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RESEARCH ARTICLE

Taxonomic benthic biotic indices in transitional waters: study cases from northern Adriatic and Black Sea.

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Abstract

1 - Four taxonomic benthic biotic indices (AMBI, BENTIX, Engle's and Paul's B-IBIs) were used to analyse benthic assemblages in two transitional water ecosystems: Pialassa Baiona, northern Adriatic Sea, and Varna lake, Black Sea.

2 - The environmental quality assessments provided by the different indices is not consistent with the patterns of environmental quality of the investigated sites. Moreover, these indices provide ambiguous information on effects of sea-land gradient and/or anthropogenic disturbance on transitional ecosystems.

3 - In transitional waters, ecological classification based on biotic indices requires an adjustment for the reference conditions, environmental features and habitat typologies.

Introduction

Biotic indices have been developed as synthetic methods aimed to provide quantitative information on ecological condition, structure and function of ecosystems, based on measures of some biotic attributes. A good biotic index should reflect the integrity of the assemblages and react to environmental stresses in monotonic way. Its attributes should be precision, cost-effectiveness, not invasive. The "taxonomic" indices utilising macrobenthos are based on the properties of assemblages, such as species diversity, relative abundance, sensitivity to disturbance, and reproductive or trophic strategies. These indices could be based on one or several metrics. Although for some application higher taxa or taxa enumeration could be sufficient, in most case the identification of the specimens at the species level is required.

In the present study four benthic biotic indices, based on two different approaches, were used to analyse benthic assemblages in two transitional water ecosystems: Pialassa Baiona and Varna lake. Results obtained form the different indices were discussed.

Material and Methods

Pialassa Baiona is a eutrophic micro-tidal lagoon located along the northern Adriatic Italian coast (44° 29' N, 12° 14' E). Artificial embankments divide the lagoon into several semi-enclosed shallow water ponds. Main ponds are connected by channels (1 to 8 m deep). The lagoon receives water inputs from five main channels that drain a watershed of 264 km^2. The ecosystem is affected by nutrients, chemical and thermal pollution from urban and industrial treatment plants and two thermo-electric power stations located along the southern edge. Summertime phytoplankton blooms, intense growth of seaweeds (*Ulva* sp., *Enteromorpha* sp., *Gracilaria* sp.) and dystrophic crises were often recorded. Sediment chemical pollution mainly concerns heavy metals (Trombini *et al.*, 2003) and polycyclic aromatic hydrocarbon (Fabbri *et al.*, 2003).

Varna Lake is located along Bulgarian Black Sea coast (43° 11' N, 27° 48' E). The lake is impacted by human activities receiving pollutants from chemical industry, agriculture, sewage plants, inflow of cooling water from a power plant, shipping activities due to presence of ports. During the last decades the high organic loads in the sediments determined recurrent hypoxia/anoxia and mass mortality of benthic invertebrates (Trayanova *et al*., 2003).

In Pialassa Baiona lagoon four sampling station were randomly chosen in the muddy and unvegetated channels along the gradient of anthropogenic stress, while in Varna lake five sampling station were located along a transect from the inner part towards the sea, with sediments characteristics varying form mud to unvegetated sand. At each station samples of macrobenthos have been sampled in autumn 2004.

The *AMBI* (*A*ZTI’ Marine Biotic Index; Borja *et al*., 2000), *BENTIX* (Simboura and Zenetos, 2002) and two indexes of biotic integrity: the Benthic Index of Environmental Condition of Gulf of Mexico Estuaries, hereafter Engle’s *B-IBI* (Engle, 2000) and the Benthic Index of Estuarine Condition for the Virginian Biogeographic Province, hereafter Paul’s *B-IBI* (Paul *et al*., 2001), have been used.

AMBI and *BENTIX* are exclusively based on species sensitivities. In the *AMBI* framework, species were assigned to five ecological groups based on their sensitivity to organic enrichment, while *BENTIX* considered only three groups. *AMBI* values were calculated for each replicate sample using the software AMBI ver. 3.0 with the latest version of the classification inventory and following the published guidelines (Borja and Muxika, 2005). *BENTIX* values were calculated according to groups of species provided by Simboura and Zenetos (2002), completing the list recurring to the classification inventory included in the AMBI software. In both cases species not assigned were not included in the calculations.

Engle’s *B-IBI* is a linear combination of five metrics originally selected on a broad range of candidate measures using discriminant analysis done on the dataset collected for the monitoring of the estuaries in the Gulf of Mexico. The calculation procedure, based on three replicate samples, takes into account the salinity.

Paul’s *B-IBI* was developed similarly to Engle’s *B-IBI* using discriminant analysis on a broad range of candidate metrics and a wide dataset collected for the monitoring program of the Virginian estuaries. The selected metrics are salinity-normalized Gleason’s diversity index, the mean abundances of spionid polychaetes, and salinity-normalized tubificid oligochaetes abundance.

