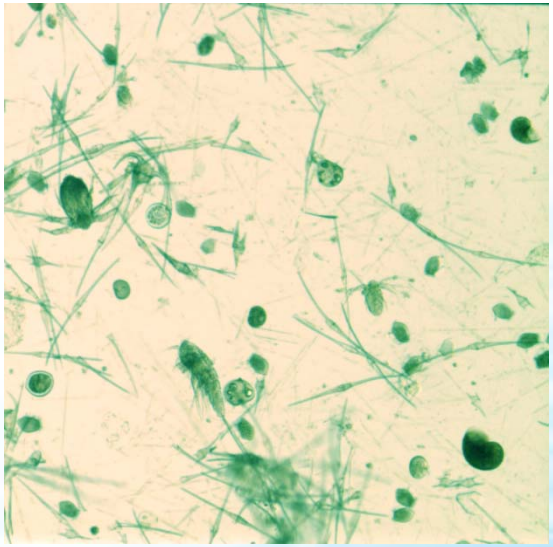
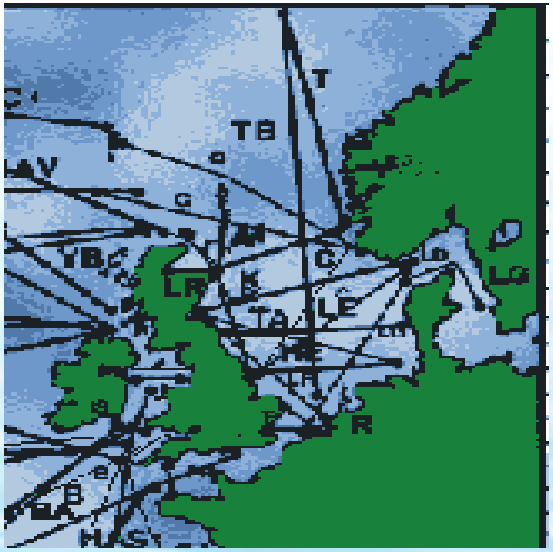
Long-term changes in the distribution and abundance of selected fish larvae from the CPR (1950-2005) over the UK shelf, in relation to biological and environmental factors





Sophie G. Pitois, Christopher P. Lynam, David Maxwell, Nicholas C. Halliday, Martin Edwards

International Zooplankton Symposium, Pucón (14-18 March 2011)

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Outline

1. **CPR survey and fish larvae**
   - The CPR survey
   - Analysis of fish larvae and area of work
   - Species caught by the CPR

2. **Biogeographical changes for main taxonomic groups and relationship with environment**
   - Clupeids, Sandeels and Atlantic mackerel
   - Distribution, changes through time and space
   - Long-term trends and links with temperature, NAO, zooplankton, phytoplankton, salinity

3. **Clupeids and fishing effects**
   - Relationship between CPR fish larvae and stock assessment data (fisheries)

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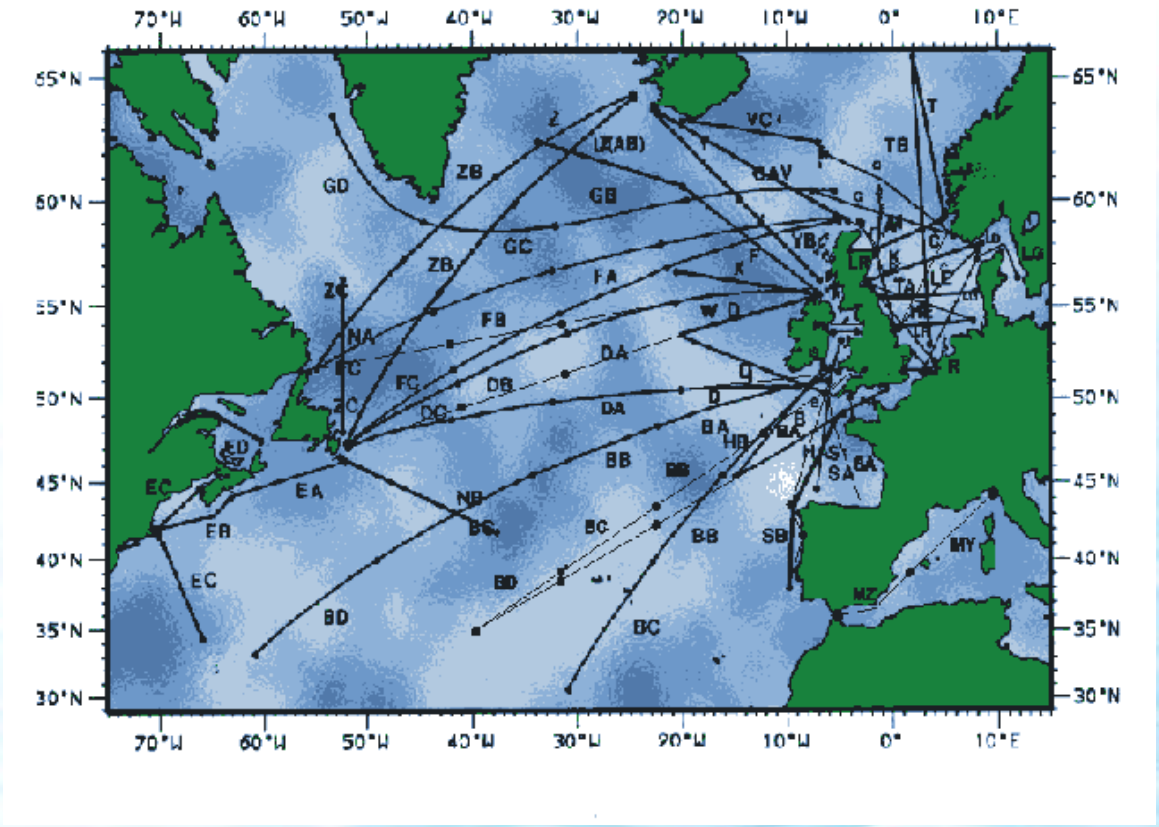
Continuous Plankton Recorder study

- CPR has been running for more than 80 years
- Unique source of long-term information of zooplankton in the North Atlantic



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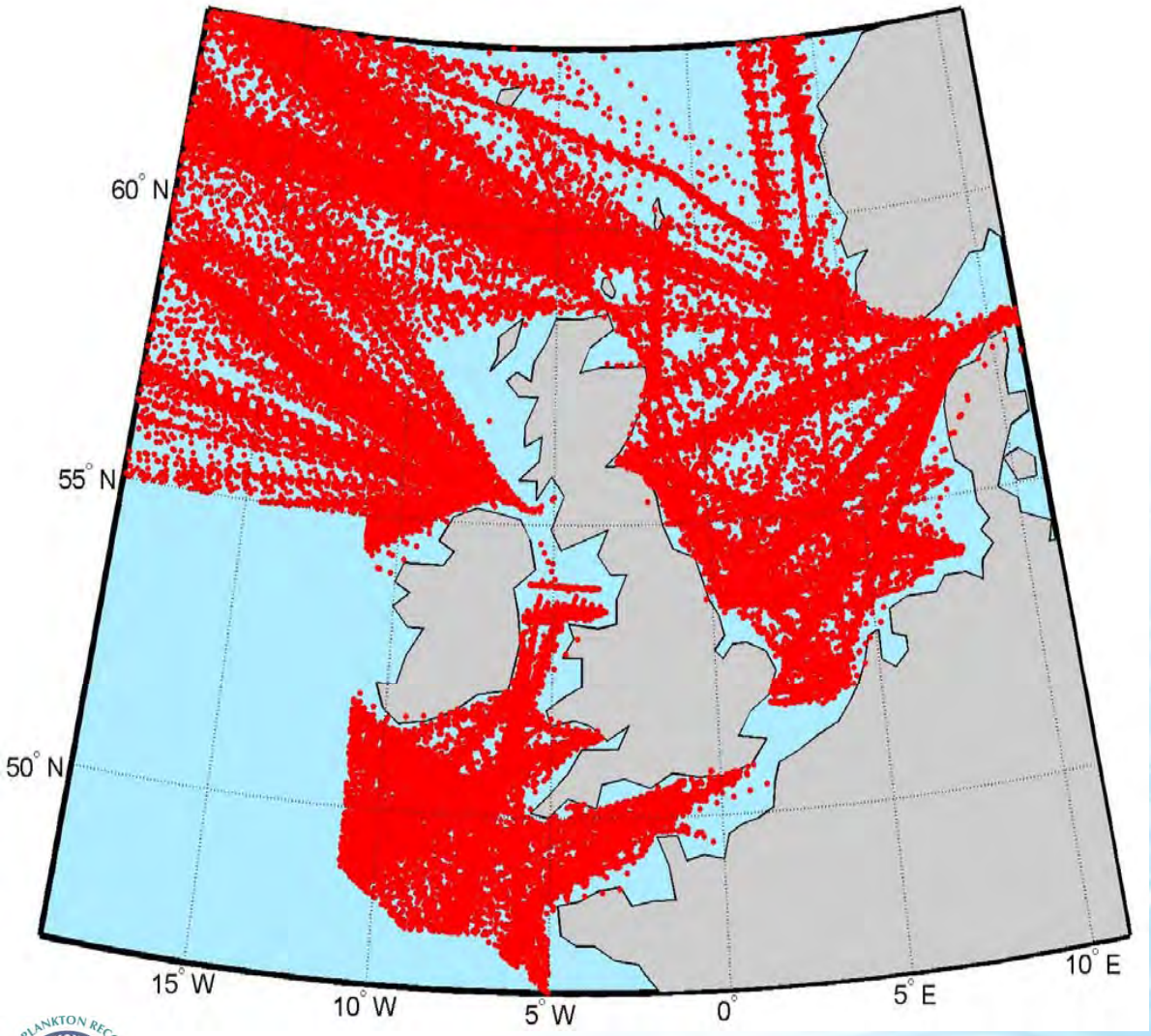
fish larvae samples and area of work



