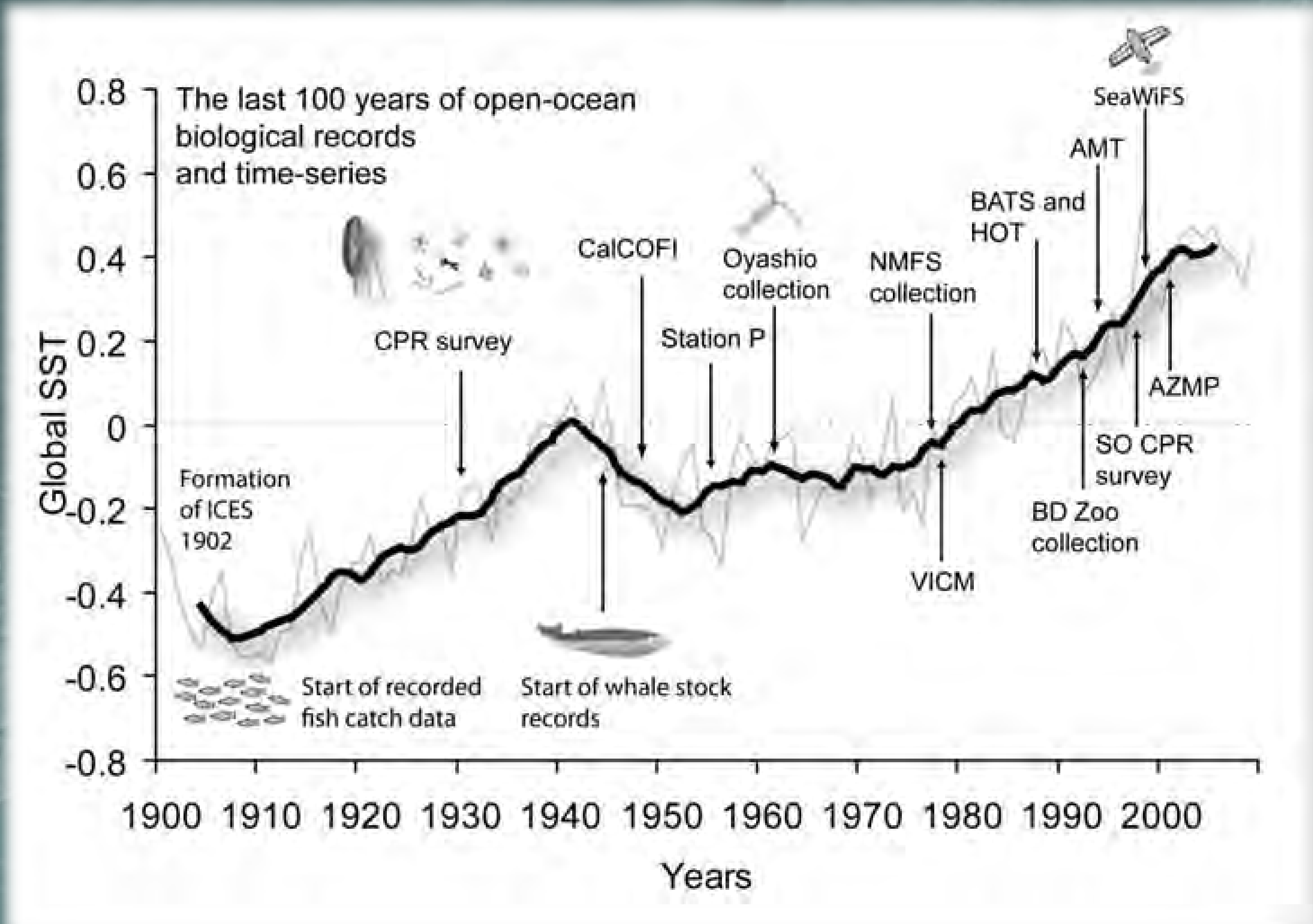
The Continuous Plankton Recorder - a lengthy history and a global future

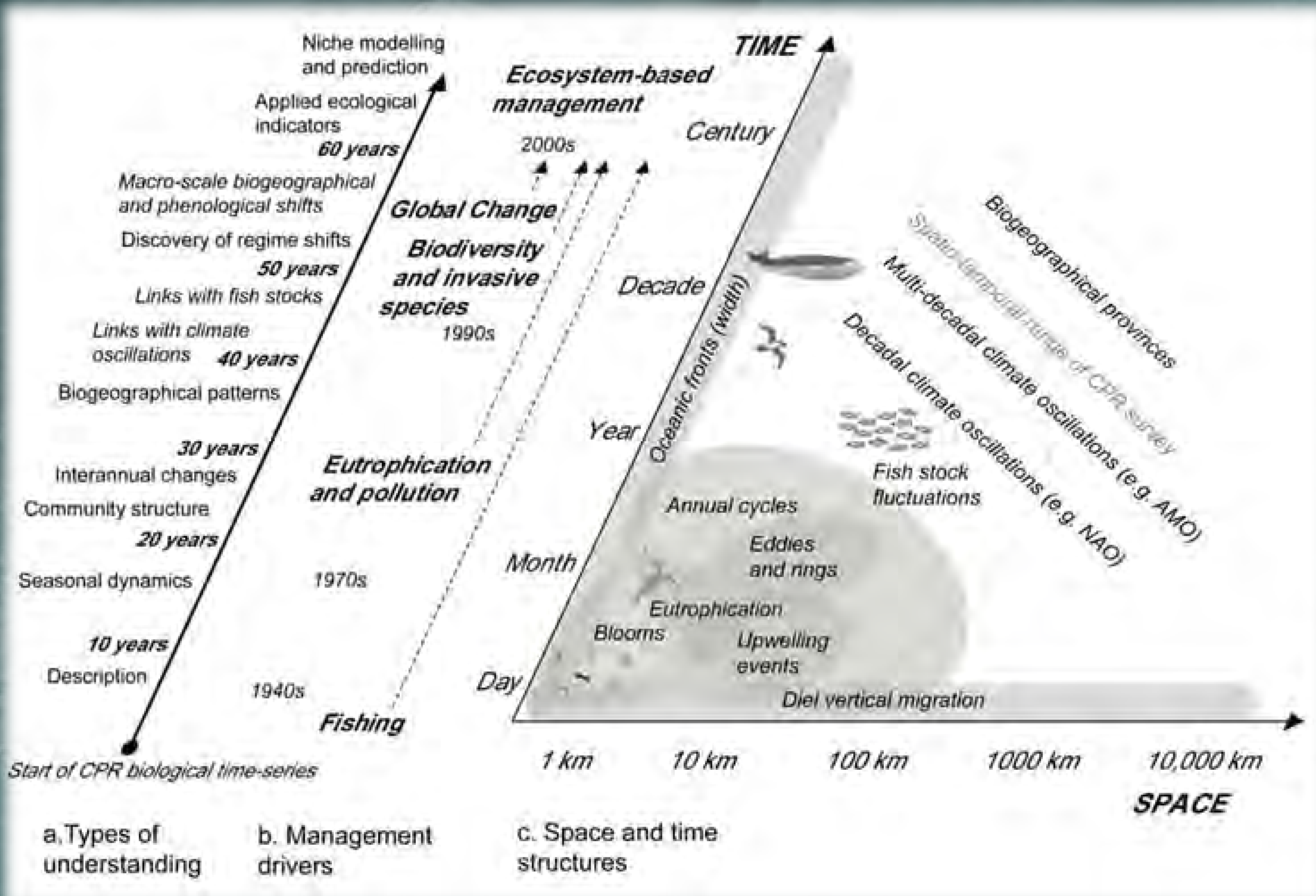
Sonia Batten

Sustained open ocean biological time series are rare……



Edwards et al., Trends in ecology and Evolution, 25, 2010

With increasing length and spatial coverage the number of management issues that can be addressed also increases



