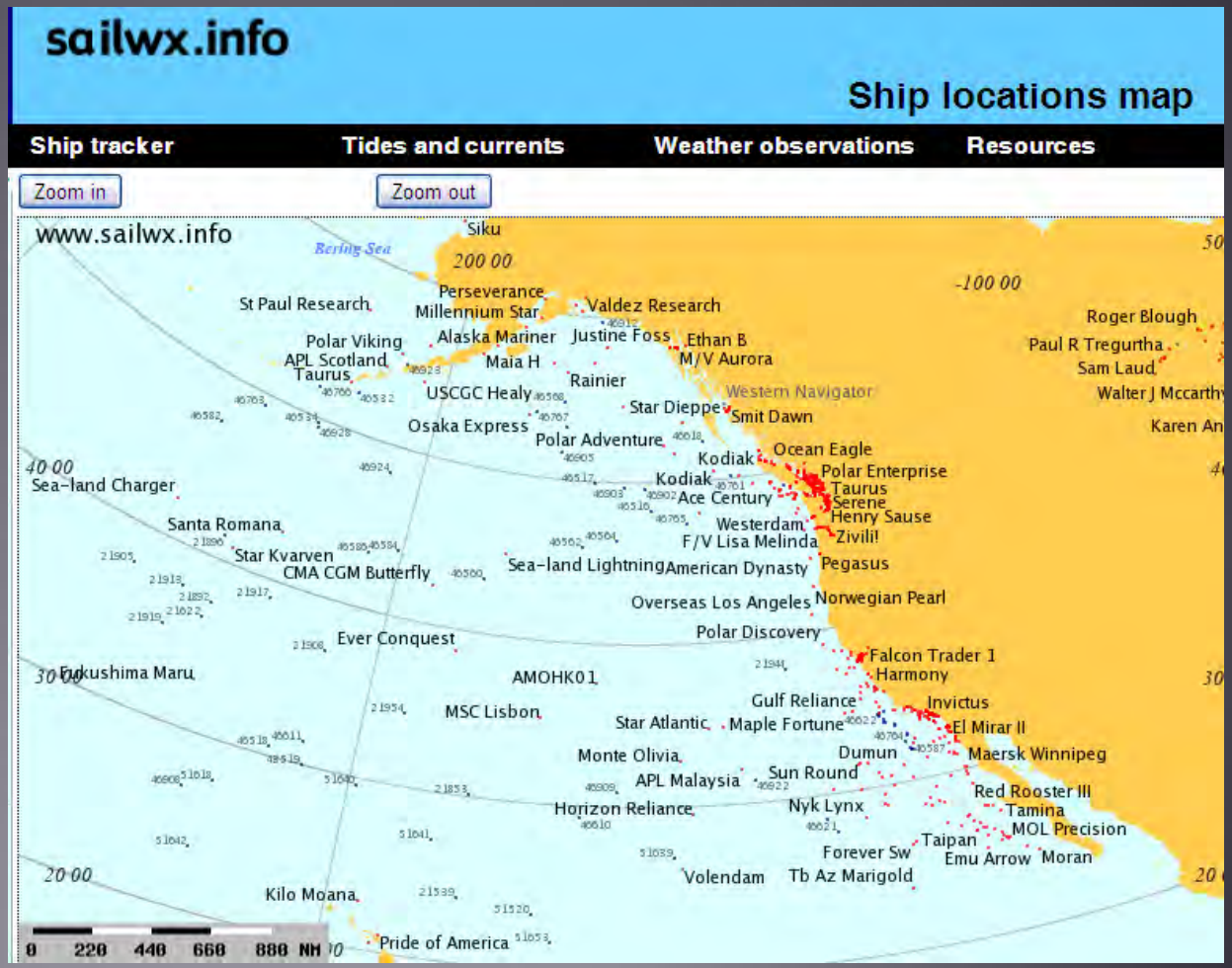
# Ship of Opportunity Sampling of Lower Trophic Levels

Sonia Batten

Since 1853 there has been an international scheme using Ships of Opportunity to collect weather data.

At any one time there are 100s of vessels crossing the oceans.

Oct 1st, 2013

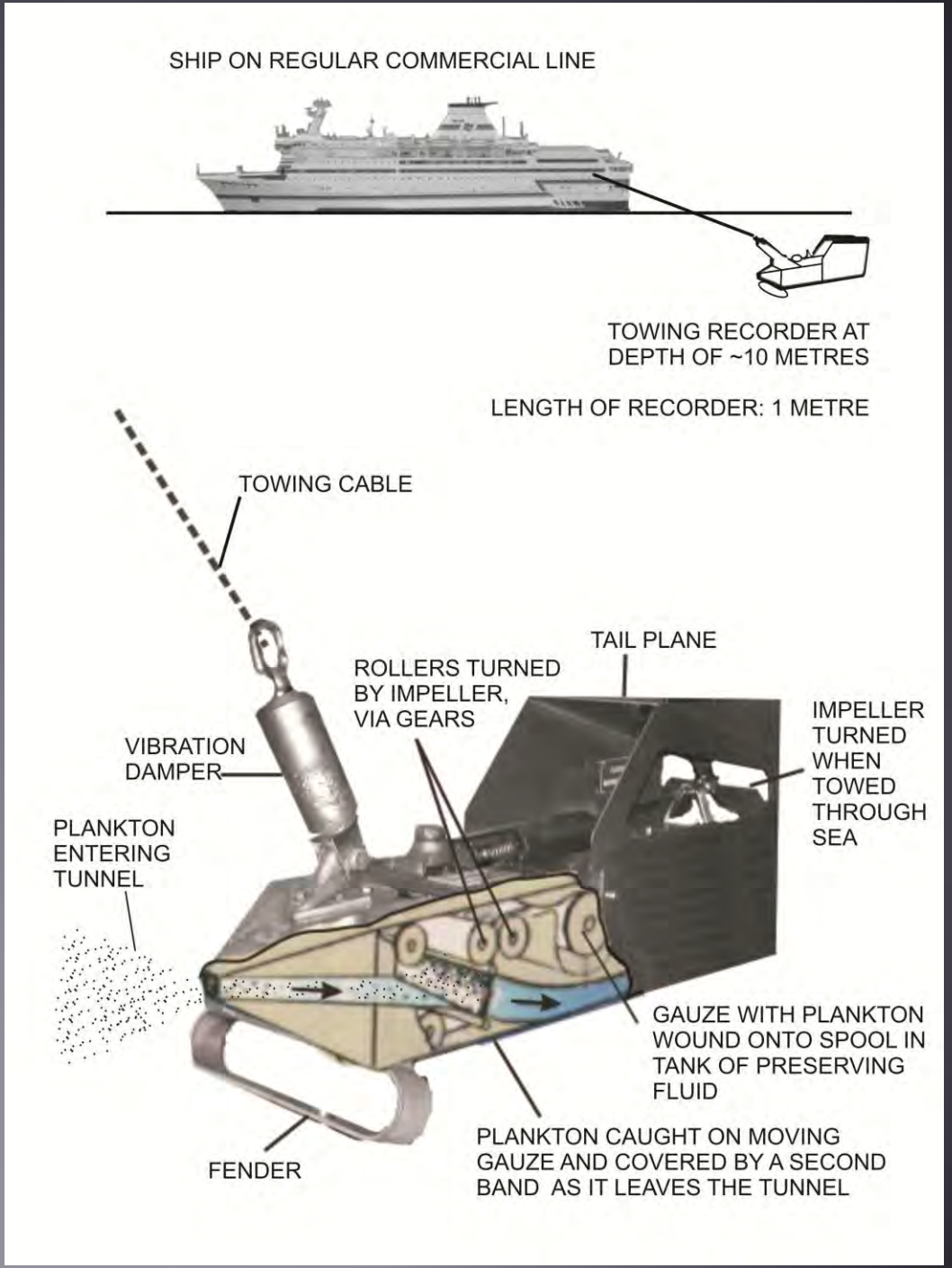


In this presentation:

- Pros and cons of SoOp sampling & the CPR approach
- Adding value to the CPR survey
  - Additional variables
  - The CPR as a platform
  - Increasingly diverse applications

# What is a CPR?

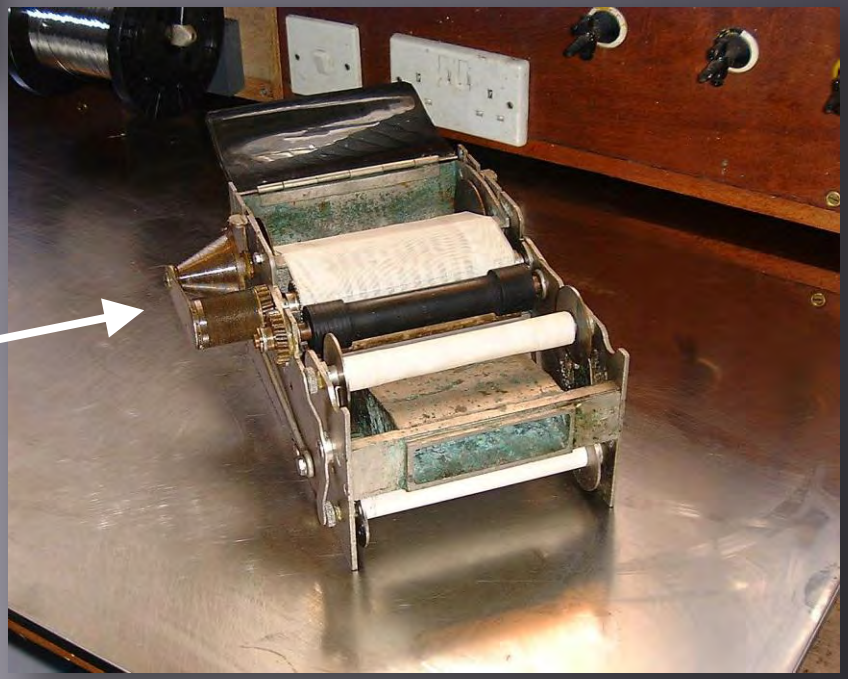
- A robust device for collecting surface plankton over large spatial scales
- capable of operating at high speeds (>20 knots)
- needs a minimum of attention
- designed for ships of opportunity



