Measuring the pulse of the Gulf of Alaska: oceanographic observations along Seward Line, 1997-2009

Russ Hopcroft, Ken Coyle, Tom Weingartner, Terry Whitledge

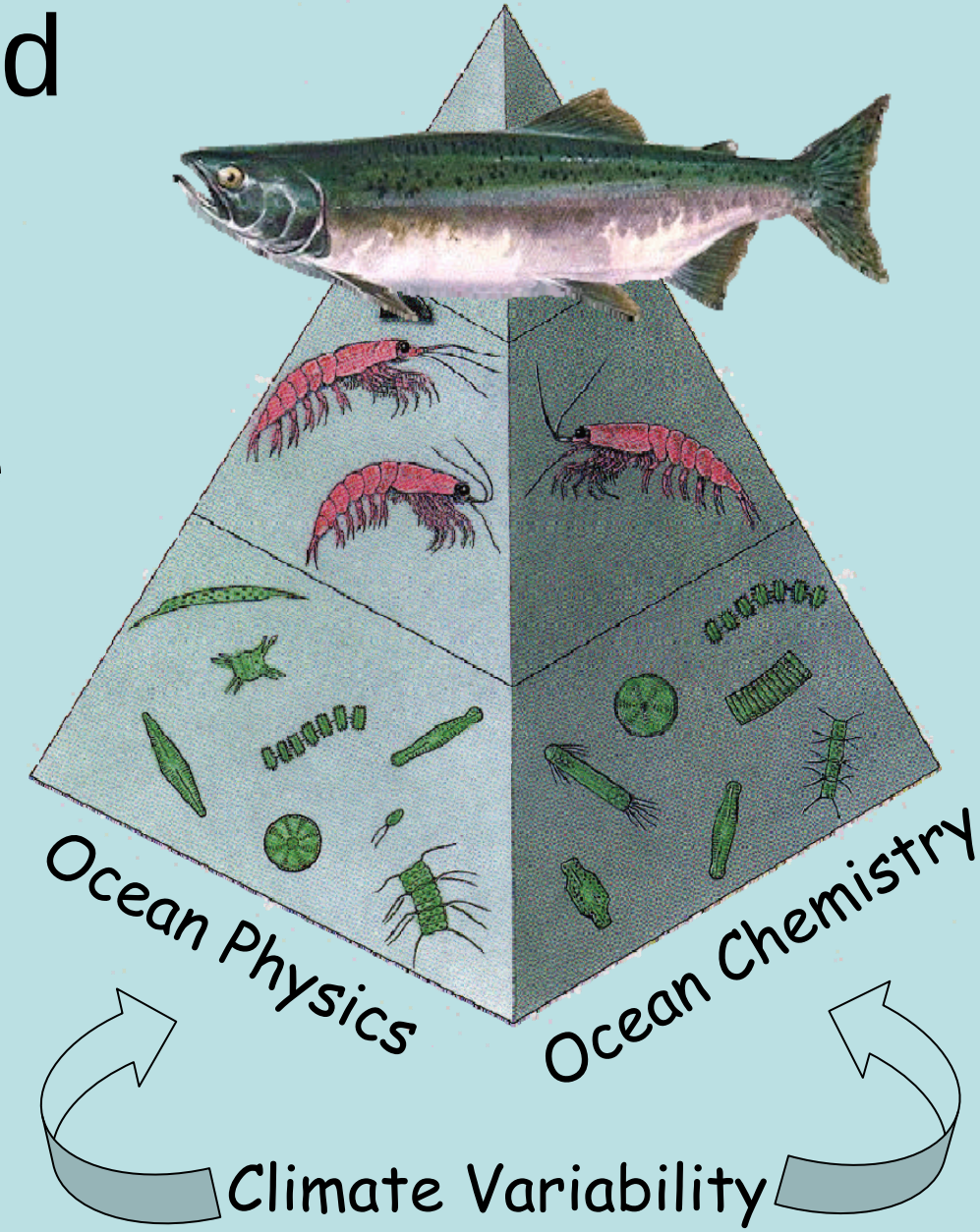
UNIVERSITY OF ALASKA FAIRBANKS

U.S. GLOBEC Northeast Pacific Program

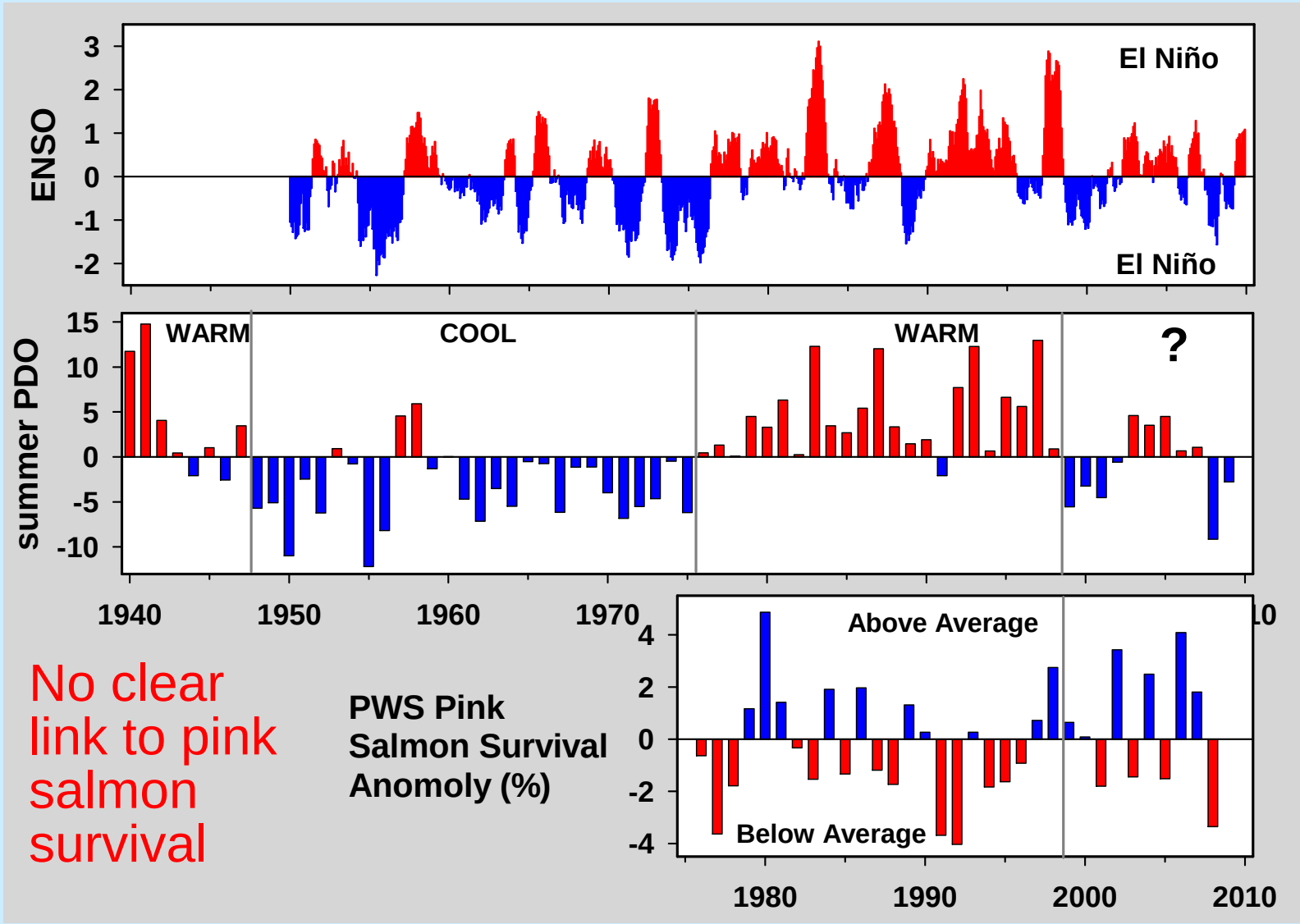
NORTH PACIFIC RESEARCH BOARD

Food Pyramid

- Climate variability alters marine groups through changes in ocean physics and chemistry that cascade through the food web
- To understand AND predict a harvested species, we need routine observations of the complete food web