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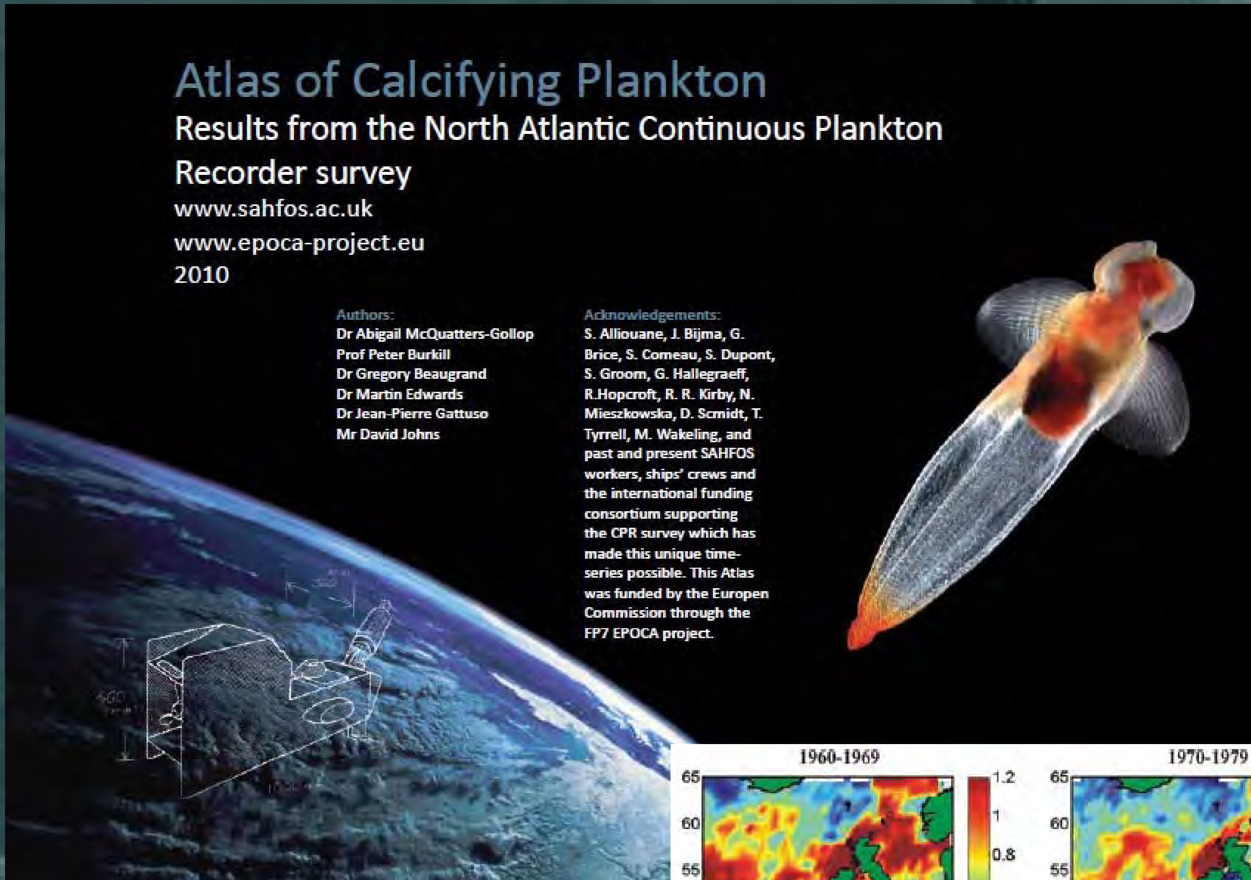
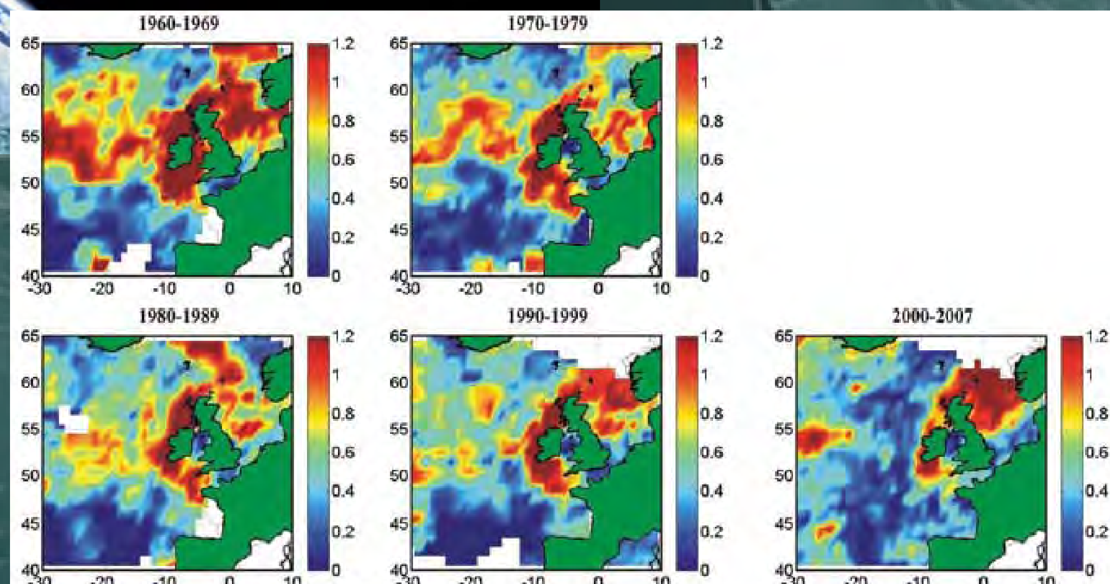




Above: Distribution maps of *Limacina* spp. abundance on CPR samples.

What is a CPR?

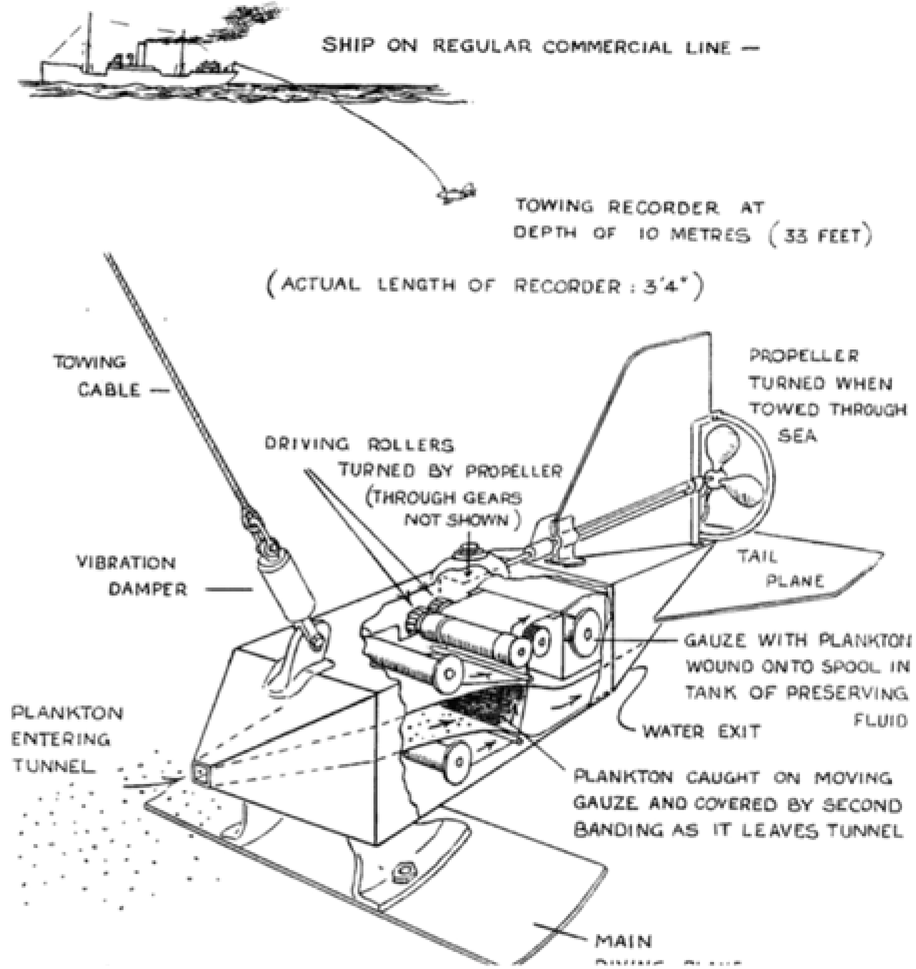
- A robust device for collecting surface plankton over large spatial scales

- capable of operating at high speeds (>20 knots)

