

Spatio-temporal changes in life-history traits of the North Sea fish community under climate change and fishing

Esther Beukhof, Tim Spaanheden Dencker, Lauréne Pécuchet and Martin Lindegren

Abstract

Marine ecosystems are exposed to both environmental and anthropogenic stressors which may impact biological communities by altering their trait composition. Individual and population responses to stressors such as climate change and fishing, have previously been demonstrated through changes in life-history traits. However, less is known to what extent entire communities demonstrate such profound responses. In this study, we describe the spatio-temporal patterns of life-history traits of the North Sea fish community, and assess whether these patterns could be explained by environmental and anthropogenic variables. We collected trait values of 90 fish species including maximum length, age at maturity, offspring size, fecundity and the von Bertalanffy growth coefficient. These were combined with abundance data from international trawling surveys between 1983 and 2015 to calculate community weighted mean traits per year and per survey area. Results revealed similar south to north spatial gradients in the community mean life-history traits. However, temporal declines were the strongest in the southern North Sea, notably for maximum length and fecundity. Using generalized additive models we explained the spatial and temporal trait patterns in relation to environmental and anthropogenic variables. Temperature, depth and fishing effort were the most important explanatory variables, indicating the importance of climate change, habitat suitability and fishing on the response of communities through the life-history traits of species. Moreover, this study emphasizes the importance of spatial heterogeneity within a management area and the usefulness of life-history traits in studying environmental and anthropogenic impacts on fish communities.

Keywords: life-history traits, fish, community, North Sea, climate change, fishing

Contact author: Esther Beukhof, Centre for Ocean Life, National Institute of Aquatic Resources (DTU Aqua), Technical University of Denmark, Jægersborg Allé 1, 2920 Charlottenlund, Denmark, estb@aqu.dtu.dk