A multi-year census of the zooplankton communities in the Pacific Arctic

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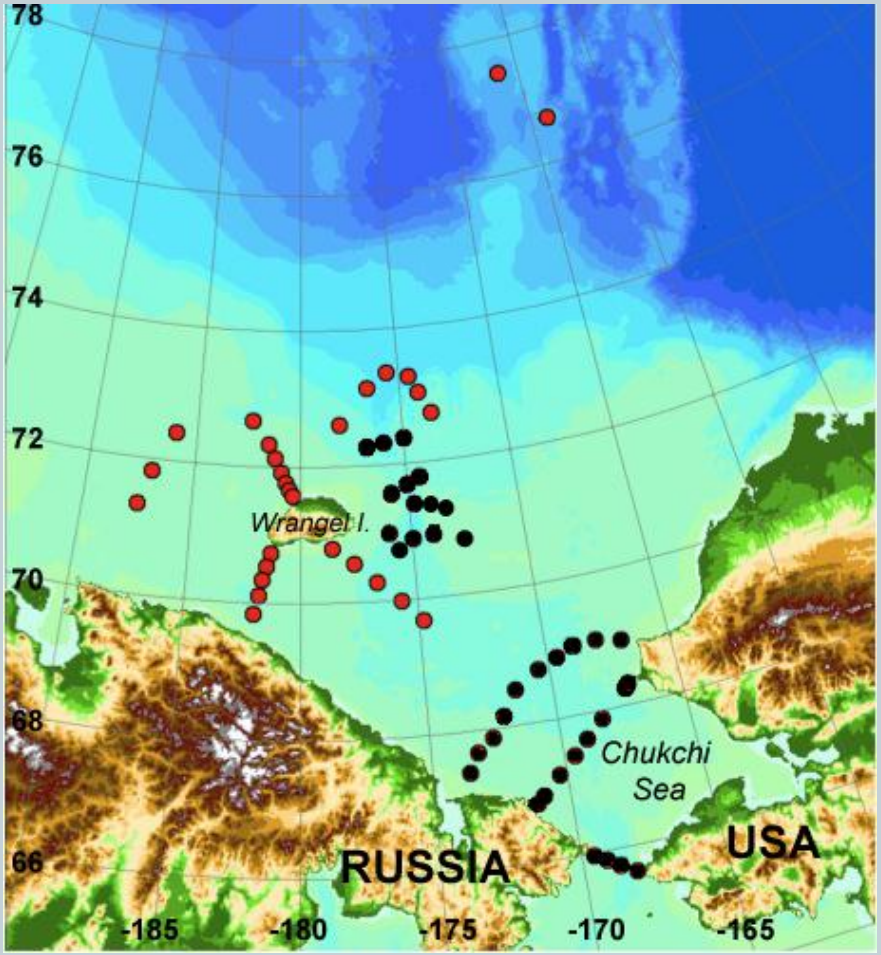
Outline:

- Introduction/approach
- Broad-scale community patterns
- Community structure
- Secondary production
- Inter-annual variability
- Summary

Introduction

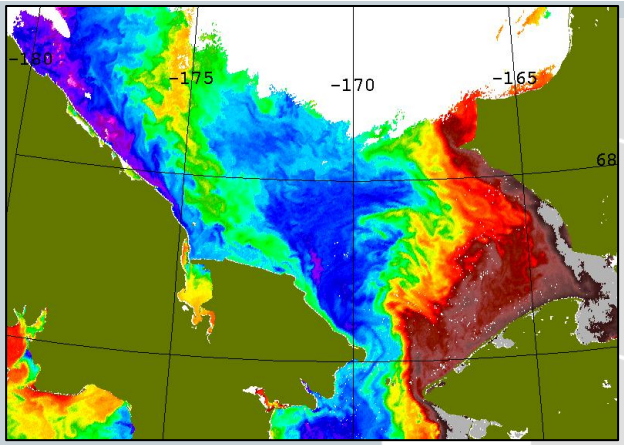
- CHUKCHI SEA
  - One of the most productive Arctic regions
  - The only gateway from the Pacific ocean to the Arctic
  - Delicate regime, which may be sensitive to climate change
  - **Historically, data collection limited to either the Russian or U.S. side of the area – missing simultaneous estimates from both sides of the Bering Strait**

RUSALCA: Russian-American Long-Term Census of the Arctic

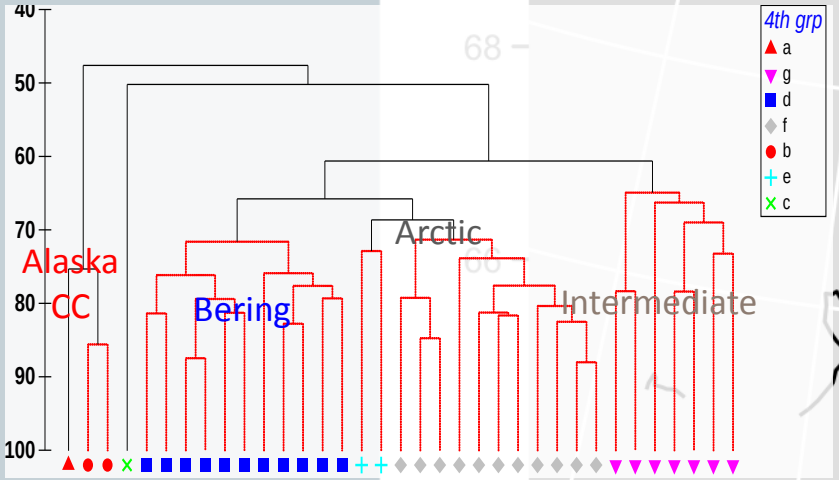


- Stations sampled: 2009 (62), 2010 (12), 2011 (12) using standard equipment (Bo 150 um nets) – compared to 34 stations sampled in 2004
- Reproduction experiments conducted on important genera with both Arctic and Pacific representatives

