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## Ecological-economic sustainability of the Baltic cod fisheries under global change

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Human-induced climate change such as ocean warming and acidification, threatens marine ecosystems and associated fisheries. In the western Baltic cod stock socio-ecological links are particularly important, with many relying on Atlantic cod for their livelihoods. A series of recent experiments revealed that cod populations are negatively affected by climate change, but an ecological-economic assessment of the combined effects, and advice on optimal adaptive management are still missing. We use experimental and time-series data to upscale physiological processes to the population level by incorporating these effects into the stock-recruitment model. Using an ecological-economic optimization approach, we assess the effect of increasing CO<sub>2</sub> and temperature levels on ecological (stock size), economic (profits), consumer-related (harvest) and social (fishing effort) indicators, ranging from present day conditions up to future climate change scenarios. Ocean warming has an overall negative effect on cod recruitment in the Baltic. Optimal management would react by lowering fishing mortality with increasing temperature, to create a buffer against climate change impacts. The negative effects cannot be fully compensated, but even at 3°C warming above the 2014 level, a reduced but viable fishery would be possible. However, when accounting for combined effects of ocean warming and acidification, even optimal fisheries management cannot adapt to changes beyond a warming of +1.5° above the current level. Our results highlight the need for multi-factorial climate change research, in order to provide the best available, most realistic, and precautionary advice for conservation of exploited species as well as their connected socio-economic systems.

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