

# **Evaluation of the Relationship Among Time of Smolt Ocean Entry, Physical and Biological Characteristics of the Estuary and Plume Environment, and Adult Return Rates**

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# Hypothesis

- Salmonid smolt to adult returns (SARs) are largely determined by environmental conditions in the estuary and nearshore ocean in the first few days or weeks at sea. Within year and between year SARs is related to these conditions

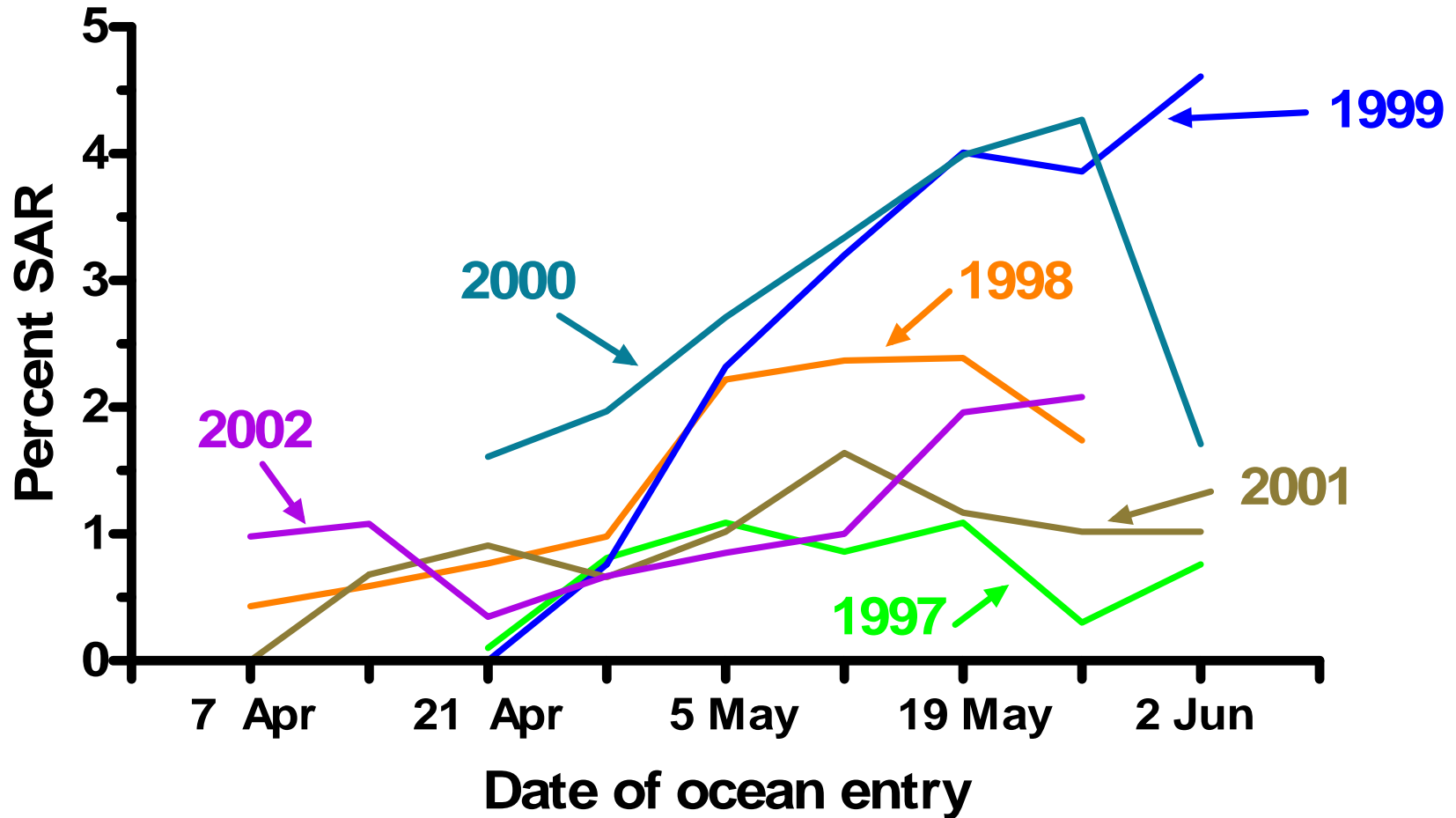


# Goal

- **Identify potential indicators of marine survival to improve management actions**
- **Selectively use transportation or time hatchery releases to optimize SARs**

