LONG-TERM CHANGES IN PHYTOPLANKTON COMMUNITY STRUCTURE FROM 1989 TO 2002, ADRIATIC SEA

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Abstract

Phytoplankton abundance was followed from 1989 to 2002 in a shallow coastal area (Adriatic Sea) and the multivariate method STATIS was used to detect any annual pattern common to 14 years. The results indicated a uniform annual distribution of phytoplankton with inter-annual changes of particular groups. Diatoms and nanoflagellates, which generally account for the majority of total abundance, had a very constant distribution through the years but they peaked in different seasons. Other groups were characterised by larger inter-annual changes, although their abundance was too low to affect significantly the general dynamic.

Key words: phytoplankton, long-term study, Adriatic

Introduction

Important information on the functioning of marine pelagic ecosystems comes from planktonic long-term studies. This knowledge is even more valuable in sensitive coastal areas and estuaries (in 1), including Adriatic Sea and its northernmost basin – the Gulf of Trieste (2, 3), where physical and biochemical processes are mainly driven by freshwater flows and nutrient loading. This work comprises a 14-year long time-series of phytoplankton abundance and community structure of the Gulf of Trieste. Phytoplankton dynamic was followed during routine monitoring from 1989 to 2002. Since the number of samples was not the same each year the multivariate method STATIS (4) was used to compare changes between years instead of time-series analysis. With this approach we tried to detect any annual pattern common to 14 years and to determine whether this pattern is stable over time or not.

Material and methods

Seawater samples for phytoplankton analysis were taken almost monthly from 1989 to 2002 on one station (21 m deep) in the Gulf of Trieste. Only data of surface layer were considered. Organisms belonging to diatoms, dinoflagellates, coccolithophorids, silicoflagellates and one non-taxonomic group (nanoflagellates) were counted on an inverted microscope (5). The results of STATIS analysis are based on a total of 160 samples.

Results and discussion

Simple time-series distribution of total abundance' medians suggested moderate differences among the years while the size of the boxes and extend of the maximum values pointed out the years with large blooms (Fig. 1). Instead, the STATIS inter-structure analysis revealed a uniform distribution of phytoplankton abundance over the 14 years on the first axis (data not shown). Since this axis explains 91 % of the total inertia, these results indicated a strong common annual pattern. The intra-structure analysis - the trajectories, showed changes of the phytoplankton groups through the study period (Fig. 2). Grouping of diatoms and nanoflagellates on the opposite sides along the first axis indicated a very constant distribution, though with different seasonal characteristics of both groups. Nanoflagellates had one distinctive and long period of predominance in spring, while diatoms abrupt significantly in autumn and July. The usual early-spring peak was apparently not constant enough in time to be identified as a baricenter by the STATIS analysis. Dinoflagellates and coccolithophorids were, on the contrary, characterised by larger inter-annual changes. These changes were due to different occurrence of seasonal blooms or to their absence. Although the trajectory of silicoflagellates appeared the most variable among all groups, this is likely due to the combination of very irregular occurrence through the year and low abundance rather than inter-annual variations.

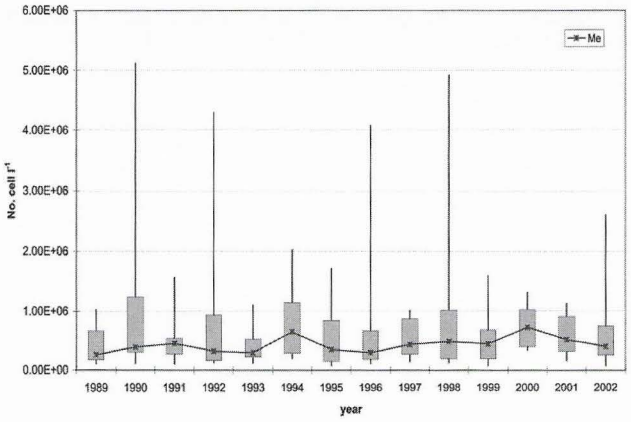

Fig. 1. Medians, quartiles (boxes) and minimal and maximal values (low-high lines) of total phytoplankton abundance, 1989-2002.

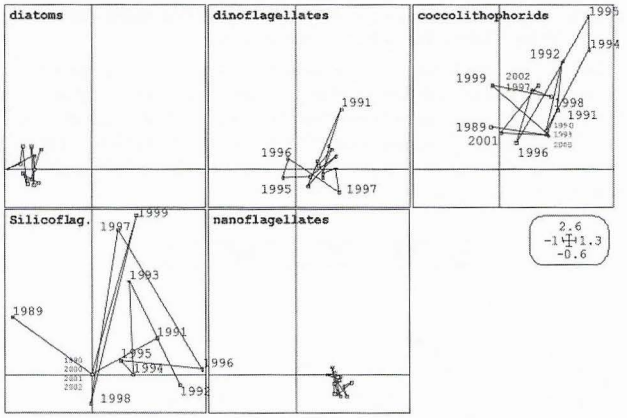

Fig. 2. Trajectories of phytoplankton groups derived from the STATIS intra-structure analysis, 1989-2002.

The present study revealed a uniform distribution of phytoplankton with inter-annual changes of particular groups, which, however, did not expose any single year. This would suggest that physical-chemical properties of the Gulf remained relatively stable or they did not affect the structure on the group level. Nevertheless, this necessitates for additional analysis on species level, which would probably point out seasonal variations or shift in dominating species and help to explain changes in trophic structure observed in last decades.

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