Reaching the target: predicting the distribution of European marine species to support the implementation of Marine Protected Areas

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Climate change is causing multiple impacts on marine biodiversity, leading to the loss of species and distributional shifts (Poloczanska *et al.* 2013; Pinsky *et al.* 2020). As biodiversity is impacted, ecosystem functioning is impaired and with this their capacity to provide essential ecosystem services. Countries have committed to protect at least 30% of the world's land and sea areas by the year 2030. However, there remains a gap in our knowledge regarding the optimal locations for establishing Marine Protected Areas (MPAs) that would effectively conserve biodiversity. Additionally, it is crucial for protected areas to consider potential changes in species ranges due to climate change.

As part of the European Union Horizon project MPA Europe, we are using species distribution models (SDMs) to predict the current and future distribution of marine species occurring on European seas. Models will be used to forecast the potential range shifts according to five CMIP6 scenarios for the years 2050 and 2100: SSP1, SSP2, SSP3, SSP4 and SSP5. SDMs are being developed using occurrence data obtained from two major biodiversity platforms, the Ocean Biodiversity Information System (OBIS) and the Global Biodiversity Information Facility (GBIF), along with environmental variables from the latest Bio-ORACLE version (v3). Models will be generated for approximately half of all marine species in Europe (~15,000). Preliminary results suggest significant shifts in the range of species, regardless of the scenario (Principe *et al.* 2023). Models are currently being optimized to address potential spatial biases on occurrence data, and to consider alternative hypothesis for predictor variables. It is expected that by June 2024, models for all species will be accessible on the OBIS platform. In a second step, we will also predict the distribution of biogenic habitats, such as cold coral reefs, seagrass meadows and Polychaetes reefs, by grouping the individual distribution models. Biogenic habitats increase the structural complexity of the environment, supporting a higher diversity and abundance of organisms (e.g. Graham & Nash, 2013), and changes in its distribution can have cascading effects on the ecosystem (Teagle & Smale, 2018). Models for the biogenic habitats will also be available by June 2024.

In addition to the outputs for the project, it is expected that new products will become available for the general community through OBIS. These include enhanced pipelines for data integration between OBIS and GBIF, a framework for developing species distribution models based on presence-only data, and distribution maps for marine species in other regions. This will add to the toolbox available for researchers, creating new paths to understand how marine biodiversity is responding to Anthropogenic pressures.

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Keywords
Ecological Modeling; Biodiversity; Climate Change; Anthropocene