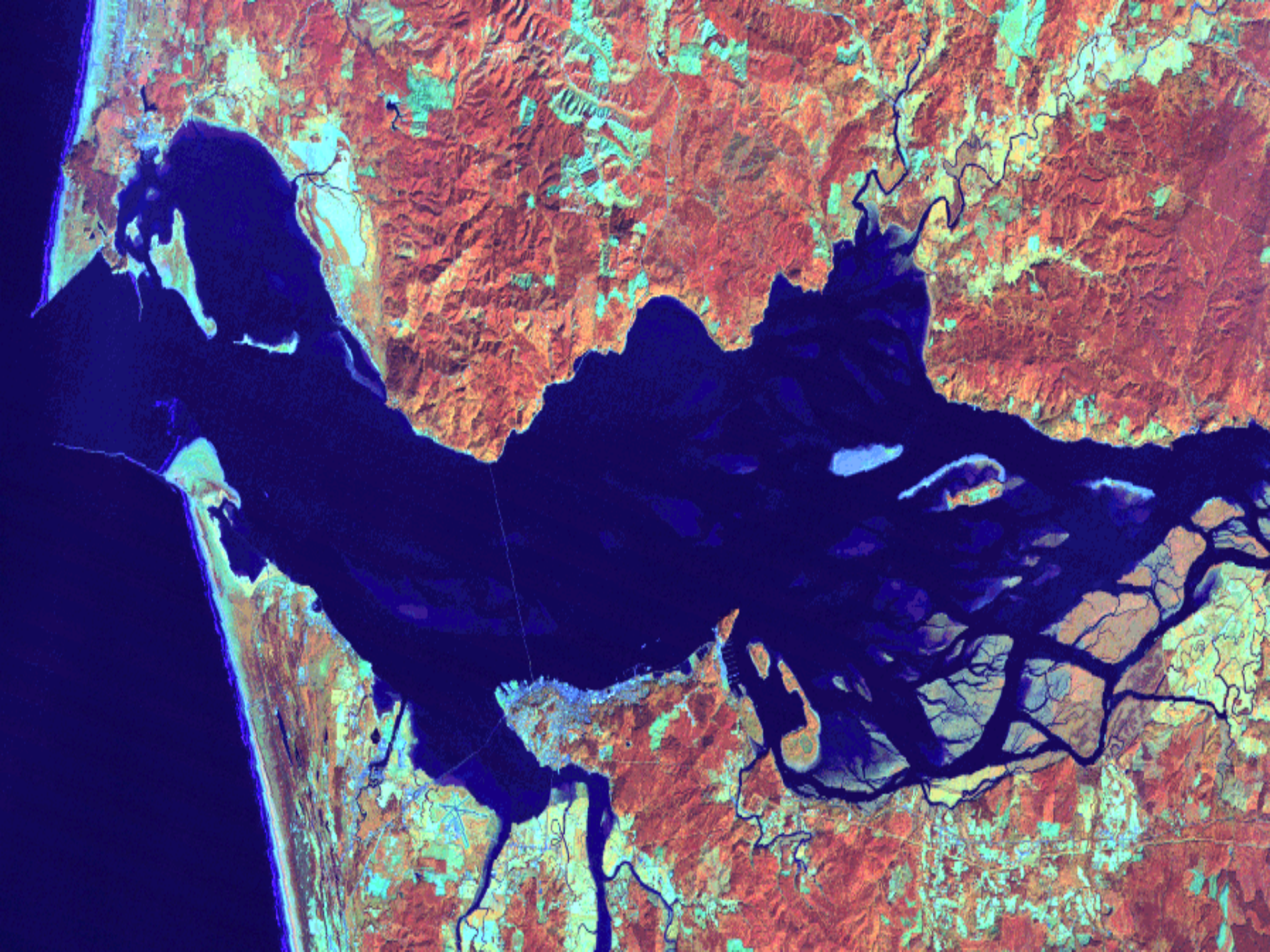


# Hatchery Chinook transports



# Releases (CWT)

- 2002 145,302
  - 2003 123,375
  - 2004 146,649
  - 2005 147,085
  - 2006 164,173
- 
- 6 groups/year, 7 Apr – 30 May
  - Releases every ~10 days





