

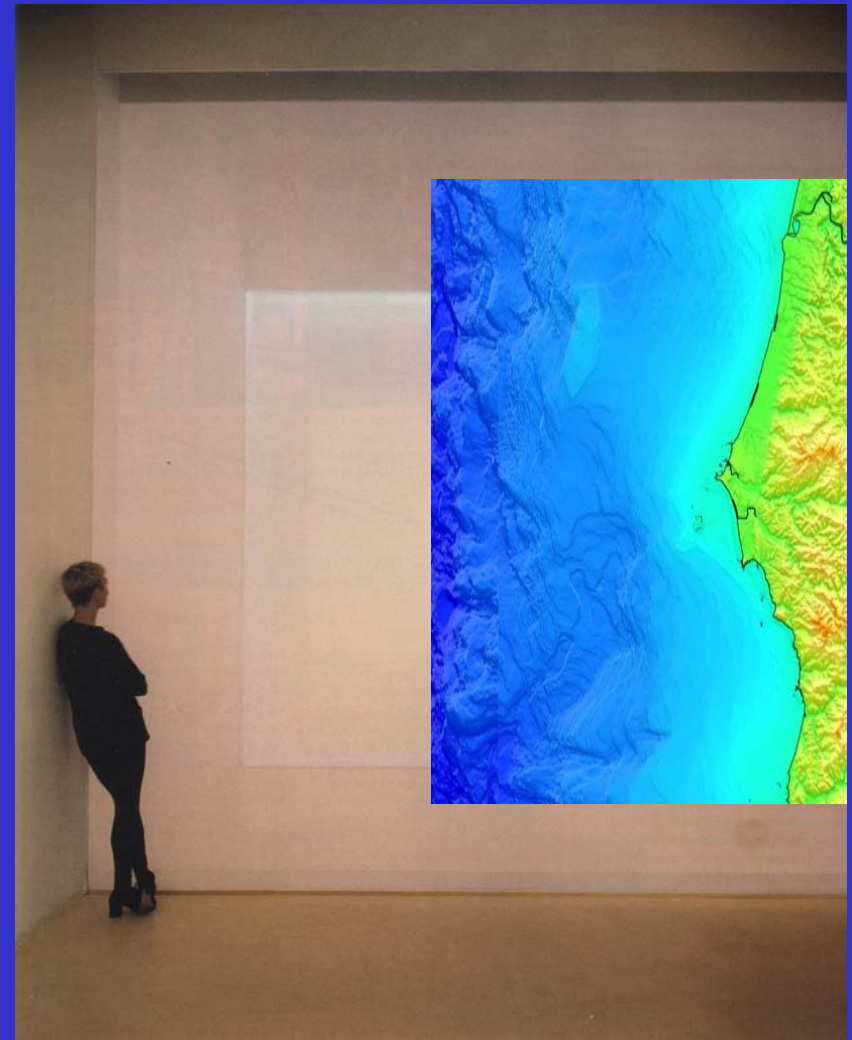
# Climate and NE Pacific Marine Ecosystems: A Matter of PLACE and FACE?

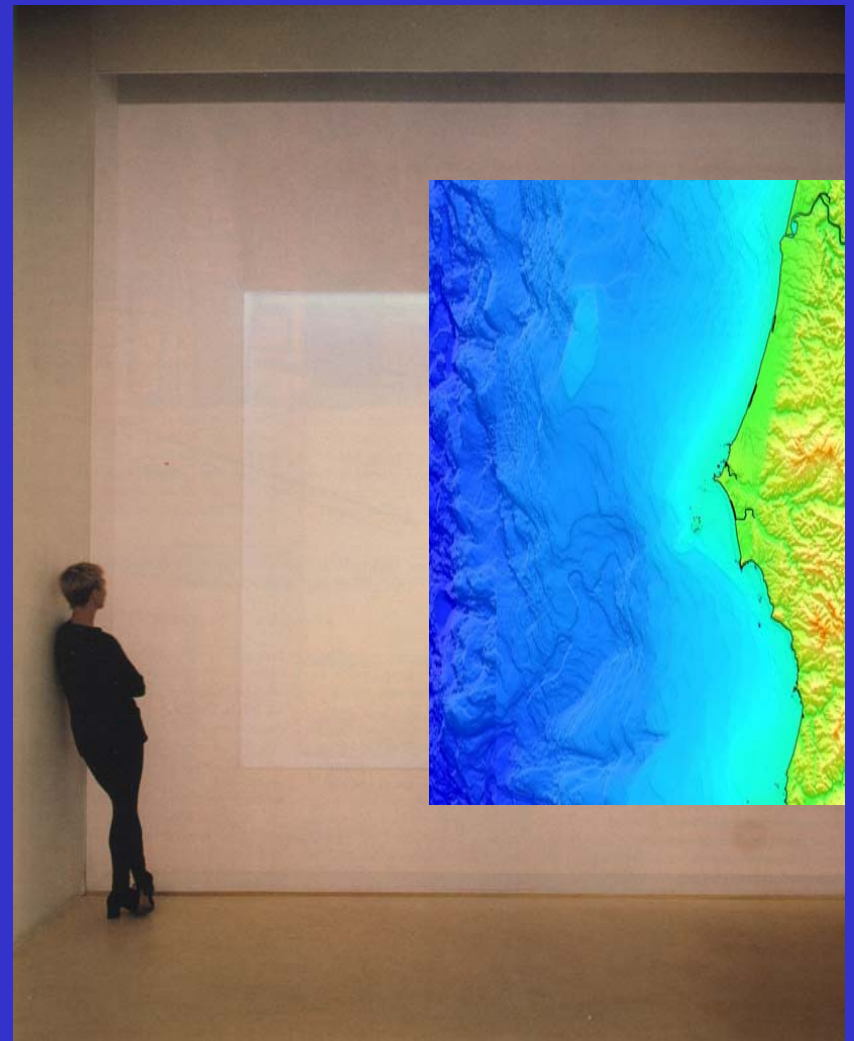
R.C. Francis

Center for Science in the  
Earth System

School of Aquatic and  
Fishery Sciences

University of Washington

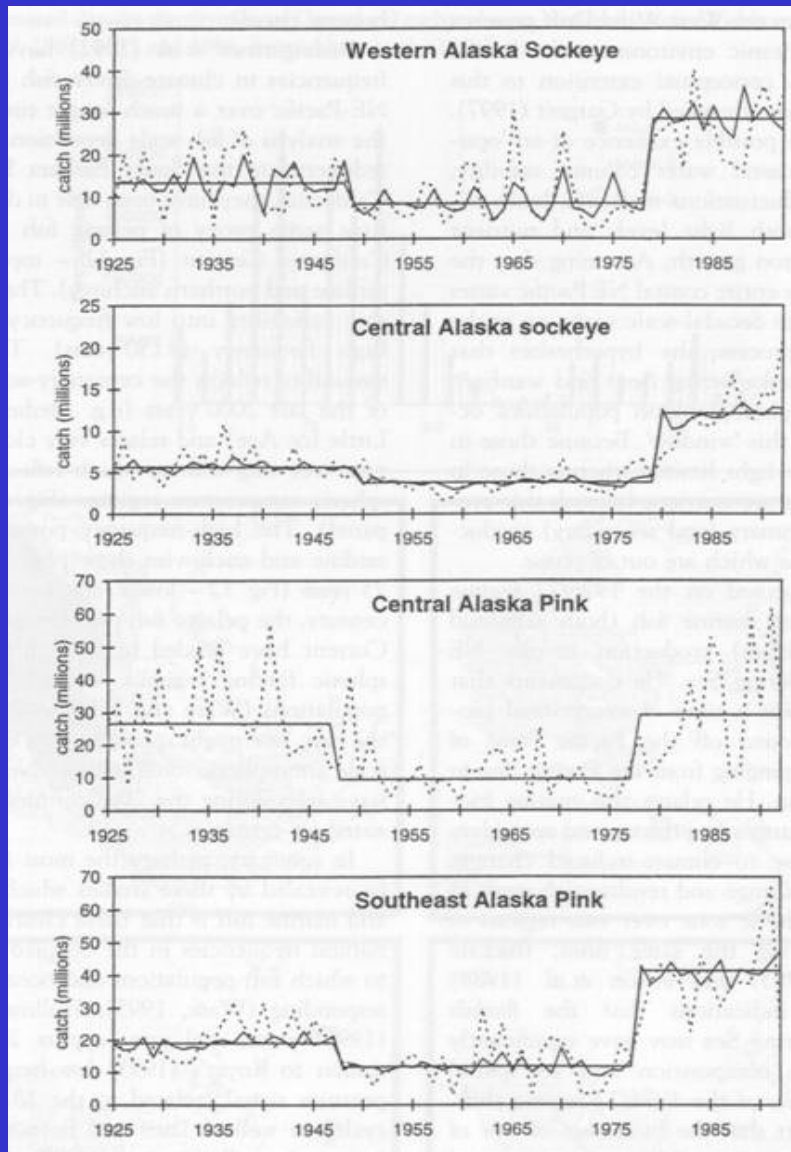




- A place is more than an area...A place is the extension of a presence or the consequence of an action.
- Whatever the painter is looking for, he's looking for its face,..., its expression - a slight sign of its inner life