- Otherwise, there is no direct connection (fish don't eat 'climate')

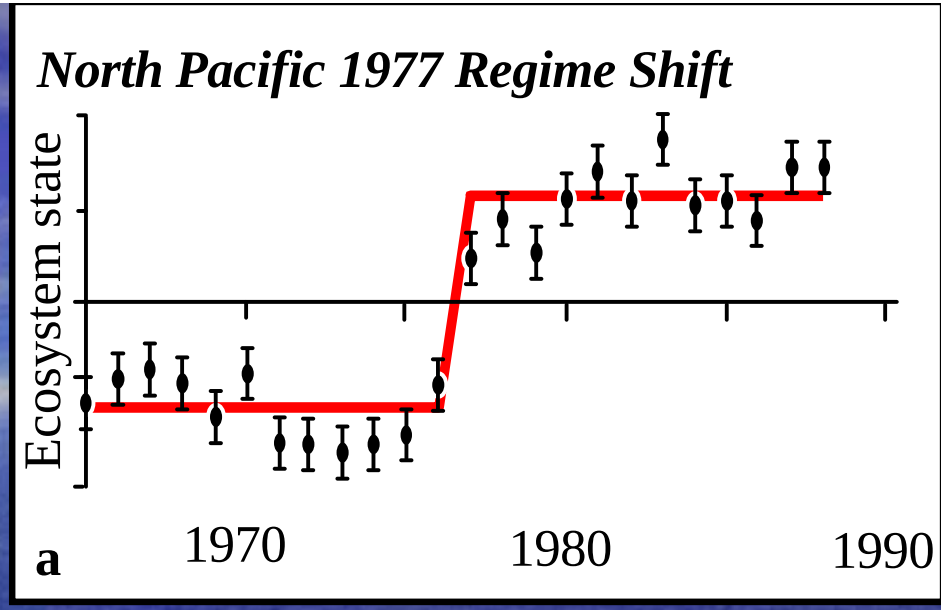


What drives productivity in GoA is complicated: seasonal, inter-annual & longer-term forcing



No clear link to pink salmon survival

Climate: Why care?



Late 1960's

Early 1980's

Changes catches in a small mesh bottom trawl in Pavlof Bay, Alaska, through the regime shift of the mid-1970s.

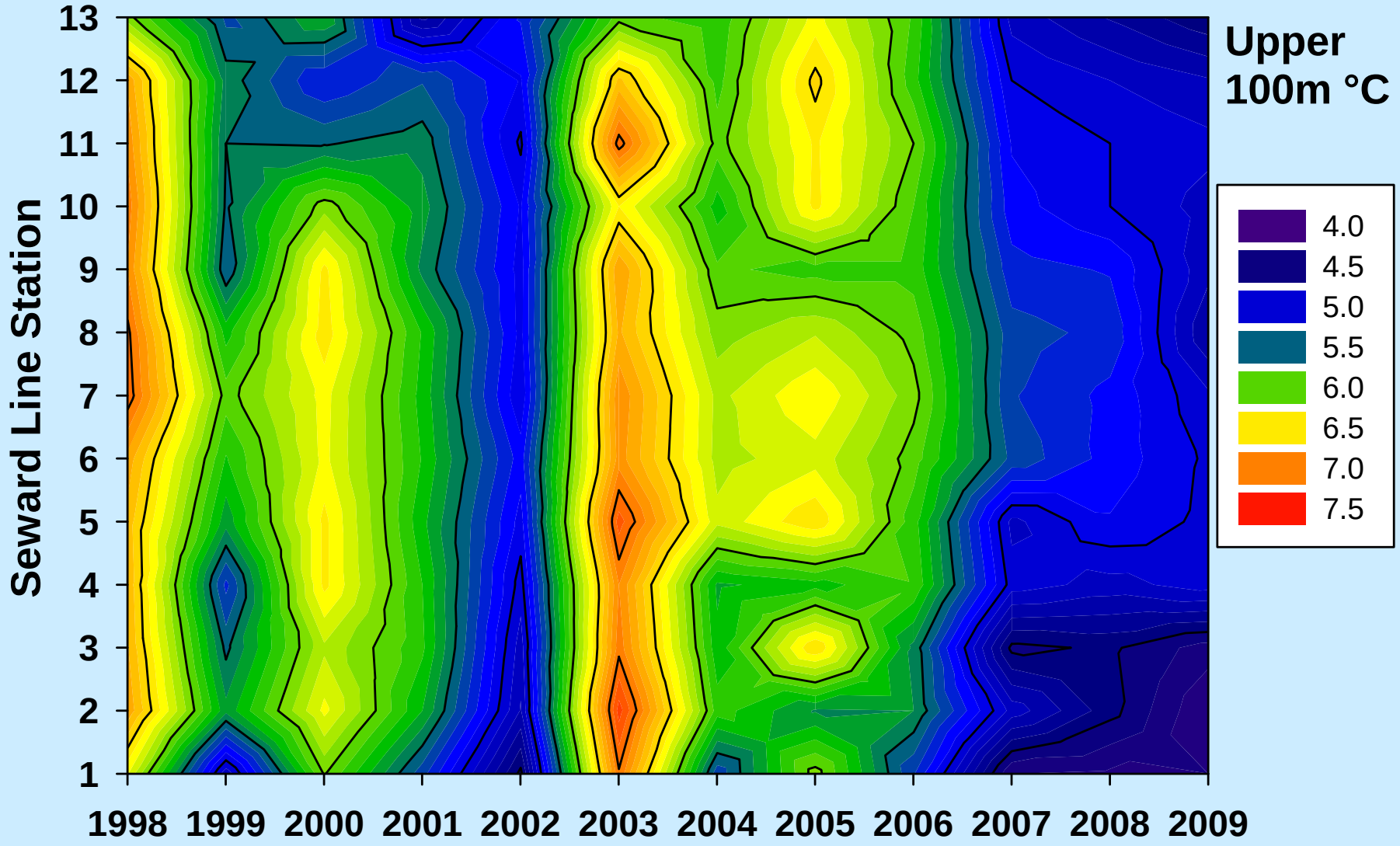
Survival of cold-blooded species depends on interaction of 3 basic factors:

- **Temperature**
  - affects maximum growth rate
  - Species preference/tolerance
- **Food concentration**
  - More food, higher growth and survival
  - at cold temperatures less food is required to reach maximum growth (less is wasted on respiration)
- **Predation**
  - You either want to be too small to be seen
  - **OR** too big to be eaten
- **Seward Line studies the first 2 parameters, NPRB's GoA IERP will add the third**

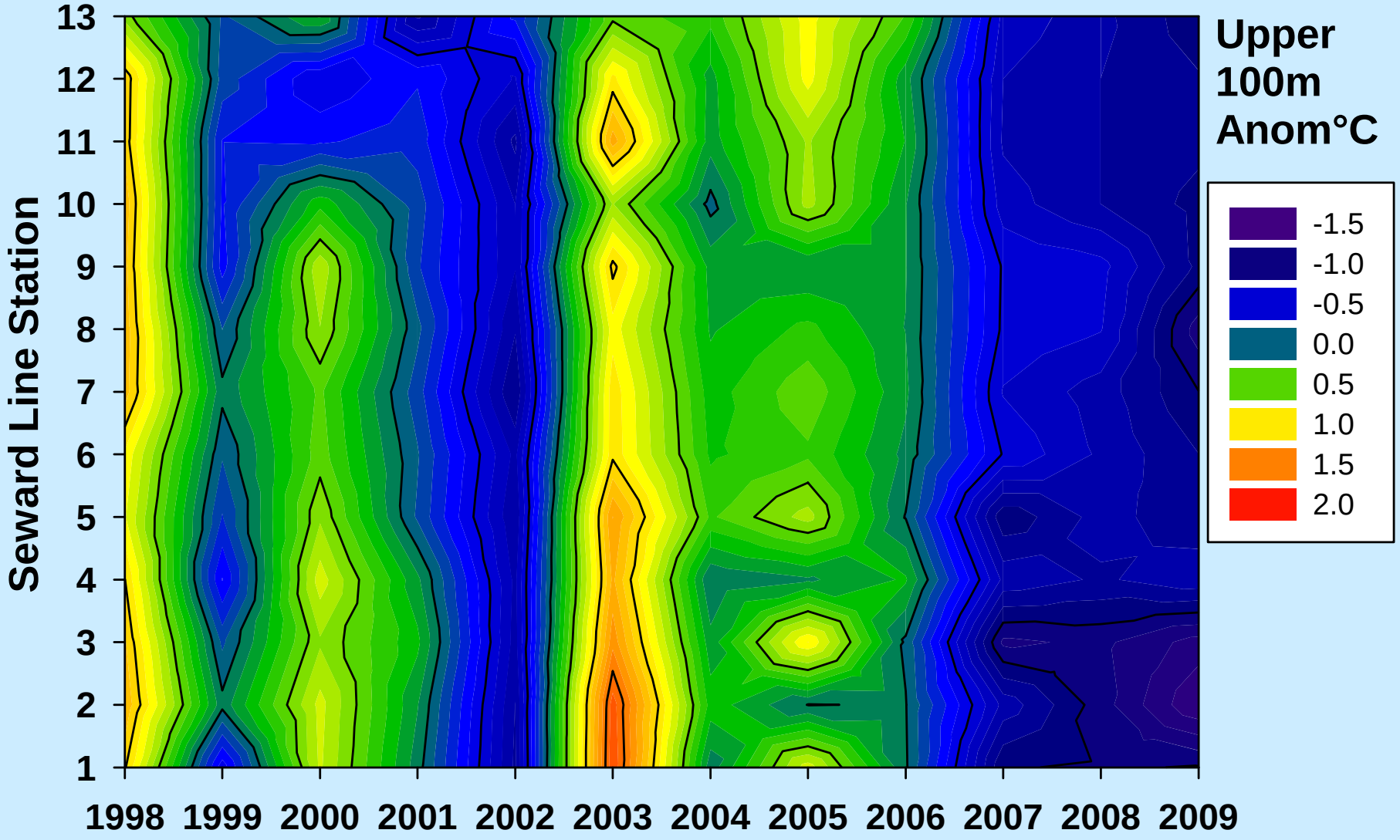
COASTAL GULF OF ALASKA SEWARD LINE

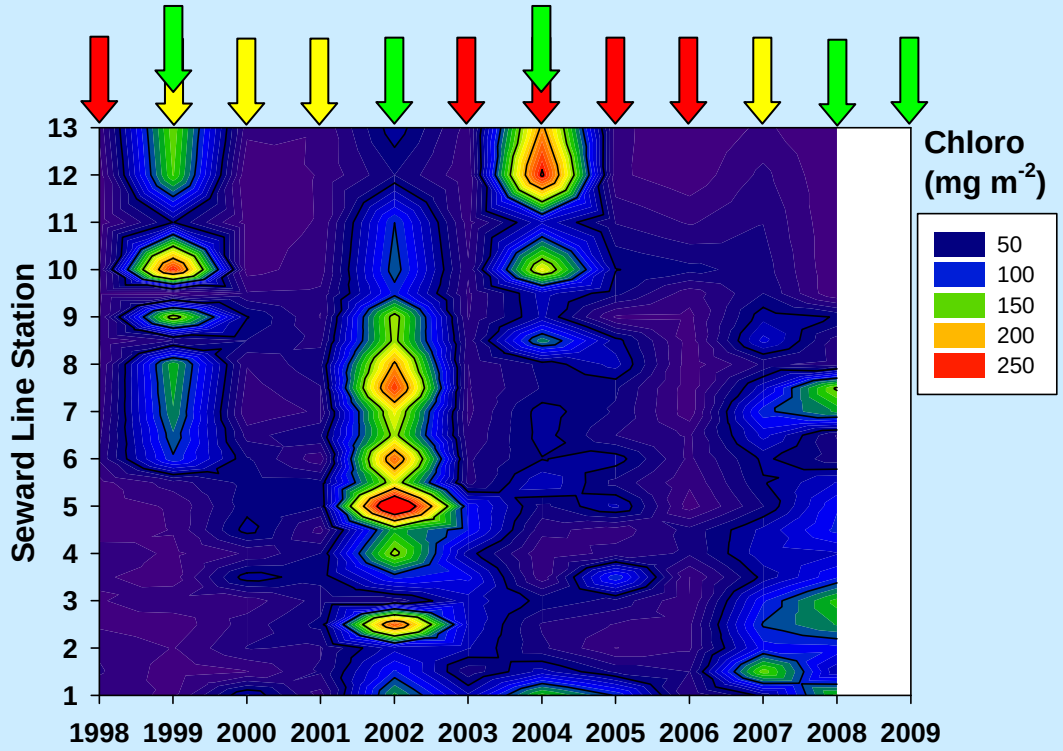
- Physical data over ~3 decades
- Biological data over 12 years
- GLOBEC 1997-2004 “Why is this system so productive…..” Climate: Salmon
- **NPRB** 2005-2009 (May)
- SFOS 2009 (Sept)
- **2010 & 2011?**
- 2012-13 GoA IERP