**Adults return to the Blind Slough terminal gillnet fishery which is heavily monitored**



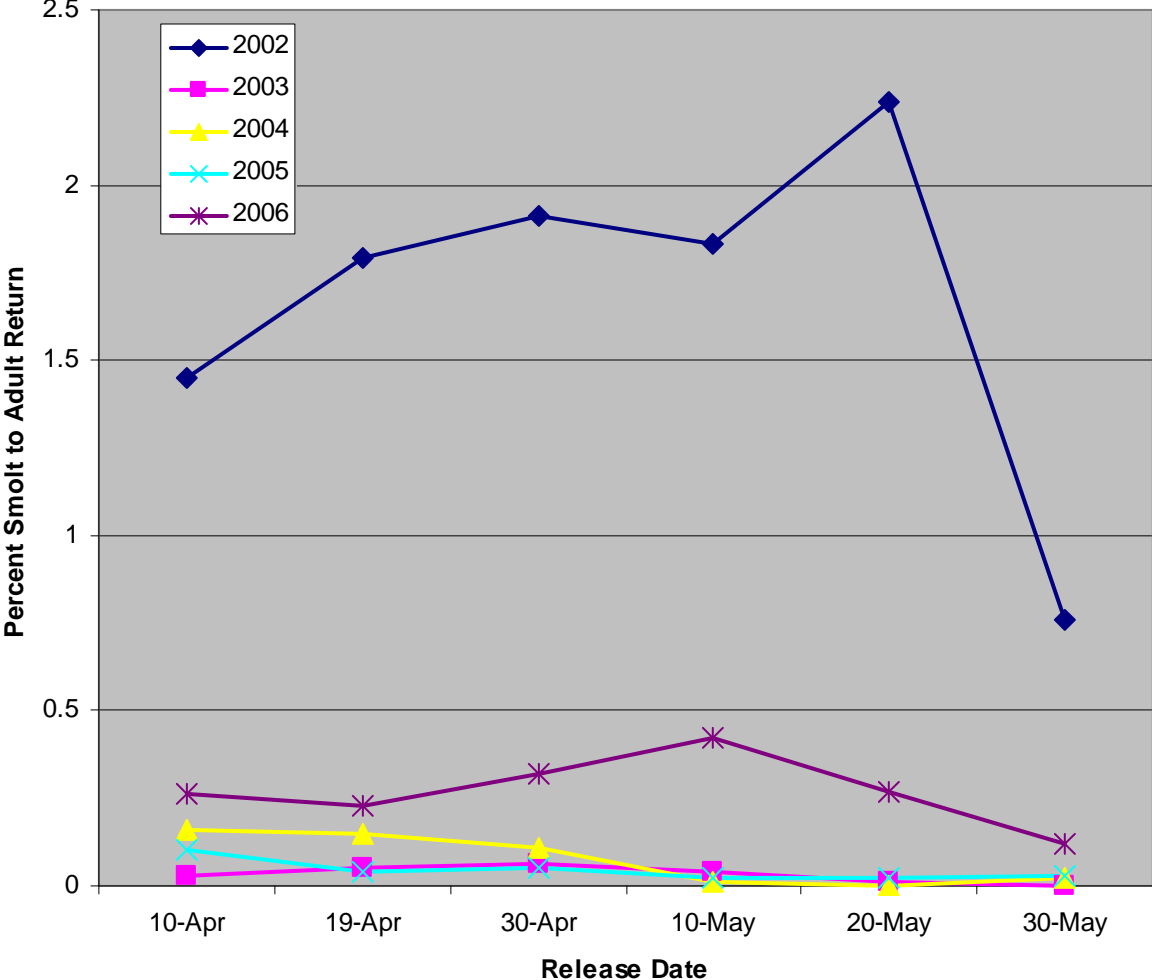
# Physical Variables

- River temperature
- River flow
- Turbidity
- Direction of plume and nearshore waters
- Size of plume
- Upwelling
- Ocean temperature
- Ocean salinity