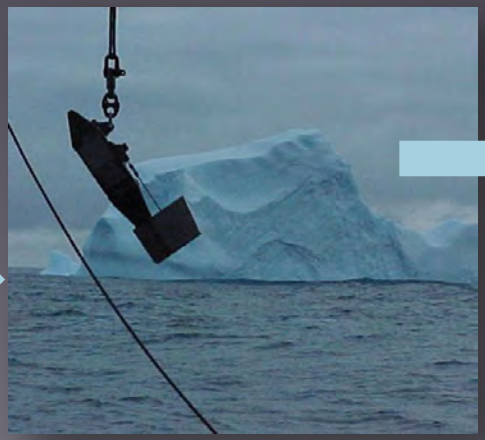
# Designed by Alister Hardy in the 1920's

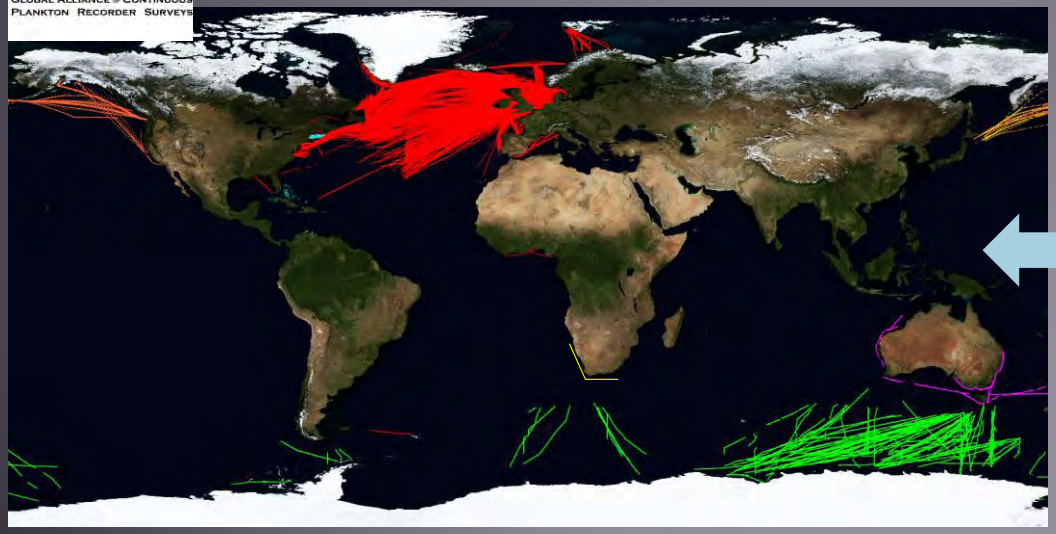
An internal cassette fits into the towing body

Pre-loaded with filtering mesh and wire on a fusee to drive the uptake spool

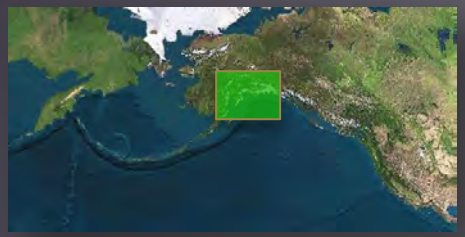


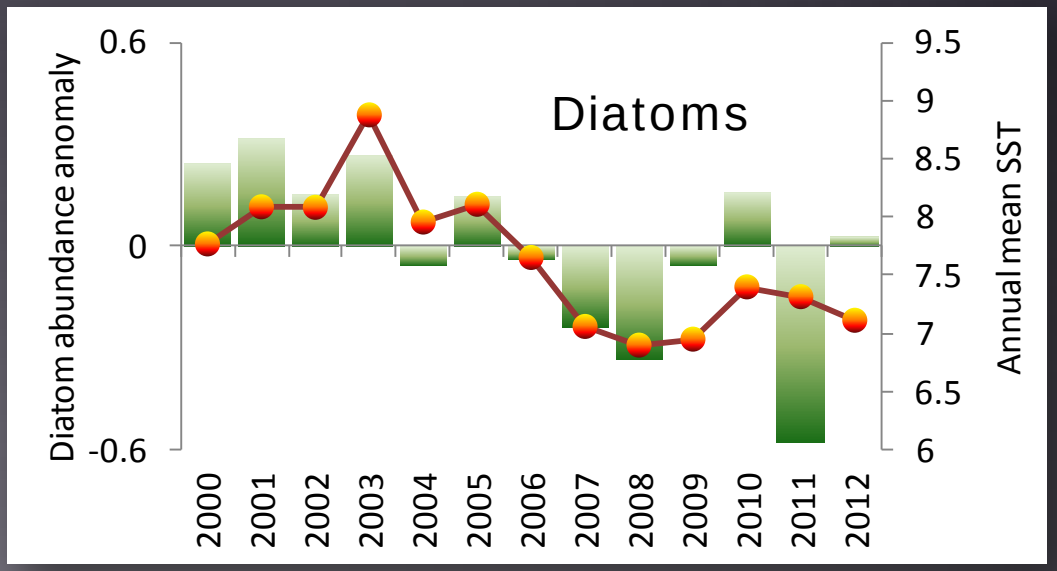
# The CPR Survey today



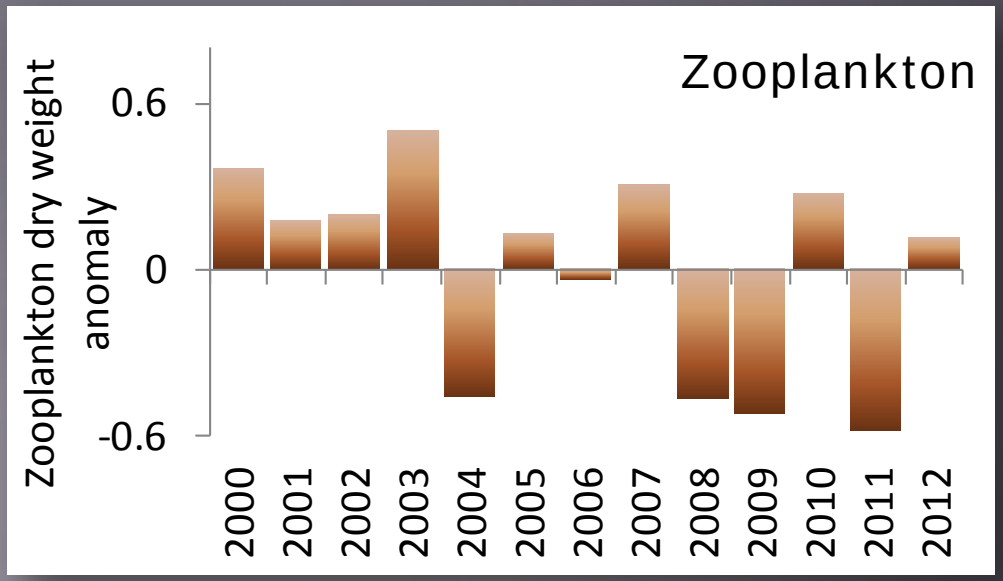


# Annual abundance anomalies, all shelf samples






positive correlation ($r^2$=0.42, $p$<0.02)




SST data courtesy of
http://las.pfeg.noaa.gov

Strong positive correlation btwn diatoms and zoopl ($r^2$=0.53, $p$<0.01)

Pros and Cons: (note that limitations of the methodology won't be discussed here, too big a topic, but see literature)

+ Cheap!
  + particularly important for remote ocean regions
  + can tailor analysis to match funding.
+ Reliable
+ Internally consistent
+ Other instrumentation can be added (see later)
+ Sample archive for future studies (see later)

- Sample analysis is labour intensive
- Lack of control over timing and location
- Liaising with ships
  - low on their priority list
  - discrepancies with info.

