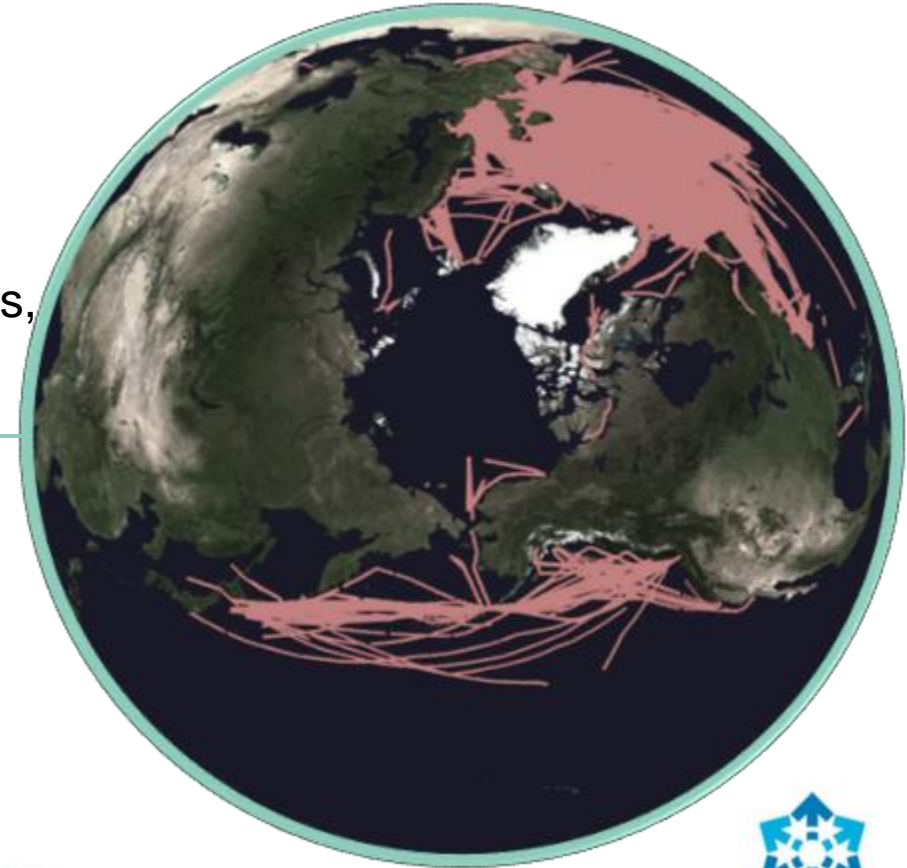


Changes in zooplankton communities from the North Pacific Continuous Plankton Recorder (CPR) Survey



**Marine
Biological
Association**

Clare Ostle, Sonia Batten, David Johns,
Loïck Kléparski, Francesca Loro, and
Akash Sastri.



