Fisheries and Oceans Canada

The influence of sea ice dynamics on plankton abundance in the Northwest Atlantic inferred from the Continuous Plankton Recorder (CPR) Survey

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Pêches et Océans Canada

ICES CM 2008/B:11

Objective:

Determine if the extent of sea ice has had a major impact on the abundance and seasonality of lower trophic levels on the northern Grand Banks using data collected by the Continuous Plankton Recorder (CPR) survey 1960-2006.

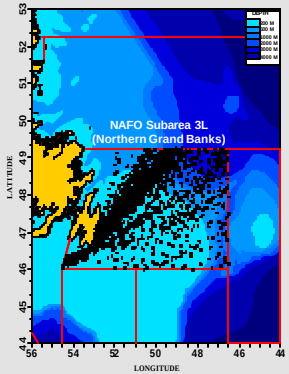

Figure 1. Station locations of the Continuous Plankton Recorder (CPR) survey in NAFO Subarea 3L during 1961-2006.

Methods

The nominal locations of CPR stations from 1961 through to 2006 on the Grand Banks are shown in Figure 1.

The CPR taxa included in this analysis Phytoplankton Colour Index [PCI], diatom [*Chaetoceros* spp.] abundance, summed dinoflagellate [*Ceratium arcticum*]. The mesozooplankton groups included *Calanus finmarchicus* (copepodite CI-CIV and adult CV-CVI stages), total copepods (copepoda). Macrozooplankton included euphausiacea and hyperiidea , and summed invertebrate larval and post-larval stages of decapoda.

The locations and concentrations of sea ice are available from the daily ice . The weekly concentration and types of ice within a 0.5° latitude by 1° longitude areas were recorded with data beginning in the early 1960s from charts published by Ice Central of Environment Canada in Ottawa. The historical minimum and maximum extent of sea ice on the Atlantic east coast is shown in Figure 2.

Historical Ice Extent Along the Atlantic East Coast

Maximum | Minimum

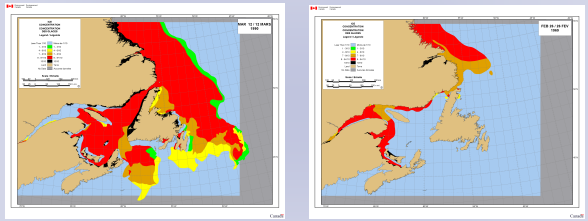

Figure 2. Historical maximum and minimum ice-extent on the Atlantic East Coast obtained from the Canadian Ice Service web site (Environment Canada; http://ice-glaces.ec.gc.ca).

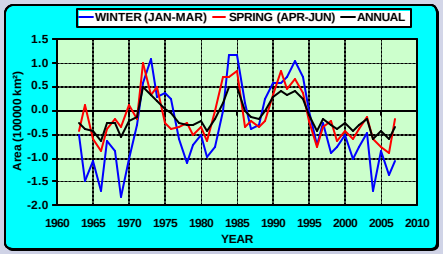

Figure 3. Time series of seasonal and annual ice extent anomalies on the Newfoundland and Labrador Shelves during 1963-2007.

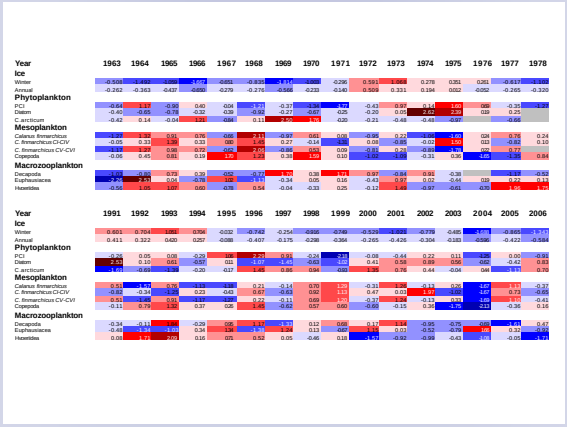

Figure 4. Time series of ice extent and dominant CPR taxa from the northern Grand Banks during 1963-1978 and 1991-2006. A grey cell indicates missing data; a blue cell indicates lower than normal levels and a red cell indicates higher than normal levels. More intense colours indicate larger anomalies. The number in the coloured cells are the differences from the long-term mean (1963-1978 and 1991-2006 respectively) divided by the standard deviation.

Results

The extent of seasonal ice coverage in the Newfoundland and southern Labrador region has varied considerably during the past five decades (Figure 3). The 1960's were below normal whereas the 1970s were above normal. Peak ice levels were observed during the early-mid 1980's and 1990's in this region.

There is greater inter-annual variability in the abundance of plankton compared to lower frequency change in ice coverage (Figure 4).

A principal component analysis indicates a positive relationship between winter ice and diatom anomalies and a negative trend with a common dinoflagellate (*Ceratium arcticum*) and the calanoid copepod *Calanus finmarchicus* (Figure 5).

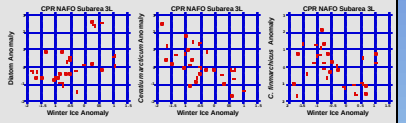

Figure 5. Relationship between the winter ice extent and plankton anomalies during 1963 to 2006.

There has been limited change in phenology of many of the dominant CPR taxa. Various indices of the timing of seasonal peaks of dominant CPR taxa during two periods (1963-1978 and 1991-2006) showed remarkable stability in the (Figure 6).

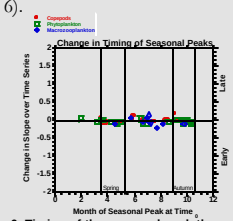

Figure 6. Timing of the seasonal peak throughout the production season using the month co-ordinate of the centre of mass index.

Conclusions

Our preliminary analysis of the spatial and temporal dynamics of dominant CPR taxa on the Grand Banks from 1960-2006 indicate a rather limited influence of changes in sea ice extent on plankton. Large changes in abundance of many CPR plankton occurred annually during periods of limited and extensive ice coverage across the region with only a clear pattern emerging for a very small number of taxa.

Acknowledgements

We thank Ingrid Peterson at the Bedford Institute of Oceanography for providing the NL Shelf monthly sea ice extents.