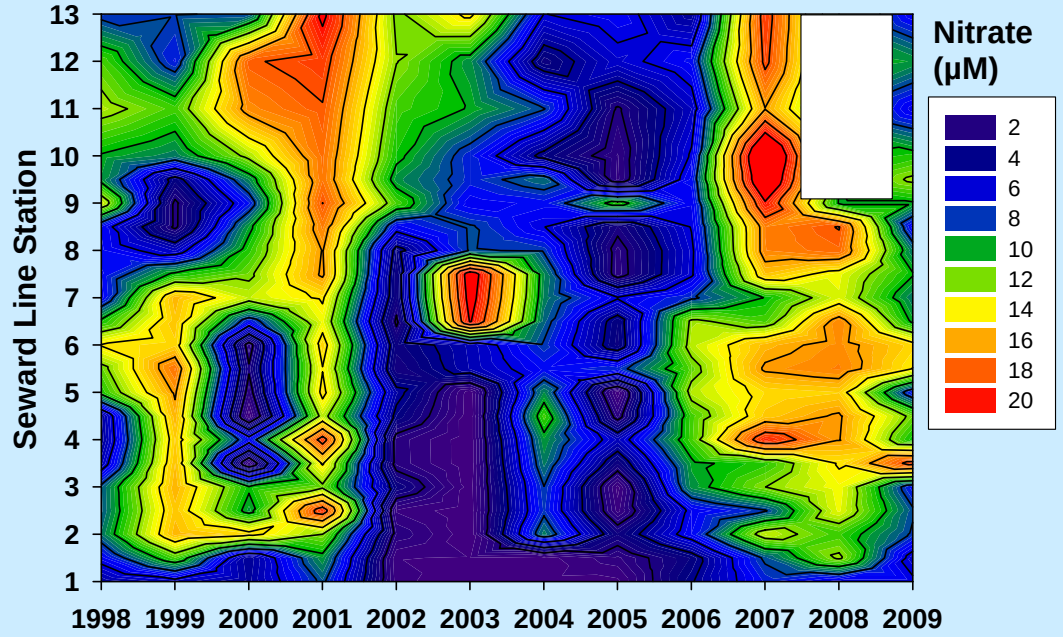
Driven by changes in the PDO, ENSO and winter weather, we have observed years of warm and cool springs - recent Mays are similar to the early 1970s



Driven by changes in the PDO, ENSO and winter weather, we have observed years of warm and cool springs - recent Mays are similar to the early 1970s