John Berger, The Shape of a Pocket

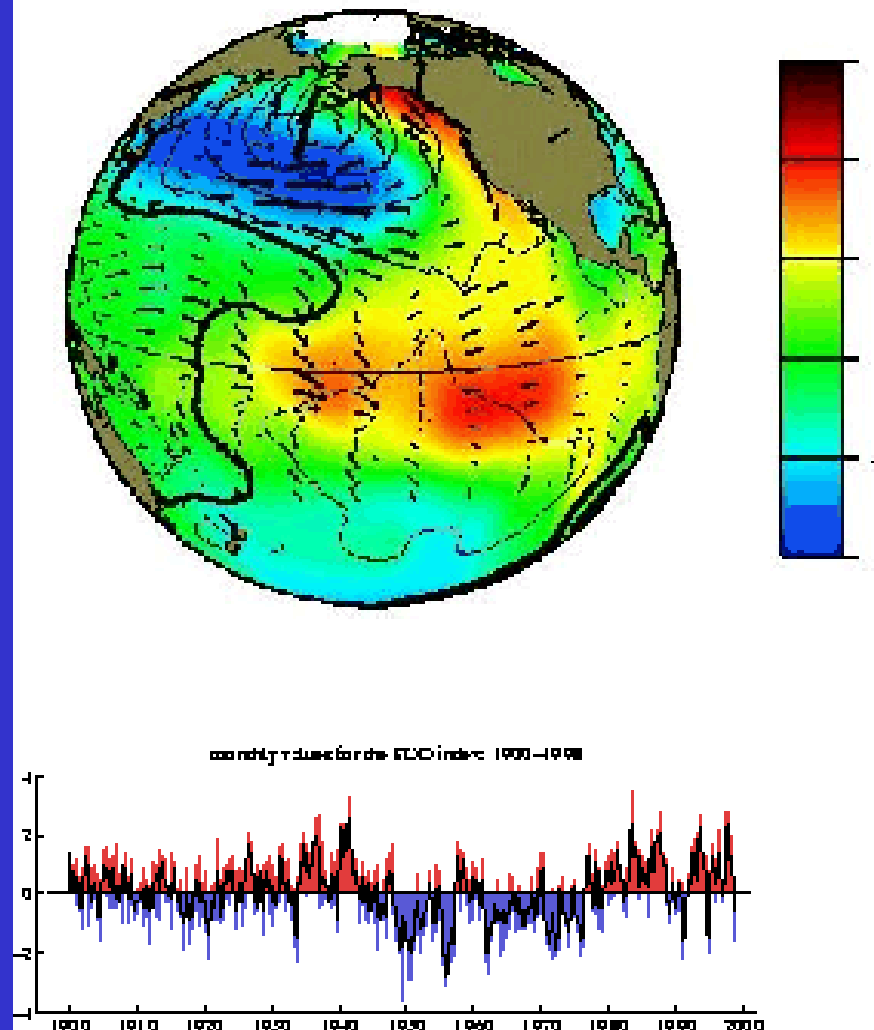
# Face



Francis and Hare 1994

# Place

## Pacific Decadal Oscillation

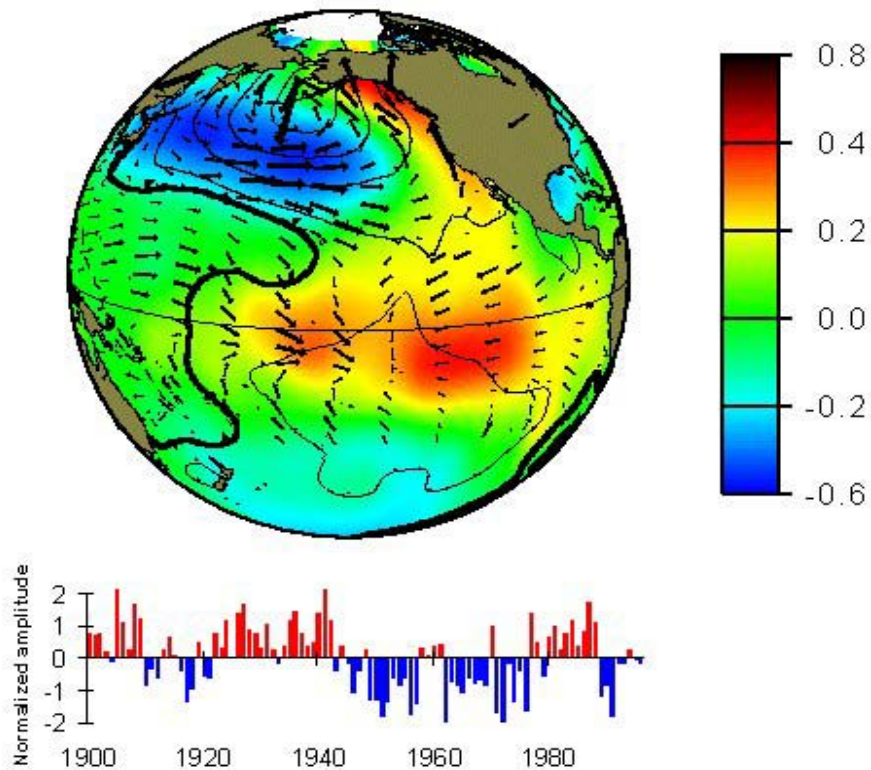


Mantua et al 1997

# Place

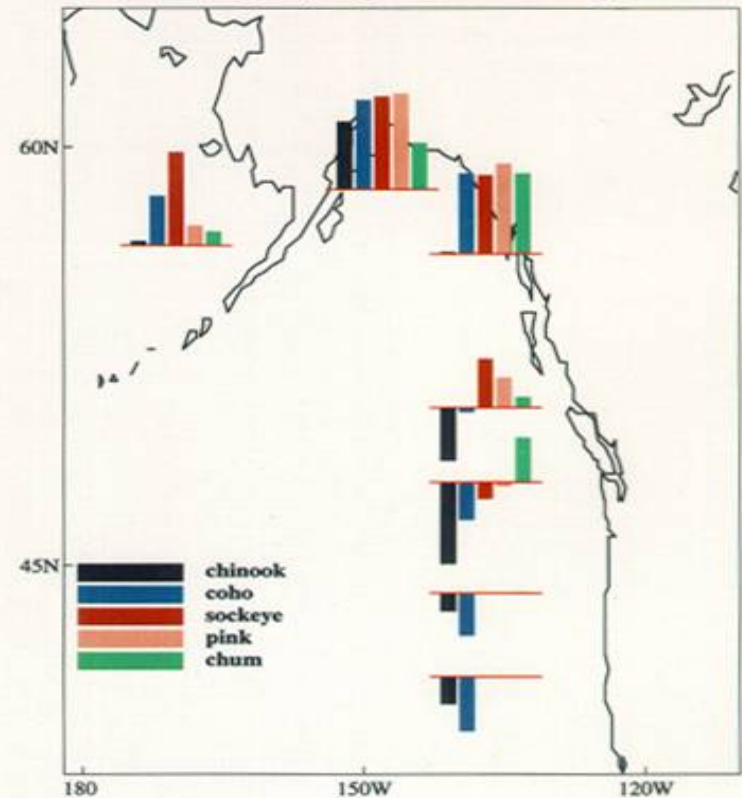
# Face

Pacific Decadal Oscillation

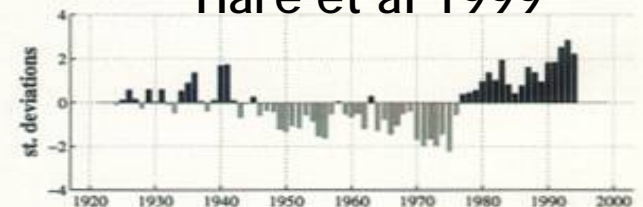


Leading EOF of NE Pacific salmon landings: 1925-1997

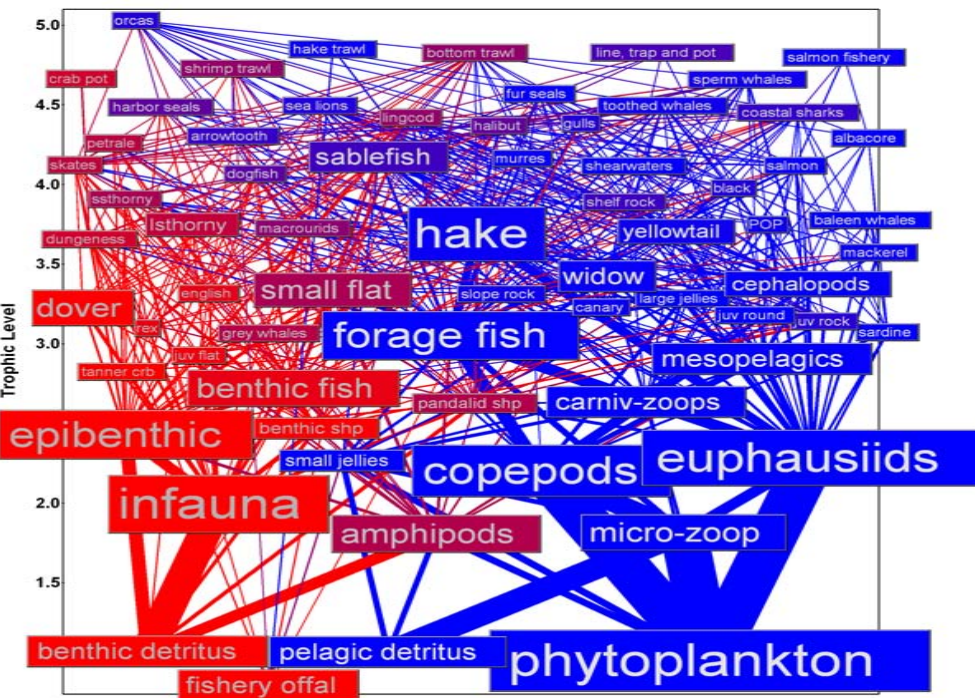
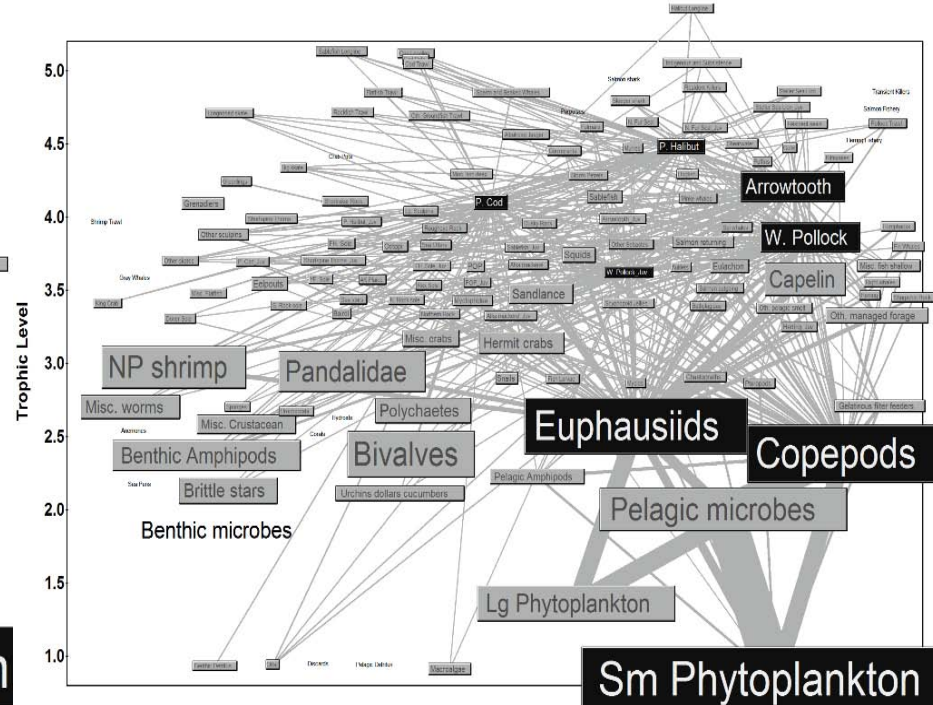
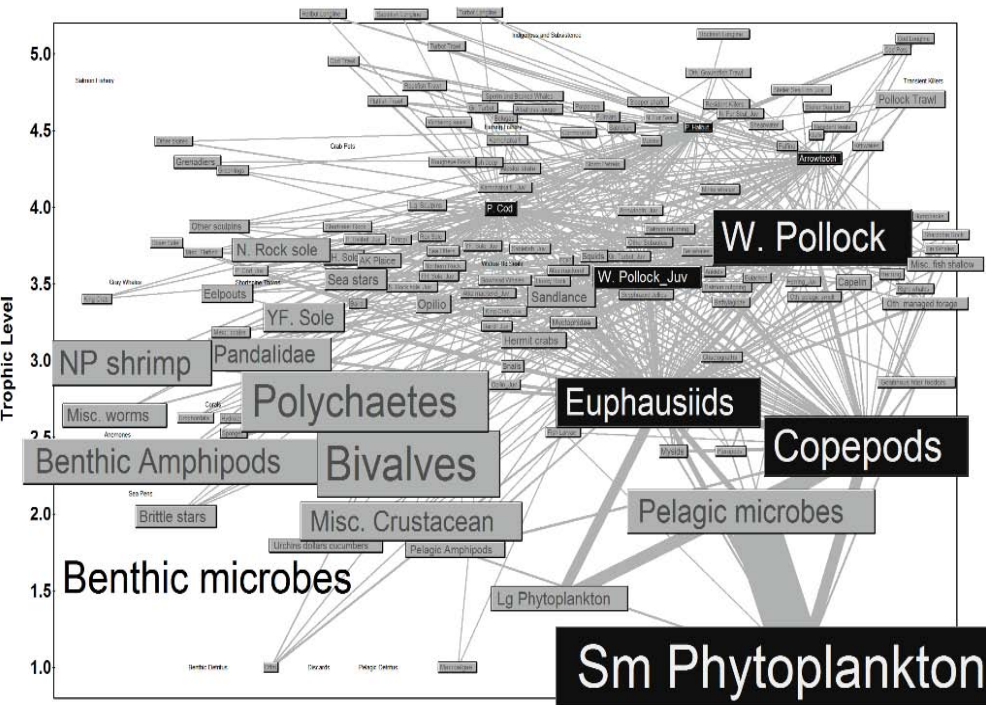
total of the regionally weighted catch variance explained: 34%



