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RESEARCH ARTICLE

Macrozoobenthic communities as a tool for assessment the ecological status of Varna lagoon.

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Abstract

The main objectives of the present study are:

1 - to assess the ecological status of Varna lagoon

2 - to identify the environmental factors governing the community pattern.

Introduction

Benthic invertebrates are used extensively as indicator of environmental status because numerous studies have demonstrated that benthos responds predictably to many kinds of natural and anthropogenic stress (Dauer, 1993; Tapp *et al.* 1993; Wilson and Jeffrey 1994; Ahn *et al.*, 1995). A number of biotic indices based on benthic community health have been developed to classify the ecological status of coastal and transitional (Borja *et al.,* 2000; Muxika *et al.,* 2006; Simboura & Zenetos, 2002) in accordance with the requirements of Water Framework Directive 2000/60/EC. The body-size distribution is alternative method for studying the structure and disturbance of benthic communities. Macroinvertebrates can be used to understand the combination of certain environmental factors affecting the structure of benthic communities.

Material and methods

The study area is located at the western part of the Black Sea coast and includes the Varna Lake, the navigation canal between the lake and Varna Bay and Varna Bay. Five sampling sites (Fig. 1) have been selected taking into account the environmental gradient of nutrients, which concentration decrease from lake to bay.

Seasonal samples from water column and soft bottom sediments have been collected in late autumn of 2004, spring and summer of 2005 to study the abiotic parameters of the environment and biotic features of macrozoobenthos. In the laboratory macroinvertebrates were removed from the remaining sediment and separated to morphological functional group level. Each invertebrate was identified at the lowest possible taxonomic level and measured along its main axis with image analysis system (Leica Mz12, photo-camera Leica IC A, software Leica Qwin). For determination of abundance individuals of each species or higher taxa were counted. Each measured macroinvertebrate was desiccated in a stove for at least 72h at 60°C and after drying was weighed on an electronic micro-scales (± 0.001mg) to determine the biomass. Primer 5.0 and AMBI 4.0 Software Programme Packages were employed in the analysis of data.

The classification of ecological status, following the requirements of WFD 60/2000/EC, is done by Shannon diversity index (H’), a Marine Biotic Index (AMBI) and multivariate AMBI (M-AMBI).

Results and discussions

The biotic indices (species richness S, Margaleff index d and Shannon diversity index

H'), calculated on the abundance data, increase in conformity with the diminishing of nutrients load thus reflecting the improvement of water quality.
The share of opportunistic species (polychaetes and oligochaetes) in the total abundance decrease with lowering the concentration of nutrients and the share of conservative (molluscs) and sensitive (crustaceans) species increase in the same direction (Fig. 1). These changes of benthic community, i. e. elimination of conservative and sensitive species in favour of tolerant opportunistic species (Pearson & Rosenberg, 1978), reflect the effect of environmental conditions on community pattern.
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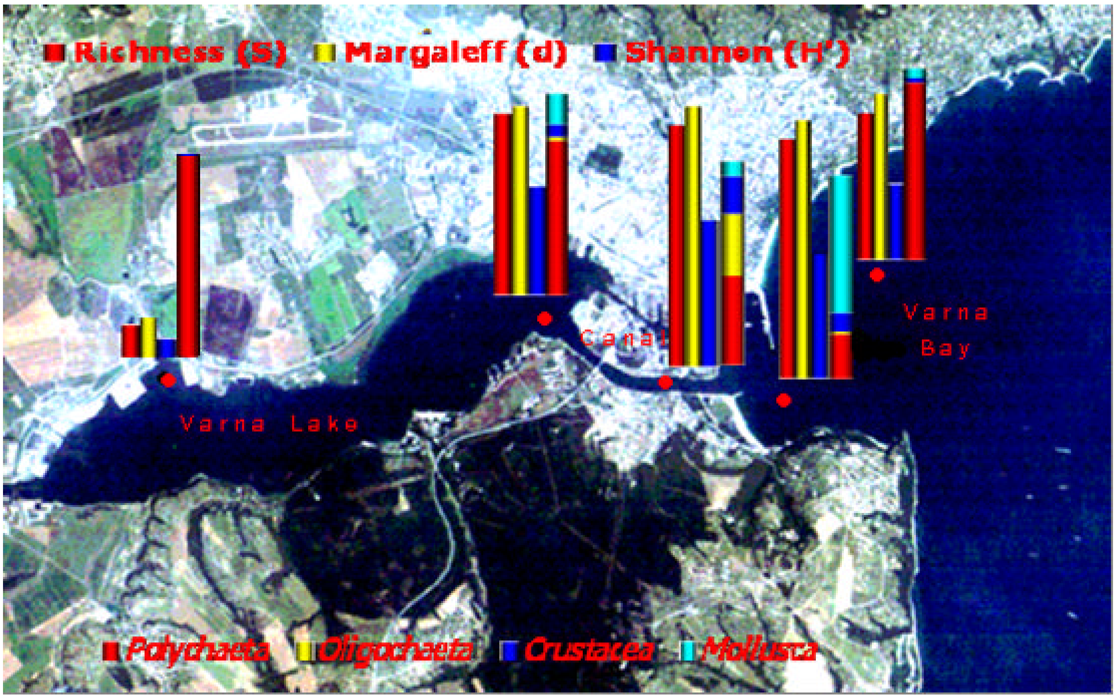

Figure 1. Location of sampling stations, values of biotic indices species richness, Margaleff, Shannon diversity and percentage share of main taxonomic group in the community structure.

