Low connectivity in a nursery-dependent fish metapopulation revealed by modeling mark-recapture data may hide seasonal variability of movements.

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Abstract

Quantifying connectivity within fish metapopulations is critical to understand population dynamics and to provide an evidence base for assessment and management. Connectivity determines the colonization of new habitats, population resiliency to harvest, and consequently should influence the design of spatial management strategies. The common sole (*Solea solea L.*) in the Eastern Channel (EC) is an ideal case study to assess metapopulation connectivity. The life cycle typology determines the spatial structure of the metapopulation. Adults spawn offshore in spring. Eggs and larvae drift passively for several weeks before settling in coastal nursery grounds, where the juveniles spend their first two years. When approaching maturity, juveniles migrate offshore to deeper waters where they recruit to the exploited adult population. Based on results from neutral genetic markers, EC sole is currently considered as a single, spatially homogeneous population. However, larval drift models and limited in situ movement of larvae and juveniles within nurseries suggest very low connectivity between EC sub-populations. However, connectivity induced by adult movements remains effectively unknown. To fill this knowledge gap, extensive tagging experiments have been carried out since 1955, covering a large area from the Celtic Sea in the west to the North Sea in the east, including the EC. We developed a state-space mark-recapture model, designed to estimate seasonal movements of fish between pre-defined sub-areas, and considering three seasons corresponding to three biological states. Our results suggest that few movements occur at the adult stage, supporting the hypothesis of segregated population subunits within the EC. Our results did, however, reveal high variability of seasonal movements, with cyclic migration patterns that may conceal intra-annual seasonal migration related to the inshore-offshore life cycle strategy.

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