- Sampling locations from CPR survey covering 1950-2005
- Over 106500 data points

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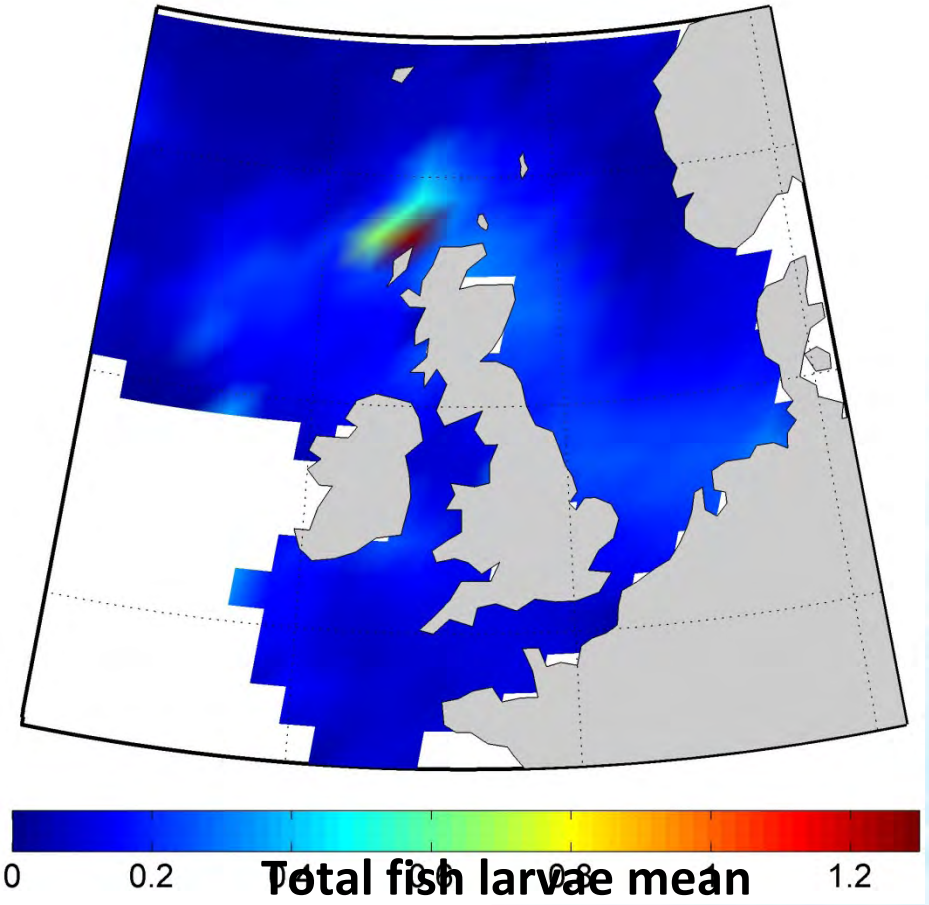
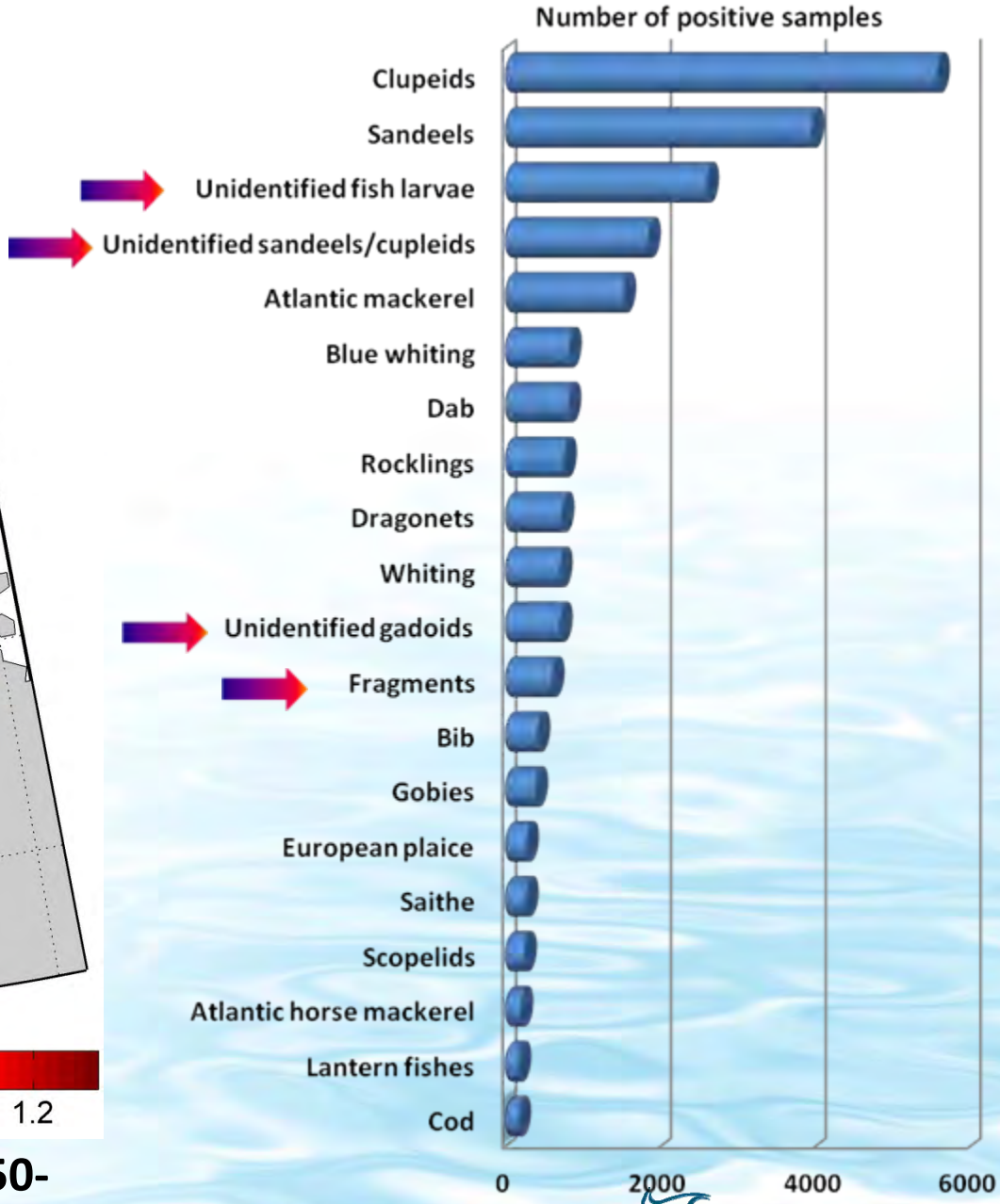
fish larvae caught by the CPR



