# Impact of the Marine Heat Wave on Gulf of Alaska plankton communities

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CONTINUOUS PLANKTON RECORDER SURVEY
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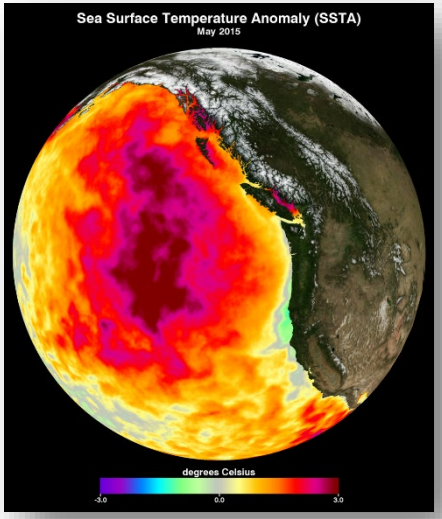
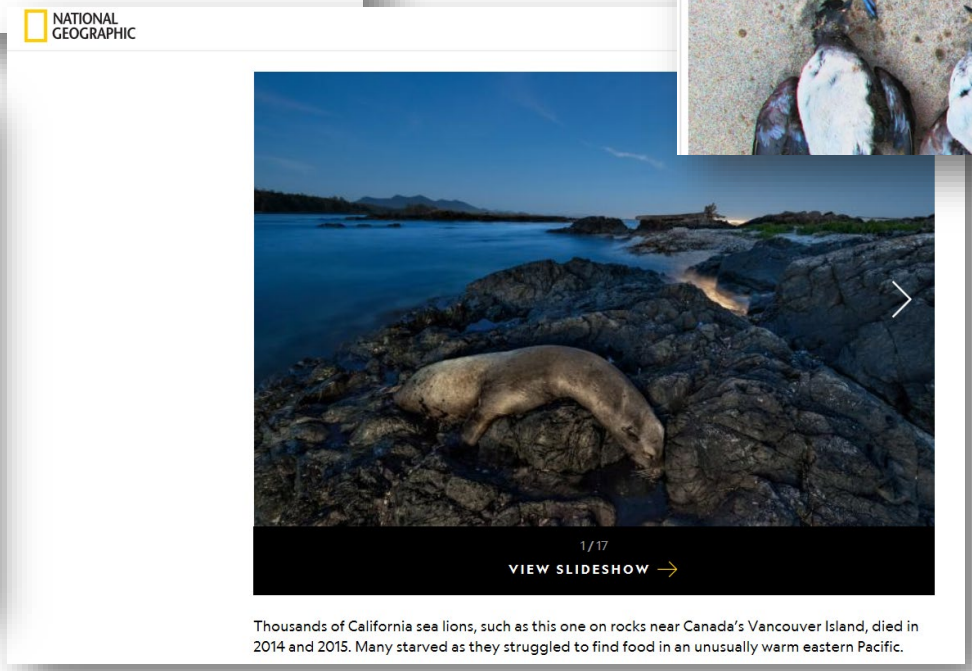
# The 2014-2016 marine heat wave





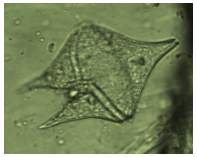

- Plankton are the base of the food chain.
- What happened to plankton during the heat wave?
- Has it "recovered" after that heat wave?

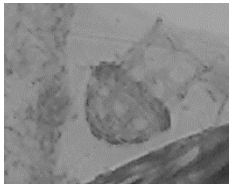
# The Challenge……

Plankton is made up of thousands of species, only some of which are measured by any sampling system.

Our project uses the Continuous Plankton Recorder (CPR), towed behind commercial ships.
We identify and count several hundred taxa in the Gulf of Alaska (phytoplankton, microzooplankton, mesozooplankton)

How to simplify these data, while still being able to relate changes to ecosystem function?

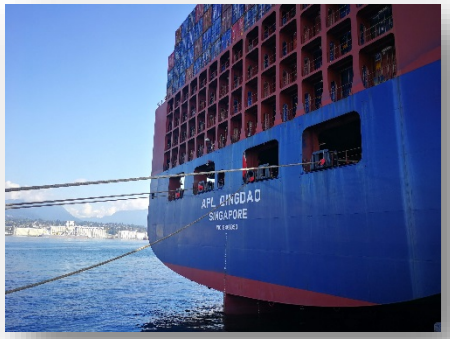


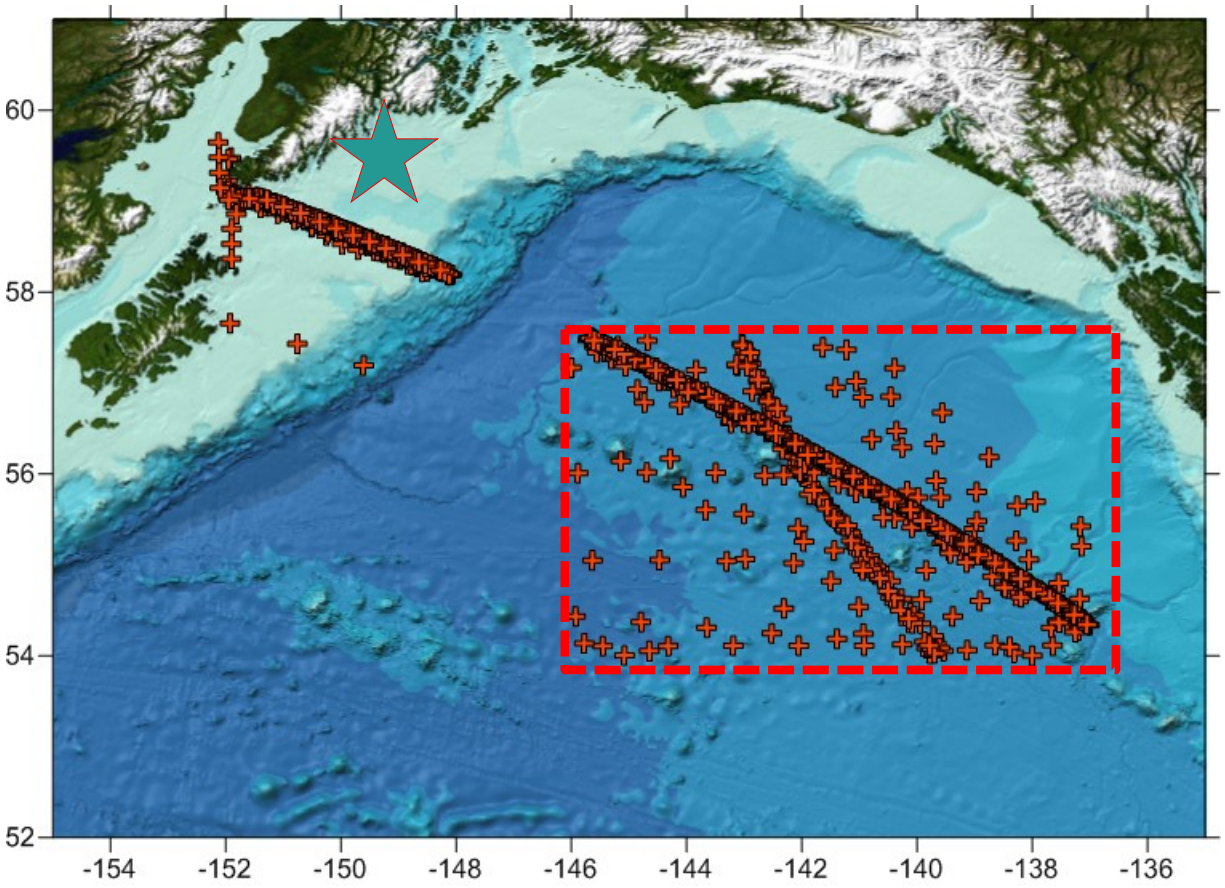


# The Data…..

**Plankton samples:**
Two regions, shelf and oceanic, sampled March-October each year

Shelf: 2004-2018 (n=887)
Oceanic: 2000-2018 (n=835)



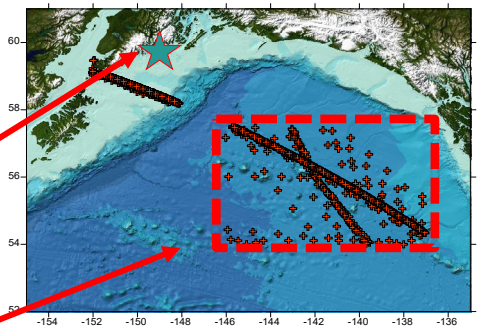
# The Data…..