Exxon Valdez
Oil Spill Trustees



UK Science & Innovation Network



Fisheries and Oceans
Canada

Pêches et Océans
Canada



Arctic Office
NATURAL ENVIRONMENT
RESEARCH COUNCIL

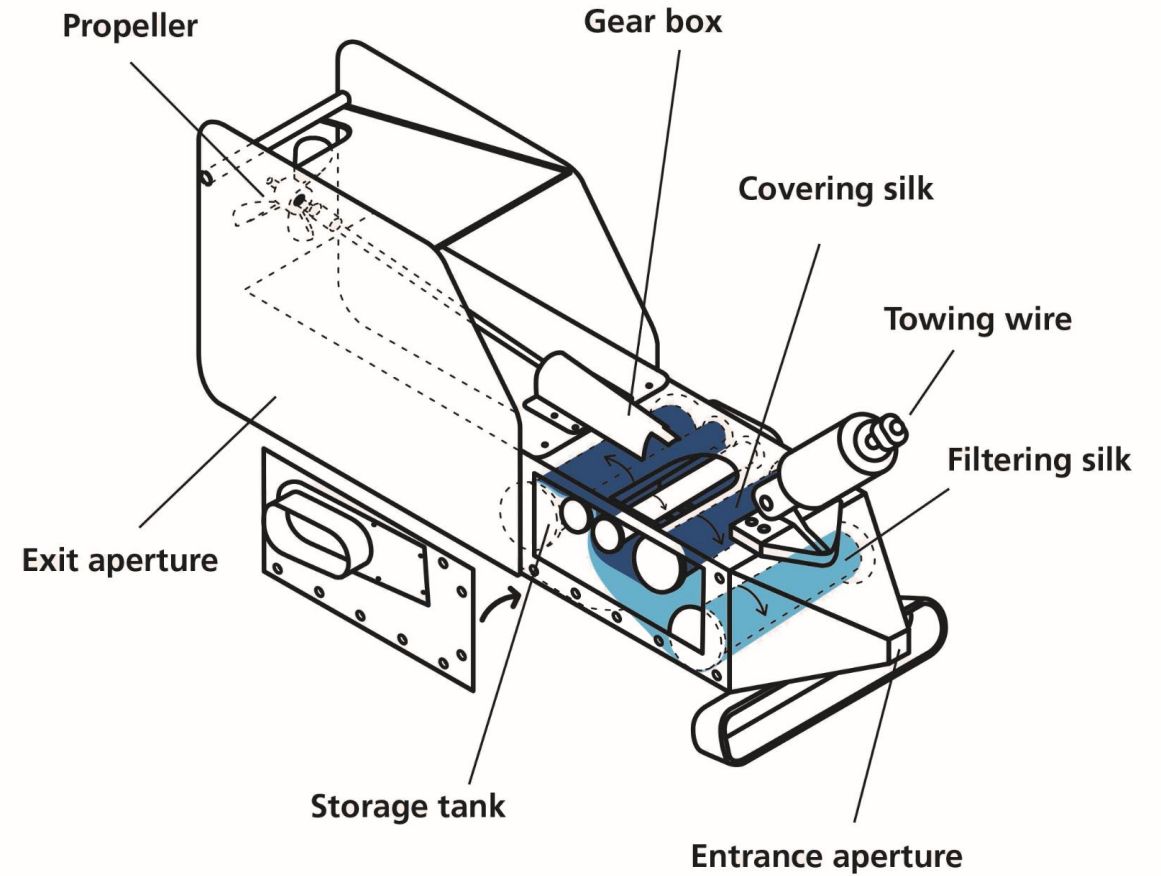


Outline

- Introduction to CPR
- The North Pacific CPR Survey
- Community Temperature Index
- Regional trends
- Summary



The Continuous Plankton Recorder

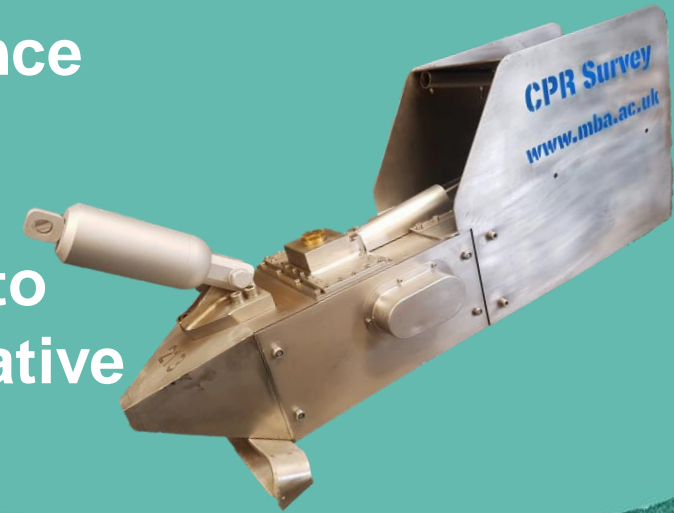






CPR Sampling

- Samples are cut into 10 nmi samples ($\sim 3\text{m}^3$ of filtered water)
- Phytoplankton colour recorded
- Zooplankton and phytoplankton counted
- Unchanged methodology since 1958
- Mesh size of $\sim 270\ \mu\text{m}$
- Can retain small ($\sim 5\ \mu\text{m}$) phyto
- Phytoplankton semi-quantitative





Sample library

In addition to the data we also maintain an archive of samples which have many additional applications - some yet to be discovered!

These samples have been preserved in 4% formalin and can be analysed retrospectively.

