

Improving Predictions of Coastal Benthic Invertebrate Occurrence and Density Using a Multi-Scalar Approach

Authors : Stephanie Watson, Fabrice Stephenson, Conrad Pilditch, Carolyn Lundquist

Abstract : Spatial data detailing both the distribution and density of functionally important marine species are needed to inform management decisions. Species distribution models (SDMs) have proven helpful in this regard; however, models often focus only on species occurrences derived from spatially expansive datasets and lack the resolution and detail required to inform regional management decisions. Boosted regression trees (BRT) were used to produce high-resolution SDMs (250 m) at two spatial scales predicting probability of occurrence, abundance (count per sample unit), density (count per km²) and uncertainty for seven coastal seafloor taxa that vary in habitat usage and distribution to examine prediction differences and implications for coastal management. We investigated if small scale regionally focussed models (82,000 km²) can provide improved predictions compared to data-rich national scale models (4.2 million km²). We explored the variability in predictions across model type (occurrence vs abundance) and model scale to determine if specific taxa models or model types are more robust to geographical variability. National scale occurrence models correlated well with broad-scale environmental predictors, resulting in higher AUC (Area under the receiver operating curve) and deviance explained scores; however, they tended to overpredict in the coastal environment and lacked spatially differentiated detail for some taxa. Regional models had lower overall performance, but for some taxa, spatial predictions were more differentiated at a localised ecological scale. National density models were often spatially refined and highlighted areas of ecological relevance producing more useful outputs than regional-scale models. The utility of a two-scale approach aids the selection of the most optimal combination of models to create a spatially informative density model, as results contrasted for specific taxa between model type and scale. However, it is vital that robust predictions of occurrence and abundance are generated as inputs for the combined density model as areas that do not spatially align between models can be discarded. This study demonstrates the variability in SDM outputs created over different geographical scales and highlights implications and opportunities for managers utilising these tools for regional conservation, particularly in data-limited environments.

Keywords : Benthic ecology, spatial modelling, multi-scalar modelling, marine conservation.

Conference Title : ICMST 2023 : International Conference on Marine Science and Technology

Conference Location : Washington, United States

Conference Dates : February 20-21, 2023