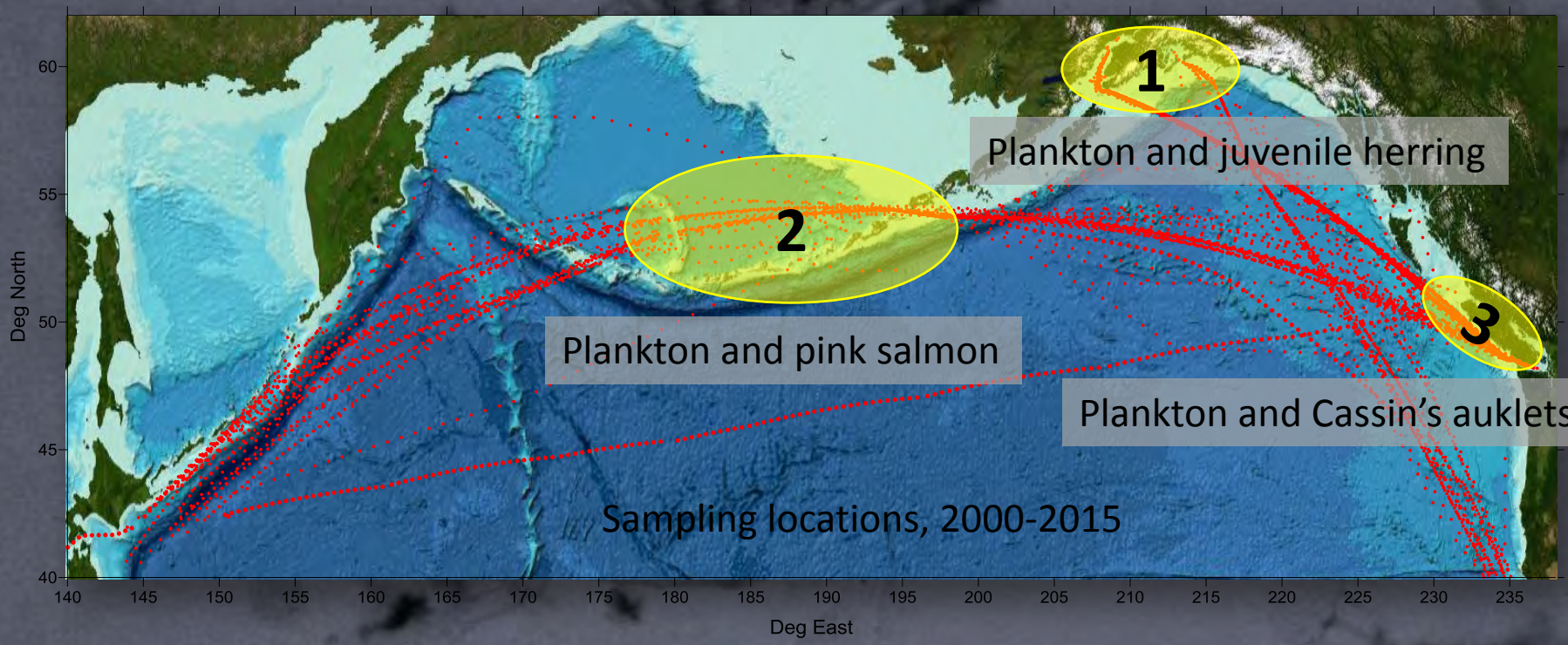
A comparison of trophic linkages across the PICES region, based on Continuous Plankton Recorder data.

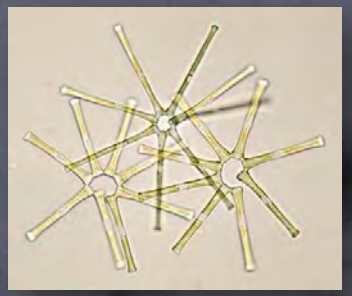
Sonia Batten, Mark Hipfner, Steve Moffitt & Scott Pegau

Continuous Plankton Recorder sampling



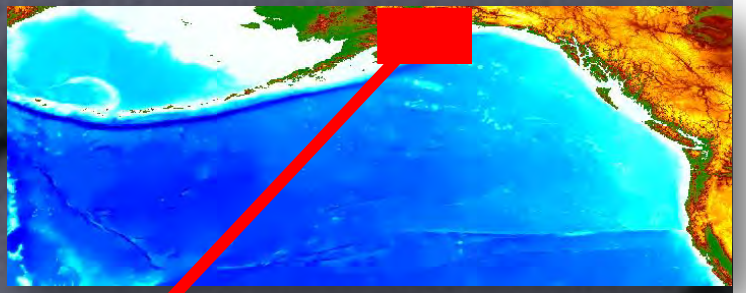
Lower Trophic Level Data from the CPR are:

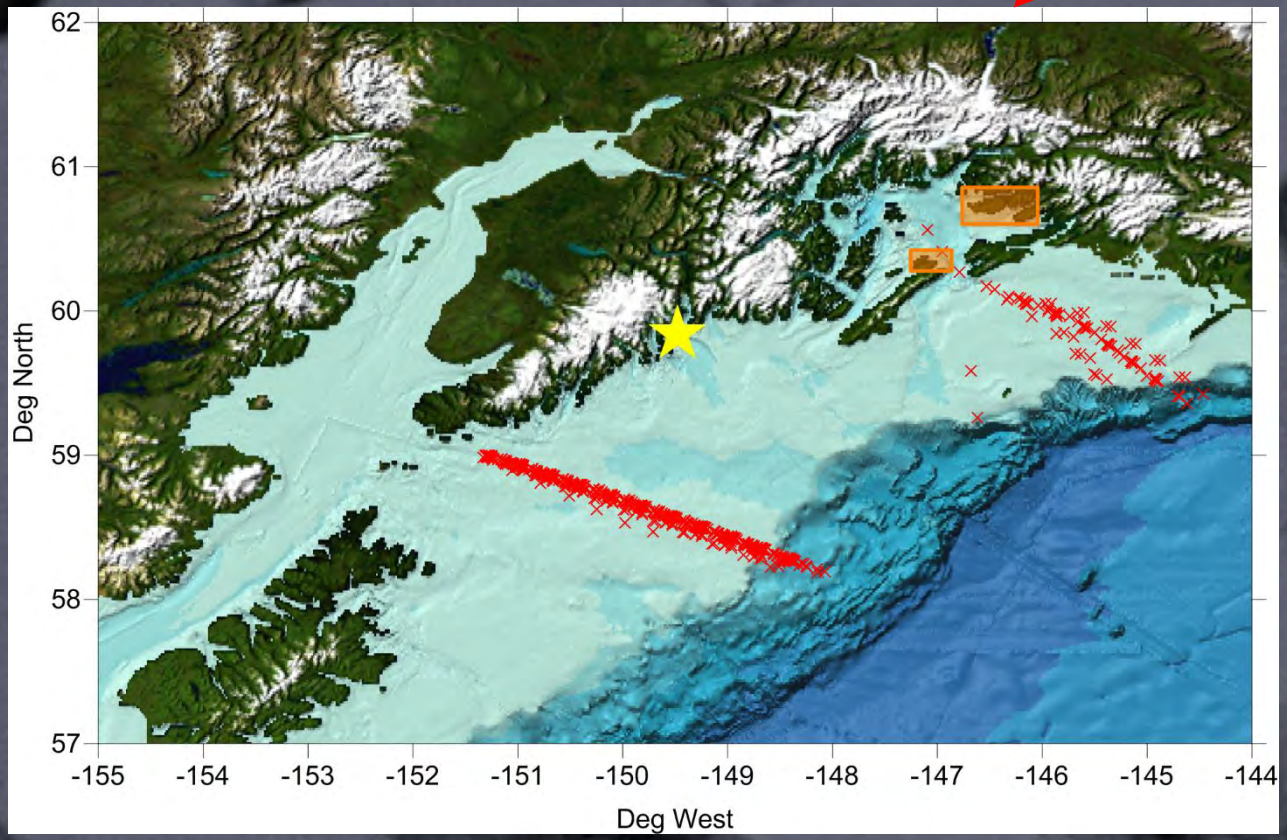
- Consistently sampled across the region, 2000-2015
- Seasonal, taxonomically resolved abundance information for:
  - Larger, robust phytoplankton cells