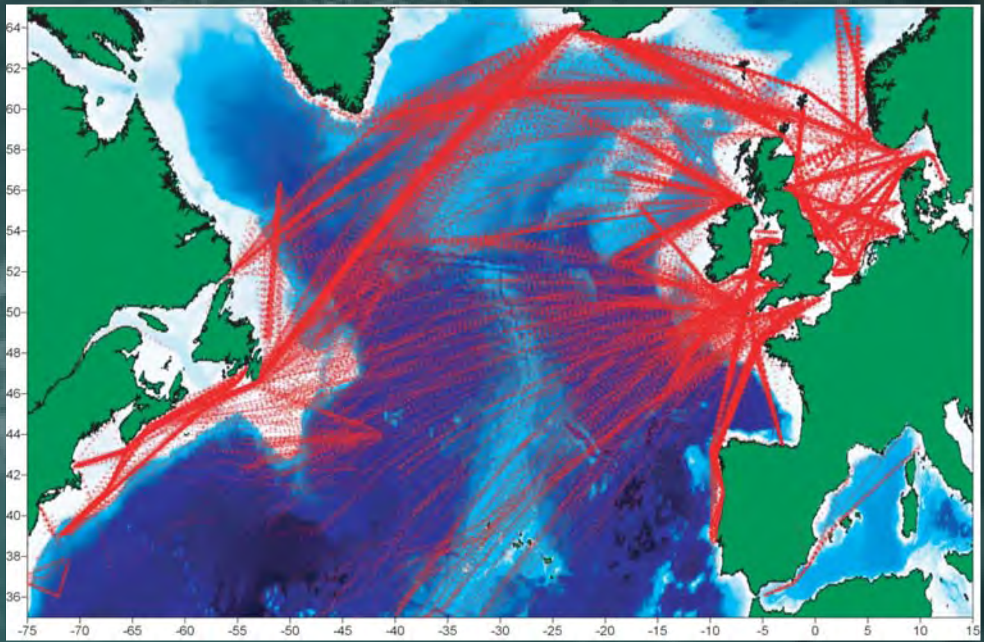
- needs a minimum of attention

- designed for ships of opportunity

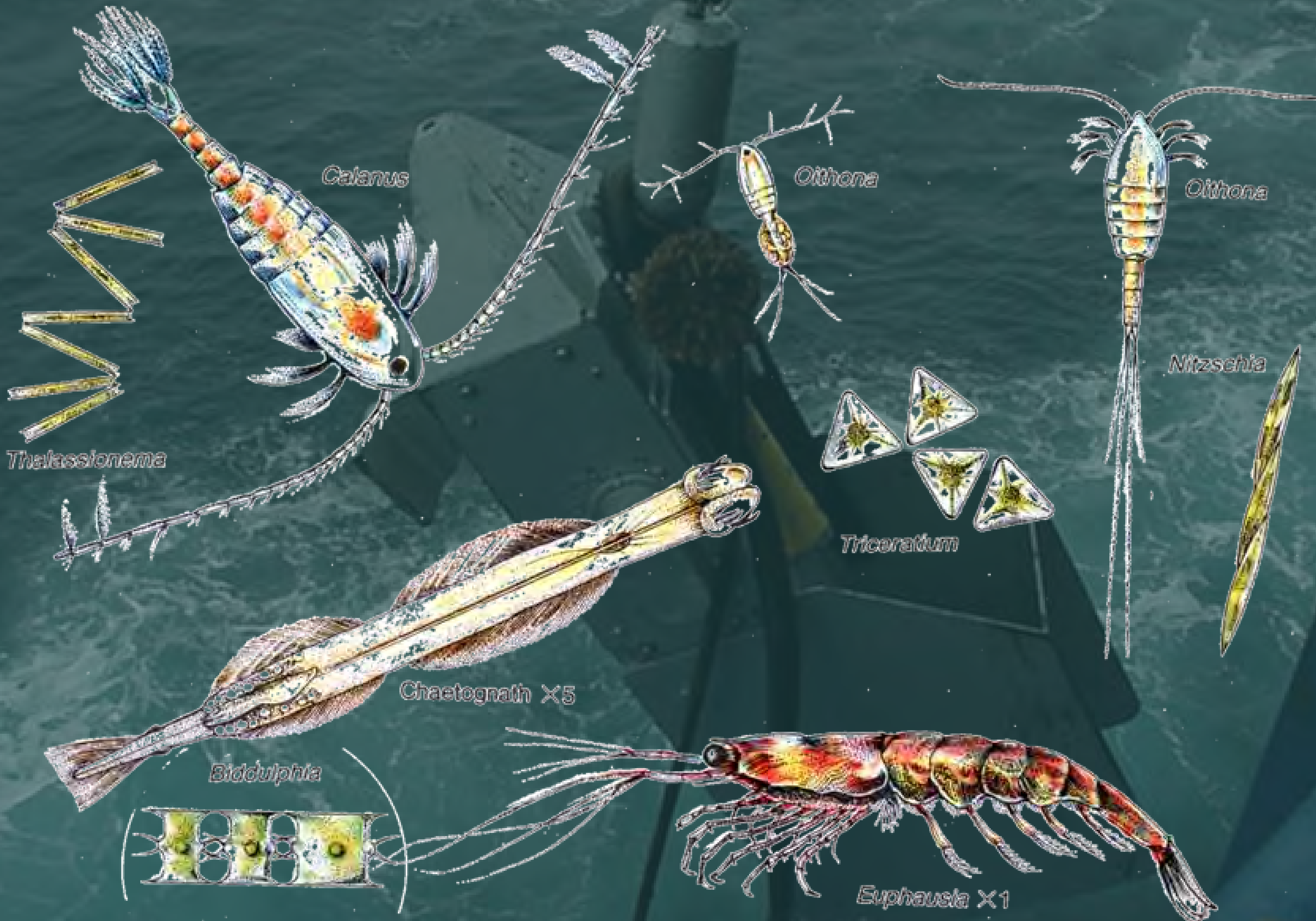
Designed by Alister Hardy in the 1920's



The North Atlantic Survey today:



Plankton caught by the CPR



Mesozooplankton and hard shelled phytoplankton

Examples of recent knowledge transfer of CPR science into policy advice and assessment

- Climate change impacts
  - Pan-oceanic changes in biogeography, biodiversity, phenology, ecosystem changes → UK, EU and IPCC 4th assessments
- Fisheries
  - Linkage between climate, plankton and cod decline
- Eutrophication and pollution
  - Increasing phytoplankton due to hydro-climatic variability not eutrophication
  - Increase in microplastics
- Harmful Algal blooms
- Ecosystem Indicators
- Biodiversity
- Non-indigenous species
  - Possible trans-Arctic migration of plankton species

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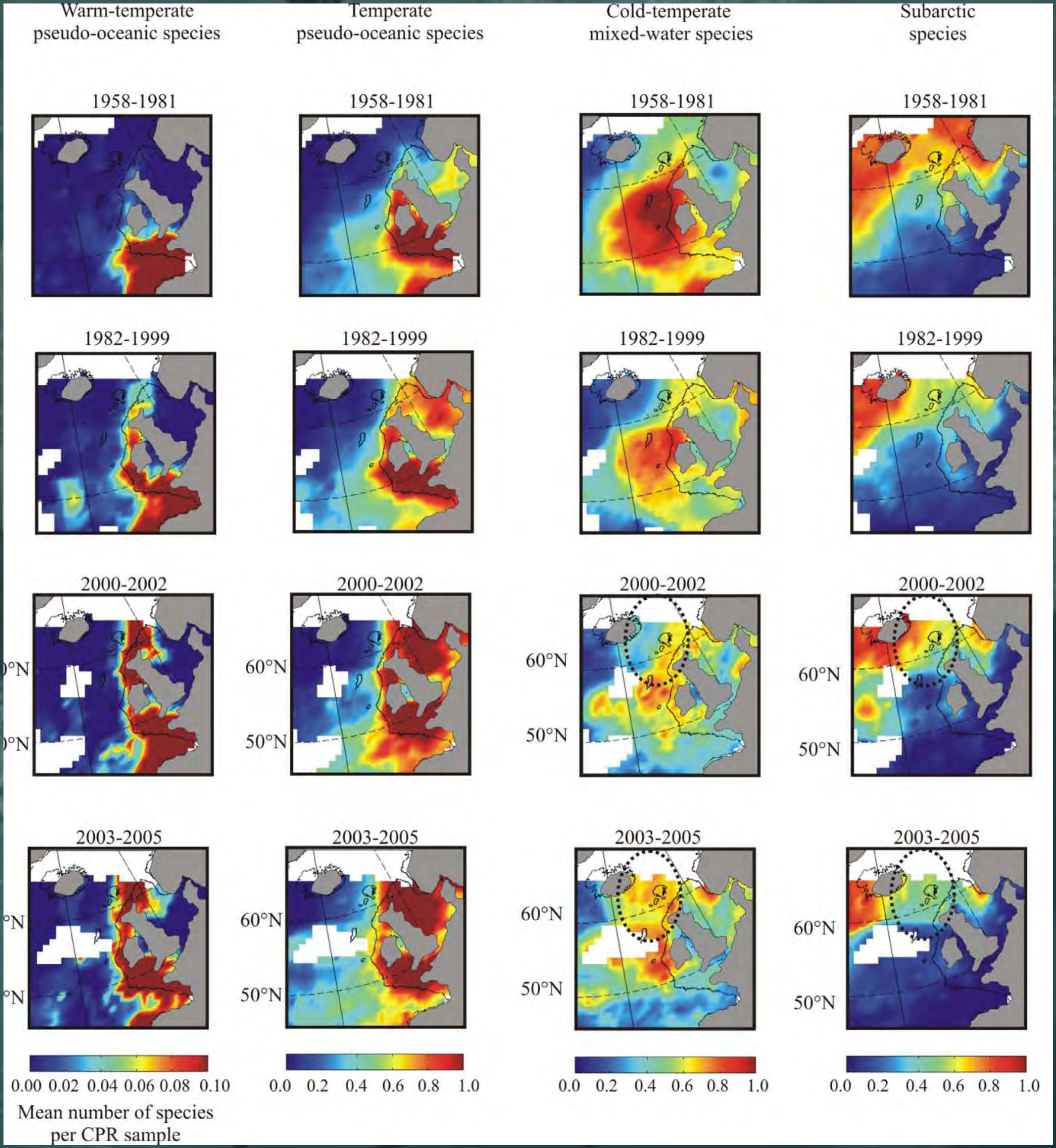
Changes in biogeography

Spatial variability in northwards movement - much faster along the European shelf edge.