Hare et al 1999

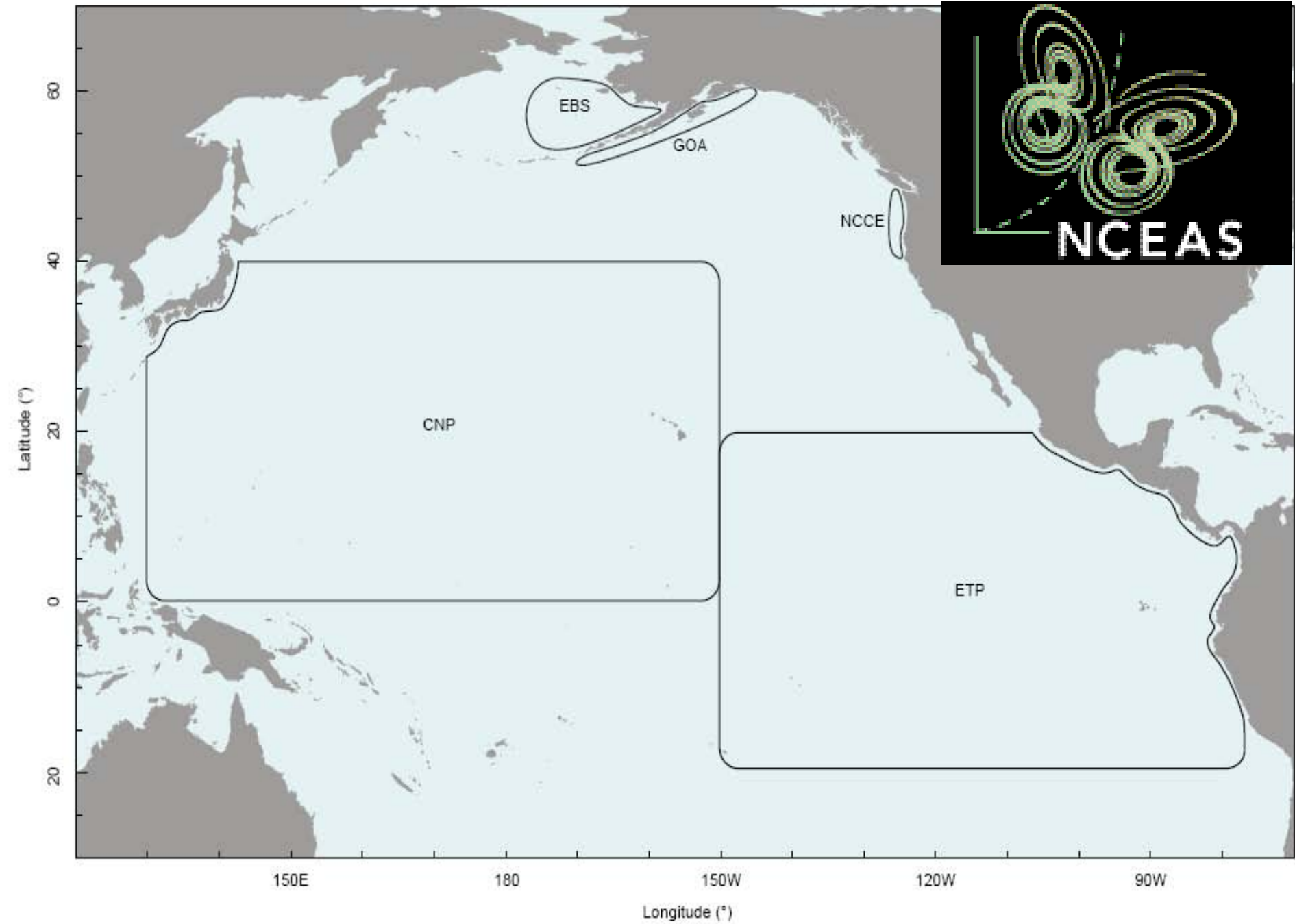




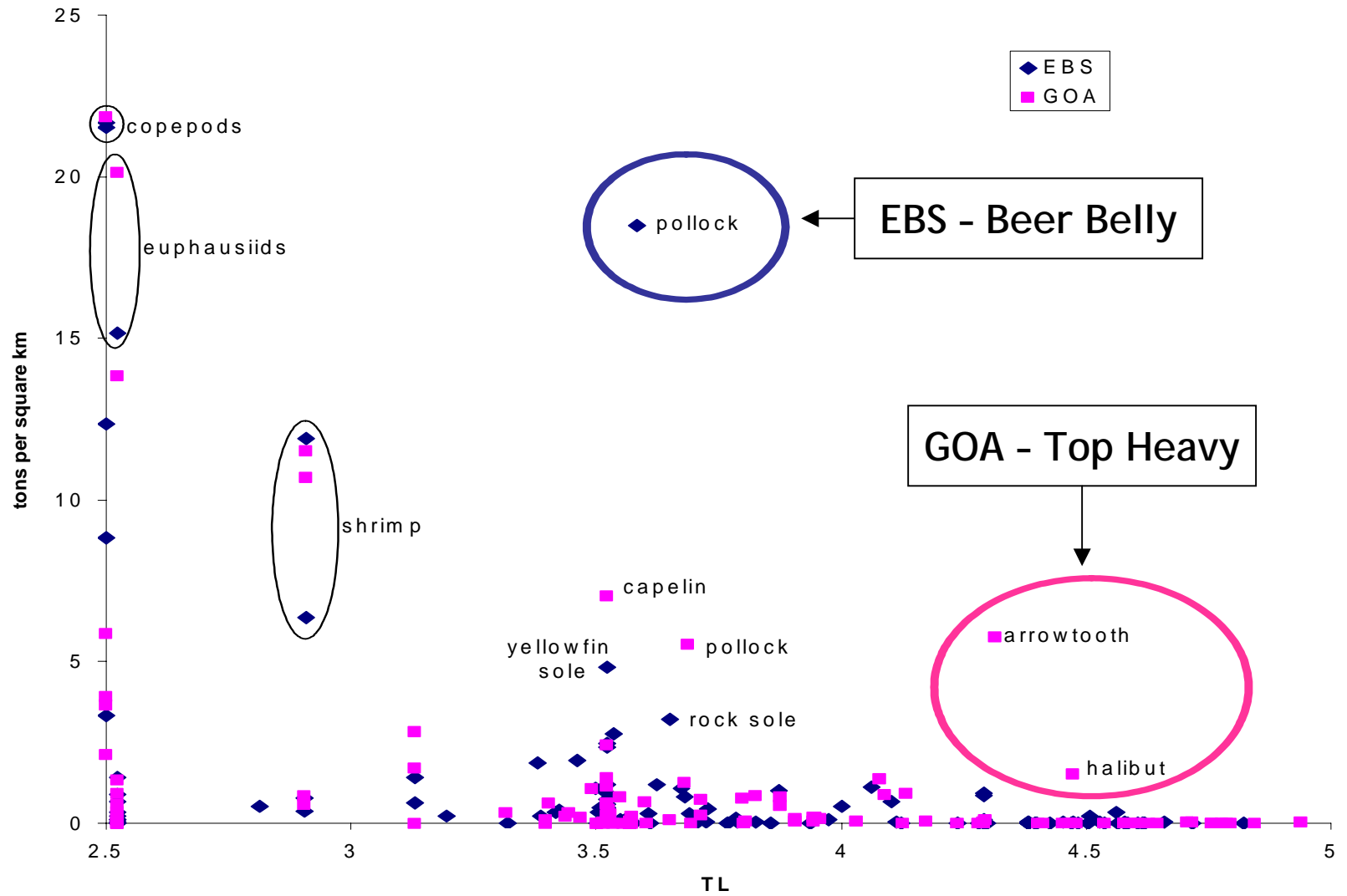


Food webs create the fundamental organizing relationships in ecosystems.