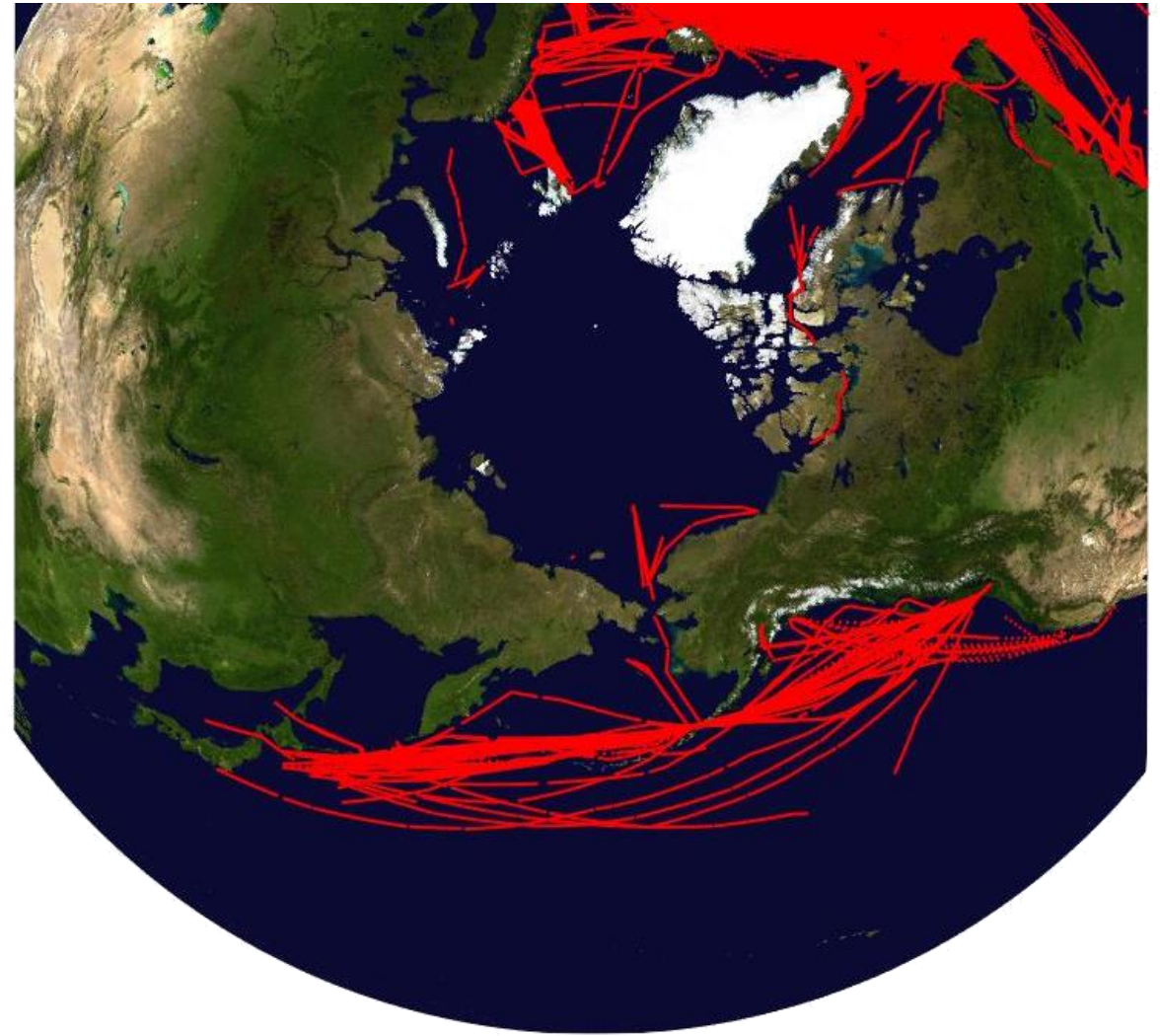


Gemma Brice © 2017 Marine Biological Association



North Pacific CPR Survey

- Started in 2000
- Consortium funding initiated in 2008 administered by PICES
- > 20 years of seasonal data
- > 33,000 samples collected and archived
- In 2018 new route through the Bering Sea into the Arctic

