

Title: **Precautionary Management of North-East Arctic Cod under Environmental and Evolutionary Change**

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Abstract: In the Barents Sea, recruitment of North-East Arctic cod is affected by sea temperature, being higher in warm years. Cod dynamics are furthermore influenced by time-lagged competition for capelin with herring, and the intensity of size-selected harvesting. The system is not stable in three ways: (1) the effect of temperature on NEA cod recruitment has increased substantially since 1950; (2) age and length at maturity has decreased since 1950; and (3) environmental noise is non-stationary: the sea has become more positively autocorrelated (redder) during the last 50 years. Using age-structured models of NEA cod we address the following questions: How does the temporal autocorrelation structure of environmental affect that of cod abundance? How do interspecific interactions (with herring and capelin) and harvesting affect how noise is filtered through cod? How does the changes in the physical system and biological parameters over the last 50 years affect the cod's abundance, fluctuations, and how climate affects cod? What are the possibilities and limits for precautionary (risk avoiding) management (harvest strategy) of the NEA cod and the two other species? Here we use several criteria for describing the risks in the fisheries economics at hand, e.g., variability of yield or income, length distribution of moratoria, and time distributions of recovery processes. There are nonlinear interactions between noise structure, the feedback structure of the cod and different harvest strategies. Our results highlight the difficulties of predicting the effects of climate change, even when climate change is as subtle as a change in autocorrelation structure.