This presentation was made to the U.S. GLOBEC Scientific Steering Committee at their semiannual meeting in November 2004 in Boulder, CO. It was made by Hal Batchelder, using mostly materials recently shown at the PICES XIII Conference in October 2004. I thank the providers of the slides for allowing me to present this information.

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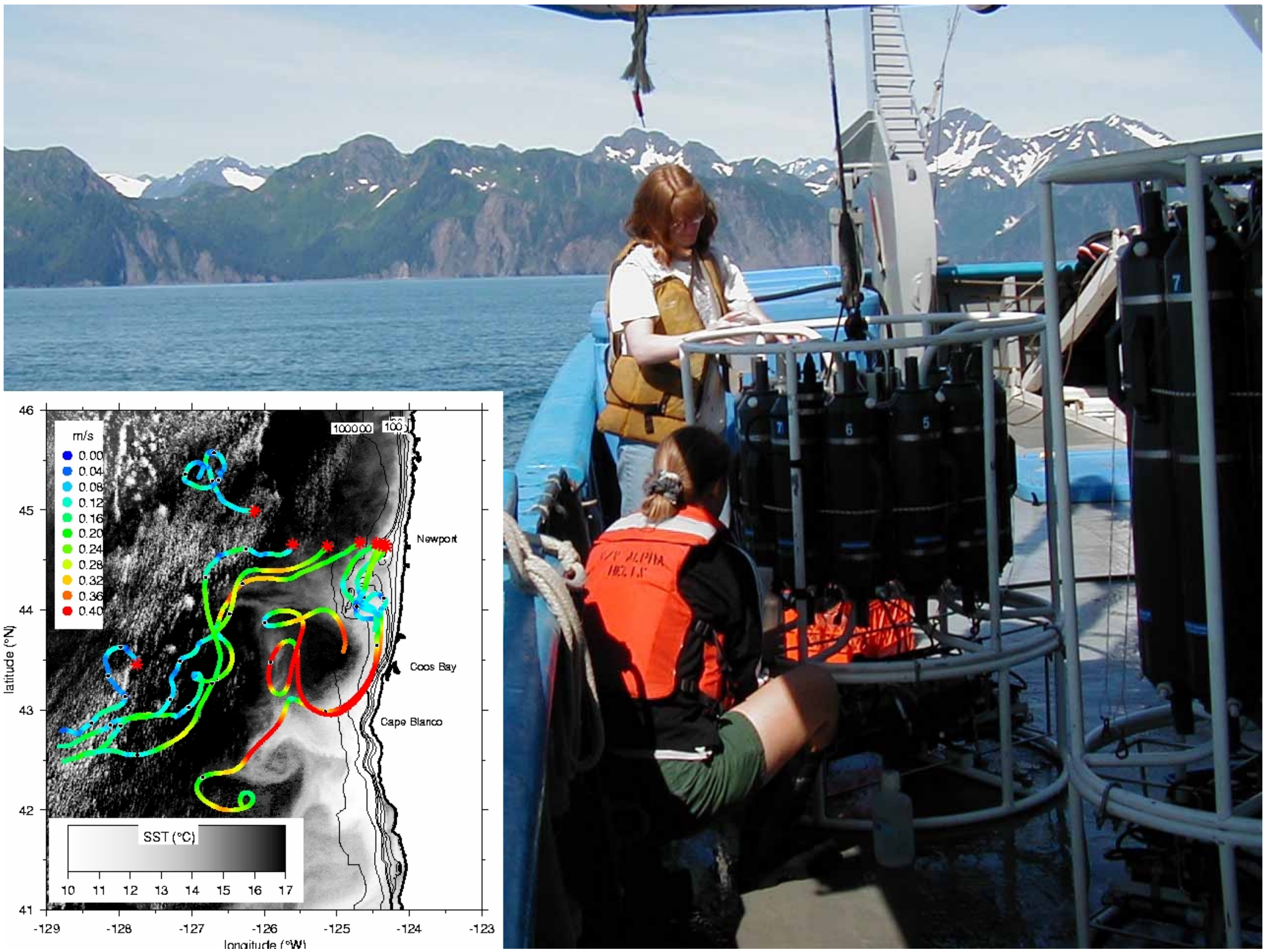
GLOBEC NEP Special Issue of DSR II—Expected 1st Issue of 2005

US GLOBEC Biological and Physical Studies of Plankton, Fish, and Higher Trophic Level Production, Distribution, and Variability in the Northeast Pacific

Guest Editors: Batchelder, Lessard, Strub and Weingartner



CCCC Topic Session (S9)

The Impacts of Large-Scale Climate Change on North Pacific Marine Ecosystems

Convenors: Hal Batchelder, Bill Crawford,
Mike Dagg, and Suam Kim

Part A. Wednesday, October 20, 2004, 1330-1710

Part B. Thursday, October 21, 2004, 0830-1630

Part C. Posters…EQUALLY IMPORTANT: ca. 19 posters on display from 19-21 October (dedicated poster session 20 October, 1730-1930)

CCCC Topic Session (S9)
The Impacts of Large-Scale Climate Change on North Pacific Marine Ecosystems

- 8 oral presentations (of 25)
- 11 poster presentations (of 19)
- +8 oral presentations in other sessions; 1 other poster

EPOC 2004 Meeting, Vancouver Island, 22-25 Sept 2004

Well attended by NEP investigators

CCS Synthesis

- 14 proposals received
- 9 may be supported, depending on availability of funds

CGOA Synthesis

- AO prepared; under review by agencies
- Target date in March-April 2005

NEP Data Streams…

Substantial effort on getting CCS data sets online this past year—much progress

Less emphasis on getting CGOA data online—less progress, but will be an emphasis for next 6 months

What's Next…Near term

15-16 November 2004 – CCS SI Mtg; Corvallis, OR

31 Jan-2 Feb 2005 – CGOA SI Mtg; Seattle, WA

Further Out…

SCOR WG on Comparative Studies of Marine Zooplankton (new 2005 SCOR WG) developed from a workshop held in Gijon at ZP Production Symposium

A PICES and GLOBEC International Symposium on

Climate Variability and Ecosystem Impacts on the North Pacific: A Basin-Scale Synthesis
19-21 April 2006, East-West Conference Center, Honolulu, HI

A PICES and GLOBEC International Symposium on

Climate Variability and Ecosystem Impacts on the North Pacific: A Basin-Scale Synthesis

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We invite papers that provide interdisciplinary or multiregional comparisons on themes of:

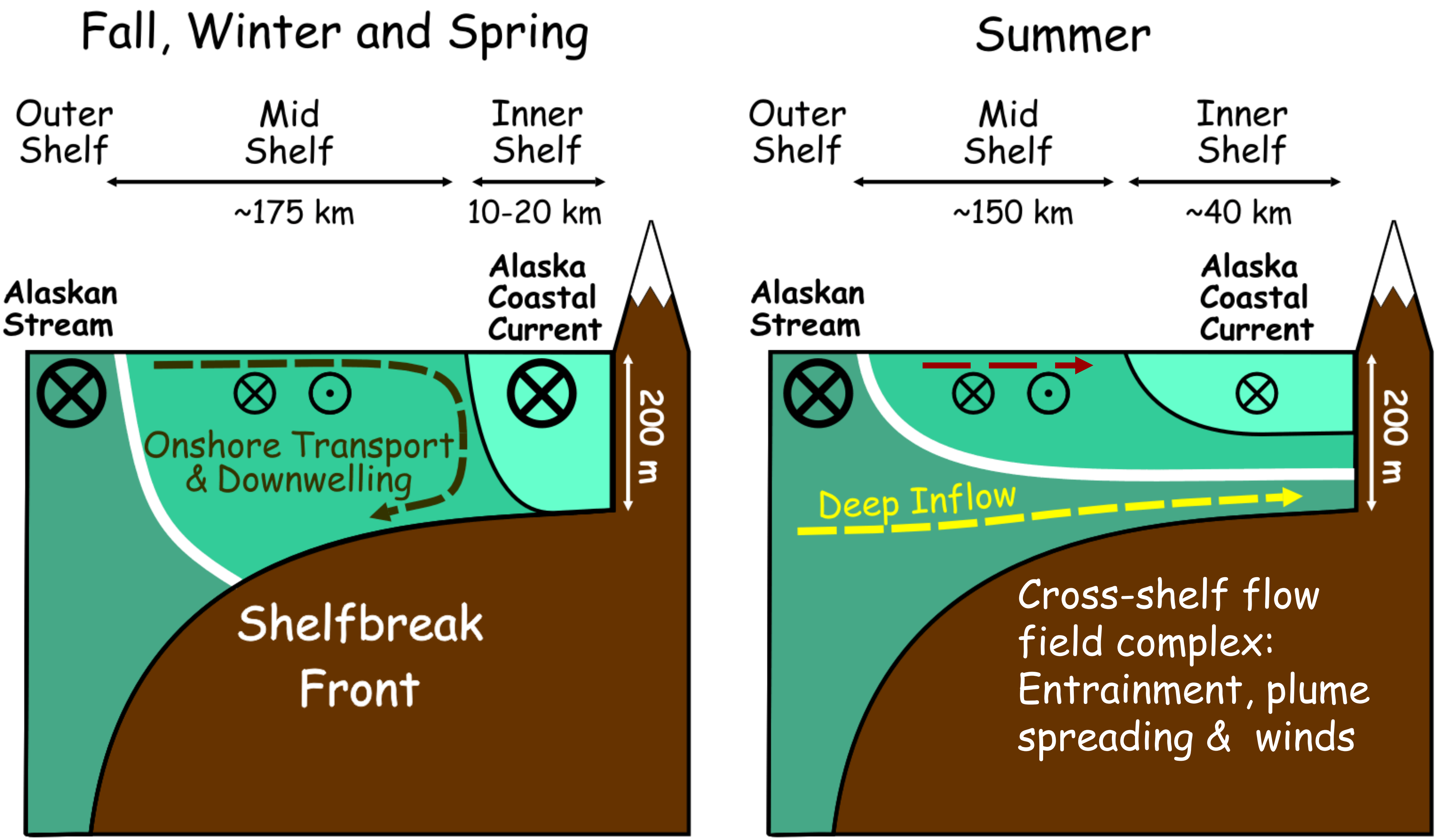
1) **Regime Shifts**, esp., examination of the ocean and ecosystem responses to known strong, infrequent changes in the North Pacific, such as those of 1977, 1989, and 1998.
2) **Ecosystem Productivity and Structural Responses to Physical Forcing**, with an emphasis on interannual (El Niño-La Niña), seasonal and event time scales
3) **Pan-Pacific Comparisons**, of similar species or processes from multiple coastal ecosystems and of open ocean-coastal linkages and climate connections.