Zooplankton communities - 2004

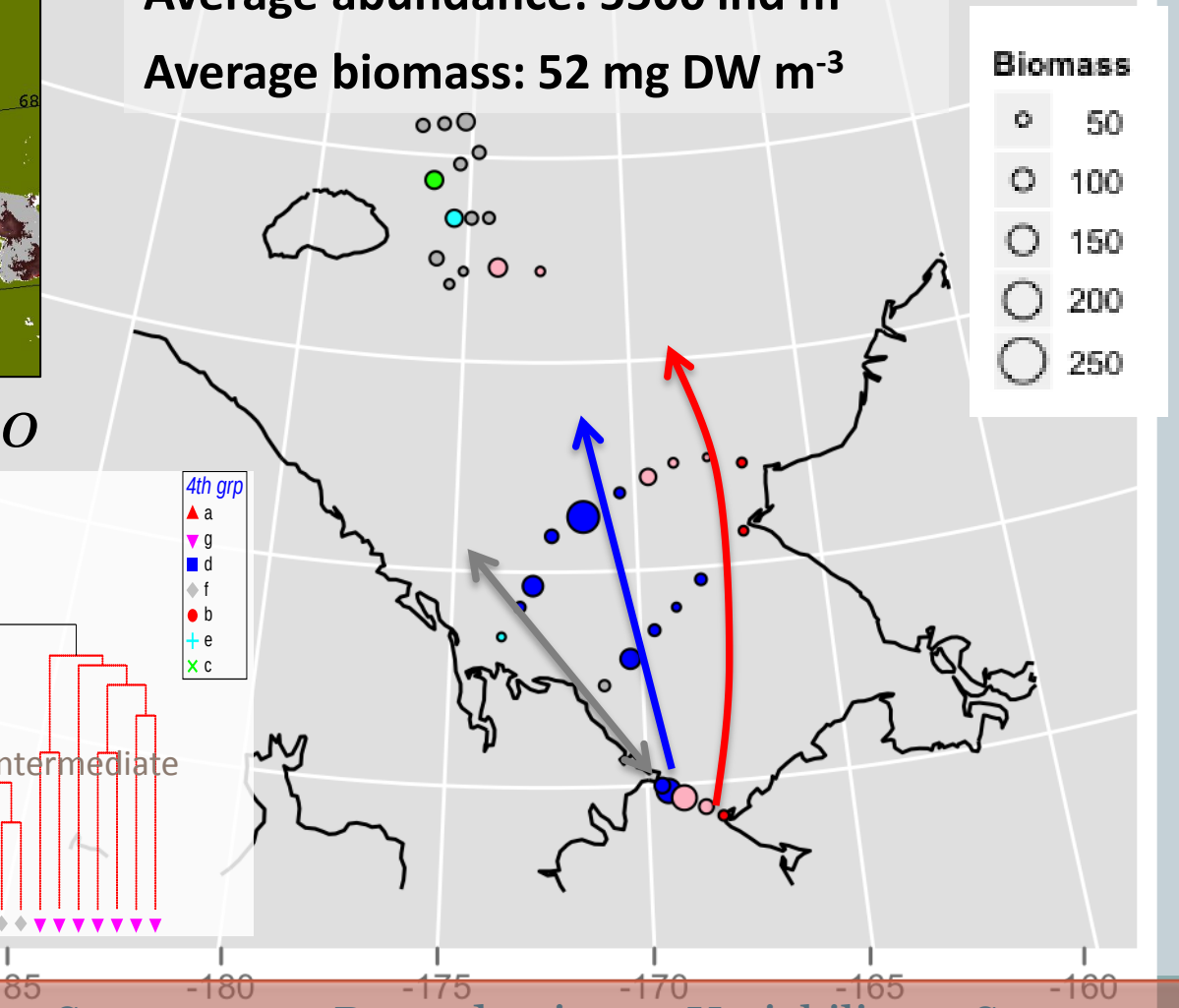


Hopcroft et al. 2010

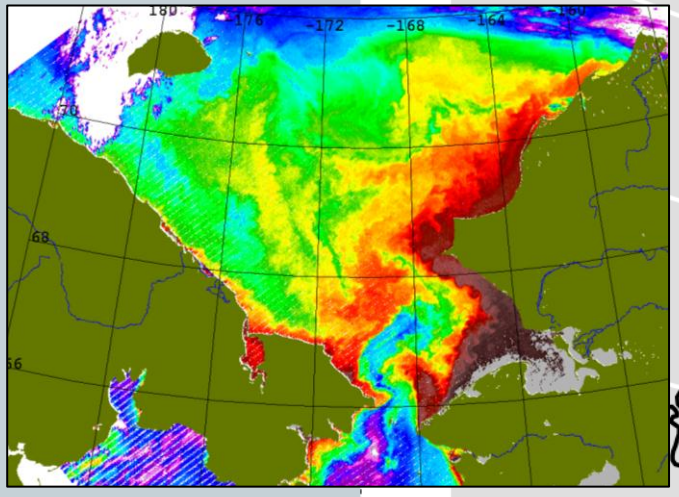


Average abundance: 5500 ind m^{-3}

Average biomass: 52 mg DW m^{-3}

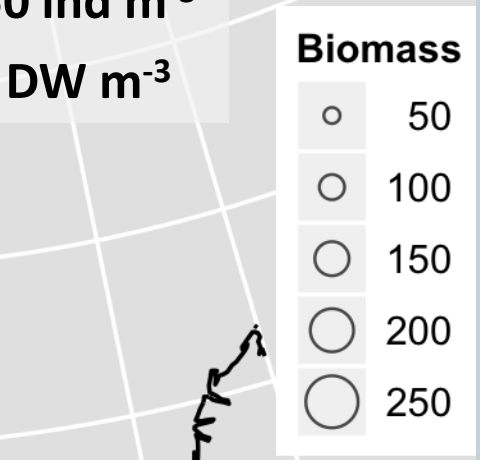


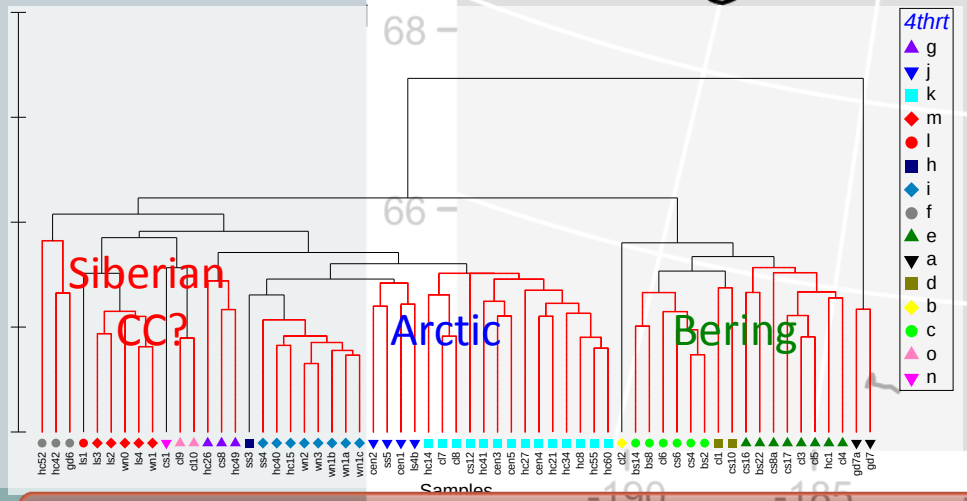
Zooplankton communities - 2009



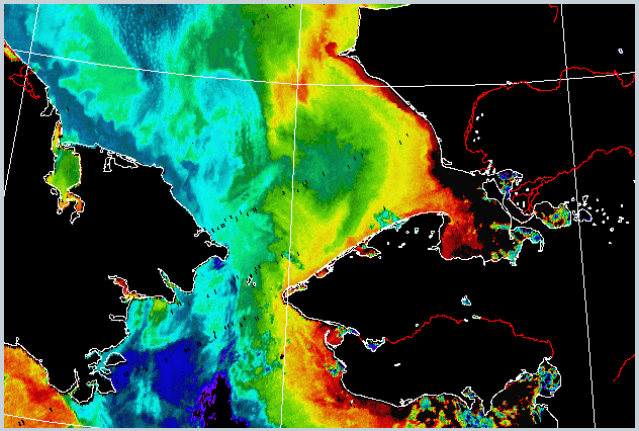