Total fish larvae mean abundance caught by CPR, 1950-2005



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Clupeids, Sandeels and Atlantic mackerel larvae in relation to their environment

Environmental Data:

- Monthly average SST and Surface salinity (1°x1° grid) obtained from the International Comprehensive Ocean–Atmosphere Data Set (ICOADS) 1960-2005
- Winter NAO Index obtained from US National Center for Atmospheric Research
- Phytoplankton Chlorophyll Index (PCI) obtained from CPR
- Dinoflagellates abundance obtained from CPR
- Diatoms abundance obtained from CPR
- Zooplankton (copepods and cladocerans) abundance from CPR

Fisheries data:

- Stock and recruitment indices for herring, obtained from the International Council for the Exploration of the Sea

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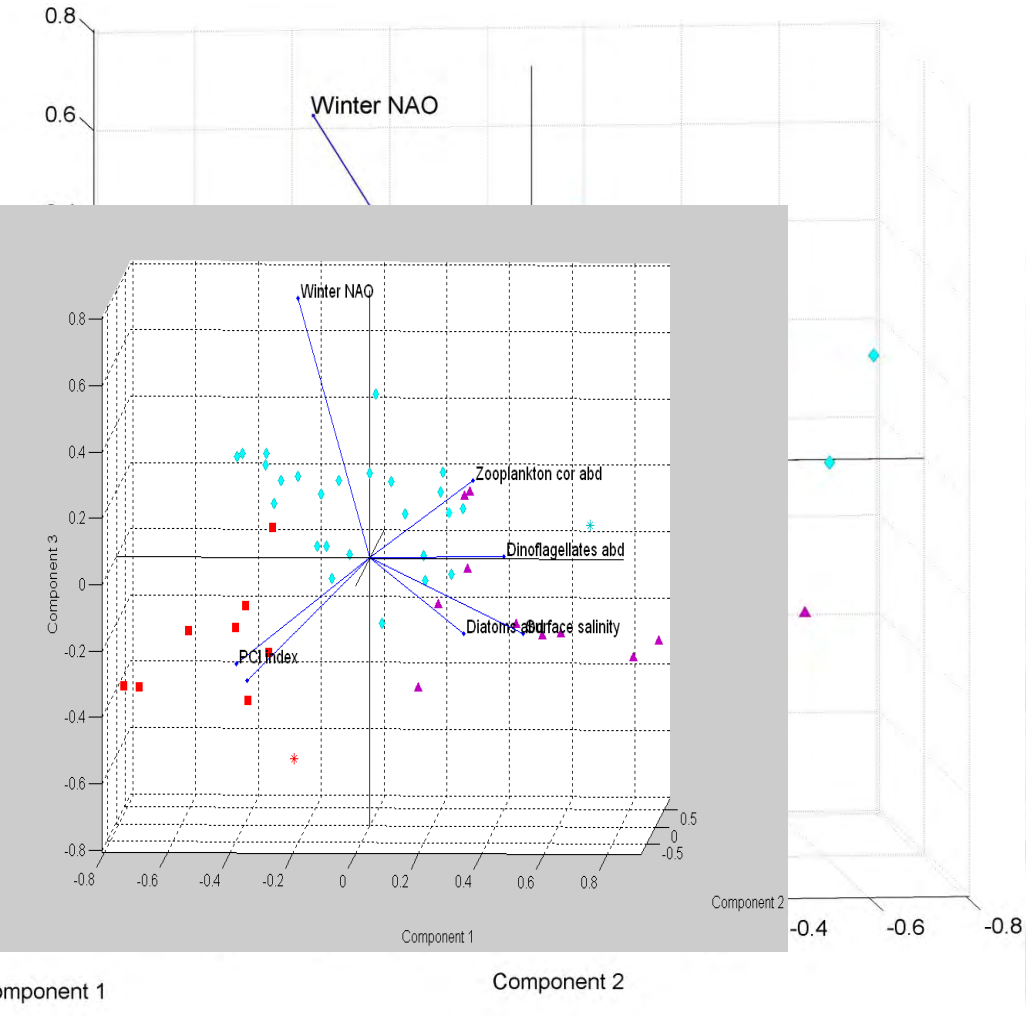
A changing environment…

Principal Component Analysis on 7 standardized environmental variables



3 distinct periods of time:

1.1960-1969 ▲

high salinity, diatoms, dinoflagellates and Zooplankton

low SST and PCI

2. 1970-1995 ◆

Low diatoms, dinoflagellates, PCI, SST, salinity

3. 1996-2004 ■

High SST, PCI, diatoms

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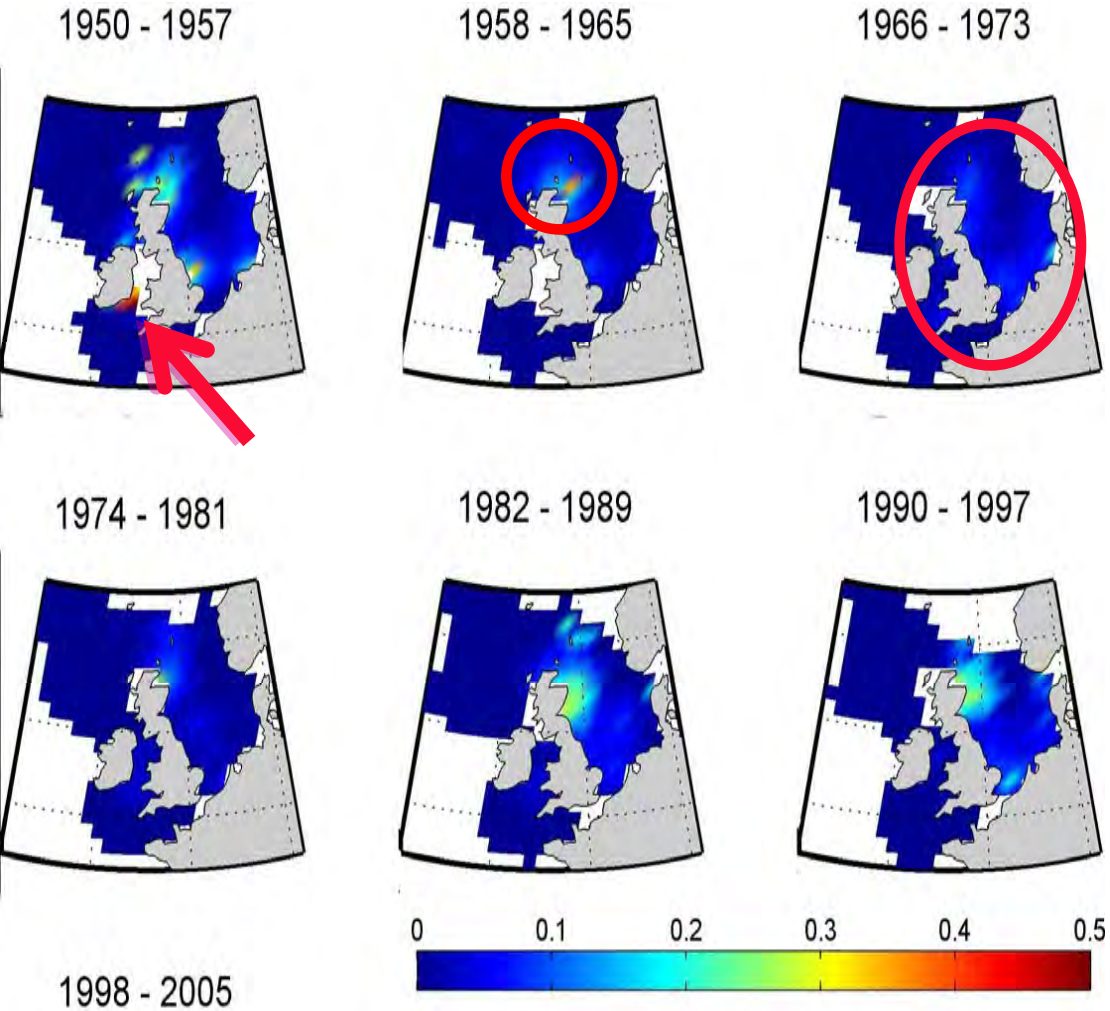
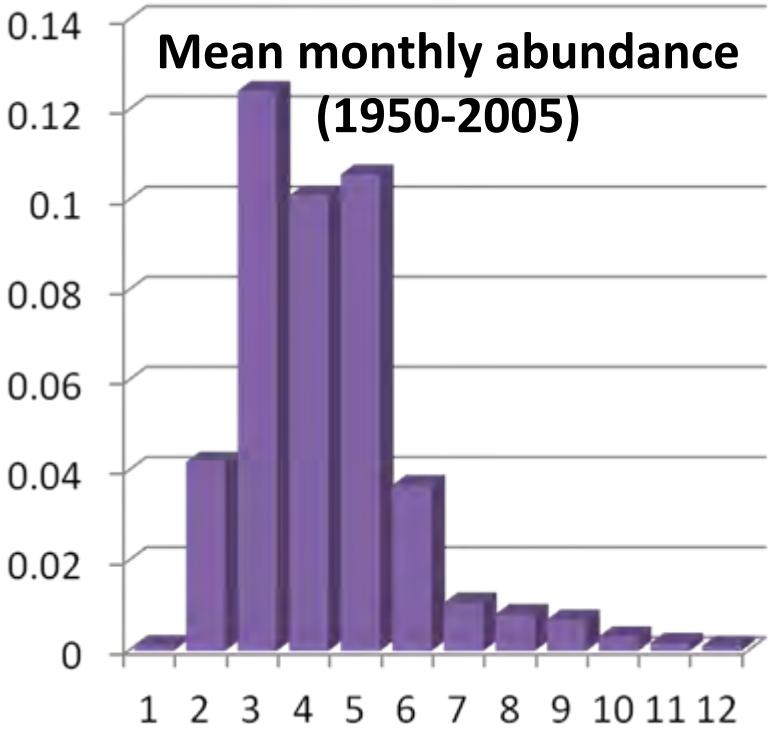
Sandeel larvae