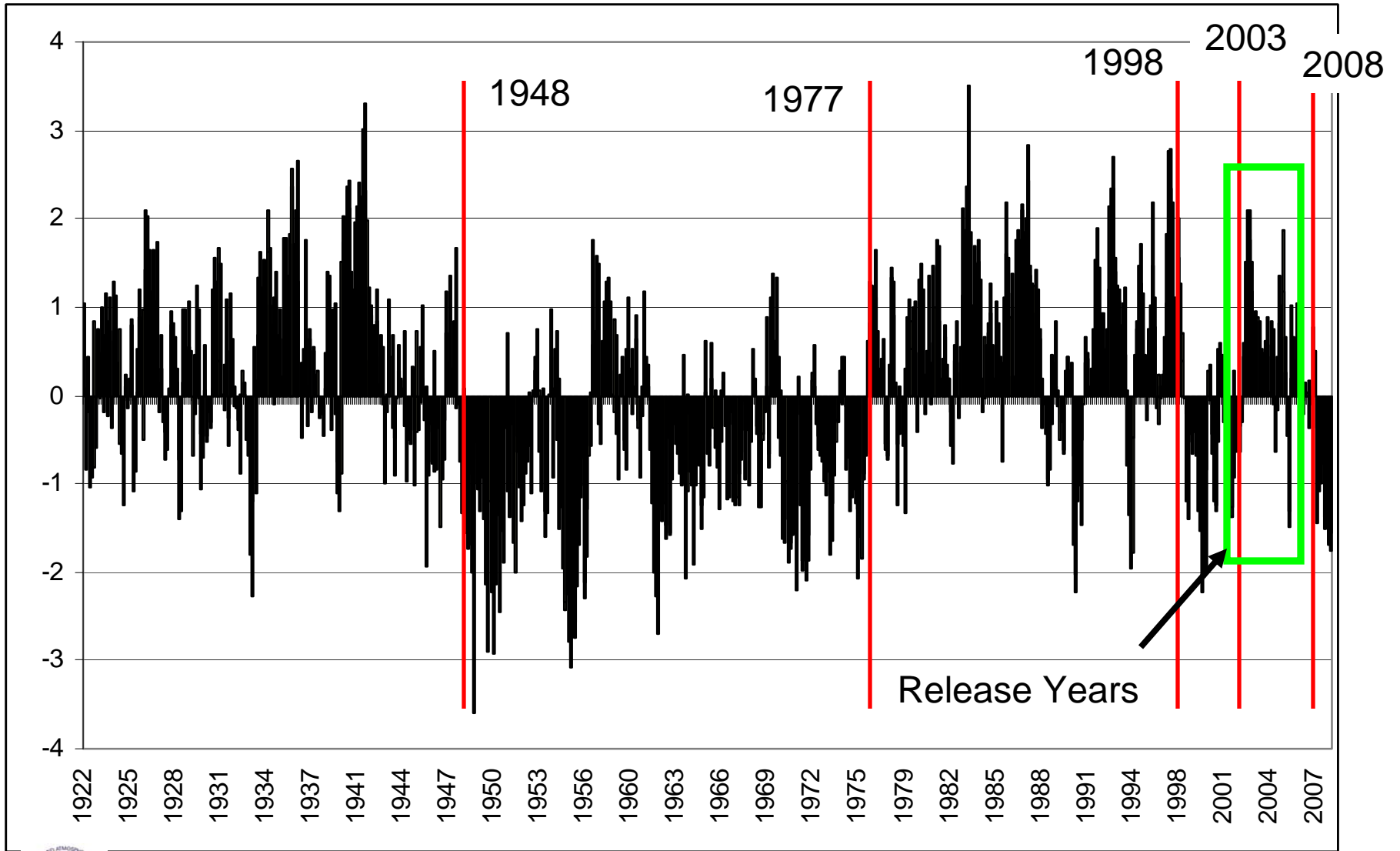
# Biological Variables

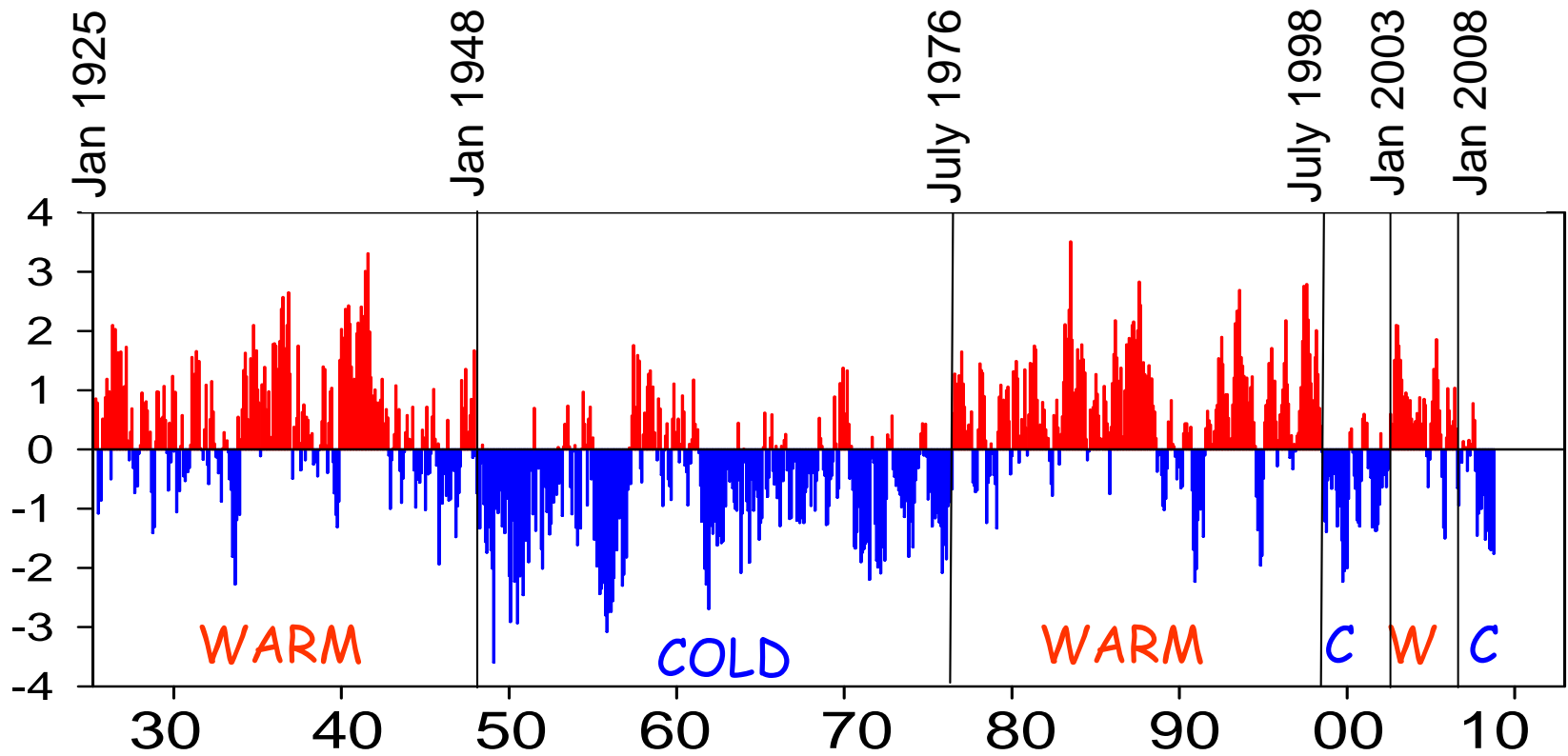
- Forage fish (anchovy, herring, smelt, etc)
- Estuarine birds (terns, seabirds, etc.)
- Predatory fish (hake, mackerel)
- Zooplankton
- Chlorophyll levels
- Number of smolts passing Bonneville Dam

