Predictive habitat suitability mapping of the North Atlantic minke whale (*Balaenoptera acutorostrata*): a comparative multi-site approach

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BACKGROUND & ANALYSIS

1. Background

Ecological niche models have become widely used for the prediction and mapping of species habitats. Many studies have attempted to explain the presence of a species within known geographic distributions (Austin *et al.*, 2007). Few examples exist which rigorously test transferability of techniques available to function across distinct geographic spaces and independent sample populations (Valavanis *et al.*, 2008). Therefore the aim of the study was to determine the functional ability of the modelling technique, principle component analysis (PCA), to predict suitable *B.acutorostrata* habitat within the North Atlantic.

2. Analysis

Sightings data analysed were collected across the period 2002-2007, May-September inclusive, from five distinct locations in Scotland, Ireland, Iceland and Canada (**Figure 1**). Eco-geographical variables used in model approaches included bathymetry (depth & slope), remotely sensed mean annual temperature (sea surface temperature), primary productivity (chlorophyll-a concentration) and surface mesoscale oceanographic features (fronts) (**Figure 2**). PCA analysis conducted within Biomapper v.4. A matrix of site comparisons was made to ensure equal testing both within and independently from each study site with respects to model performance. Models were validated using a receiver operator characteristic (ROC) approach based on the outcomes of 100 optimal iterations (after Phillips *et al.*, 2006).

3. Results

Results of the study showed that when tested across all distinct areas PCA consistently performed and validated greater than a random probability (Mean AUC = 0.68, Range = 0.70-0.55, Random = 0.50). Within the complete N.Atlantic prediction, areas of noted *B.acutorostrata* occurrence modelled (beyond presence data) included the Gulf of Maine, West Greenland, North Sea and Norwegian Fjords (**Figure 3**).

4. Concluding Remarks

Study findings indicate that presence-only habitat modelling techniques, such as PCA, appear to be suitable for the large scale mapping of *B.acutorostrata* habitats and inferred distributions. However contrary to current practice in macro-ecological studies, emphasising geographic extent for presence collection and large-scale surveys (NAMMCO, 2009), similar outputs (though not superior) are also achievable with focal time-series data across the species environmental, not necessarily spatial, range.

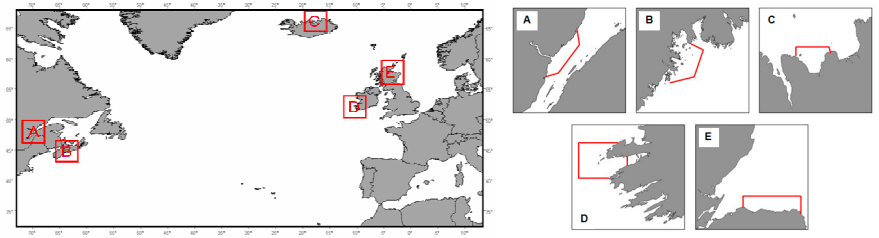

Figure 1. Approximate locations of *B.acutorostrata* presence and extent of non-contiguous areas for comparative ecological niche modelling within the North Atlantic: **A.** St. Lawrence Estuary, Quebec (ORES) **B.** Atlantic Coast, Nova Scotia (LWW) **C.** Skjalfandi Bay, Iceland (HWM) **D.** Blasket Islands, Ireland (IWDG) **E.** Outer Moray Firth, Scotland (CRRU).

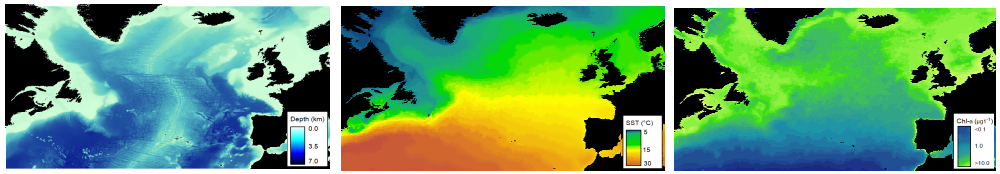

Figure 2. North Atlantic scale environmental distributions of bathymetry (source GEBCO), mean annual (May-Sept) surface temperature (source AVHRR NEODAAS) and chlorophyll-a concentration (source MODIS NEODAAS). Interpolated 1km^2.

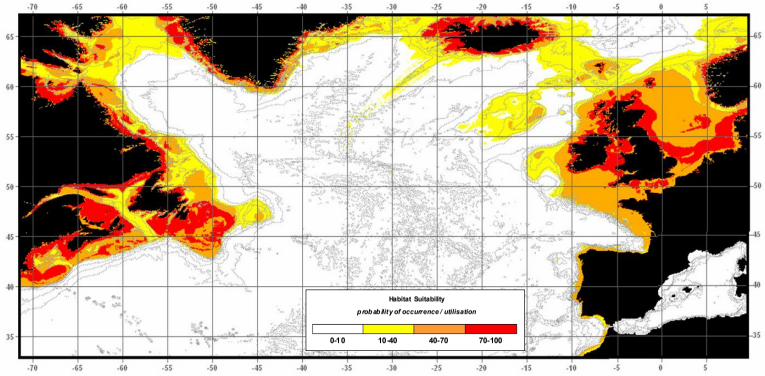

Figure 3. Predicted mean (of 100 model iterations) summer (May-September) habitat suitability (1km^2) of *B.acutorostrata* within the contiguous North Atlantic. Produced using a presence-only PCA (covariance) matrix within BIOMAPPER v.4.

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