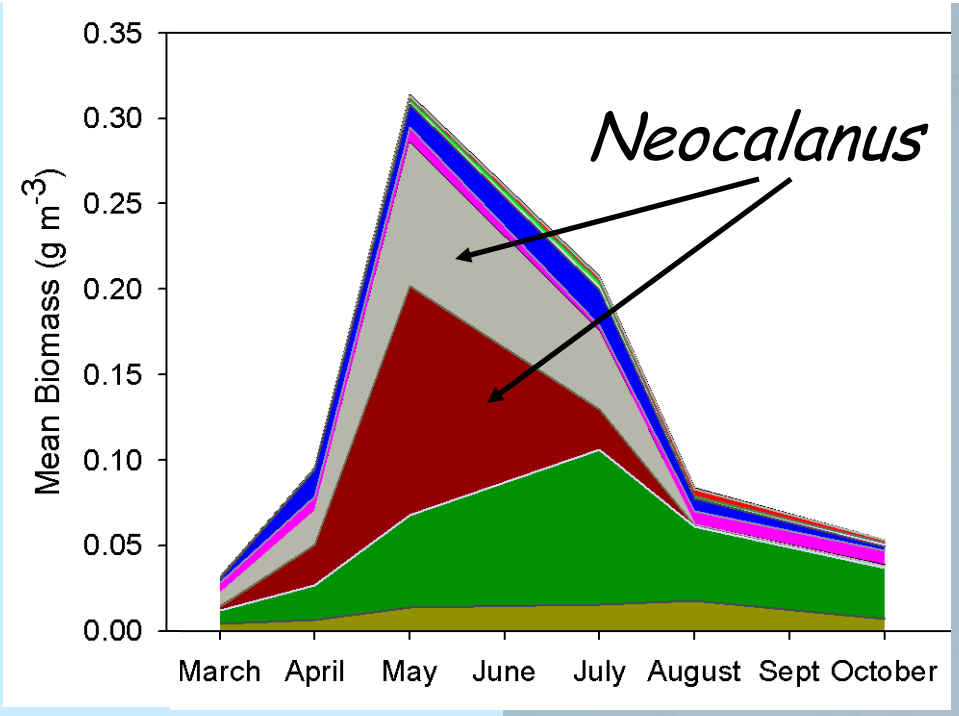




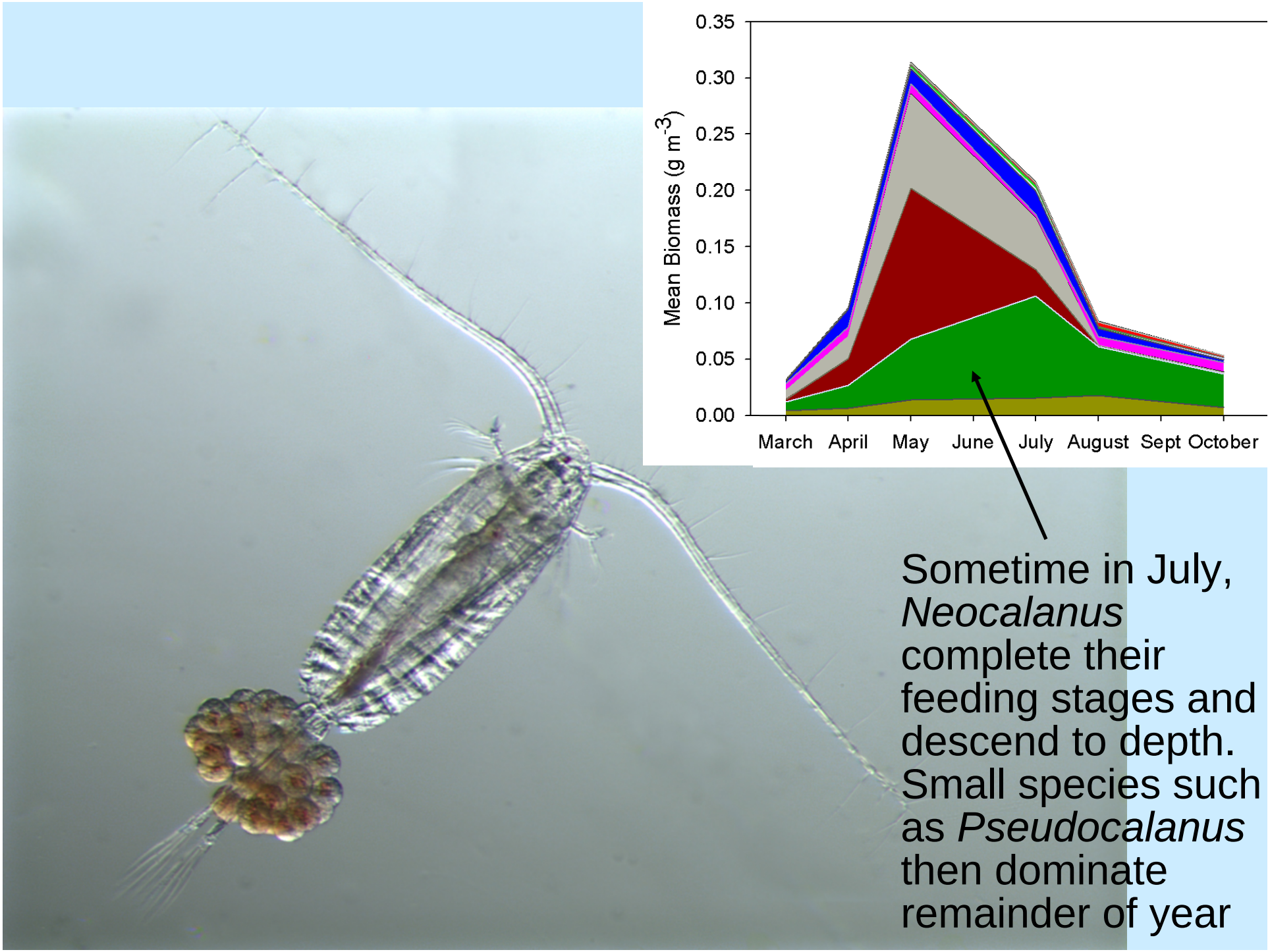


Spring Bloom

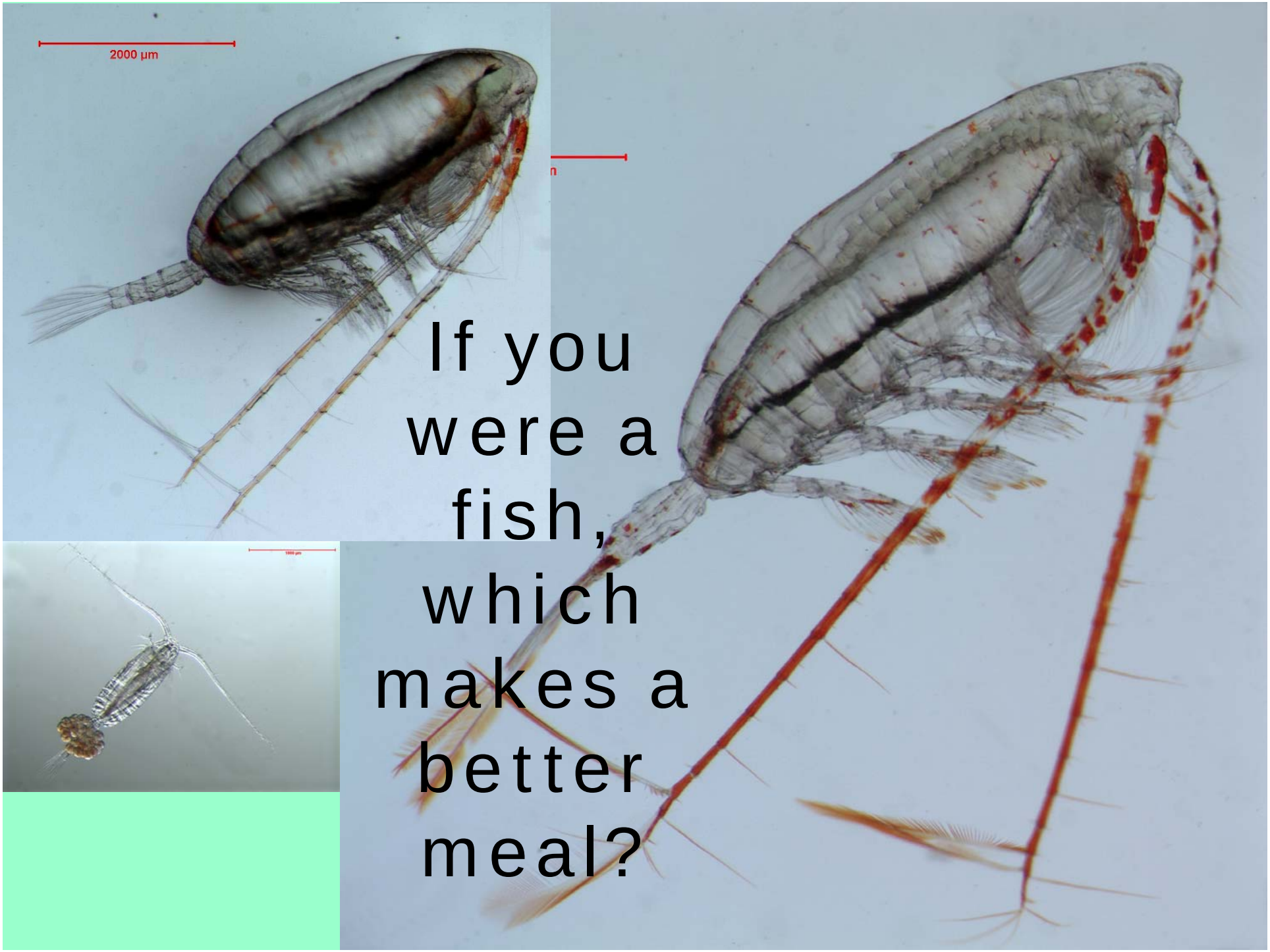
- Short-lived (1-2 weeks) so hard to hit when sampling
- Comparing to nutrients allows determination if we are sampling pre-bloom, post-bloom or the bloom
- 1998, 2003-2006 warm years had early blooms
- Blooms more typical timing (or late) in other years