Paine 1980

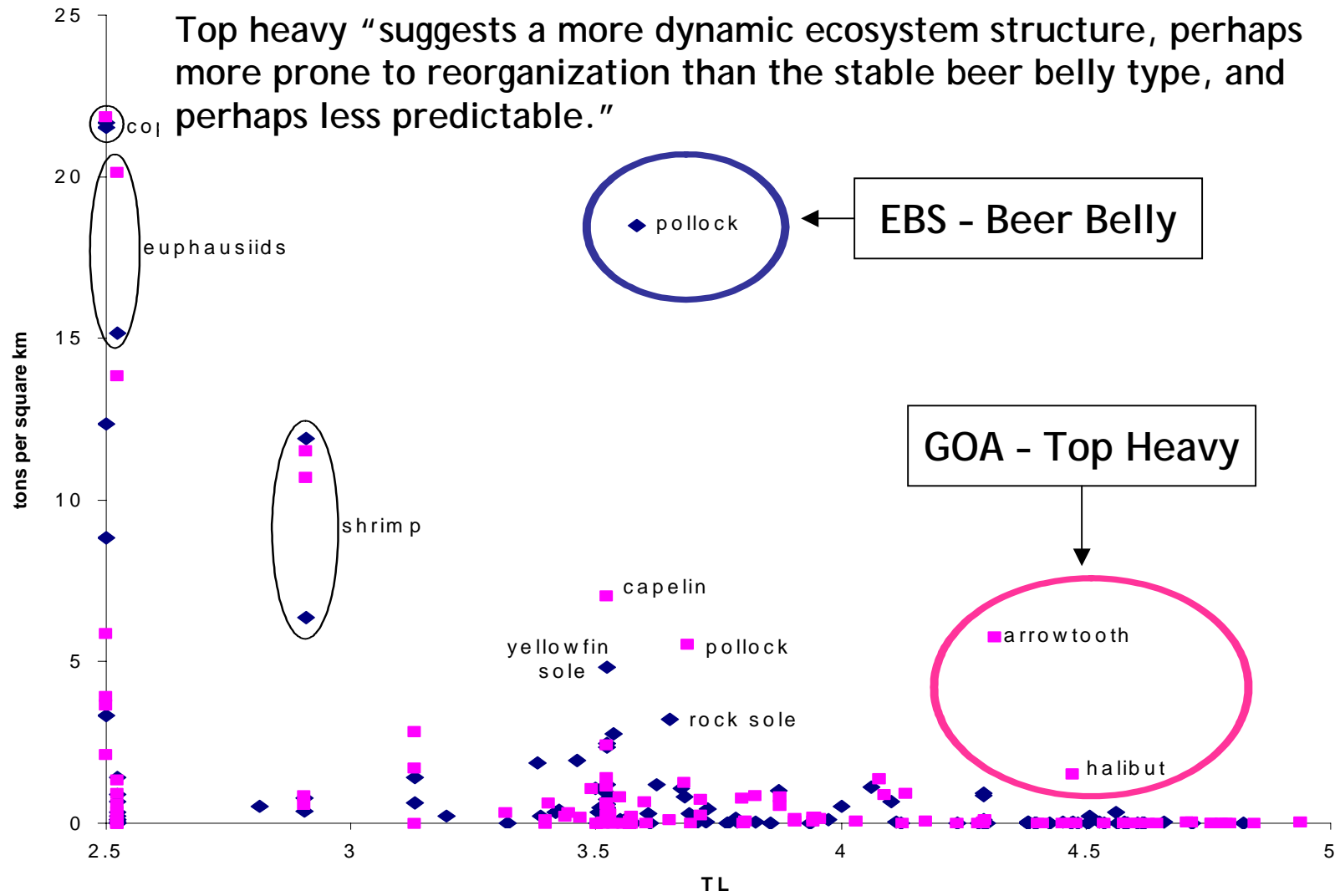


# Biomass by Trophic Level

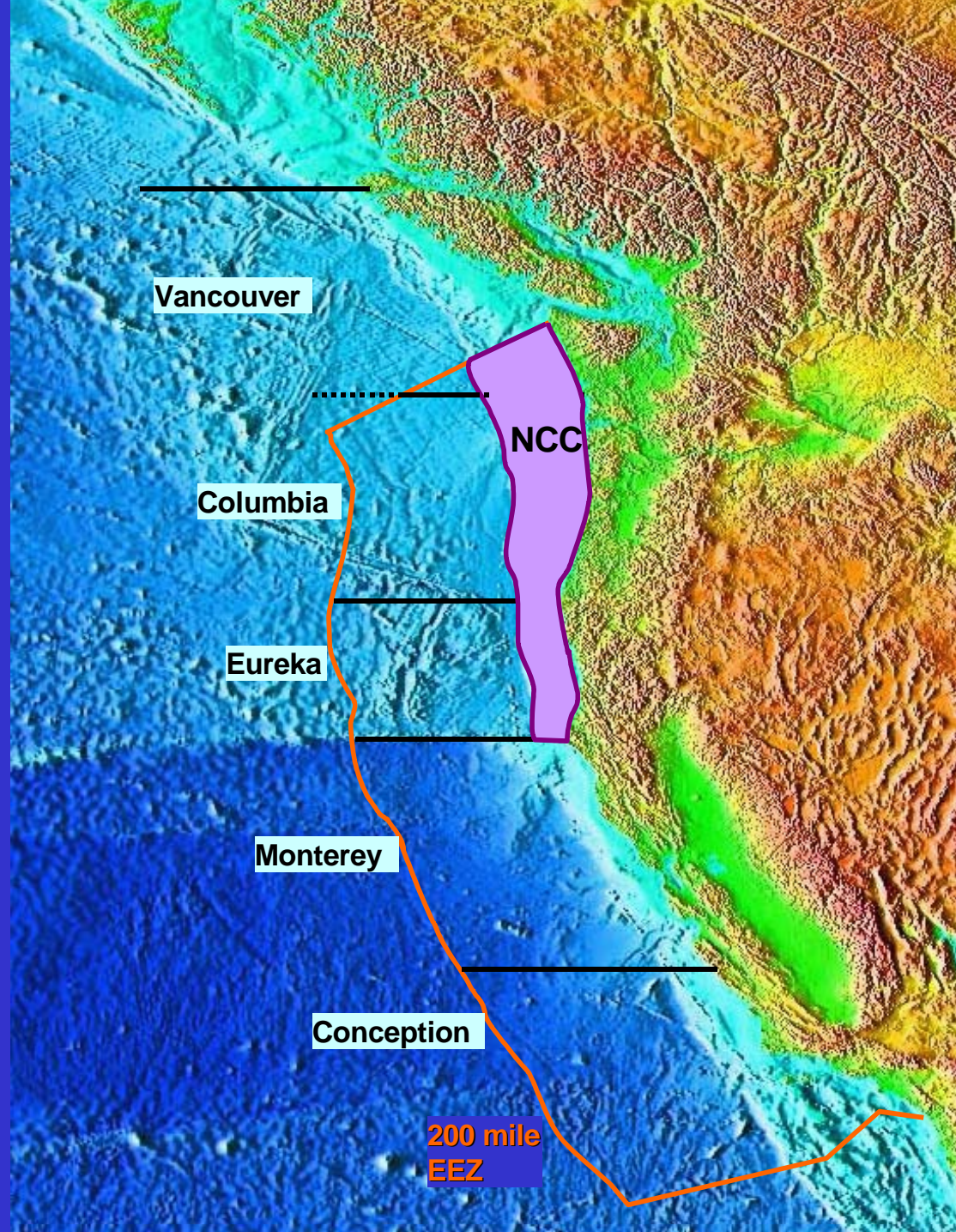




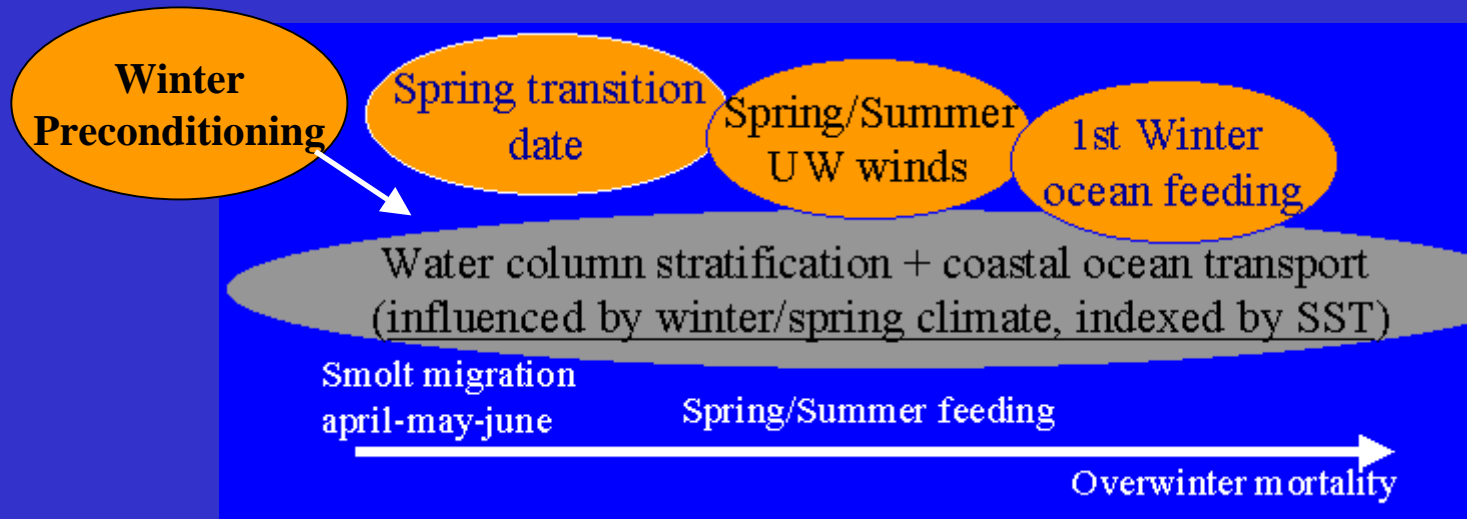
# Biomass by Trophic Level



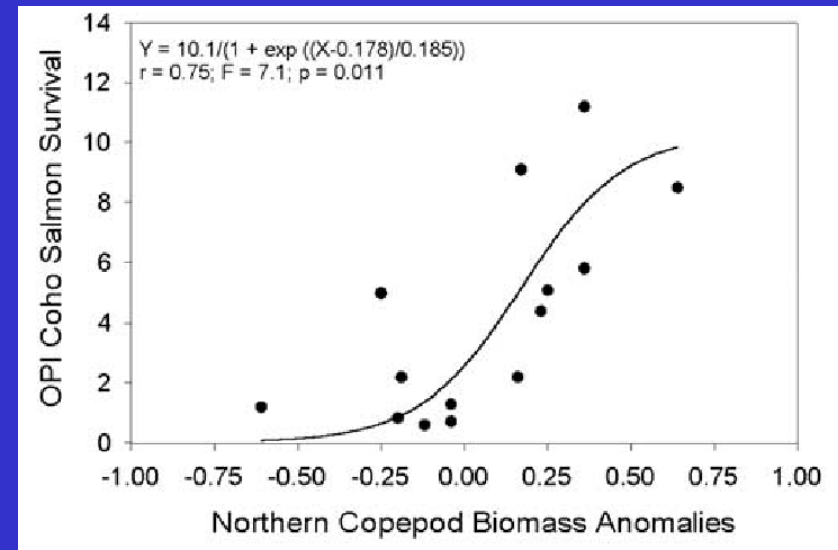
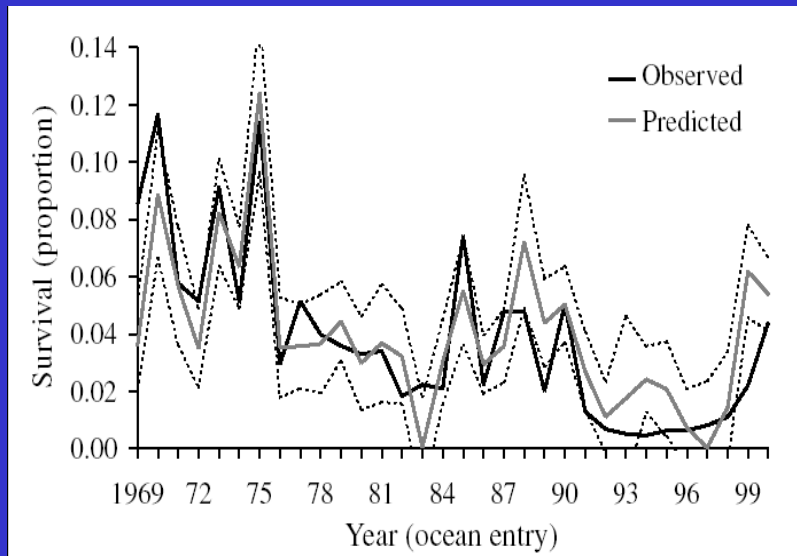
# Northern California Current (NCC) Ecosystem



Logerwell et al. (2003) found that Oregon coastal coho salmon survival was influenced by a series of (mostly) independent physical ocean processes..

