

Methodological procedure for water quality management in port areas at the EU level

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ABSTRACT

ROM 5.1 is an environmental management standard designed by the Spanish National Ports Administration to bring port authorities a standardized tool to increase the knowledge about the connections between anthropogenic disturbance and the environmental attributes of water bodies (pressures/effects relationships). Based on the requirements of the WFD, ROM 5.1 provides a set of technical and methodological tools with capacity to predict and verify environmental problems and to recognise the elements on which management efforts should focus.

As part of the calibration process, this standard has been tested at different Spanish ports, in the Mediterranean Sea, the Atlantic Ocean and the Biscay Gulf. This contribution describes the results obtained in the port of Gijón (Biscay Gulf). In the implementation process the main point and diffuse discharge sources in the port area have been characterized; the significance of the risk caused to the quality of water bodies by these discharges has been evaluated; the effect of the port activity in the water bodies quality has been assessed; and the locations where the management efforts should be focused have been identified. All these processes have demonstrated that although a number of anthropogenic activities and uses with potentially negative impacts take place in the port of Gijón, the disturbance caused in the quality of the water bodies is negligible, local and mostly restricted to the inner and more sheltered areas. As a final outcome, the implementation in Gijón has highlighted the suitability of ROM 5.1 as an integrated tool to manage environmental port challenges.

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1. Introduction

The overall goal of the European Water Framework Directive (WFD; 2000/60/EC) for surface water bodies is to achieve the good ecological status by 2015. However, water bodies substantially modified in their physical features may not be able to harmonize the economic development with the ecological objectives required by the WFD (European Commission, 2003). This category of surface waters, altered to support specific uses, such as navigation or port activities, may be designated as Heavily Modified Water Bodies (HMWB) from a socio-economic perspective, when the cessation of such uses and the removal of the physical modifications would have significant adverse effects on water uses (Kampa and Laaser, 2009). Once a water body is designated as HMWB its status should be based on the good ecological potential, instead the good ecological status required to evaluate natural water bodies (CIS, 2006).

The management approach of the WFD focuses on the application of integrated policies for the aquatic systems. Ports are not

an exception and their sustainability depends on the application of well-defined environmental management instruments considering social, economic, legal, technical and environmental imperatives (Wooldridge et al., 1999). In the last years, a number of methodologies to analyse the environmental risks (Aenor, 2004; Wang et al., 2004; Jones et al., 2005; Peris-Mora et al., 2005; Ronza et al., 2006; Eide et al., 2007; Grifoll et al., 2010; Petrosillo et al., 2010), or the status and evolution of port environments (Darbra et al., 2004; Xu et al., 2004; Darbra et al., 2005; Borja and Elliot, 2007; Marin et al., 2008; Quynh et al., 2011) have been developed. These examples confirm an evolution towards management approaches in which both the economic and the environmental factors are considered as development variables. Most of them are specific approaches to provide answers for legal requirements, control port management sustainability, identify significant environmental aspects or prevent and assess water quality degradation. However, a complete sustainability can only be achieved by tools integrating together all these aspects.

This paper introduces ROM 5.1, a methodological standard directed to unify and group the set of tools adopted by ports to satisfy the environmental requirements. This standard, included in the Spanish Standardization of Maritime Works (ROM Programme), and published under the denomination "ROM 5.1. Quality of coastal

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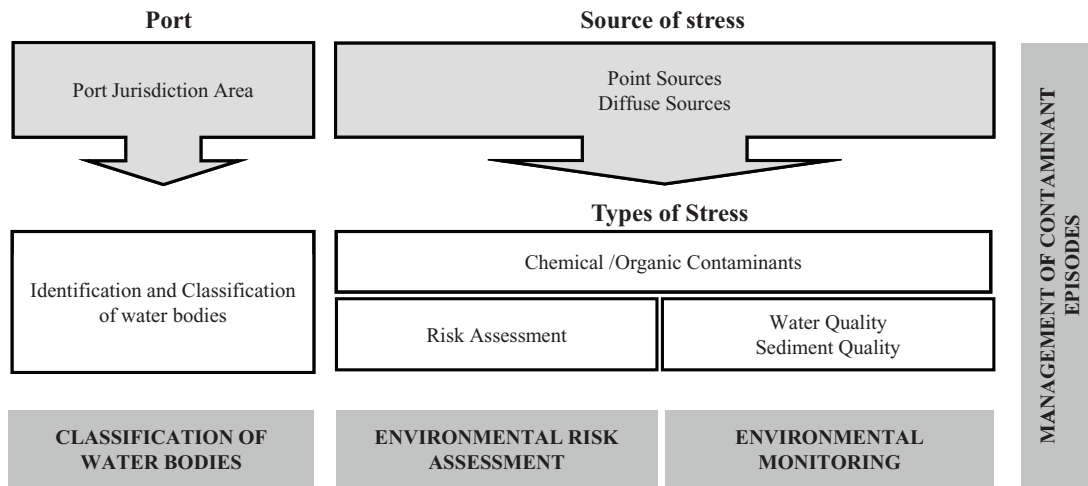


Fig. 1. Methodological procedure of ROM 5.1. Linkages between port environment and the management and assessment of water and sediment quality are showed.

waters in port areas” (Revilla et al., 2007), was elaborated through a participatory process (i.e. port authorities, consultants, marine scientists) led by the Spanish Port Administration.

