

**Abstract:**  
**Improved Management of North East Atlantic Mackerel, Using Bayesian Modelling Methodologies.**

The management of highly migratory fish populations, consisting of more than one distinct stock, could have considerably different consequences on the fishery and population, depending on the assumed stock structure. The North East Atlantic mackerel population consists of more than one distinct spawning stock, one of which, the North Sea spawning stock, is severely depleted. These stocks migrate annually between their spawning and feeding grounds, with overlapping feeding grounds in the north. For management purposes, the population has been assessed as one stock, with an annual TAC based on reference points for the entire population. Bayesian decision analysis is utilised here in order to determine the most effective management methods for such populations.

In order to implement Bayesian decision analysis, several issues need first to be resolved. Three different methods of Bayesian integration, namely the Grid-based method, Sampling Importance Resampling algorithm and Markov Chain Monte Carlo methods, are reviewed and their properties compared in order to identify the most appropriate method to be applied to the mackerel models. Some possible problems of Bayesian state-space models are investigated. It is shown that when priors are assigned to the state parameters in the model, misleading results can be obtained. However, when priors are assigned to the process error parameters, the results appear to be more reliable.

Alternative operating models for the North East Atlantic mackerel population and fishery are developed and explored. The distinct spawning stocks are modelled separately, with quarterly migration. Alternative operating models consider, among others, different migration patterns and fishing mortality hypotheses. Alternative fishery management options include area closures and the redistribution of fishing effort. Bayesian decision analysis is used to identify which strategies are the most effective at managing this fishery under the alternative hypotheses, given a pre-selected set of management objectives.