

Avoiding the curse of circularity: building a multi-species model from the ground up

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Abstract

In marine management, fish stocks are typically managed on a stock-by-stock basis using single-species models. These models are based upon numerical techniques, do not consider interacting stocks and hence are less good at making longer-term predictions. Additionally, there are multi-species models that represent key biological processes and consider interactions between stocks such as predation and competition for resources. Many multi-species models depend upon single-species models, either to drive the dynamics or in their calibration. This means that errors in the single-species models propagate through the multi-species model. Fitting a multi-species model directly to data without using a stock-assessment intermediate is difficult on account of the large number of parameters to be fitted, and the computational expense of the model. In this talk we will demonstrate that by taking a state-space approach, many of the uncertain parameters can be treated dynamically, allowing us to fit the multi-species model directly to data without needing to use stock assessments in the process. We do this by fitting, with quantifiable uncertainty, a size-based multi-species model of the Celtic Sea with 17 species to landings and IBTS survey data. We find good agreement with all stocks that have full assessments. The methods that we have developed and the approach that we use allows multispecies models to be used either to validate single-species models or directly in management, and they have broad applicability to models of intermediate complexity.

Keywords:

Multi-species model, Uncertainty quantification, State-space models, Ecosystem models, Bayesian statistics

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