Impact of climate variations on the north-east Atlantic shelf-break systems: Lessons from a recent past

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Impact of climate variations on the north-east Atlantic shelf-break systems: lessons from a recent past

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The marine system along the north-east Atlantic continental-shelf margin between 45° and 60° N is highly dynamic. The water masses responsible for the exchange of heat and nutrients at the global scale meet and mix at these latitudes (Hátún et al., 2005), translating into large variability of water-mass characteristics, at both the temporal and spatial scale. The weakening and strengthening of the main ocean gyres, subtropical and sub-polar gyre, are very likely to impact the hydroclimate of this region, with strong repercussions on the ecology of its marine system, as demonstrated in historical records of regime shifts in the North Atlantic area. We question to what extent it is possible to learn a lesson from these records, and what physical, climatic or biological indicators are most suitable to identify the socio-ecological critical points of the Irish-shelf marine system. From the analysis of the HAdSST2data (Rayner et al., 2006), surface water temperature has increased by 0.85 deg. C in the northeast Atlantic area (NEA) (45÷60 °N; 5÷20 °W), over the past 150 years. More than half this signal is attributed to anthropogenic activity (H. Cannaby, submitted), with the Atlantic Multidecadal Oscillation (AMO) (Enfield, 2001) as the main (23%) driver of variability. Warmer water temperature associated with the current warm phase of the AMO seems to explain the expansion of the phytoplankton blooming season in the Irish Shelf Seas, north (Malin Shelf) and south (Celtic Sea) of the Island. Springtime temperature, arbitrarily chosen to be represented by 10 deg. C, is recorded recurrently earlier in the year, since 1987. Our study confirms the prevailing hypothesis (Beaugrand et al., 2002; ICES, WGECO 2008; ICES, ADGCLIM 2008) that changes in seawater temperature is affecting the biogeographical distribution of zooplankton species (Fig.1). Southern shelf edge assemblages of zooplankton appear abundant in Irish waters only during the warm phase of the AMO, while cold-temperate species have now decreased to unprecedented levels (Fig. 1). Links with the main oceanic circulation patterns are less clear instead, as a lag is to be expected between the gyre index (Hatun et al., 2005) and the biological response on the shelf seas (Fig.1). Temperature and salinity are certainly important conditions for the larval stages of fish. In this study, we examine the distribution of mackerel and horse mackerel larvae and egg data along the eastern Atlantic shelf edge from the Bay of Biscay to the Scottish shelf, since 1977 (30 years). As hypothesized from a recent ICES working group (WGMHSA), an overall northerly shift in the distribution of northeast Atlantic mackerel has taken place in 2005–2007, with an associated westerly shift in the northern part of the spawning and feeding areas. These results might partially explain the dramatic alteration of population sizes of relevant marine and diadromous fish species which has occurred over the past three decades. Further investigation will try to explain the links between the northeast Atlantic shelf ecosystems and the main oceanic circulation patterns, as a means to predict future likely dynamics of relevant fish stocks, in relation to hydroclimatic conditions and to the patterns of atmospheric variability. Detection and attribution of changes in the marine environment as a consequence of global change are extremely relevant at regional levels, especially for the small countries at the eastern Atlantic margins, like Ireland, Iceland and the Faroes, where the marine sector traditionally contributes significantly to the coastal economy.

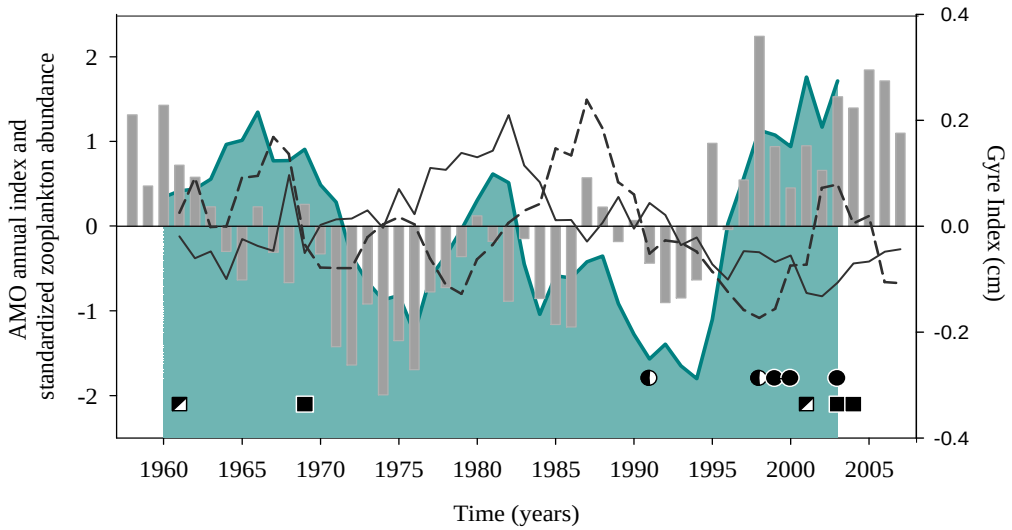

Figure 1 - Long term changes in the standardized mean annual abundance of cold-temperate zooplankton species assemblage (CPR, SAHFOS). The dashed line is relative to assemblages of the shelf seas in the north of Ireland; the continuous line refers to the Celtic Sea, in the south. In the background, the Gyre Index (*Hatún et al., 2005*) is represented by the coloured area, while the bars represent the Atlantic Multidecadal Oscillation (AMO) index (*Enfield et al. 2001*). At the bottom of the graph, with no relation to the y axe scale, the figure shows symbols representing the relative abundance of southern shelf edge species, in the Celtic Sea (squares), and in the Malin Shelf areas (circles). The symbols are filled when the standardized abundance was >2.

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