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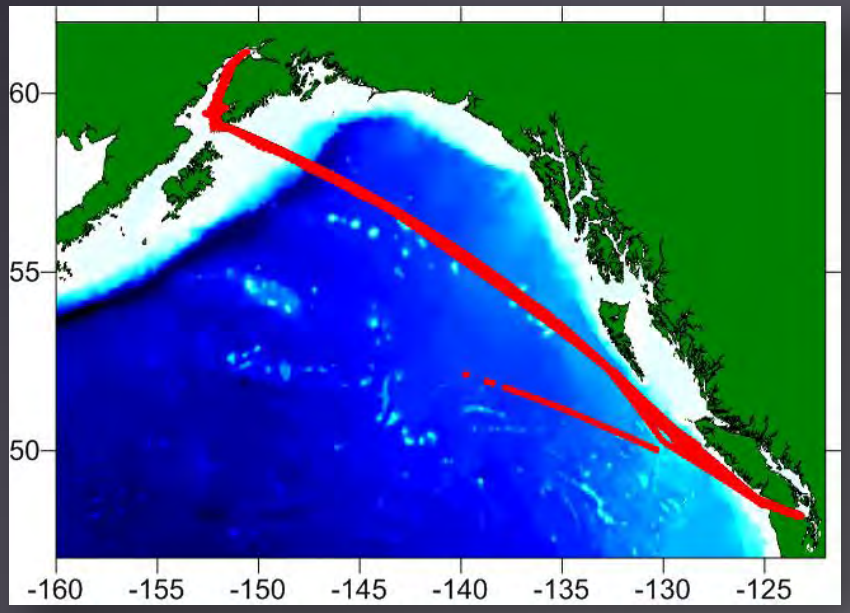
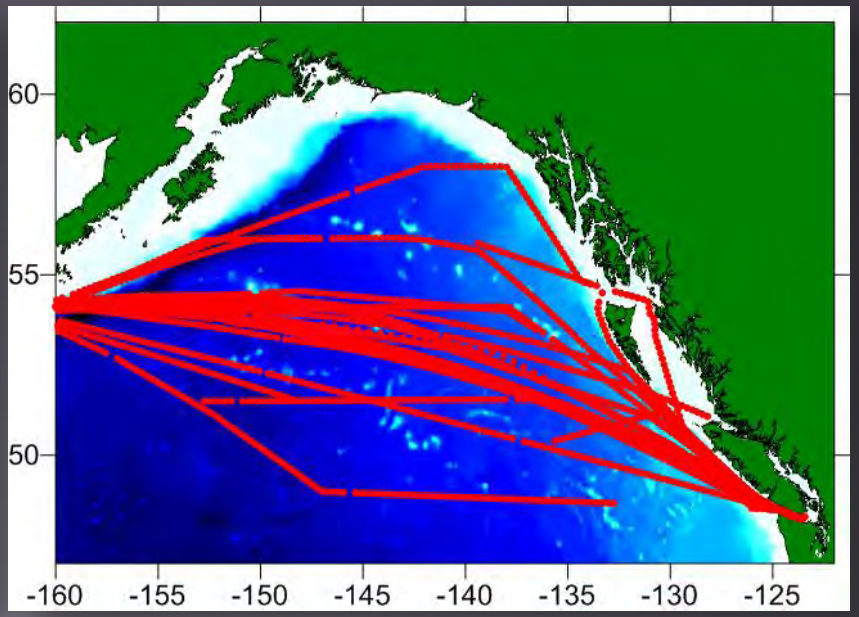
# Examples of route consistency




Pacific survey, north south transect.

53 separate transects, 2004-2012
High repeatability

Pacific survey, east-west transect.

33 separate transects, 2000-2012
Lower repeatability

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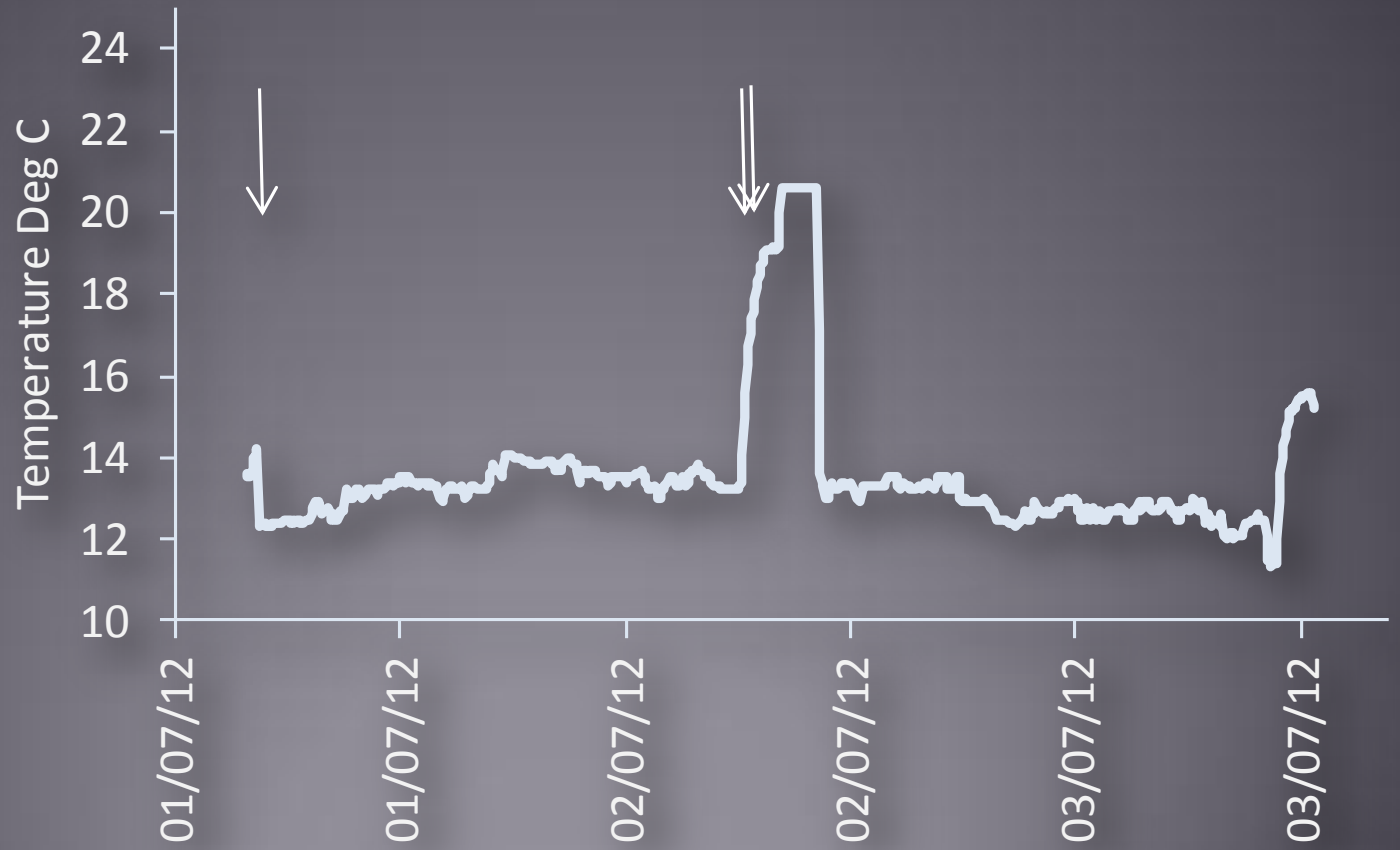
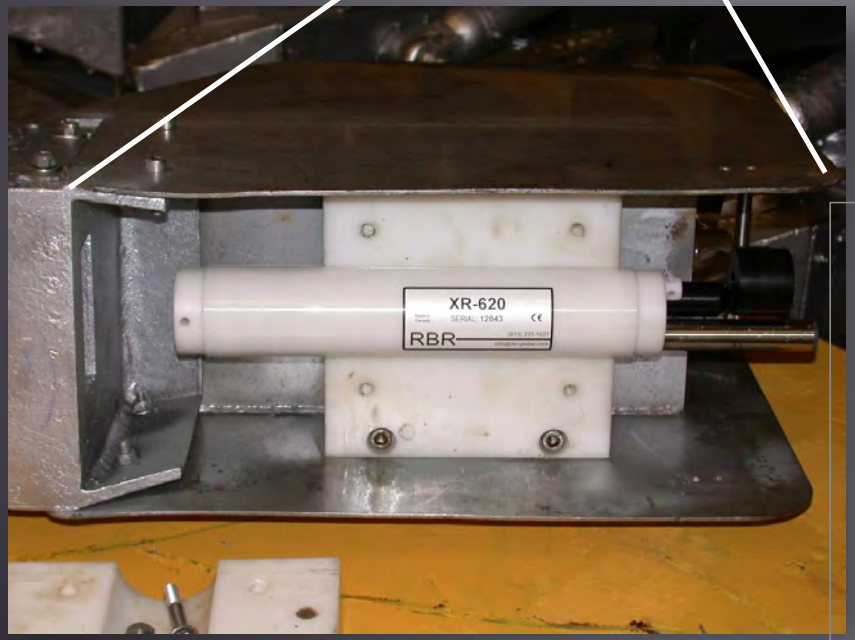
# Example of Ship's log conflict

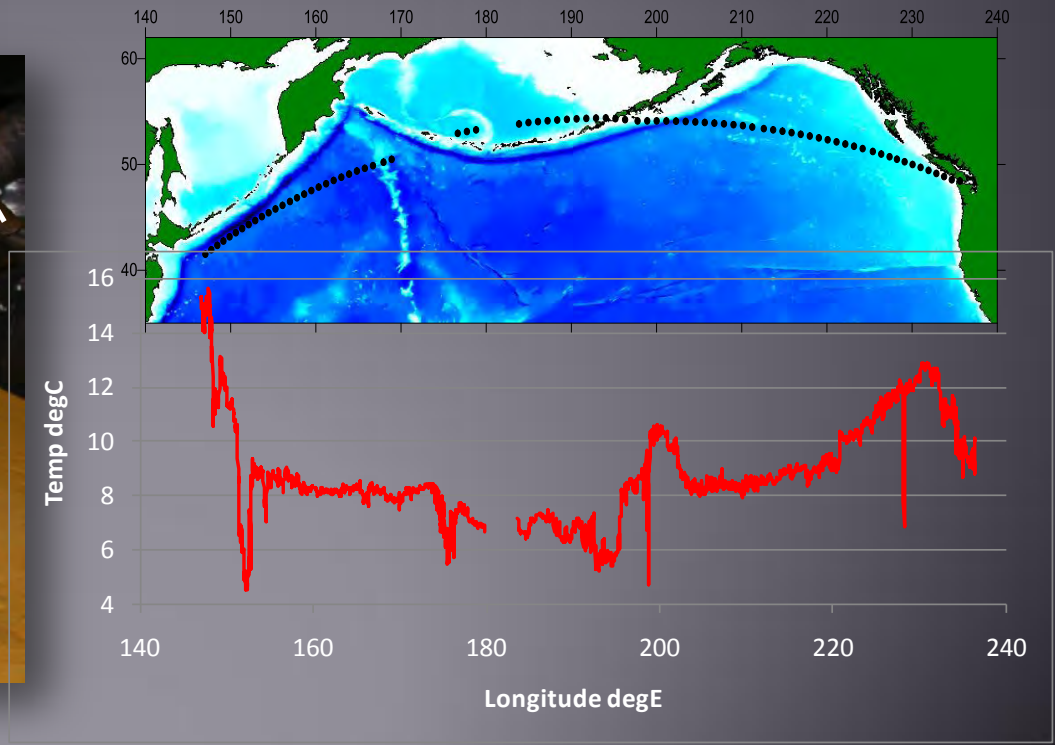
CPR with a temperature sensor fitted was deployed in the N Atlantic. Arrows mark ship's log times of shoot and haul – first 2 agree with temperature record, but 4 hour discrepancy with 2nd shoot.
What to do?