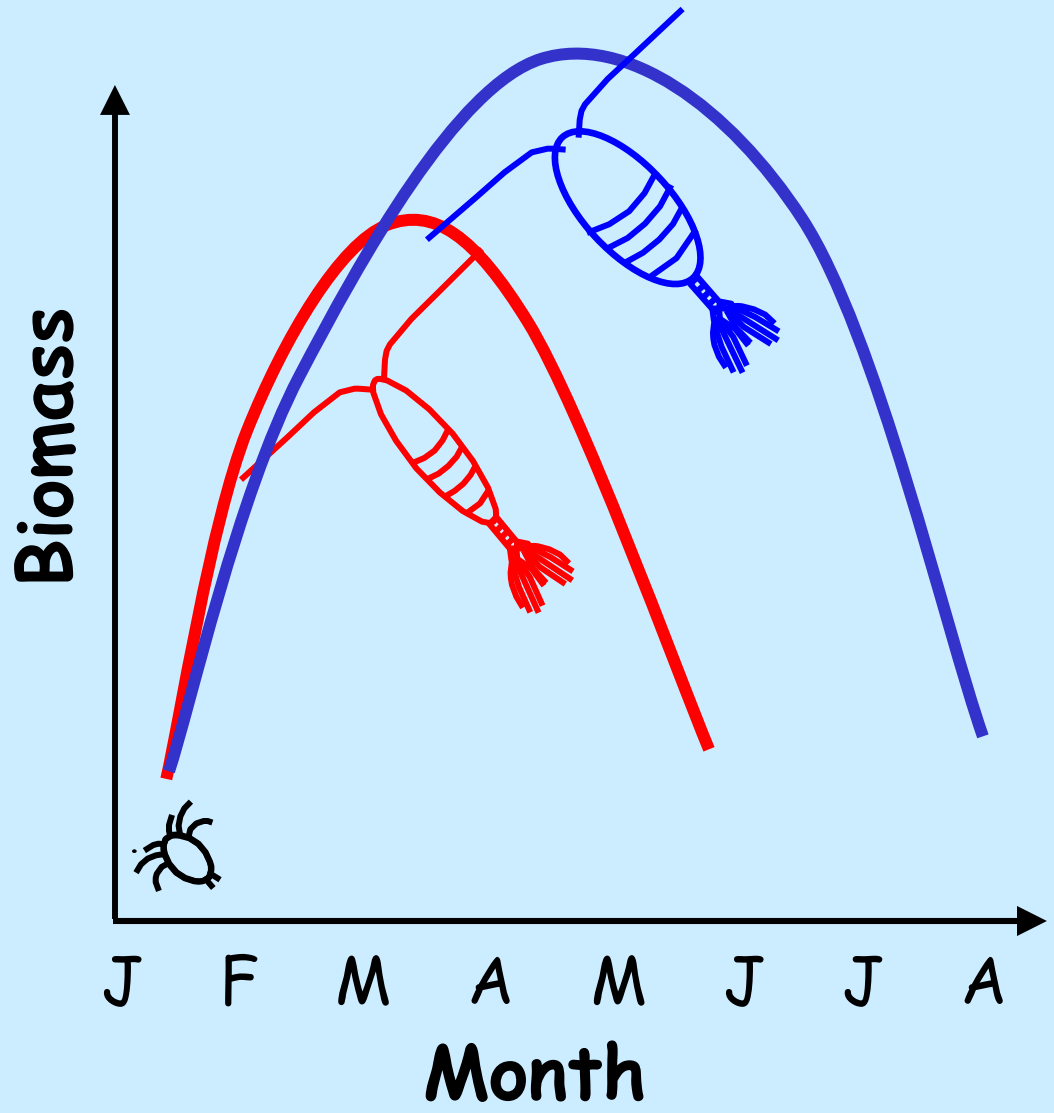
The success of the zooplankton that dominate the spring is related to their unique adaptations to the production cycles of the Gulf



Sometime in July, *Neocalanus* complete their feeding stages and descend to depth. Small species such as *Pseudocalanus* then dominate remainder of year



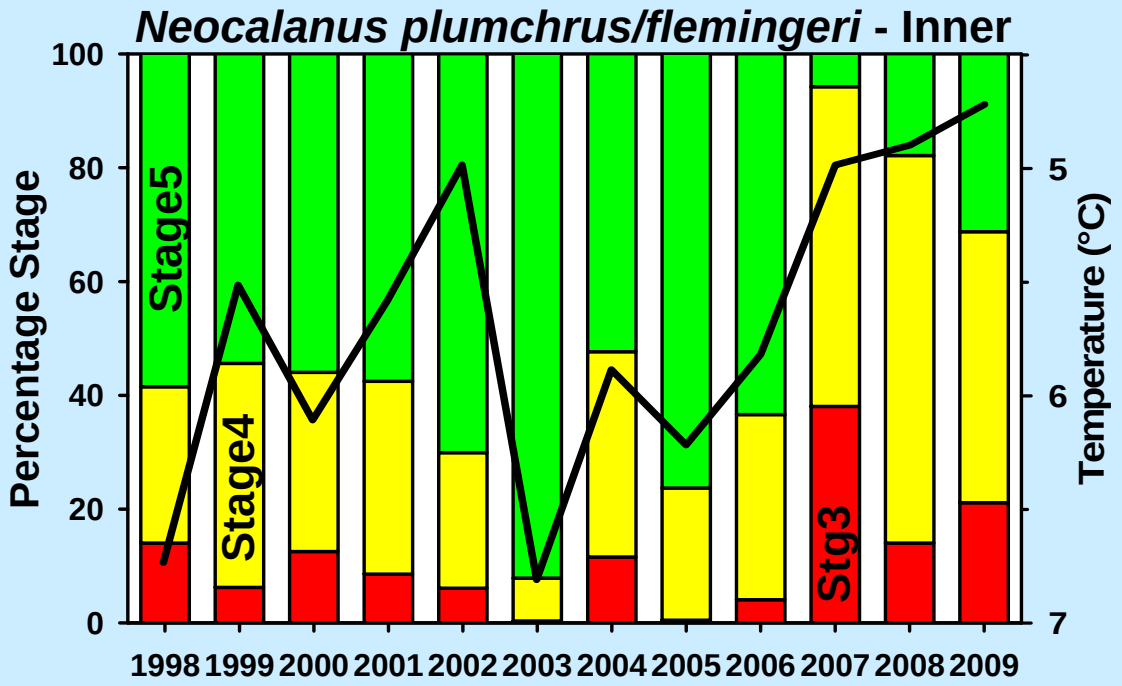
If you were a fish, which makes a better meal?

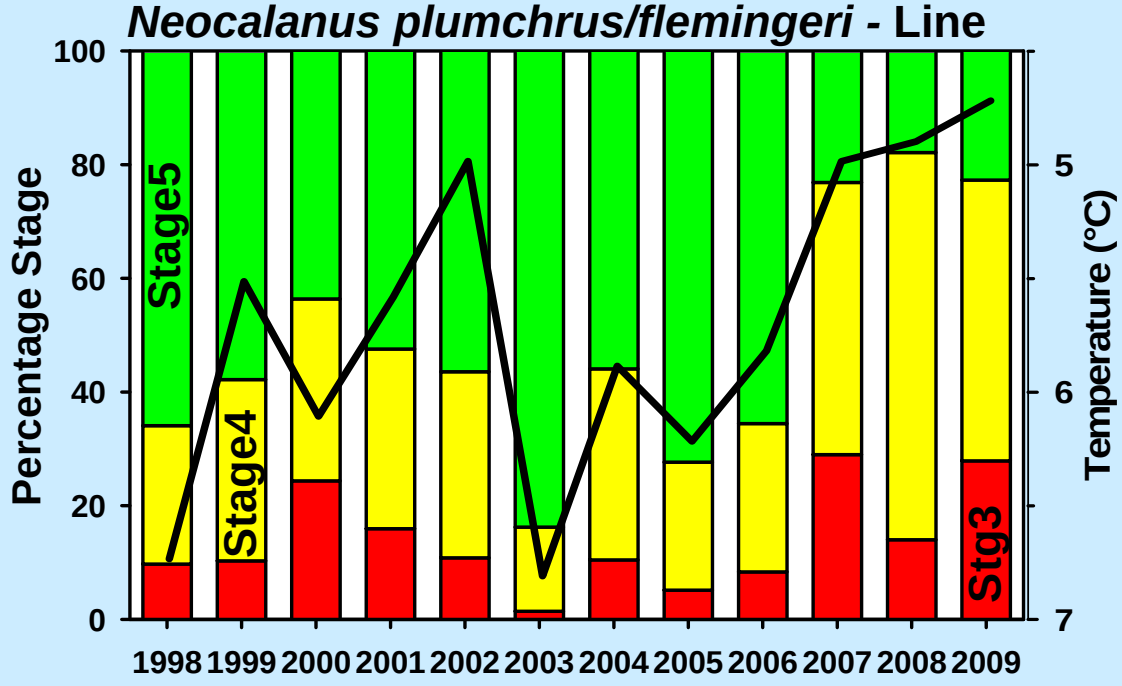


Initial paradigm:

