Climatic variations and salmon mortality: stable isotope evidence

Sub-Polar Gyre (SPG) Modal variability

After Hatún et al. 2005, 2009
Ecosystem effects in NE Atlantic associated with shift from strong to weak SPG (see Hatún et al., 2005, 2009)

<table>
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<tbody>
<tr>
<td>Total P production</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td><em>C. finmarchicus</em></td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Small ‘warm’ Calanus</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Blue whiting</td>
<td>Restricted</td>
<td>widespread</td>
</tr>
</tbody>
</table>

**Phytoplankton**

**C. Finmarchicus (inverse)**

**Blue Whiting**
England + Wales

P = 0.1 (0.01)  ICES E+W PFA

Scotland

P < 0.05 (<0.001)  ICES E+W PFA

High level of co-incidence: note anomalous years
Removing effect of Sub Polar Gyre -Regime shift in 1988 – large ecosystem shift
Isotope Background

• Already seen how isotopes can provide hypotheses about feeding grounds

• Based on environmental effects on primary production that propagate through the food web

• Use same SI time series to explore climate effects on salmon populations on a stock specific basis
River Frome

MSW returning fish are isotopically distinct from 1SW fish

Co-incident multi-year cyclical fluctuations in C and N

Variations <0.5 per mil

Variations <1 per mil
NE Coast

Co-incident cyclical fluctuations in C - similar isotopic composition

Relatively large, high frequency fluctuations – less stable ecosystem

NOT feeding in the same place as R Frome fish
Conclusions and questions

- Is return rate equal for feeding areas? Bet hedging around SPG conditions?

- Remove dominant regional climate signal to see wider ecosystem effects

- 1988 regime shift was not accompanied by large changes in carbon isotopes - maybe a small increase in trophic level

- Stable isotope analyses give a lot of information about feeding area and climate-ecosystem linkages on a river and cohort specific level - retrospectively
Data: Mass

- d15N increases with mass as expected for a pelagic predator. Smaller fish have a wider trophic niche—relatively stable by c.6Kg.
- Note apparently different slopes— but NE Coast mass data missing so poor data