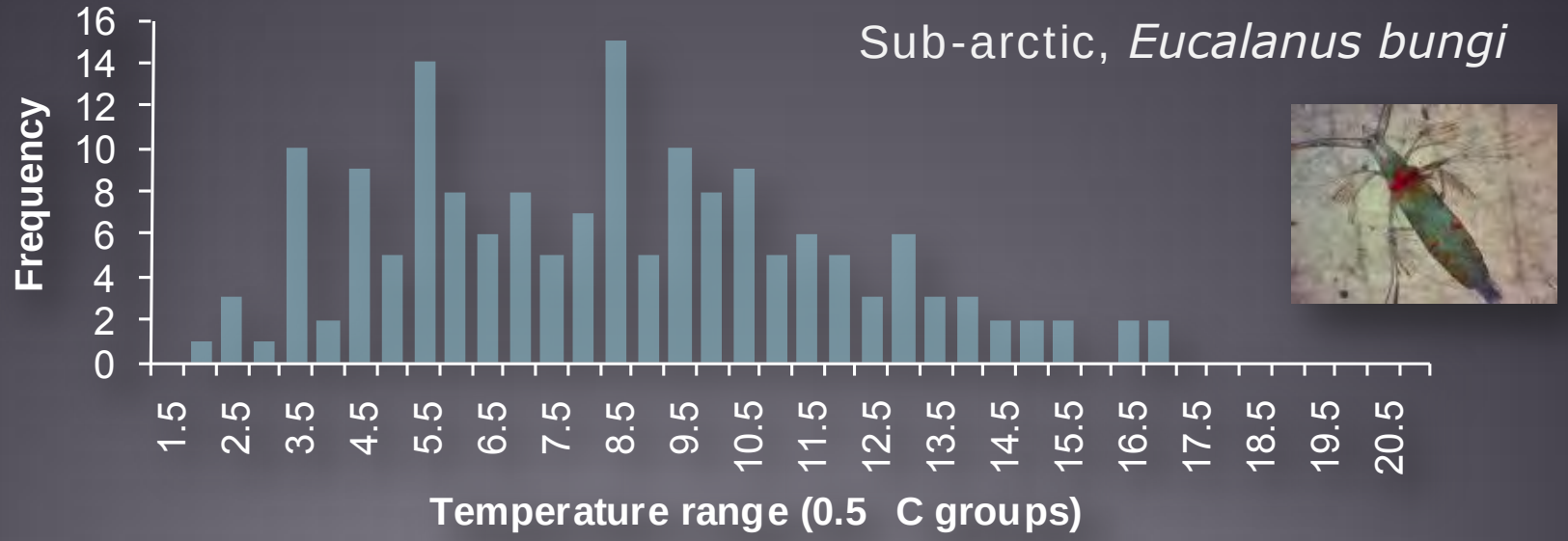
# The CPR as a platform – adding instrumentation

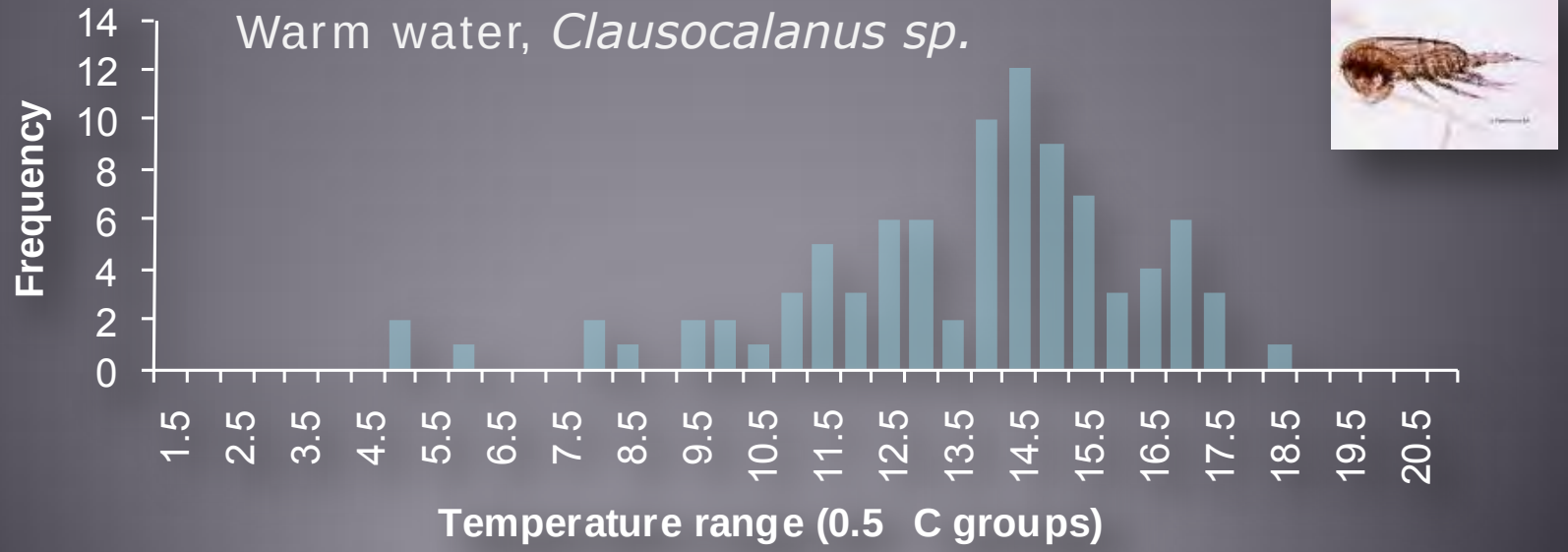
Temperature loggers (most basic)
CTD-F (more expensive)

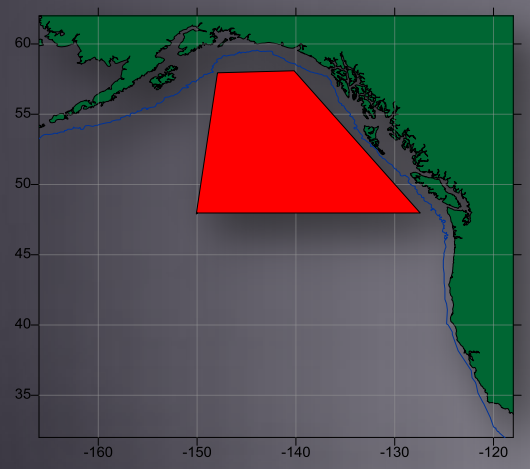



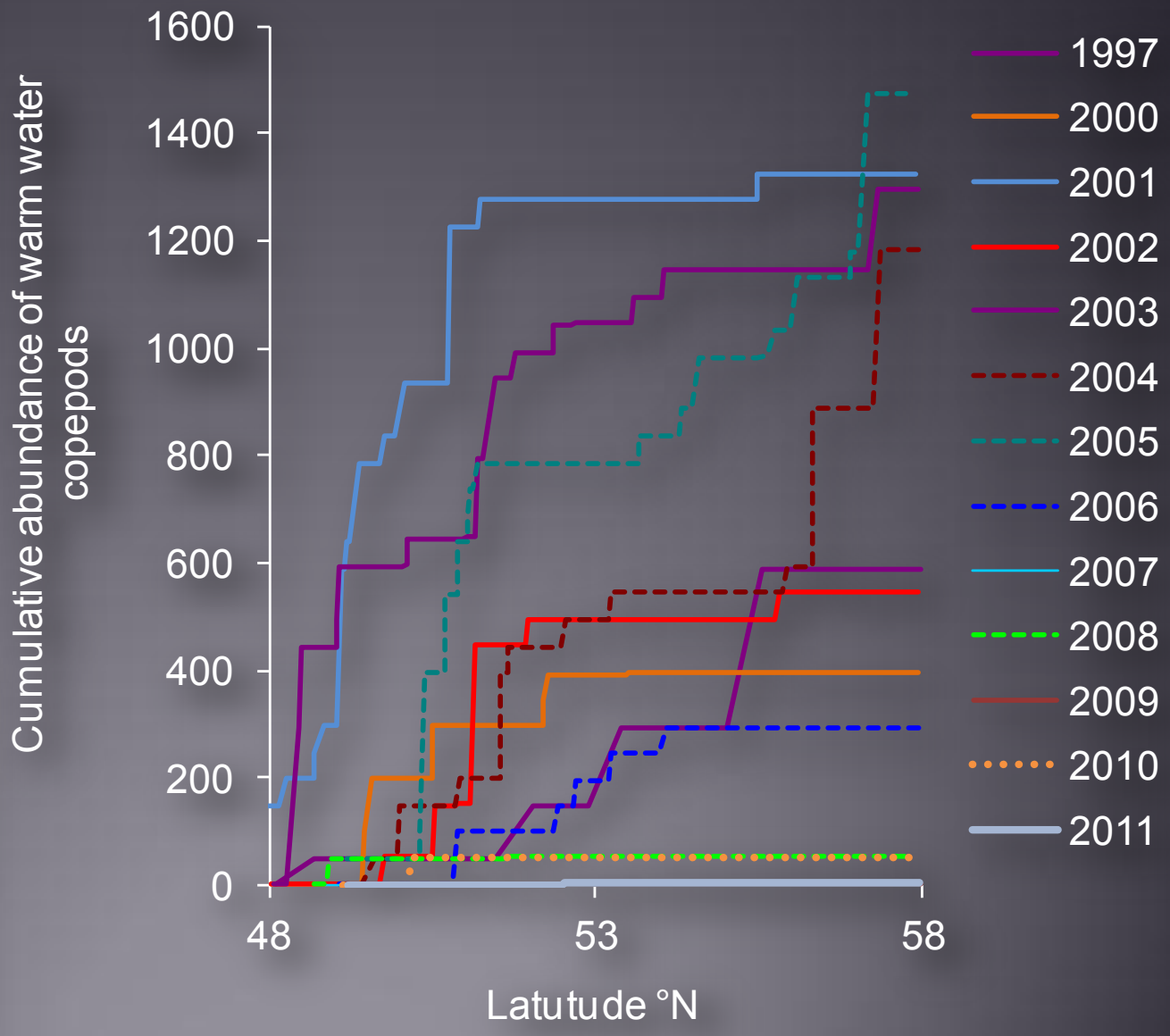
# Temperature distributions of two example taxa