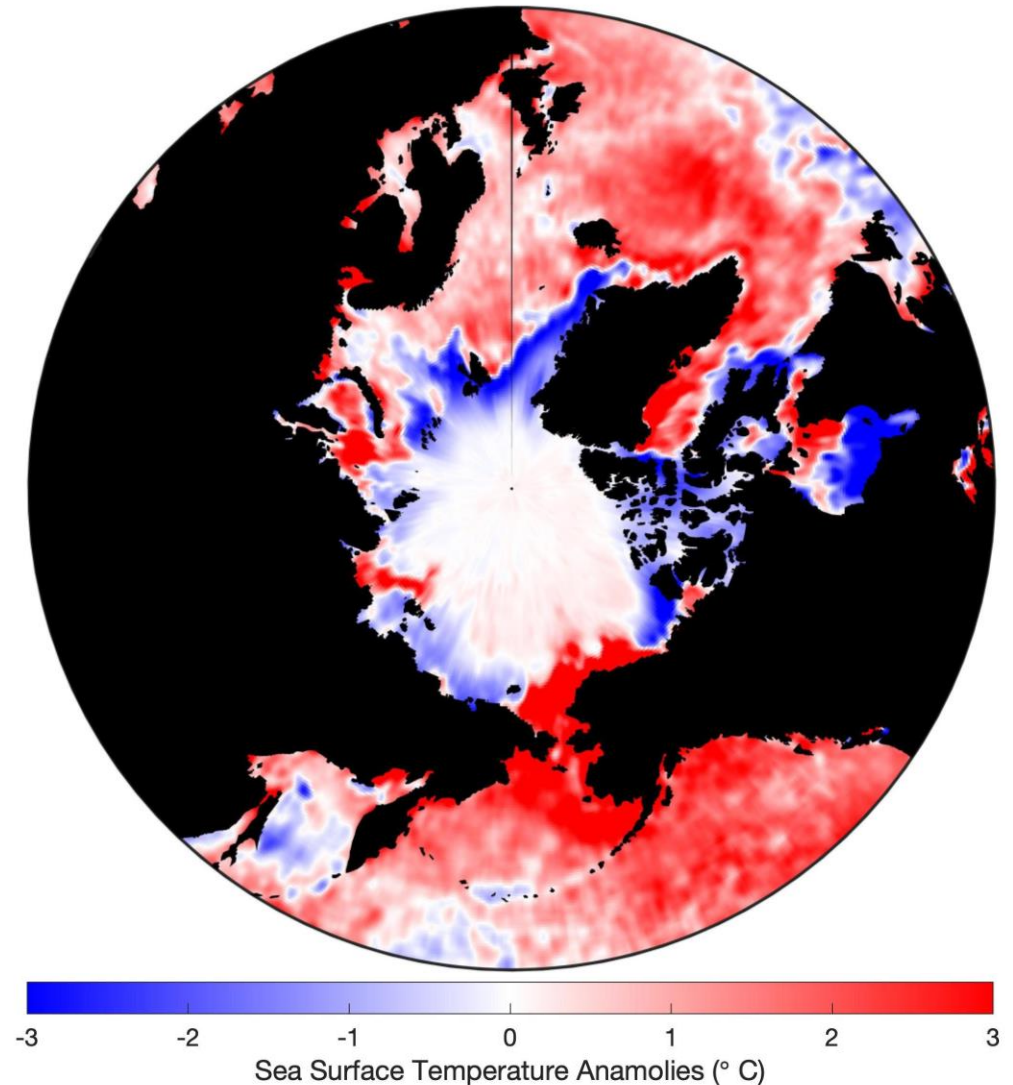




Continued warming predicted to lead to geographical shifts in zooplankton.

Pacific – Bering – Arctic represents an important transition zone.

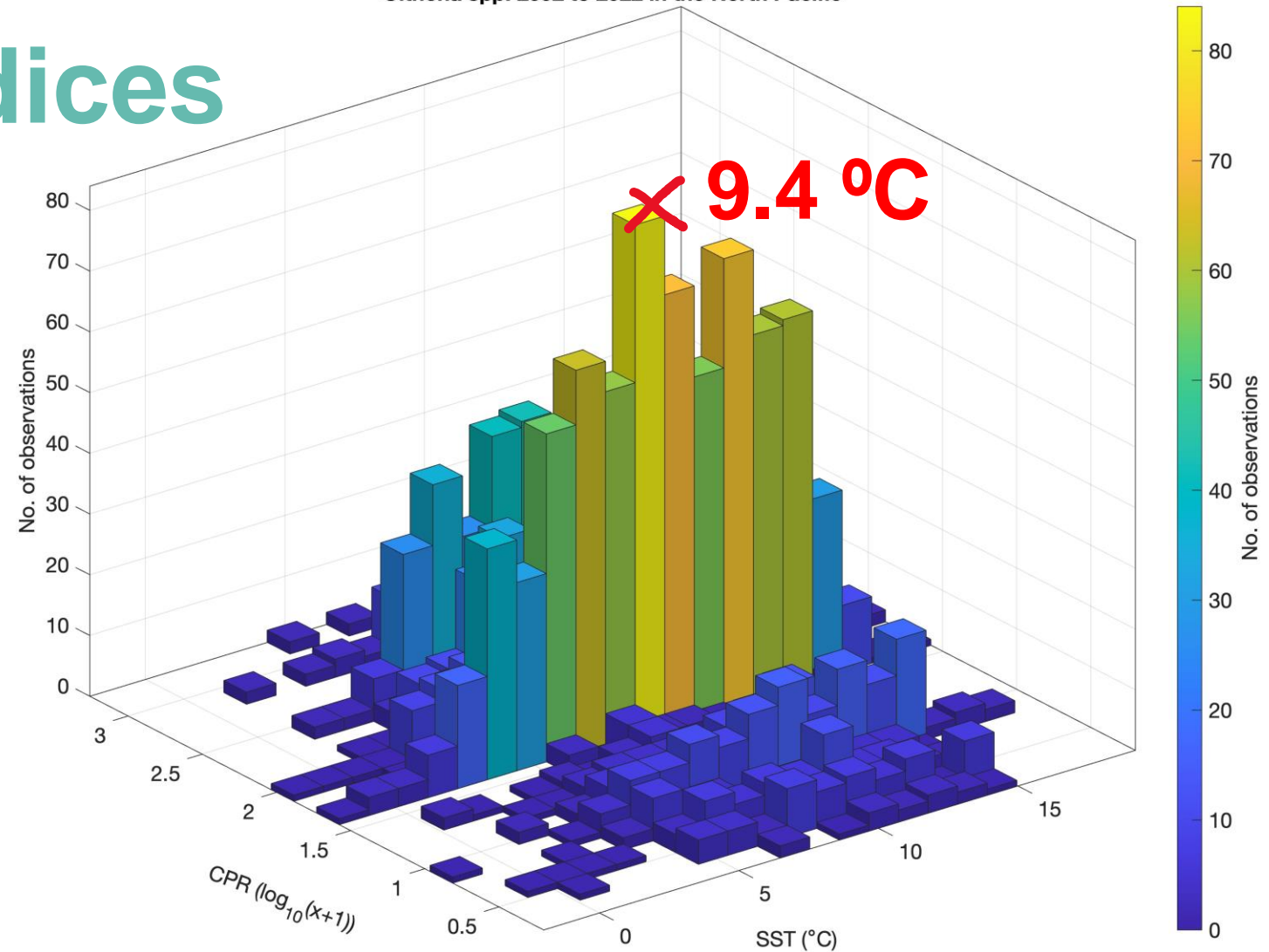
CPR provides cost-effective coverage.





