A case study to evaluate the environmental impact of relict sand dredging along the Tuscany continental shelf

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Introduction: Tuscany coastal area is a territory of special interest for sustainable strategic development. In these areas social and economic interests and the protection of natural ecosystems must meet the target of Integrated Coastal Zone Management (ICZM). In fact, management of Tuscan coastal areas is of key importance due to the threat they bear, the highly-priced uses they host and the unique environmental value. One of the objectives of the Regional coastal restoration Plan is a gradual conversion of *archaeostructures* (hard shore protection with seawalls, detached breakwaters and groins) into soft shore protection (beach nourishment), following the "*Back to the beach*" strategy initiated in Tuscany in the late 1990's. Thus, it is of crucial importance the availability of large volumes of sand and gravel at a reasonable price and with a minimum impact on the fragile Tuscan environment and landscape. As a consequence, Tuscany Region has planned nourishment operations exploiting two relict sand deposits detected with a previous study along the continental shelf [1]. In order to evaluate the environmental impact of continental shelf dredging, sand transport and deposition activities, the present study provides several innovative investigation and laboratory analyses and a numerical model, as reported below, whose results will be crucial in order to obtain the due authorizations for extraction of relict sand from the two sites and their use for beach nourishment. The importance of this study is due to the fact that it is the first time that Tuscany Region is planning marine aggregates dredging from relict deposits. In addition, the Tuscan continental shelf belongs to the marine protected area called "Pelagos" since 1990; thus it is a priority to evaluate the potential impacts on this valuable environment.

Methods: The two relict sand deposits, called "Massa" and "Piombino", located 11 and 3 nautical miles from the Tuscany coast, are in the Ligurian and Tyrrhenian Seas respectively. Both areas are on the continental shelf at water depth ranging from -45 to -105 m. To this purpose a specific study on the environmental characteristics of the area was made. A new automatized vibro-coring system (SHSBD-A) for seabed sampling (Fig. 1) has been developped by Geopolaris s.r.l and used to collect 6 m cores in the two sand reservoirs [2]. Samples of superficial sediment were collected through a grab along the hypotetical navigation routes that will be used to trasport sand from the two deposits to the deposition sites. Chemical, physical, textural, microbiological and ecotoxicological analyses were performed on the bottom sediment according to Italian regulations. Furthermore, water column and marine circulation [3], fish and benthic communities and fishing activities in the two areas were studied. Methylmercury analyses according to the method by Scerbo and Barghigiani [4] in superficial sediments and chemical sequential extraction for metal partitioning [5] in sandy sediments were also performed to evaluate metal bioavailability. Finally, a numerical model was improved to better highlight the evolution of the nepheloid layers during the dredging operations in the predicted site, and eventual sediment overflow along the dredge courses.

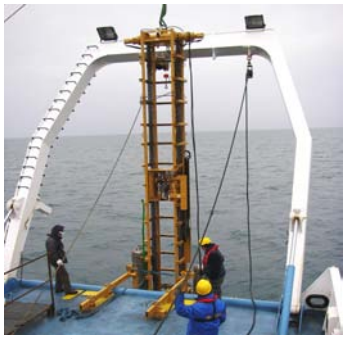

Fig. 1: Vibrocore Self-sheating Hydraulic Sampling Bottom Device

Results and discussion: The studies of coastal morphodynamics, the data on fish and benthic communities, together with the results of laboratory analyses, demonstrated to be very useful for programming an environmentally compatible management of the relict sands dredging and beach nourishments along the Tuscany coasts. The chemical speciation of metal through the sequential extraction techniques used, gave important information on the bioavailability and potential toxicity of the most abundant trace elements of geological origin. Following the results of the numerical model, a detailed monitoring plan was also proposed for the sand dredging, transport and deposition activities.

References

[1] Chiocci F.L., et al. 2009 *Abstract book, 27th IAS Meeting of Sedimentology*. [2] Bartolini E. et al. (2008) *Sea Technology* Vol. 49, **1:**37-40 [3] Capello *et al*., (2010) *Chemistry and Ecology*, **26** Supplement, 359-369. [4] Scerbo R. and Barghigiani C. (1998). *Environ. Technol*. **19**:339-343 [5] Pueyo M. et al. (2001) *J. Environ. Monit*., **3**:243-250