Cumulative abundance of warm-water copepods each year, south to north, Mar-Sept, for oceanic region



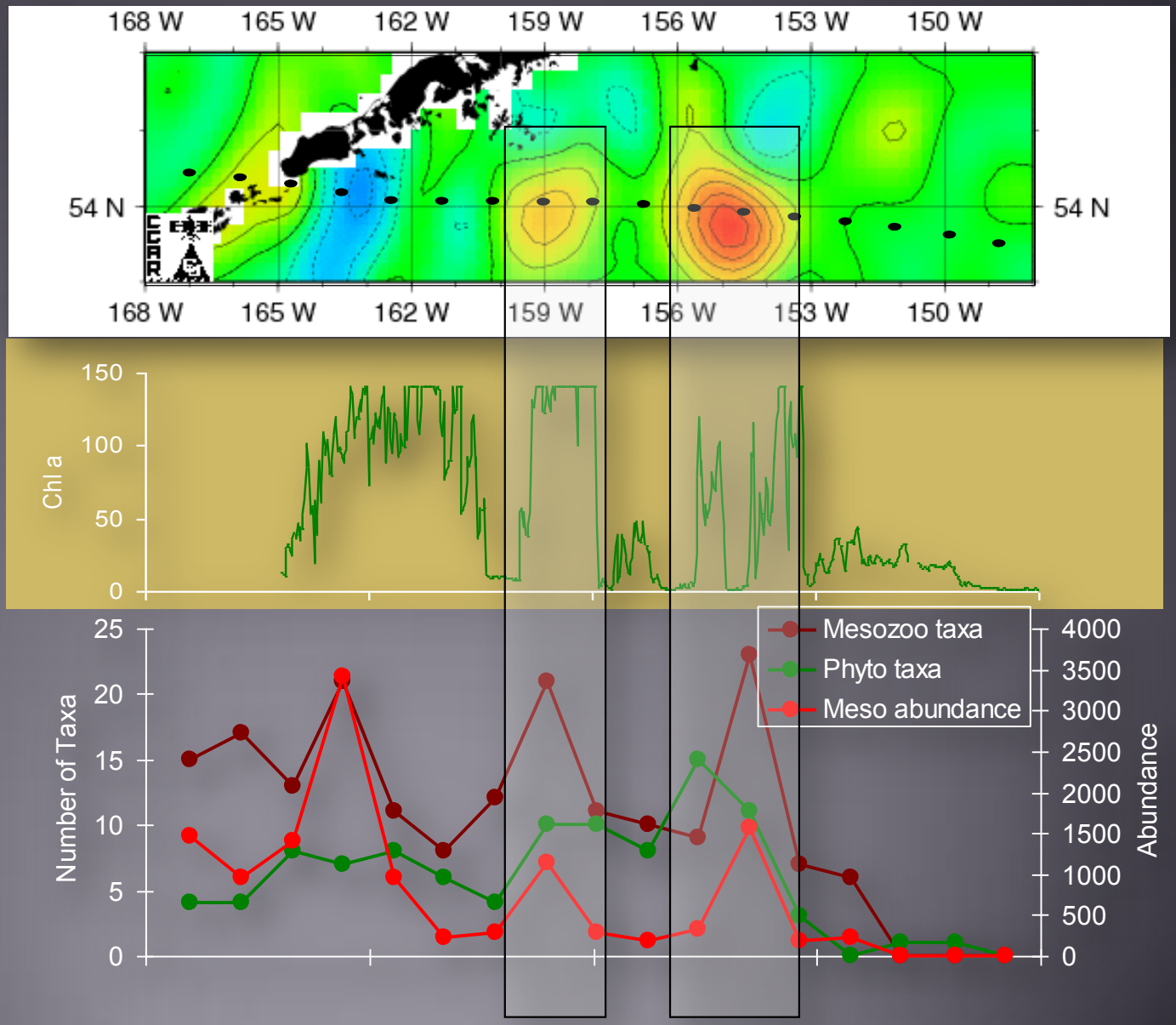




Updated from Batten & Walne (2011), Journal of Plankton Research

Chlorophyll from the CTD-F

June 2005

Transect through 2 eddies



# Bird/mammal observers

- logistically more complex (e.g. diversion insurance, port of departure/arrival)
- more expensive

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# Macro-ecology of plankton–seabird associations in the North Pacific Ocean

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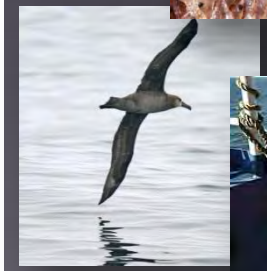
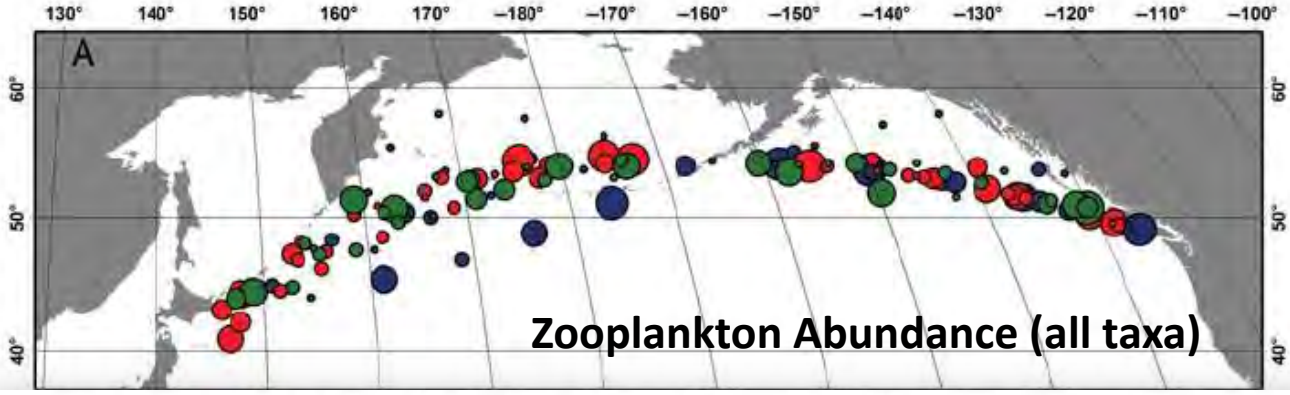
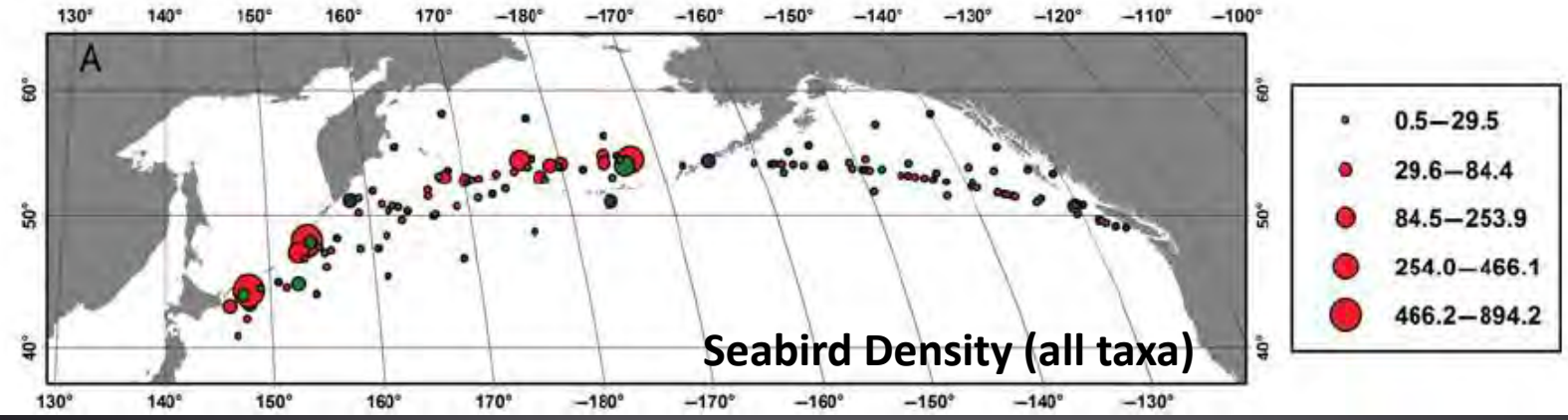
[1]FARALLON INSTITUTE FOR ADVANCED ECOSYSTEM RESEARCH, PO BOX 750756, PETALUMA, CA 94952, USA, [2]CANADIAN WILDLIFE SERVICE, ENVIRONMENT CANADA, C/O INSTITUTE OF OCEAN SCIENCES, FISHERIES AND OCEANS CANADA, 9860 W. SAANICH ROAD, SIDNEY, BRITISH COLUMBIA, CANADA AND [3]SIR ALISTER HARDY FOUNDATION FOR OCEAN SCIENCE, CITADEL HILL, THE LABORATORY, PLYMOUTH PL1 2PB, UK






