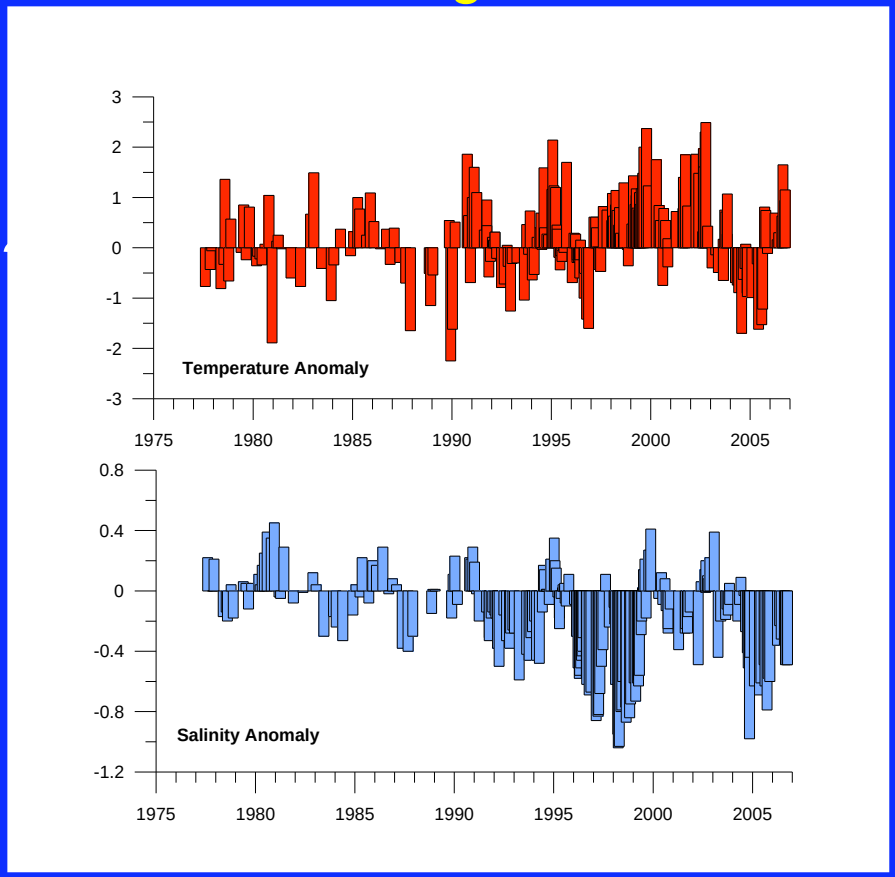
Recent Oceanographic Variability in the Gulf of Maine/Georges Bank Region

David Mountain

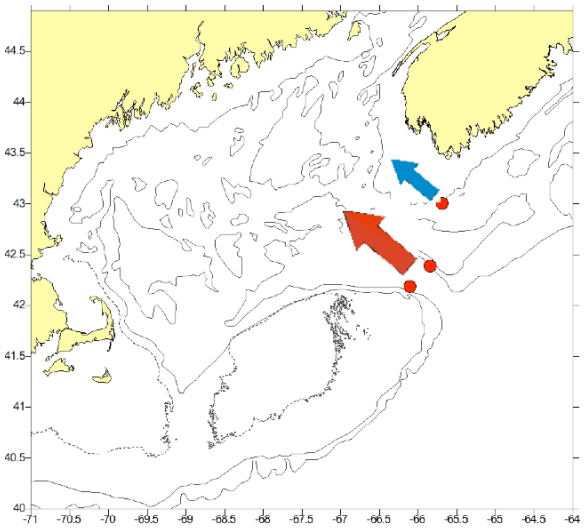
Temperature & Salinity Anomalies
NW George Bank