AMBI and *BENTIX* provide a classification scheme of the water body in five classes of ecological status (high, good, moderate, poor, and bad), while Engle and Paul’s *B-IBIs* provide only a threshold between putative pristine and degraded sites.

Result and discussions

AMBI and *BENTIX* classified the environmental quality of Pialassa Baiona as moderate – poor, and did not detect any clear gradient of anthropogenic stress (Fig. 1). The classifications provided by Engle’s *B-IBI* seems in accordance with the gradient of anthropogenic pressure, instead the classification provided by Paul’s *B-IBI* appeared inversely related to it.

In Varna lake *AMBI* and *BENTIX* provided different classifications of the environmental quality and did not show any clear gradient (Fig. 2). Engle’s *B-IBI* showed a fluctuating trends form the inner to the outer side of the lake, while Paul’s *B-IBI* showed a clear inside-outside gradient (Fig. 2).

The environmental quality assessments provided by the different indices is not consistent with the patterns of environmental quality of the investigated sites. The ecological indices we have tested do provide ambiguous information on effects of sea-land gradient and/or anthropogenic disturbance on transitional ecosystems. Moreover, the application of these indices required taxonomic expertise and a deep knowledge of the responses of the single species to different sources of disturbance in each ecosystem. Ecological classification based on biotic indices requires an adjustment for the reference conditions, environmental features and habitat typologies.

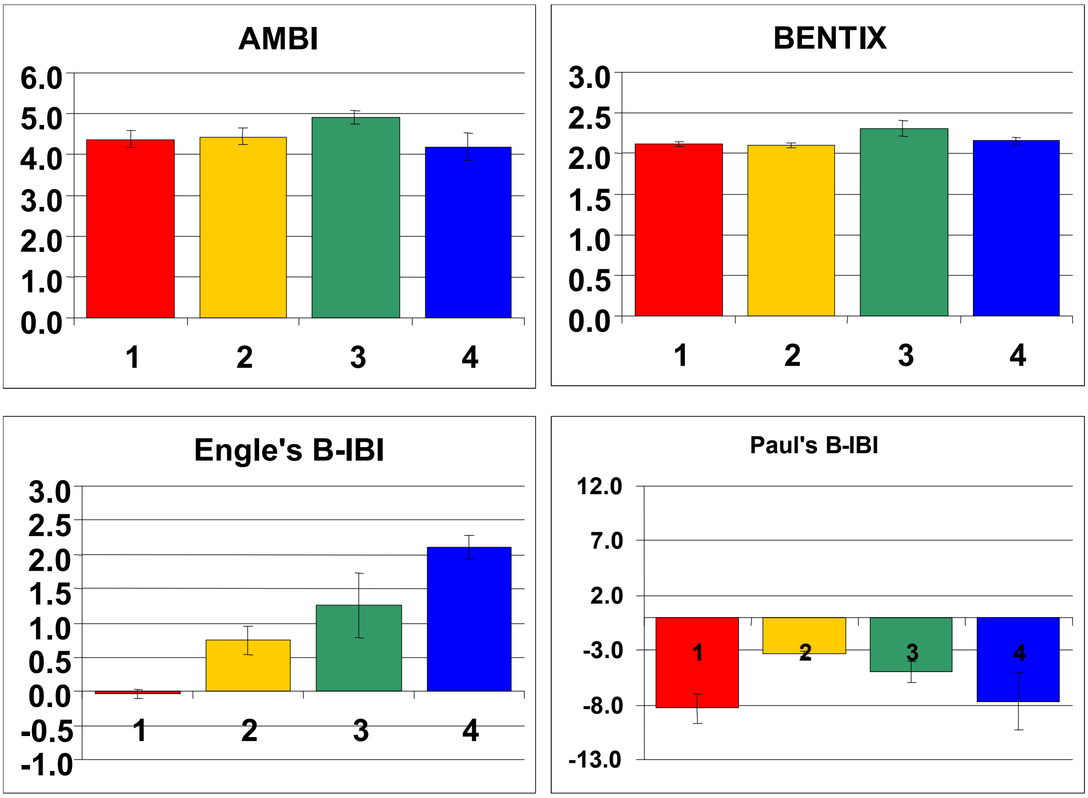

Figure 1. Taxonomic macrobenthic indices (±se) calculated for each Pialassa Baiona sampling site along the anthropogenic pressure gradient (from more [1] to less [4] impacted areas).