Average abundance: 8250 ind m^{-3}

Average biomass: 81 mg DW m^{-3}



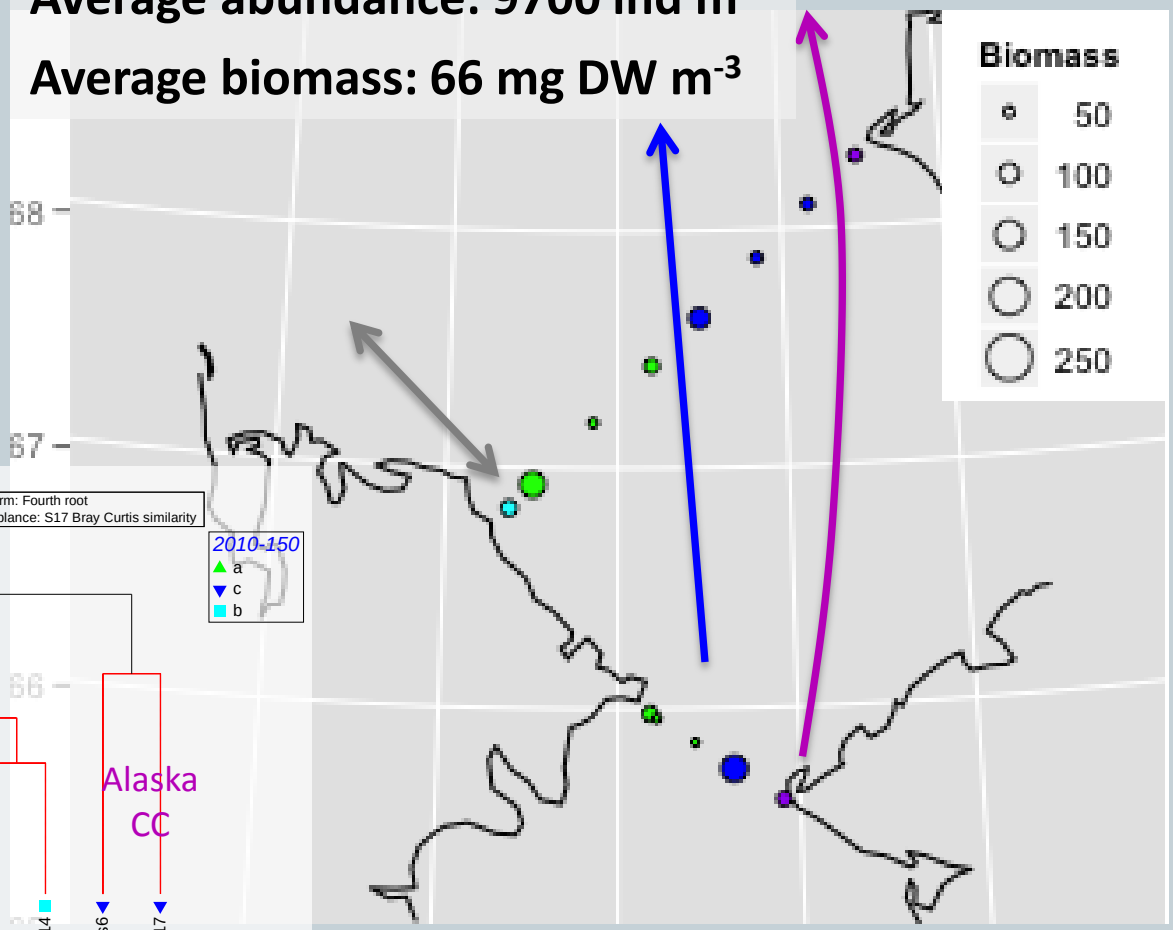


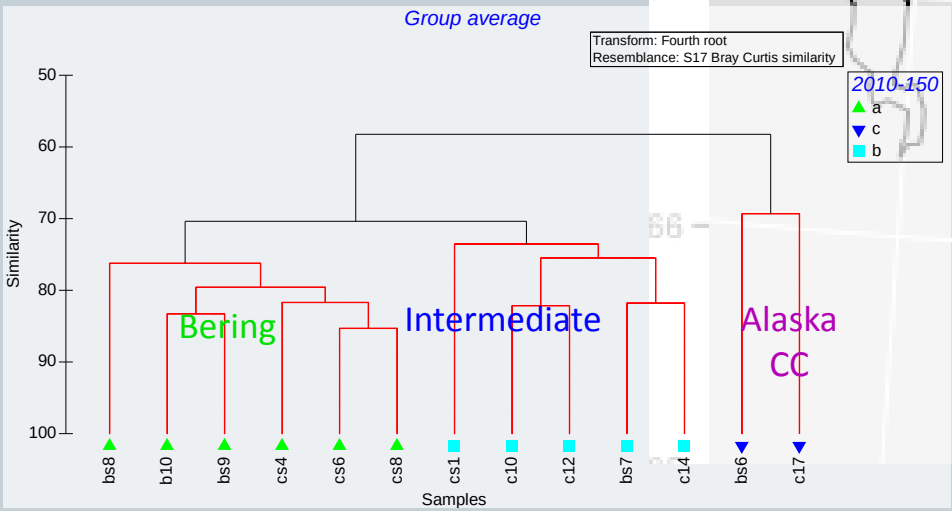
Zooplankton communities – 2010



Average abundance: 9700 ind m^{-3}

Average biomass: 66 mg DW m^{-3}

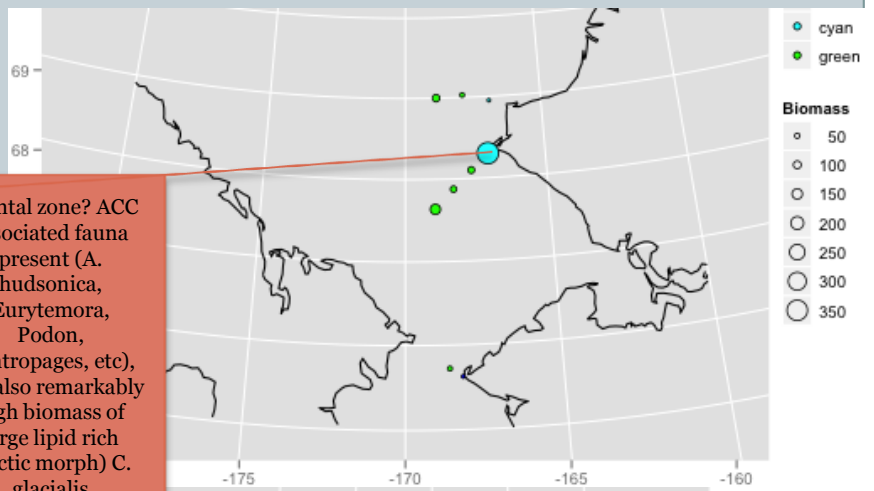




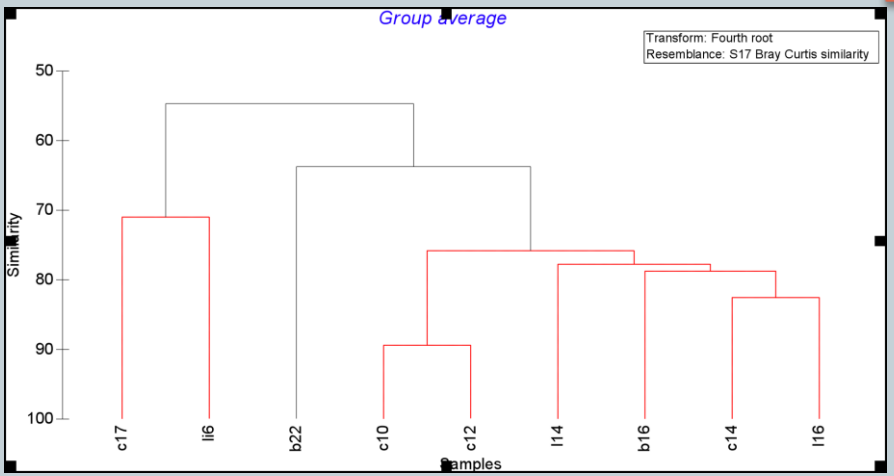
