Large bio-geographical shifts in the north-eastern Atlantic Ocean: From the subpolar gyre, via plankton, to blue whiting and pilot whales

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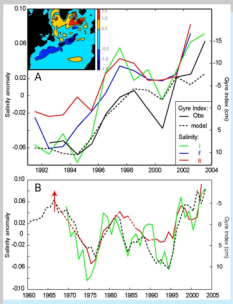
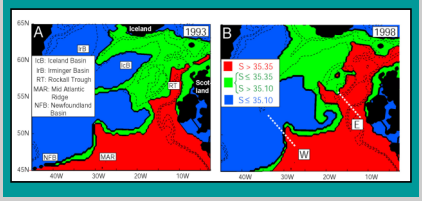
1. Influence of the subpolar gyre on the North Atlantic hydrography

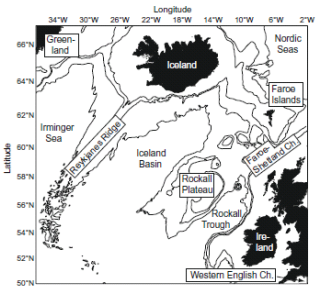


Temporal evolution of observed salinity in Irminger Current, Faroe Current and Rockall Trough, and the inverted observed (upper) and modelled (lower) North Atlantic gyre index (GI). The timeseries are shifted to account for advective delays.

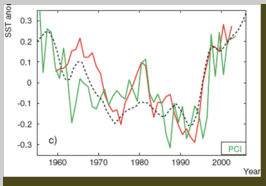
The salinity of the Atlantic inflow is tightly linked to the dynamics of the subpolar gyre circulation. Shifts in the frontal zone between the cold and fresh subpolar gyre and the warm and saline subtropical gyre regulate the proportions of mixture of these to waters (Hátún et al., 2005).



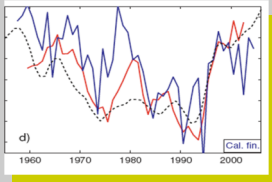
Background: Pronounced changes in fauna in the north-eastern Atlantic Ocean have occurred in the late 1920s, the late 1960s and again in the late 1990s. The ecosystem in this area is characterized by cold subarctic fauna within the North Atlantic subpolar gyre, warm Lusitanian fauna from the Bay of Biscay and, between these, a cold-temperal boreal fauna. The physical oceanography of this region is dominated by the dynamics of the subpolar gyre of relatively cold and low-saline subarctic water. During the early 1990s the gyre was intense, but declined substantially after 1995, leading to a rapid warming and salinification after 1995. It is therefore tempting to suggest that these simultaneous physical and ecological changes are related.



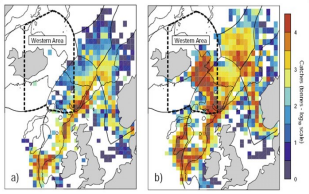
2. Physical implications for biology?



Principal components associated with the inverted North Atlantic mode (GI) and the Phytoplankton Color (PCI). Plankton data were obtained from the Continious Plankton Recorder (CPR) (Batten et al., 2003, Reid et al., 2003)

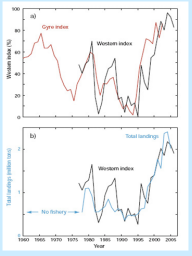


Principal components associated with the inverted North Atlantic mode (GI) and the inverted Calanus finmarchicus .

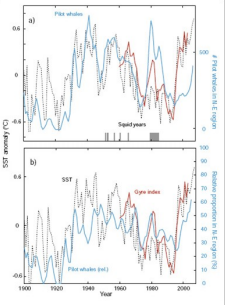


Catches of blue whiting during (a) high–gyre index years (1990-1995), and (b) low gyre -index years.

Western index for blue whiting catches and (a) inverted GI, (b) total annually blue whiting landings.

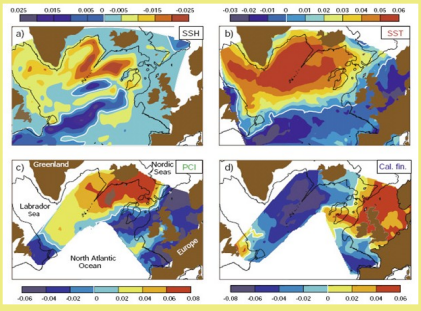


Number of whales beached at the north-eastern region the Faroe Islands, inverted GI, and SST anomalies in the north-eastern Atlantic.



Conclusions:

Large subarctic-subtropical water-mass exchanges, related to the strength of the subpolar gyre, enforce a bottom-up control of the marine ecosystem, which is characterized by highly variable influence of the Arctic-boreal and Lusitanian–boreal faunas.
When the subpolar gyre is *strong*: (1) phytoplankton abundance is *low*, (2) Calanus finmarcicus is *high*, (3) the density of blue whiting is *low*, and (4) the occurence of pilot whales is *low*, and vice versa when the gyre is *weak*.



Spatial patterns associated with the modes, whose time series are provided to the right.

Hátún, H., **A.B. Sandø**, H. Drange, B. Hansen, H. Valdimarsson. 2005. Influence of the Atlantic subpolar gyre on the thermohaline circulation. Science, 309, 1841-1844.
Batten, S.D., R. Clark, J. Flinkman, G. Hays, E. John, A.W.G. John, T. Jonas, J.A. Lindley, D.P. Stevens, A. Walne. 2003. CPR sampling: the technical background, materials and methods, consistency and comparability. Progress in Oceanography, 58, 193-215.
Reid P.C., J.M. Colebrook, J.B.L. Matthews, J. Aiken. 2003. The Continious Plankton Recorder: concepts and history, from plankton indicator to undulating recorders. Progress in Oceanography, 58, 117-173.