

**Understanding and adapting to effects of climate change on groundfish stocks and stock assessments**

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The New England groundfish fishery suffers poor biological and economic performance, despite management measures that are effective elsewhere. Multiple indicators suggest global climate change is affecting New England waters more strongly than almost anywhere else, which might be compromising management success. Climate change can decrease stock productivity and increase scientific uncertainty. We conducted a literature review of 136 studies of four groundfish species, which revealed considerable gaps in our knowledge of potential effects of climate change, but generally negative outcomes where evidence exists. Attributes likely to change as climate effects unfold include behavior, which can alter survey catchability, and natural mortality. To explore the implications of these changes, we simulated the dynamics of a cod-like population incorporating directional change in natural mortality and catchability. This generated retrospective patterns in simulated stock assessments with magnitude similar to that seen in real assessments in recent years. However, we also used bio-economic modeling to illustrate that changing the harvest control rule from a fixed fishing mortality approach to one that adjusts fishing mortality as a function of biomass results in much improved biological and economic performance in the face of both climate effects and scientific uncertainty. Importantly, these benefits were realized even if the climate effects were not explicitly incorporated in the harvest control rule and uncertainty was not reduced. Therefore, despite the considerable complexities and uncertainties being faced, it is possible to adopt simple management strategies that are inherently more resilient and improve fishery performance.

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