Zooplankton Abundance (all taxa)

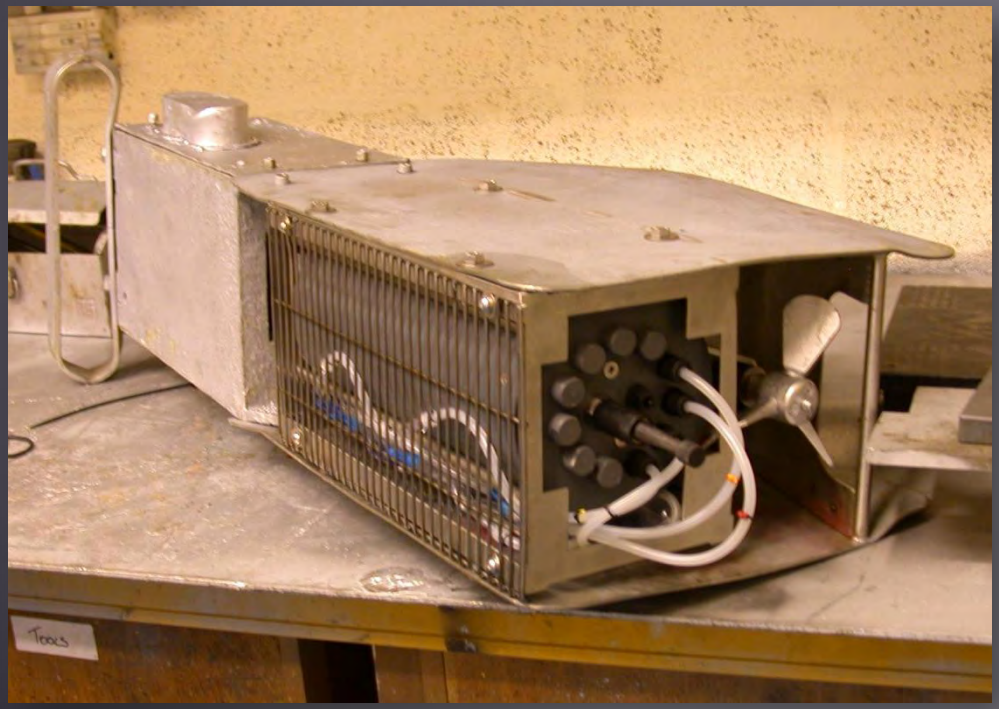



Seabird Density (all taxa)

# Water and Microplankton Sampler (WaMS).

Aimed at smaller size-fraction (nano and pico) plankton community.

Flow cytometry, Molecular probes and barcoding, Harmful Algal Bloom microarrays



"*Bring back data, not samples*" MBARI

However, an archive of samples allows for un-envisaged future applications, e.g. (just in last few years):

•Mapping microplastics

•Stable isotope work to reveal trophic linkages

•Molecular studies

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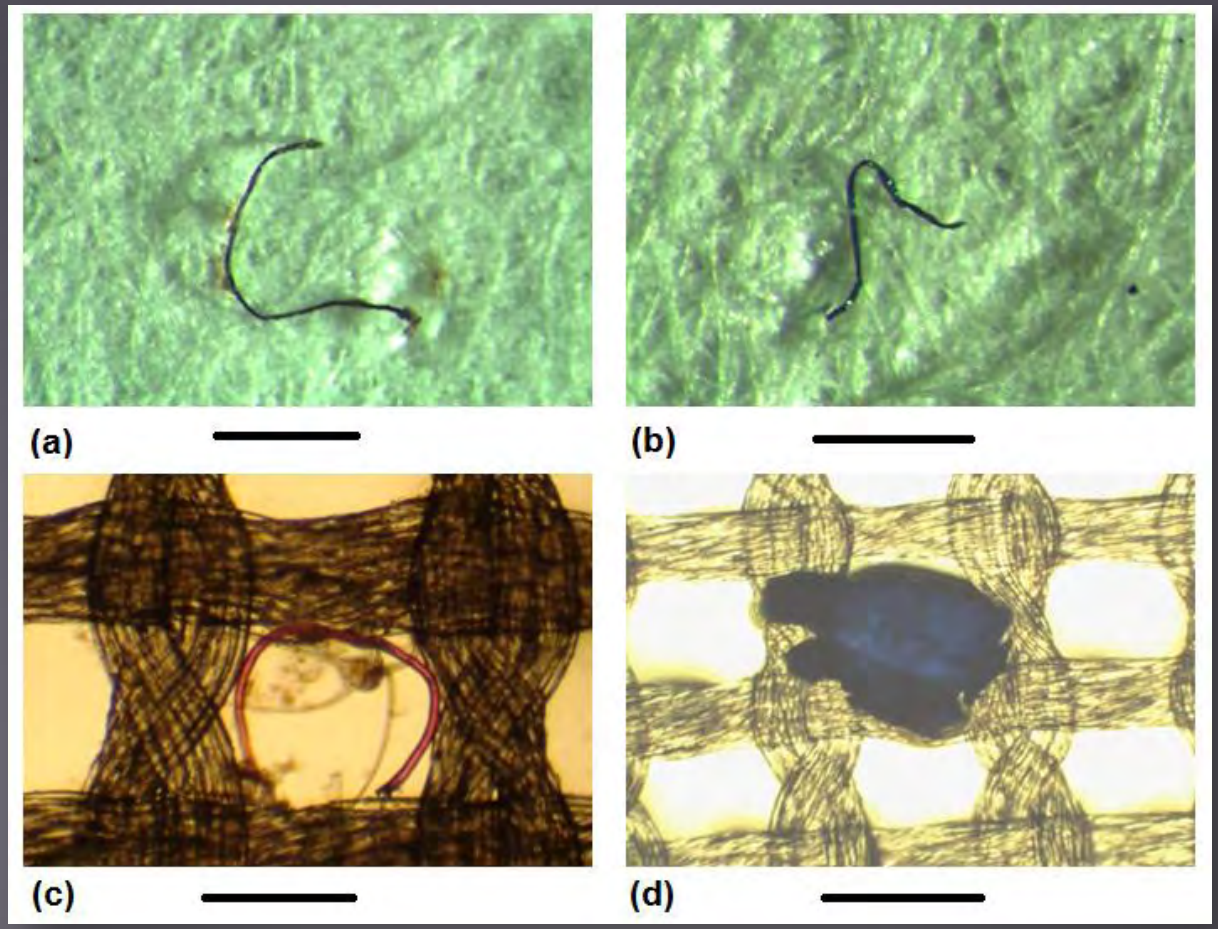
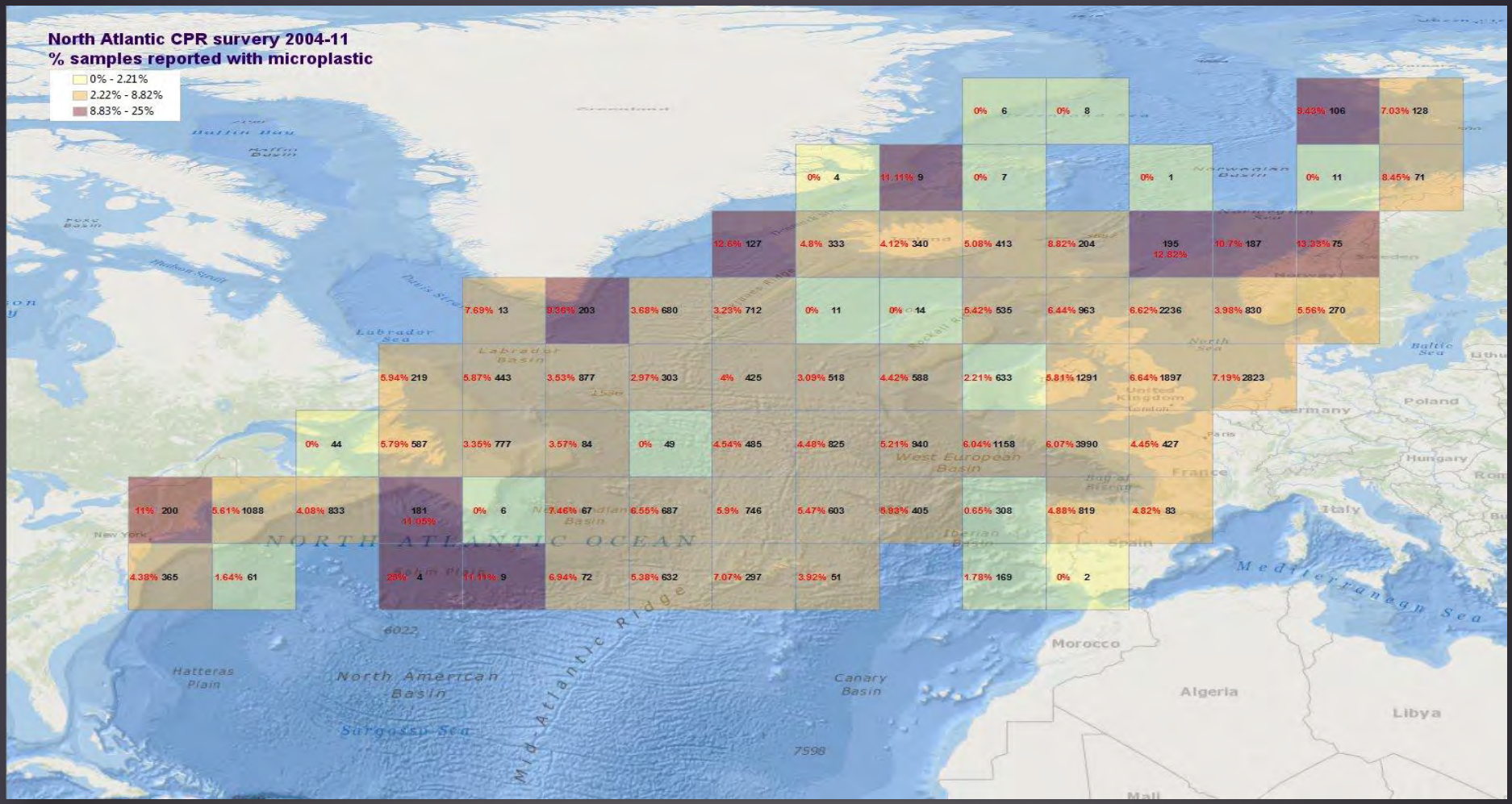
# Examples of different forms of microplastic debris found in CPR samples.

