

# Internal and external validation of predictive habitat maps: Why we need independent data even if it is deep, and tricky to obtain

**Katleen Robert**<sup>1</sup>, Veerle A.I. Huvenne<sup>2</sup> and Daniel O.B. Jones<sup>2</sup>

<sup>1</sup> School of Ocean and Earth Science, University of Southampton, Waterfront Campus, European Way, Southampton SO14 3ZH, UK

<sup>2</sup> National Oceanography Centre, European Way, Southampton SO14 3ZH, UK

In the deep-sea, data collection is prohibitively expensive and as such data remain sparse. Faunal data is particularly time consuming to collect, and as a result regularly suffers from small spatial coverage. A bottom-up approach is often employed whereby relationships between the observed fauna and environmental variables acquired via acoustics mapping techniques are used to produce full coverage biotope maps. Many statistical techniques are being developed, but as data is limited, opportunities for an external validation process with independent data are rare. In this study, predictive habitat modelling approaches (Redundancy analysis, MaxEnt and Random Forest) were applied to a highly heterogeneous section of Rockall Bank (100-350 m in depth), Northeast Atlantic. The predictive maps were based on 8 km of remotely operated vehicle (ROV) imagery transects, 37 km<sup>2</sup> of sidescan backscatter maps and 380 km<sup>2</sup> of ship-based multi beam bathymetry collected during the 2011 JC-060 cruise. In 2012, a section was revisited and two additional ROV imagery transects (1 km) were collected. Three very different maps were obtained with each approach weighting more strongly environmental variables varying over specific spatial scales. Internal validation processes showed similar fair performances, with error rates of ~30%. However, the external validation process (contingency tables, kappa statistics and area under the curve (AUC)) all clearly demonstrated that the approaches considered were unable to adequately capture the spatial variation observed. Possible explanations for these discrepancies may include (1) different vehicle systems causing differences in observed fauna and leading to relative positioning errors or (2) the very fine scale variation in sediment composition, found to greatly affect variation explained, was not adequately captured by the environmental variables considered. Research into other potential explanations is still on-going, but the present results suggest that independent data collection for external validation is critical to ensure the usefulness of the products created. Our research highlights the fact that, although it is repeatedly mentioned as a crucial step in model assessment, external validation is still infrequently carried out in the deep-sea.