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# Testing BOPA index in sewage affected soft-bottom communities in the north-western Mediterranean

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ABSTRACT

The implementation of the European directive (ELD) 2000/60/EC has produced the development of several biotic indices based in benthic communities. These indices try to summarise ecological quality status of different communities. However, a universal index that works in all situations is difficult to establish, because there are several sources of variation. Therefore, there is the need for testing and validation of these indices which is required for making management decisions on different scales, and in different regions and communities. In this study we test one of these indices, BOPA index, developed by Dauvin and Ruellet [Dauvin, J.C., Ruellet, T., 2007. Polychaete/amphipod ratio revisited. Marine Pollution Bulletin 55, 215–224] in five locations affected by sewage disposal. These disposals are often released via outfall into shallow subtidal habitats, leading to a common source of pollution in coastal marine environments. BOPA index provides a valuable overview of the gradient status of a benthic environment, discriminating between stations more affected by discharge. Nevertheless, BOPA index, used to establish the ecological quality status, seemed to overestimate the status and hence there is the need to calibrate the thresholds between EcoQs classes as defined for these medium-to-fine sand communities, which are characteristics of shallow sublittoral soft-bottoms of the north-western Mediterranean Sea.



## 1. Introduction

Due to the increase in pressure on aquatic ecosystems which in turn is a consequence of continuous population growth, the European Parliament on 23 October 2000 established a framework for the Community to protect waters, the European directive (ELD) 2000/60/EC. One object of the directive 2000/60 is the protection and improvement of the aquatic environment with the progressive reduction of discharges and emissions. To comply, member states have to ensure that the highest ecological and chemical status possible is achieved, given impacts that could not reasonably have been avoided due to the nature of human activity or pollution.

A common source of pollution in coastal marine environments is sewage discharges that are often released via outfall into shallow subtidal habitats (McIntyre, 1995; Koop and Hutchins, 1996). This source is regulated by the urban waste water treatment directive (91/271/EEC), which established that there is a general need for secondary treatment of urban waste water to prevent the environment being adversely affected by the disposal of insufficiently-treated urban waste water. Member states will monitor and carry out any other relevant studies to verify that the discharge or disposal does not adversely affect the environment. Therefore, identification and characterisation of the locations affected by sewage discharge is necessary for efficient urban waste water management.

For the implementation of both directives it is necessary to have new tools to assess the anthropogenic impacts on marine habitats (Borja et al., 2003). This necessity has led to the development of different indexes based on soft-bottom communities, which summarise ecological status and ecological quality. The relationships between macrofaunal assemblages and the effect of contaminants on them have been described extensively in the literature, (Pearson and Rosenberg, 1978; Gray and Mirza, 1979; Dauvin, 1982; Warwick et al., 1990; Simboura et al., 1995; Estacio et al., 1997; Ellingsen, 2002; Morrisey et al., 2003; Guerra-García and García-Gómez, 2004).

Several biotic indexes have been developed with the aim of standardizing the use of benthic communities in order to establish marine habitat quality. Some of these indices are based on the classification of species (or groups of species) in several ecological groups representing specific sensitivity levels to disturbance. Two of the most widely used developed indexes are AMBI (AZTI, Borja et al., 2000) and BENTIX (Simboura and Zenetos, 2002). Both these indexes require classification to species level. However, this operation is labour intensive and time-consuming, especially for certain difficult groups such as spionid or cirratulid polychaetes, ampeliscid amphipods, etc. (De Biasi et al., 2003). Nevertheless there are others, such as BOPA index, in which the taxonomic effort is reduced. After an initial proposal which had only considered the ratio