Zooplankton communities – 2011

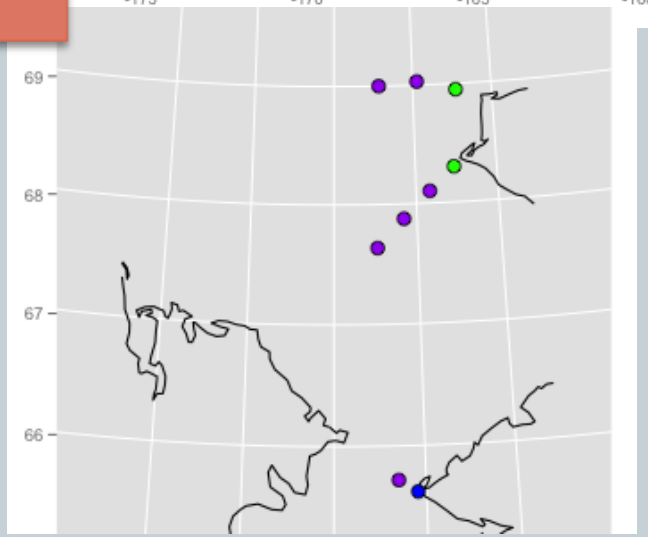
Average abundance: 3500 ind m^{-3}

Average biomass: 98 mg DW m^{-3} (or 64 mg if st. CS17 is excluded)



Frontal zone? ACC associated fauna present (A. hudsonica, Eurytemora, Podon, Centropages, etc), but also remarkably high biomass of large lipid rich (arctic morph) C. glacialis

