

The use of the marine biotic index AMBI in the assessment of the ecological status of the Óbidos lagoon (Portugal)

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Abstract

This study reports the longitudinal distribution of sediment properties, including inorganic and organic contaminants, and the structure of the benthic community in Óbidos lagoon, a coastal system permanently connected to the sea and with negligible freshwater sources. Sediments from the upper to central lagoon consist of fine particles (91%) and from the lower lagoon of sands (94%). Chemical composition is strongly correlated to the percentage of fine particles. Contamination is relatively low in those sediments suggesting the effect of diffuse sources. The increase in organic matter content from down- to upstream areas was associated with the dominance of opportunistic species, while sensitive and indifferent species to organic enrichment were mainly associated to the clean sandy downstream area. The marine biotic index (AMBI) was suitable for the discrimination of the biological and environmental gradients in the Óbidos lagoon and was highly related with the gradient of organic matter content in this system.

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1. Introduction

Benthic assemblages are broadly recognised as a proper tool to describe ecological conditions of marine and brackish systems. Nevertheless, some shallow coastal areas of Europe remain poorly documented in terms of general composition, structure or ecology (Rueda et al., 2001). Infaunal communities are in direct contact with the sediment, where organic matter and multiple contaminants are accumulated, and also have an important role on the structure and functioning of ecosystems (Rhoads et al., 1978; Chapman et al., 1987; Rees et al., 1990). Distribution patterns of macrobenthic communities are usually associ-

ated with environmental variables, such as salinity, grain-size, organic carbon, and the presence of contaminants (see reviews by Gray, 1974; Snelgrove and Butman, 1994). The influence of each of these variables is difficult to isolate due to the dynamics of water column and spatial variability of sediment properties existing in coastal ecosystems. However, with the implementation of the Water Framework Directive (WFD) it is crucial, in European waters, to distinguish natural variability from effects of anthropogenic pressures on macrobenthic communities. A wide variety of procedures have been developed aiming to assess the effects of environmental changes on the ecological quality status using macrobenthic communities. These procedures are either related with measures of community structure (species abundance, diversity and faunal composition) and/or community function, such as species colonization rates (Long et al., 1995). The WFD establishes

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that surface waters should be divided into Water Bodies subjected to monitoring in order to determine their Ecological Quality Status (EcoQ). This is done through Biological Quality Elements and Supporting Quality Elements. The EcoQ classes range from High to Bad quality status. The WFD demands EU member states to assess the EcoQ in inland surface waters, transitional (or estuarine) waters, coastal and ground-waters (Borja et al., 2004b). The definition of water bodies – management units – reflects both the significant pressures and the uniformity of state. According to the WFD, the EcoQ should be assessed upon the biological, hydrological, hydromorphological and physico-chemical quality elements, with particular relevance for the biological components (Borja et al., 2004c). Phytoplankton, macroalgae and benthos should be analysed in both coastal and transitional waters, while fish must also be taken into account for the ecological classification of transitional water bodies (Borja et al., 2004b). One method to be used when assessing the EcoQ of transition water bodies is the abundance and species composition of benthic macrofauna that can be complemented with the concept of sensitive and tolerant taxa (Rosenberg et al., 2004). Several ecological indices have also been proposed in order to assess the benthic quality status (Borja et al., 2000; Simbora and Zenetos, 2002; Rosenberg et al., 2004) and some of them were already adapted in conformity with the classifications recommended by the WFD. One of the indices extensively applied in the last years with good results is the Marine Biotic Index (AMBI). This index was developed by Borja et al. (2000) and is based on the assignment of a certain ecological behaviour to each taxon observed during a survey. Five ecological behaviours were established (sensitive, indifferent, tolerant, second-order opportunistic taxa, and first-order opportunistic taxa), based on data from different works and also on the experience of the authors. Borja et al. (2004a) established the equivalence between the values observed by AMBI and the ecological status' classification of the WFD. Moreover, another advantage of this index is the fact that it has been extensively tested for different regions along the European coast by different scientific teams (see Muxika et al., 2005, for a review).

The Óbidos Lagoon is located in the west coast of Portugal. This is a shallow lagoon with a mean depth of 1 m and a wet area of 7 km². It is permanently connected to the sea, although the position and shape of the narrow inlet channel have changed naturally during the last decades. The inner part of the lagoon contains extensive inter-tidal sand flats and channels, ending in two branches oriented to NW and SW, respectively. Freshwater inputs are negligible and water and particles are discharged into these branches only during rainy periods. The influence of the tide extends to the entire lagoon, without pronounced longitudinal variation of salinity and vertical density stratification (Instituto Hidrográfico, unpublished data). The composition and structure of the benthic community within the lagoon were studied in the 1980s (Quintino,

1988) and discussed in light of the morphology, major characteristics of water column and sediment grain size distribution.

This paper reports the longitudinal distribution of sediment properties, including trace elements and organic contaminants, and benthic communities in this coastal lagoon. The aim of the present work was to assess the applicability of the AMBI index in classifying the ecological quality status of this system and to provide baseline information concerning the EcoQ for future monitoring studies.

2. Materials and methods

2.1. Sampling

Surface sediments were collected with a Van Veen grab (0.05 m²) at 24 stations located from upper to lower part of the Óbidos Lagoon in February 2001 (Fig. 1). Five samples were collected at each station. Sediments of three replicates were sieved on board through a 1 mm square mesh and the retained material was fixed in 4% buffered formalin stained with Rose Bengal for macrofaunal studies. The upper 1-cm layer from a fourth replicate was sub-sampled for the determination of organic carbon, chlorophyll *a*, phaeopigments, major, minor and trace elements, and organochlorine compounds. Samples were frozen until subsequent analysis. Additionally, a grab sediment sample was collected at each station for grain-size analysis.

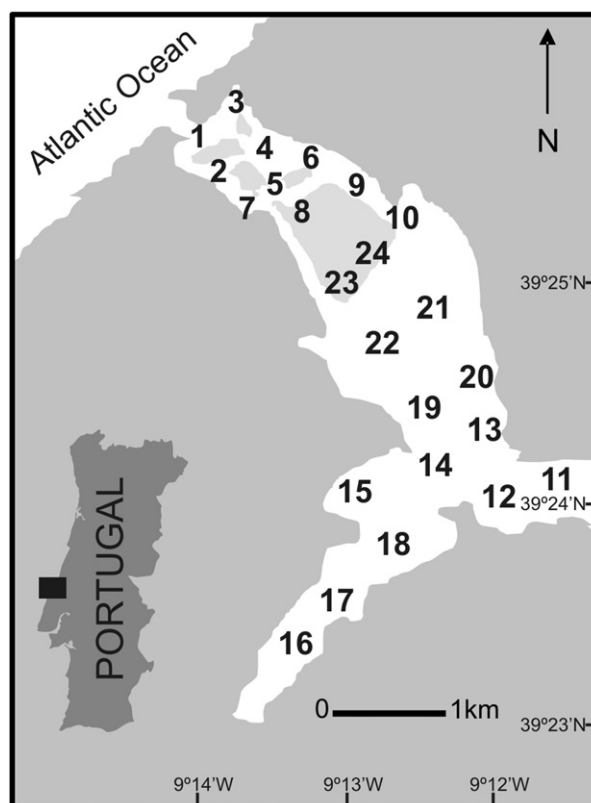


Fig. 1. The Óbidos lagoon. Location of the sampling stations.

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