Symposium will be a combination of plenary oral sessions and poster sessions each day. Symposium proceedings will be published in a refereed journal still to be determined. Papers for publication must be submitted at the symposium.

Symposium Co-Convenors: Hal Batchelder and Suam Kim

Symposium Steering Committee: Makoto Kashiwai, Sandy McFarlane, Vladimir Radchenko, Yasunori Sakurai, Frank Schwing, Sinjae Yoo, and Cisco Werner

Seasonality of GOA Continental Shelf Flow Fields

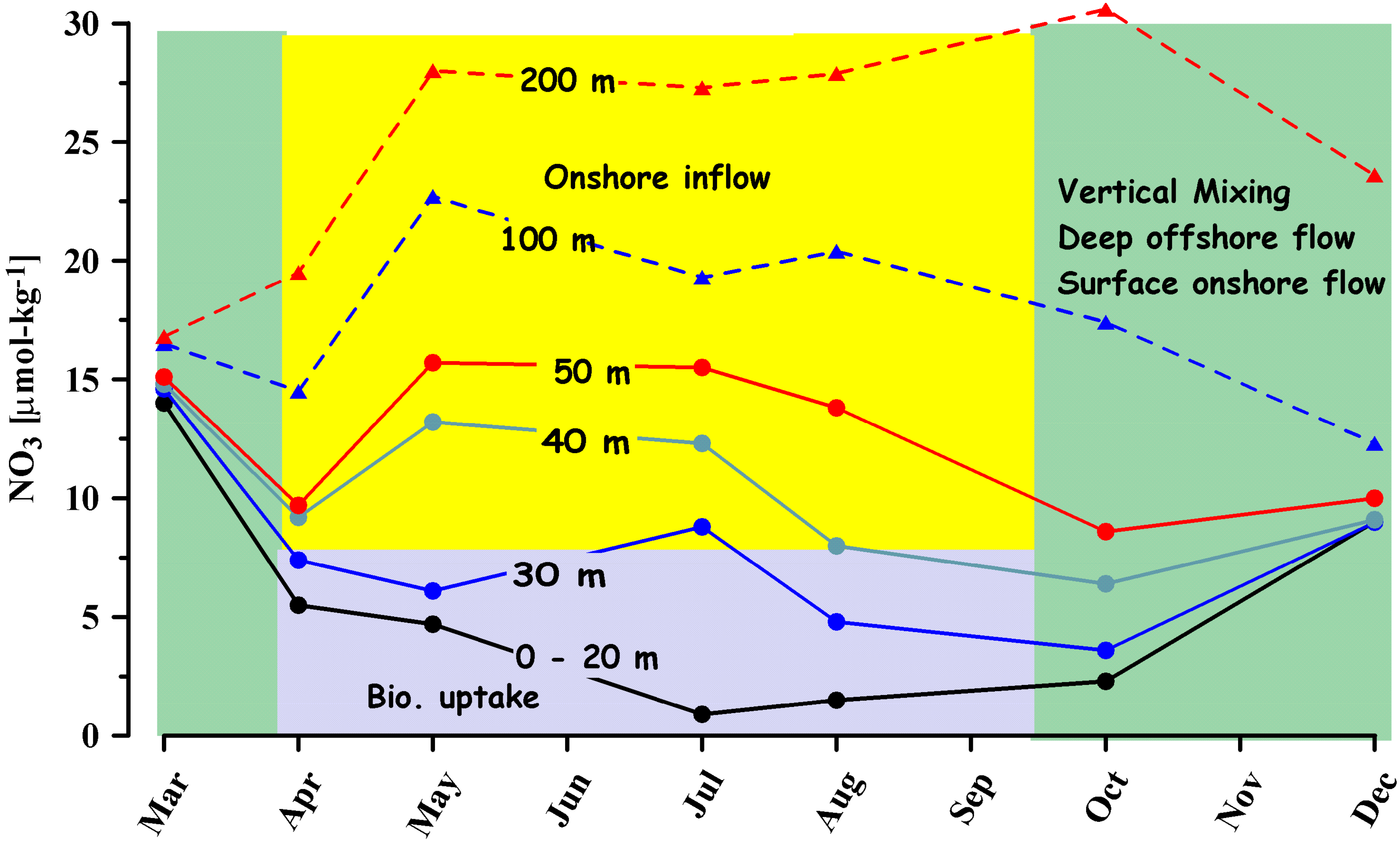


Strong alongshore winds & transport

Weak alongshore winds & transport

From Weingartner

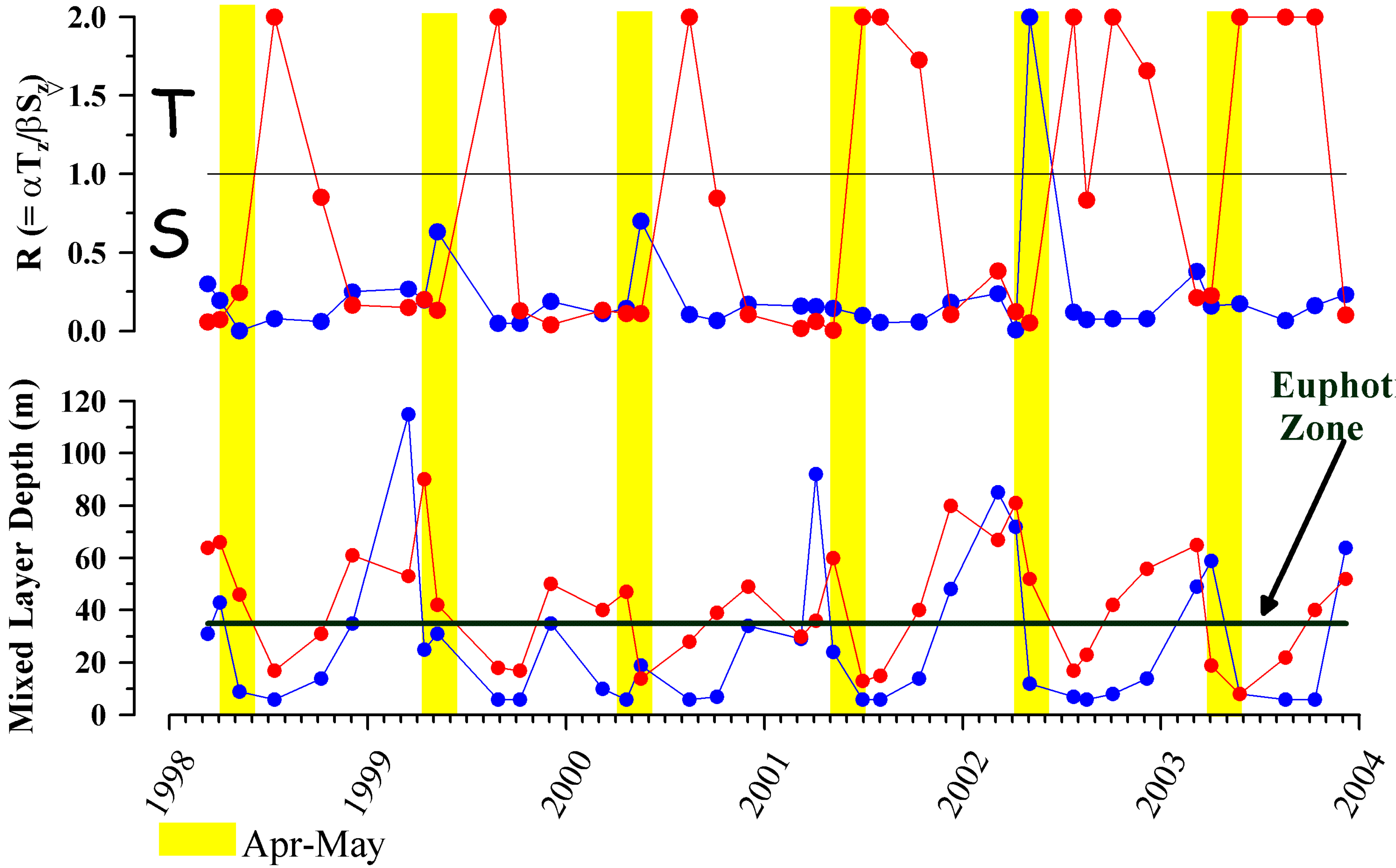
Annual nutrient cycle mimics salinity cycle



A NUTRIENT RESERVOIR AT DEPTH IN SUMMER

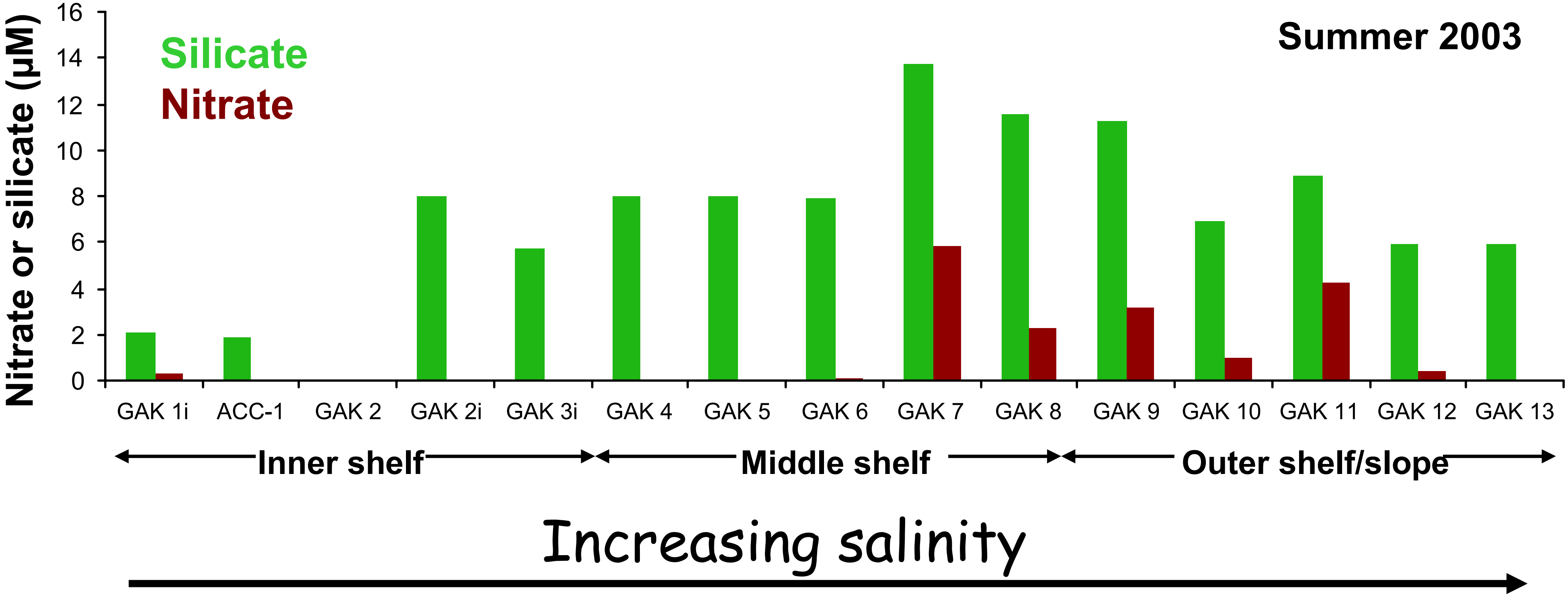
(Silicate and phosphate are similar)