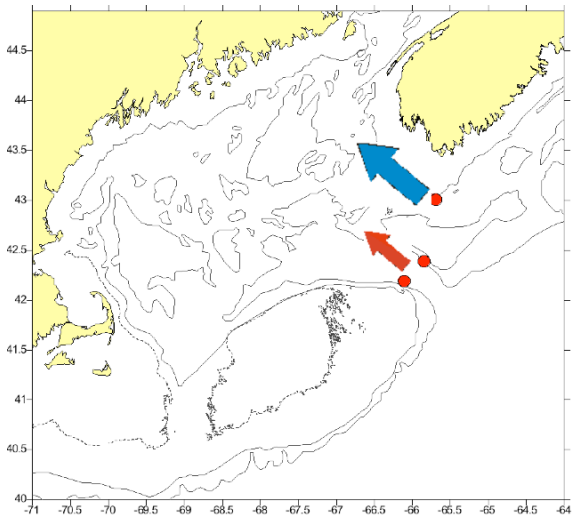
Temperature – subtle warming

Salinity – decrease in 1990's



Gulf of Maine Inflows





1976-1979 1993-1996

More inflow of water from the Scotian Shelf (…lower in salinity) during the 1990's (i.e., not originating locally – but coming from outside the region)

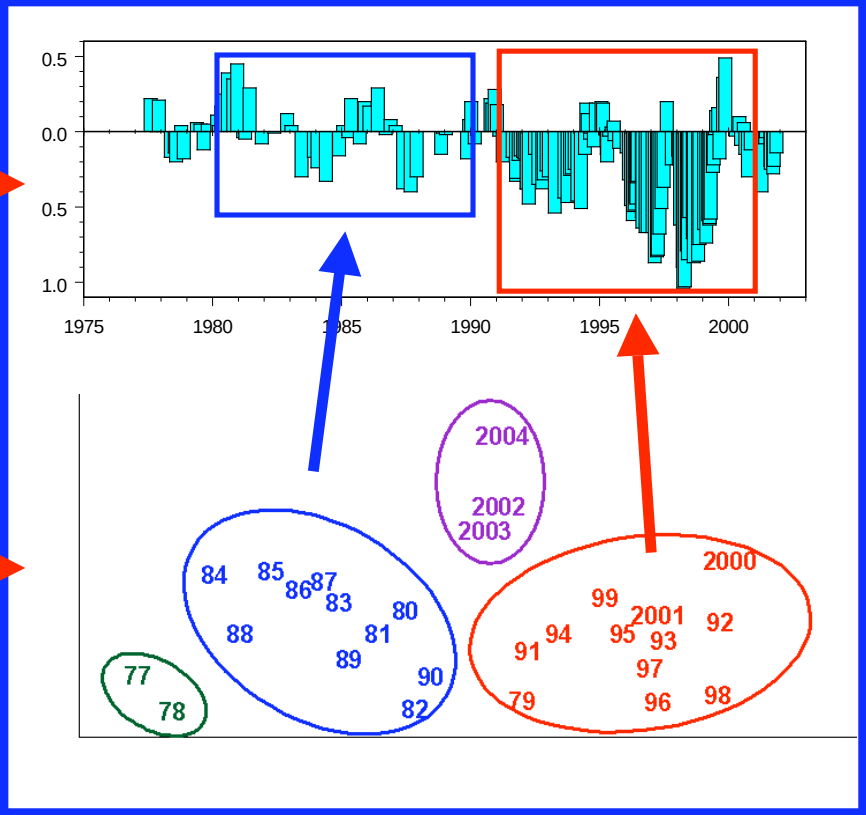
Changes in the Georges Bank ecosystem –

Change in zooplankton community structure between the periods

Favored smaller copepods during the 1990's

Georges Bank salinity anomaly

Multi-dimensional Scaling analysis of zooplankton community (Kane, 2007)



Pershing et al. (2005) found similar zoo changes in the Gulf of Maine

Possible salinity to zooplankton connection: Low salinity – early stratification, early/larger winter bloom, favoring smaller zooplankton species

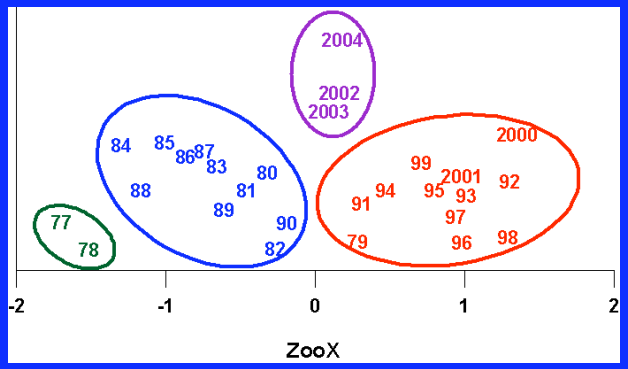
Also:

Durbin et al. (2003)
salinity to stratification to phytoplankton to zoo

Taylor and Mountain (2009)
salinity and change in winter mixing convection
deep layer temperatures

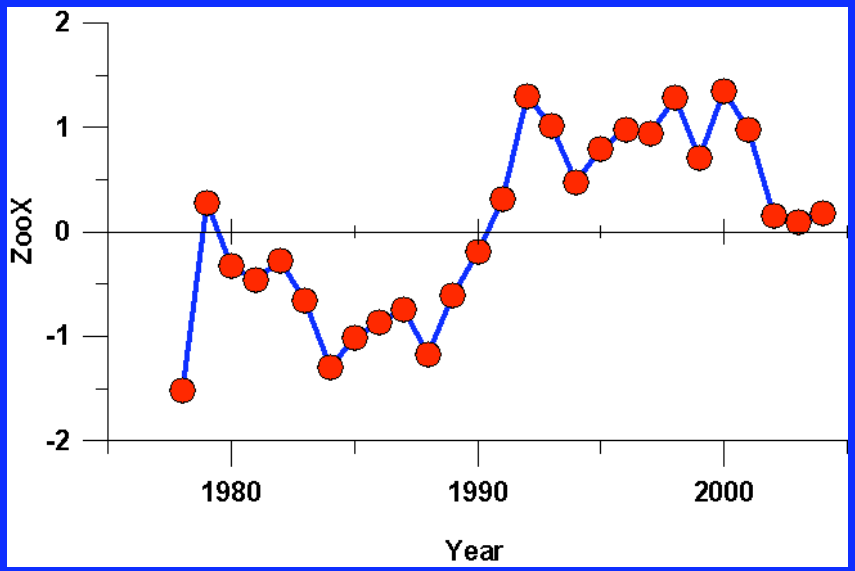
Ji et al (2007)
salinity and earlier blooms on Scotian Shelf and

ZooX Coordinate



Major Shift around 1990

(‘regime shift’ ?)