Based on a DPSIR scheme (Driver, Pressure, State, Impact, Respond), ROM 5.1 provides new technical tools for: the classification of water bodies in port areas, the environmental risk assessment, the ecological potential assessment, and the recognition of sites where management efforts should be focused. The methodological procedure has been tested in a selection of ports which are representative of the different social, economic, hydrodynamic, and environmental conditions: the port of Tarragona (Mediterranean Sea), the port of Huelva (Atlantic Ocean) and the port of Gijón (Biscay Gulf), and is being implemented in three other Spanish ports in the Canary Islands, the Mediterranean and the Biscay Gulf. Moreover, this standard has been adopted as a general framework to be validated within 10 ports placed in 4 countries (Portugal, Spain, France and UK) along the “Atlantic Space” (Interreg Project nr.2009-1/119/PORTONOVO).

Nowadays, ROM 5.1 is playing a relevant role in the implementation of the WFD. The Spanish regulations for the planning process of the WFD (Ministerio de Medio Ambiente y Medio Rural y Marino, 2008) recognise ROM 5.1 as a specific measure to achieve the WFD environmental objectives and incorporate the proposals developed for the classification and quality assessment of HMWB.

This contribution introduces the methodological process of ROM 5.1, describes the results obtained in the port of Gijón (Biscay Gulf) and verifies the suitability and strength of the methodological procedure to identify where the problems are, which are their sources and what types of measures should be applied.

2. Development of the ROM 5.1 standard

ROM 5.1 is a methodological procedure structured in four independent and integrated programmes applicable in the port jurisdiction area: i) Classification of water bodies; ii) Environmental Risk Assessment; iii) Environmental Monitoring; and iv) Management of Contaminant Episodes (Fig. 1). The whole methodology is reported in Revilla et al. (2007).

2.1. Classification of water bodies

ROM 5.1 is based on a type-specific referencing approach to assess the surface waters with enough entity to be recognised as individual water bodies. This approach requires some form of classification so that similar ecosystem types can be compared. The aim

of this classification system is to define water management entities, homogeneous in their characteristics, surrounded by specific port activities and with an appropriate size for the scale required for the management of the environmental risk and the monitoring.

The classification scheme performed in ROM 5.1 is a hierarchically arranged system based on the integration of four physical attributes: i) Hydromorphological features (heavily modified water bodies/natural water bodies; classification modified from the preliminary proposal of the European Commission (2003); ii) Salinity (transitional/coastal waters; in agreement with the proposals of the river basin districts); iii) Flushing rate (>7 days/<7 days; according to the modelling procedures established by Gómez et al. (2006) and iv) Substratum type (hard/soft; according to the geophysics characteristics).

In compliance with the WFD, heavily modified water bodies (HMWB) are defined as bodies of surface water which, as a result of physical alterations by human activity, are substantially changed in character and cannot meet the good ecological status. Based on this definition and according with the specificities of port areas, ROM 5.1 classifies as HMWB all water bodies: i) physically confined (e.g. in docks) or dredged; and ii) substantially changed in their physical or hydromorphological conditions.

The classification process recognizes four possible types of natural water bodies representing specific and particular physical conditions (N1-N4; combining salinity and substratum type), and four types of HMWB (M1-M4; combining flushing rate and substratum type).

2.2. Environmental risk assessment

The Environmental Risk Assessment (ERA) is the process to evaluate the likelihood that adverse ecological effects may occur as a result of exposure to one or more stressors (US EPA, 1998). In this paper, ERA is the tool to predict the significance of the stress caused by port discharges in the quality of water bodies. Although discharges have been reduced considerably in the last years they still constitute the major cause of concern when considering the quality of water bodies. To achieve a better comprehension, discharges are classified as point, when they come from well-defined contamination gradients around the source, and diffuse, when they come from different sources and cause an irregular distribution of substances over a large area.

The environmental risk of the individual discharges which take place in the port jurisdiction area is calculated by a multi-metric index assembled by three factors: i) probability (frequency of the

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