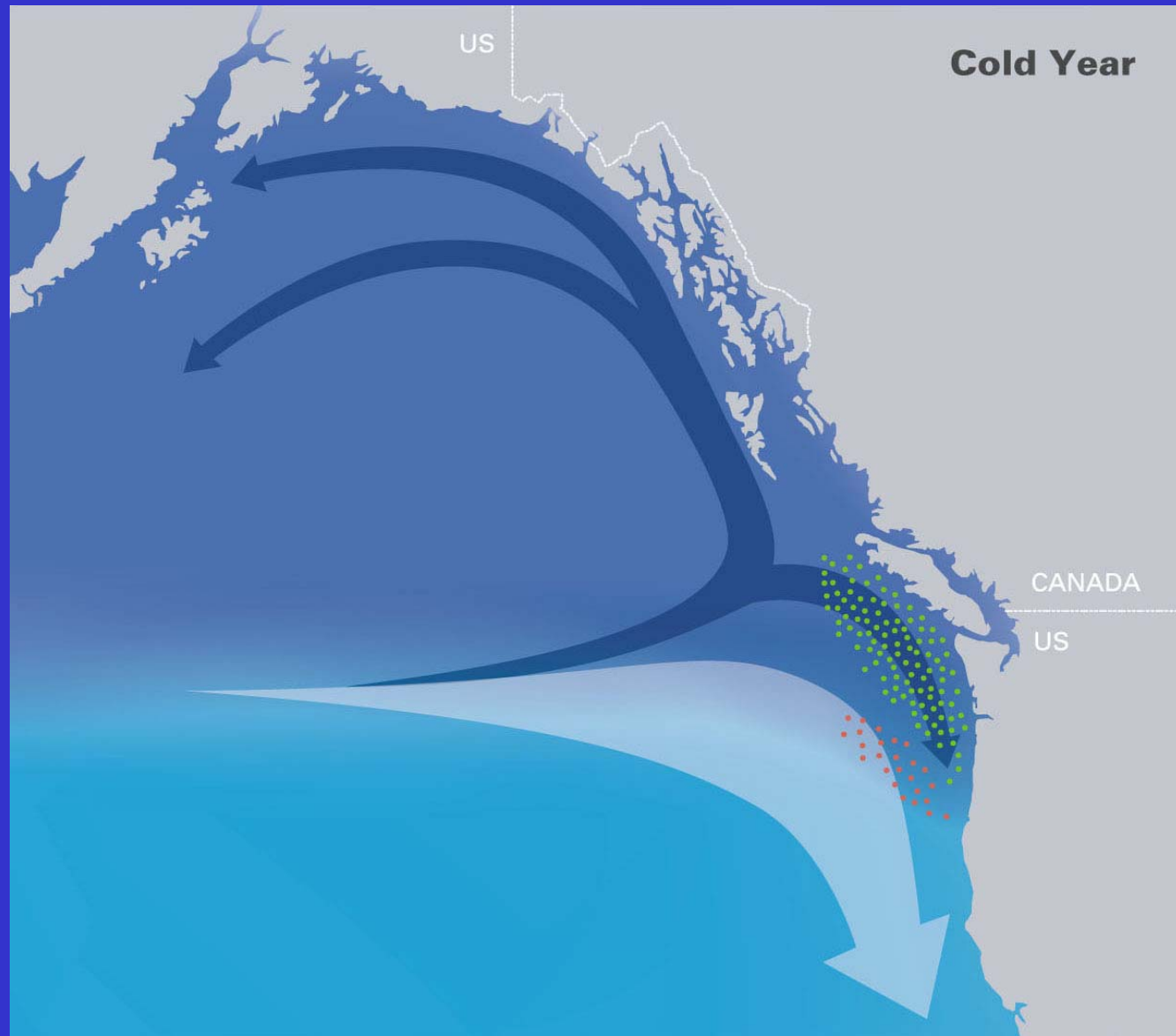


Peterson & Schwing 2004



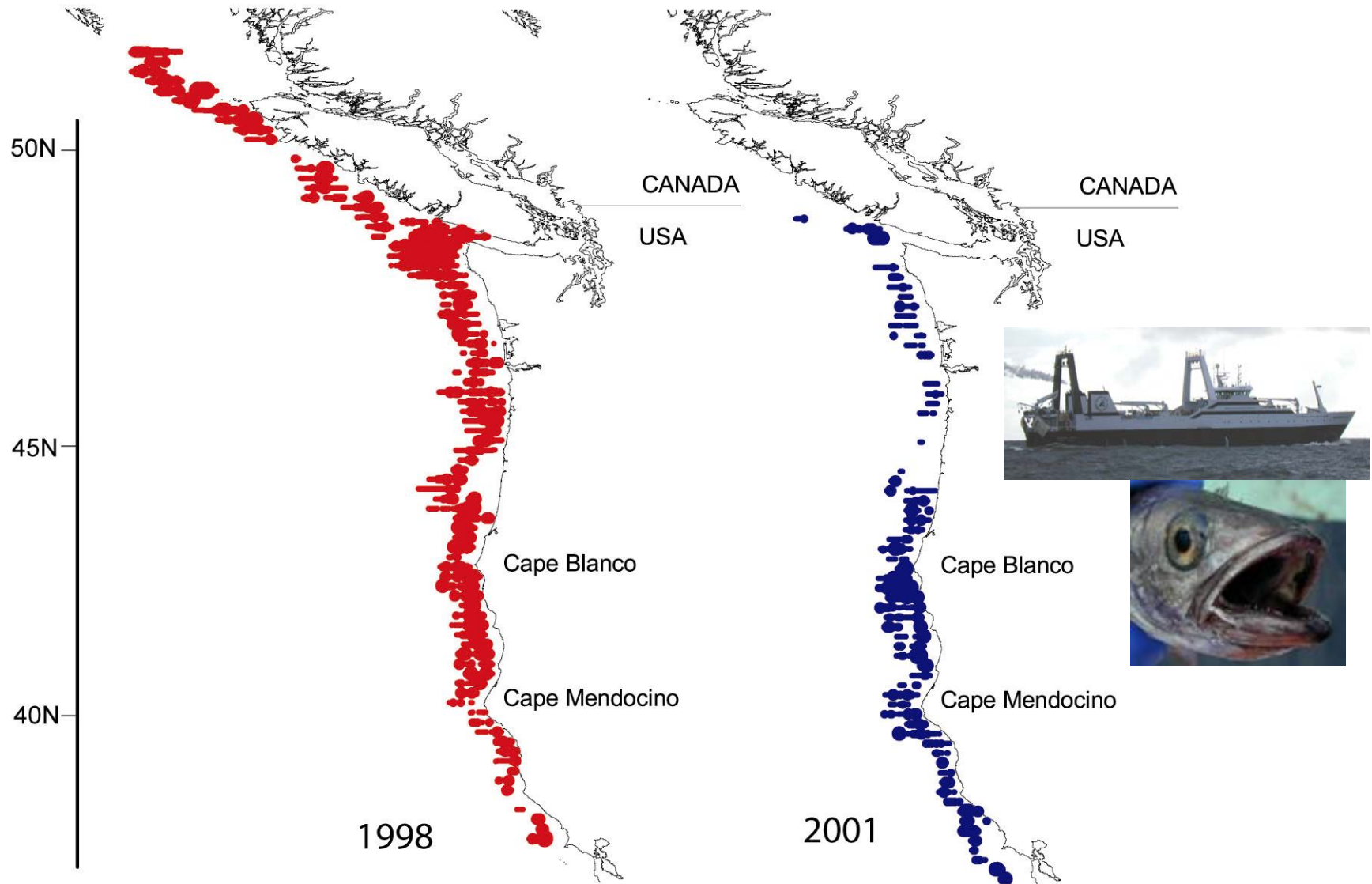


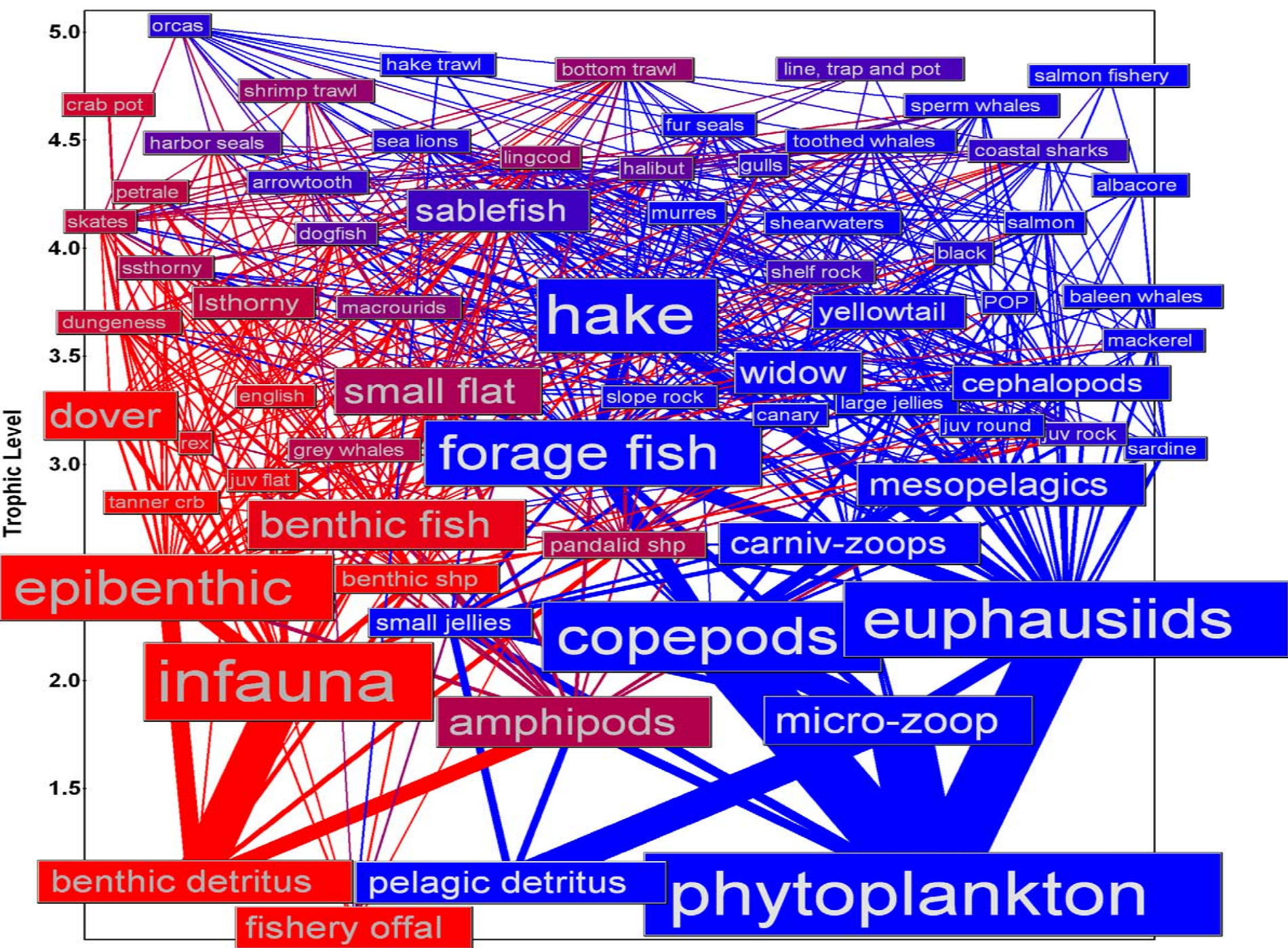
Climate drives  
the system from  
the bottom up ...  
(Logerwell)





# And the top down ... (PDO)





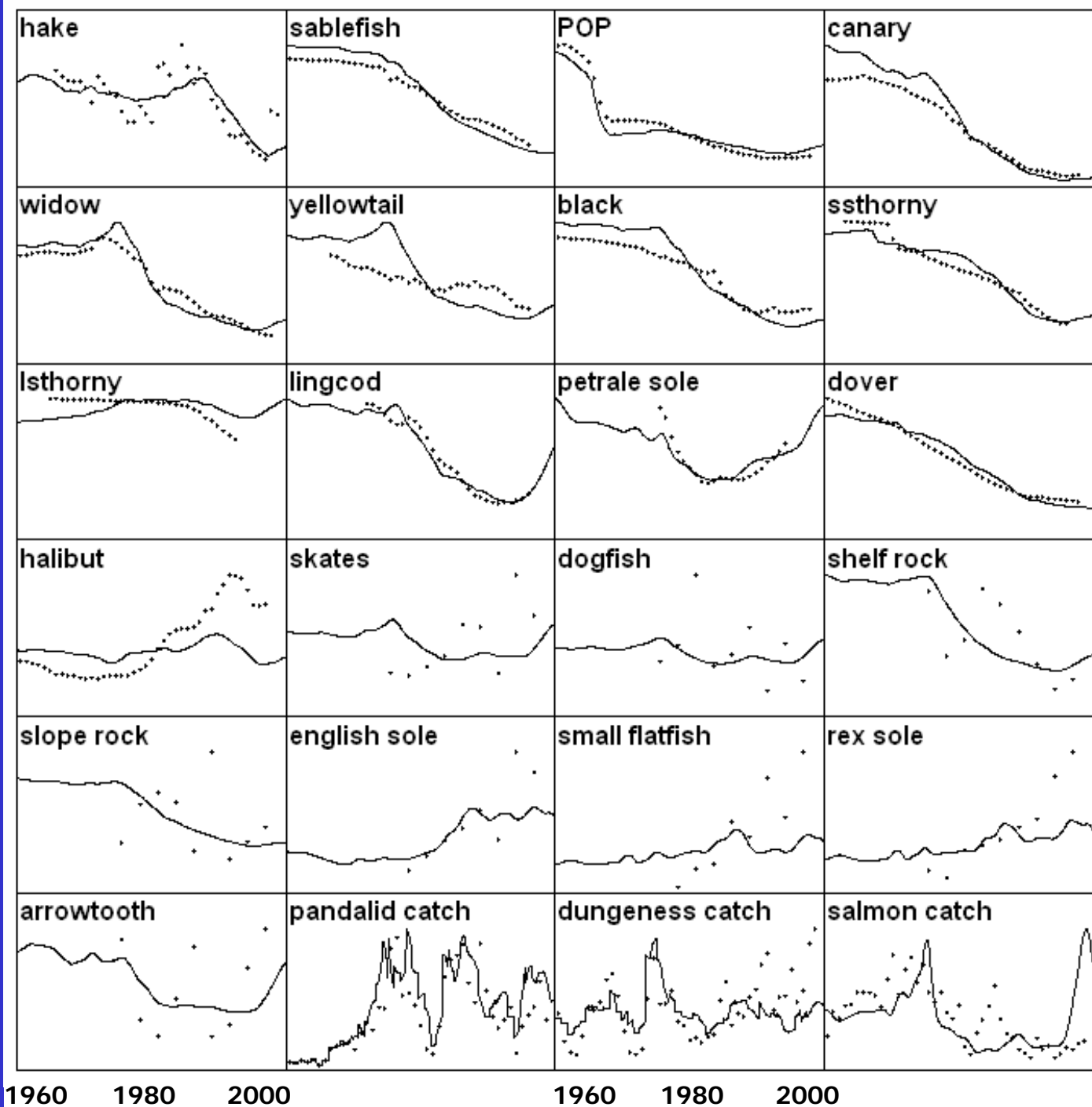


Model fitted to  
assessment,  
survey and catch  
data (1960-  
2002) with both  
the Logerwell  
index (bottom-  
up) and PDO  
(top-down)  
forcing