Temperature Indices

Species
Temperature Index
(STI) = median
temperature of
each species
occurrence across
dataset



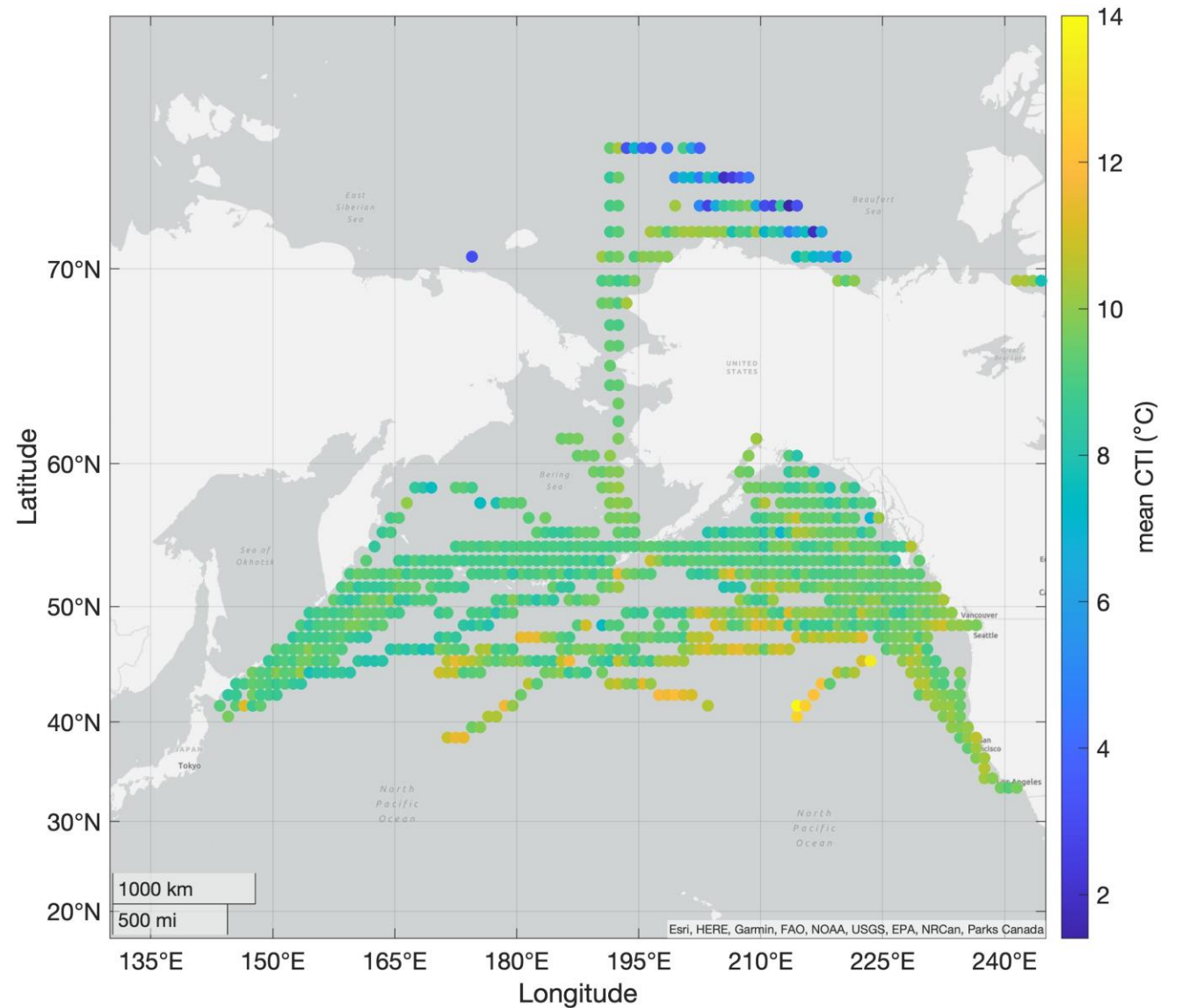
ICOADS SST (Woodruff *et al.*, (1987))