### Percent Returns



# Pacific Decadal Oscillation 1922-2008



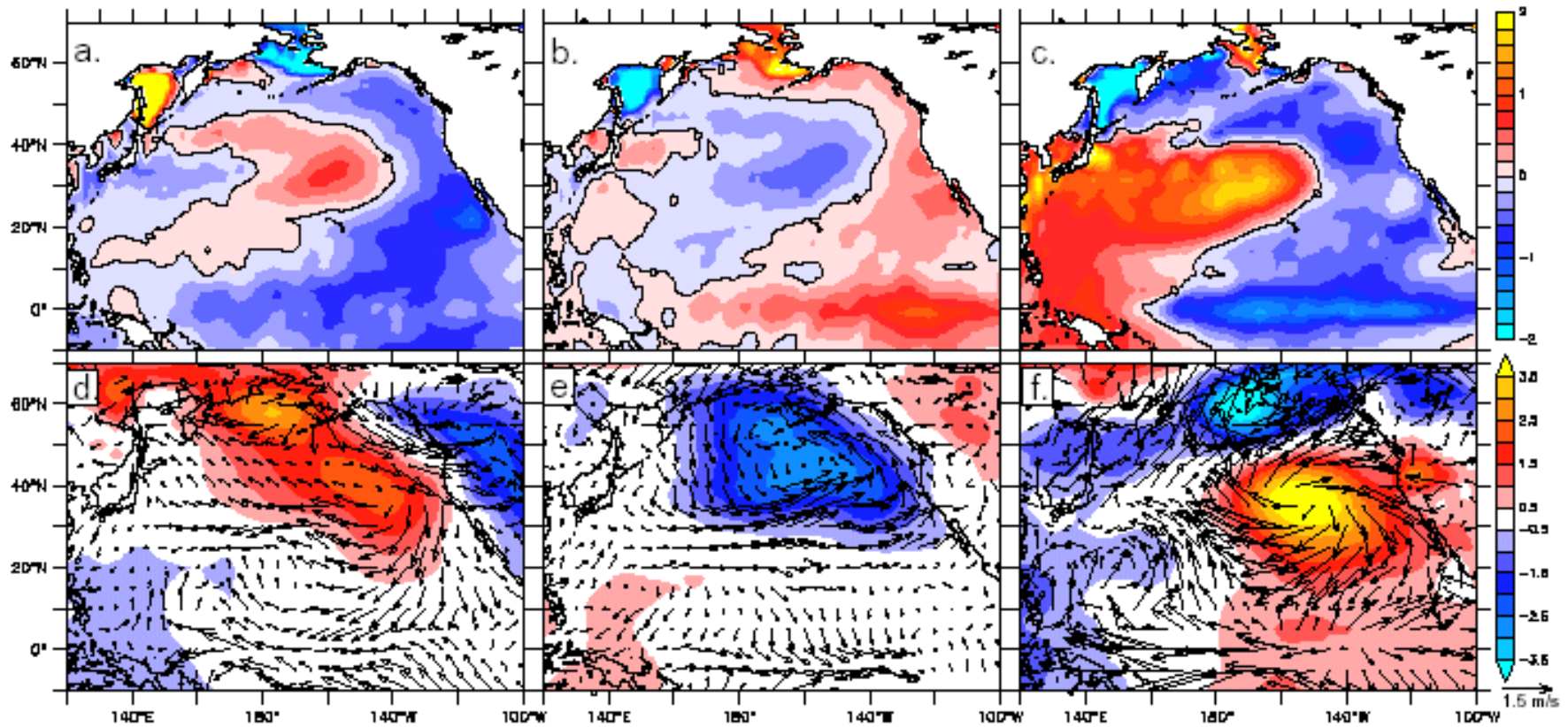


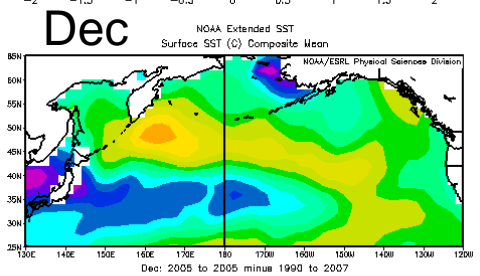
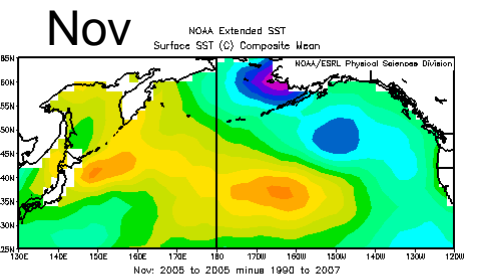
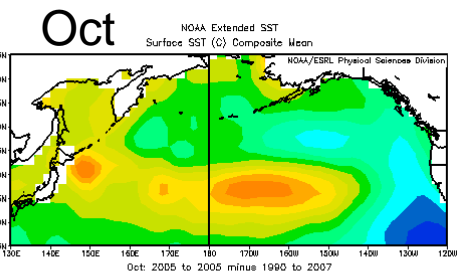
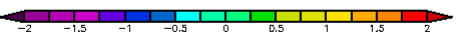
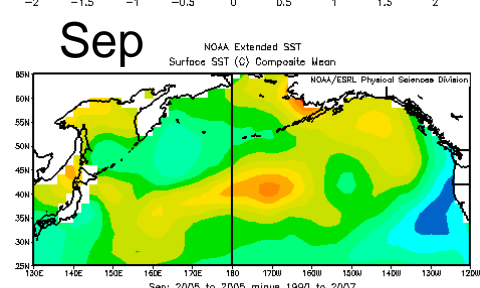
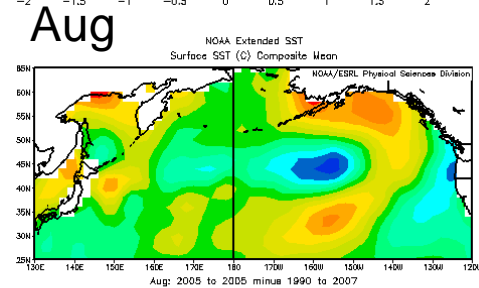
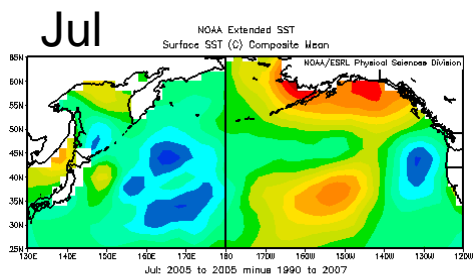
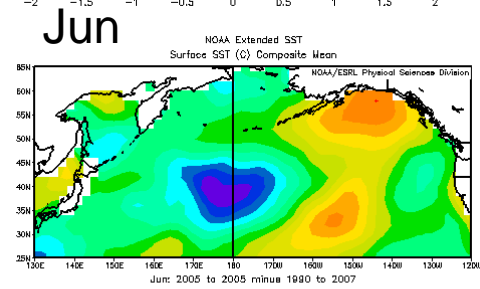
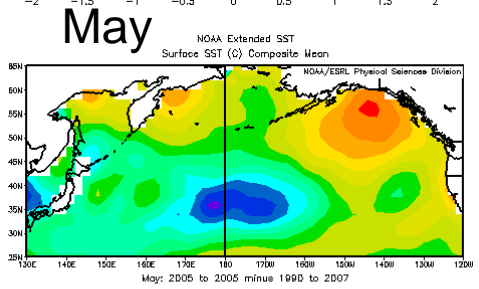
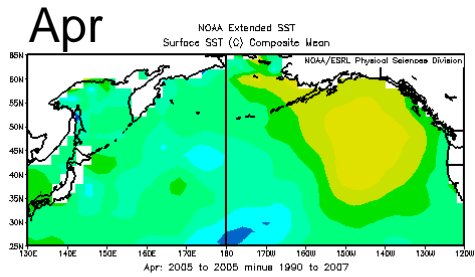
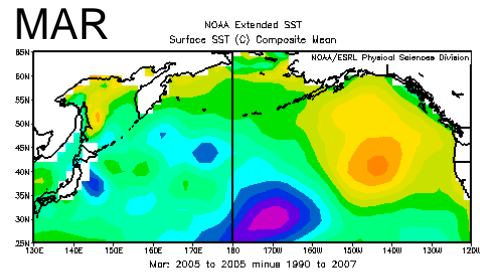
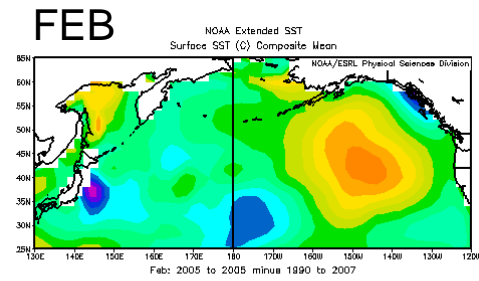
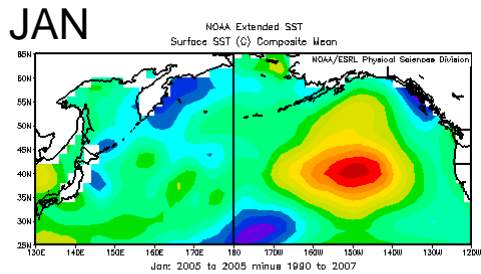
# Pacific Decadal Oscillation