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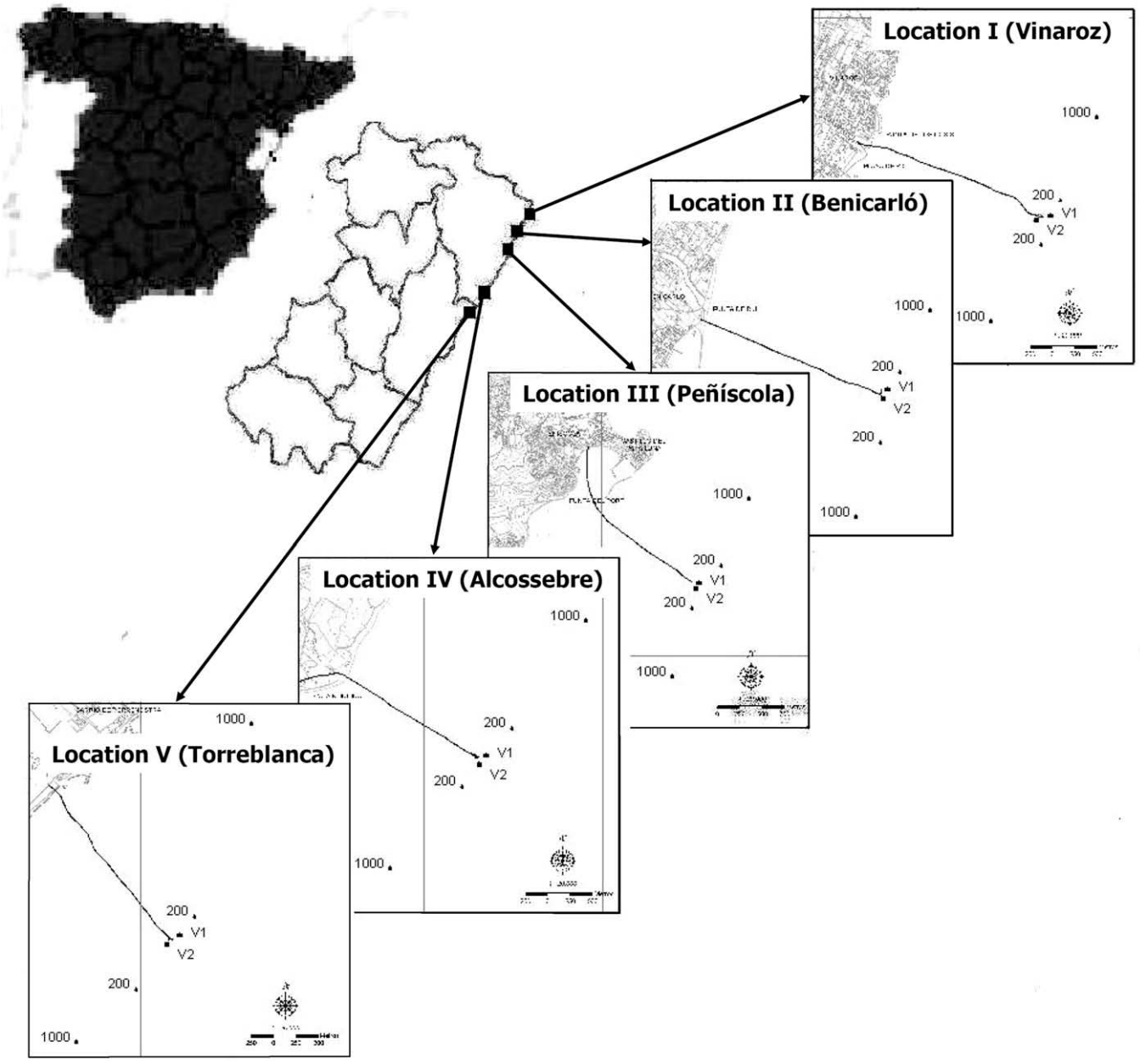


**Fig. 1.** Study area. Location of the five pipelines and the sampling stations.

amphipod/opportunistic polychaetes (Gomez Gesteira and Dauvin, 2000), BOPA has since been created and applied to the soft-bottom communities in the English Channel leading to the proposal of a modified index (Dauvin and Ruellet, 2007). BOPA index is based on ratio opportunistic polychaetes and amphipods (except the genus *Jassa*). Opportunist polychaetes are resistant, indifferent or favoured by organically enriched sedimentary matter, whereas amphipods form a particular zoological group which is sensitive to significant increases in organic matter. The main advantages of this index, as well as the reduced taxonomic knowledge, are its independence of sampling protocols, its use of mesh sieves and of the surface unit chosen to express abundances, since this uses frequency data and the proportion of each category of organism (Pinto et al., 2009).

This index has already been used for monitoring the impact of pollution on different macrobenthic communities (Quintino et al., 2006; Dauvin et al., 2007; Pranovi et al., 2007; Munari and Mistri, 2007, 2008; Afli et al., 2008; Blanchet et al., 2008; Bouchet and Sauriau, 2008). However, a biotic index is unlikely to be universally

**Table 1**
Characteristics of the sewage outfalls analysed: pipeline length, outfall depth and sewage treatment.

| | Pipeline length (m) | Outfall depth (m) | Sewage treatment |
|---|---|---|---|
| Vinaroz (location I) | 2489 | 15.81 | Pre-treatment |
| Benicarló(location II) | 2141 | 14.58 | Pre-treatment |
| Peñíscola (location III) | 2001 | 15.50 | Pre-treatment |
| Alcossebre (location IV) | 1886 | 14.00 | Pre-treatment |
| Torreblanca (location V) | 2175 | 14.00 | Biological treatment of activated sludge, biological aerated filters |