  - Hard-shelled microzooplankton
  - Robust mesozooplankton (especially crustaceans)

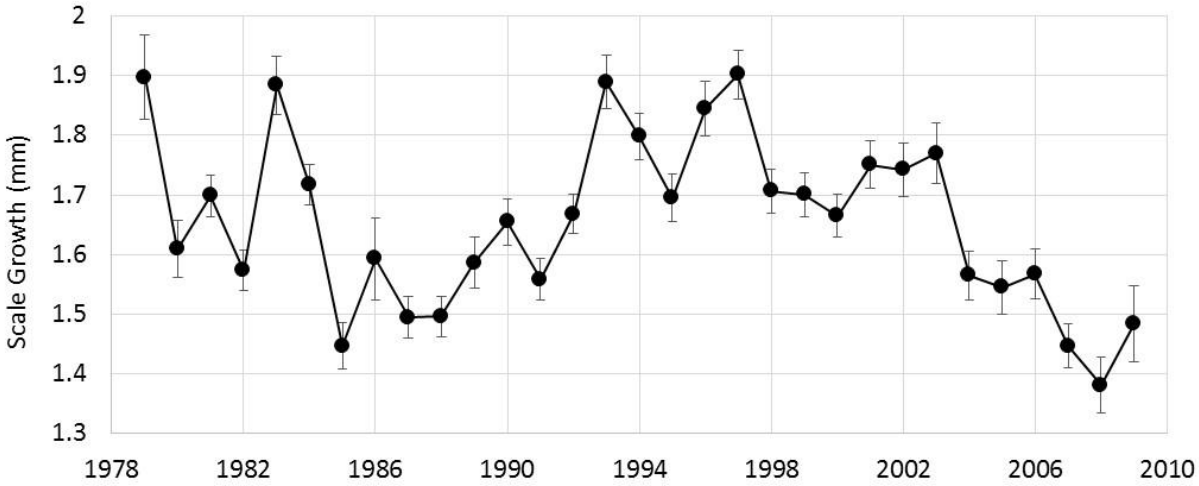
1. Plankton and juvenile herring.

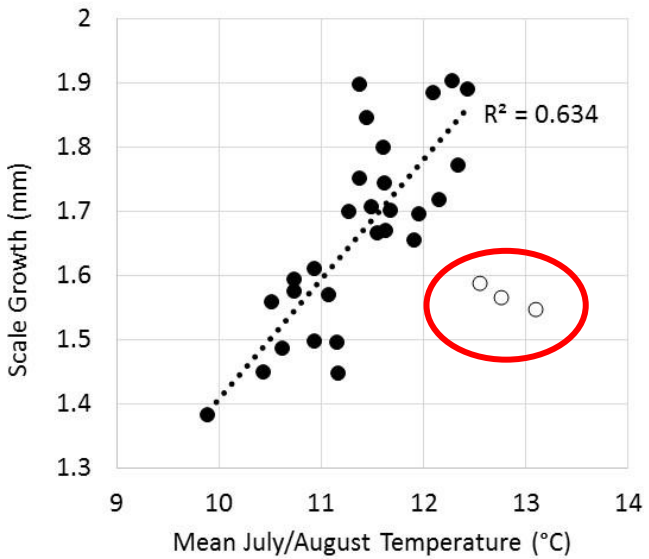




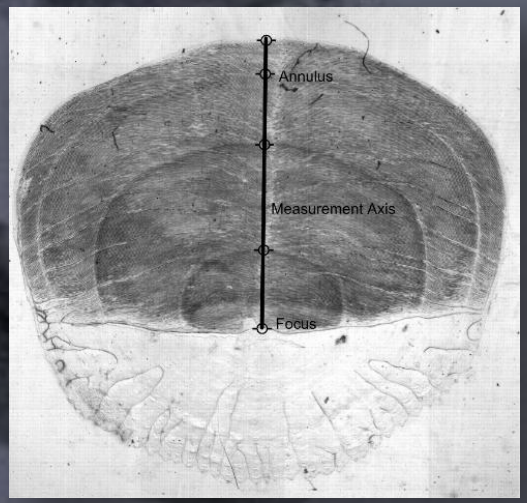
Red X indicate CPR samples, which represent wider shelf productivity
Orange boxes indicate the location of herring sampling in PWS