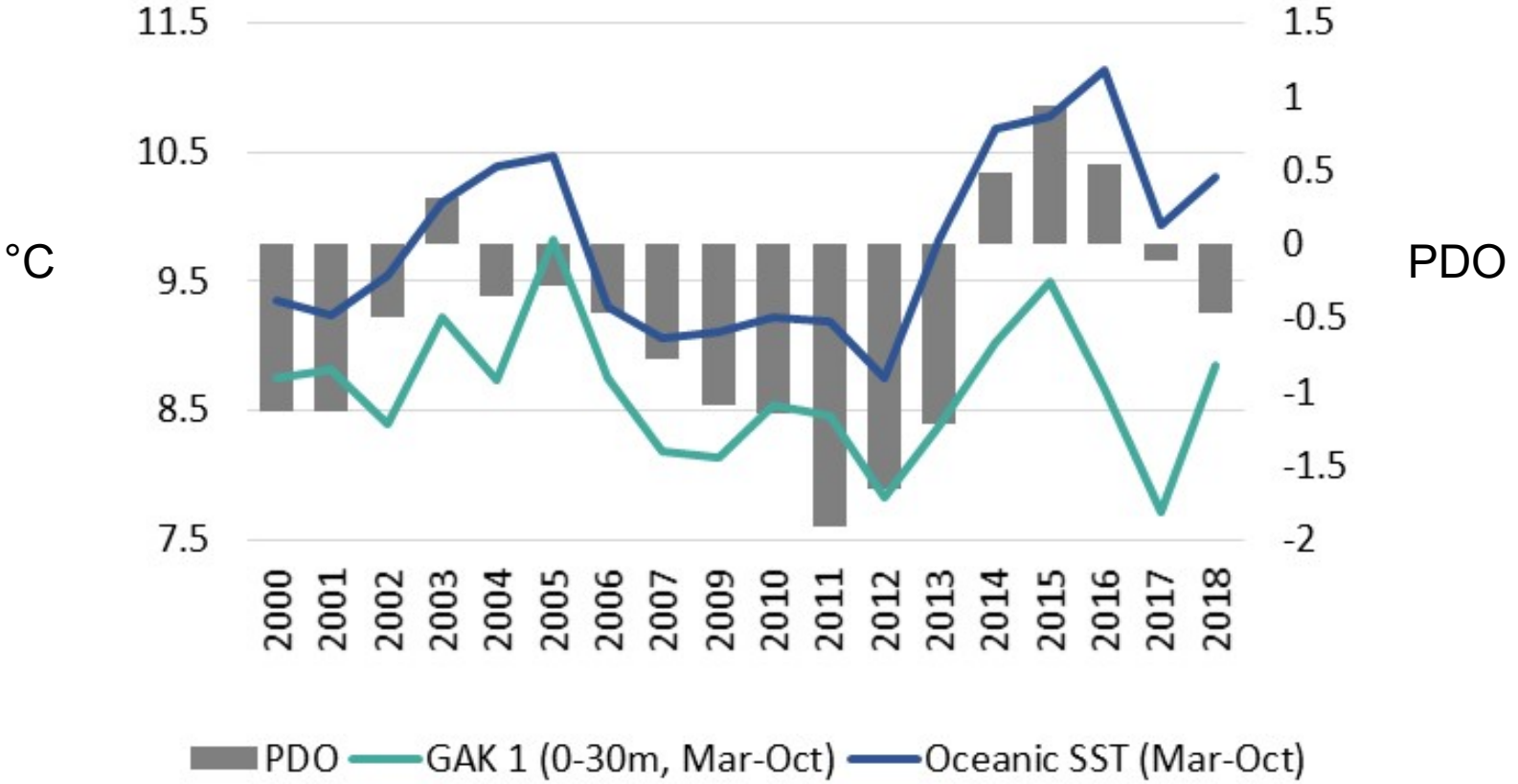
**Climate Indices:**

Pacific Decadal Oscillation (PDO, annual)

0-30m T (Mar-Oct) from the GAK1 data set (to represent the shelf region

SST (Mar-Oct) for the oceanic region (Hadley, HadISST dataset)



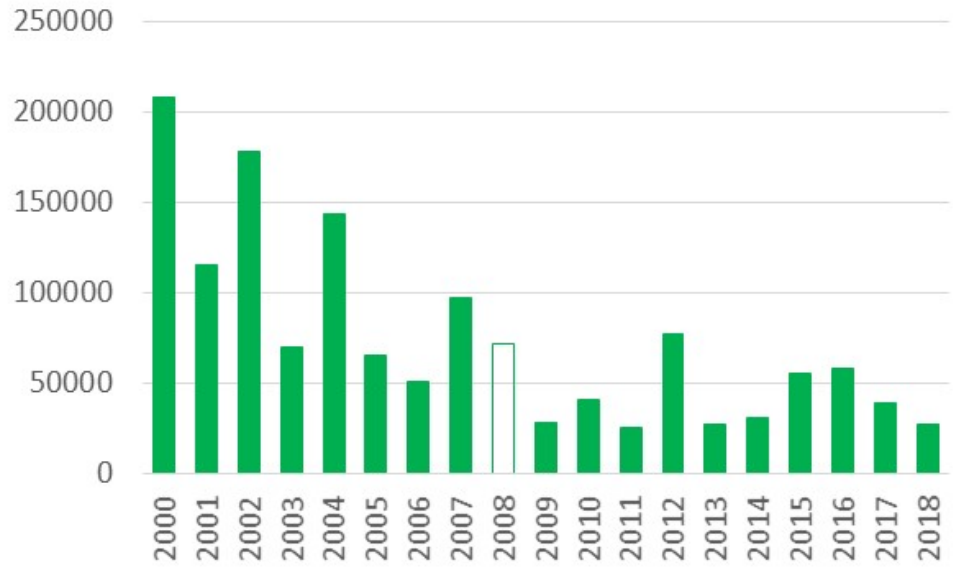



# Two types of metrics:

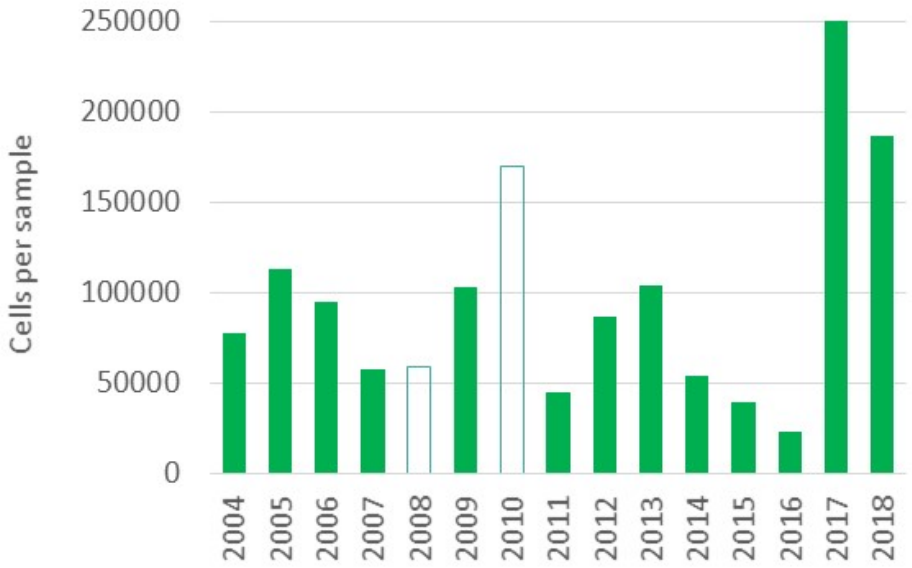
"bulk", equivalent to food quantity
"community composition", equivalent to food quality