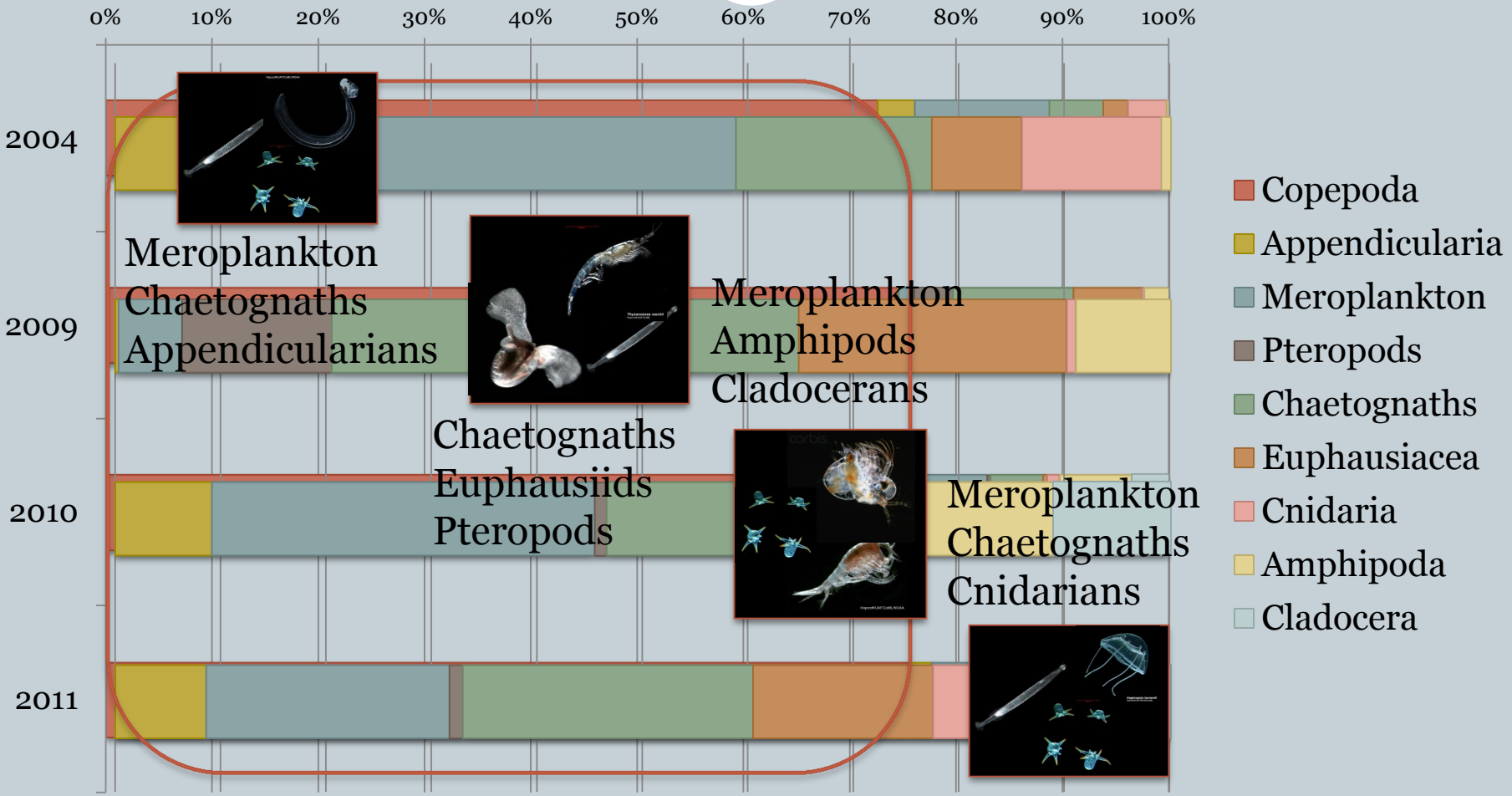




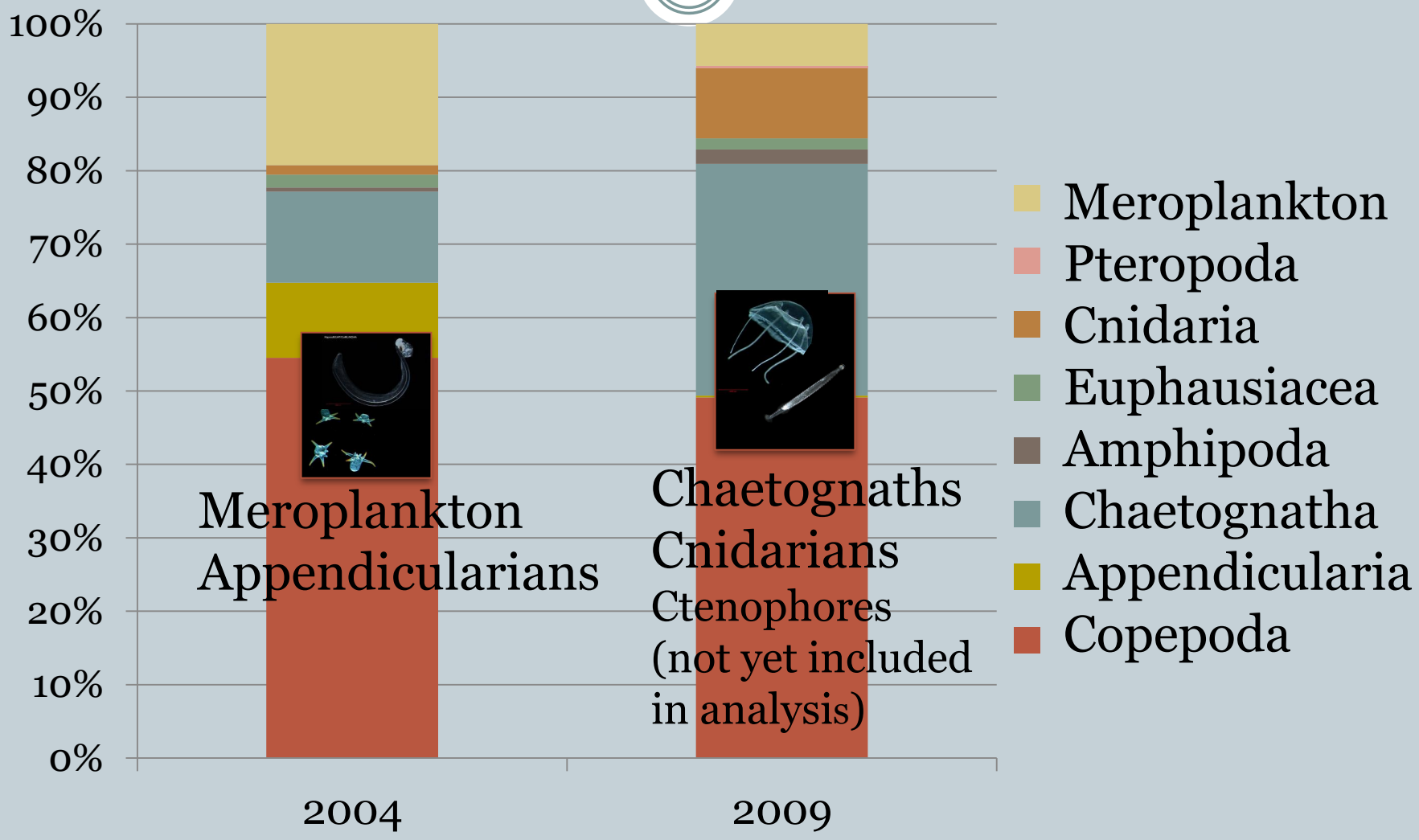
Community structure

- Total 64 holoplanktonic species from 8 different taxonomic groups plus a wide variety of meroplankton
- Copepods dominate in biomass and abundance during all years – expected.
- However, relative contribution of other groups varies significantly!