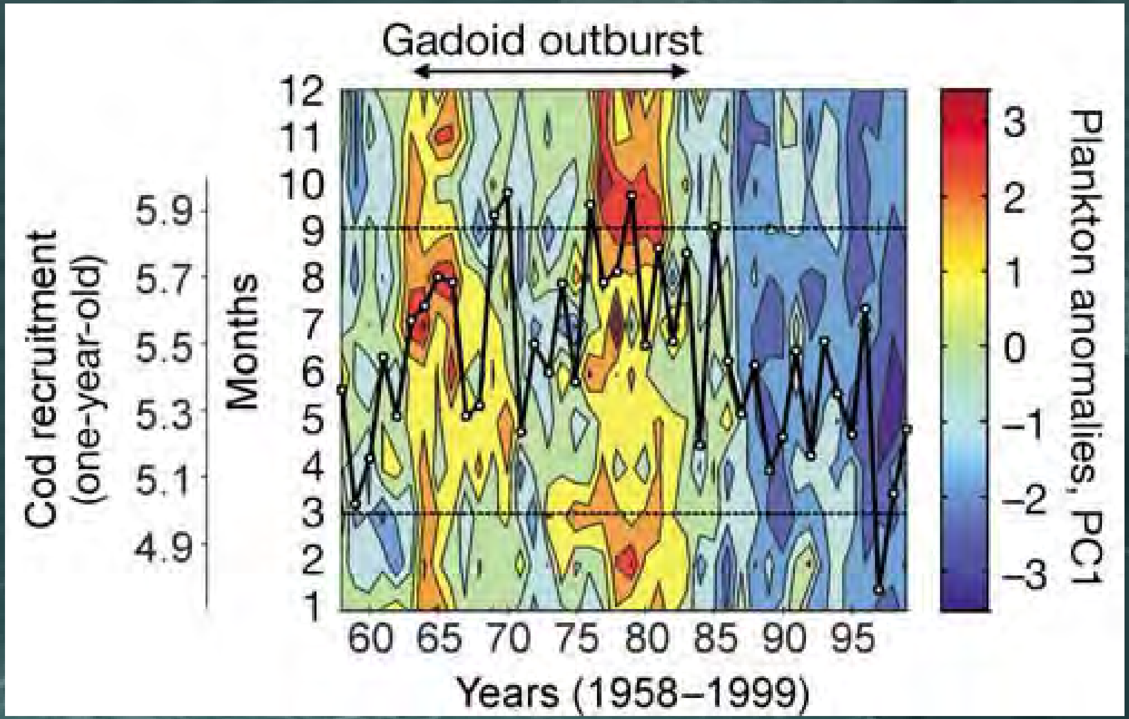
Warm-temperate species have moved 1000 km northward along the continental shelf-edge much further and faster than terrestrial studies.



Updated from Science, 296

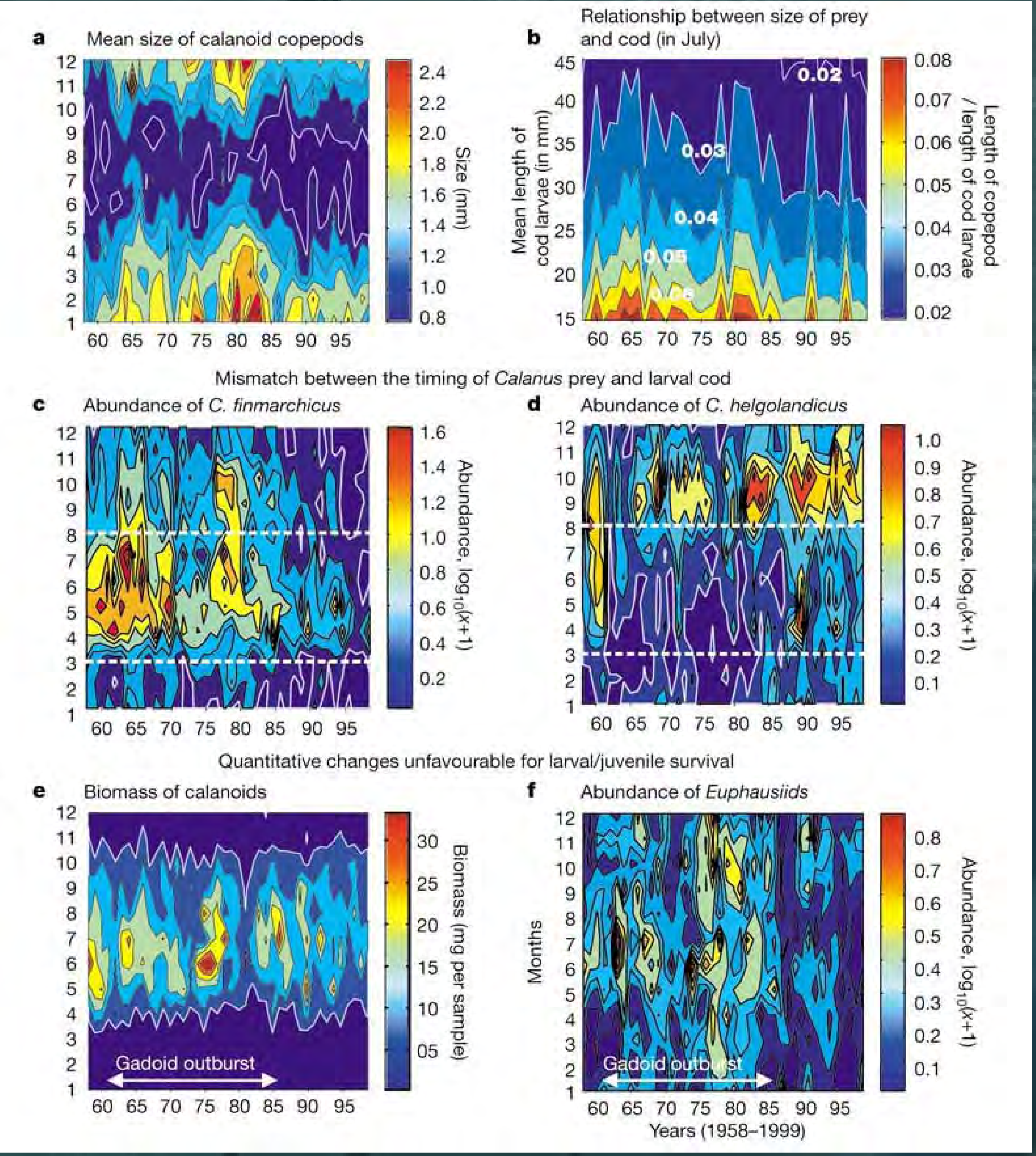
Climate→Plankton→Cod (Beaugrand et al., Nature 426, 2003)

Rising temperatures since the mid-1980s modified the plankton ecosystem in a way that reduced the survival of young cod.

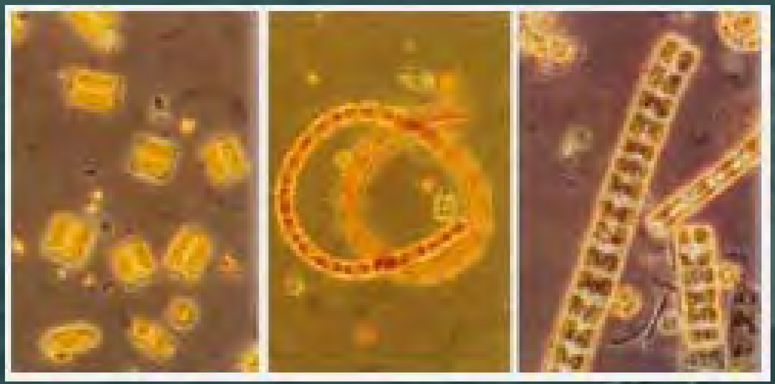


Long-term monthly changes (1958–1999) in the plankton index.
Cod recruitment (one-year-olds; in decimal logarithm) in the North Sea is superimposed with a lag of one year.
Horizontal dashed lines indicate the period (March–September) of larval cod occurrence in the North Sea.