1. Plankton and juvenile herring.





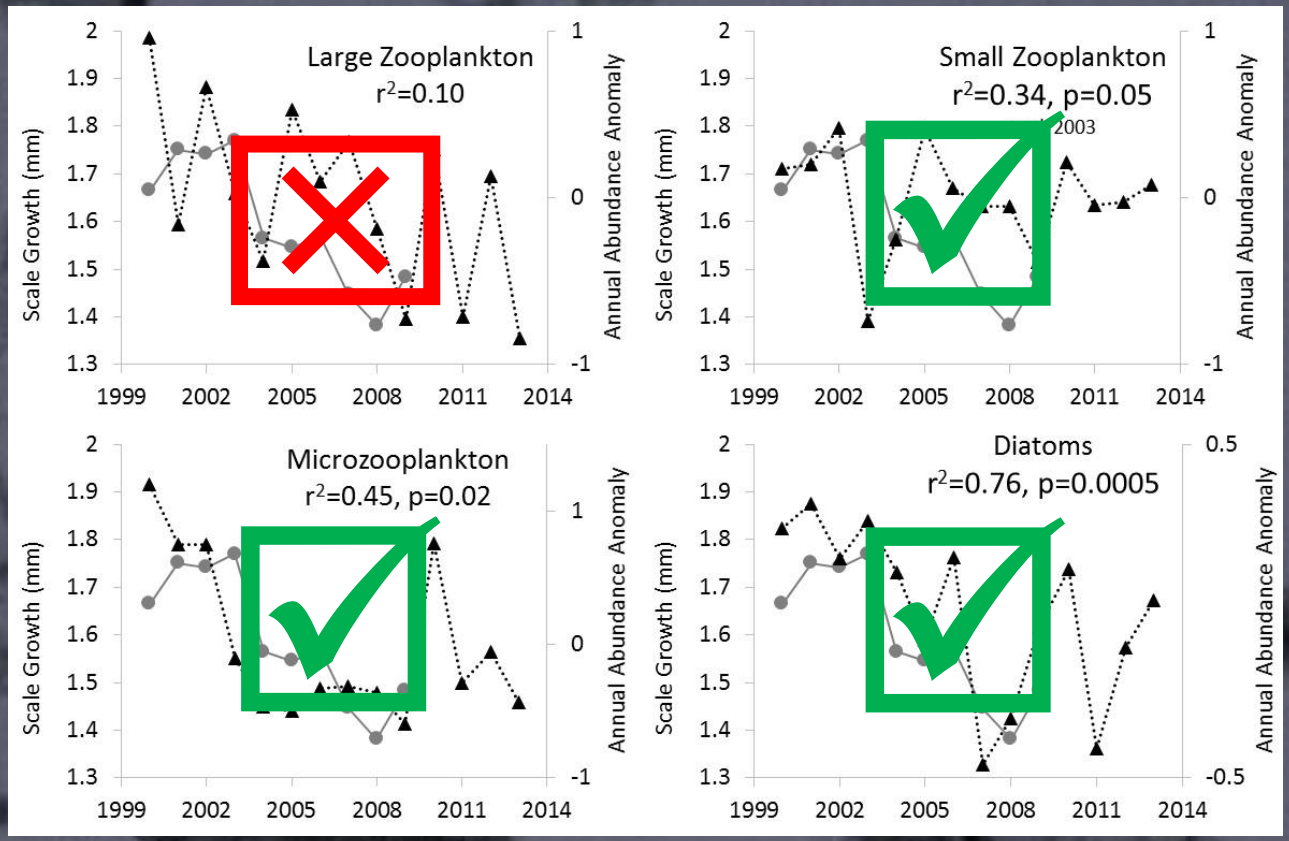
A time series of first year herring growth was generated from scale measurements of 4-6 year old fish (Moffit)



There was a good relationship with temperature, except in the 3 warmest years (89, 04 and 05)

1. Plankton and juvenile herring.

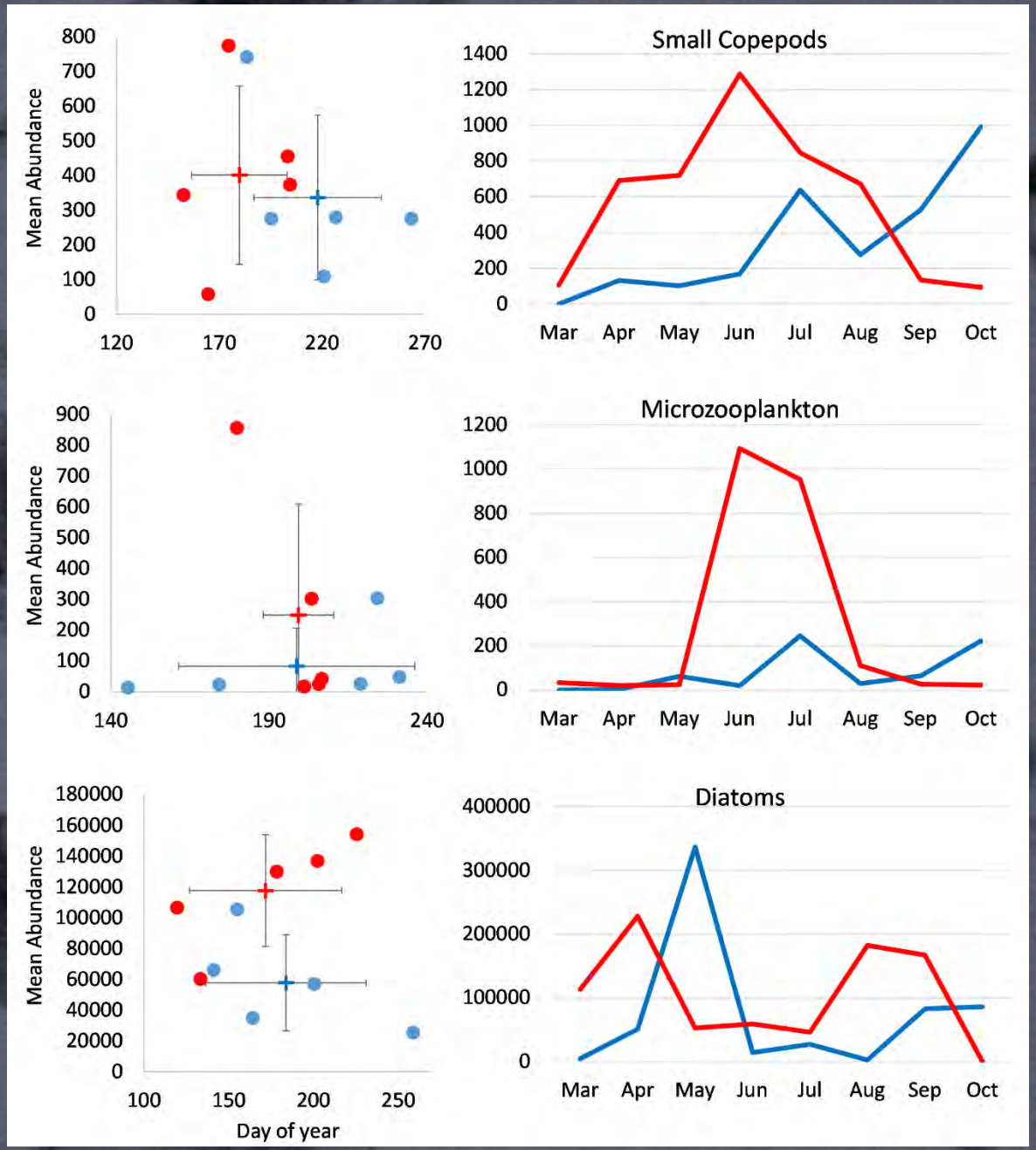
Annual abundance anomalies for groups of plankton were compared with the herring growth data for years where the time series overlapped:



Groups that are known to be in the diet of first-feeding herring correlated significantly, and explained growth better than just temperature.

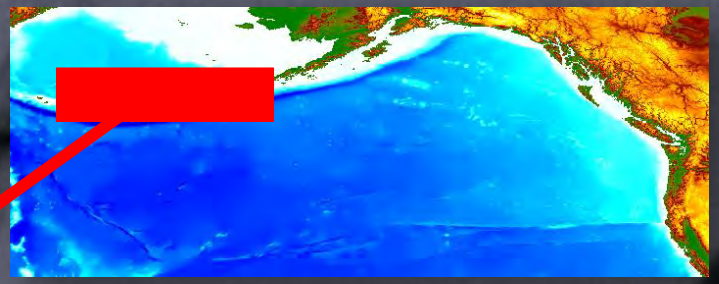
1. Plankton and juvenile herring.