(Childers & Whitledge)



Spring & Summer Stratification	Inner Shelf ●	Outer shelf ●
Controlled by:	Salinity	Temperature
	Winter Precipitation	Solar heating/
	Freeze/Melt	Wind-mixing
Processes:	3-D	1-D

Cross-shelf gradients in nutrient utilization reflect differences in phytoplankton communities



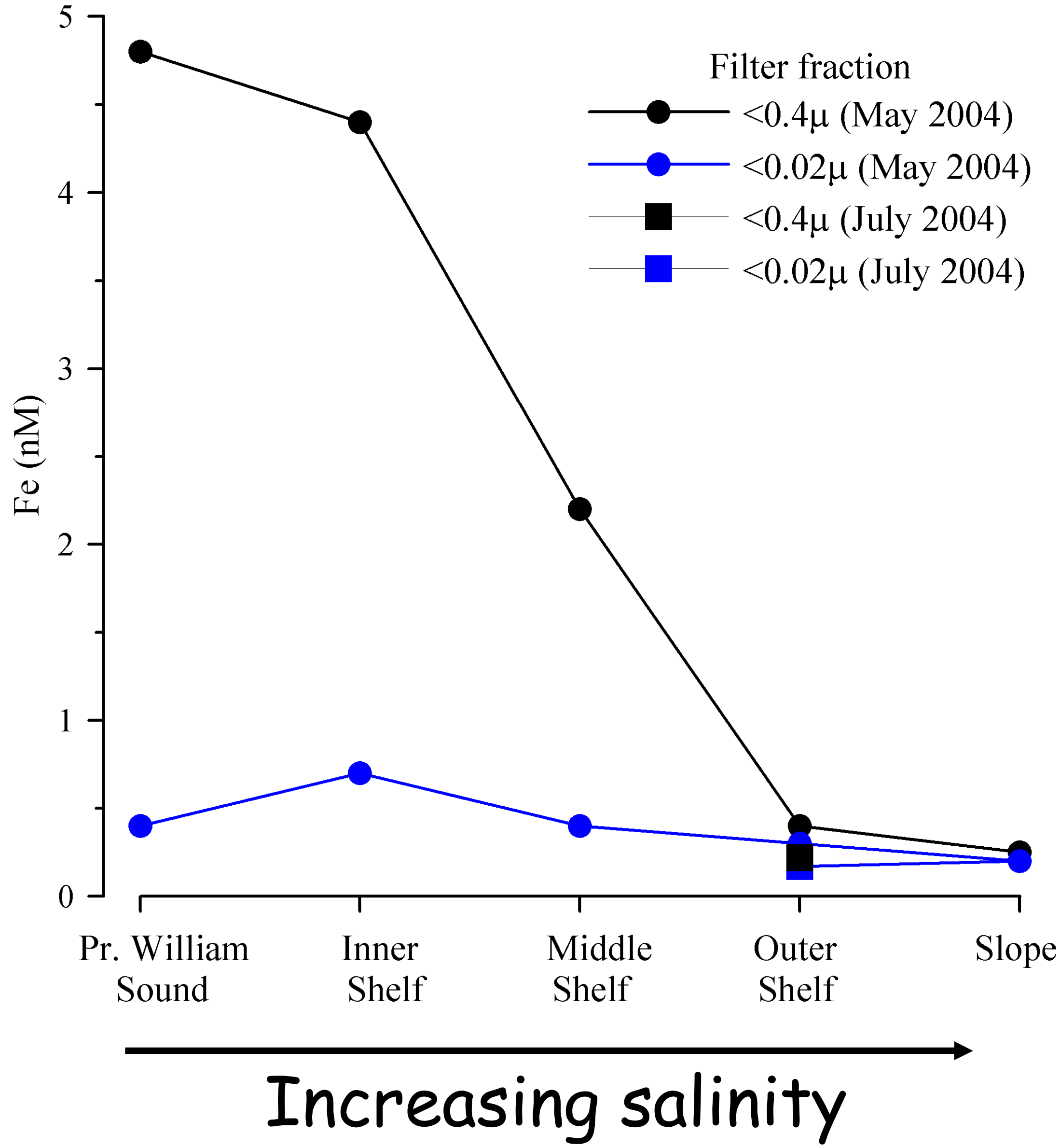
Inner shelf: Spring/Summer Production limited by NO_3

Outer shelf: Iron limitation might inhibit diatom growth and hence silicate utilization

Middle shelf: A transition zone

(S. Strom)

Surface bio-available iron concentrations decrease offshore

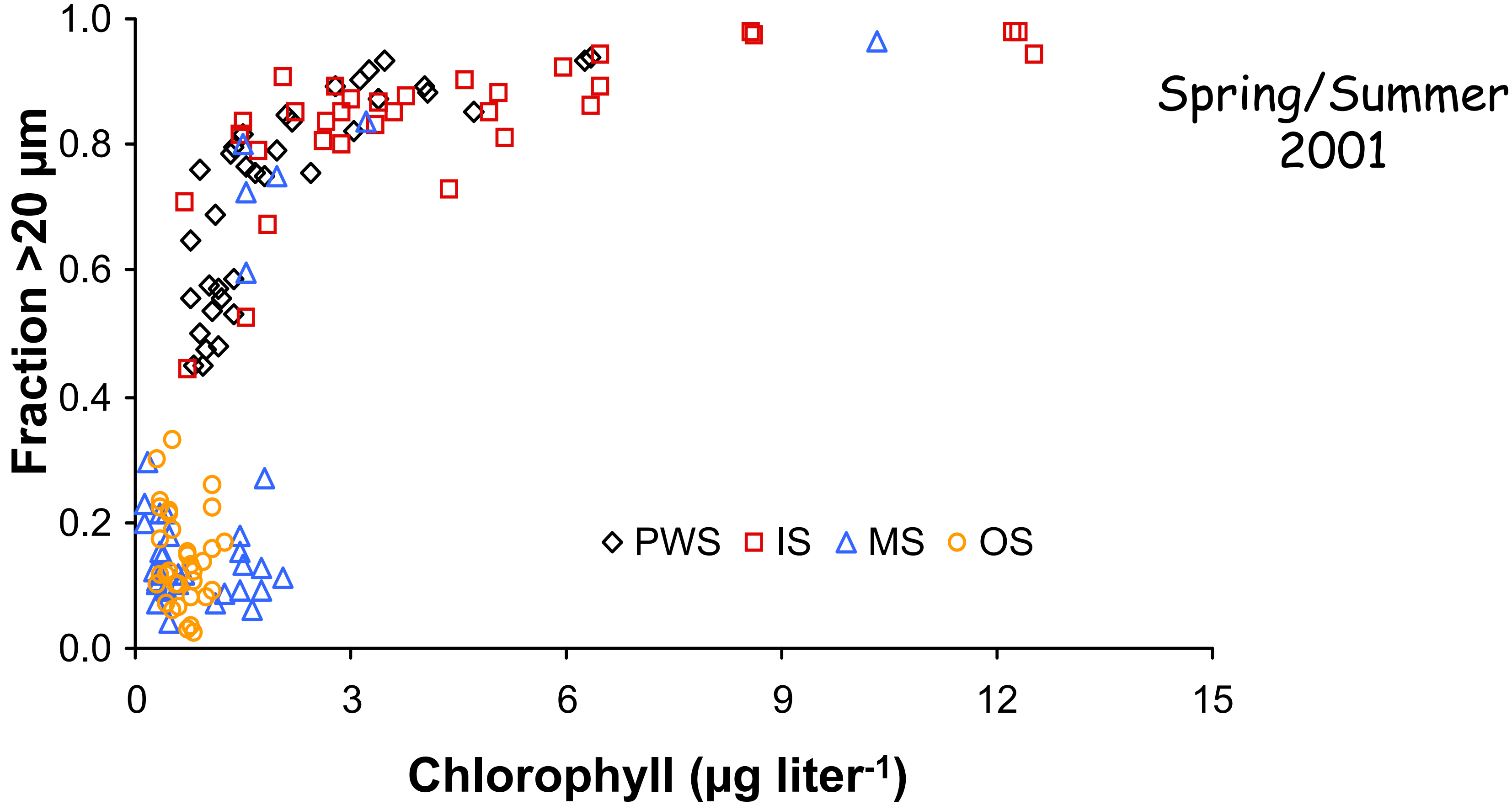


Deep (≥50m) iron concentrations > 1 nM

Is outer shelf production controlled by mixing and/or the offshore spread of low-salinity, high Fe waters?