70's

80's

99-02

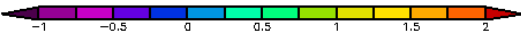
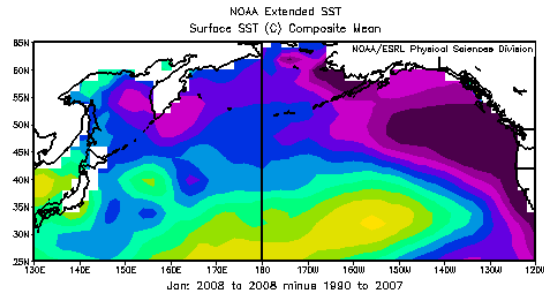




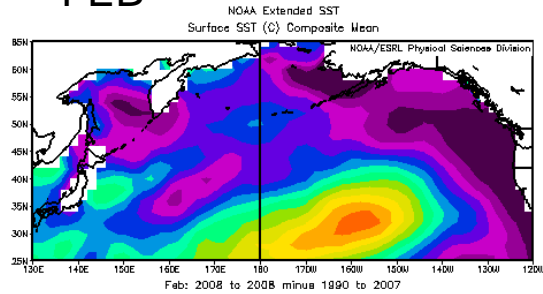
2005  
Yellow  
& Red  
are warm  
anomalies

# 2008

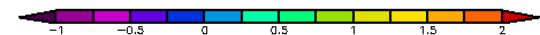
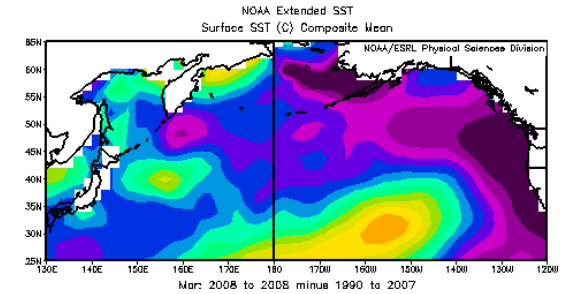
## JAN



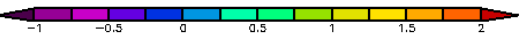
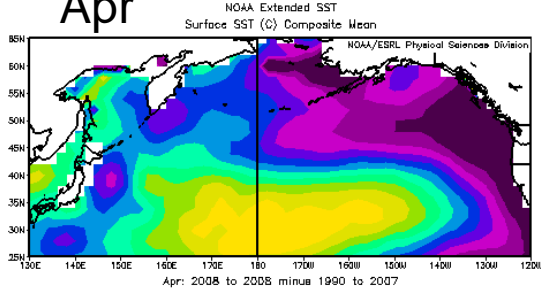
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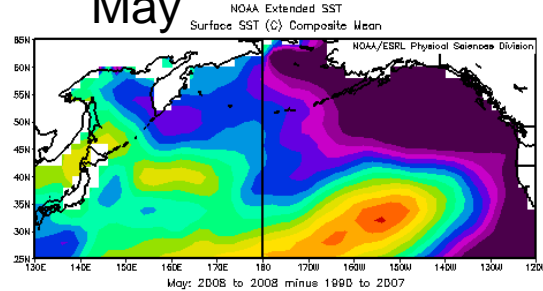
## MAR