Community structure – Bering

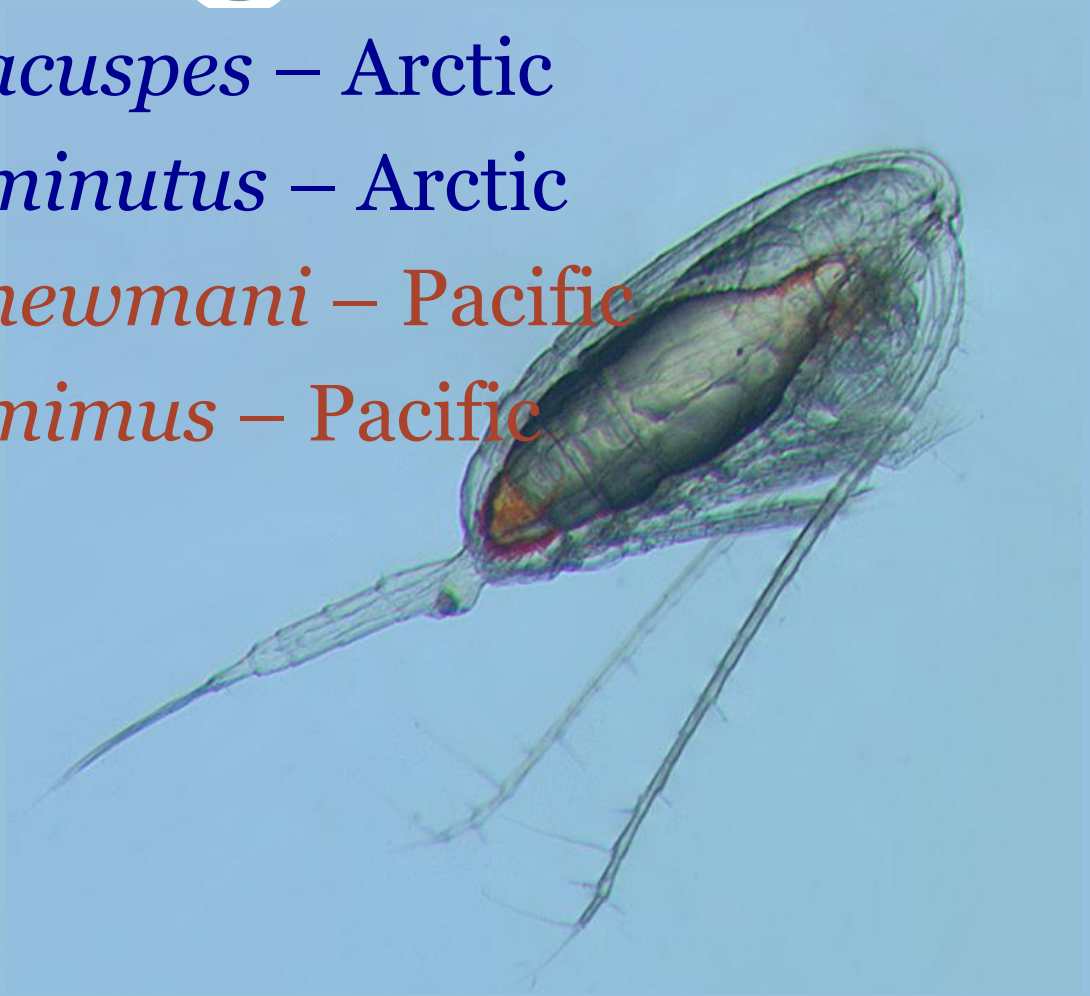


Community structure – Arctic

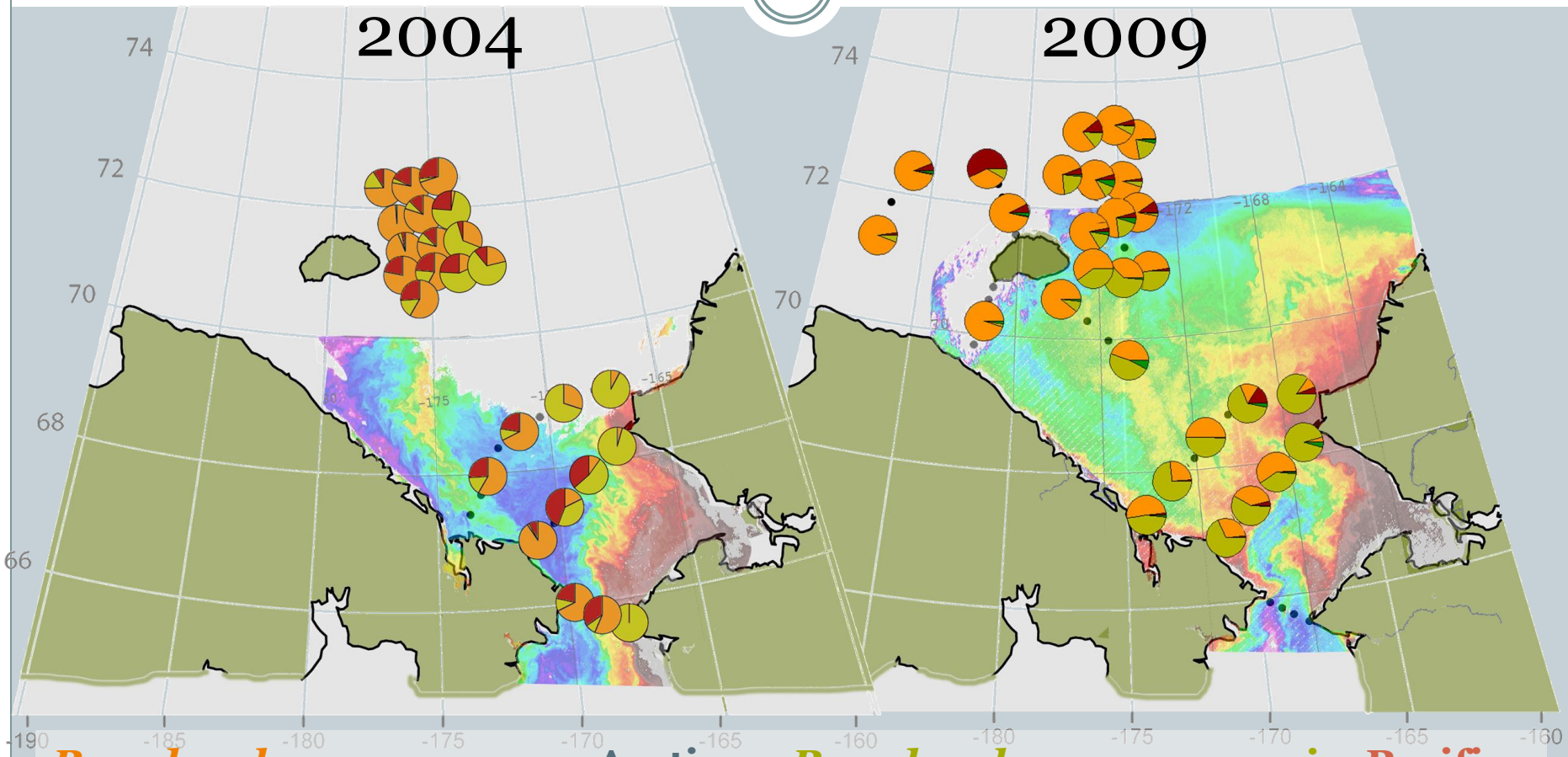


A case study: *Pseudocalanus*

- *Pseudocalanus acuspes* – Arctic
- *Pseudocalanus minutus* – Arctic
- *Pseudocalanus newmani* – Pacific
- *Pseudocalanus mimus* – Pacific



