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ECSC 2022/1A

Evaluating the consequences of misdiagnosing population structure within spatial stock assessment models

Authors: Katelyn M. Bosley, Amy Schueller, Aaron M. Berger, Jonathan Deroba, Daniel R. Goethel, Kari H. Fenske, Dana Hanselman, Brian Langseth

Abstract

Contemporary spatially explicit assessment models have the ability to inform fine-scale processes and spatial management of heterogeneous populations. For example, estimates of productivity may be improved by simultaneously modeling individual spawning components instead of aggregating data and parameters across the entire spatial domain. Although spatial models provide a more realistic representation of the true population dynamics, few studies have evaluated the potential risk associated with incorrect assumptions regarding population structure. We simulated the dynamics of a long-lived demersal species (sablefish) under different assumptions of population structure, then applied various assessment approaches (panmictic, fleets-as-areas, and spatially explicit) to simulated data. Model performance was evaluated for scenarios where the assumptions of spatial population structure in the assessment either matched or incorrectly diagnosed the underlying spatial population dynamics. Parameter estimates were generally unbiased at the system level even when the spatial structure was incorrectly specified, however, area-specific values were often biased. Fleets-as-areas models performed poorly primarily because the method does not explicitly account for movement or spatial variation in recruitment. Models that incorporated tagging data improved the estimation of area-specific parameters even when the models were misspecified. These results elucidate how incorrect assumptions regarding population structure influence the estimation of key parameters used in fisheries management and which model parameterizations are robust to lack of information on the true population structure. Spatial models are advantageous because outputs are generated at scales relevant to important sources of variability, therefore they can inform spatial management even if incorrectly specified.

Keywords:
simulation model, sablefish, stock assessment, recruitment, movement, tagging, spatial structure

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