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Geospatial modeling for evaluating restoration suitability of Posidonia oceanica meadows offshore Civitavecchia (eastern Tyrrhenian margin, Mediterranean Sea)

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Marine ecosystem restoration actions are becoming increasingly more popular in many areas of the world, representing one of the greatest challenges to date that can deliver results in line with the UN 2030 Agenda for Sustainable Development. However, their success rate is highly variable and depends mainly on the specific biological and ecological characteristics of the species involved, their ecosystem functioning, and undoubtedly on how, where and when restoration is conducted.

Knowledge about the factors that enhance or limit the success of restoration efforts, with respect to a given habitat is, to date, very limited for the marine environment. Different sensitivity to human pressures and the spatial variability in the ecological variables that determine their presence and distribution are undoubtedly key factors, and it is therefore necessary to provide detailed and focused information on the selection of restoration sites and methods, from which successful and sustainable restoration actions depend.

The national RENOVATE project (ecosystemic appRoach to the EvaluatioN and testing of cOmpensation and mitigation actions in the marine enVironment: the cAse of the civiTavEcchia harbuor), coordinated by CMCC (Mediterranean Centre for the study of Climate Changes) and funded by “AdSP (Autorità di SIstema Portuale) of the north-central Tyrrhenian Sea” is performing an integrated methodology for the compensation of Mediterranean marine ecosystems, damaged by anthropogenic impacts, in selected areas located offshore Civitavecchia harbor, where port expansion activities will soon be started. In this context, the present work focuses on providing a high resolution mapping of *Posidonia oceanica* meadows within the targeted project areas and introduces a new approach, based on the application of geospatial modeling techniques, to perform a semi-automatic detection of appropriate restoration sites. The proposed work flow is based on performing quantitative analysis of acoustic remote sensing data (i.e. Multibeam bathymetry and side-scan sonar backscatter intensity) applying Object-Based Image Analysis (OBIA) techniques, and ad-hoc developed numeric modeling. Our major goal was to classify seafloor suitability for restoration actions, according to variation in landscape spatial arrangement of *P. oceanica* meadows (determined by type of lower and upper limit, type of seagrass bed morphology, meadow patchiness, etc), quantified through the morphometric characterization of their geospatial configuration and architecture, and the operational depth for planned seagrass implantation strategy. Our work attempts to contribute to the development of efficient methodologies for the detection of suitable restoration sites that can support long-term growth and survival of P. oceanica meadows.

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