as stabilizers of the water-column community [4]. Therefore the aim of this study was to investigate possible changes in nonloricate (NLC) and tintinnid (TIN) assemblages after the activation of new sewage system.

Monthly samples were collected at one station located in the Vranjic Basin (43° 31.9'N; 16°27.2'E) in the middle Adriatic Sea, from January 2004 until November 2005, at 5 m depth intervals between the surface and bottom (15 m), using 5 l Niskin bottles. The plankton material was preserved and prepared for microscopic analysis as described in the reference [3].

Average column ciliate density values in the Vranjic Basin in 2004 ranged from 404±131 (December) to 2510±1638 ind.L^{-1} (May), while the oscillations in 2005 decreased by the factor 2.2, ranging from 75±54 (January) to 829±249 (September). Temporal variability was primarily due to changes in NLC community (r=0.95; p<0.0001; N=67), representing 34.0-96.4% of the total ciliate abundance.

The most prominent feature of NLC seasonal dynamics was the occurrence of three peaks in 2004, and two in 2005 (figure 1). Unlike the spring and autumn increases recorded in both years, the summer maximum was not found in 2005. During the whole investigated period, the highest average abundance values of 1545±1350 and 575±283 ind.L^{-1} were recorded in May, while autumn maxima were somewhat less pronounced. Apart from the high TIN abundances recorded in spring 2004, with the average column values of 966±593 ind.L^{-1} in May, TIN concentrations did not vary significantly during the rest of sampling period (figure 1).

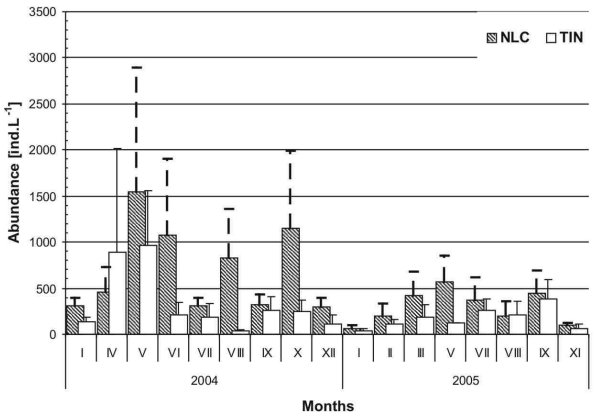

Fig. 1. Seasonal distribution of ciliates in the Vranjic Basin during the 2004-2005 (NLC, nonloricate ciliates; TIN, tintinnids)

In both sampling years the NLC vertical distribution was characterised by quite homogenous distribution during the isothermal conditions. However, temperature stratification caused the redistribution of NLC, with the maximum in surface layers, particularly in May 2004 (3389 ind-L^{-1} at 0 m). The exception was noted only in October 2004, when majority of NLC migrated to 10 m depth (2176 ind-L^{-1}). Apart from the hydrographical properties of the Basin, vertical distribution of TIN was related to their taxonomical structure. Among 44 determinated TIN species, statistical analysis extracted *Favella ehrenbergii*, *Codonellopsis schabi*, *Tintinnopsis beroidea* and *Helicostomella subulata* as discriminator species that contributed to dissimilarities between the sampling years with 23.4%.

Although the differences in ciliate abundances between 2004 and 2005 were not significant (p=0.0592), the distinction was clearly evident in the absence of NLC summer peak and reduction of average NLC and TIN abundances in 2005, 2.3 and 1.9 times, respectively [3, 5]. The differences in TIN taxonomical composition between years were not evident.

Future long-term investigations of the trophic relationships within microbial food web and interactions with abiotic environmental factors are needed for better explanation and understanding of ciliate role in this eutrophic marine ecosystem.

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