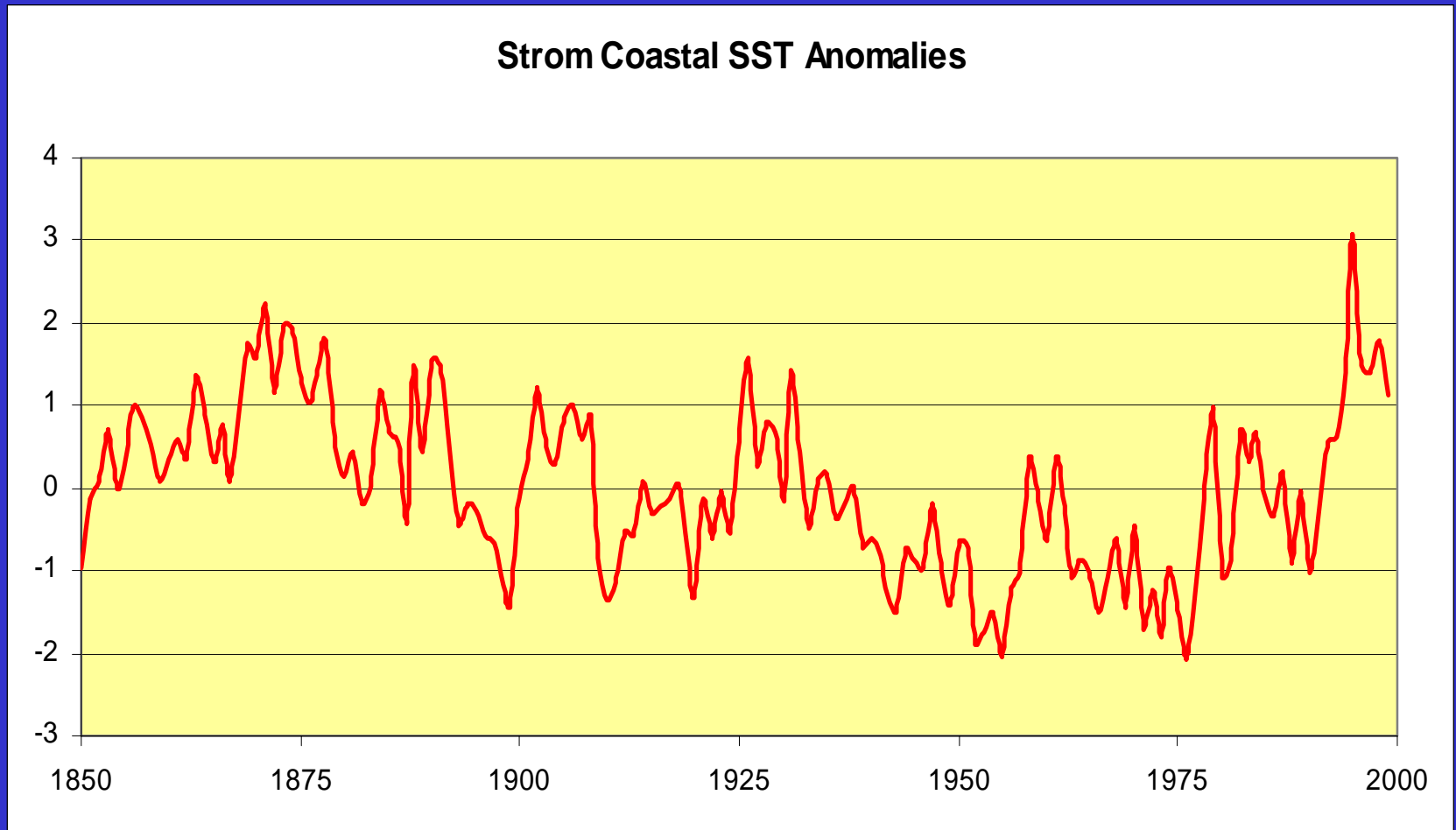
Neg log like:  
-379

no climate:  
-352

John Field  
Ph.D. dissertation  
SAFS UW, 2004



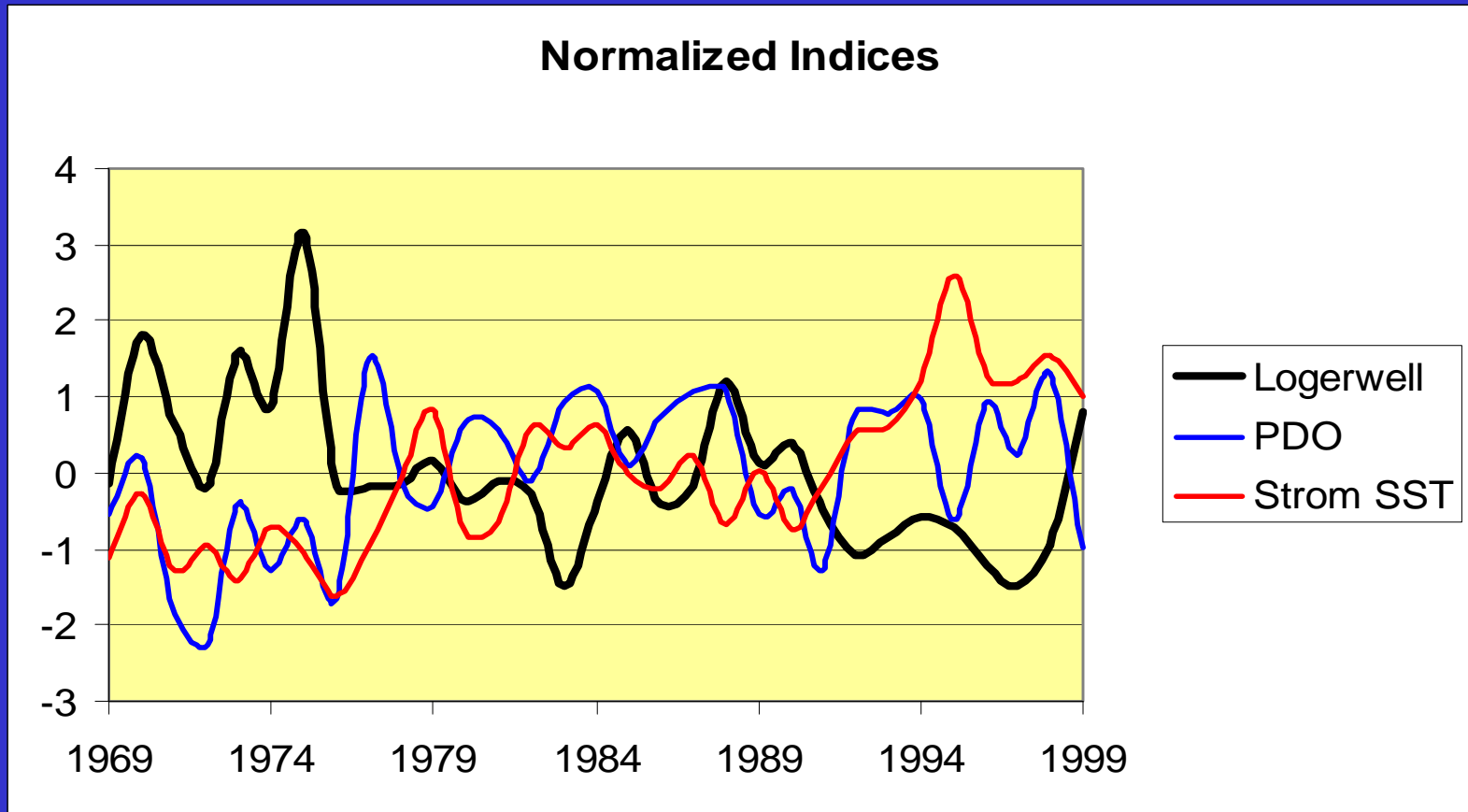
# Enter the Strom Coastal SST Index



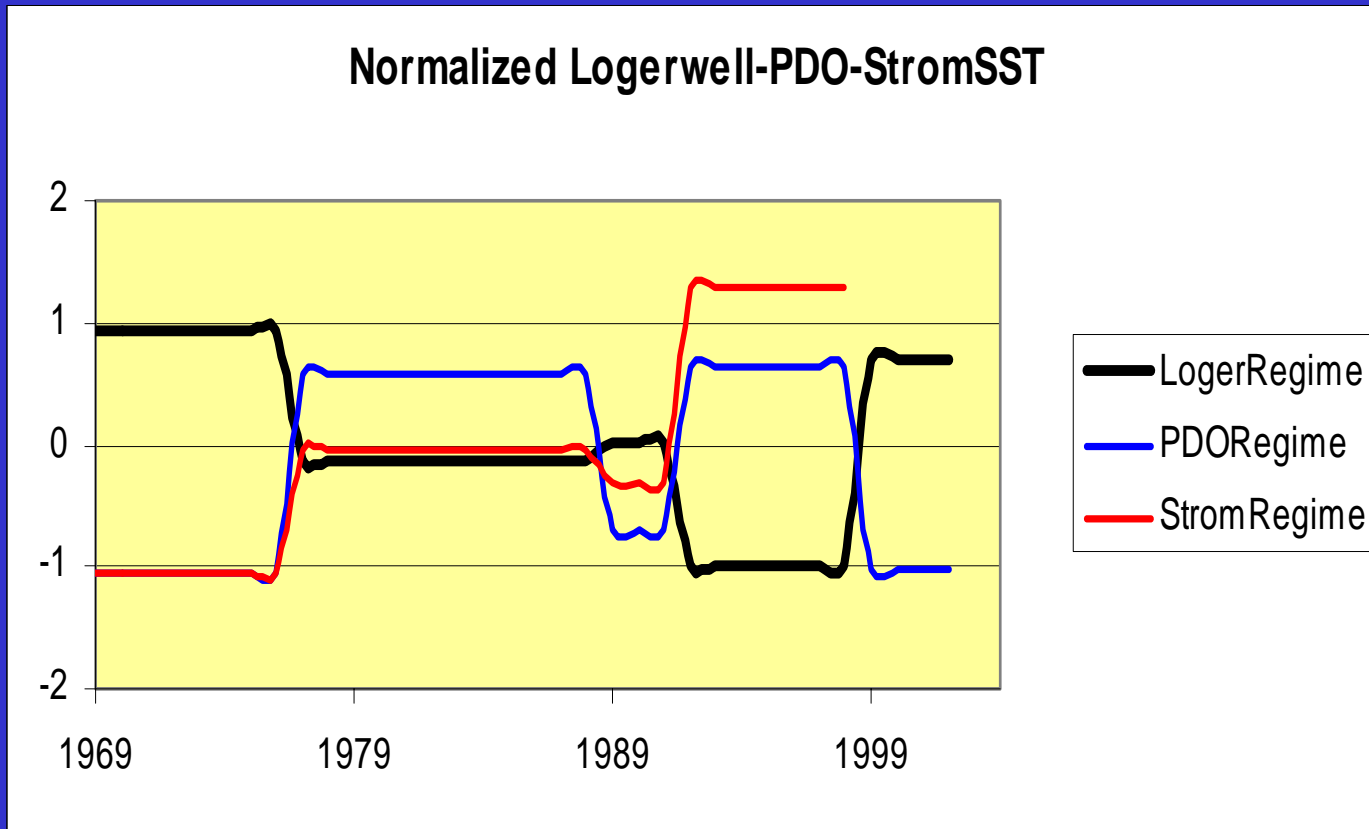
Strom et al (2004) Geophys. Res. Lett. 31



Question: How do PDO and Strom (SST) relate to Logerwell (salmon survival)?