J. Wu (preliminary data)

Cross-shelf differences in phytoplankton communities



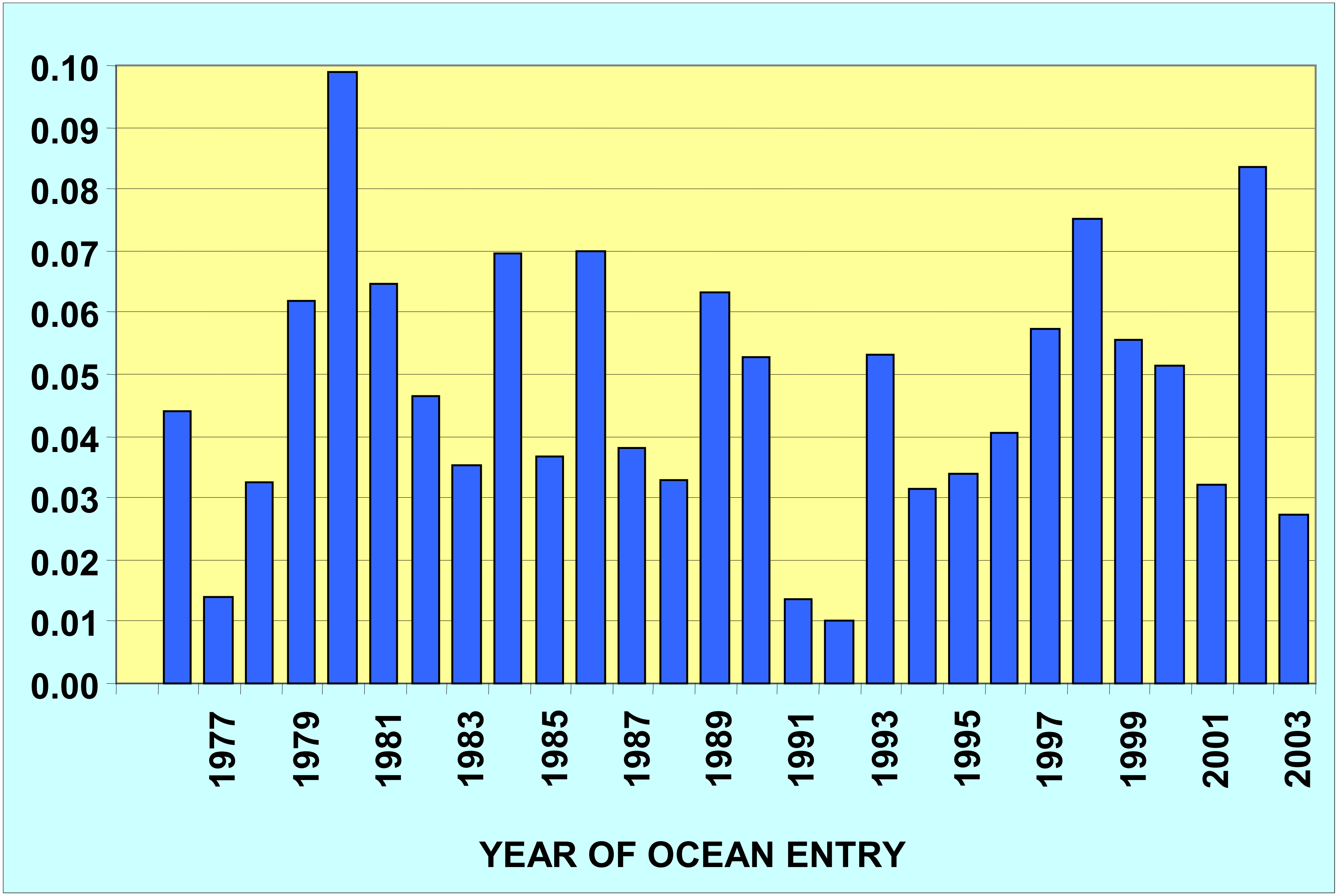
Large phytoplankton cells dominate inner shelf

Small phytoplankton cells dominate outer shelf

Mid-shelf is a transition zone

(S. Strom)

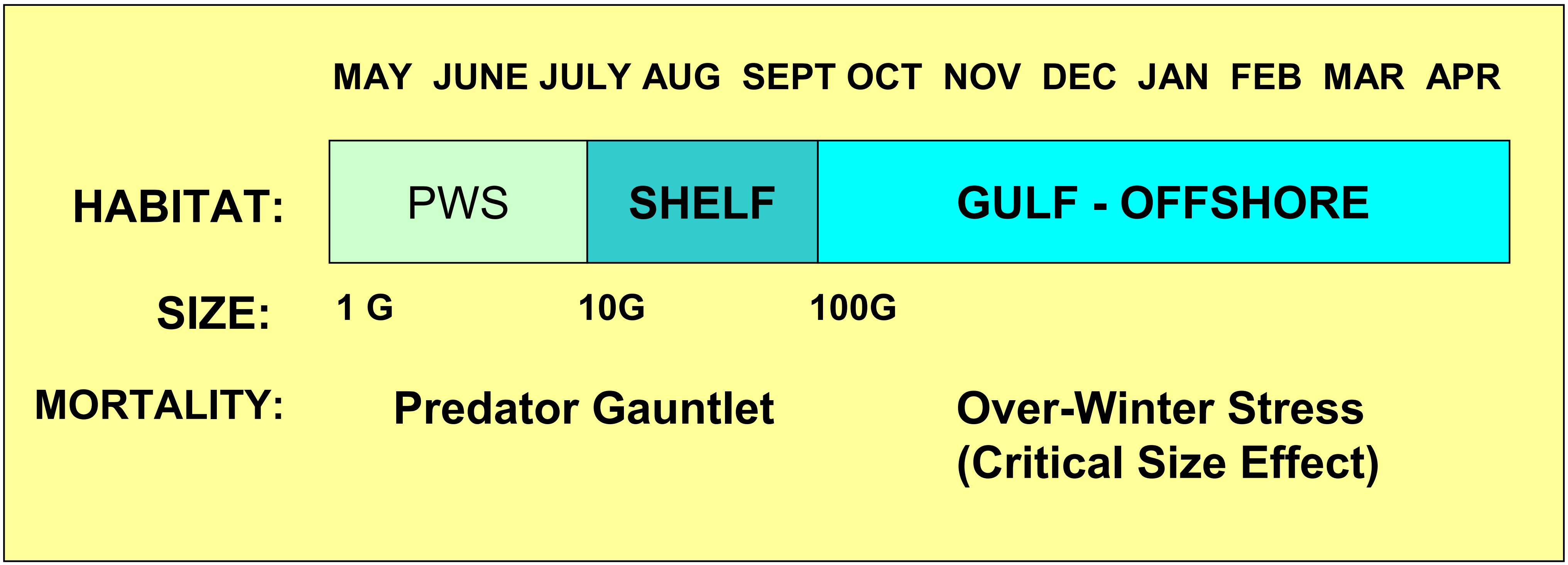
Marine Survival of Pink Salmon From Hatcheries in PWS
(2003 is preliminary - only 3 of 4 hatcheries)



From Haldorson

Habitat Use by PWS Juvenile Pink Salmon During First Year at Sea - With Size at Habitat Transitions and Possible Sources of Mortality

BIGGER IS ALWAYS BETTER



Critical Size Hypothesis - Juvenile Salmon That do not Reach a Critical Level of Size and Energy Reserves Will Experience Physiological Stress and Increased Mortality During Winter.

From Haldorson

Summary:

Pink Salmon Move Sequentially Through PWS, ACC and Shelf Habitats From July - August

The Size Attained Differs Among Habitats: Shelf Fish were Bigger in 02 and 03, ACC Fish Bigger in 01

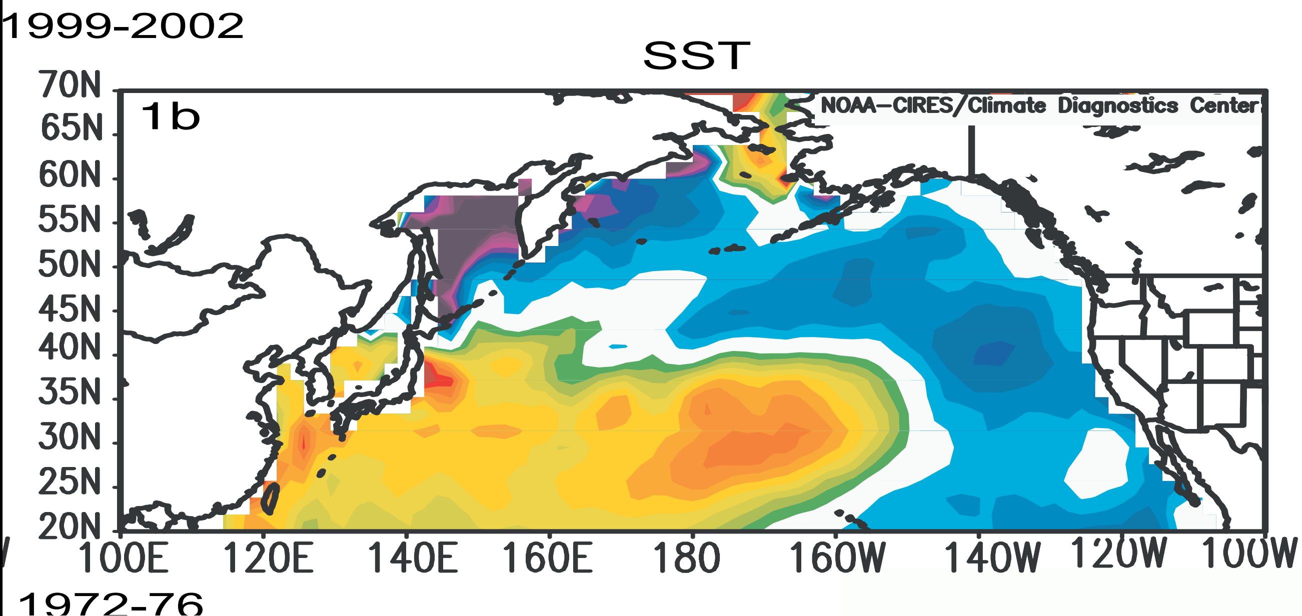
Condition Differences Among Habitats Were Similar to Size: Shelf Fish Were in Better Condition in 02 and 03

Growth Differed Among Years: In 02 Fish Were Larger, Especially in the Shelf Habitat

Temperatures Were Similar Among Habitats, but Differed Among Years: 02 was the Coldest Year, 03 was Warmest

