

Combining ecosystem models to define multi-species reference points

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Abstract

Current ICES advice calculates FMSY on a stock by stock basis, however in reality, multiple stocks interact with one another and the yield of one stock depends, not only on its own fishing level, but that of all other stocks. Although there are several definitions of multi-species MSY, there is no consensus. Furthermore, calculating a multi-species MSY can be difficult as there are many models, of varying complexity, each with their own strengths and weaknesses, and the fishing levels that satisfy the multi-species MSY can be sensitive to the model(s) chosen.

Here we develop a method that uses an ensemble model to combine multiple multi-species models to compute, with quantifiable uncertainty, long-term yields under several future fishing levels. Using a Gaussian process emulator, we estimate long-term yields for all future fishing levels, which we optimise to calculate fishing levels for multi-species MSYs. We demonstrate our method by exploring the environmental and economic consequences of different definitions of multi-species MSY in the North Sea.

This new method can define more robust estimations of FMSY, allowing for improved sustainability of the marine environment.

Keywords:

Multi-model ensemble, Uncertainty, Multi-species MSY, Ecosystem models

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