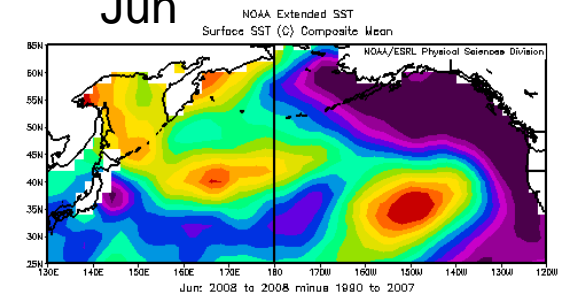
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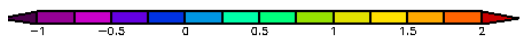
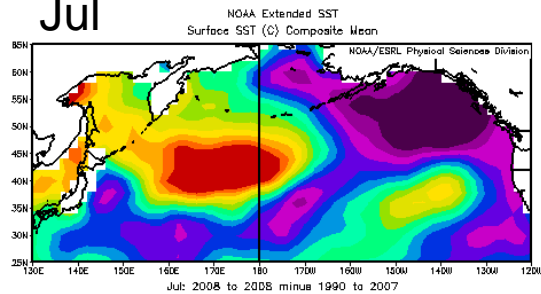
## May



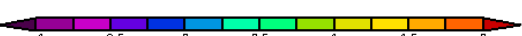
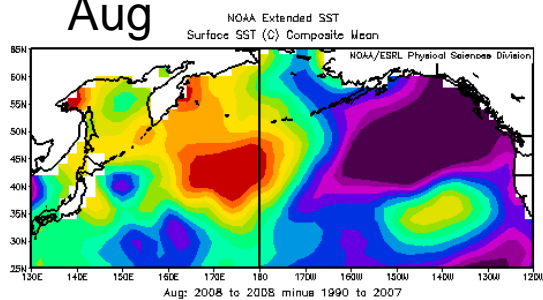
## Jun



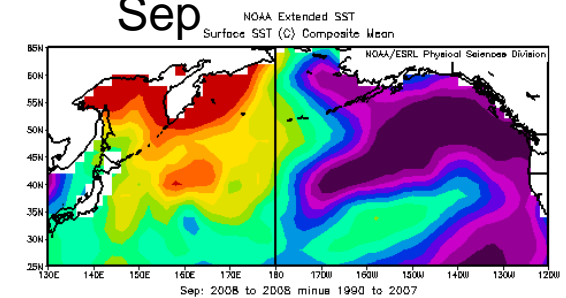
## Jul



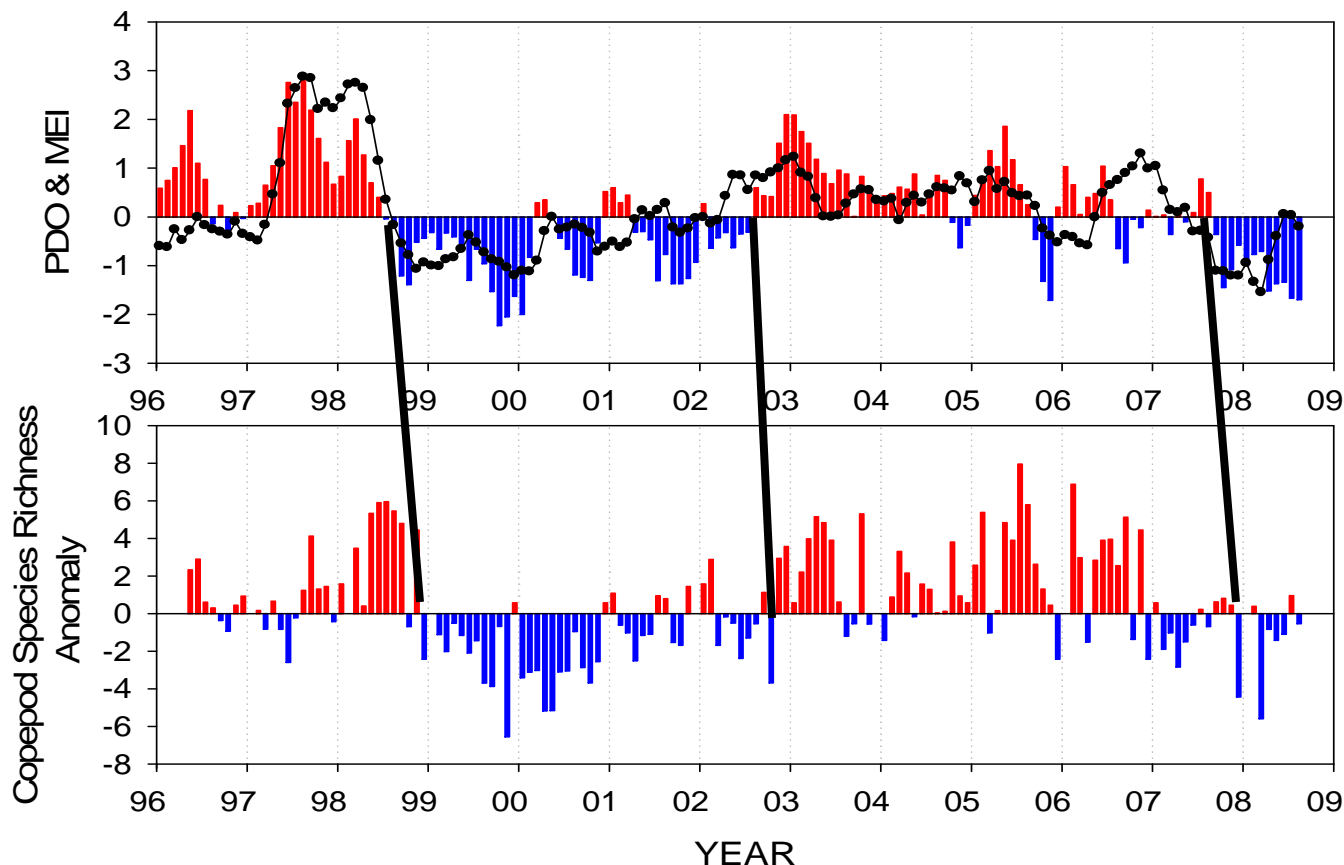
## Aug



## Sep



13 year time series of zooplankton sampling off Newport shows that monthly anomalies of copepod species richness are correlated with the PDO