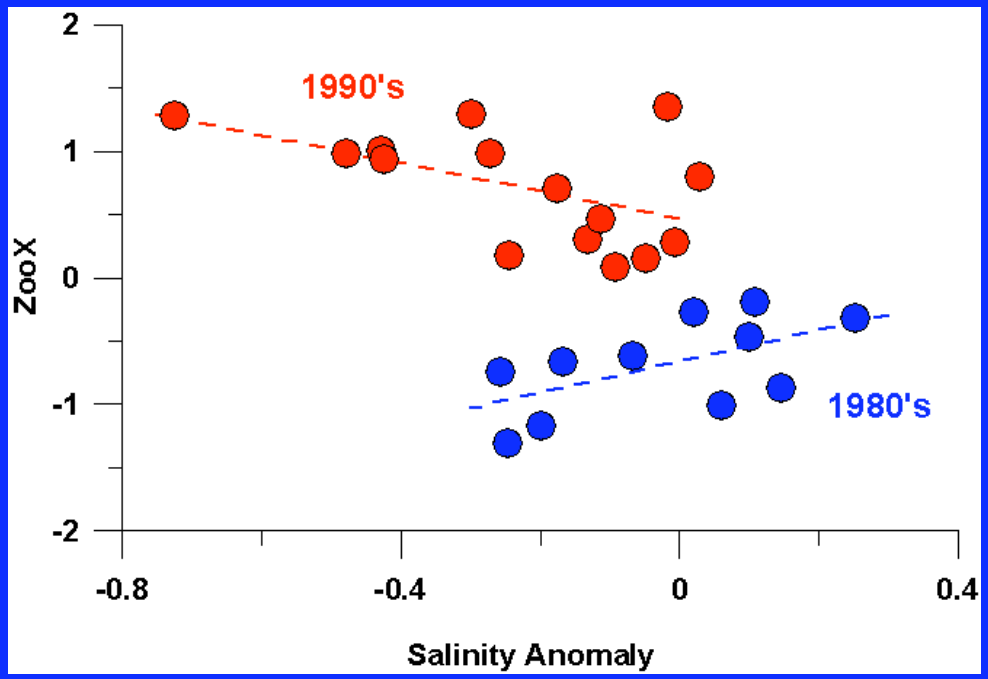
ZooX vs Annual Salinity Anomaly

No overall ZooX –Salinity relationship

Overlap in salinity values between 1980's and 1990's

Separate ZooX –Salinity relationships

Salinity did not cause the zooplankton shift



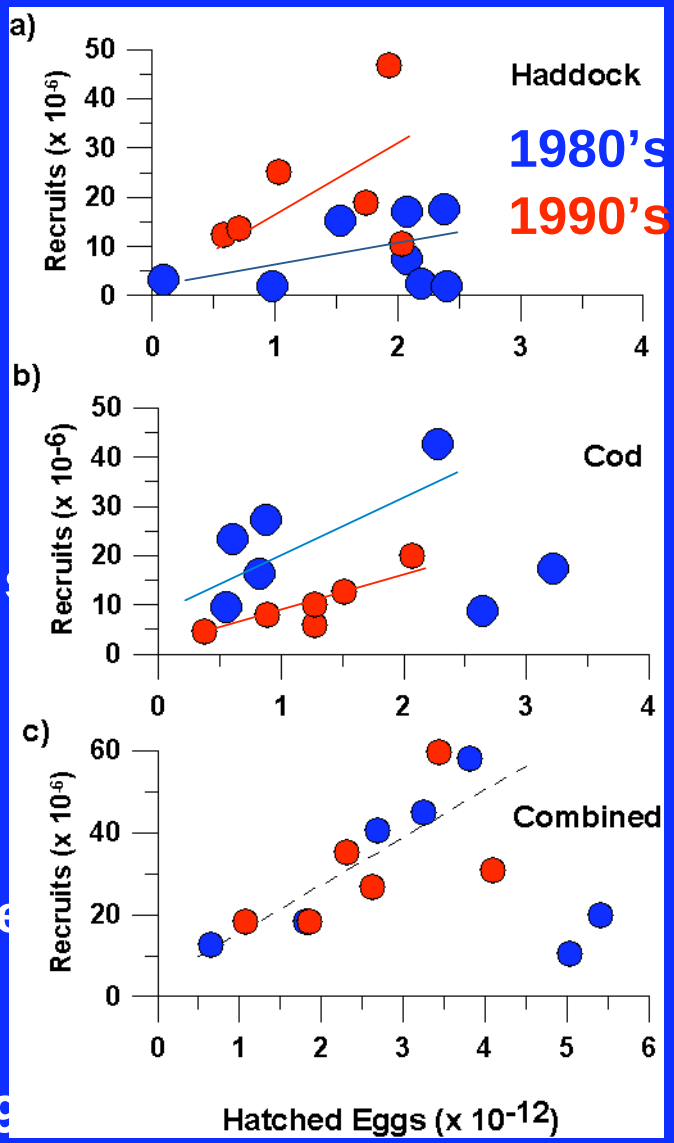
Georges Bank Cod and Haddock Recruits vs Egg Hatching (survivorship)

Haddock – survivorship low in 1980's
high in 1990's (x 2 or 3)