## 1. Bulk phytoplankton – Total Diatom Abundance

Oceanic



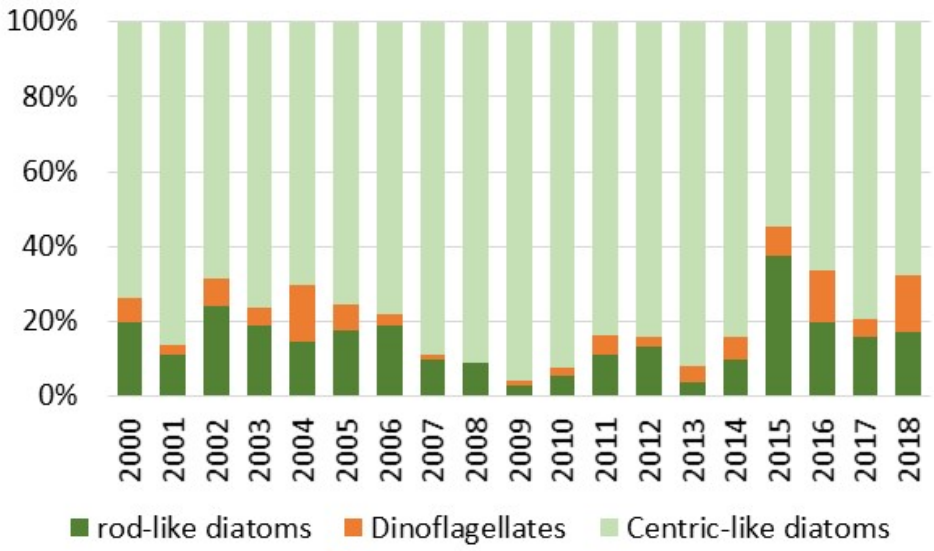

Shelf




Numbers were low in the heat wave years in both regions, shelf more so than ocean, then very high here in 2017 and 18.

# 2. Phytoplankton Coarse Community Composition

Oceanic

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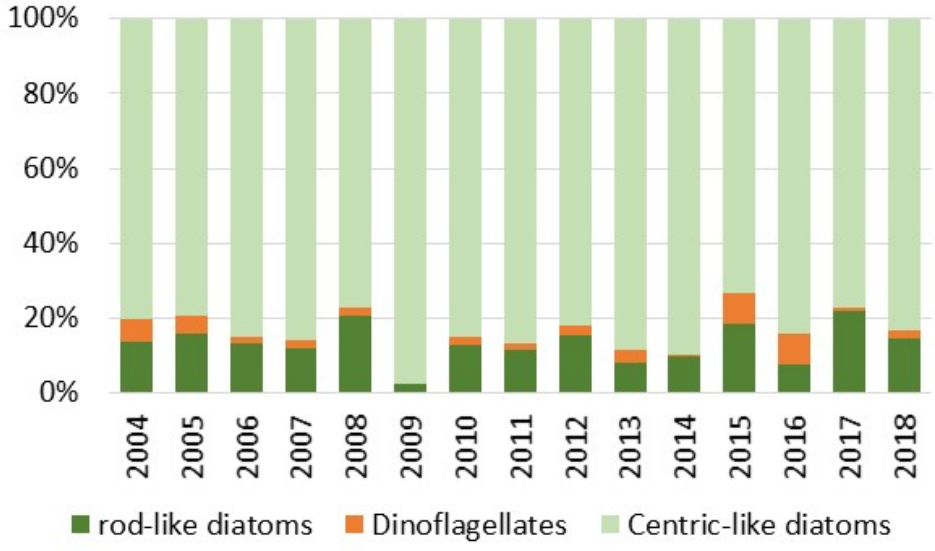
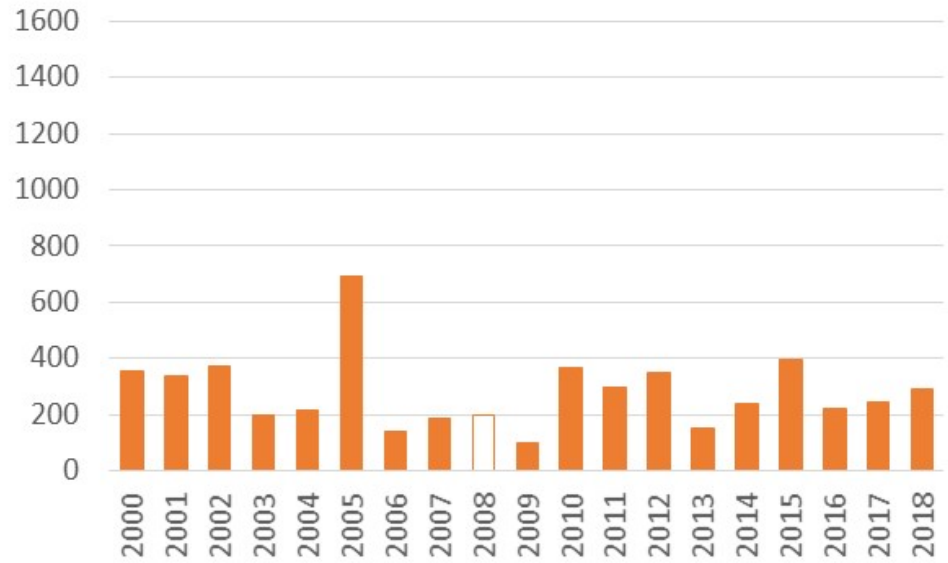


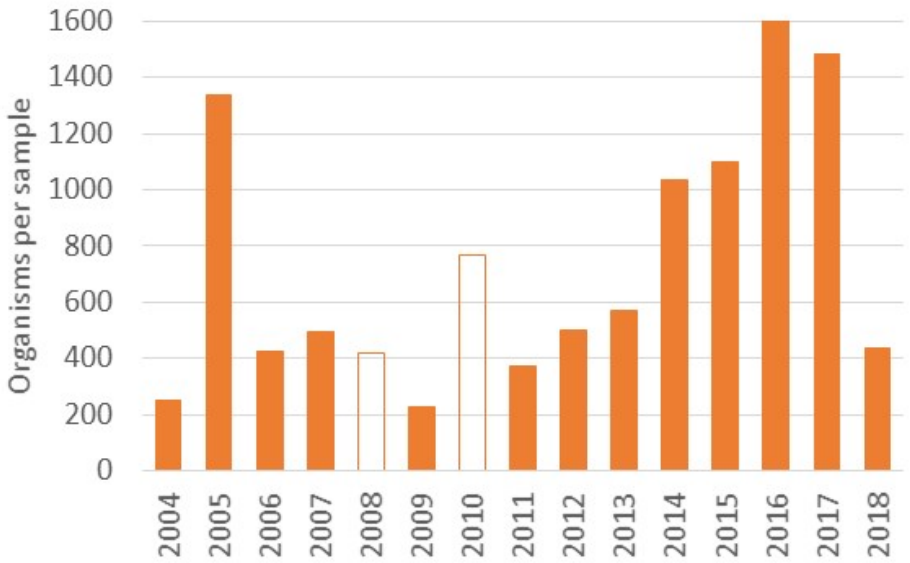

- Centric-type diatoms always dominate CPR counts
- Dinoflagellates relatively more abundant in warm years
- Proportion of rod-like diatoms higher in warm years, especially 2015 (both regions) and 2016 in the ocean. Still relatively high in 2017/18, suggesting low nutrient conditions.