Community Temperature Index (CTI)

$$CTI = \frac{\sum_i^n STI_i w_i}{\sum_i^n w_i}$$

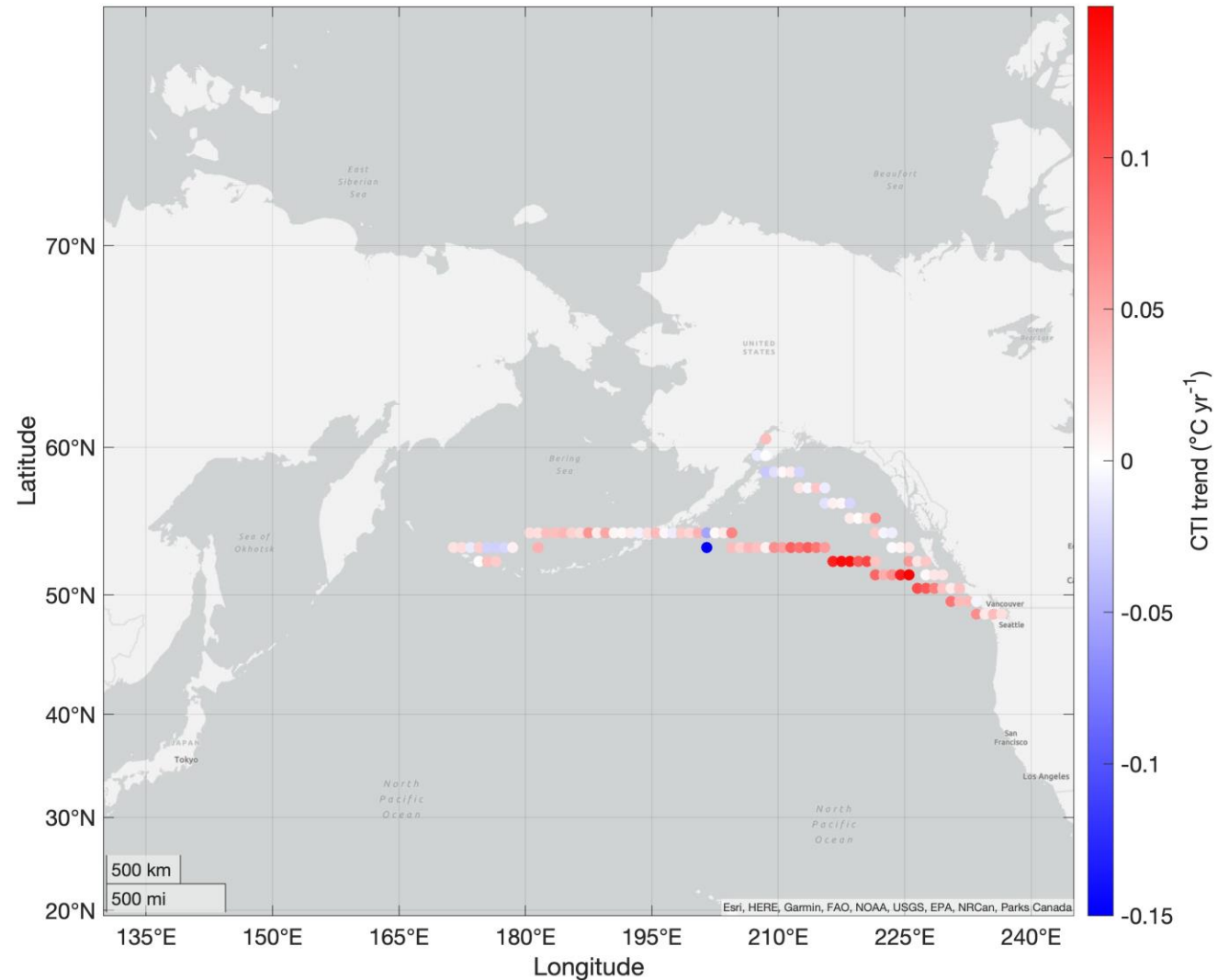
Abundance-weighted mean thermal affinity of the zooplankton community with a sample