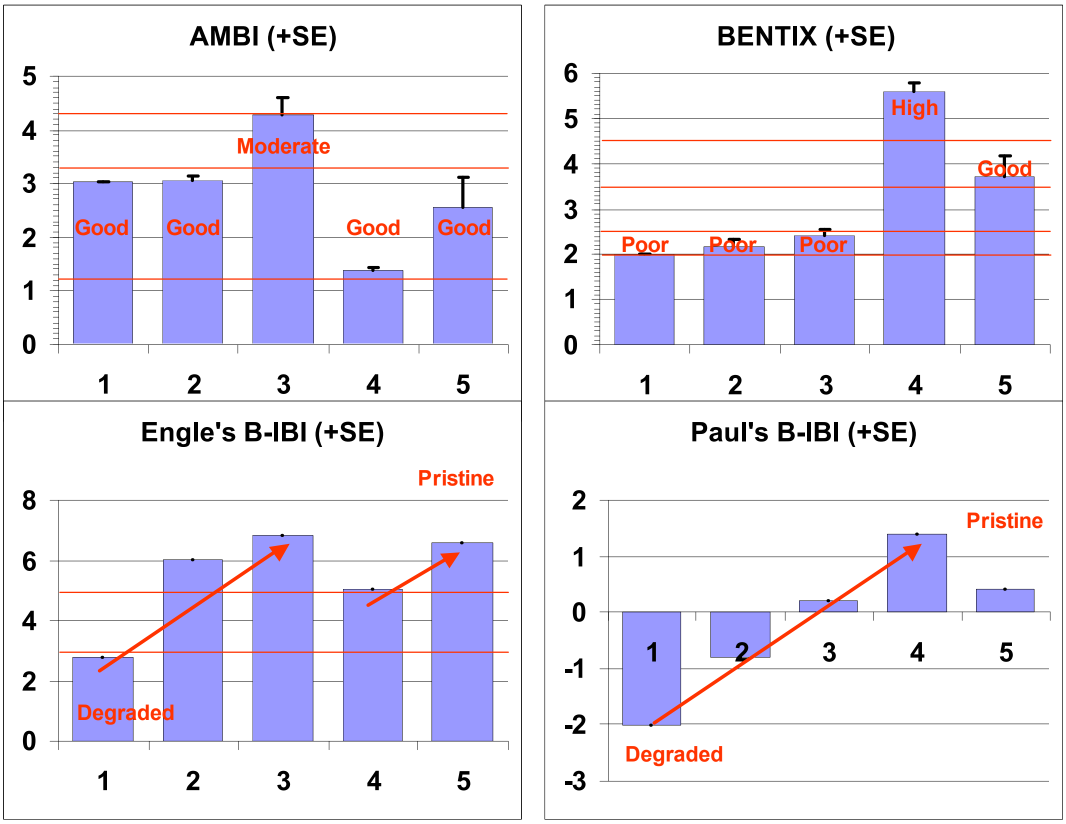

Figure 2. Taxonomic macrobenthic indices (±se) calculated for each Varna lake sampling site (from inner part [1-3] to open sea [4-5]).

Data collected in the frame of the TWReferenceNET project provide the opportunity to test the available indices over a wide range of habitats and may allow the development of an integrated approach to the quality assessment of Mediterranean and Black Sea transitional waters.

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References

Borja A., J. Franco, V. Pérez. 2000. A marine biotic index to establish the ecological quality of soft-bottom benthos within European estuarine and coastal environments. *Marine Pollution Bulletin* **40**: 1100-1114.

Borja A., H. Muxika. 2005. Guidelines for the use of AMBI (AZTI's Marine Biotic Index) in the assessment of the benthic ecological quality. *Marine Pollution Bulletin* **50**: 787-789.

Engle V. D. 2000. Application of the indicator evaluation guidelines to an index of benthic condition for Gulf of Mexico estuaries. In Jackson L. E., J. C. Kurtz, W. S. Fisher. *Evaluation guidelines for ecological indicators*. U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, NC: 3-1/3-29.

Fabbri D., I. Vassura, C.-G. Sun, C. E. Snape, C. McRae, A. E. Fallick. 2003. Source apportionment of polycyclic aromatic hydrocarbons in a coastal lagoon by molecular and isotopic characterisation. *Marine Chemistry* **84**: 123-135.

Paul J. F., K. J. Scott, D. E. Campbell, J. H. Gentile, C. S. Strobel, R. M. Valente, S. B. Weisberg, A. F. Holland, J. A. Ranasinghe. 2001. Developing and applying a benthic index of estuarine condition for the Virginian Biogeographic Province. *Ecological Indicators* **1**: 83-99.

Simboura N., A. Zenetos. 2002. Benthic indicators to use in Ecological quality classification of Mediterranean soft bottom marine ecosystems, including a new Biotic Index. *Mediterranean Marine Science* **3**: 77-111.

Trayanova A., K. Stefanova, T. Trayanov, N. Niermann. 2003. Zooplankton and Macrozoobenthic communities of the Varna-Beloslav Lake system 1906 - 2001: How economy and industry affected the ecology, a case study. In *Proceeding of Second International Conference on Oceanography of the Eastern Mediterranean and Black Sea: Similarities and Differences of Two Interconnected Basins*, 799-804.

Trombini C., D. Fabbri, M. Lombardo, I. Vassura, E. Zavoli, M. Horvat. 2003. Mercury and methylmercury contamination in surficial sediments and clams of a coastal lagoon (Pialassa Baiona, Ravenna, Italy). *Continental Shelf Research* **23**: 1821-1831.