Environmental framework related to Marine Aggregates exploitation in Greece

Karditsa, A.[1], Velegrakis, A.[2], Poulos, S.[1], Kapsimalis, V.[3], Stamatakis, M.[1], Tsoutsia, A.[1], Anastasatou, M.[1], Hasiotis, T.[2], Rousakis, G.[3], Panagiotopoulos, I.[3]

[1]*Department of Geography & Climatology, Faculty of Geology & Geoenvironment, National & Kapodistrian University of Athens, kkarditsa@geol.uoa.gr, poulos@geol.uoa.gr, stamatakis@geol.uoa.gr, antat@geol.uoa.gr*

[2]*Department of Marine Sciences, School of Environment, University of the Aegean, afv@aegean.gr, hasiotis@aegean.gr*

[3]*Hellenic Centre of Marine Research, Institute of Oceanography, kapsim@hcmr.gr, rousakis@ath.hcmr.gr*

Abstract

The extraction of Marine Aggregates from the seabed could have significant physical and biological effects on the marine and coastal environment, if undertaken in an inappropriate way. The extent of the effects depends upon a range of environmental criteria that should be included in managing schemes in order to minimize the associated environmental impacts. Considering the fact that in Greece there is not any specific legislation related to the exploitation of MA deposits, the present contribution tries to summarize and constructively describe a strategic framework suitable for Greek waters, based on the experience of European practices.

Keywords: MA management, environmental criteria, dredging criteria

1. Introduction

The extraction of marine aggregates (MA) from the seabed could have significant effects on the marine and coastal environment, if undertaken in an inappropriate way. The extent of the physical and biological effects depend upon a variety of factors related to the extraction site, such as the nature of the surface and underlying sediment, the coastal hydrodynamic processes, the method used for both exploration and dredging, the rate and the intensity of the extraction, the sensitivity of habitats and assorted biodiversity and fisheries, and other uses in the locality. Thus, in the designated sites international, European, national and local (regional) legislation should be considered in order to protect habitats, species, and other related features.

Against the background of exploiting and managing a finite resource with the associated environmental impacts, a strategic framework which sustainably manages the resource surrounding area has to be recommended. Many countries have a comprehensive framework for managing sand and gravel extraction incorporating a number of international and regional initiatives e.g. the EU Directives, Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA), the OSPAR and Helsinki Conventions and other regional agreements (Radzevicious et al., 2010; Velegrakis et al., 2015).

The scope of this contribution is to describe a set of environmental criteria and a strategic framework suitable for Greek waters, on the basis of the aforementioned international best practices, taking into account existing frameworks in other European countries e.g. United Kingdom and Belgium (BMAPA, 1995; O'Mahony et al., 2008; ICES, 2009).

2. Setting environmental criteria and strategic framework

It is clear that the sustainable exploitation of MA requires a well-established exploitation plan, which would provide significant benefits in terms of minimising environmental effects, in a cost effective way. Relevant frameworks are already in use in other European countries e.g. United Kingdom and Belgium (O'Mahony et al., 2008; ICES, 2009). Based on the European experience, a potential Environmental Framework for MA extraction can be described by the flow chart presented schematically in Fig. 1.

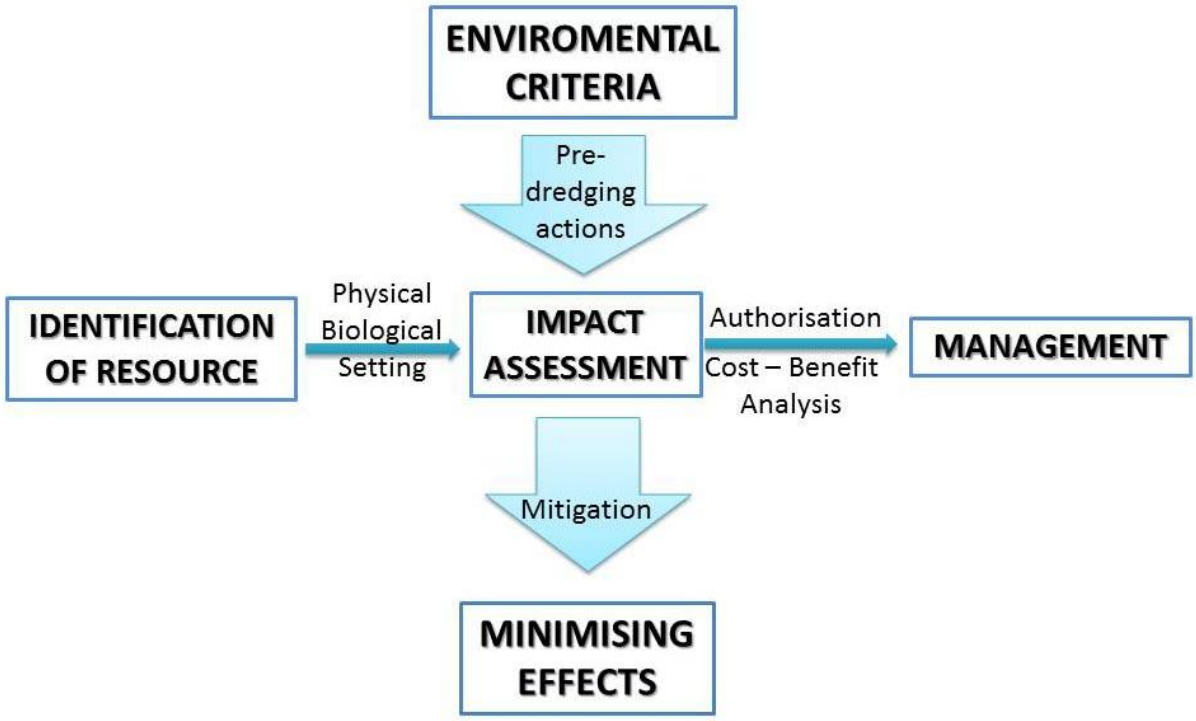

Fig. 1. Environmental framework and management activities for the minimization of environmental effects coming from MA exploitation (based on O'Mahony et al. (2008) and ICES (2009))