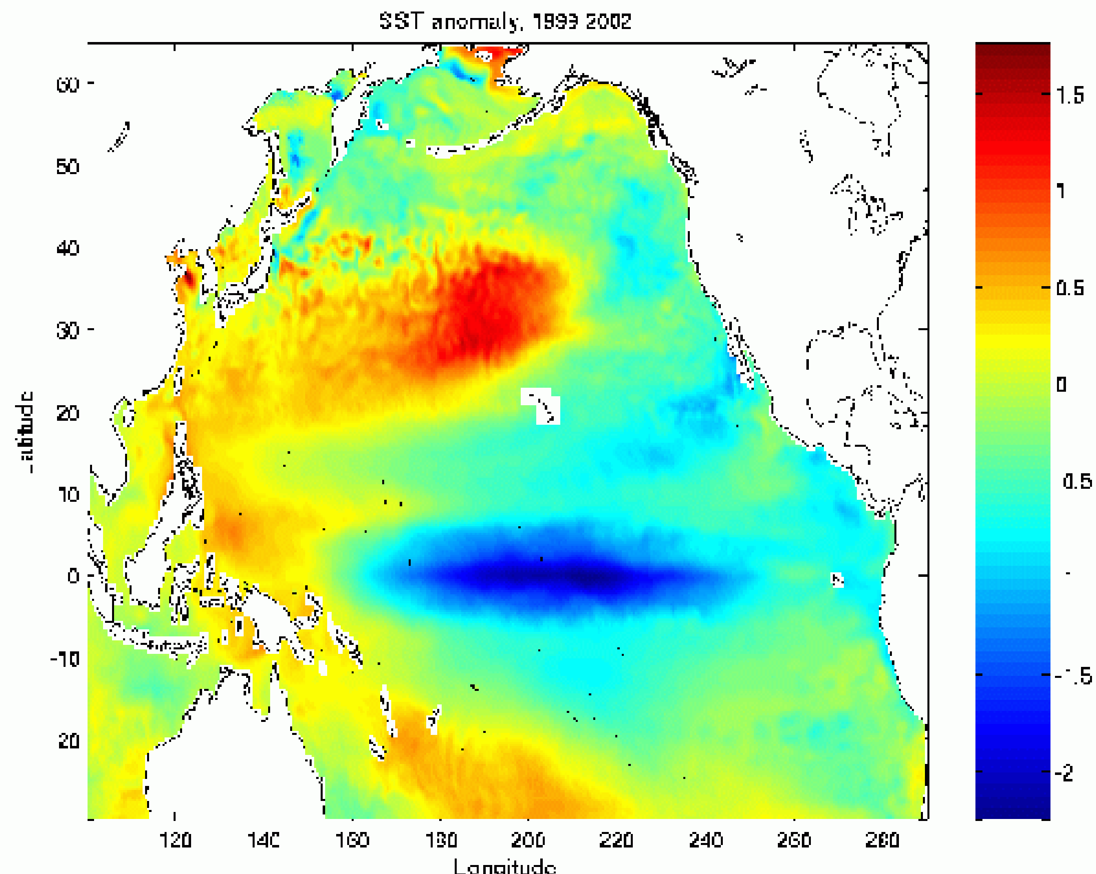
The Faster Growth Attained by Fish in 02 May Have Led to the Exceptionally High Marine Survival by that Year-Class

From Haldorson



Bond et. al.

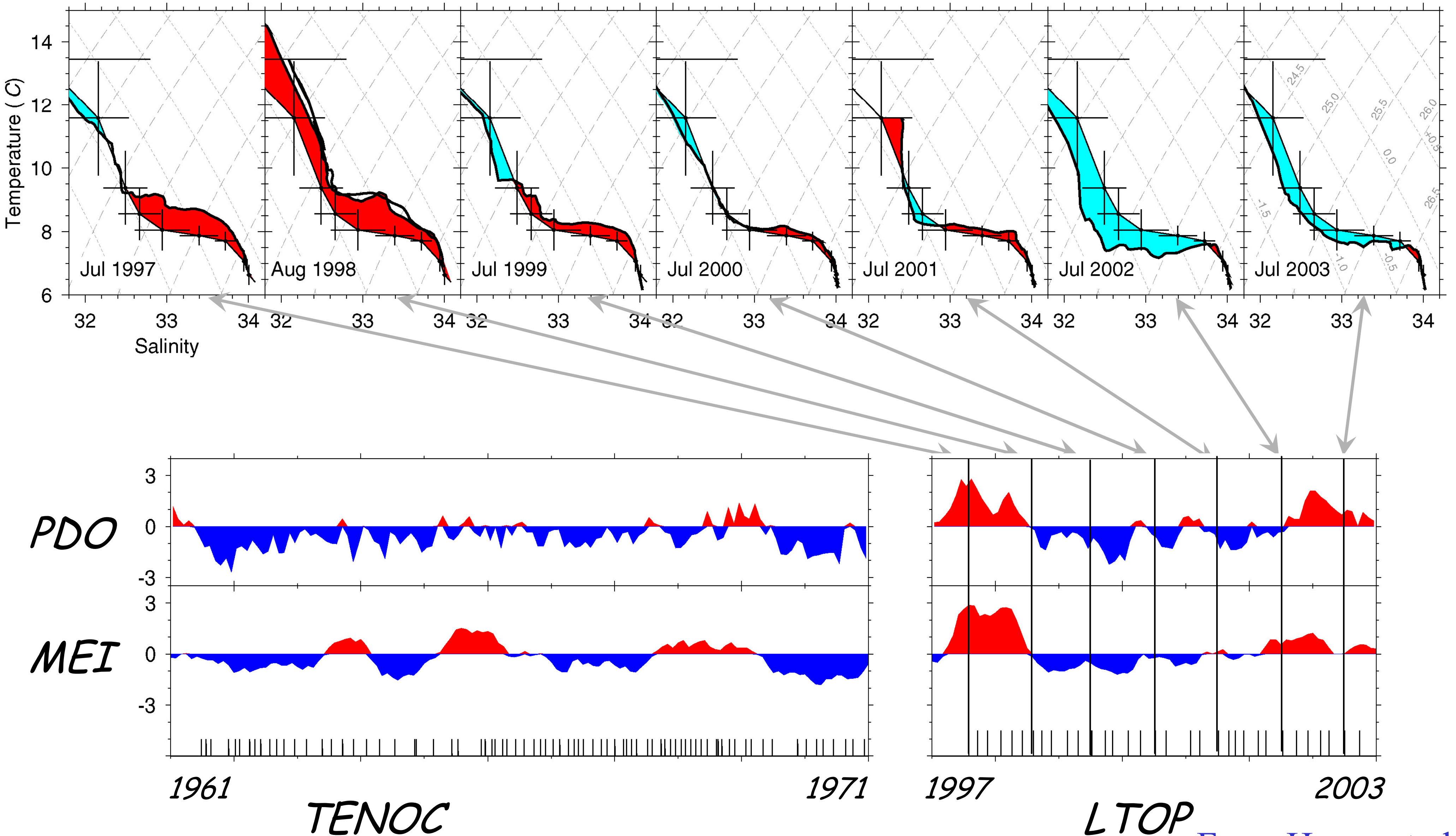
ROMS



From Curchitser

Shelf-Break T-S in LTOP Summers

(compared to 1961-71 winter average)



From Huyer et al.

Local Ocean Indices

Coho Survival (%)

Ave. Integrated Chlor. (mg/m^2)

NH-25 Halocline Nitrate
(μM at S = 33 psu)

NH-25 Halocline T (C at 33)

Coastal Current Shear
$V_{10}-V_{60}$ (cm/s^{-1})

Large-Scale Indices

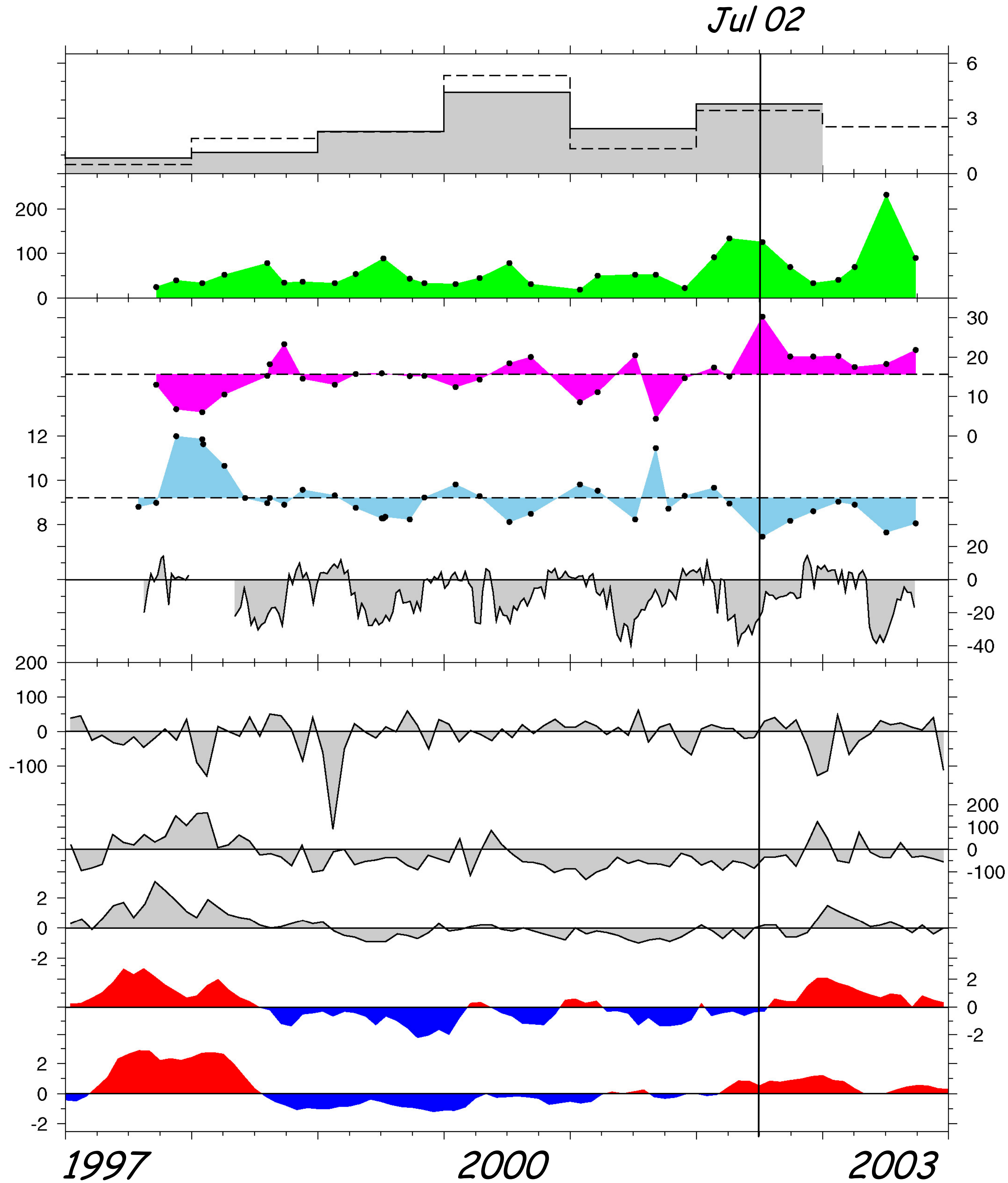
Upwelling Anom at 45N

Sea Level at 42N

SST at 48.5 N

PDO (North Pacific)