# Let's look at the regime scale



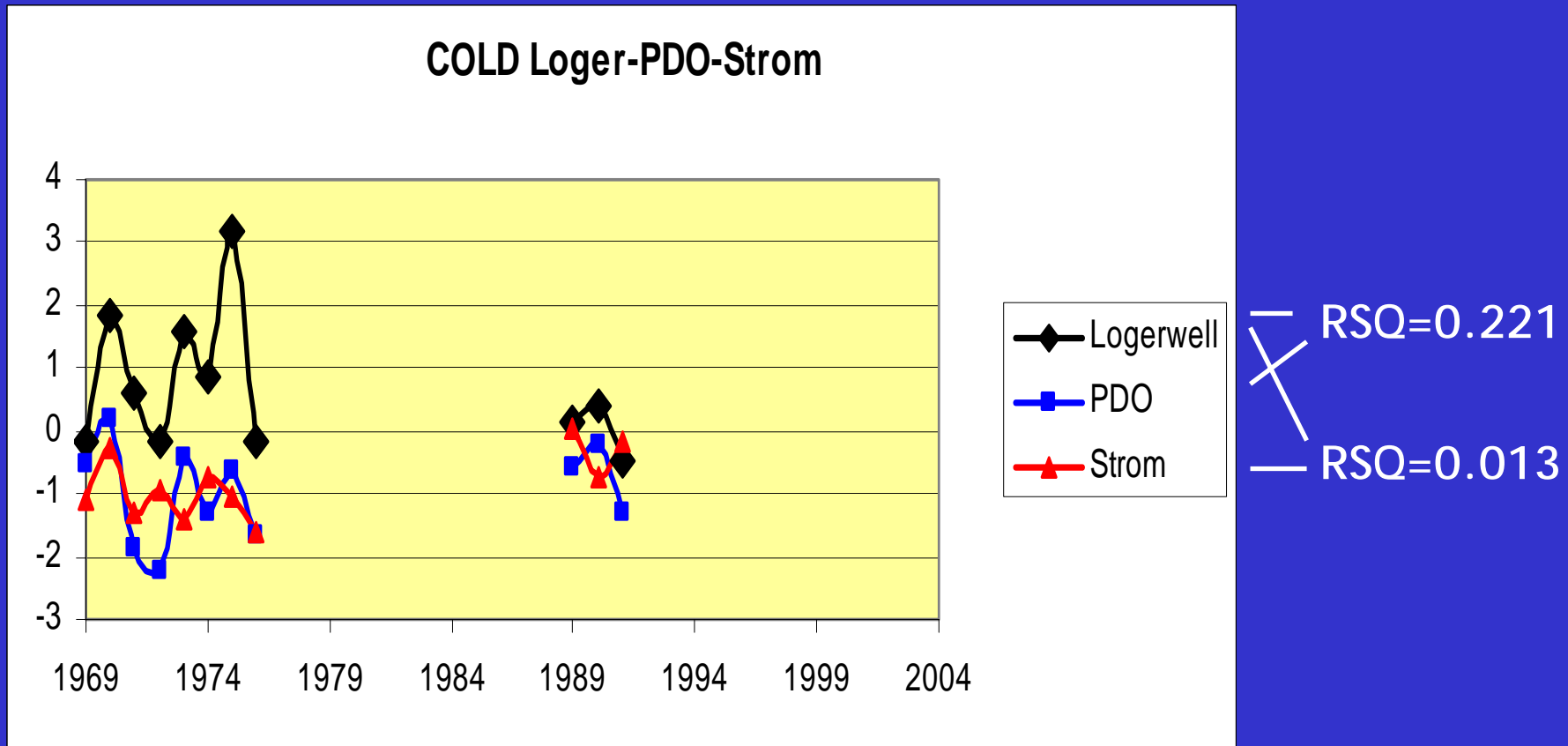
RSQ=0.703

RSQ=0.960

# So what does this say about the structuring of the NCC by climate?

- At the regime scale, whatever affects salmon marine survival is better described by coastal SST than PDO.
  - ❖ This was particularly the case in the 1990s.
  - ❖ The global SST trend is removed in the PDO index calculation (Nate Mantua, pers. commun.)

# Now let's look at the interannual scale within a cold regime



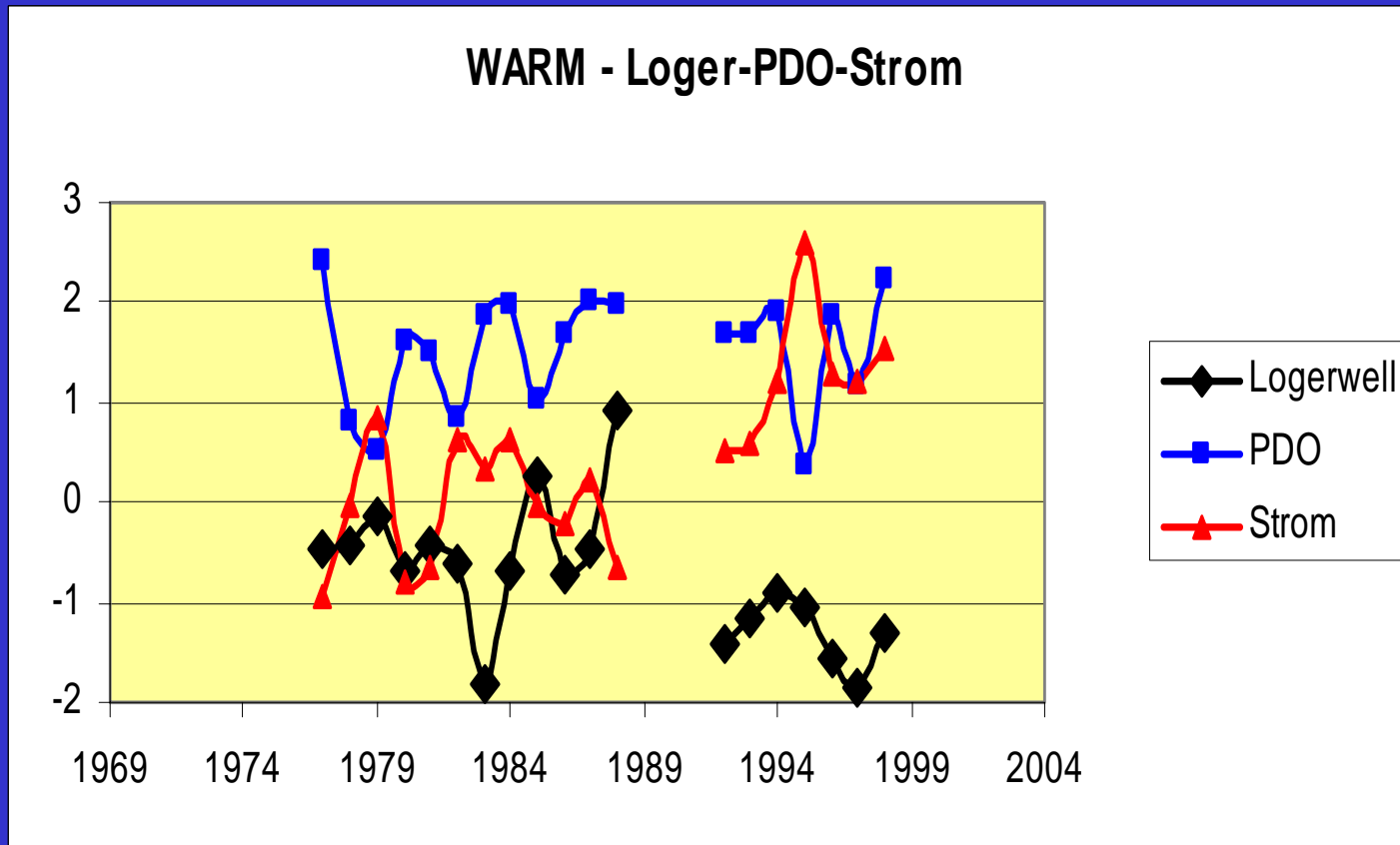
R.C. Francis, SAFS UW, Just messin' around more, 2006



# So what does this say about the structuring of the NCC by climate?

- During cold regimes PDO better describes interannual variability in salmon survival
  - ❖ Is PDO a better indicator than SST of upper ocean structure and dynamics (winter preconditioning, advection) which leads to high productivity?
  - ❖ During times of high productivity, “everything eats euphausiids” (Todd Miller, grad student OSU)

# Now let's look at the interannual scale within a warm regime



— RSQ=0.013  
X  
— RSQ=0.278

# So what does this say about the structuring of the NCC by climate?

- During warm regimes SST better describes variability in salmon survival.
  - ❖ Does this indicate the dominance of top-down forcing (predation, competition) during warm periods?
  - ❖ When productivity is low, predators eat “whatever they can find.” (Todd Miller, OSU)

# So what does this say about the structuring of the NCC by climate?

- Logerwell salmon survival index may reflect different climate processes at work during cold (bottom-up) and warm (top-down) regimes.
- Logerwell has ecosystem carryover - salmon provide a good model for climate-ecosystem forcings.
- PDO fails as top-down indicator in 90s when warming signal in coastal ocean very strong.



## SPECIAL REPORT GLOBAL WARMING

## TIME

BE  
WORRIED.  
BE **VERY**  
WORRIED.

Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well

EARTH AT THE **TIPPING POINT**

HOW IT THREATENS YOUR **HEALTH**

HOW **CHINA & INDIA** CAN HELP  
SAVE THE WORLD—OR DESTROY IT

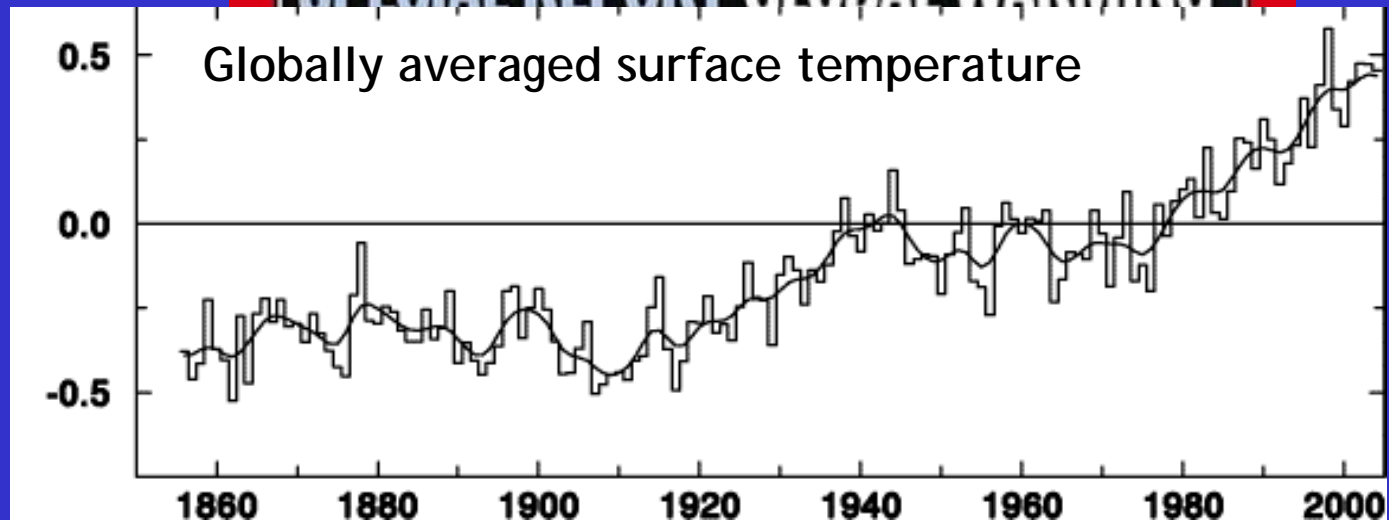
THE CLIMATE **CRUSADERS**



APRIL 3, 2006

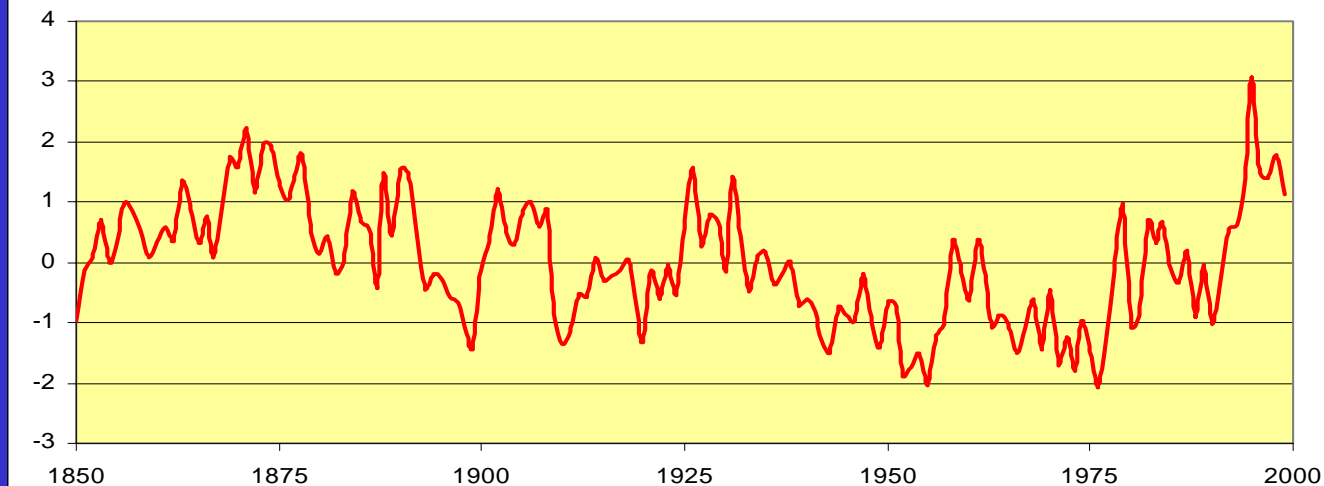
www.time.com AOL Keyword: TIME

## SPECIAL REPORT GLOBAL WARMING

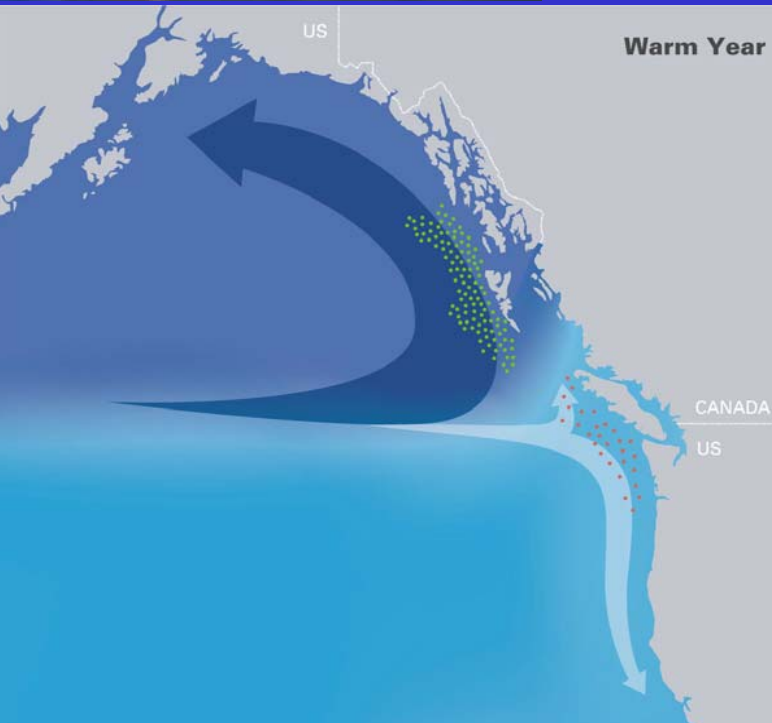
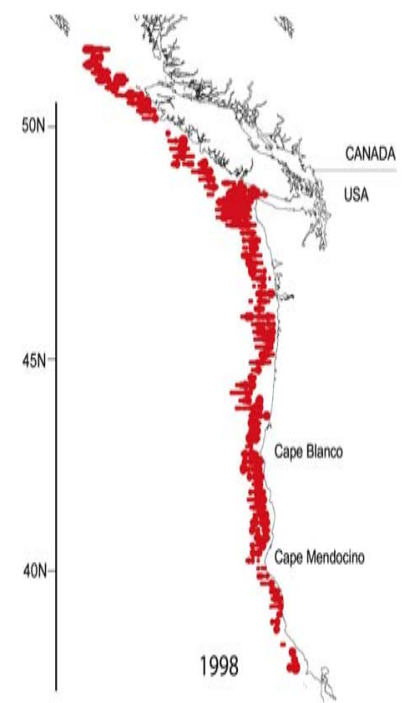


**BE VERY  
WORRIED.**

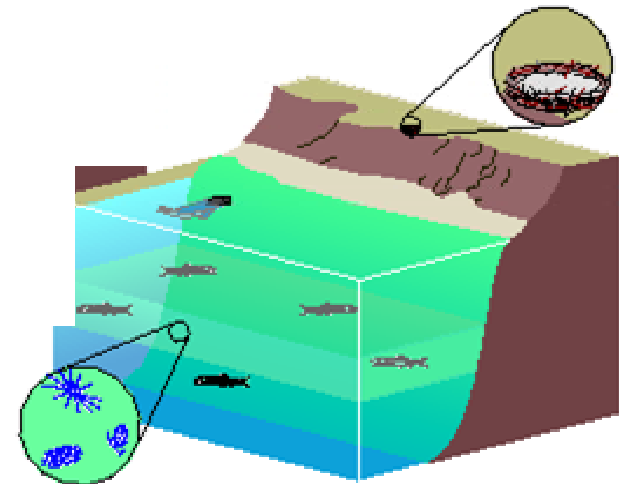
Strom Coastal SST Anomalies



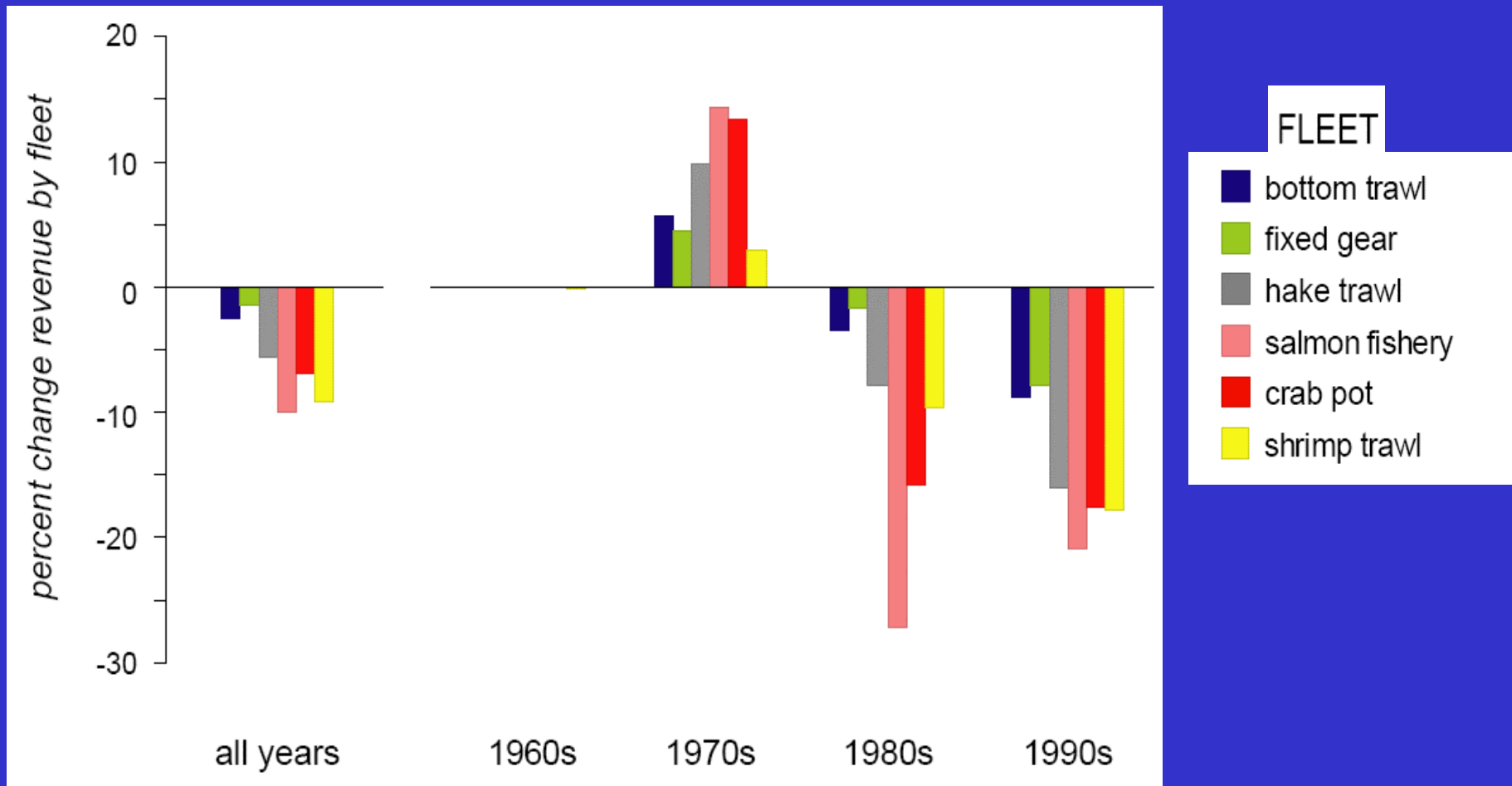
# PLACE



Warm water, Strong stratification,  
Low productivity, "Subtropical"  
food web, Strong top-down effects)



# FACE



Jodie Little, Ph.D. dissertation, SAFS UW, in progress