ID: W2336218061

TITLE: Improving predictive mapping of deep-water habitats: Considering multiple model outputs and ensemble techniques

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ABSTRACT:

In the deep sea, biological data are often sparse; hence models capturing relationships between observed fauna and environmental variables (acquired via acoustic mapping techniques) are often used to produce full coverage species assemblage maps. Many statistical modelling techniques are being developed, but there remains a need to determine the most appropriate mapping techniques. Predictive habitat modelling approaches (redundancy analysis, maximum entropy and random forest) were applied to a heterogeneous section of seabed on Rockall Bank, NE Atlantic, for which landscape indices describing the spatial arrangement of habitat patches were calculated. The predictive maps were based on remotely operated vehicle (ROV) imagery transects high-resolution autonomous underwater vehicle (AUV) sidescan backscatter maps. Area under the curve (AUC) and accuracy indicated similar performances for the three models tested, but performance varied by species assemblage, with the transitional species assemblage showing the weakest predictive performances. Spatial predictions of habitat suitability differed between statistical approaches, but niche similarity metrics showed redundancy analysis and random forest predictions to be most similar. As one statistical technique could not be found to outperform the others when all assemblages were considered, ensemble mapping techniques, where the outputs of many models are combined, were applied. They showed higher accuracy than any single model. Different statistical approaches for predictive habitat modelling possess varied strengths and weaknesses and by examining the outputs of a range of modelling techniques and their differences, more robust predictions, with better described variation and areas of uncertainties, can be achieved. As improvements to prediction outputs can be achieved without additional costly data collection, ensemble mapping approaches have clear value for spatial management.

SOURCE: Deep-sea research. Part 1. Oceanographic research papers/Deep sea research. Part I, Oceanographic research papers

PDF URL: None

CITED BY COUNT: 50

PUBLICATION YEAR: 2016

TYPE: article

CONCEPTS: ['Random forest', 'Computer science', 'Statistical model', 'Range (aeronautics)', 'Redundancy (engineering)', 'Data mining', 'Artificial intelligence', 'Engineering', 'Aerospace engineering', 'Operating system']