Abundance distribution in 8-years groups



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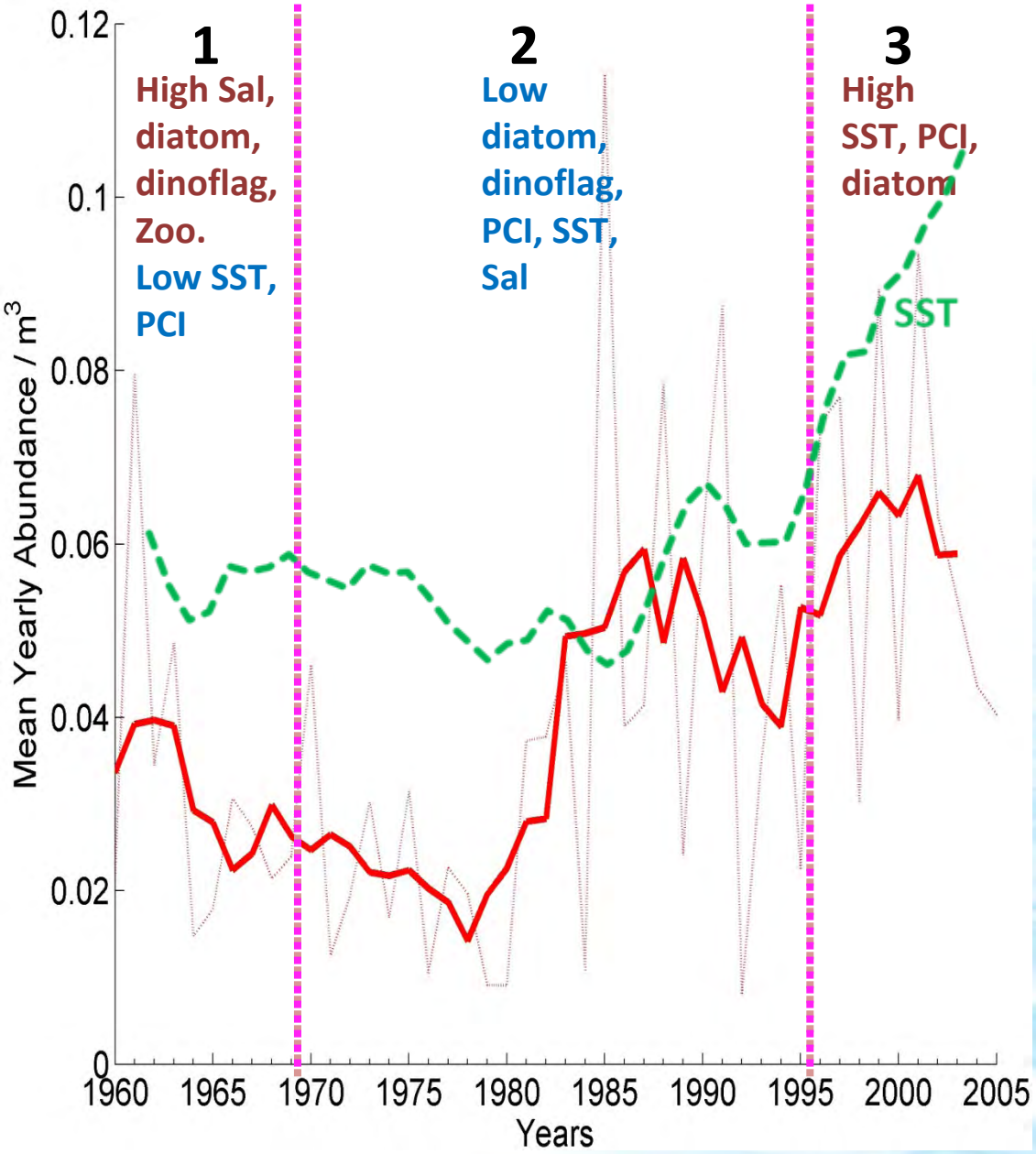
Sandeel larvae

Long-term trend



Correlations with sandeel larvae abundances (1960-2005)

	R	p
zooplankton Abundance	0.077	0.575
diatoms	0.076	0.607
Dinoflagellates	0.036	0.806
PCI	0.382	0.007
Surface salinity	-0.05	0.743
SST	0.298	0.044
Winter NAO	-0.319	0.03