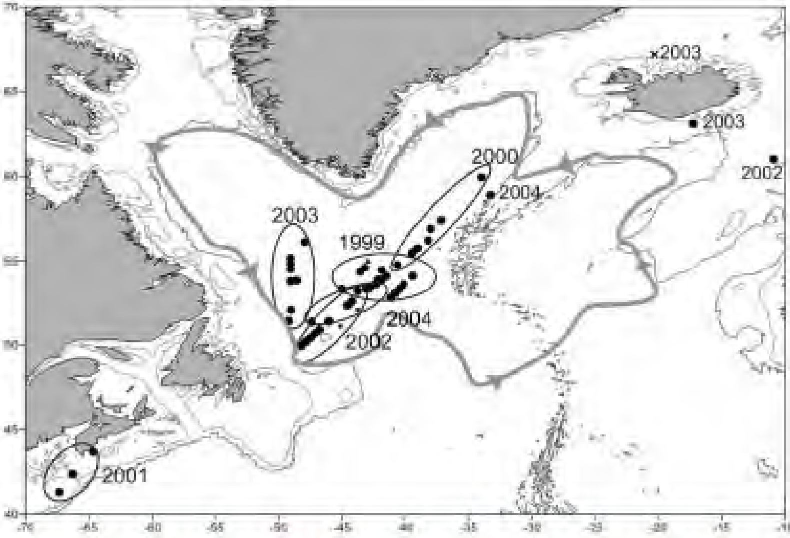
Biological variables from the CPR suggested that the warming reduced the mean size of prey (calanoid copepods, euphausiids) because of community structure changes in the North Sea



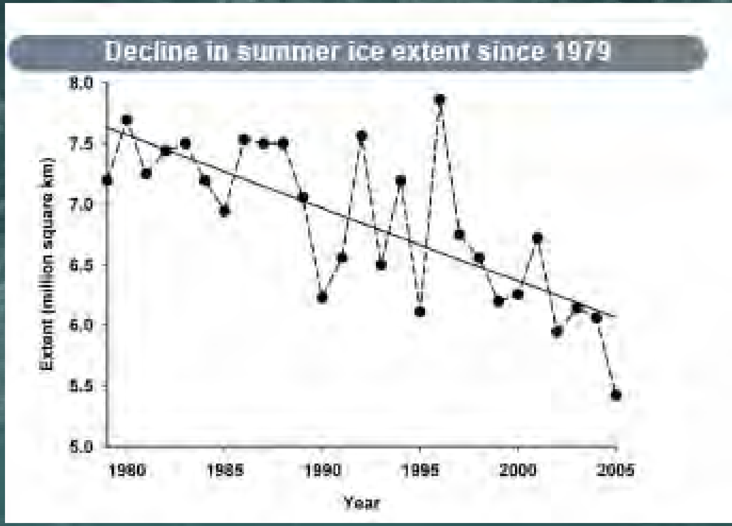
Non-Indigenous species: where the Pacific meets the Atlantic



Neodenticula seminae

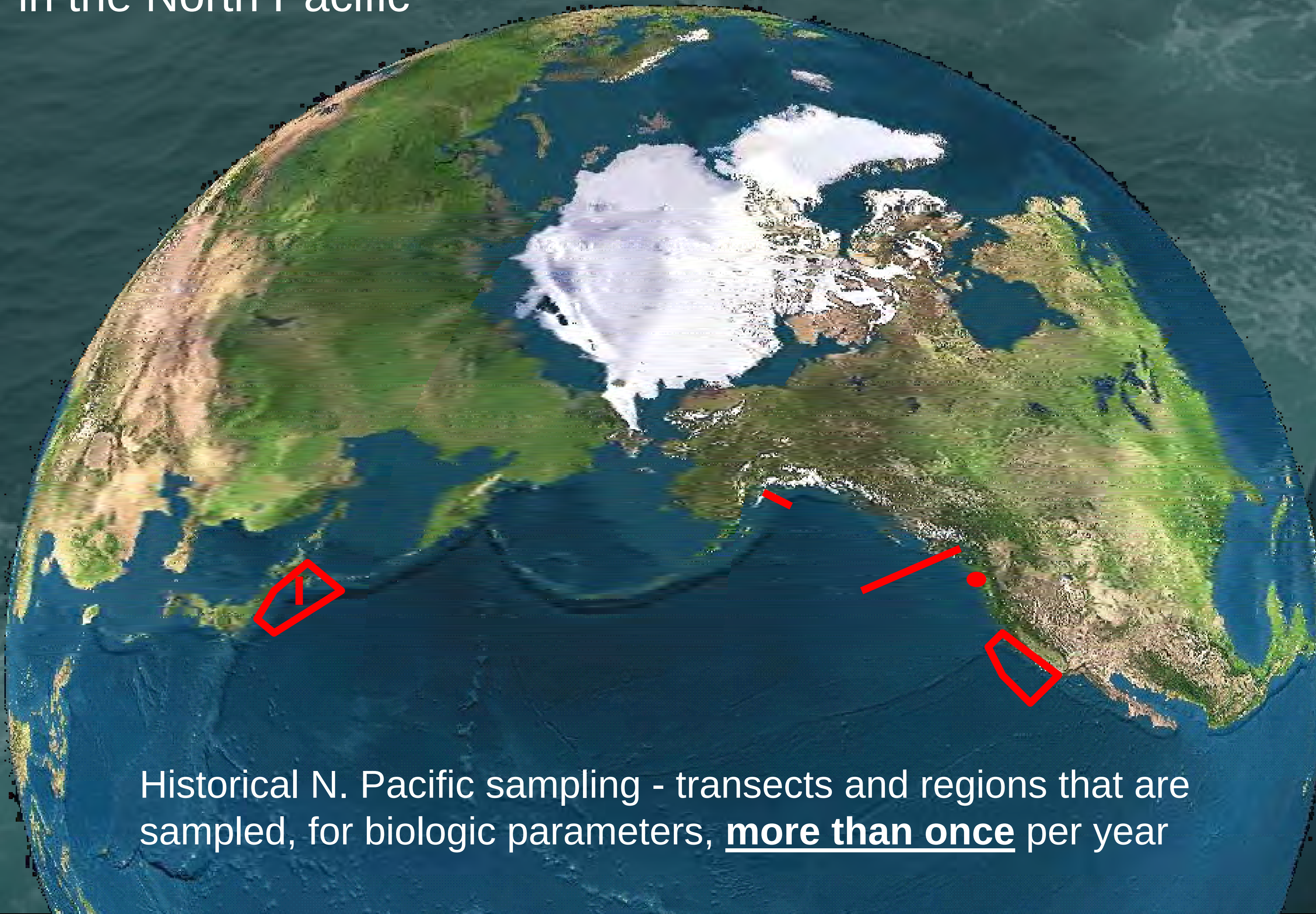


Distribution since 1999



Reid et al 2007 *Global Change Biology* & 2007 News Feature in *Nature*

In 1998 PICES approached SAHFOS regarding CPR sampling in the North Pacific

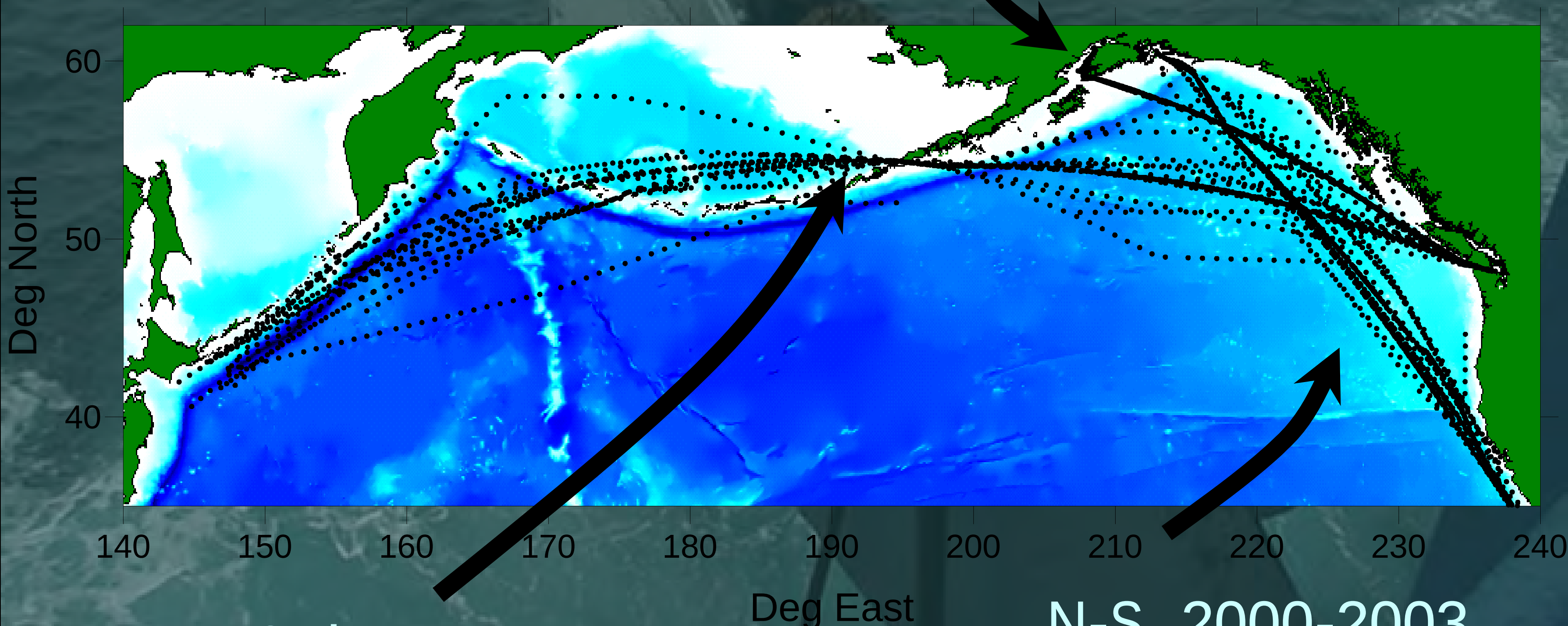


Historical N. Pacific sampling - transects and regions that are sampled, for biologic parameters, **more than once** per year

CPR sampling of the N Pacific

2000-2009: 4,230 analysed samples

N-S, 2004+
6 times p.a.