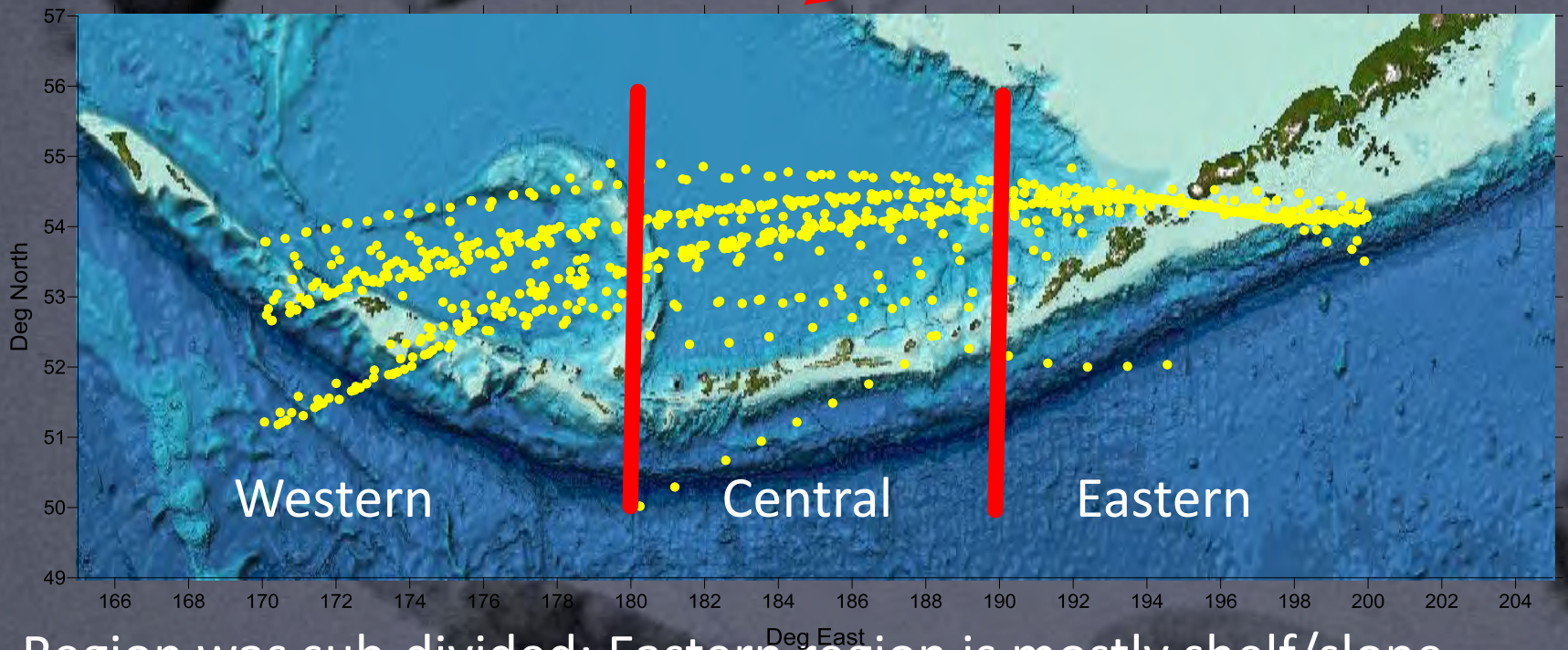
We showed that the timing and/or abundance of the plankton prey differed between warm and cold years (based on the 5 warmest/coldest years of CPR sampling)



Batten et al., 2016. Fisheries Oceanography 25.

2. Plankton and pink salmon



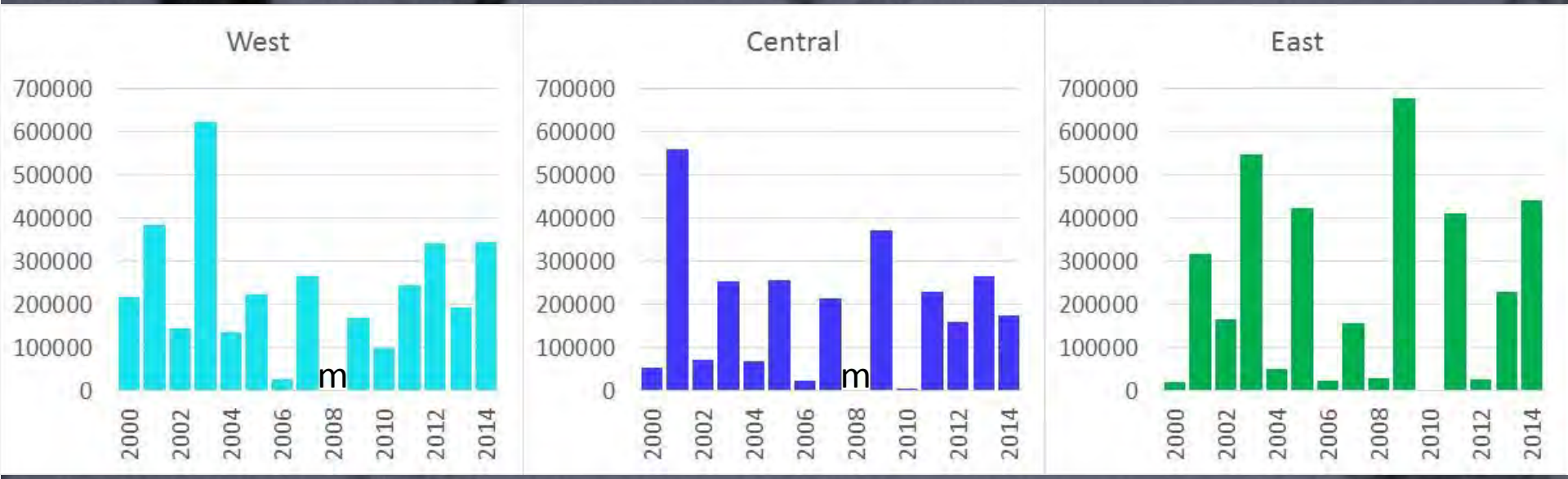


Region was sub-divided: Eastern region is mostly shelf/slope, central and western regions are mostly deep water.

Analysis focused on summer data (June/July) since seasonality less well resolved here, and summer is less affected by weather.