Cod – the reverse

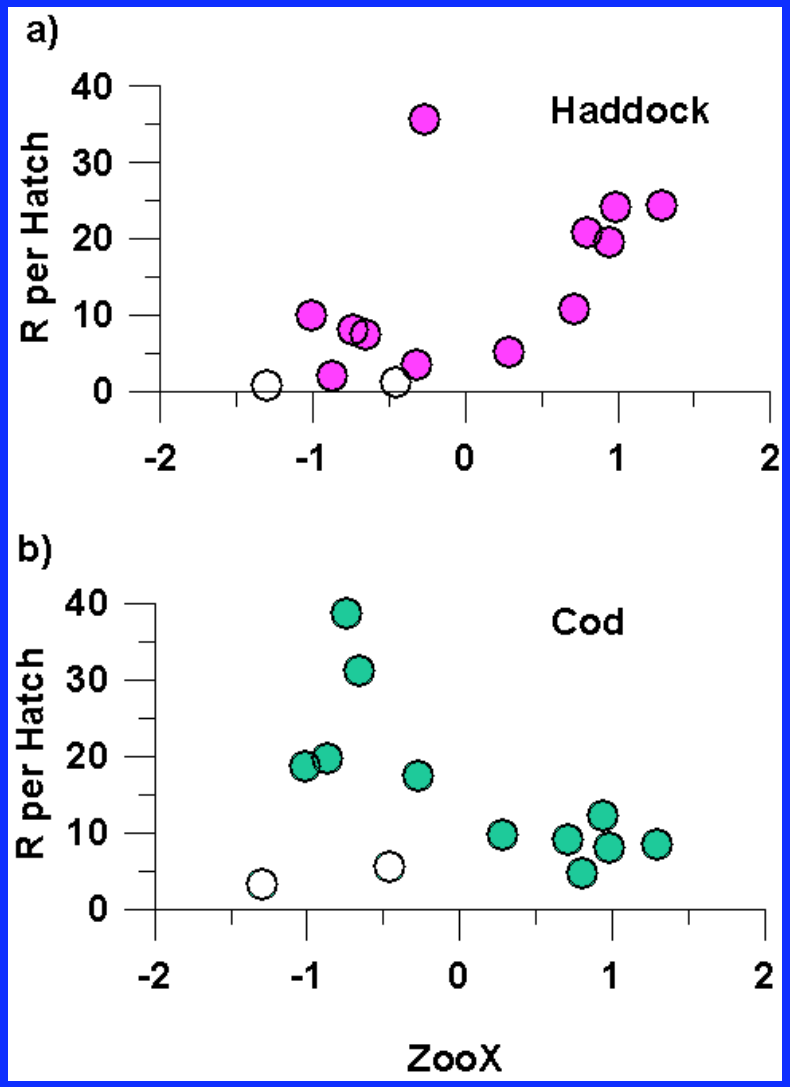
Combined – no shift between decade

Survivorship also shifted around 199



Survivorship vs ZooX

Suggestion of linkage between survivorship and zooplankton community structure



Link et al. (2002) PC1 vs ZooX

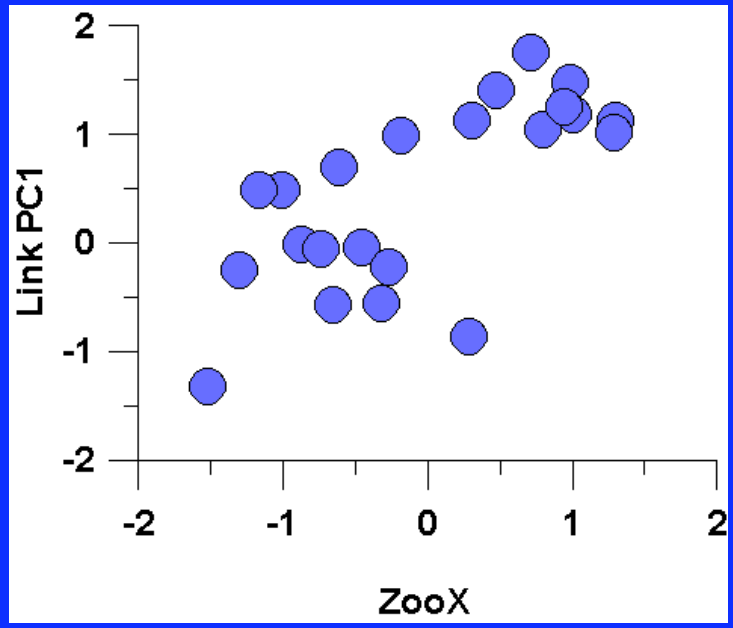
Perhaps …

Not just zooplankton,

Not just cod and haddock,

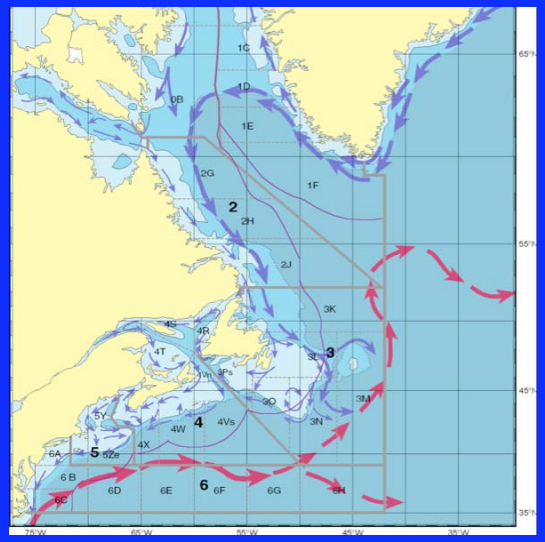
But whole ecosystem experienced a major change around 1990