MEI (Equat. Pacific)



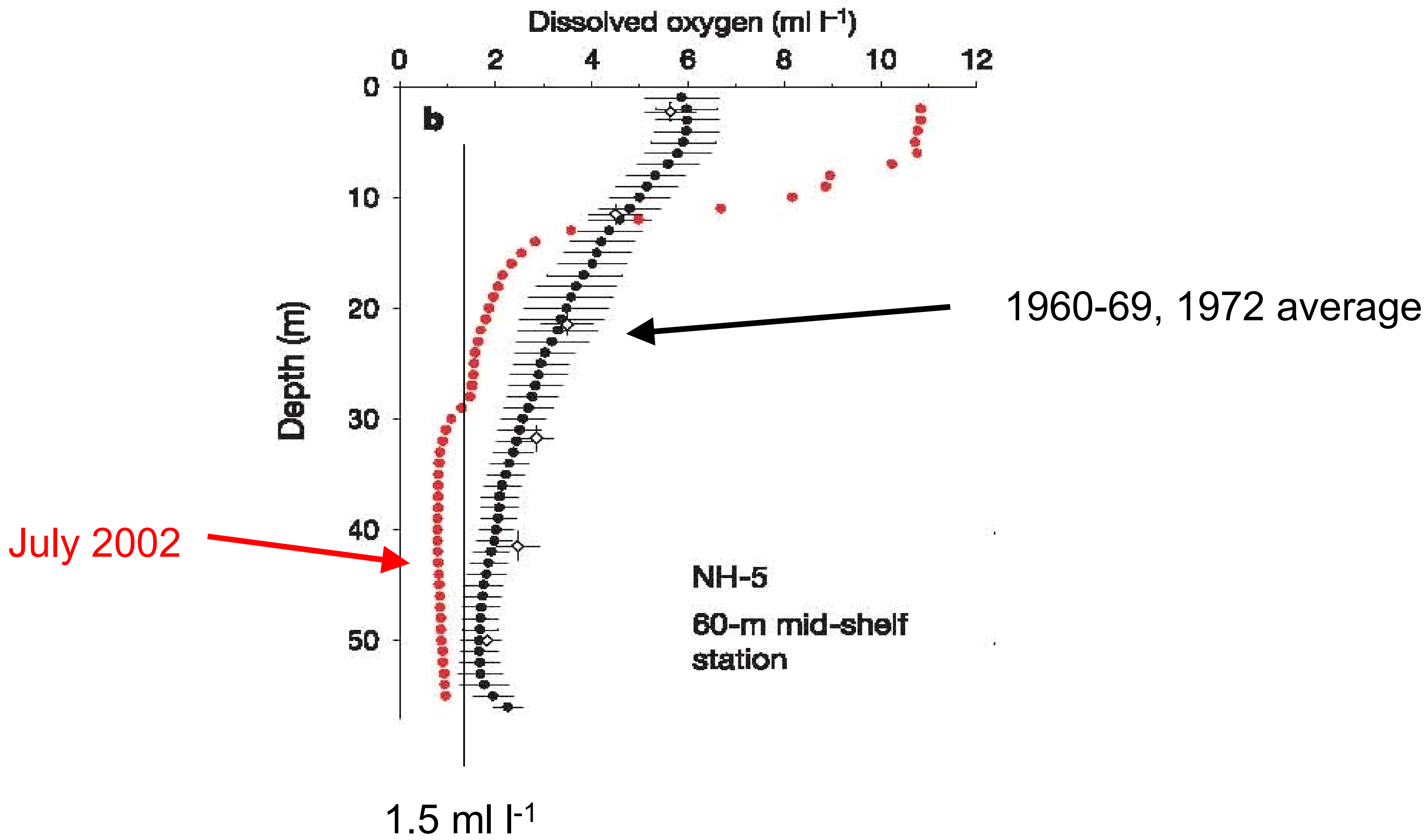
From Huyer et al.

Conclusions

- **MEI & PDO highly variable** during LTOP (cf 1961-71).
- **T_{33} highly variable** during LTOP (cf 1961-71).
- 1997-8 **warm anomalies** clearly associated with **El Niño.**
- 2002-3 **cold halocline anomaly** occurred **in spite of** positive MEI and positive PDO.
- excluding 1997-8 El Niño, the **LTOP winter average** temperature is similar to 1961-71 winter average except that **halocline is slightly cooler** (by 0.2 C, P >90%).
- Excluding 1997-8 El Niño, but including 2002-3 cold anomaly, the **LTOP summer average** temperature **is warmer** than 1961-1971 summer average **in two locations**:
  - by >1 C at base of seasonal thermocline, and
  - by 0.3 C in subsurface patch over continental slope.

From Huyer et al.

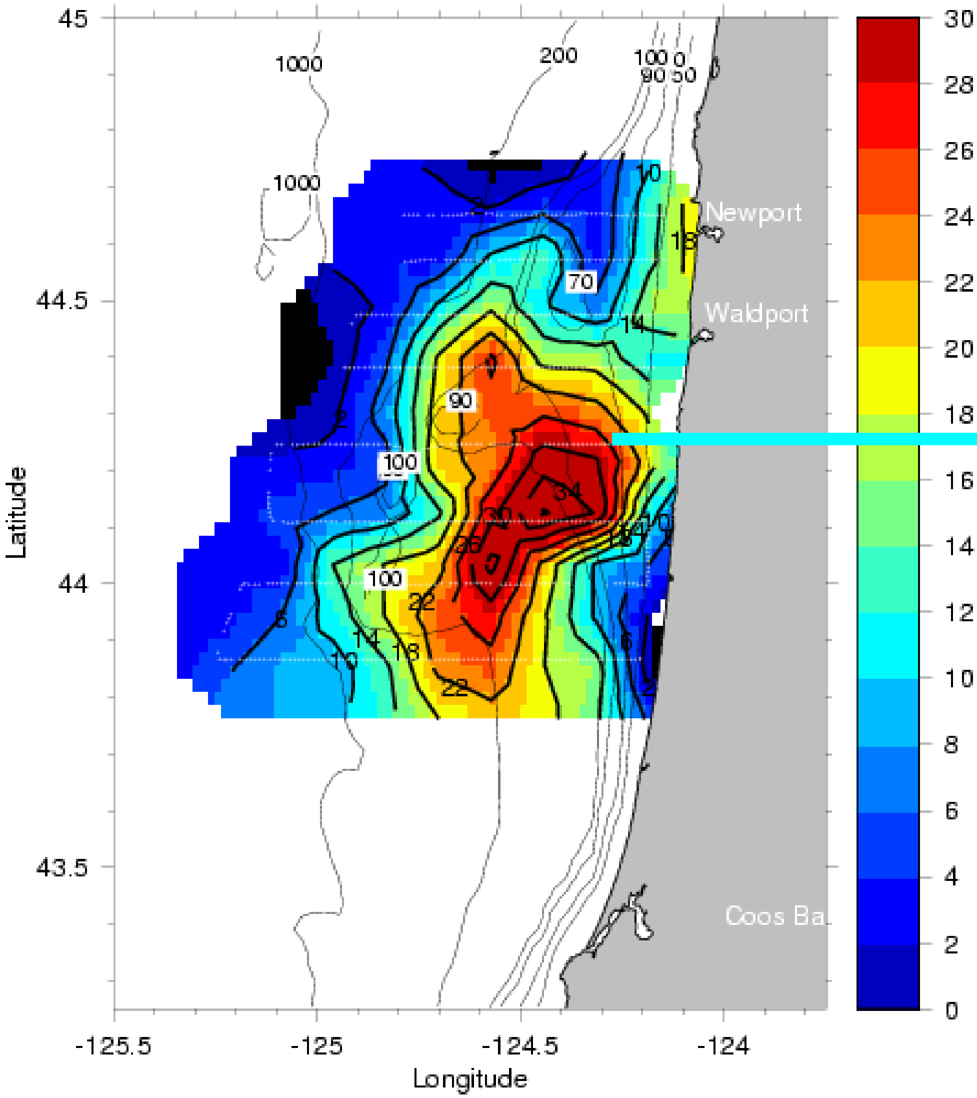
Low-oxygen shelf water

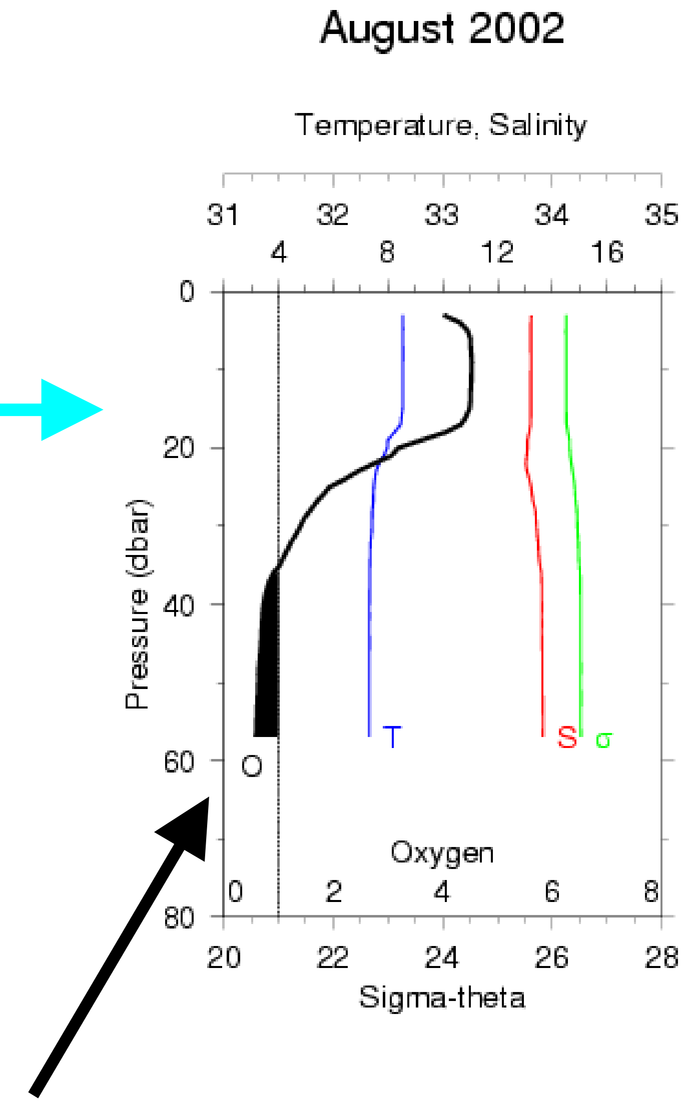


Grantham et al. (2004)