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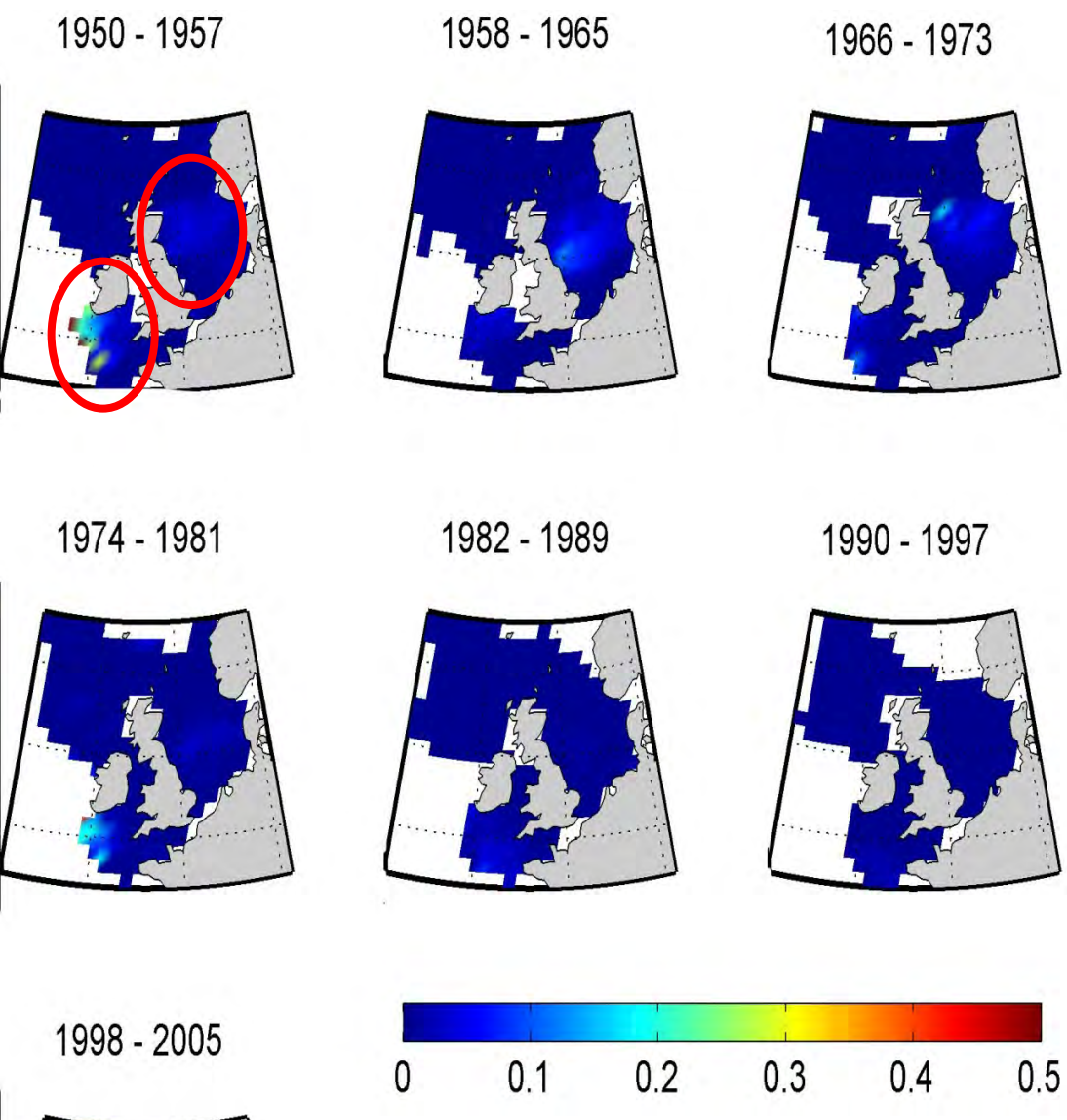
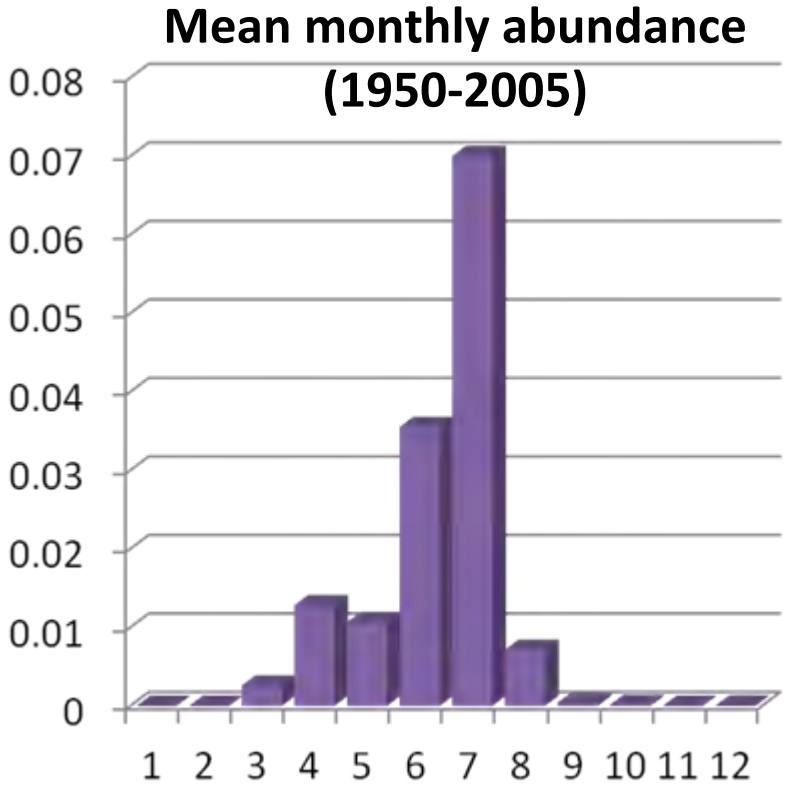
Atlantic Mackerel larvae



Abundance distribution in 8-years groups



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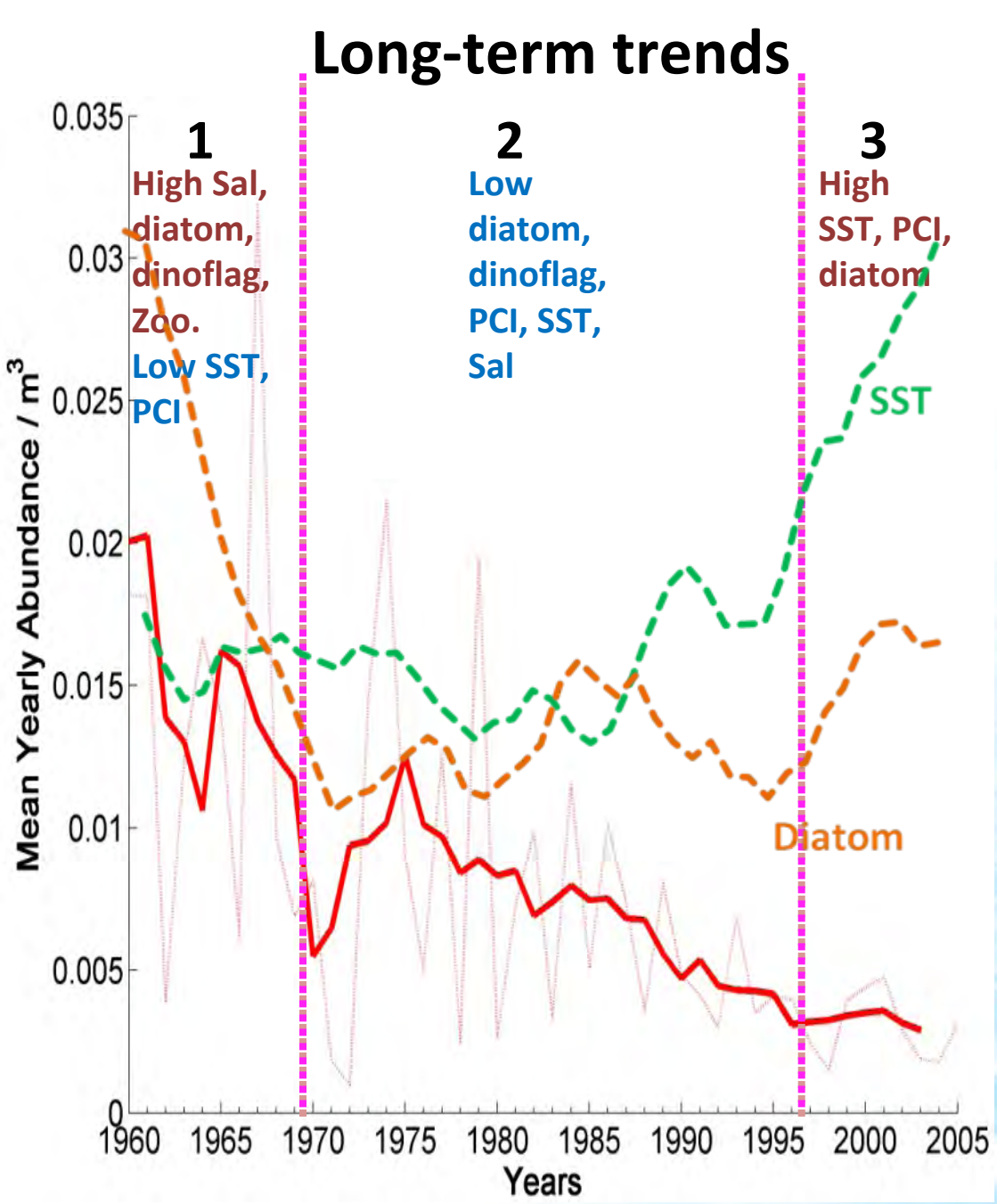
Atlantic Mackerel larvae



Correlations with Atlantic mackerel larvae abundances (1960-2005)

	R	p
zooplankton Abundance	0.348	0.009
diatoms	0.461	0.001
Dinoflagellates	0.296	0.041
PCI	-0.342	0.017
Surface salinity	0.303	0.0427
SST	-0.319	0.030
Winter NAO	-0.014	0.921