Polyester fibres (a,b), nylon (c) and Polyethylene terephthalate fragments (d). Scale bar represents 270 µm.




Courtesy of Saeed Sadri, PhD student, University of Plymouth/SAHFOS




5x5 degree grid with number in black representing the sampling effort.

Courtesy of Saeed Sadri, PhD student, University of Plymouth/SAHFOS

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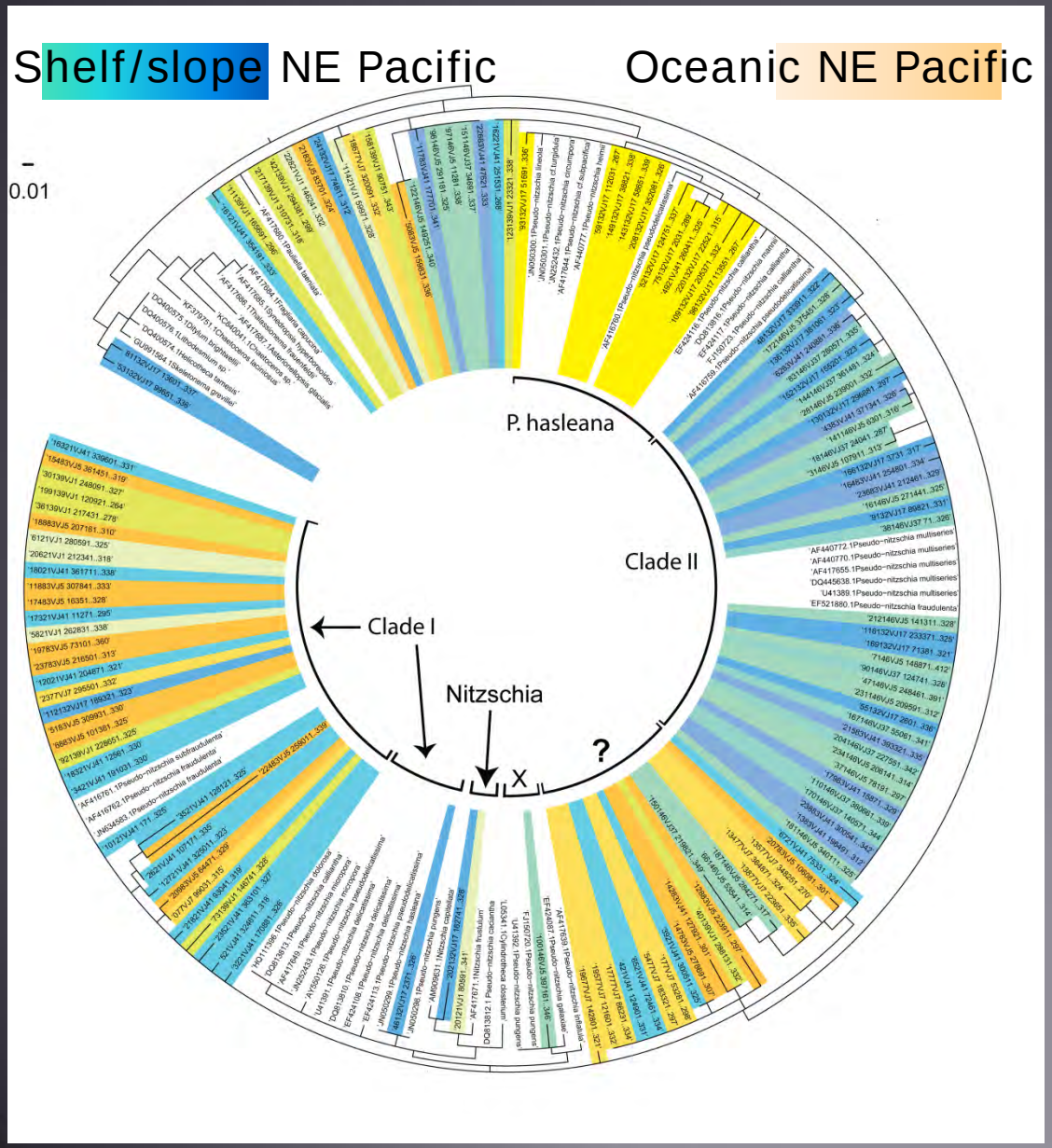
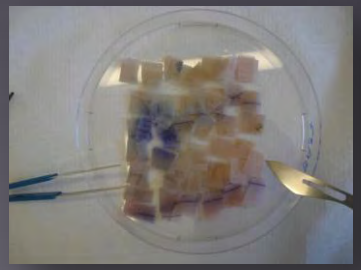
# Molecular studies on NE Pacific CPR samples



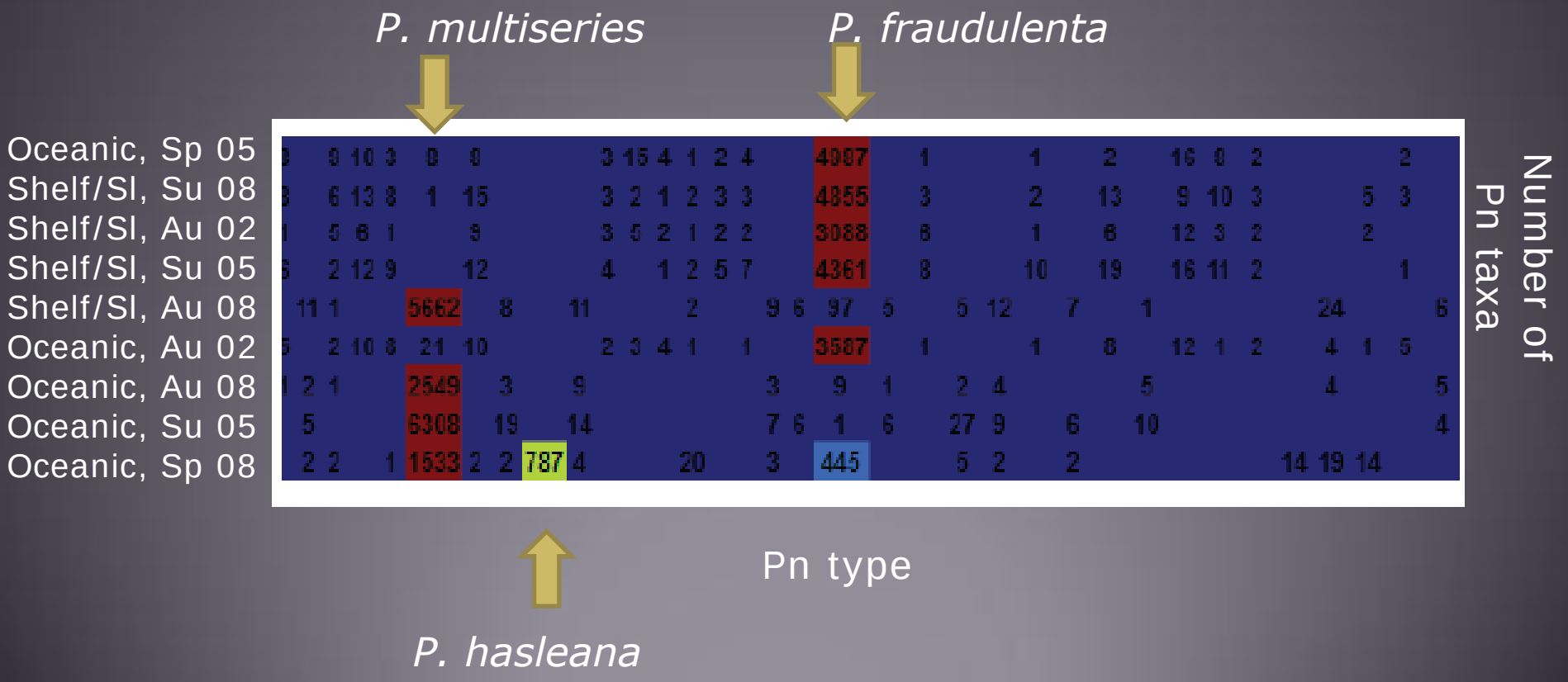
- 12 out of 30+ Pseudo-nitzschia spp. form HAB
- Not identifiable by microscopy
- Using DNA marker: D1-D2 large ribosomal subunit, identified into genetic clades

**CPR samples contained**

- Clade I: *P. fraudulenta*
- Clade II: *P. multiseries*
- P. *hasleana*- new Pacific NE species