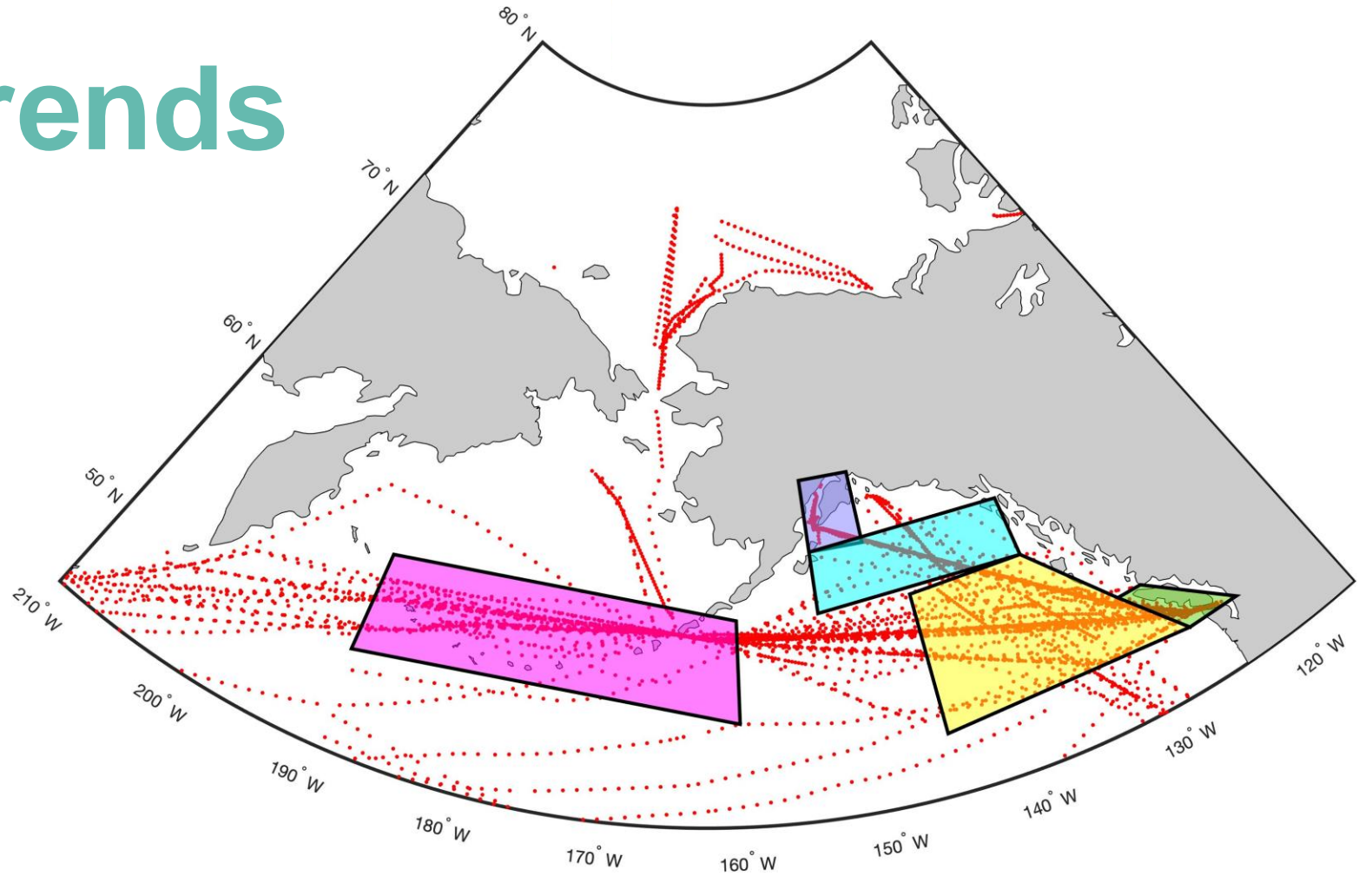
CTI trend

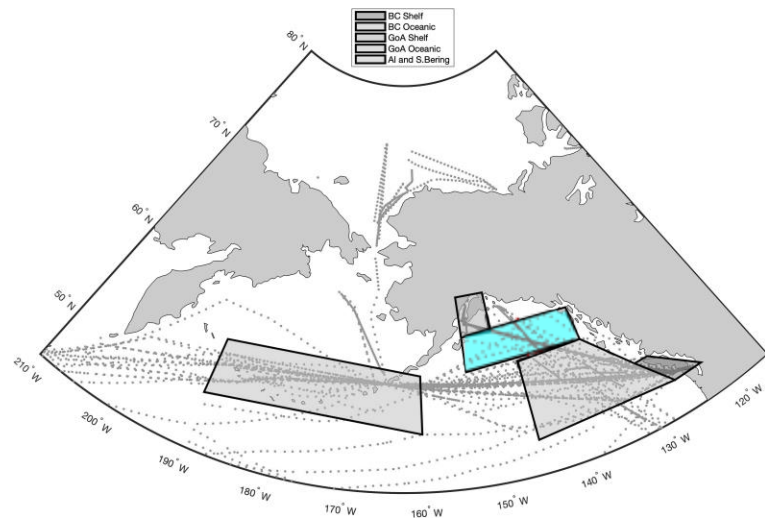
- Where > 10 years
- Change in CTI per year
- General increase in CTI over sampling period
- Strongest in the oceanic region