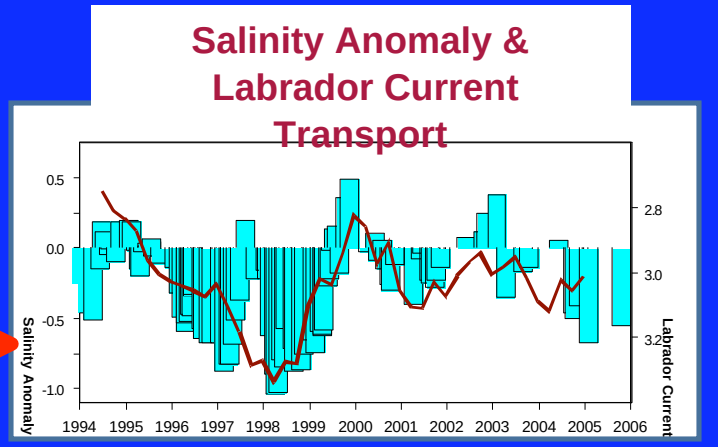
Associated with the change in inflows to the system

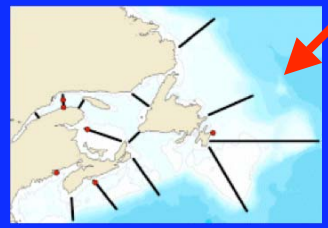


Origin of low salinity?

1. **O^{18} analysis indicates high latitude source:**
   - **Chapman & Beardsley (1989) In general**
   - **Houghton & Fairbanks (2001) For GLOBEC years**
2. **Greene and Pershing (2007) Arctic source**
3. **Labrador Current transport**







So,

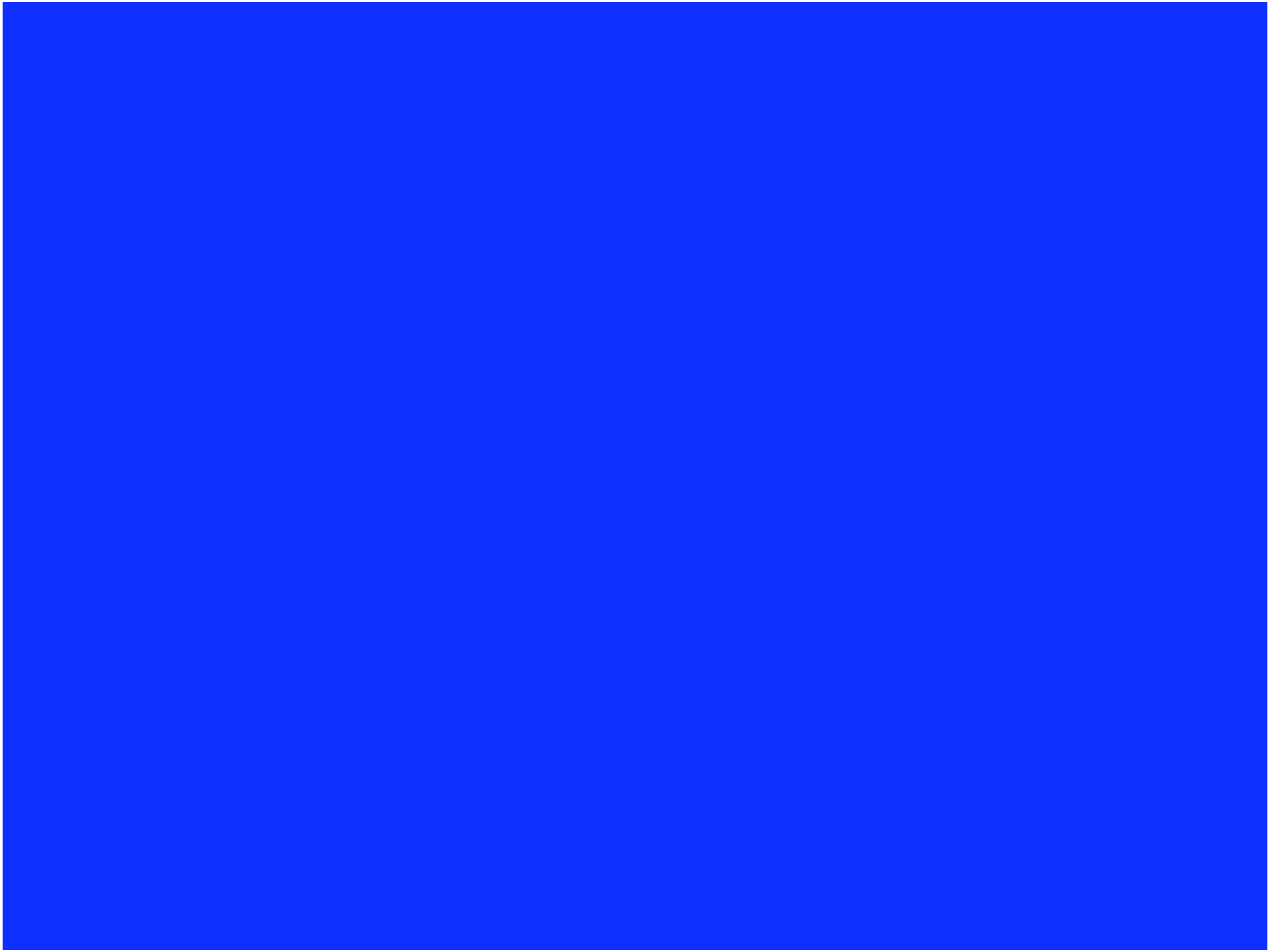
Major system changes associated with change in inflows –