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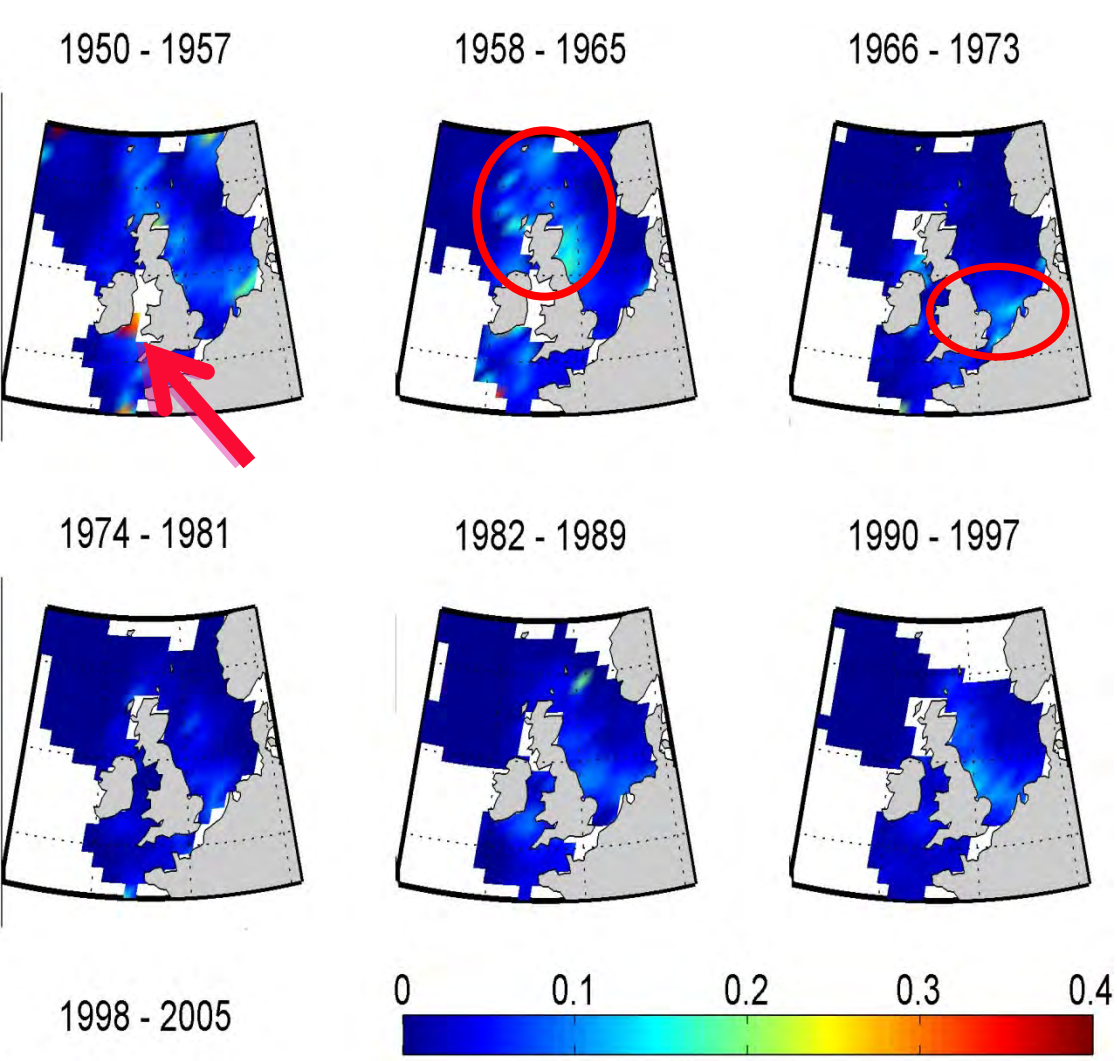
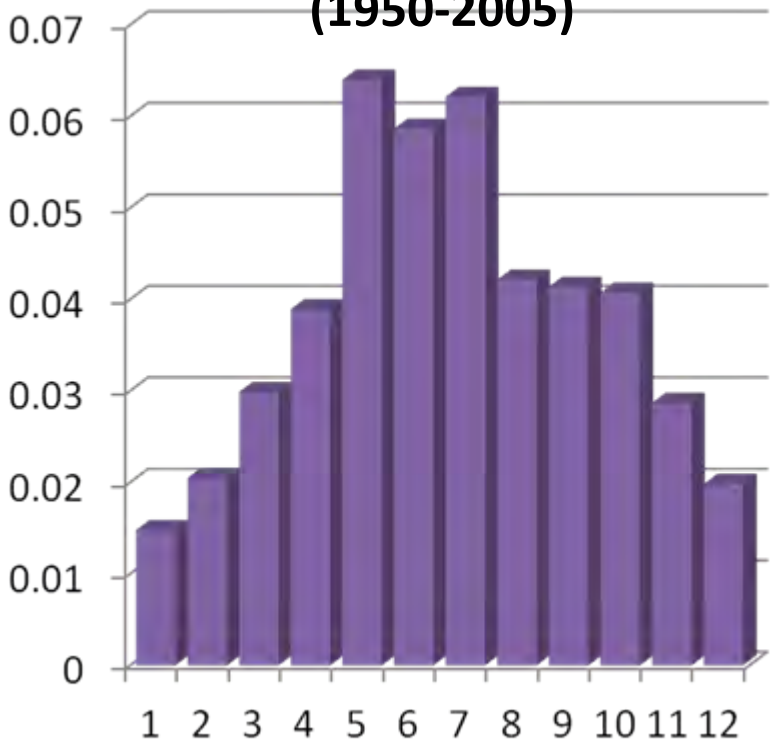
Clupeid larvae



Abundance distribution in 8-years groups

Mean monthly abundance (1950-2005)



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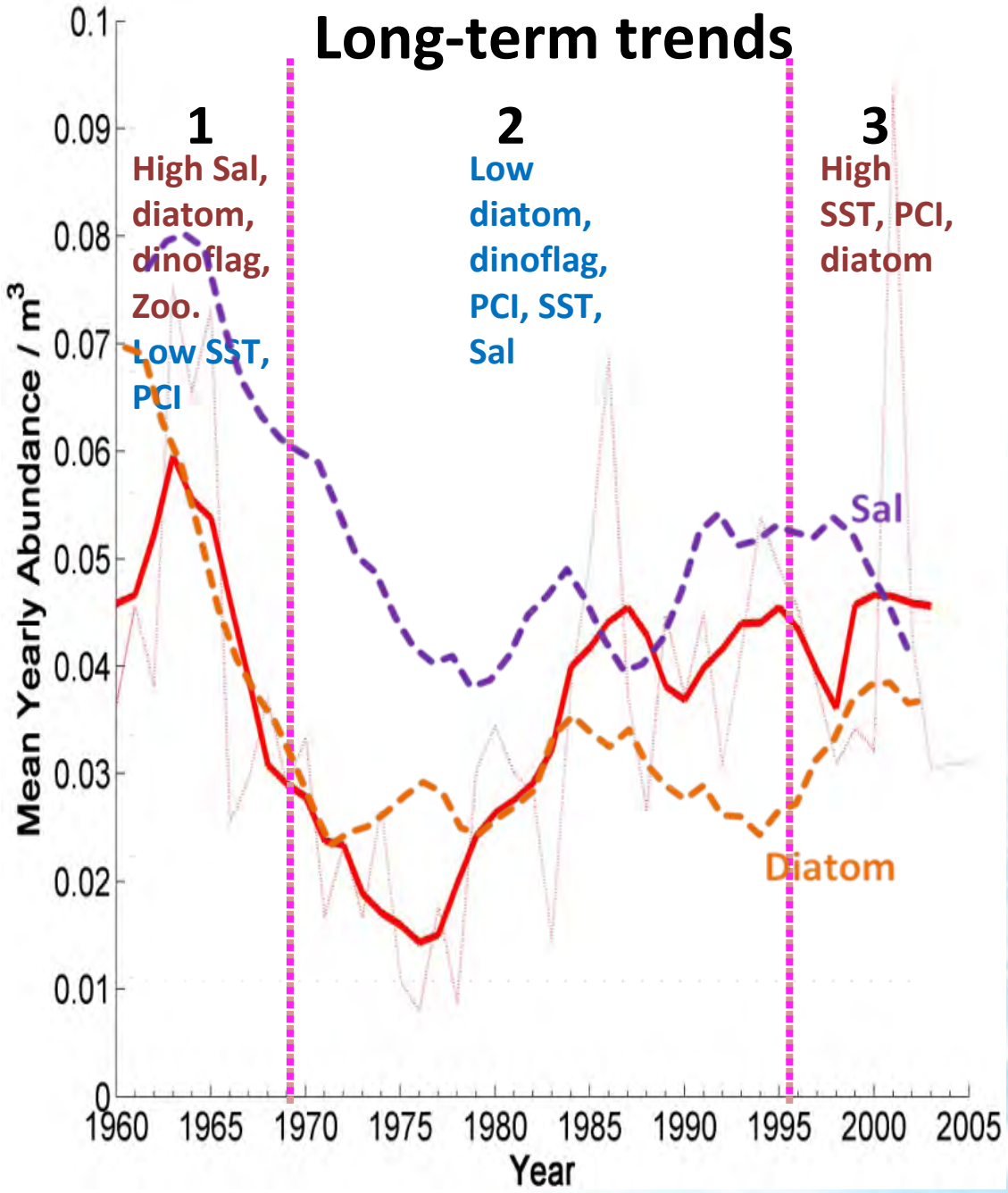
Clupeid larvae



Correlations with clupeid larvae abundances (1960-2005)

	R	p
zooplankton Abundance	0.429	0.001
diatoms	0.353	0.014
Dinoflagellates	0.142	0.337
PCI	0.097	0.510
Surface salinity	0.420	0.004
SST	0.032	0.829
Winter NAO	-0.154	0.257

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Results environmental impacts on fish larvae

- **Our results suggest that different type of fish larvae respond differently to changing environment:**

  - Sandeels: SST seems the most critical driver?