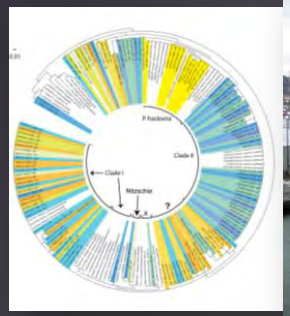
Courtesy of Rowena Stern, SAHFOS

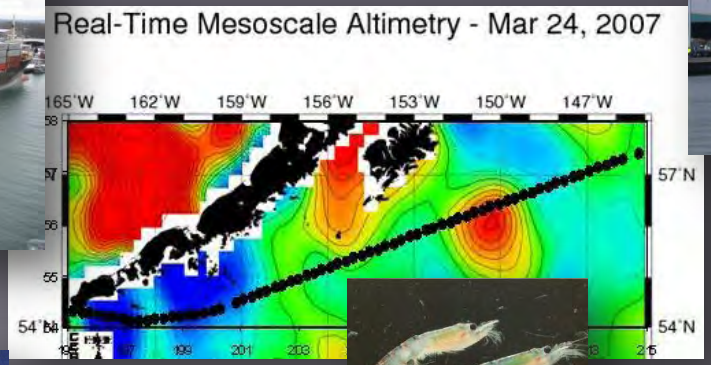
- Regional differences (Oceanic v shelf/slope)
- Anomalous seasons (e.g. Spring 2008)

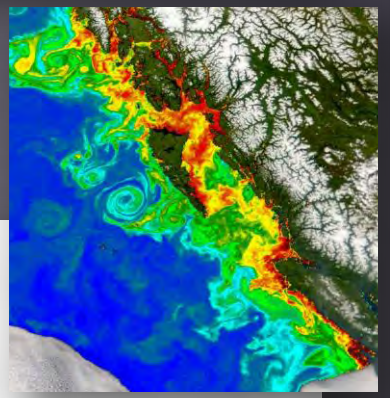


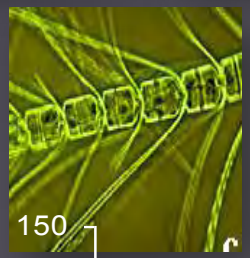

Courtesy of Rowena Stern, SAHFOS

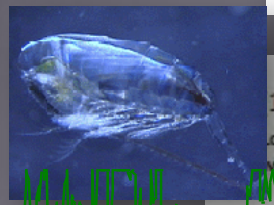
# The capabilities for a multi-disciplinary, cost-effective sampling program exist.

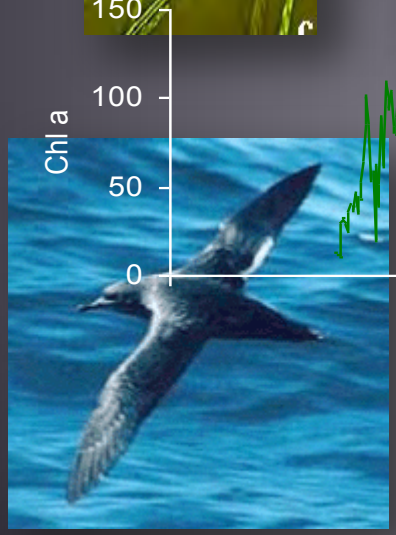


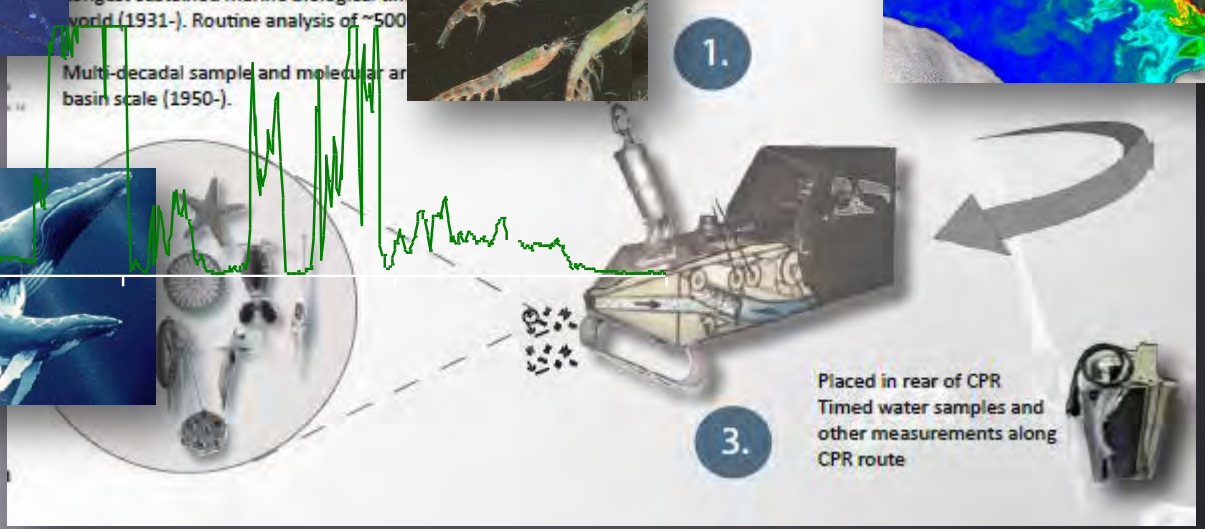








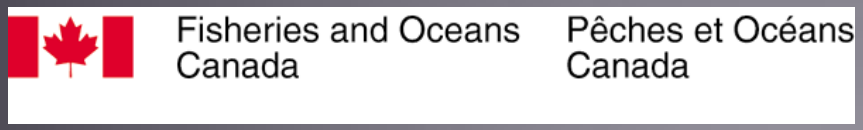


Further information can be found at:

**www. globalcpr.org** (GACS)

**www.sahfos.org** (CPR parent organisation)

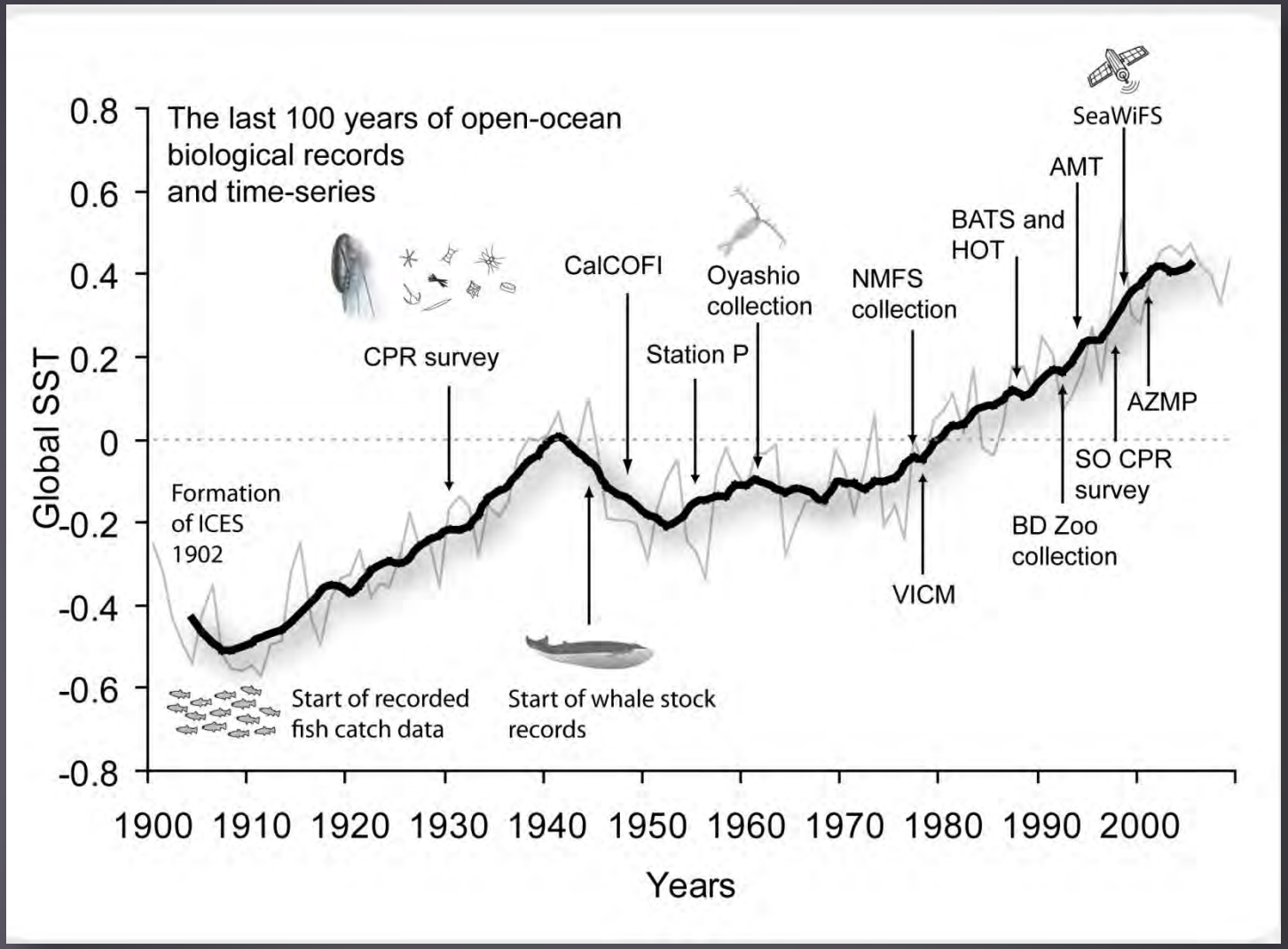
**www.pices.int/projects/tcprsotnp/default.aspx**
(N Pacific survey and CTD data)








# Sustained open ocean biological time series are rare……




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