Ecosystem Response

GLOBEC NEP, 9-11 August 2002
5-m chlorophyll (mg/m³)

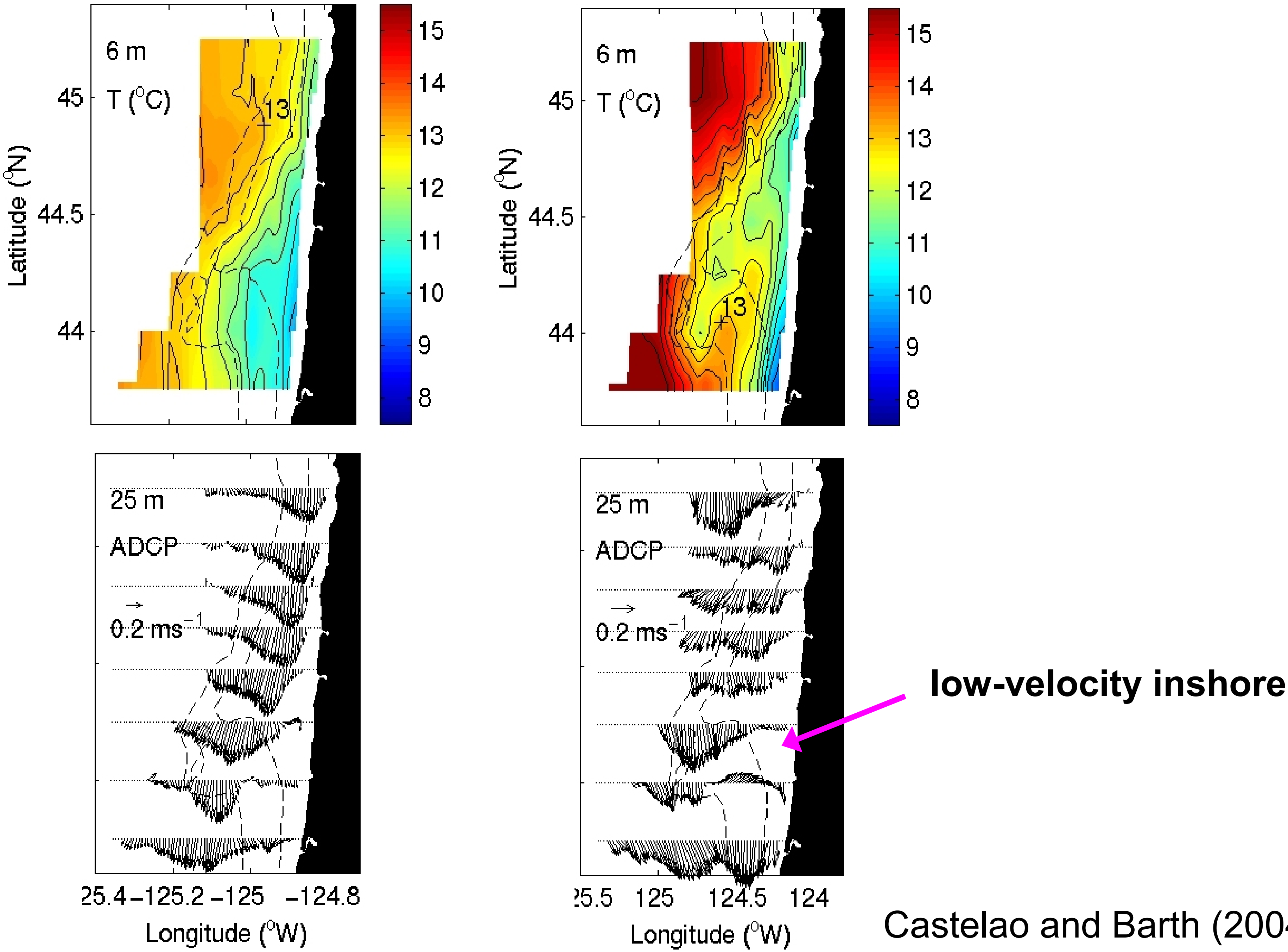




hypoxic

Grantham et al. (2004)

Heceta Bank deflects coastal upwelling jet offshore



Castelao and Barth (2004)

Upwelling-Driven Inner-Shelf Hypoxia: Summary

Deep low-oxygen water upwelled onto continental shelf (this is normal)

Shelf bottom water can become hypoxic from a combination of low-oxygen source waters and respiration

Flow-topography interaction at Heceta Bank creates low-velocity lee region with high surface chlorophyll

Location and duration of hypoxic water in inner-shelf habitats controlled by event-scale wind forcing

Low-oxygen source water in 2002 from Subarctic invasion

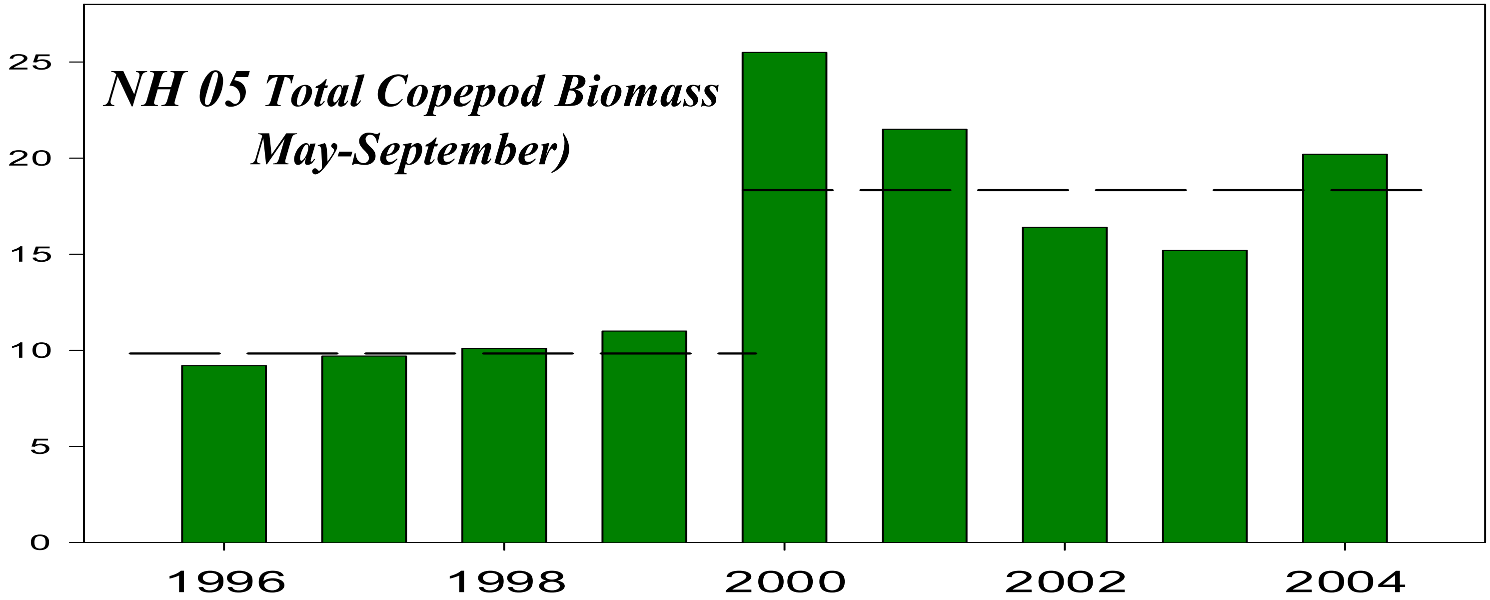
Relatively normal source water properties in 2004: respiration more important

Future events?