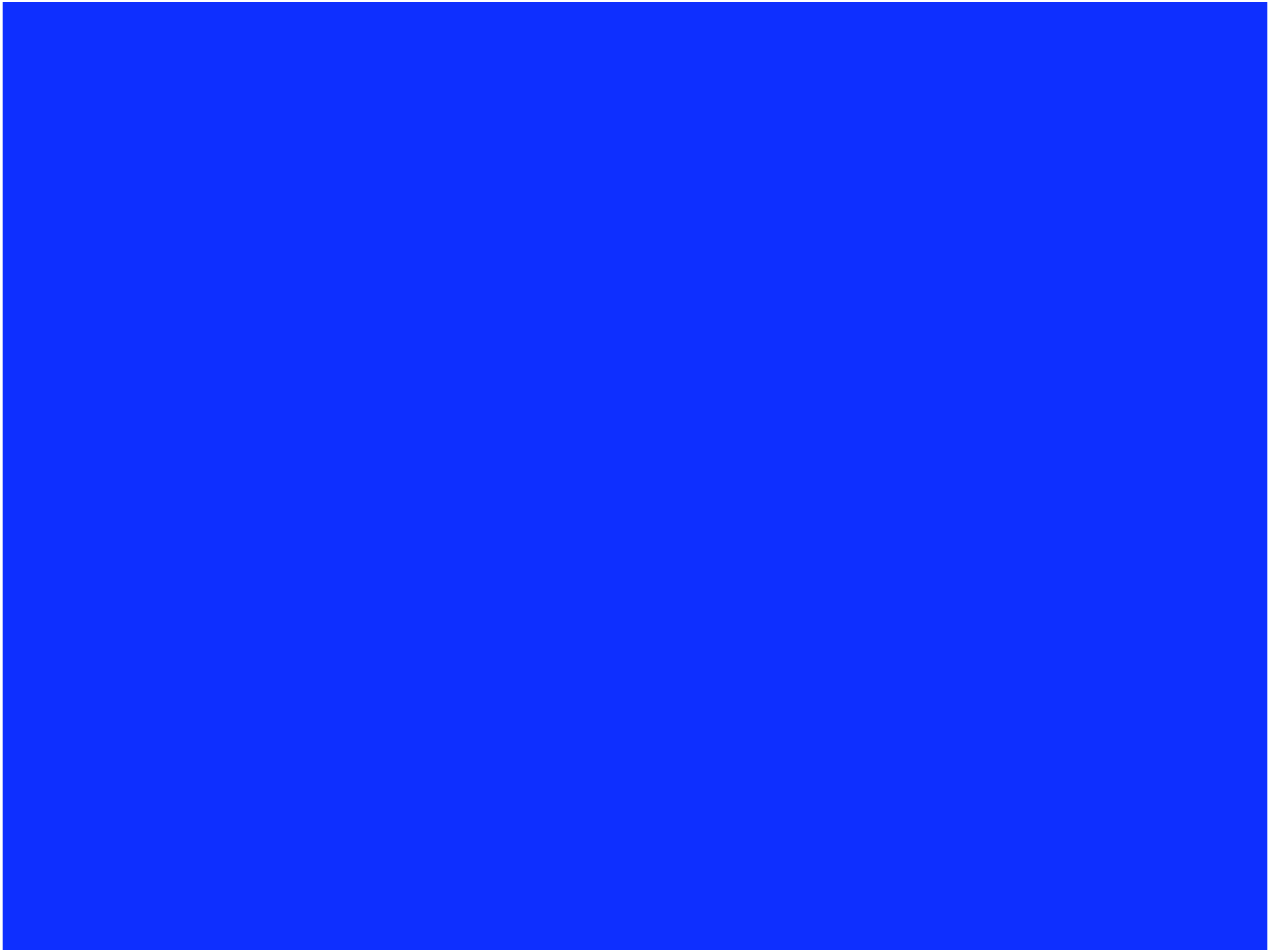
perhaps including salmon

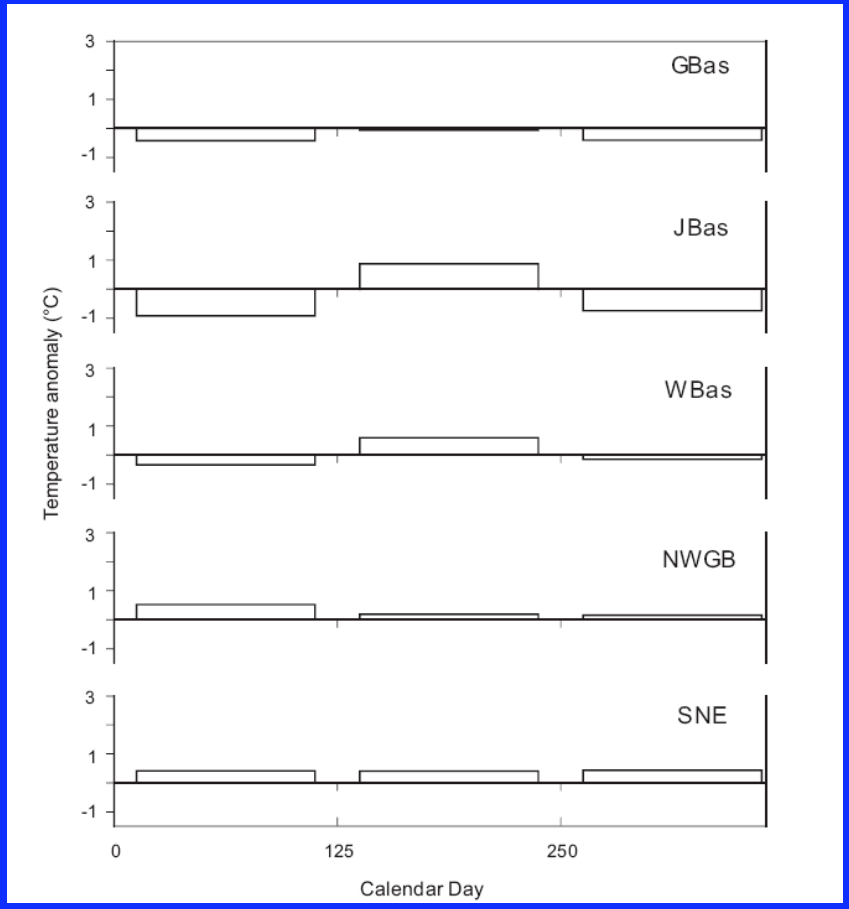
Whole shelf system from Labrador to Hatteras could be affected

Question:

What are the biological implications within the Gulf of Maine of the change in inflows – nutrients, phytoplankton, zooplankton influx changes with more Scotian Shelf Water and less Slope Water?






GBas
JBas
WBas
NWGB
SNE
3
1
-1
Temperature anomaly (°C)
0
125
250
Calendar Day