

Multi-annual forecasts of Bluefin tuna habitat and distribution in the North Atlantic

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We describe one of the first known examples of forecasts of a marine biological variable on a multi-annual to sub-decadal scale. While recent advances in oceanographic modelling have yielded significant skill on the sub-decadal time-scale for certain variables in certain areas, translating these physical predictions into biological predictions remains a challenge. We propose that the distribution of pelagic fish may be a “low-hanging fruit” due to their close coupling to the physical environment and ability to respond to inter-annual variability. The northern limit of bluefin tuna (*Thunnus thynnus* Linnaeus 1758) distribution in the North Atlantic is thought to be constrained by temperature, as recent observations of this species east of Greenland in Denmark Strait have borne out. We examine the predictability of this thermal constraint, and thereby the potential summer foraging habitat of tuna, using a state-of-the-art decadal forecast system. We found skill over and above a persistence forecast (ie. assuming no change) with a three-year lead time, and statistically significant skill on even longer time-scales. We demonstrate that recent changes in this region, including the appearance of tuna, could have been predicted with similar multi-annual lead times. Finally, we show good agreement between our forecasts and some limited catch records near this region. We therefore conclude that multi-annual forecasts of biological variables are indeed possible, and discuss the applications of these results.

Keywords: Bluefin tuna, seasonal-to-decadal prediction, biological forecasting, operational ecology, North Atlantic

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