# 3. Bulk zooplankton – Total Abundance

Oceanic



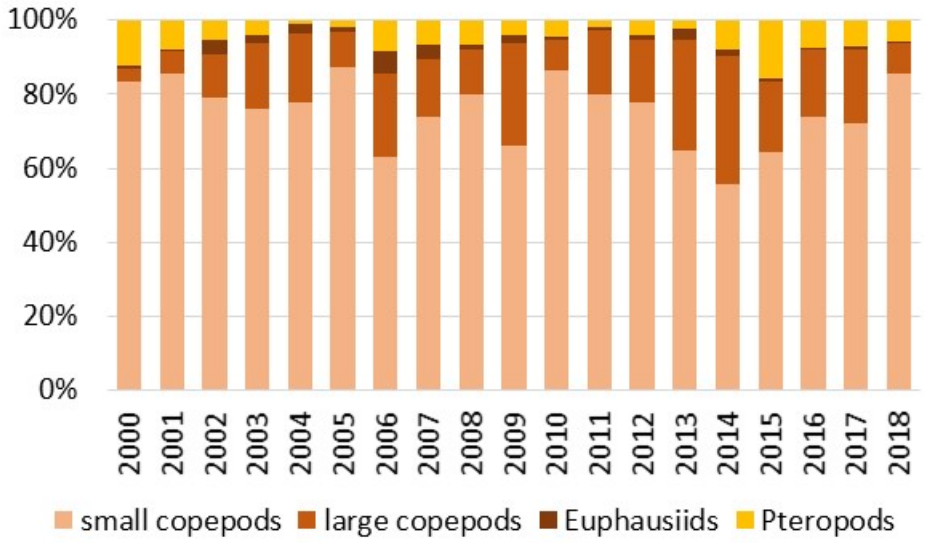

Shelf



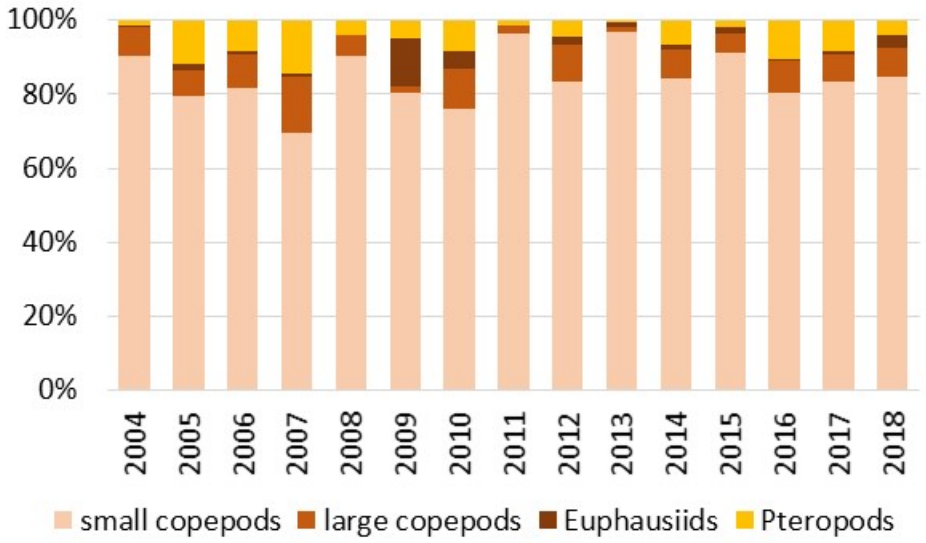

- In the oceanic region, numbers were a little lower than average in the heat-wave years but not exceptional
- On the shelf numbers were much higher, and remained high in 2017.

# 4. Zooplankton - Coarse Community Composition

Oceanic




Shelf

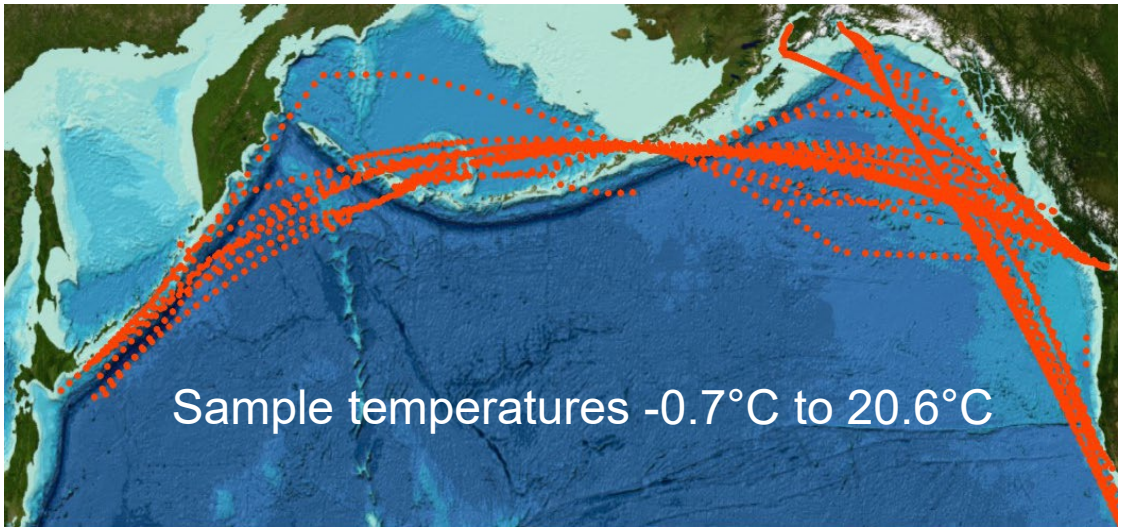



- Small copepods always dominate CPR counts, especially on the shelf.
- No dramatic changes in relative proportions of the main groups (subtle changes only). But high numbers on the shelf in 2014-16 mean that most were small copepods.

# Community Temperature Index (CTI)

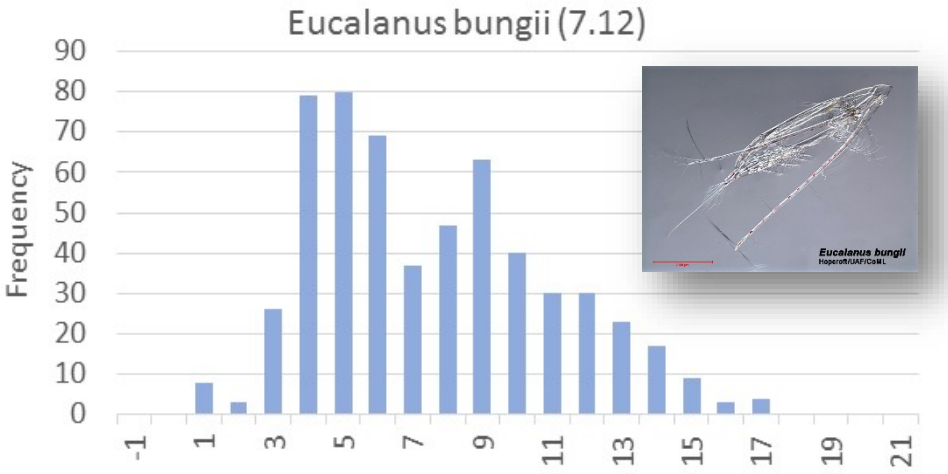
- Uses the maximum taxonomic resolution we have
- Reveals changes in species distribution that influence the overall local community composition.

