Deconstructing the response of plankton lifeform indicators to climate change

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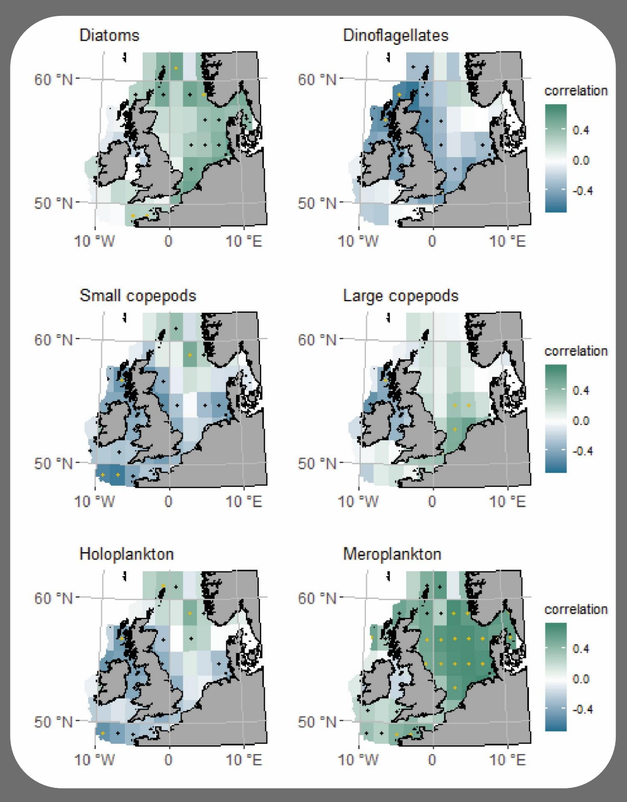
Background: Plankton lifeforms as biodiversity indicators

- Change in the abundance and balance of plankton 'lifeforms' (broad functional taxonomic groupings) is used as a biodiversity indicator in North East Atlantic ecosystem assessments, reflecting change in the functioning of lower trophic levels.
- Plankton indicators respond to both direct localised anthropogenic pressures (for example, eutrophication) and large scale climate change (for example, as a result of range shifts).
- Policy makers need to understand the response of plankton lifeforms to climate change so they can make decisions about the management of marine biodiversity and food webs.

Key message 1: Plankton lifeforms are showing regional scale change, often aligned with temperature change

Method:

- Interpolation of Continuous Plankton Recorder samples onto a 2 degree grid
- Correlation between annual mean abundance and Sea Surface Temperature (SST) calculated for each grid square- coefficients mapped below



Maps show the correlation coefficient between annual mean lifeform abundance (sample totals log10 x+1 transformed) and annual mean SST. Black dots show statistical significance, yellow dots show significance accounting for autocorrelation (modified Chelton method).

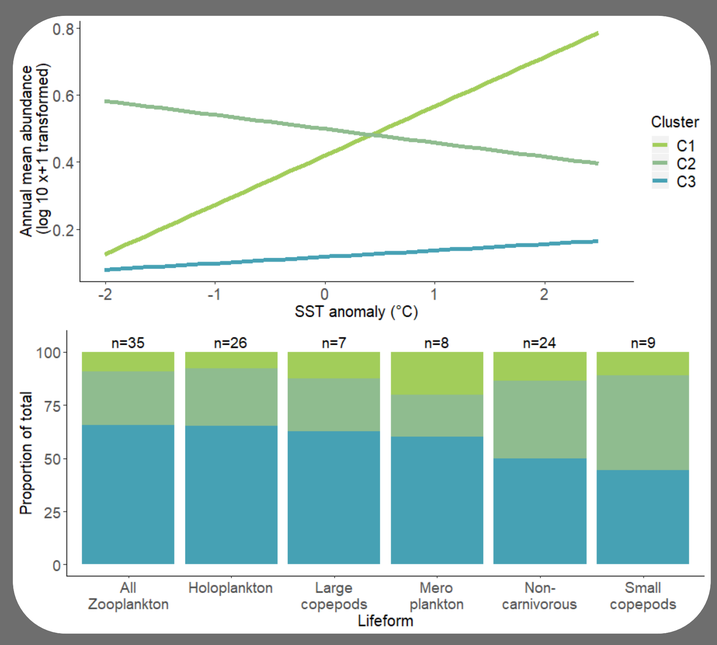
Results:

- Diatoms positively and dinoflagellates negatively correlated with increasing SST in the North Sea.
- Differences in small copepods correlation with SST within the region. Large copepods largely weakly correlated with increasing SST.
- Meroplankton strongly positively correlated to SST increase.

Key message 2: The taxa making up lifeform groups can show different responses to temperature

Method:

- K means clustering on regression coefficients of individual plankton taxa with SST
- The proportions of each clustered response within each lifeform group examined

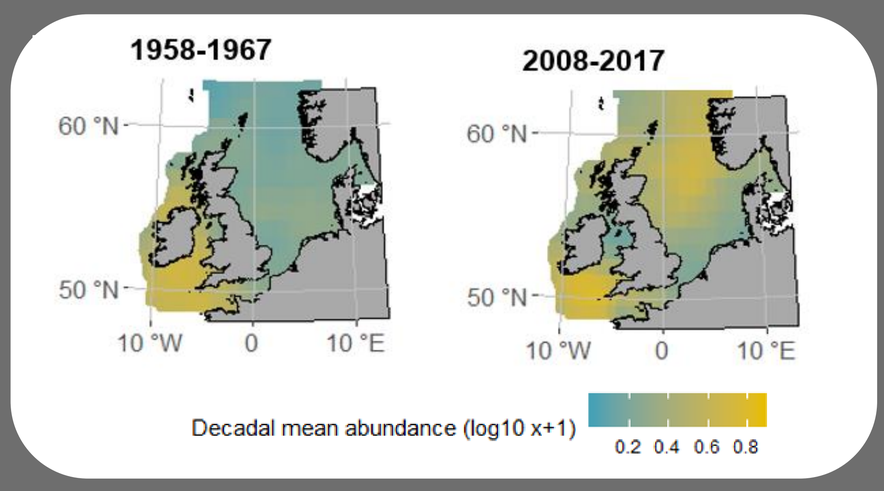


Top plots show the main responses of zooplankton taxa to SST (based on cluster analysis). Bottom bar plots then show the proportion of taxa within the different lifeforms that display each response. Results shown for 'permanently/seasonally stratified' areas of the North Sea.

- Zooplankton show mixed responses to SST within each lifeform group. For example, meroplankton show a highly mixed response despite total abundance increasing with increasing SST.
- More negative responders within small copepods, but still all clustered responses represented.
- Suggests other traits (such as biogeographical affinity) more important than lifeform traits in determining SST response.

Key message 3: Spatially extensive, taxonomically resolved data vital for interpreting policy assessments

- Indicators can show different trends within policy regions (for example, due to climate driven range shifts, or local environmental conditions)
- Identifying individual taxa causing change helps to link to drivers (for example, increasing warmer water affiliated species indicative of climate driven change). Lifeforms need to be constructed from taxonomically resolved data so they can later be 'deconstructed' to individual taxa for interpretation.
- Sustaining plankton time-series is vital for the construction, assessment and interpretation of biodiversity indicators used in policy



Range shift of Calanus helgolandicus- *a warmer temperate water indicator species*