2. Plankton and pink salmon

Mean summer **diatom** abundance

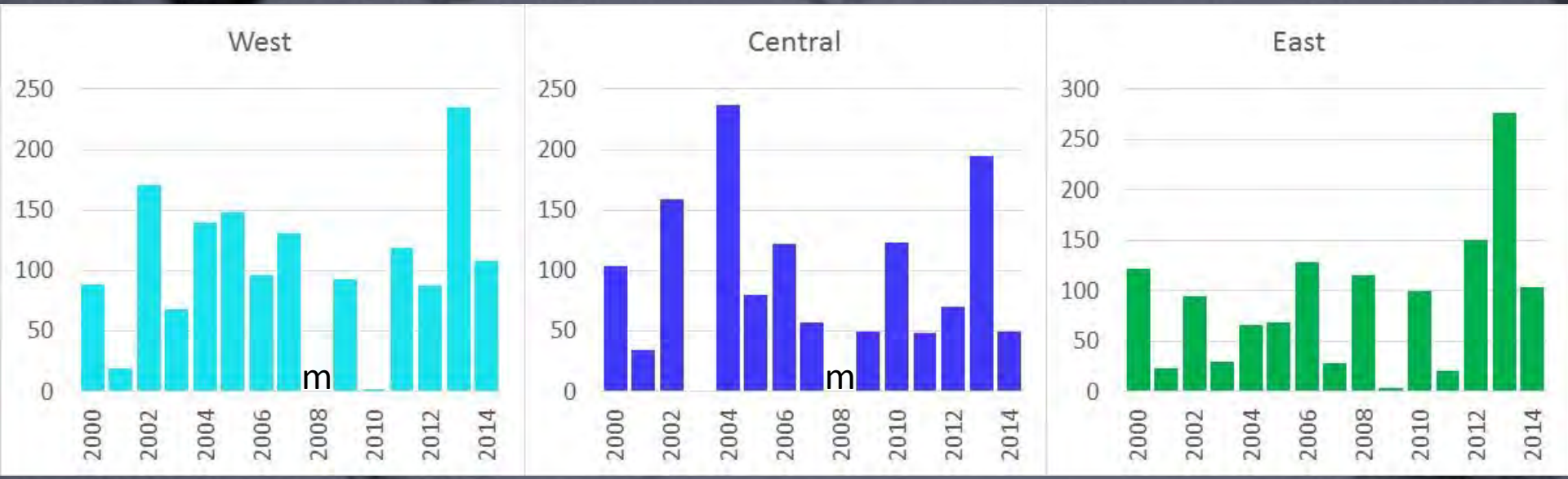


All regions, but especially central and eastern, showed alternating pattern with high abundances in odd years and low in even years, at least until 2012.

m=region not sampled that season.

2. Plankton and pink salmon

Mean summer large copepod abundance

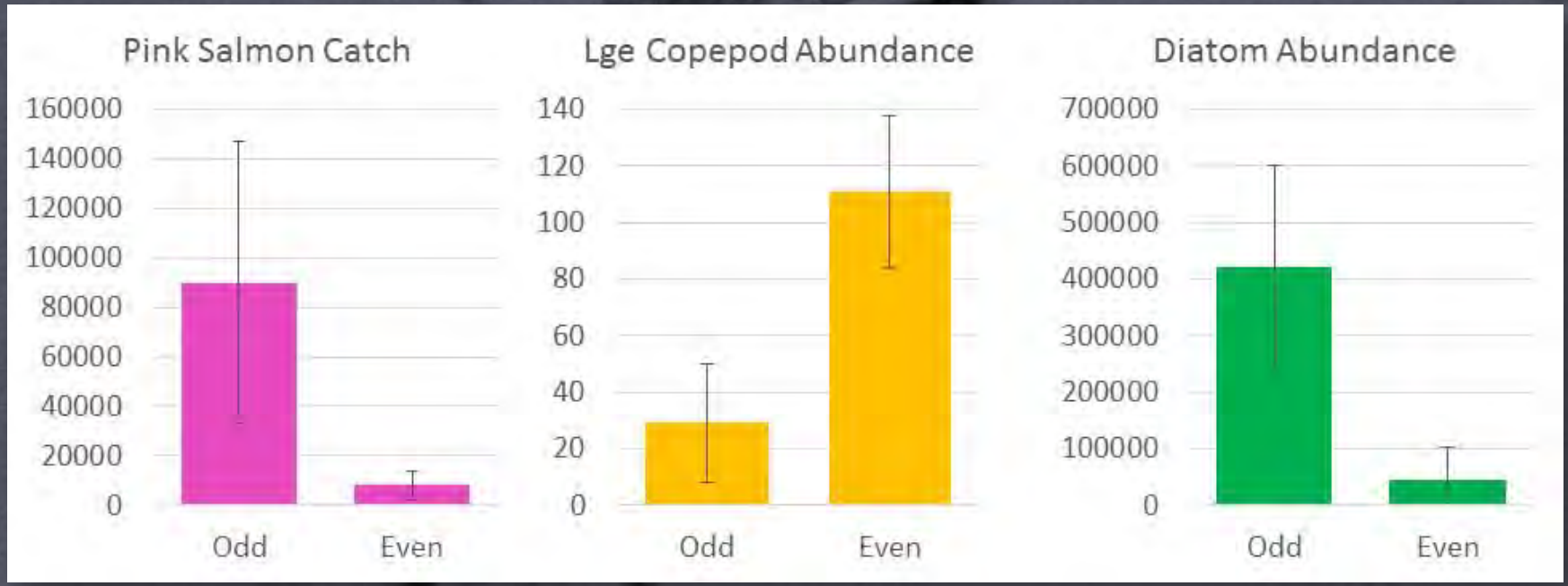


Central and eastern region show alternating pattern, high in even years, low in odd years (opposite to the diatom pattern) again until 2012.

Suggestive of a trophic interaction, with forcing provided by pink salmon (only known alternating pattern)

2. Plankton and pink salmon

Summary for the eastern region, 2000-2012:



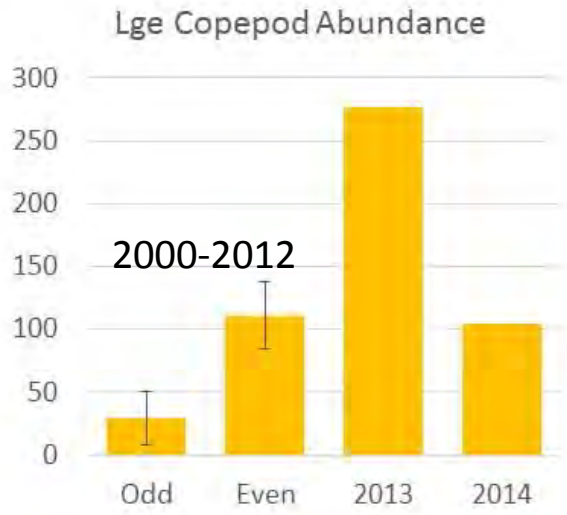
East Kamchatka Pink salmon data from Springer and van Vliet, 2014

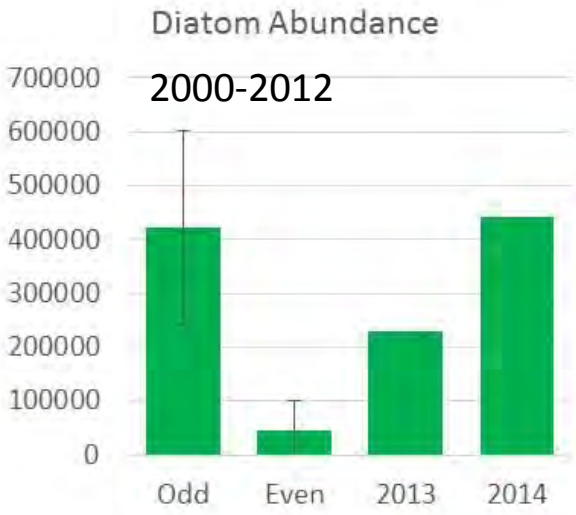
In odd years, lots of pink salmon eat more large copepods reducing grazing pressure on diatoms.