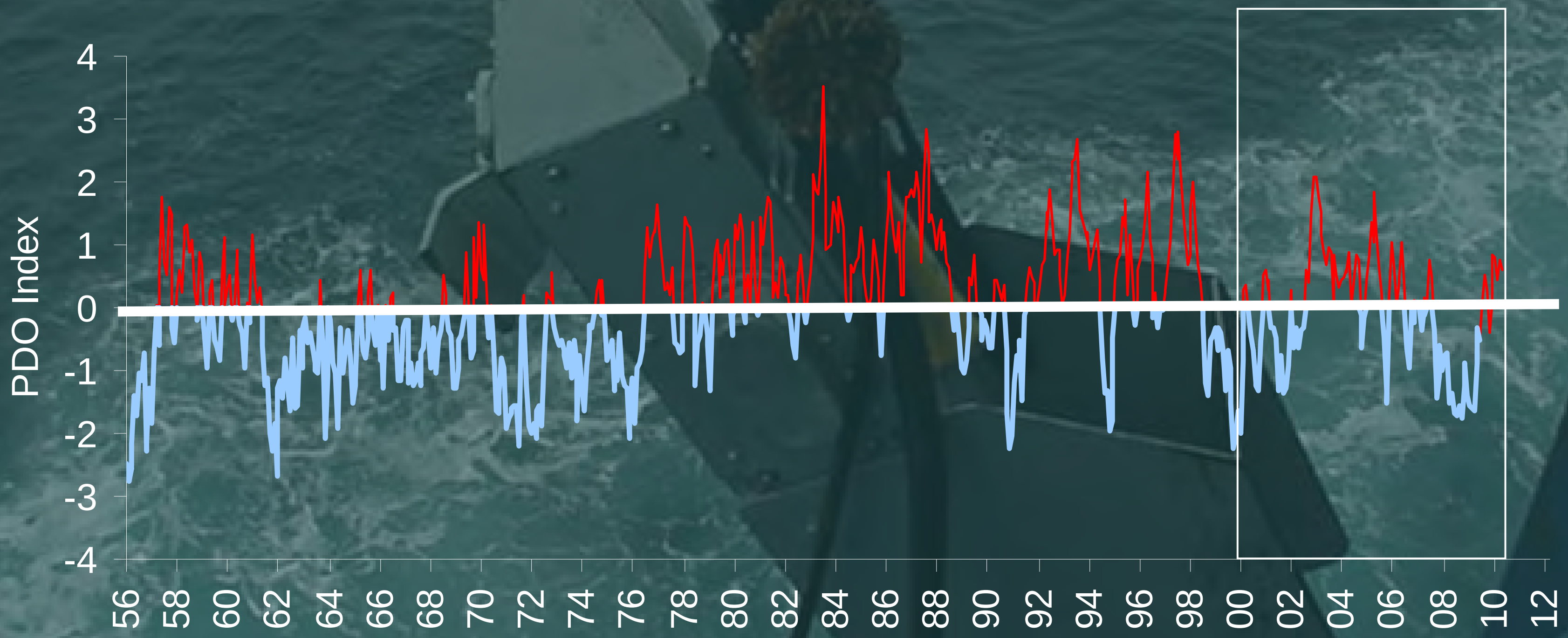


E-W, 3 times p.a.
(Apr, June, Oct)

N-S, 2000-2003
5 times p.a.

We have sampled at a time of high frequency changes in the dominant climatic signal:

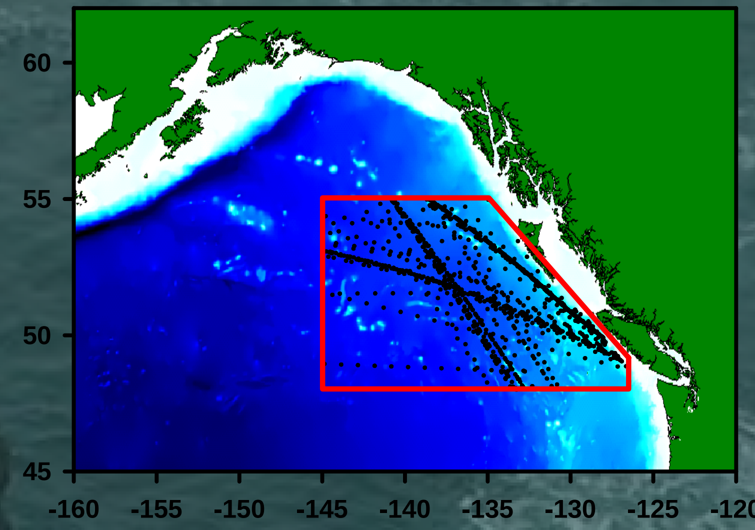
The Pacific Decadal Oscillation

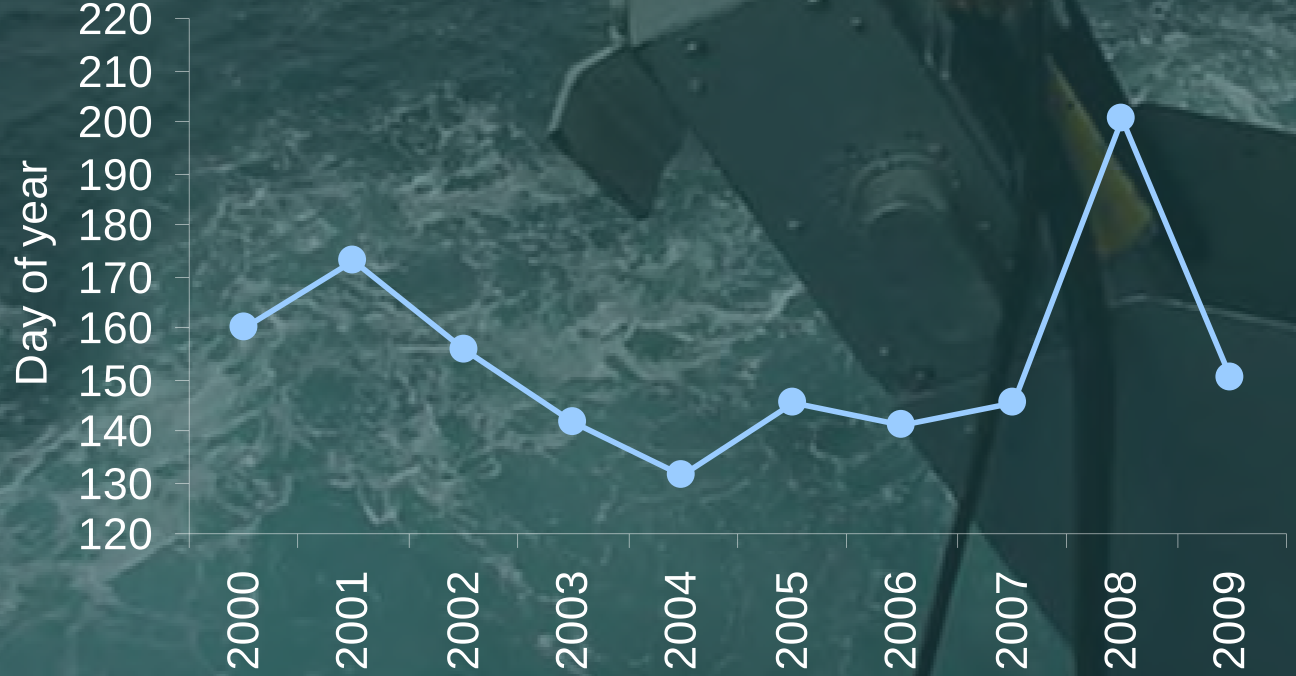


http://www.jisao.washington.edu/pdo/

Some effects:

The seasonal cycle of mesozooplankton biomass is influenced by ocean climate



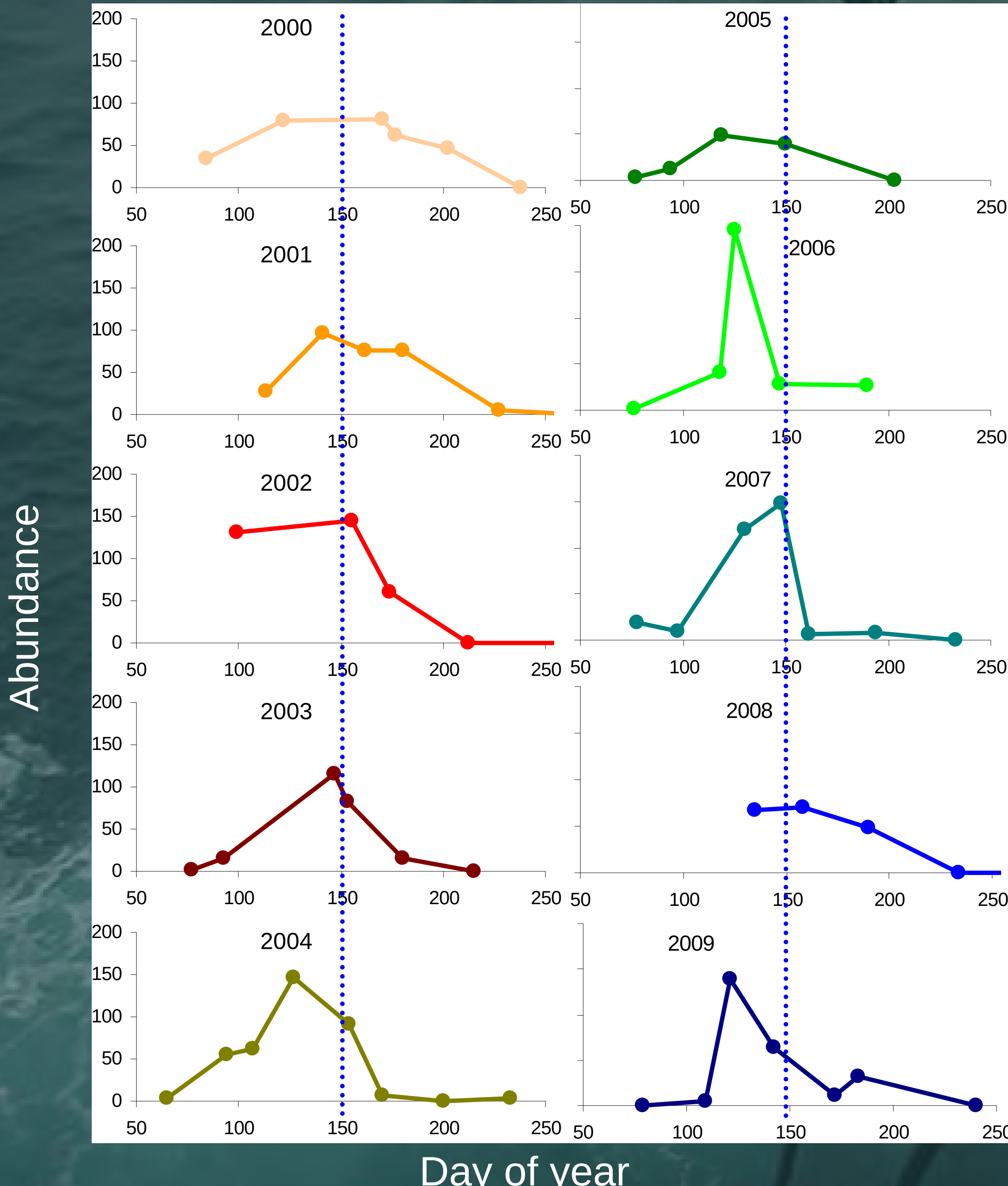


Spring biomass timing (50% cumulative integrated biomass).
Day of year sig., -vely correlated with PDO ($p<0.01$)

One copepod dominates spring mesozooplankton, and has been studied in relative detail (in CPR data ID’d to stage)

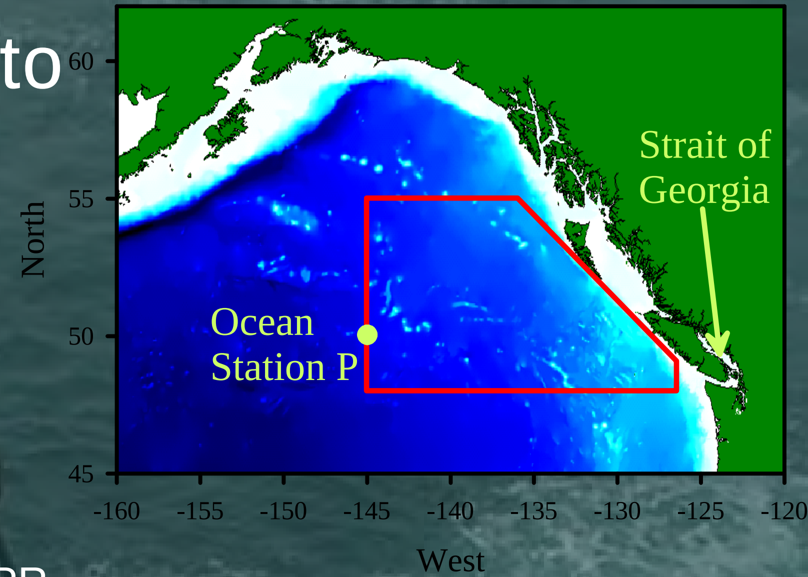
Neocalanus plumchrus (and congener *N. flemingeri*) can account for ~50% of the biomass in spring (only in surface waters for a few months) and are a key prey item (lipid rich).

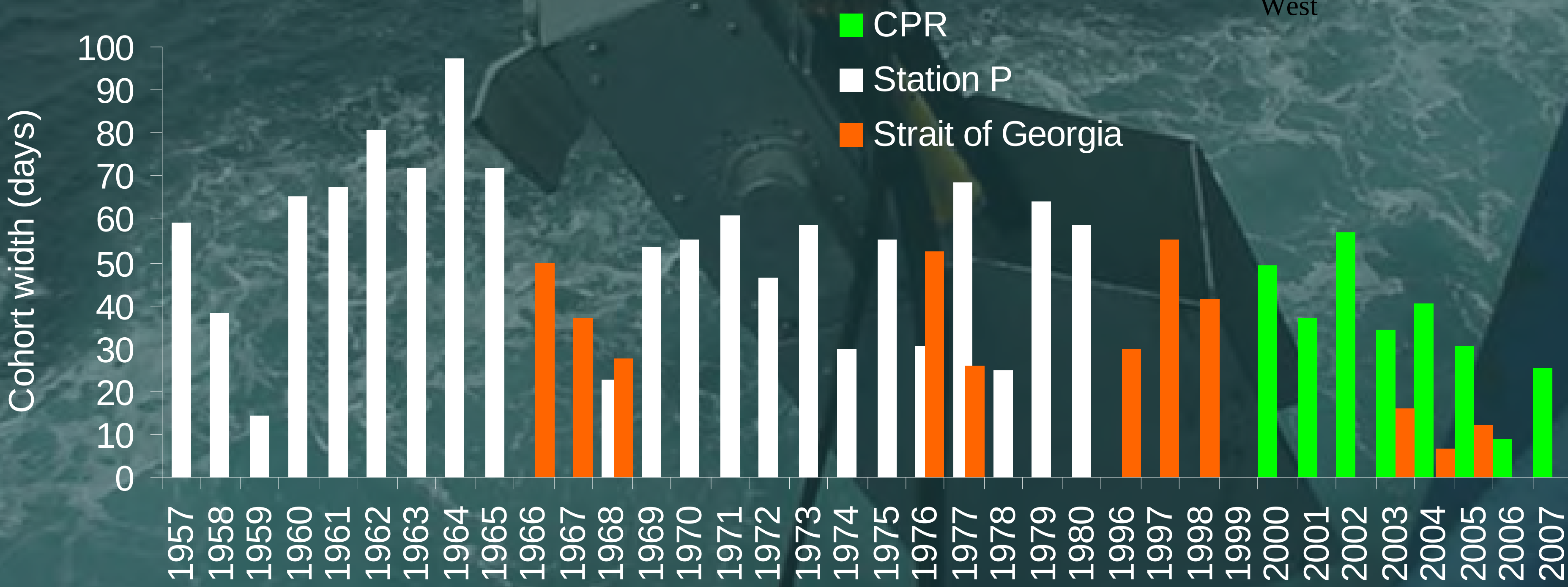

Photo: M. Galbraith



Interannual variability in seasonal cycle of *N. plumchrus/ flemingeri*

Combined with other local data to show that cohort width at its narrowest in recent warm years

