

The role of spatial processes in North Sea herring larval survival and recruitment

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The North Sea autumn spawning herring stock consists of several substock components distributed along the east coast of Great Britain. In recent years, this stock, as a whole, has exhibited an unprecedented sequence of poor recruitment, despite simultaneously having a large adult population and historically low exploitation rates. The weak year classes arise as a consequence of poor survival through the larval overwintering period, between the end of the yolk-sack phase and metamorphosis. However, the mechanism responsible is, as yet, unclear. In this work, we reanalyse 25 years of extensive larval surveys through the use of an individual-based hydrographic advection model. We run the model in a backtracking mode to identify the most likely spatial and temporal origin of a particular larval observation, and then use this information to assign it to a component. By performing this exercise for every single larva observed in surveys performed both prior to and after the overwinter period, it is possible to build up a picture of the annual larval survival rates of each component, and thereby identify any potential spatial differentiation in these processes. When combined with integrated information along the reconstructed drift trajectory (e.g. temperature, modelled plankton abundance), the patterns identified give us insight into the processes that drive both the survival of individuals from each component and the fundamental mechanisms causing the recent recruitment failure.

Keywords: North Sea herring, recruitment, individual-based modelling, survival.

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