Environmental and demographic controls on the distribution of North East Arctic cod spawning around the Lofoten Islands

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Summary
Constructing statistical models for the distribution of recently spawned eggs of North East Arctic cod (Gadus morhua) we attempted to elucidate the influence of environmental, temporal, demographic and spatial factors, of local up to habitat-wide relevance, on variations in the distribution of spawning gadoid fishes. Statistical models explained between 23 and 42 % of deviation from the mean. The explained variation for observations on the inshore side of the Lofoten Islands (Vestfjord) was primarily related to environmental variables, while on the Outer Shelf spatial dependency appeared more important. Similarly shaped spline smooths for large scale variables and different shapes in relation to local variables indicate a primarily local control on the proportions between the regions.

Materials and Methods
We grouped data from egg surveys in 1983-1985, 1997-1999 and 2004-2012 into periods with higher egg density on the inshore or the offshore side of the archipelago. These data sets were then mapped out for single stages and we constructed Generalized Additive Models (GAMs) for non-zero abundance and presence/absence of stage 1 (following Fridjófrós 1978) eggs in the two areas. Independent variables were environmental, temporal, demographic and spatial dependency constructed with Moran’s Eigenvector Maps (MEMs). The statistical models were optimized by stepwise regression within the groups of variables and by testing all possible combinations between them.

Results
When cod eggs were more abundant in Vestfjord, patches of high egg densities were small and dispersed over time, while a dominant Outer Shelf meant aggregation into a single, relatively stable patch. Relation of stage 1 distribution to variables affecting the entire stock (Regional Temperature Index, proportion fish age-9+, Day of the Year) was similar in both regions, while the relation to local conditions (temperature, distance from coast, bottom depth) differed to some extent. Spatial dependency played a greater role on the Outer Shelf than in Vestfjord.

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Reference