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~~Title:~~ Prospects for environmental prediction of annual fishery range expansion and contraction: a case study in the Northwest Atlantic

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Abstract~~:~~
Fluctuations and trends in sea surface temperature (SST) are behind major shifts in the spatial distribution of living marine resources (LMRs). Management strategies for many commercial fish stocks have lagged behind such biogeographical changes. Ability to skillfully forecast changes in species distributions under novel environmental conditions can assist managers to formulate adaptive management strategies. We demonstrate that an empirical thermal-habitat model combined with the GFDL CM 2.1 10 member-ensemble global SST data can provide skillful prediction of the expansion and contraction of the distributional range occupied by LMRs. A non-parametric thermal habitat model was developed to calculate historical changes in the availability of species-specific thermal habitat. The resulting time series of species-specific thermal habitat availability was then passed to a generalized additive model to forecast the expansion and contraction of area needed to contain average density (i.e. effective area occupied) over 1- or 5- year periods for 16 commercial stocks in the Northwest Atlantic. The multi-annual SST-based species range forecast skill was retrospectively verified by comparing forecasts with historical survey-based species range over the period of 1982-2017. The results showed that the simple SST-based range model can skillfully predict short-term changes in species effective area occupied (average correlation coefficient = 0.78 for 1-year lead forecast, = 0.84 for 5-year lead forecast) across different taxa. Our analysis demonstrates the strategic utility of global SST data in fisheries forecasts and, more generally, paves the way for a simple and transparent model-based inference to be applied in management contexts.

Keywords:
thermal-habitat model, species range expansion and contraction, marine ecological forecasting, multi-annual climate forecasts, Northeast US large marine ecosystem, spatiotempral model

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