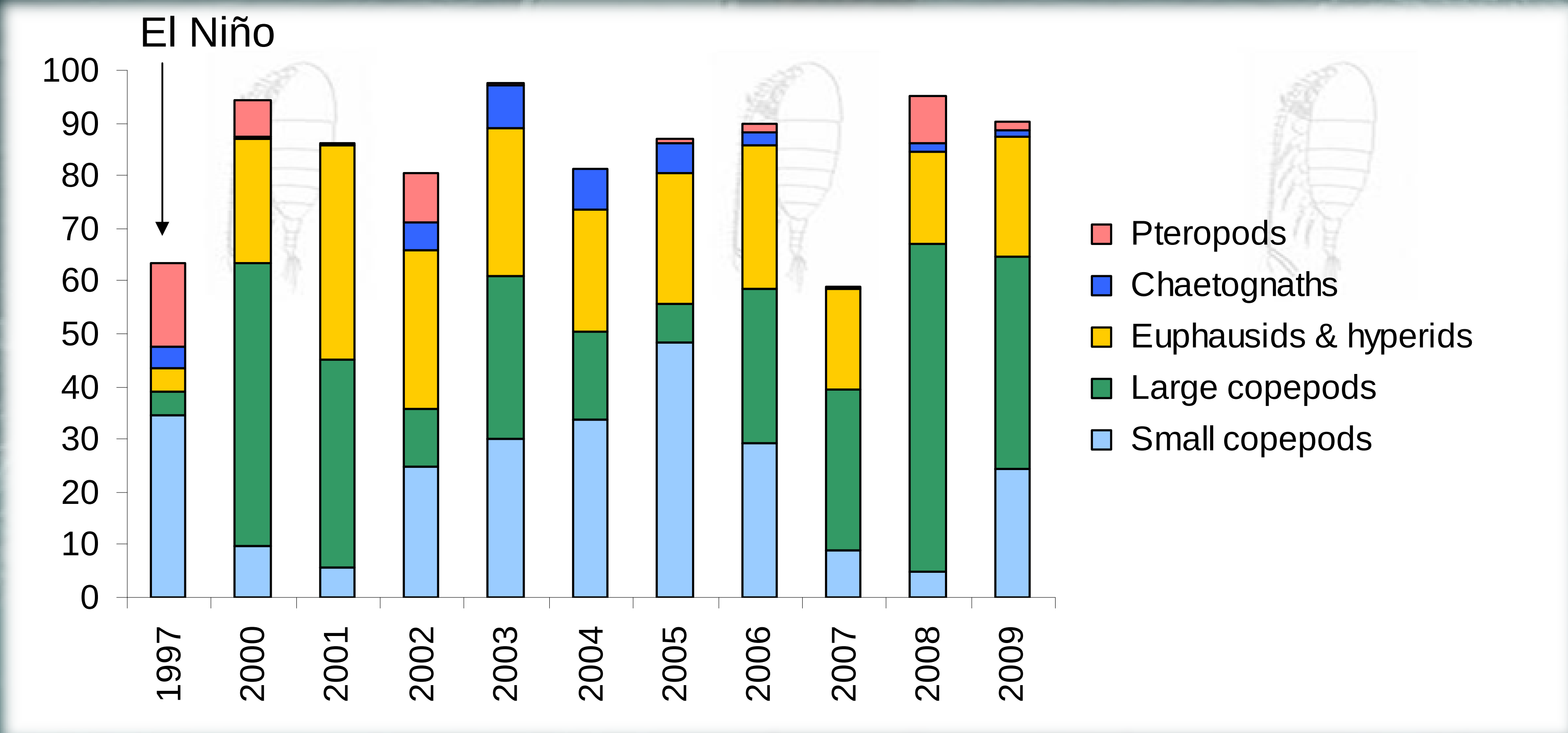




Batten and Mackas, MEPS, 2009

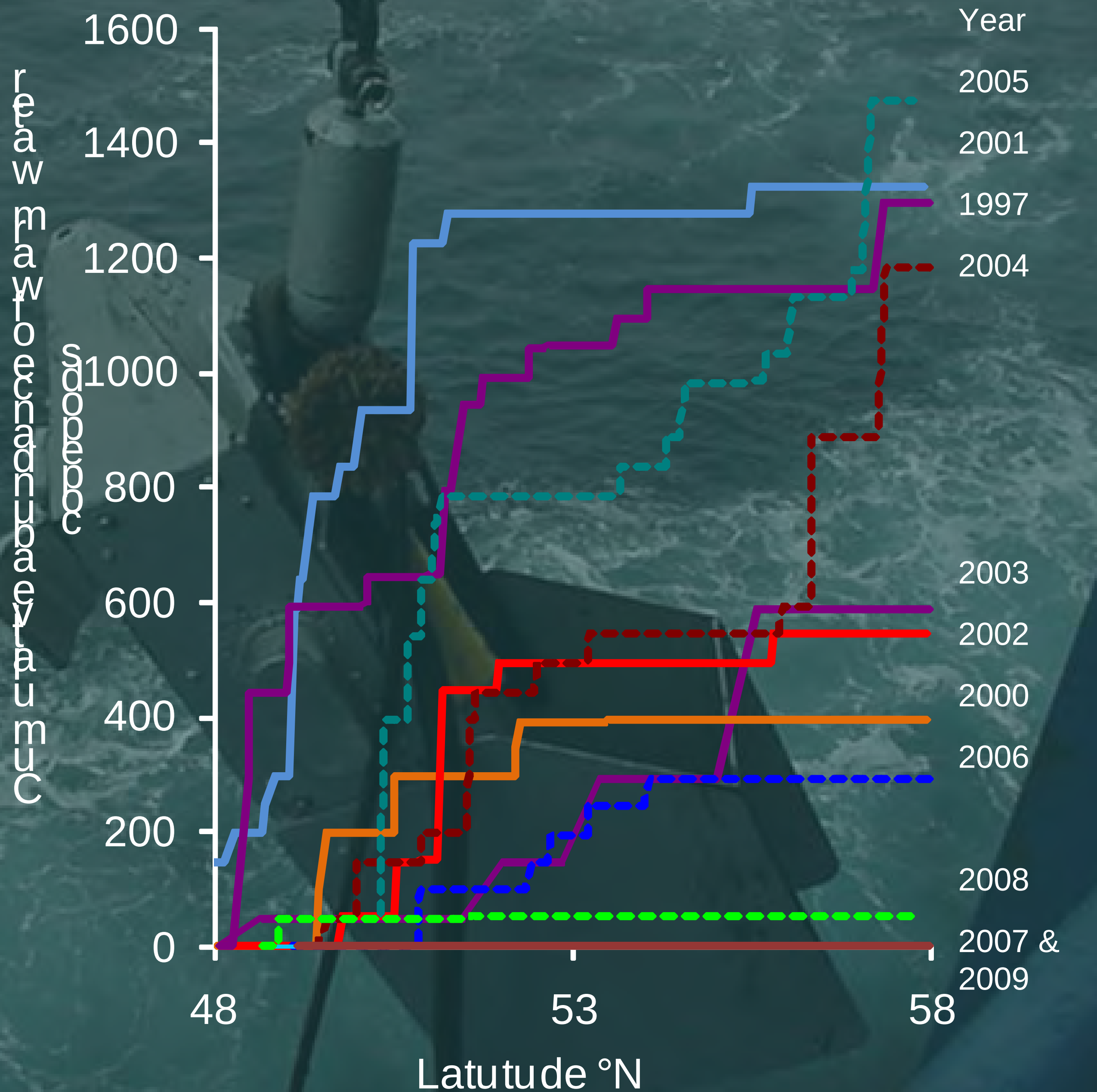
Average contribution (%) to the dry weight biomass by each major group in July+August each year.

Small copepods ↓ in cool/PDO -ve years and large copepods ↑ (esp. 2008). Vice versa in warm/ PDO +ve years



Warm-water taxa were identified based on their measured temperature distribution

Northwards extension, and total abundance, of warm-water copepods are significantly +vely correlated with PDO



Session S6 at 16:40

Subarctic species

Warm water species

Photo: Moira Galbraith

Summary of climate-related impacts in NE Pacific

- Peak in spring biomass shifts earlier in warm/+ve PDO and later in cooler/-ve PDO conditions

- *N. plumchrus/flemingeri* dominates spring biomass and timing of its peak and width of annual cohort shifts with temperature.

- Community composition changes consistent with warm/cool conditions

All these factors change ‘availability’ of zooplankton to predators

Our science strategy – ‘Going Global’, sampling climatically sensitive areas

Acknowledgments

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Ship's officers and crew and port-based personnel

Staff of SAHFOS, and Doug Moore for the dedicated hours at the microscope

www.sahfos.org
www.pices.int/projects/tcprsotnp/default.aspx