2.1 Identification of resource

The first criteria to be examined are the characteristics of the prospective area which may be associated with spatial and temporal features and in many cases may be site-specific. The main geographic and morphometric characteristics are the bathymetry and topography of the area under consideration, the distance from the nearest coastline. The oceanographic and sedimentological characteristics are related to the local hydrography, the wave characteristics and the bed load sediment transport, the location of the closure depth, the grain size and mineralogy of the deposit. The definition of the extent, volume and thickness of the deposit are also significant, whilst, the geochemical characteristics and, in particular, the presence of contaminated sediments is another important factor to be examined. Relative to the biological setting, there is special interest in flora and fauna that may be affected by aggregate extraction, as well as, fishery and shell-fishery resources. Finally, the proximity of proposed extraction sites to areas of special scientific or biological interest or under protection areas is an additional restrictive factor.

2.2 Impact assessment

The environmental impacts associated with the extraction of marine aggregates are related to the short-, medium- and long-term physical and biological characteristics of the marine system hosting the MA deposit. An Environmental Impact Assessment should always precede aggregate dredging activities and include information relative to the changes of the seabed topography and sedimentology and implications of extraction in the coastal and offshore processes, including potential effects on beach erosion, changes to sediment supply and transport pathways and changes to wave and tidal regime. In addition, the potential risk of contamination by toxic natural substances and the effect on water quality should be also taken into consideration. Another important factor is the time scale for the potential physical "recovery" of the benthic community. The effects on any ecologically sensitive species, or habitats, that that may be particularly vulnerable to the extraction

operations, on the marine flora, on pelagic biota, on fish population and on trophic relationships must be considered. The recovery analysis should lead to an estimation of the rate and mode of recolonization of the dredged site.

The relation between MA exploitation and other legitimate uses of the sea, such as commercial fisheries, shipping and navigation lanes, military exclusion zones, offshore drilling platforms, is also an important issue and their interaction should be assessed. In addition, it is associated with engineering uses of the seafloor, wind farms, recreational units as well as areas of wrecks and designated areas.

2.3 Management of the MA extraction

General principles for the sustainable management of mineral resources require knowledge of the resource and understanding the potential impacts of its extraction and the potential extent of the rehabilitation of the seabed.

2.3.1 Authorisation

Authorisation (in the form of a permit, license or other regulatory approval) is a mandatory for the implementation and management of a MA extraction. In the authorisation the terms and conditions under which aggregate exploitation should be carried out, must be mentioned. Authorisation conditions should be designed to ensure that the material is extracted only within the specified extraction site, monitoring demands are met and mitigation requirements are fulfilled.

2.3.2 Economic sustainability

The establishment of an integrated economic plan based on a cost benefit analysis would serve as a decision tool for managers. The analysis should be developed in the context of societal and environmental costs and gains, in order to evaluate and insure the economic sustainability of the resource. Economic projections can support the appraisal of the economic impacts, as well as, the ability of the MA extraction to be carried out in a cost effective way. Thus, the development of economic models is valuable in issuing the permits, estimation of prospecting, and finally to the financial agreement negotiations between the industry and the State.

2.3.3 Monitoring

Monitoring activities should be carried out prior to the initiation of the dredging activities in order to set a reference point, during and after the end of the extraction of MA. Monitoring activities should be adapted according to the special characteristics each site, aiming to survey the compliance with the agreed conditions that have been defined during licensing. Moreover, monitoring is required in order to attest the appropriateness of the mitigation measures, to extent the knowledge relating to the impacts of the exploitation and to function as an early warning of any adverse effects.

3. Minimising environmental effects

3.1 Mitigation

The environmental impact of MA extraction is highly associated to the mitigation of the exploitation and its effects. This can be achieved, for example, with the selection of appropriate aggregate dredging equipment and timing of aggregate dredging operations, in order to limit impact upon the biota and to minimise the effects on fishing. Also, through the modification of the depth and design of aggregate dredging operations, in order to limit changes to hydrodynamics and sediment transport. Furthermore, spatial and temporal zoning of the area of extraction is needed in

order to protect sensitive fisheries and to respect access to traditional fisheries. This would be a useful approach to mitigate extraction effects in both environmental and societal environments. Furthermore, specific mitigation measures should be designed according to each location and the wider environmental setting, which are based on more general mitigation measures.

3.2 Sustainable exploitation

A forward looking environmental framework ensures an ecosystem-based management and sustainability. The broad purposes of an environmentally friendly framework aims to protect the living and non-living constituents of the marine and coastal environment, minimise the wastage of marine aggregate extraction within acceptable levels and enhance the methods used for marine aggregate extraction. It should also be mentioned that improvements in technology may allow exploitation of marine sediments reducing to a great extent side effects on the surrounding area.

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