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Theme session H: Evolutionary effects of exploitation on living marine resources

Effects of different management regimes on harvest-induced life history evolution in Northeast Arctic cod

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Introduction

Field (Reznick et al. 1990) and laboratory (Conover and Munch 2002) experiments, analyses of fisheries data (e.g., Olsen et al. 2004), theory (Law and Grey 1989), and models (Ernande et al. 2004) all corroborate that harvest may induce rapid and substantial life history changes in many exploited fish stocks. Which life history trait will change and to what degree depend on the selectivity of the fishery and the ecology and life history of the species in question, making it hard to reach generalizable conclusions about potentially successful management options (see e.g., Heino 1998). Here, we ask to what degree different management regimes may decrease or reverse the negative effects of harvest-induced life history evolution in the Northeast Arctic cod.

The model

We use a state-dependent energy-allocation life-history model for cod (the model is presented in detail in Jørgensen and Fiksen 2006) solved by dynamic programming . A set of life history strategies are optimized by varying the strength and size-selectivity of the fisheries mortality, and we then use quantitative genetics to describe how these strategies change in frequency in a population due to harvest-induced selection. We can thus quantify the evolutionary effect of fishing on life history changes and assess evolutionary rates.

Results

Mean age at maturation depends strongly on the fisheries mortality (Fig. 1), and the rates of evolution depend on the type of management regime. We present the effects of three different management regimes: marine protected area, maximum size-limit, and minimum size-limit.

Discussion

The potential for harvest to lead to life history evolution can be modified by adopting different management strategies. By changing the selectivity of the fishery for specific sizes or life history stages, both evolutionary rates and evolutionary endpoints may vary. Further studies are required to assess the potential life history impacts of different harvest regimes, and to assess also the potential evolution of other life history traits than age and size at maturation.

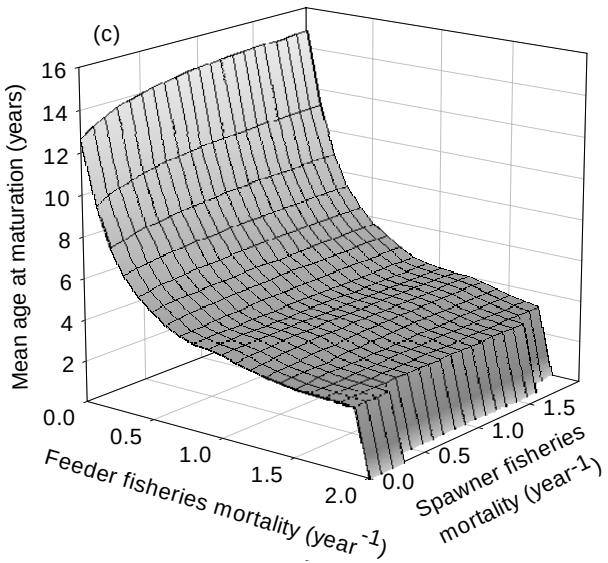

Figure 1. Mean age at maturation (years) in a life history model for Northeast Arctic cod *Gadus morhua* in a baseline scenario for variable fisheries mortalities in the spawner fishery (mature individuals only) and the feeder fishery (trawling for mature and immature individuals). Figure taken from Jørgensen et al. (2006).

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