A geo-statistical predictive approach to the Habitat mapping of Vulnerable Marine Ecosystems along the northern Sicily inner continental shelf (southern Mediterranean)

Zizzo E.[1], Sulli A.[1], Agate M.[1], Lo Iacono C.[2]

[1] Department of Earth and Marine Sciences, University of Palermo, Via Archirafi 22, 90123 Palermo, Italy

[2] National Oceanography Centre, European Way, SO14 3ZH Southampton, UK

The main aim of this work is to statistically predict the distribution of Vulnerable Marine Ecosystems (VMEs) along the continental shelf regions of the northern Sicilian margin (southern Mediterranean).
The considered habitats, already mapped in the area on a qualitative base, are the *Posidonia oceanica* and *Cymodocea nodosa* seagrasses and the Coralligenous biocenosis. *Posidonia oceanica* and Coralligenous are considered as VMEs owing to their value as environmental indicators and biodiversity hotspots in coastal marine areas. For this reason, several actions were aimed in recent years to their complete characterization and mapping.
The study area is located in the continental shelf of the northern Sicily margin, between the Cape San Vito (Gulf of Castellammare) and Cape Zafferano (Gulf of Palermo).
Different physical characteristics of the seafloor were extracted from a database acquired in recent years in the frame of official national cartography (CARG) and hazard assessment (MAGIC) Italian Projects, including geological and geophysical data (seabed sampling, ROV footage, multibeam bathymetry, backscatter maps, high resolution seismic reflection records).
The ultimate goal is to apply a statistical methodology allowing to predict the distribution of marine habitats from a "presence only" sampling dataset. This target was pursued by using a multidisciplinary approach, including abiotic (i.e. depth, morphological and hydrodynamic features, type of seabed) and biotic components (benthic communities) that define and characterize the mapped habitats.
Predictive maps are based on the Maximum Entropy model (MaxEnt), a statistical method based on punctual occurrence of specimen (presence-only). The punctual occurrence of the three habitats was already known, whilst we considered the bathymetry, seabed steepness, aspect, fluid escape, erosional areas and sediment type as physical features for the model.
The analysis was also aimed to test the performance of models obtained by choosing the training samples with different criteria. Therefore, different outputs (42 in total) have been produced by selecting samples on the basis of the area (regional analysis), the type of coasts (morphological) or randomly (random). Moreover, the models were built up both with only training samples either with training and test samples to obtain more constrained distribution patterns.
Almost all the created predictive models produced good performances, with statistical parameters (gain, AUC standard deviation) very positive on average. The models derived from the regional analysis resulted to be more performing than the others, with the random-derived being the worst. The response curves pointed out that bathymetry and sediment types are the most important physical features influencing the distribution of the mapped VMEs, whereas aspect and slope are not-independent variables. These outputs also provided important information and constraints on the favorable environmental conditions for the three habitats.
Results from this preliminary statistical modeling appears potentially useful in the evaluation of important environmental parameters, allowing to draw the broad distribution of marine habitats in areas where only presence data are available, and can represent a contribution in the design and monitoring of marine protected areas.