The classification of ecological status according to value of Shannon diversity index ranks the lake site in bad, the canal sites in poor and moderate and the bay sites in moderate and poor status respectively. The ecological status assessed by the index AMBI (Borja *et al.,* 2000) classifies the lake site in bad status, the canal sites in good and poor, and the bay sites in good status. The multivariate AMBI (M-AMBI) (Muxika *et al.,* 2006) combining the values of AMBI, species richness and Shannon diversity categorizes the lake site in bad status, the canal sites in bad and poor status and the bay sites in moderate and poor ecological status (Tab. 1).
It is obvious form the table that the overall classification of ecological status differentiates depending on the indices applied. The exception is the lake station which ecological status is classified as bad by the three metrics due to the dominance of opportunistic species. For the second canal site the status falls into two neighbour categories. For the rest of the sites higher degree of inconsistency in classification is observed.
The size structure of macrozoobenthos reveals diversification of body length classes and increasing the width of body size distribution from lake to bay. The weight per length ratio also increases in the same direction suggesting that lighter individuals develop in lake environment.
The best combination of variables explaining the biological pattern is found to be the salinity, the organic carbon percentage in sediments and

the percentage share of sand fraction (Spearman rank correlation ? = 0.818). The environmental variables and community pattern show good correspondence (Fig. 2).

Table 1**.** Ecological status classification according to the biotic indices

Site	H'	AMBI	M-AMBI
Lake	Bad	Bad	Bad
Canal	Poor	Good	Bad
Canal	Moderate	Poor	Poor
Bay	Moderate	Good	Moderate
Bay	Poor	Good	Poor

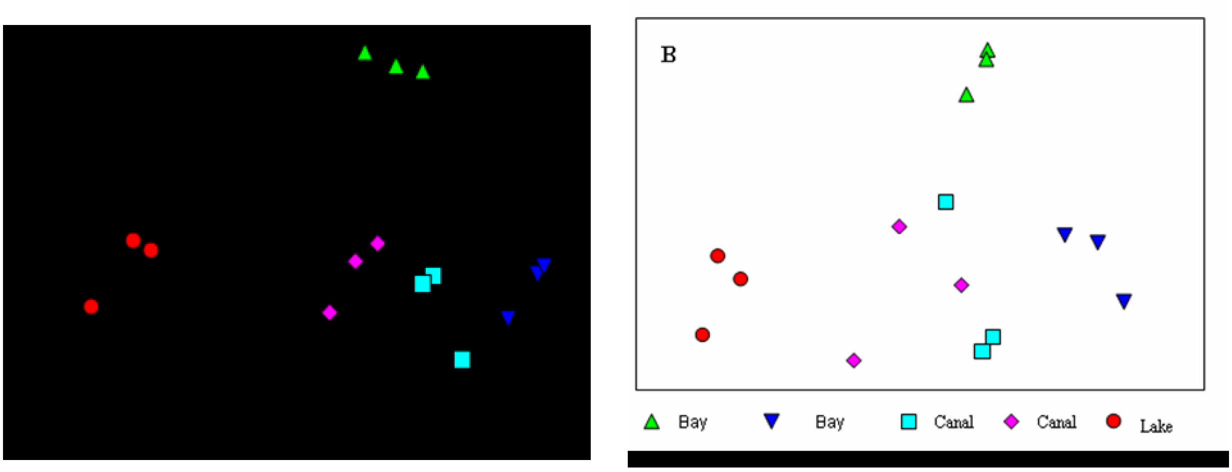

Figure 2. PCA of selected environmental variables (A) and BIOENV analysis of macrozoobenthos community pattern (B).

Conclusions

The biotic and multivariate indices for evaluation the disturbance of benthic communities are reliable tool for categorization of the ecological status in accordance with the requirements of WFD 60/2000/EC. Because some inconsistencies in the classification have been detected, the metrics require further validation for better understanding of the community response to different natural and/or anthropogenic pressures.

Body size distribution of benthic assemblages appears to be an objective method for assessment of the ecological status.

The environmental factors affecting the structure of benthic community should be taken into consideration in the process of ecological status scaling.

Acknowledgments

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