

Stock collapse and its effect on species interactions: cod and herring in the Norwegian-Barents Seas system as an example

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Abstract

Both the Norwegian Spring Spawning herring (*Clupea harengus*) and the Northeast Arctic cod (*Gadus morhua*) are examples of how the overexploitation of marine fish populations was leading to a strong reduction even so stock collapse, with a strong decline in the associated fisheries, followed by a recovery. Cod and herring are both part of the Barents Sea ecosystem, which experienced major warming events in the early (1920-1940) and late 20th century. While the collapse or near collapse of these stocks seems to be linked to instability created by overfishing and climate, the difference of population dynamics before and after is not fully understood. In particular, it is unclear how the changes in population dynamics before and after the collapses are associated with biotic interactions. The combination of the availability of unique long-term time series for herring and cod makes it a well-suited study system to investigate the effects of collapse. We examine how species interactions may differently affect the herring and cod population dynamic before and after a collapse. Particularly we explore, using a GAM modelling approach, how herring could affect cod and reciprocally. We found that the effect on herring of cod biomass that was generally positive (i.e., covariation) became negative after the collapse (i.e., predation or competition). Likewise a change occurred for the cod, the juvenile herring biomass that had no effect before the collapse had a negative one after. Our results indicate that population collapses may lead to altered inter-specific interactions as well as altered response to abiotic environmental variations. While the stocks are at similar abundance levels before and after the collapses the system is potentially different in its functioning and may require different management action.

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