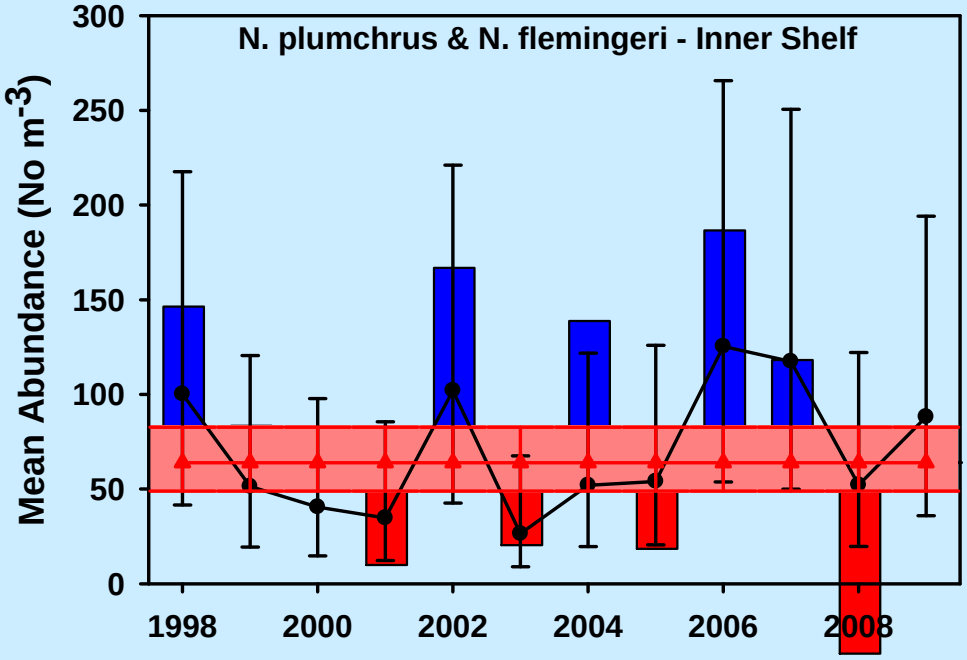
- In a warm year, the spring bloom is earlier (and often smaller) – *Neocalanus* growth phase is completed earlier….

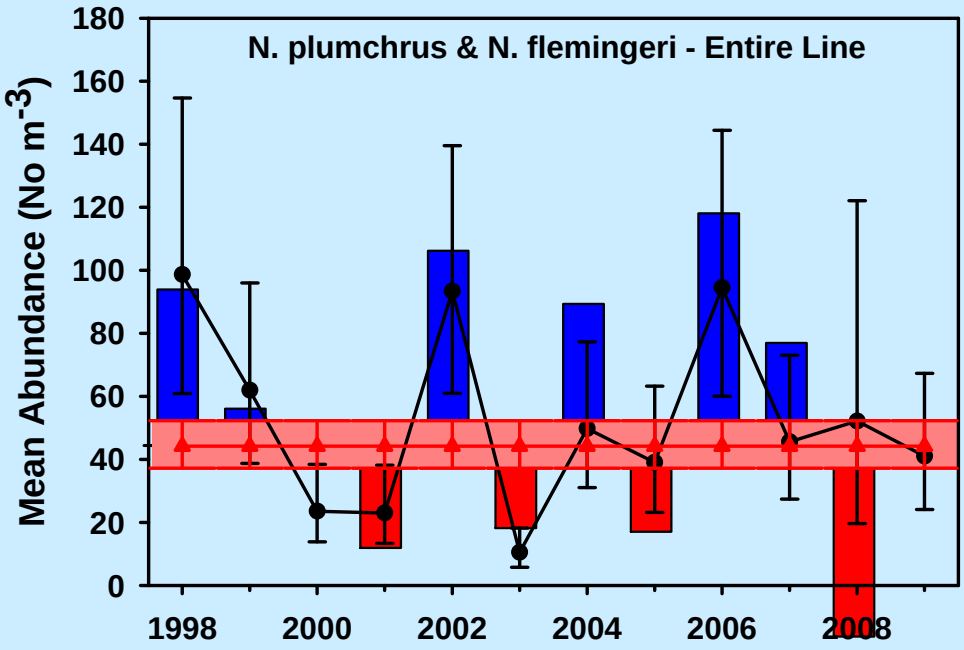
- In a cold year, the bloom is later, often larger and longer – *Neocalanus* success can be greater, growth is completed later….



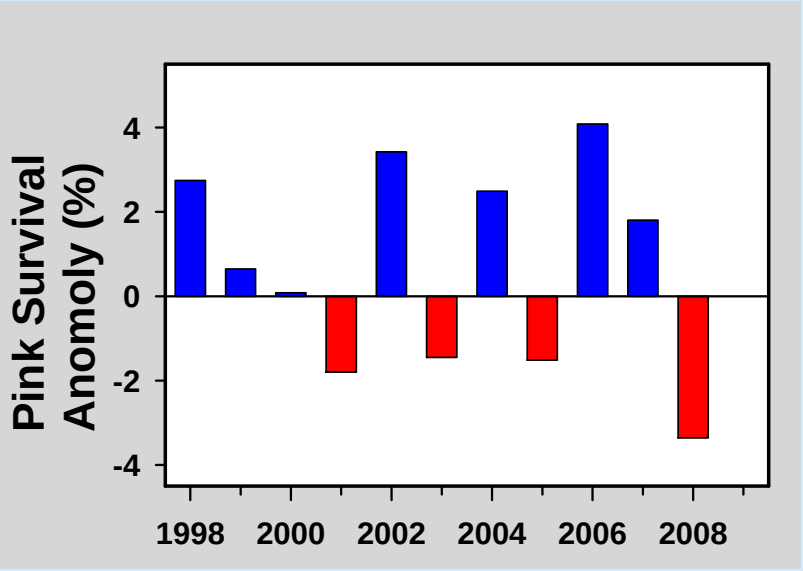


- *Neocalanus* have 6 life-stages, more late stages indicate faster growth and an earlier descent (at stage-5)
- Warm year 2003 (and 2005) show faster development
- Cold years, 2007-2009, have **strikingly** slow development compared to all other years
- **2007-9 are 2-3 weeks behind normal!**
- Some years don't fit
- BUT is hot or cold better for population?