Distribution of *Pseudocalanus spp.*



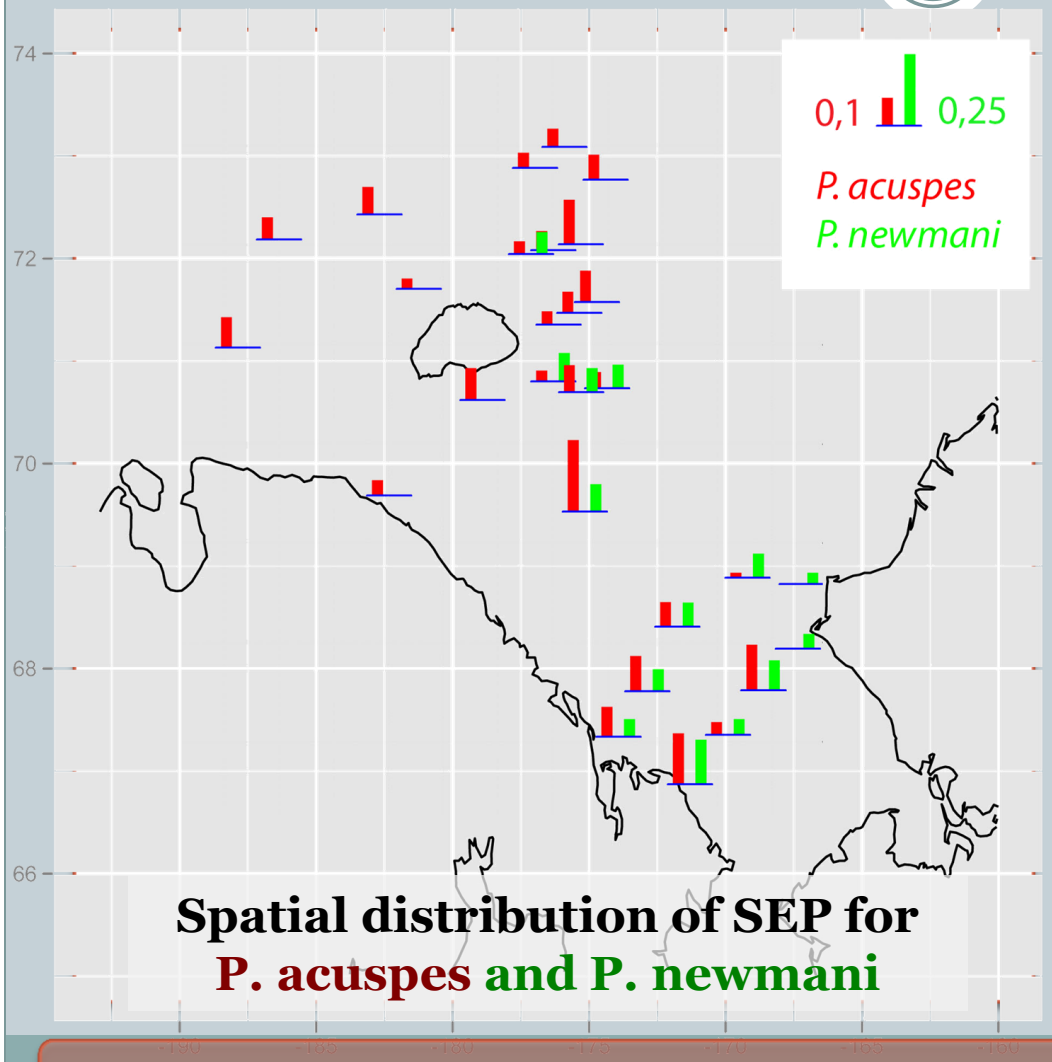
Pseudocalanus acuspes **– Arctic**

Pseudocalanus minutus **– Arctic**

Pseudocalanus newmani **– Pacific**

Pseudocalanus mimus **– Pacific**

Pseudocalanus Egg Production



Spatial distribution of SEP for P. acuspes and P. newmani

EPR (Egg production rate)

P. acuspes – 2.6 eggs/f/day

P. newmani – 1.8 eggs/f/day

2004 Average

P. acuspes – 4.3-5.2 eggs/f/day

P. newmani – 2.6-3.8 eggs/f/day

SEP (Specific egg production)

P. acuspes – 8.5-9.2%

P. newmani – 7.3-8.2%

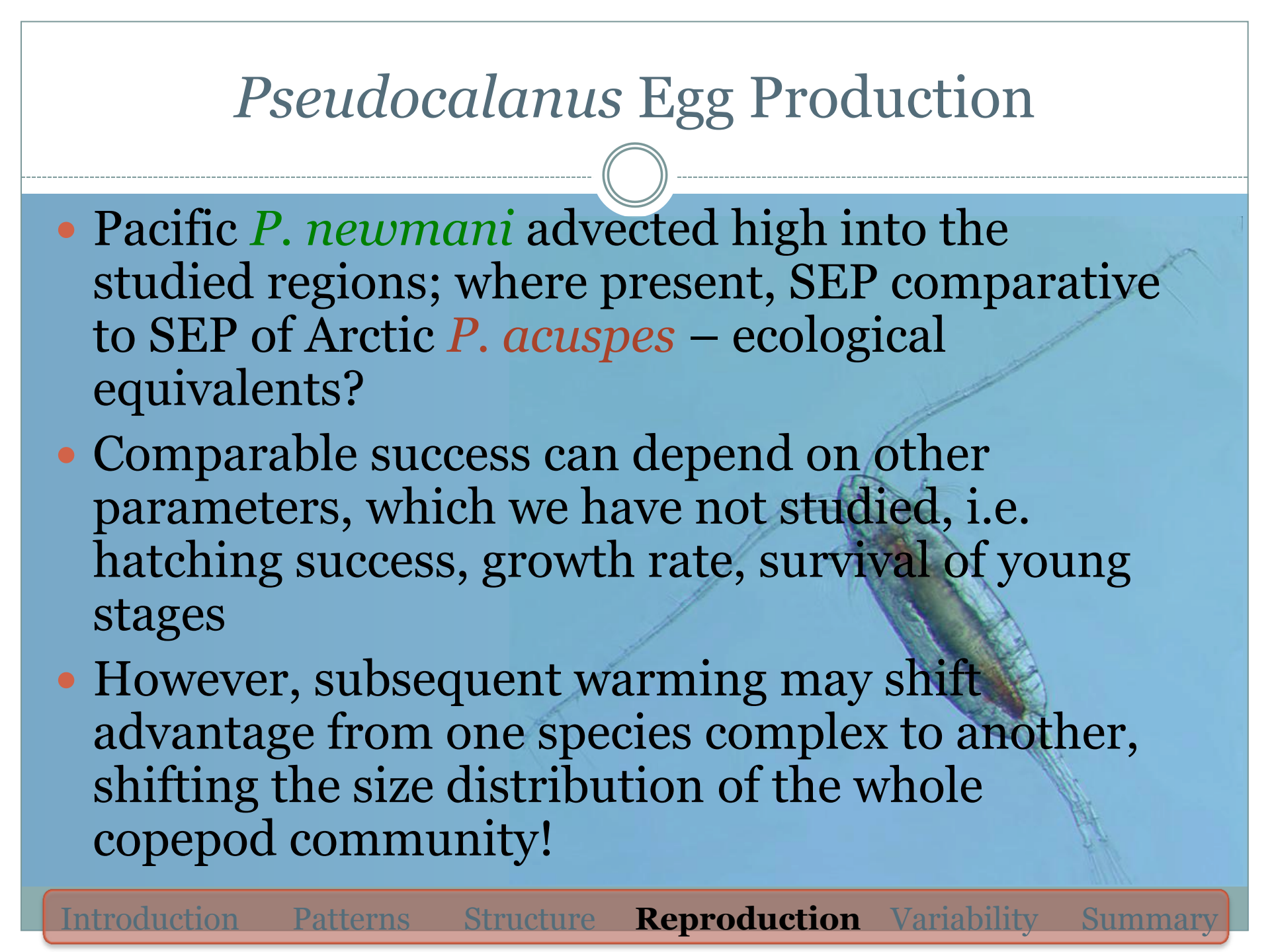
2004 Average

P. acuspes – 15-20%

P. newmani –15- 20%

Pseudocalanus Egg Production

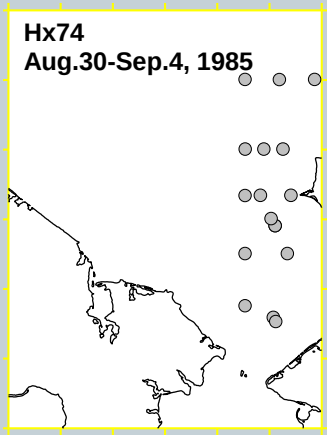
- Pacific *P. newmani* advected high into the studied regions; where present, SEP comparative to SEP of Arctic *P. acuspes* – ecological equivalents?
- Comparable success can depend on other parameters, which we have not studied, i.e. hatching success, growth rate, survival of young stages
- However, subsequent warming may shift advantage from one species complex to another, shifting the size distribution of the whole copepod community!