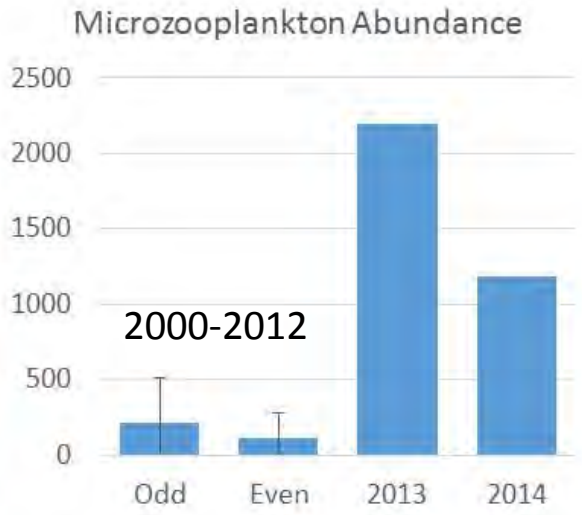
In even years, few pink salmon mean more large copepods are present, with a higher grazing pressure on diatoms.

But what happened after 2012??

2. Plankton and pink salmon





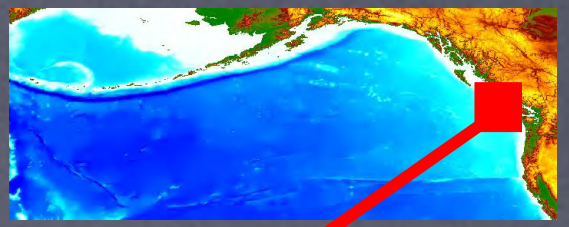


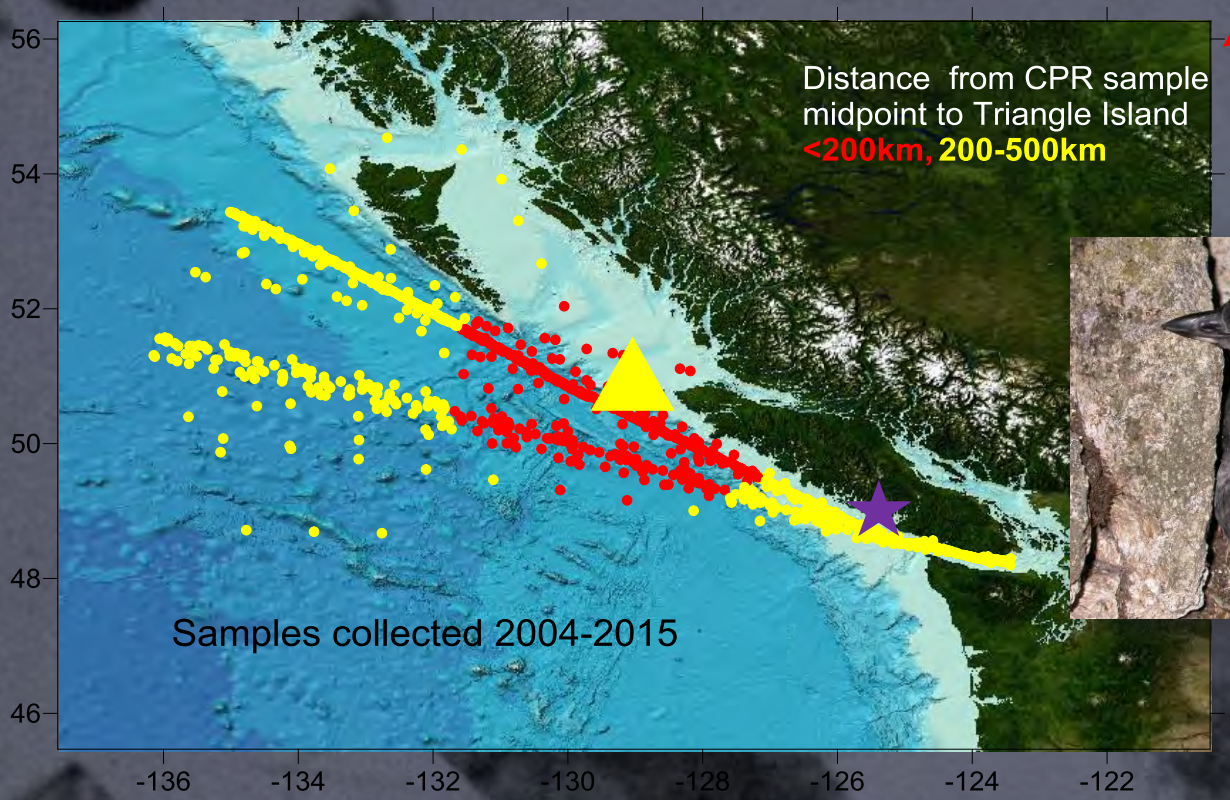
The 2013 run was much lower than expected

Dramatic changes in plankton community in 2013/14, with many large copepods (not predated), and still high numbers of diatoms. Microzooplankton also very abundant. Still need to figure this out….

3. Plankton and Cassin's Auklets

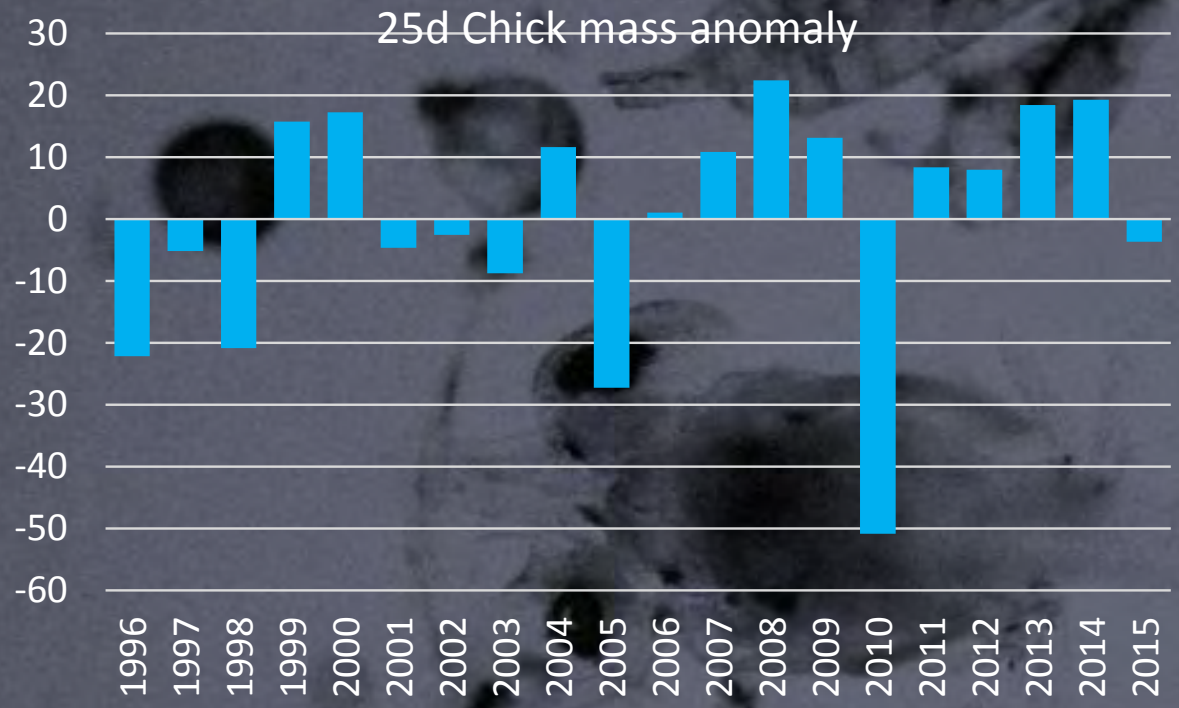
The world's largest breeding colony of this planktivorous seabird is on Triangle Island, BC.