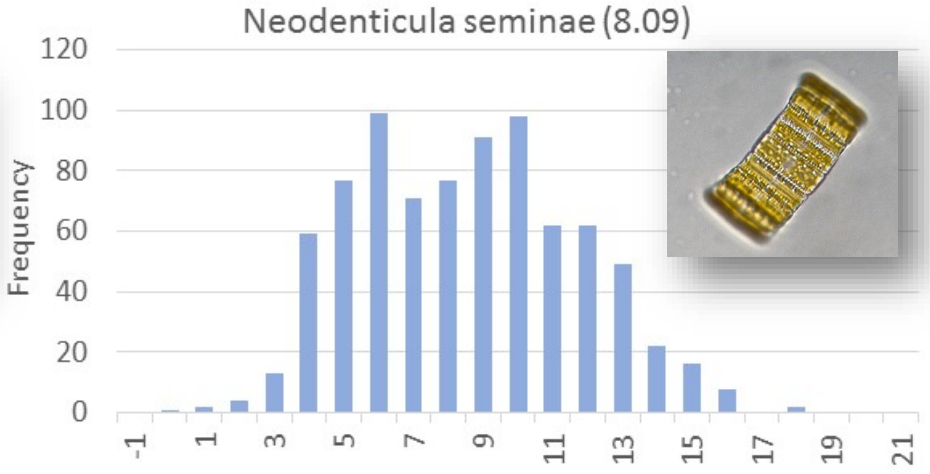
Many of the CPR tows record in-situ temperature: 3,133 samples with T and plankton counts, 2000 to 2014, across the whole N Pacific:

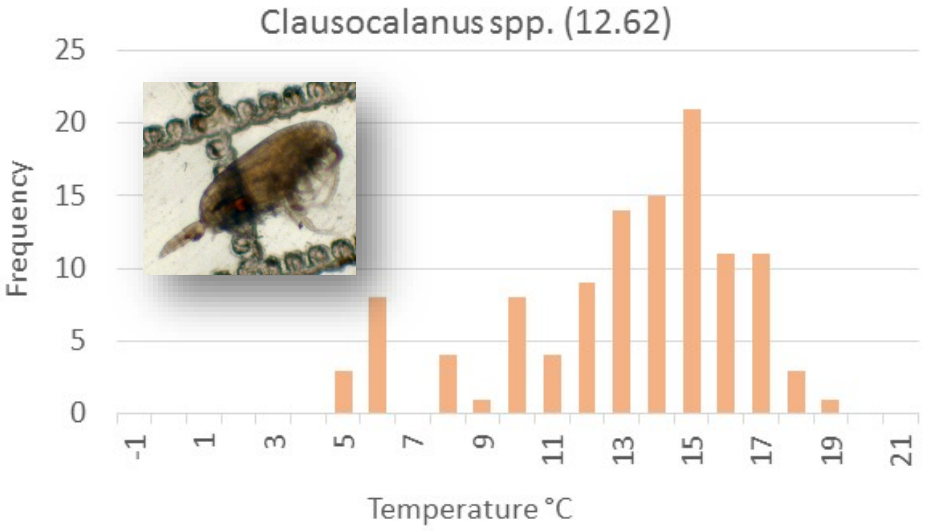


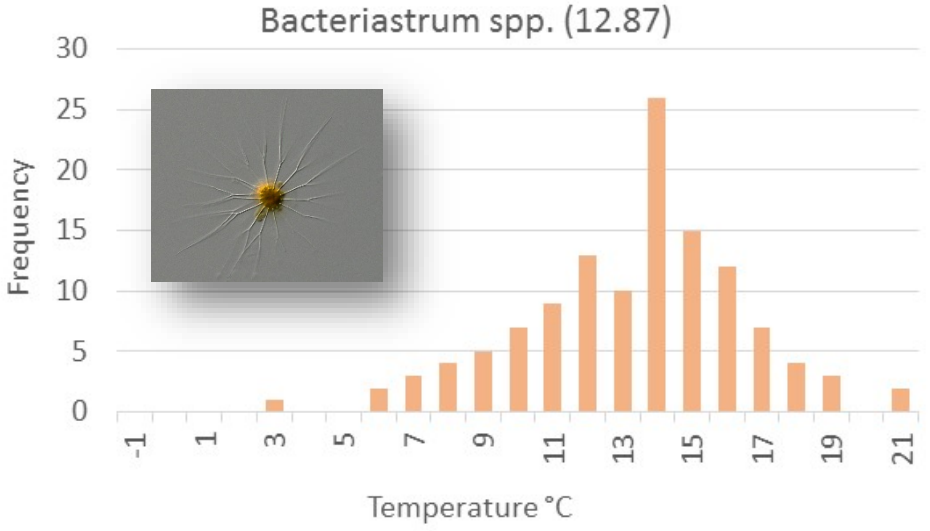

Species temperature index (STI) then calculated for each taxon occurring in the Gulf of Alaska samples

