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Evaluating the impact of thermal habitat availability on recruitment dynamics: A case study with American lobster in the inshore Gulf of Maine

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Abstract

The Gulf of Maine (GOM) American lobster landings have increased dramatically in the past few decades, as a result of substantially increased recruitment, making it the most valuable fishery in the United States. However, a functional stock-recruitment relationship is difficult to define. This is partly due to recruitment processes occurring at a spatial scale smaller than the whole GOM and large environmental variability in the ecosystem. As the GOM water temperatures increase, thermal habitat for juvenile lobsters expands, adding to the complexity of understanding recruitment dynamics. In this study, we evaluate the effect of thermal habitat availability on American lobster recruitment dynamics. We fit Ricker models to inshore trawl survey data and analyzed the change in stock-recruitment parameters over space and time. We then investigated relationships between recruitment dynamics parameters and changes in availability of thermal habitat quantified from a habitat suitability index model. The results showed that recruitment productivity decreased significantly ($p < 0.05$) over time in the western GOM, and recruitment productivity and maximum recruitment increased significantly ($p < 0.05$) over time in the eastern GOM. A generalized additive modelling approach revealed changes in thermal habitat availability can explain changes in recruitment dynamics. Results indicate that lobster in the GOM has experienced a shift in recruitment dynamics over time and space related to thermal habitat availability. Our study showed that climate-driven stock-recruitment relationships should be considered for American lobster, which will impact biological reference points and fishery projections.

Keywords:

recruitment, productivity, thermal habitat, climate change, stock-recruitment

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