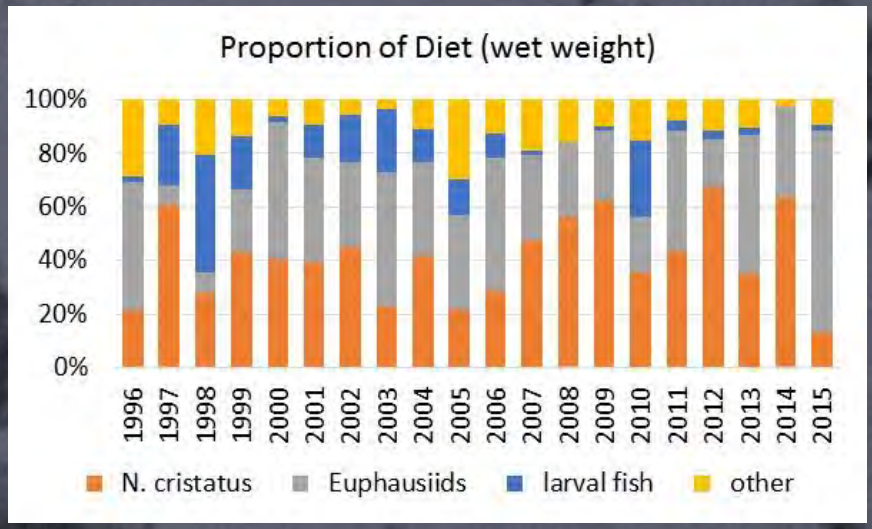
Over 1,200 analysed CPR samples within a 500km radius of Triangle Island, 40% within 200km. ★ - Amphitrite Pt lighthouse data.

3. Plankton and Cassin's Auklets

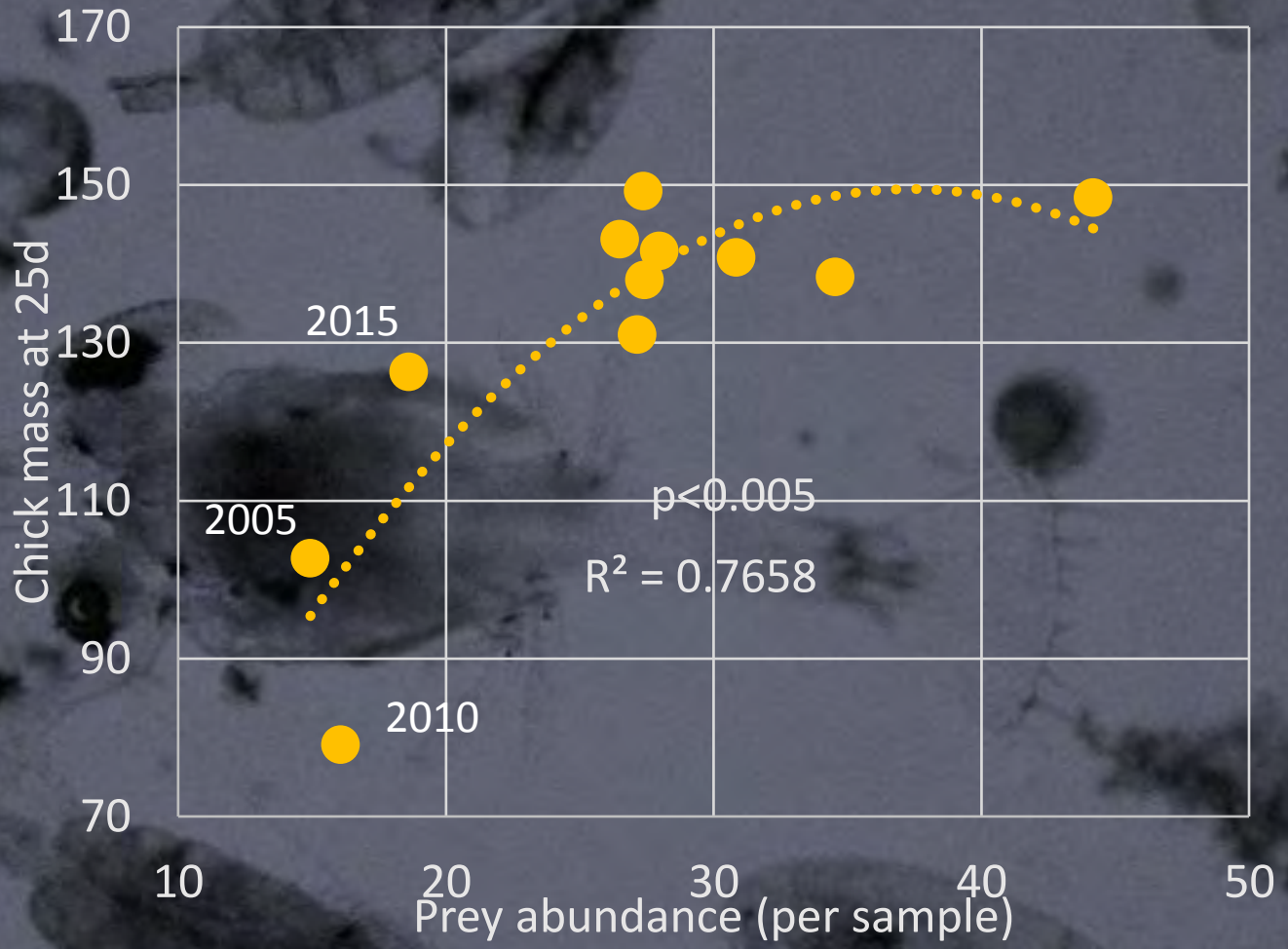


Data from Hipfner: Anomalously low growth years in 2005, 2010 and 2015 (less so)

Diet data showed *N. cristatus* and some euphausiid species to be the main prey.