# Examples of temperature profiles and STI for two copepods and two diatoms:



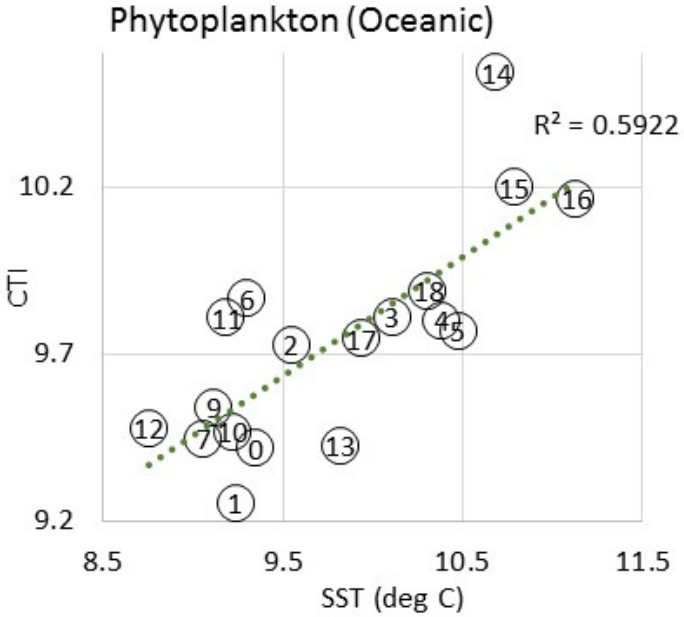



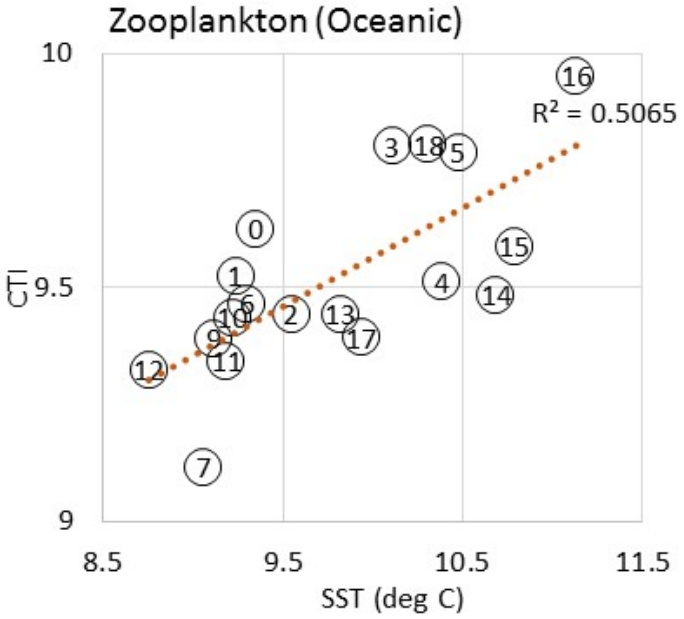
# Mean annual local CTI: Oceanic region



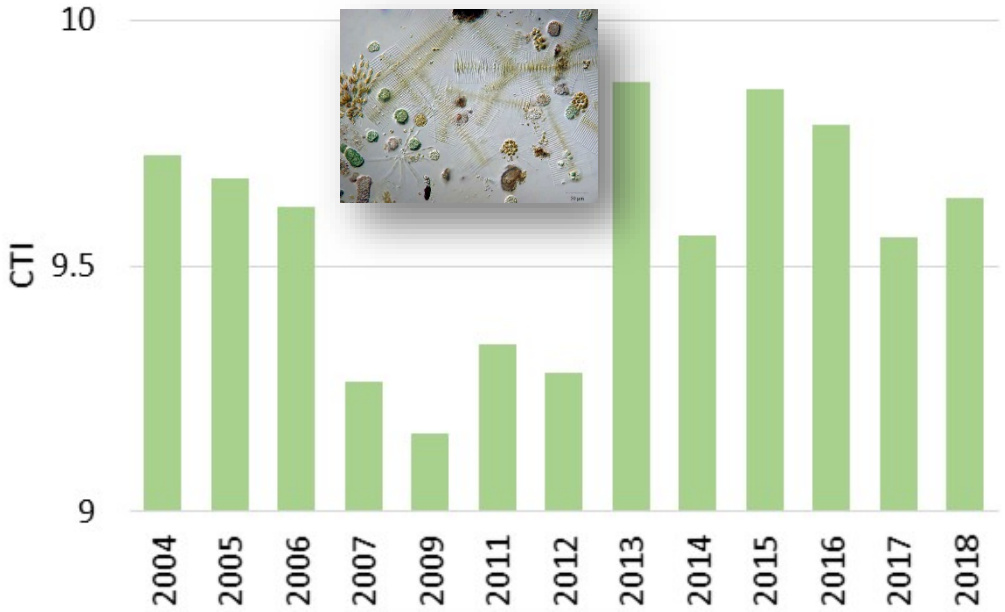



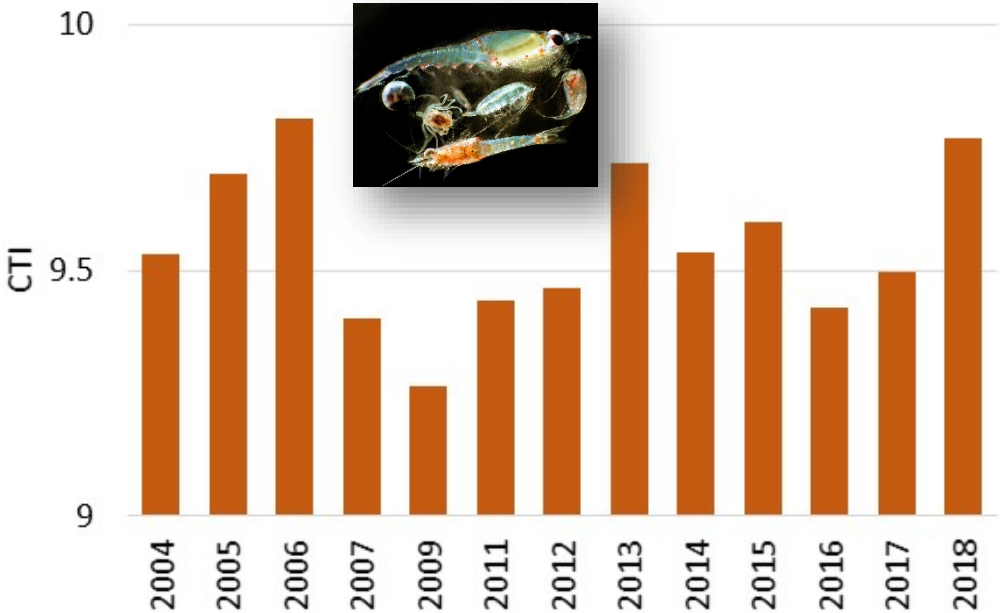


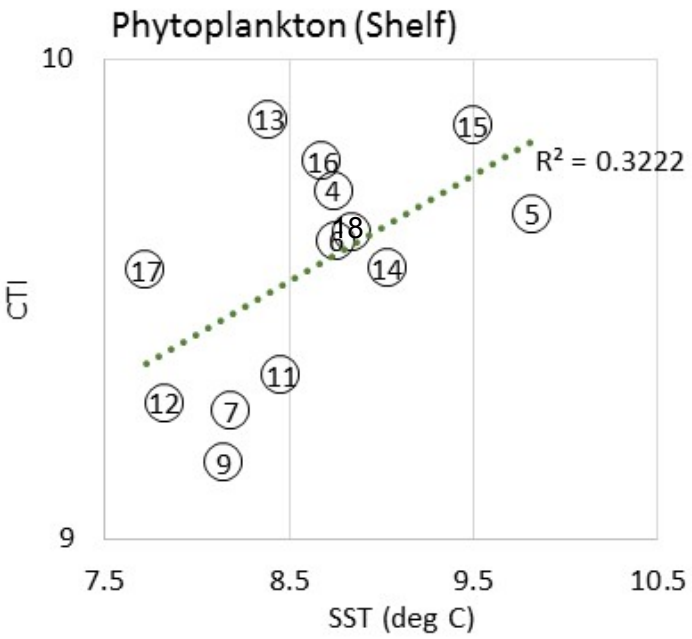


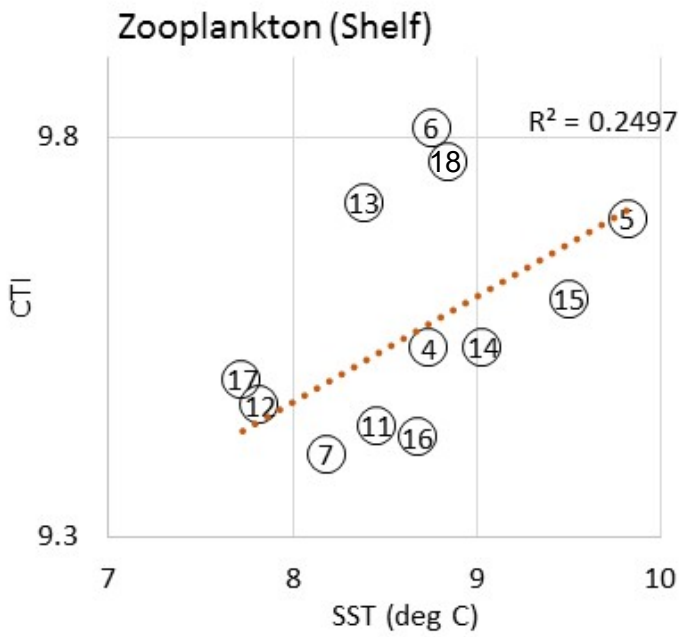


# Mean annual local CTI: Shelf region



# Shelf v Ocean….

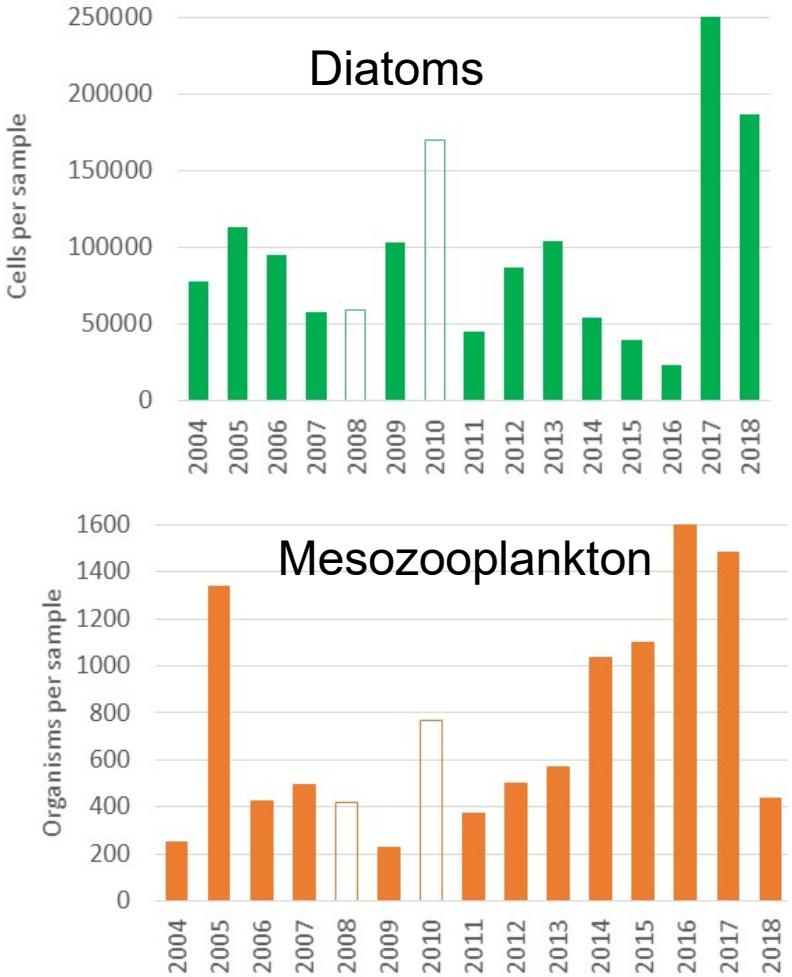
What's the same in both regions?

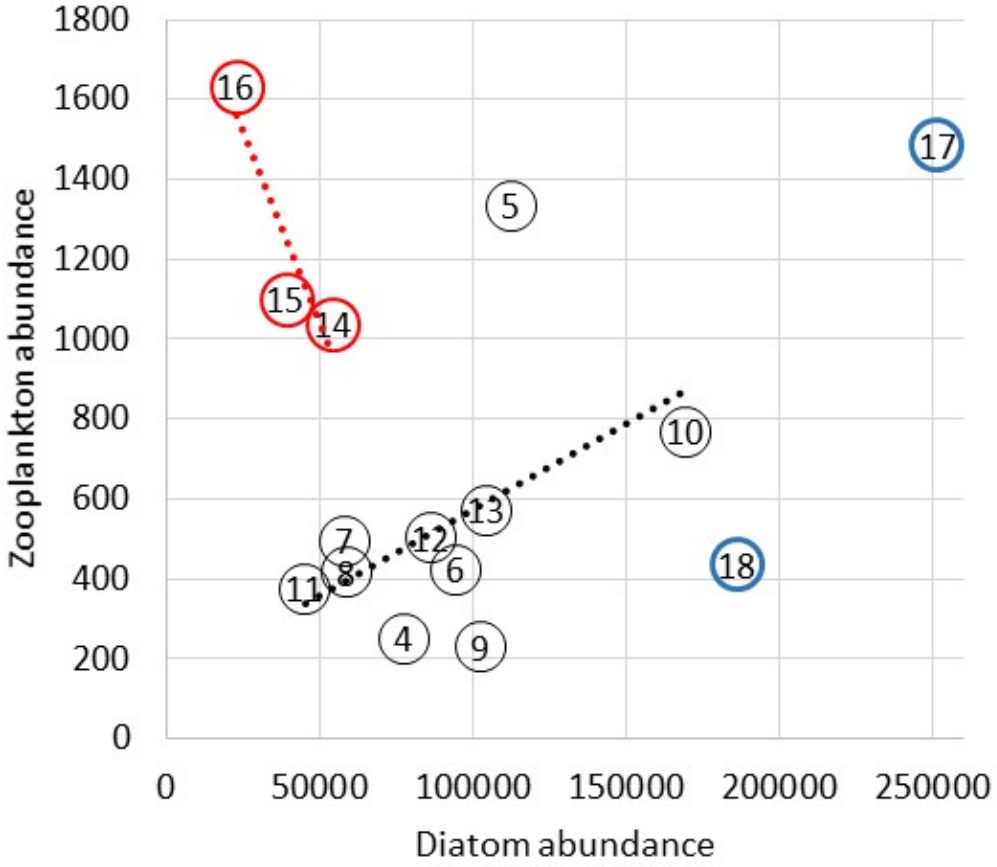