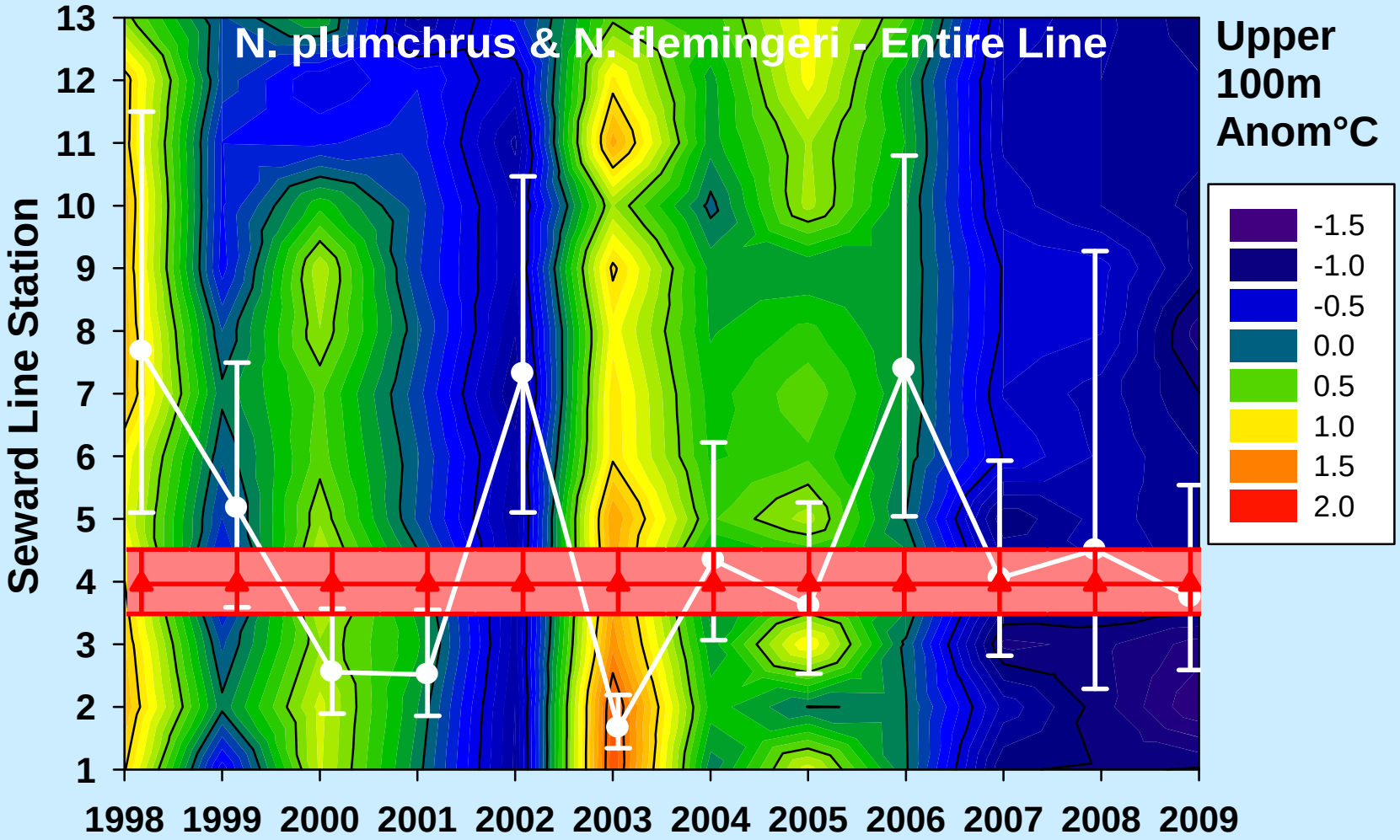




- 1998, 2002, 2006 were best years for *Neocalanus*
- 2007 was above average, in the Inner Shelf, but not on the entire shelf (2009 is average to just above it)
- Every year with high *Neocalanus* had good survival of Pink salmon. Low *Neocalanus* often yielded low Pink survival

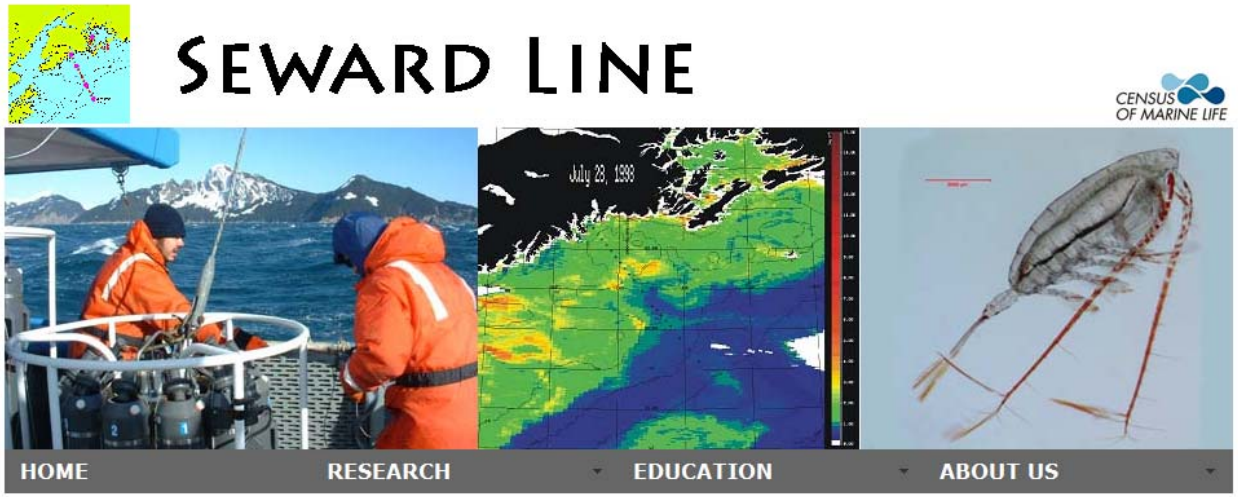


Although temperature drives rates of *Neocalanus* development, it does not seem coupled to their overall success on the shelf, suggesting other mechanisms must be important



Thoughts

- *Neocalanus* populations are correlated with Pink salmon survival BUT
  - Simple predictions of warm years => bad for *Neocalanus* => bad for salmon are **too simplistic**
  - Other mechanisms (e.g. timing and magnitude of spring bloom, cross-shelf exchange) must also be important for *Neocalanus* and should be explored (i.e. GOA IERP)
  - Other factors also affect Pink survival beside *Neocalanus*, but a very strong *Neocalanus* years appears to their benefit
- At present, establishing the population size of *Neocalanus* requires an annual monitoring program like the Seward Line to index zooplankton productivity and the resources available to higher predators like Pink Salmon
- *Neocalanus* populations estimates for 2009 do not favor strong return of Pinks in 2010



For more information

New ***Seward Line*** Website available through SFOS > Research

Contains:

- time-series results
- individual cruises
- information on key species
- content still growing