

Assessing fishery and ecological consequences of alternate management options for multispecies fisheries using an ensemble approach

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Abstract

Demands for management advice on mixed and multispecies fisheries pose many challenges, further complicated by corresponding requests for advice on the environmental impacts of alternate management options. Here, we develop, and apply to North Sea fisheries, a method for collectively assessing the effects of technical interactions, multispecies interactions and the environmental effects of fishing. Ecological interactions involving 21 species are characterized with an ensemble of 188 plausible parameterizations of size-based multispecies models, and four fleets (beam trawl, otter trawl, industrial, pelagic) characterized with catch composition data. We use the method to evaluate biomass and economic yields, alongside the risk of stock depletion and changes in the value of community indicators, for 10000 alternate fishing scenarios (combinations of rates of fishing mortality F and fleet configuration) and present the risk/reward tradeoffs. Technical and multispecies interactions linked to the beam and otter trawl fleets were predicted to have the strongest effects on fisheries yield and value, risk of stock collapse and fish community indicators. Given the high value of demersal species, permutations of fleet effort leading to high total yield were not the same as permutations leading to high catch values. A transition from F for 1990 to 2010 to F_{MSY} , reduced risk of stock collapse without affecting long-term weight or value of yield. Our approach directly addresses the need for assessment methods that treat mixed and multispecies issues collectively, address uncertainty, and take account of tradeoffs between weight and value of yield, state of stocks and state of the environment.

Keywords: LFI, mixed, multispecies, fisheries, North Sea, trade-off, risk, indicator, uncertainty