1. Rod-like diatoms made up more of the community during HW and diatoms lower in abundance during HW (suggests lower productivity)
2. Phyto CTI higher in HW years – warm water species increased
3. Zoo CTI higher in HW years – warm water species increased

What's different?

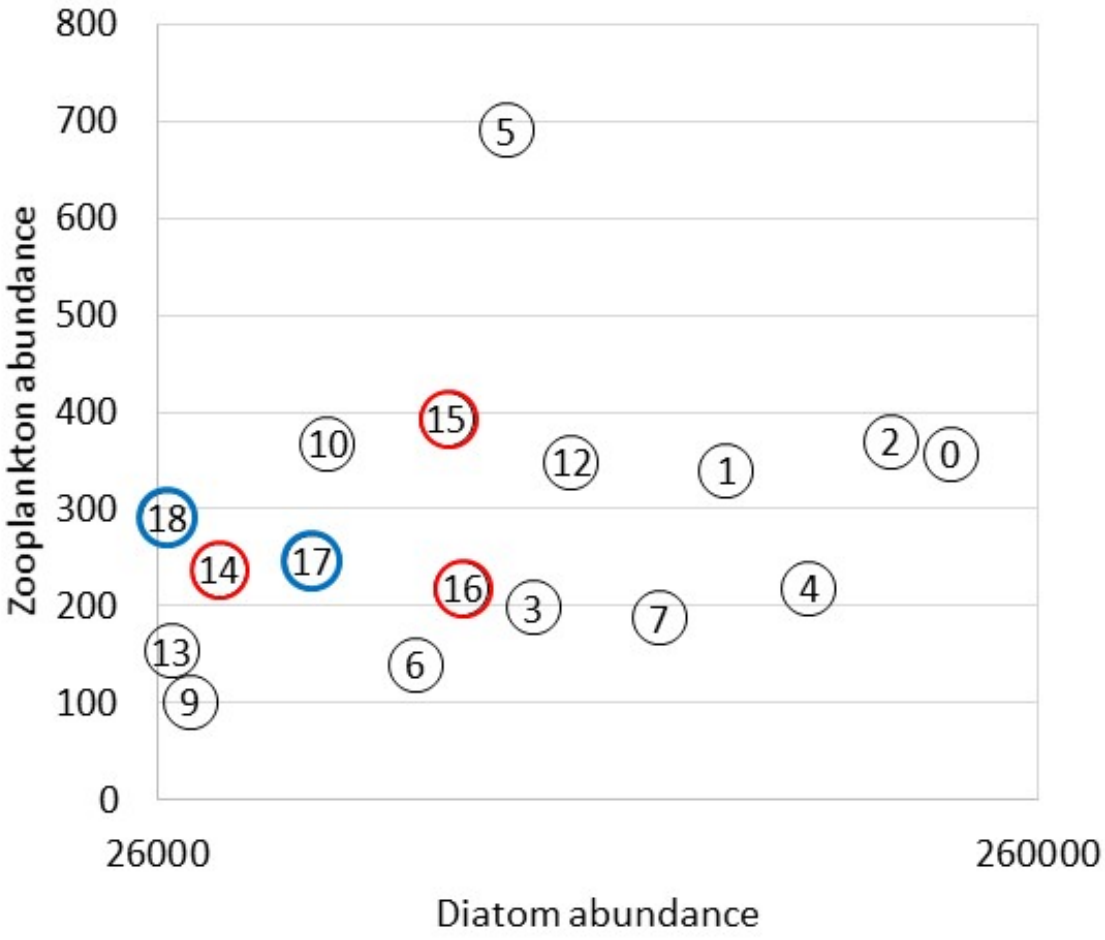
1. Offshore we see low diatoms AND low mesozooplankton during HW (suggests low productivity and bottom up)
2. On the shelf, zooplankton numbers were high during HW and into 2017 (dominated by small copepods) but diatoms were low during HW (top down?)