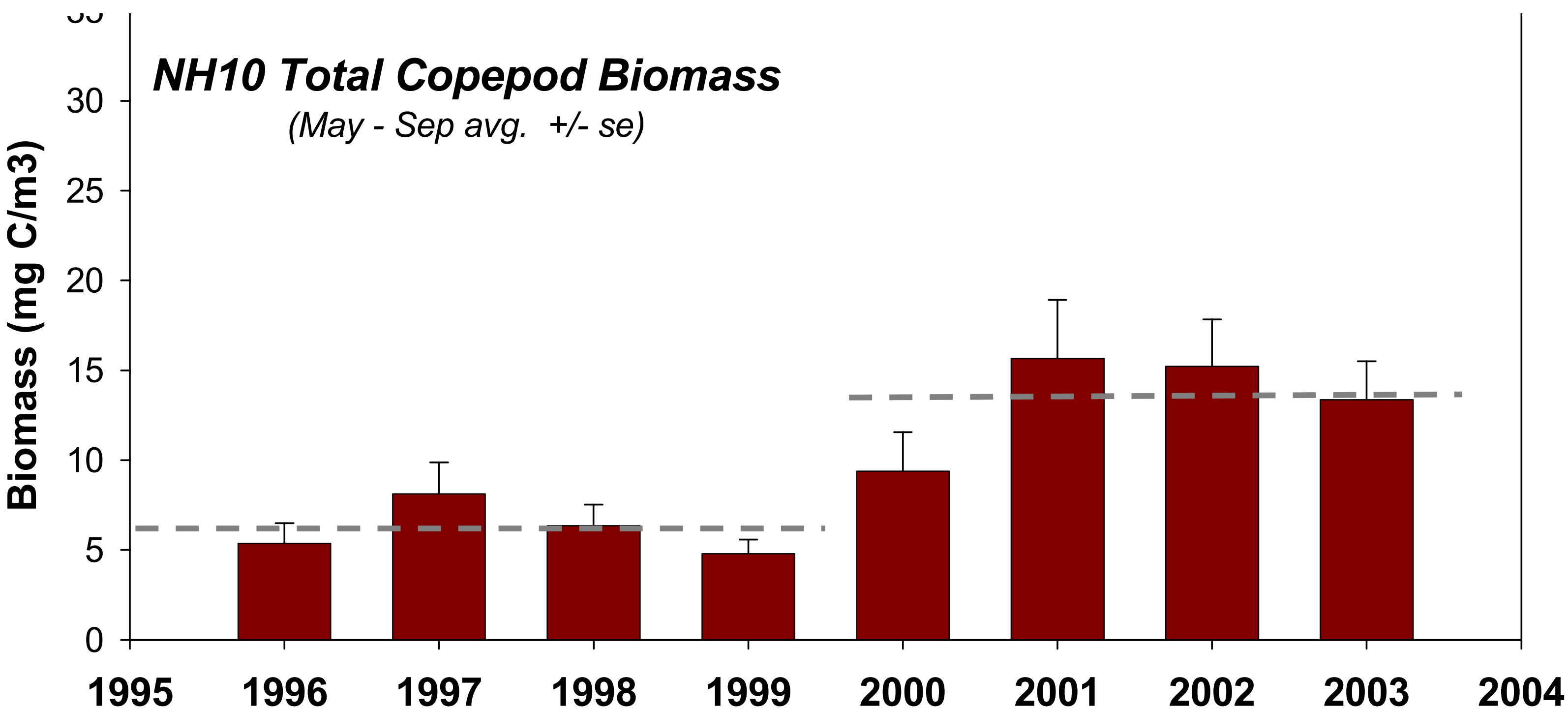
- Hypothesis testing with models
- Observing systems

From Barth et al.

Copepod biomass increased dramatically in 2000 and 2001

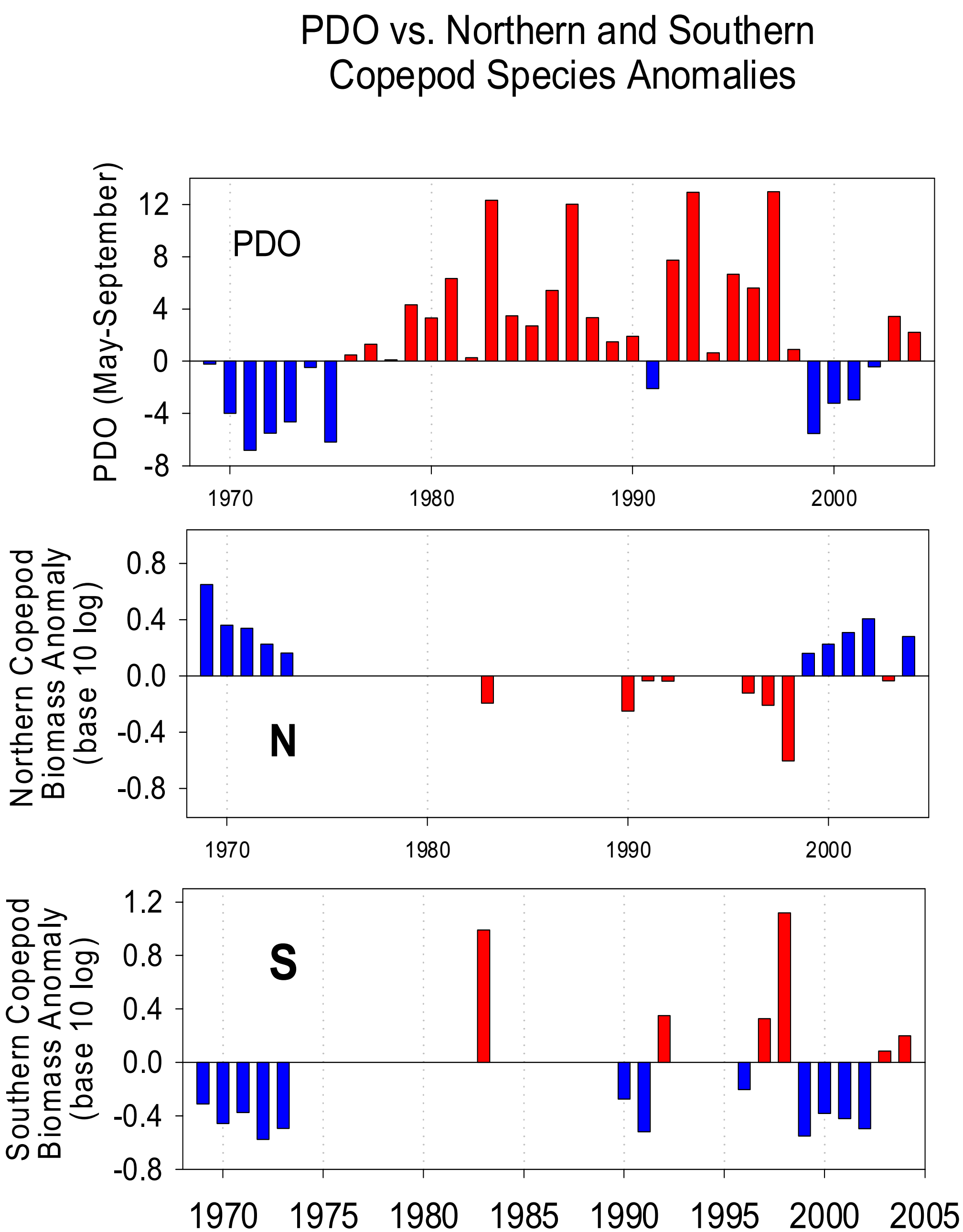


= 1.9 x ↑



= 2.2 x ↑

From Peterson



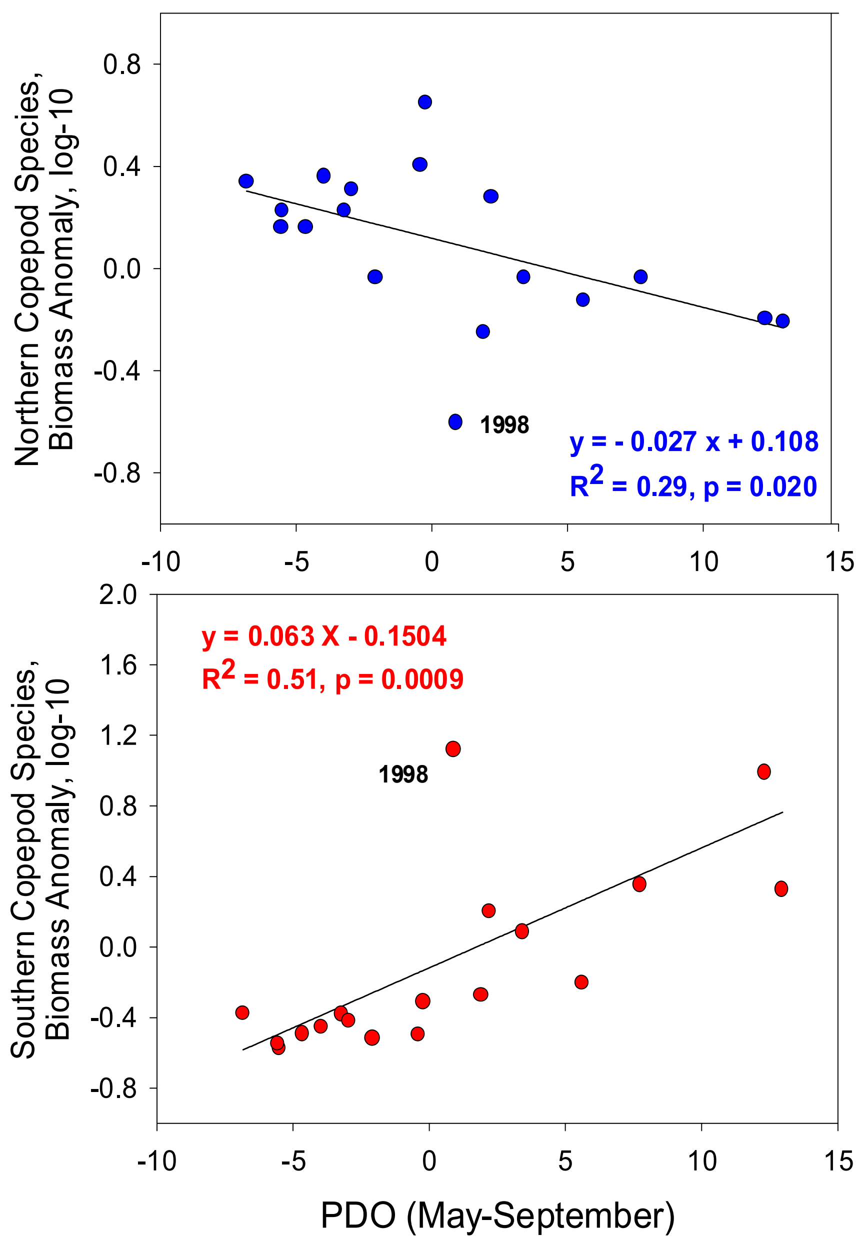
Now a pattern is evident…

When PDO is negative, ("cool phase") cold water or northern species have high biomass whereas the warm water southern species have low biomass

and vice versa…

The changes are rapid and approach order of magnitude differences among years.

From Peterson



N and S Copepod biomass anomalies are significantly correlated with the Pacific Decadal Oscillation

- **Warm-water taxa** - (from offshore OR) are **small** in size and have limited high energy wax ester lipid depots
- **Cold-water taxa** – (boreal coastal species) store **wax esters** as an over-wintering strategy

From Peterson

Which type of food particle would you prefer if you were a sardine, salmon or sablefish?

Ample evidence has been presented at this meeting as well as in publications, that a fat fish is a fish that will almost certainly survive the winter whereas a slim fish is threatened.

Northern (boreal) copepod species package up those lipids needed for successful over-wintering not only for themselves (if they survive) but for fishes.

This lipid hypothesis may be that which gives definition to the meaning of a negative or positive value of the PDO.

From Peterson