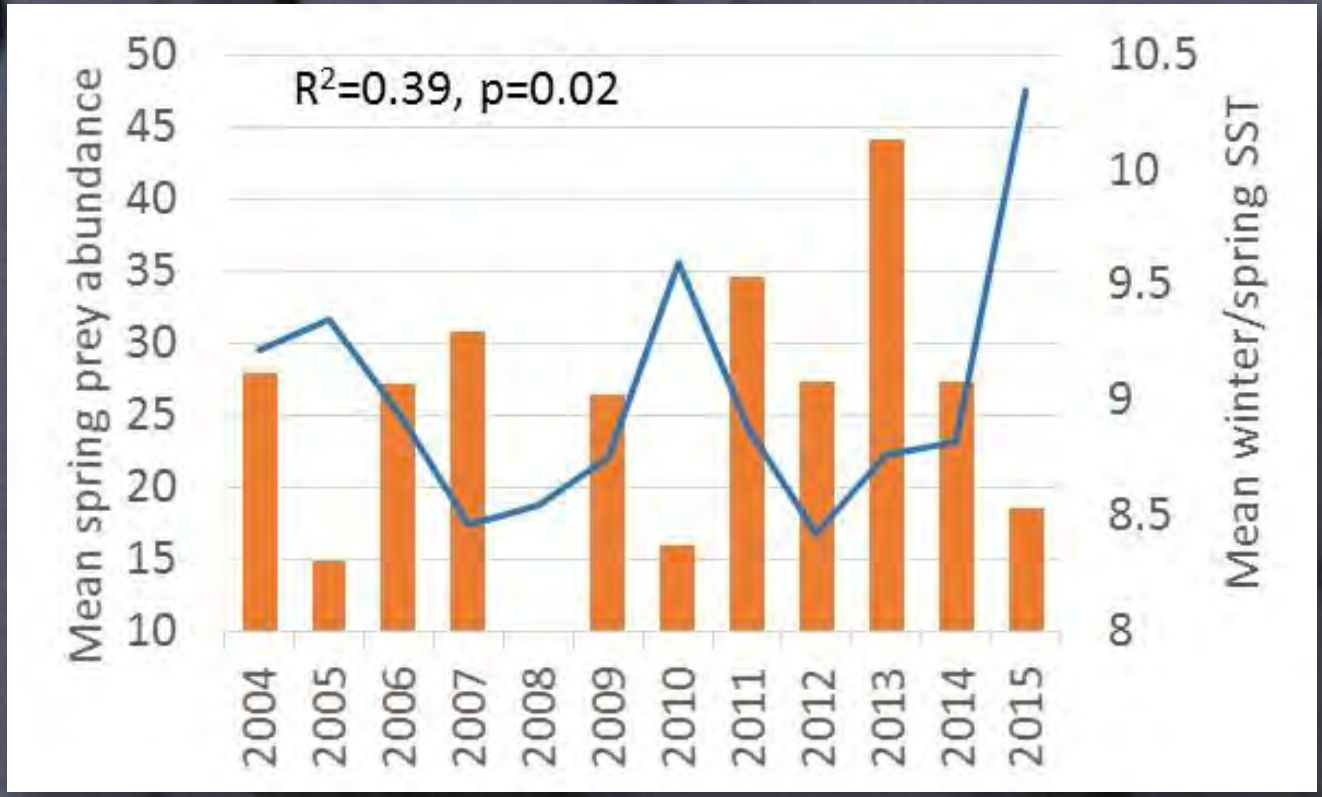
3. Plankton and Cassin's Auklets



The combined abundance of *N. cristatus* and euphausiids, from spring CPR samples, was the best plankton predictor of chick mass

3. Plankton and Cassin's Auklets

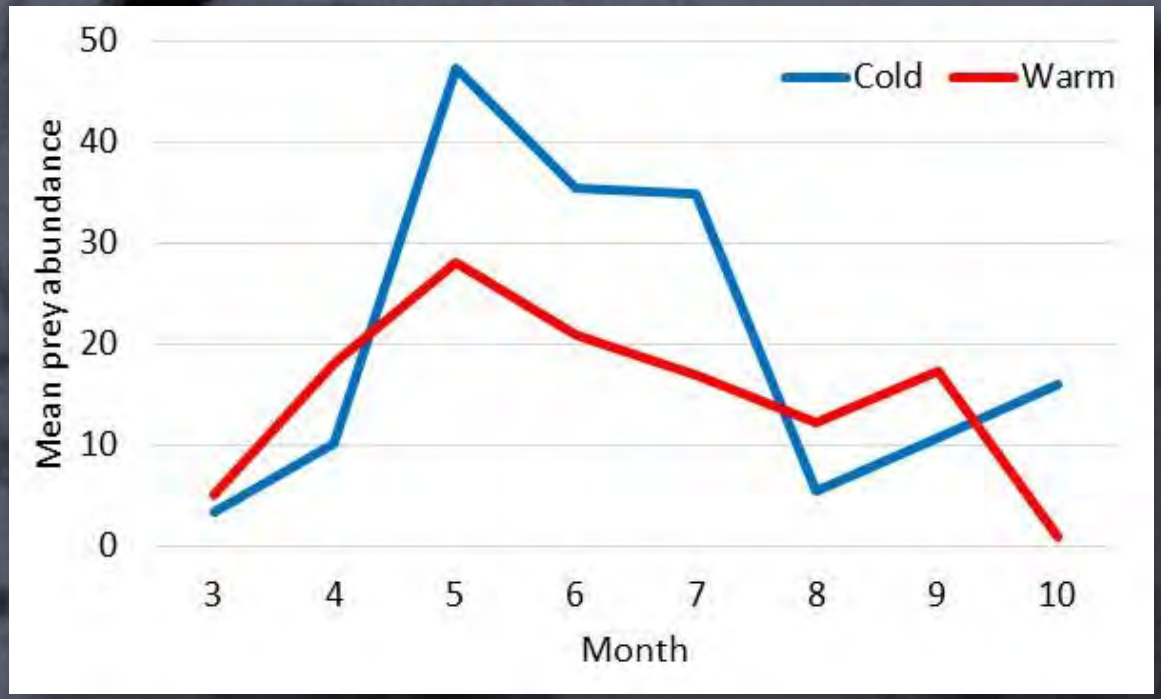
When the preceding winter and spring is warm (Dec-May Amphitrite Pt. data), spring abundance of plankton is low. 2005, 10 and 15 were warm



Its not the whole story, because 2015 should then have had really low plankton, but both prey and chick mass anomaly were only slightly negative.

3. Plankton and Cassin's Auklets

May be some influence of seasonal timing, warmer years appear to have a longer, but reduced season, while colder years have a narrower, more intense peak – perhaps there needs to be a threshold of prey abundance?



Mean seasonal cycle of plankton prey abundance in the 5 warmest and coldest years

Acknowledgements

Thanks to the ships and personnel that tow CPRs,
The microscope hours put in by many people to generate the data.
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