# Switch from bottom-up to top-down on the shelf?



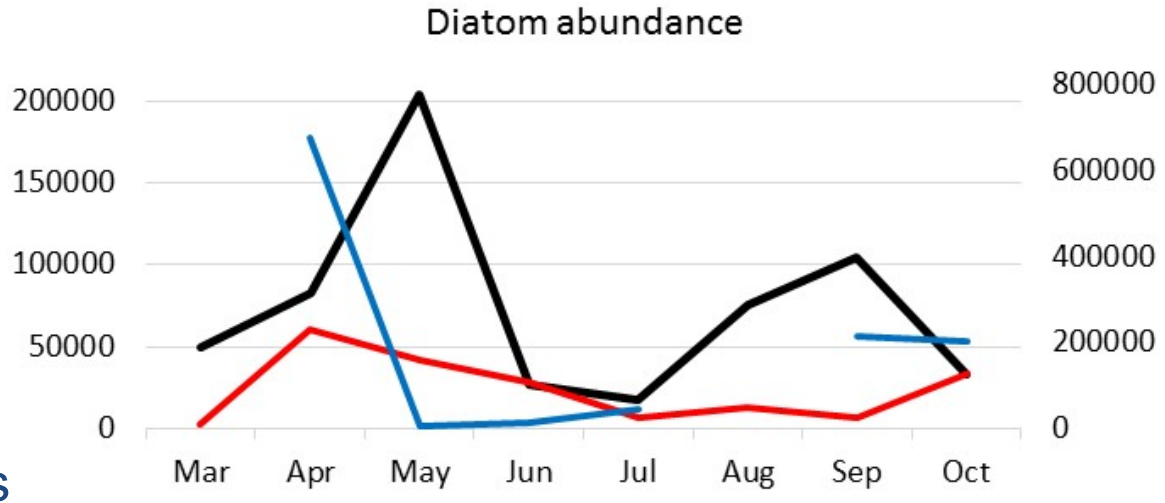
# The oceanic relationship between diatoms and zooplankton. HW and post-HW years low and not unusual

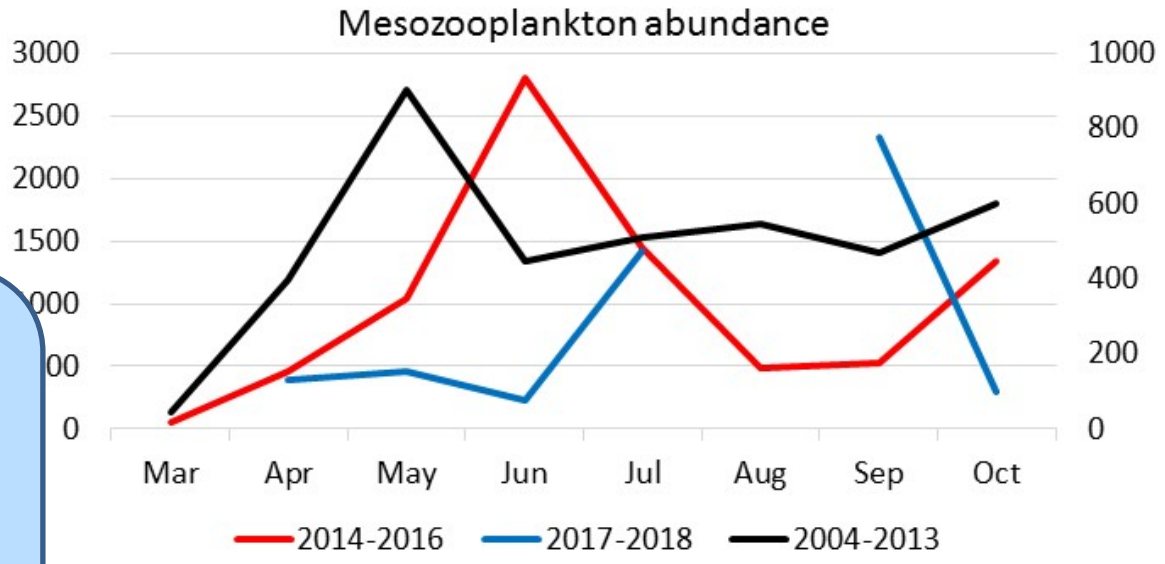


# Seasonal Timing?

Pre-HW diatom peak is May/Aug-Sept
Post HW peaks are less clear, but April/Sept-Oct

Pre-HW, zooplankton peak is May
During HW peak is June, post HW its July/Sept

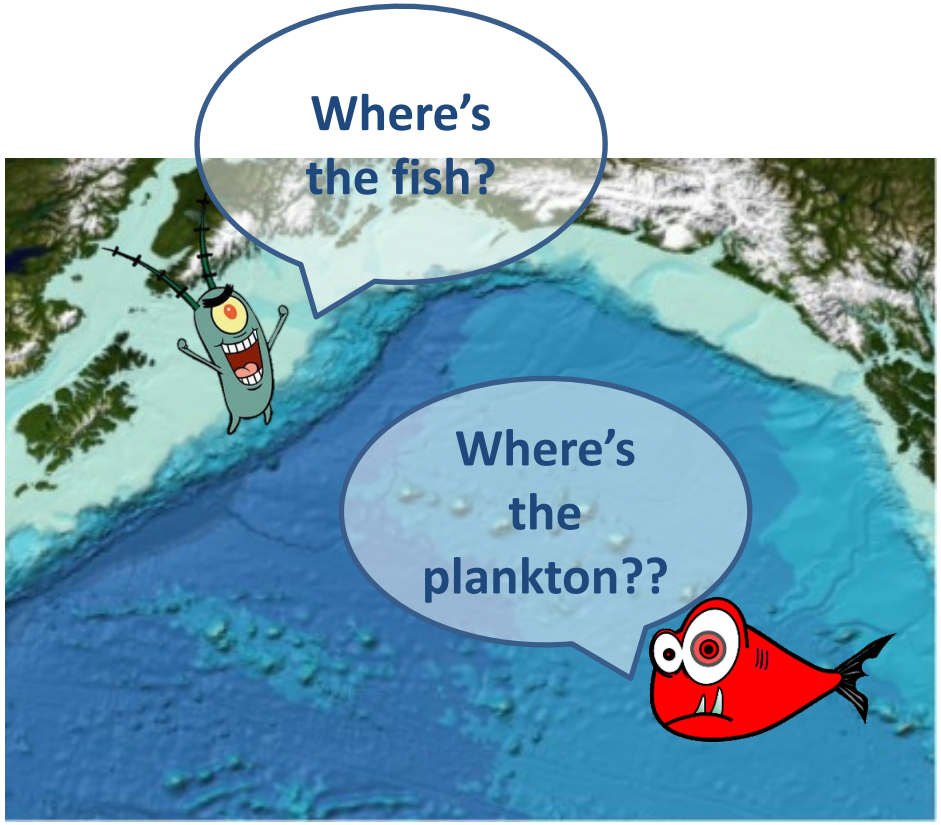



So - Absence of predation by fish in summer?
More generations because of early diatoms and warmer temps?

# Conclusions


- Yes, the heat wave affected the lower trophic levels, and no, things are not back to the way they were.
- Quantity and "quality" were both affected.
- While bottom-up processes seem to be driving the offshore plankton, a switch to top-down processes and changes in timing seem to be driving the shelf plankton.



***Thank you to:***

***The volunteer ships and shipping companies***

***Analysts who work at the microscopes***

***Kinnetic Labs in Anchorage***

***Funders and Pacific CPR consortium members:***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