  - Atlantic mackerel: Temperature and prey?

  - Clupeids: prey and salinity?

- **However relationships between fish larvae and individual variables are weak, highlighting the complexity of the mechanisms involved.**

  - variables may have a direct or indirect effect (or both)

  - several variables acting at the same time not always in the same direction

- **Possibility to develop species specific indices of survival with selected environmental variable? And on specifically delimited areas?**

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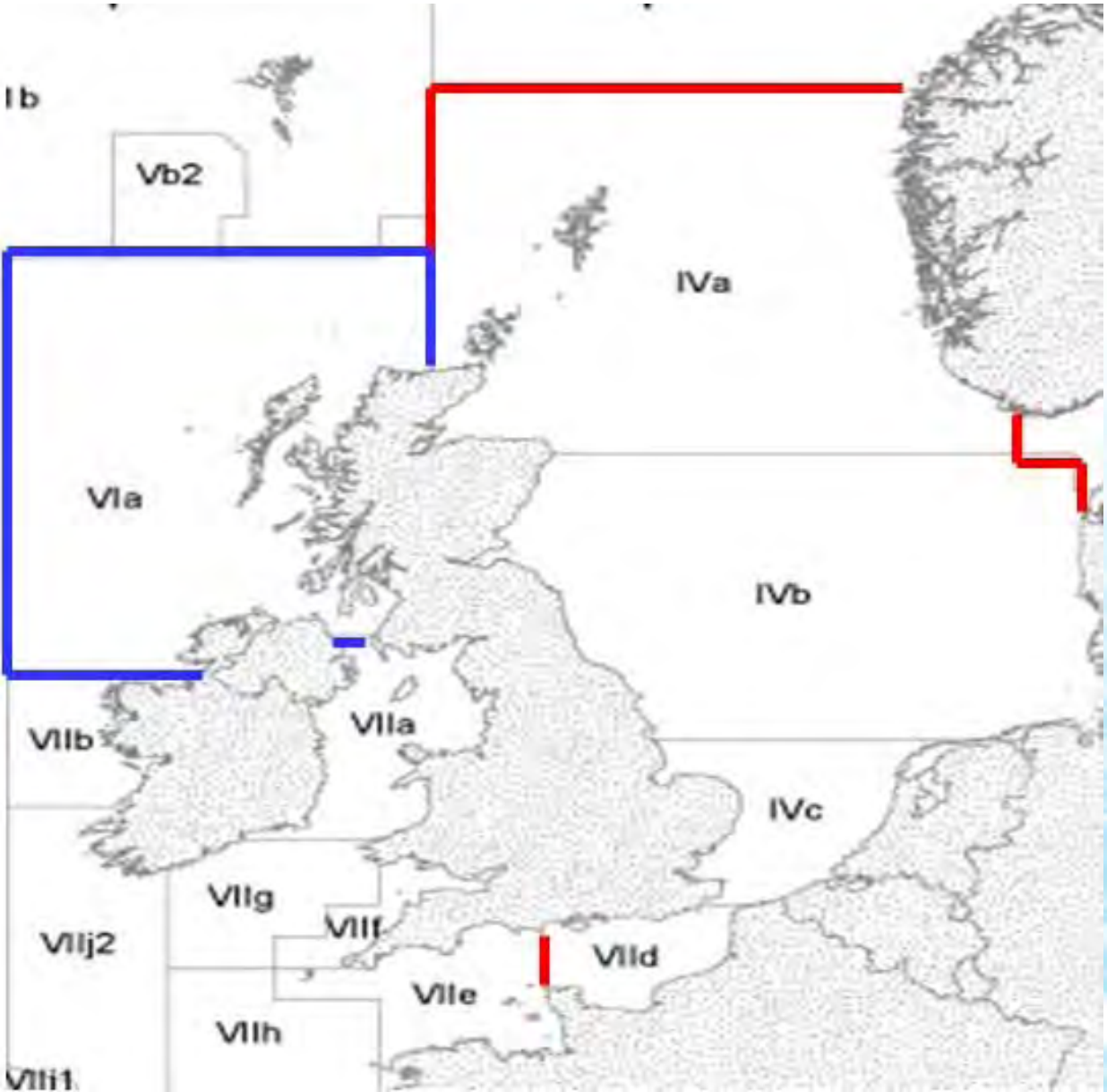
CPR clupeid larvae and herring stock assessment data



2 areas selected:

North Sea & eastern channel

West of Scotland

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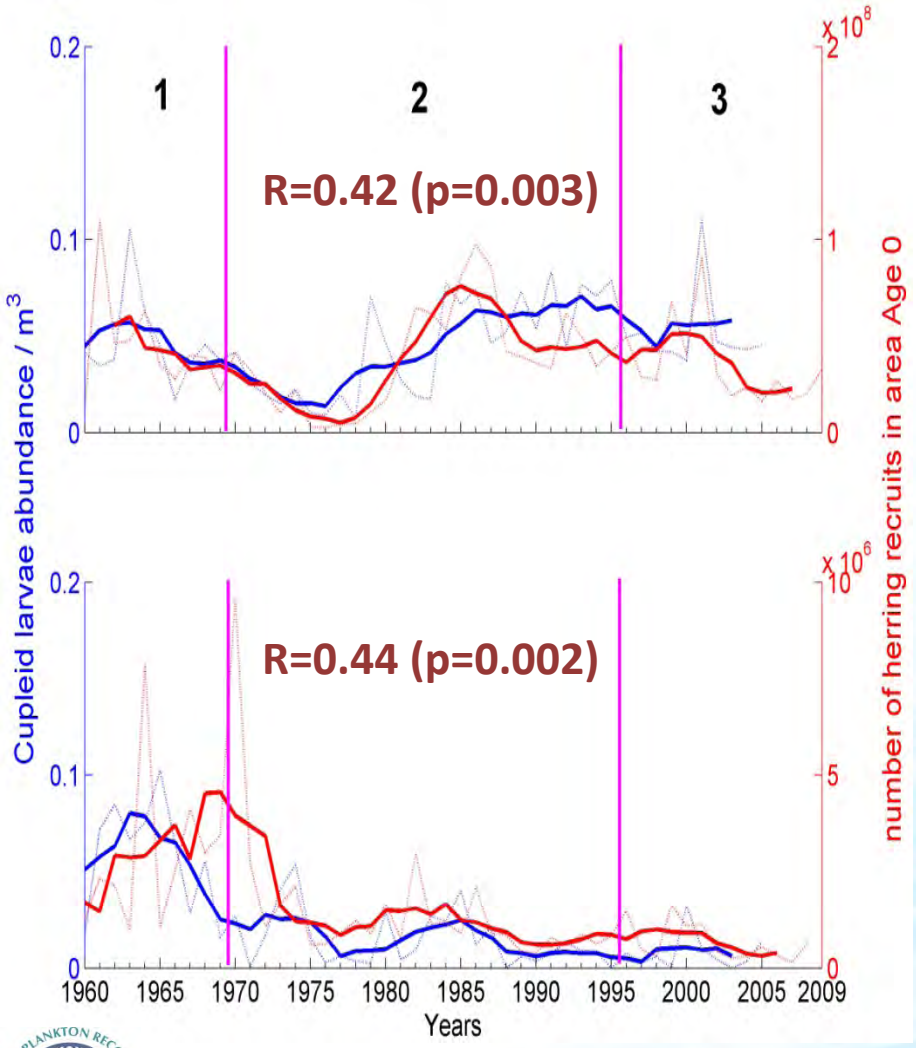
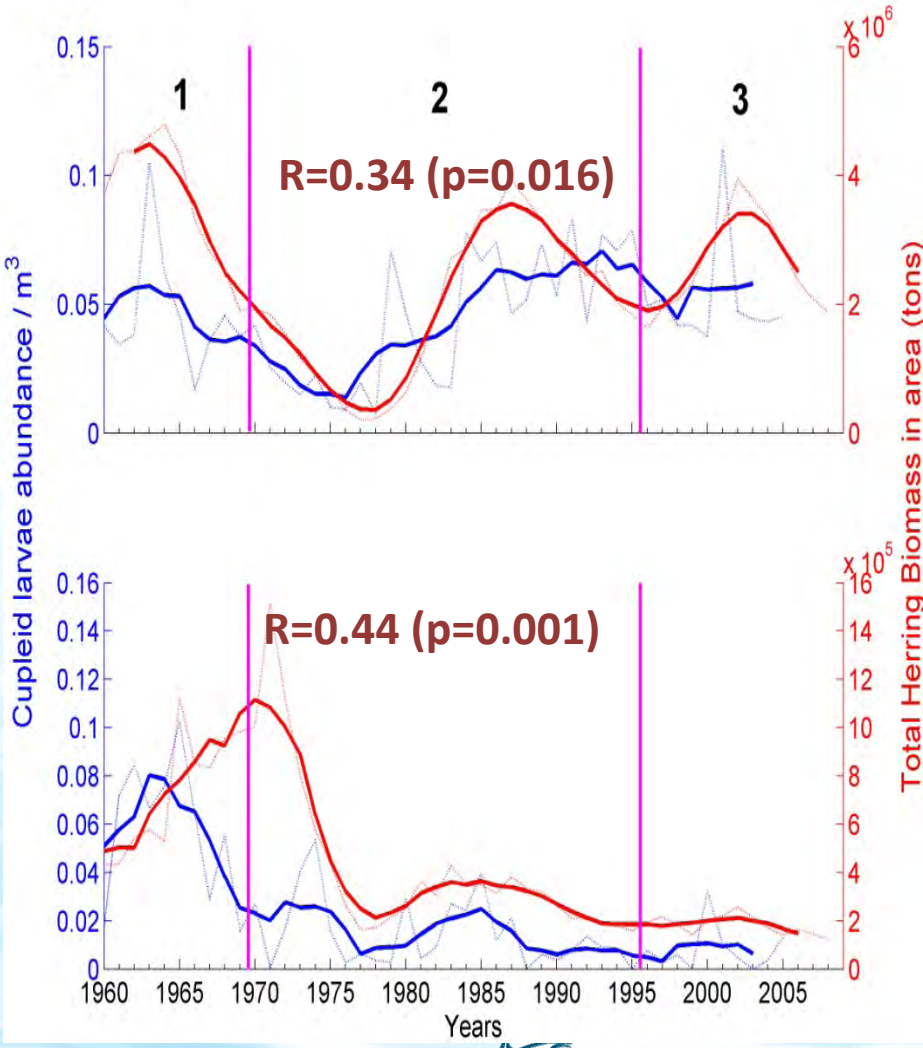
Clupeid larvae from CPR vs Herring recruits and total biomass



North Sea

West Scotland



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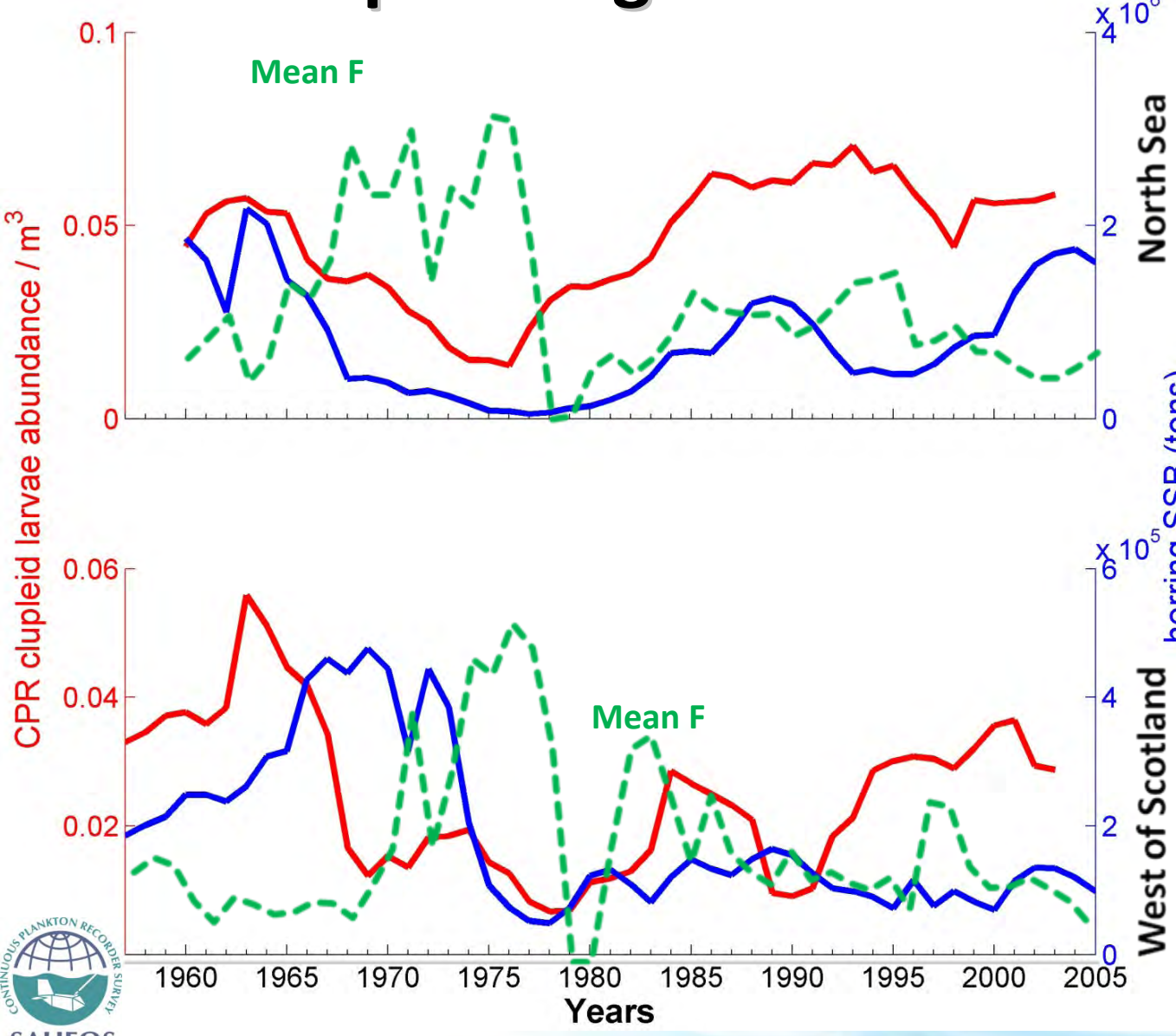
Clupeid larvae from CPR vs Herring Spawning Stock Biomass (SSB)



- Differences in the two areas with much closer relationship between SSB and fish larvae abundance in the North Sea.

- SSB dropped dramatically in the 70s as a result of fishing.

- F variations roughly in line with SSB in North Sea also in line with larvae. **Top down control?**

- In West of Scotland Since late 80s, although number of larvae has increased and fishing decreased, this hasn't been followed by a recovery in SSB. **Other component of the clupeids or Environmental effect?**

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Conclusion and what's next…

- Difficult to separate all the individual environmental effects on fish larvae as these are species specific, act directly and/or indirectly, with and/or against other environmental variable. But potential to develop species specific indices.

- fishing mortality impacts directly on the adult population but the impact on fish larvae is difficult to disentangle from environmental effects, so a lot more work needed before we can separate the two effects.

- Great potential for Continuous Plankton Recorder Data to be used in fisheries science.

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Acknowledgements

Project funded by the Department of Environment, fisheries and Rural Affairs (Defra)