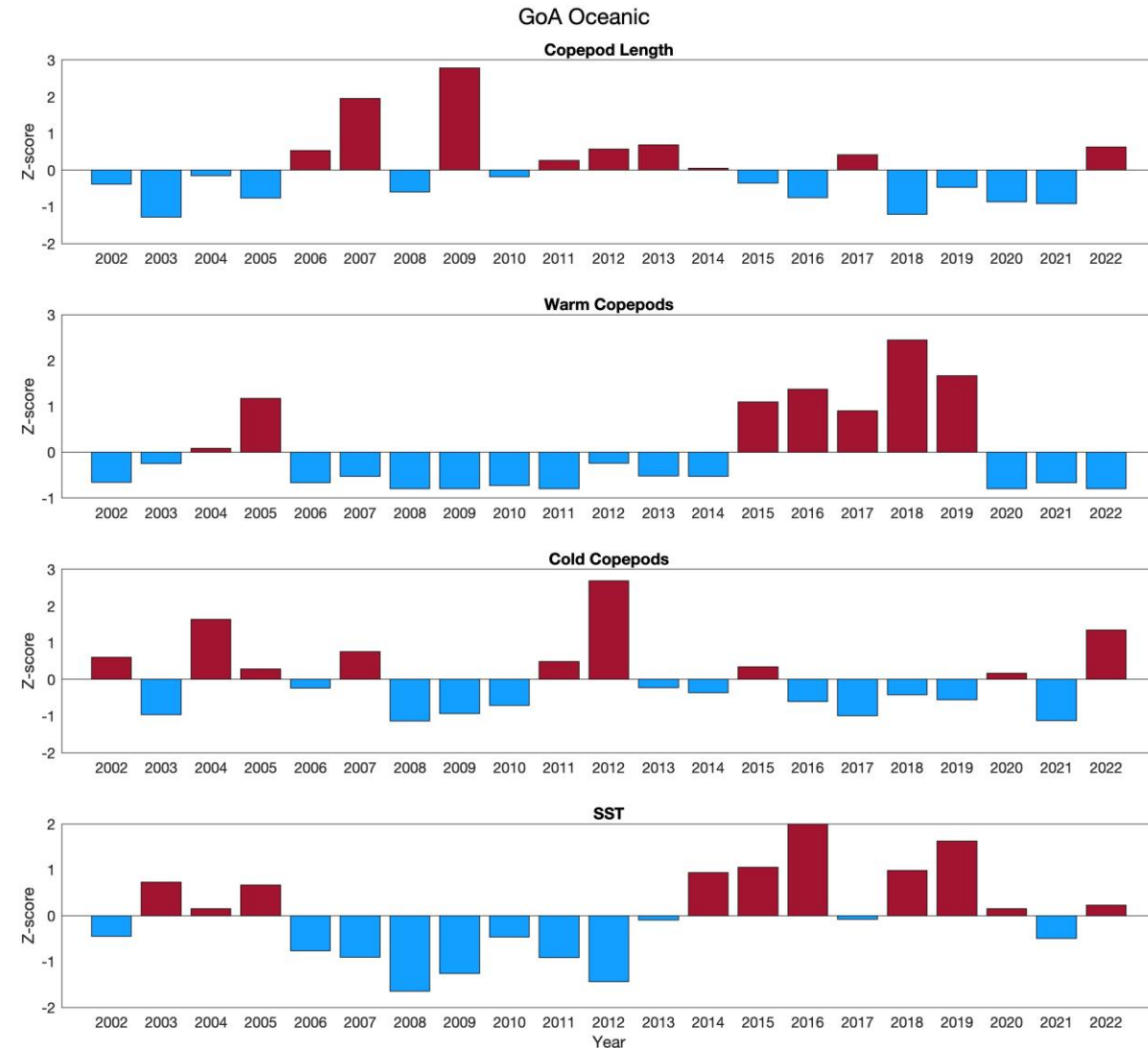


Regional trends





- Warm cops = $STI > 12\text{ }^{\circ}\text{C}$
- Cold cops = $STI < 8\text{ }^{\circ}\text{C}$
- General pattern: warm periods = decreased length and increased warm copepods





Summary

- Zooplankton community shifting towards taxa with warmer thermal niche
- Copepod size also decreased
- Some regions suggest a return to pre-heatwave conditions
- Size and prey-type can be important for predators, e.g. fisheries: Arimitsu *et al.*, (2021)
- Further investigations with regional predators needed

Thanks to all the **analysts**, **shipping** companies, **crews** and **funders** that make the CPR survey possible!



**Marine
Biological
Association**

Thank you!

email: claost@mba.ac.uk



Exxon Valdez
Oil Spill Trustees



UK Science & Innovation Network



Fisheries and Oceans
Canada

Pêches et Océans
Canada