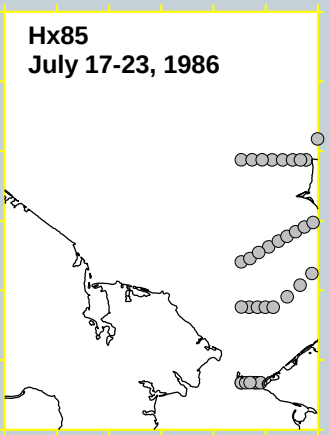


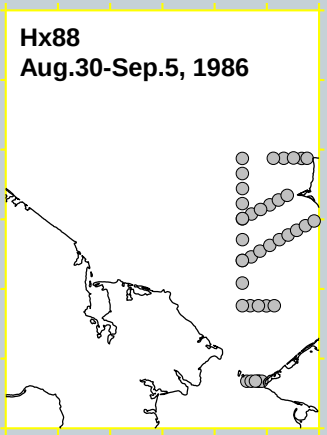
Yearly summary

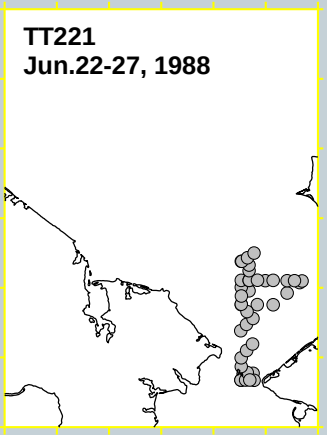
		2004	2009	2010
MONTHS SAMPLED		August	September	August
AVERAGE BIOMASS	Bering	55 mg DW m^{-3}	120 mg DW m^{-3}	66 mg DW m^{-3}
	Arctic	51 mg DW m^{-3}	60 mg DW m^{-3}	-
CROSS-SHELF GRADIENT		strong	weak	strong
IMPORTANT TAXONOMIC GROUPS		Copepods, meroplankton, appendicularians	Copepods, chaetognaths, cnidarians, ctenophores	Copepods, meroplankton, amphipods, cladocerans
PSEUDOCALANUS EPR		higher	lower	--

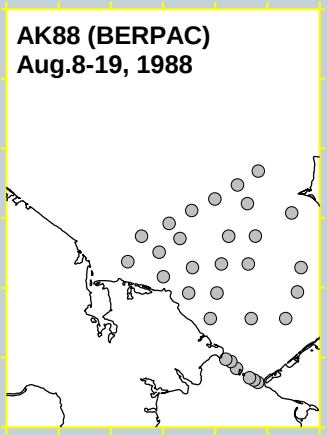
Some more inter-annual comparisons…

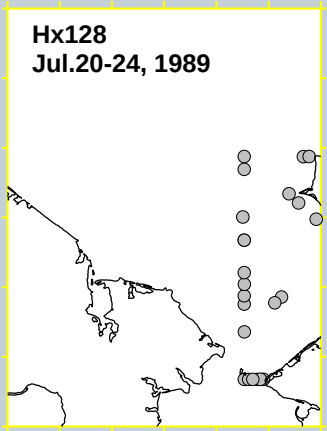








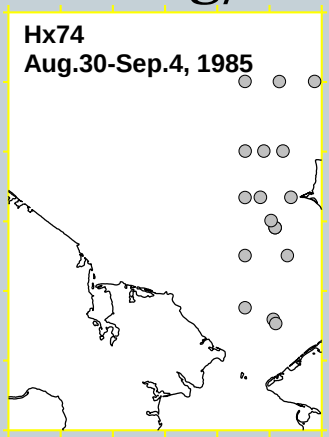




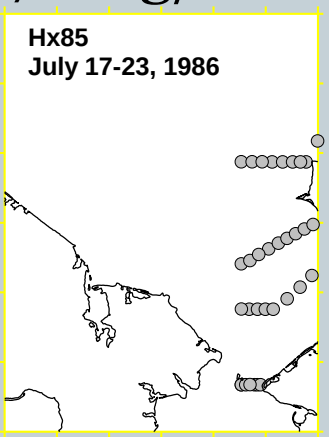
- ISHTAR program (1985-1989)
- Same area, but generally only US side
- Difficult to compare due to inconsistencies in collection and processing

Some more inter-annual comparisons…

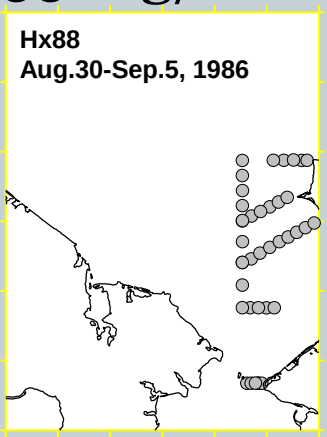
122 mg/m³



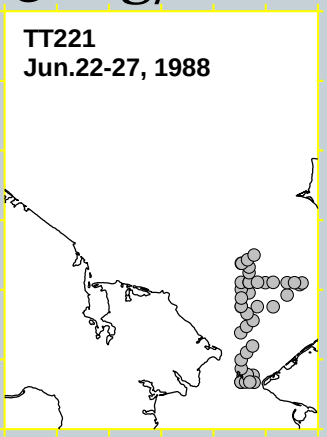
71 mg/m³



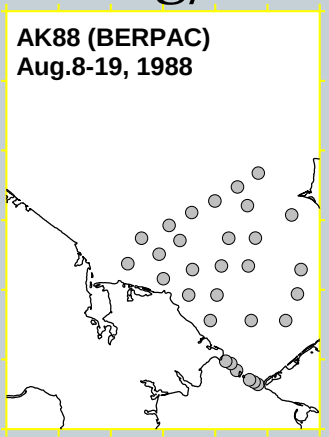
55 mg/m³

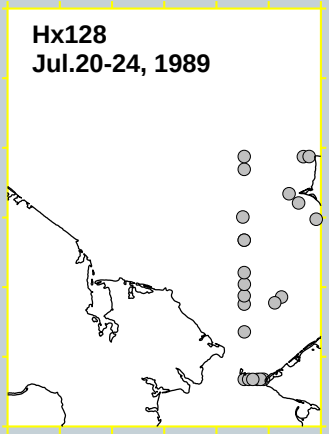


13 mg/m³



28 mg/m³





68 mg/m³

- **Aug 2004 - 55 mg/m³**
- **Sept 2009 – 120 mg/m³**
- **Aug 2010 – 66 mg/m³**
- **Jul 2011 – 93 mg/m³**

Summary

- While it is early to talk about long-term change, our data shows how drastically structure of zooplankton communities can vary between the seasons and years – **shows high flexibility to changing conditions**
- Experiments on *Pseudocalanus* suggest that at least in terms of egg production Arctic and Pacific members are ecological equivalents – and **further climate change may significantly shift relative importance of species**
- **RUSALCA 2012 cruise will build upon these observations, and efforts are being directed toward assembling and comparing the concurrent observations with the baseline from the last century**

Thank you for your attention!