DISTRIBUTION AND TAXONOMIC COMPOSITION OF PHYTOPLANKTON IN A SHALLOW, ADRIATIC ESTUARY (ZRMANJA, JULY 2000)

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Abstract

The abundance and taxonomic composition of phytoplankton was determined in the highly stratified Zrmanja Estuary, eastern Adriatic Sea, Croatia, during the low river inflow (July 2000). Microphytoplankton accumulated in the middle reach of the estuary, were the living conditions were most stabile. Accumulation of nanoplankton, at the head of the estuary, indicated higher microbiological recycling of organic mater. CCA biplot indicated the diatom *Chaetoceros socialis*, as well as cryptophytes and nanoplanktonic dinoflagellates, developing exclusively in the estuary, while the rest of phytoplankton community had freshwater or seawater origin.

Key words: phytoplankton, estuary, Adriatic Sea

Introduction

The karstic Zrmanja River discharges into the Adriatic Sea forming a small, highly stratified estuary. Stratified water column is characterized by the sharp and shallow halocline (1). The concentration of orthophosphates is low and increased downstream in the estuary. Higher concentrations of total inorganic nitrogen (TIN) and silicates (SiO_4) is usually detected in the upper estuary. Concentration and distribution of nutrients indicates oligotrophic conditions in the estuary.

Material and Methods

The research was carried out in upper (Stations Z1, Z2, Z3, Z4, Z4a, Z4b) and middle (Station N1) reach of Zrmanja Estuary (Fig. 1) in July 2000. Phytoplankton samples were taken using 5l Niskin bottles at one meter intervals along the water column. Phytoplankton was preserved in a 2% neutralized formaldehid solution and counted by inverted microscope method (2). Canonical Correspondence Analysis (CCA; 3) was used to display influences of environmental conditions on distribution and taxonomic composition of dominant phytoplankton taxa.

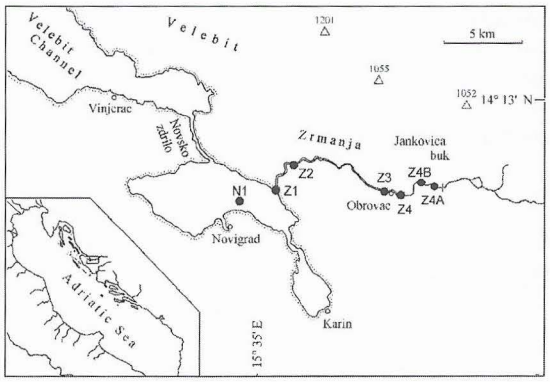

Fig.1. Investigated area.

Results and Discussion

In July 2000, marine microphytoplankton dominated in the community, below the halocline, in middle reach of the estuary (5×10^5 cellsL^{-1}). It was composed of diatoms (51%), dinoflagellates (37%), coccolithophorides (8%), euglenophytes (2%) and chrysophyceae (2 %). The abundance decreased in the upstream direction. At the head of the estuary, at station Z4a, the abundance of freshwater species (*Dinobryon* spp. and pennate diatoms) increased. Freshwater phytoplankton sank to the halocline and died gradually in the seaward direction.

Nanoplankton accumulated at the head of the estuary (6.4×10^5 cells L^{-1}). It was composed of dinoflagellates, coccolithophorides, cryptophytes and green flagellates.

Microphytoplankton reached maximum abundance in the middle reach of the estuary due to most stabile living conditions. On the other hand, in the upper estuary, living conditions are stressful providing adequate growth conditions only for nanoplankton. In the upper estuary, nanoplankton was probably composed of mixotrophic species that participate in the microbiological recycling of organic matter.

The frequent diatom in the estuary was *Chaetoceros socialis*, that usually forms large chains and is thus considered as microphytoplankton. In the Zrmanja estuary it was present as single-cell species, and followed the distribution of other nanoplankton.

Orthophosphates and nitrites are products of microbiological regeneration in the estuary. Nanoplanktonic dinoflagellates (I), cryptophytes (K) and *Chaetoceros socialis* (M) showed high correlation (Fig. 2) with orthophosphates (PO4) and nitrites (NO2), indicating their development exclusively in the estuary.

Green flagellates(L), freshwater pennate diatoms (N) and brackish diatom *Cocconeis scutellum* (B) show high correlation with nitrates (NO3) and silicates (SiO4) indicating their freshwater origin and ability to maintain in the estuary.

The coccolithophorid *Syracosphaera pulchra* (A), as well as the diatoms *Proboscia alata* (D) and Leptocylindrus danicus (C) showed high correlation with salinity (S) and ammonium (NH4), indicating their seawater origin.

Nanoplanktonic coccolithophorides (J), the diatoms *Cyclotella striata* (F), *Pseudo-nitzschia* sp. (E) and the dinoflagellate *Mesoporos perforatus* (G) showed negative correlation with the rest of the estuary community, preferring lower temperatures (T) and higher salinity.

Conclusion

According to CCA biplot, nanoplankton was the most characteristic phytoplankton in the upper Zrmanja estuary, while microphytoplankton came either from the sea or from the freshwater accumulations above the estuary. Freshwater species mostly die in the estuary, due to stressful environmental conditions along the salinity gradient. Phytoplankton community in the Zrmanja estuary is composed mostly of species that can tolerate stressful environmental conditions.

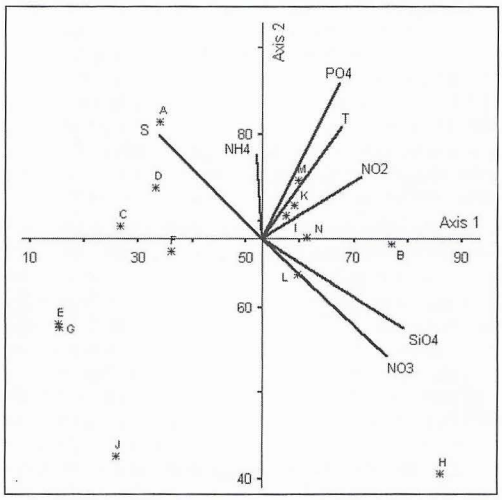

Fig. 2. CCA ordination biplot. Species and enviromental labes are listed in the text. Environmental variables are displayed as lines.

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