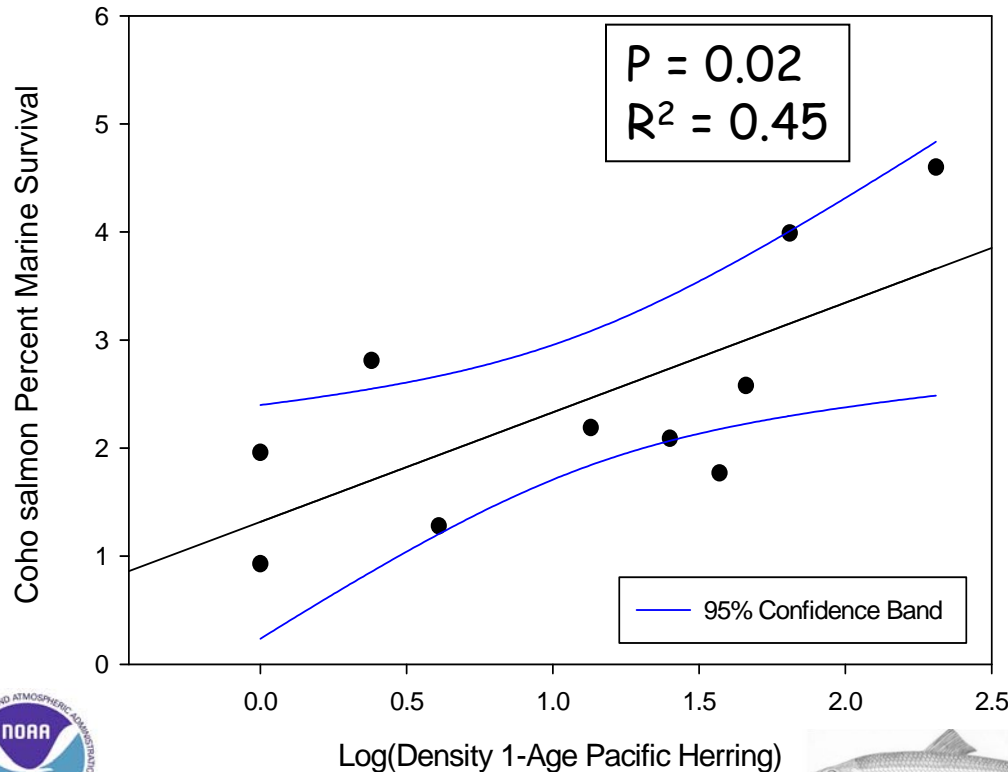


As with SST, there are time lags of a few months between the 4-year "cold periods" and "warm periods". Cold periods are characterized by "cold water" copepods and warm periods by "warm water" copepods

There is a significant relationship between the abundance of age-1 Pacific herring during the spring that coho salmon migrate to sea and coho salmon marine survival

**Reasons:**

- Protection from Predators (alternative prey)



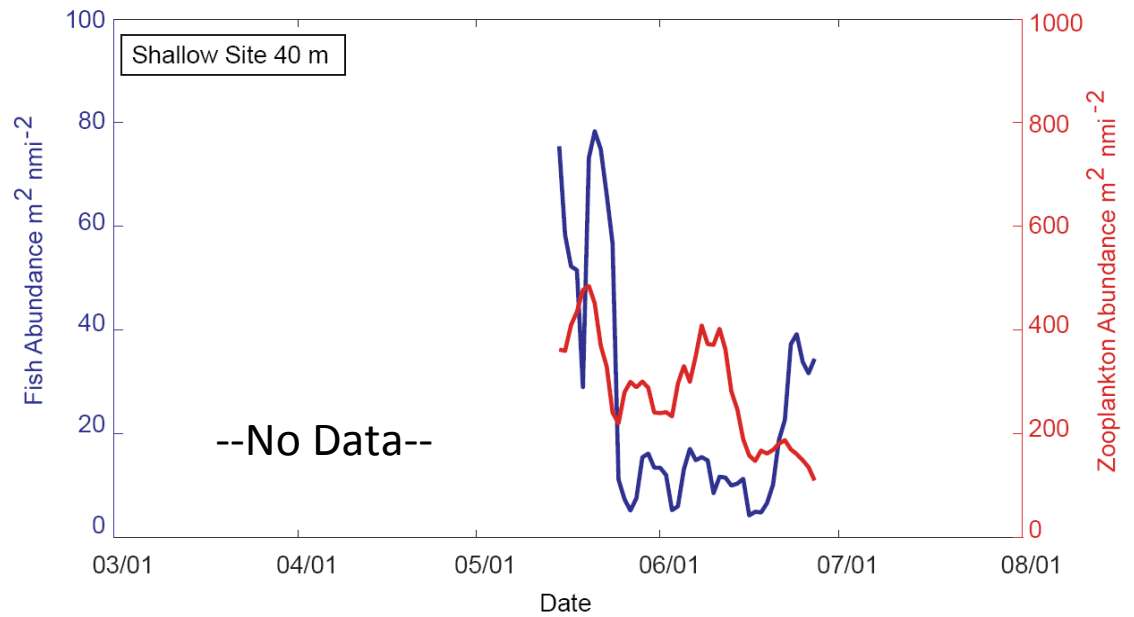
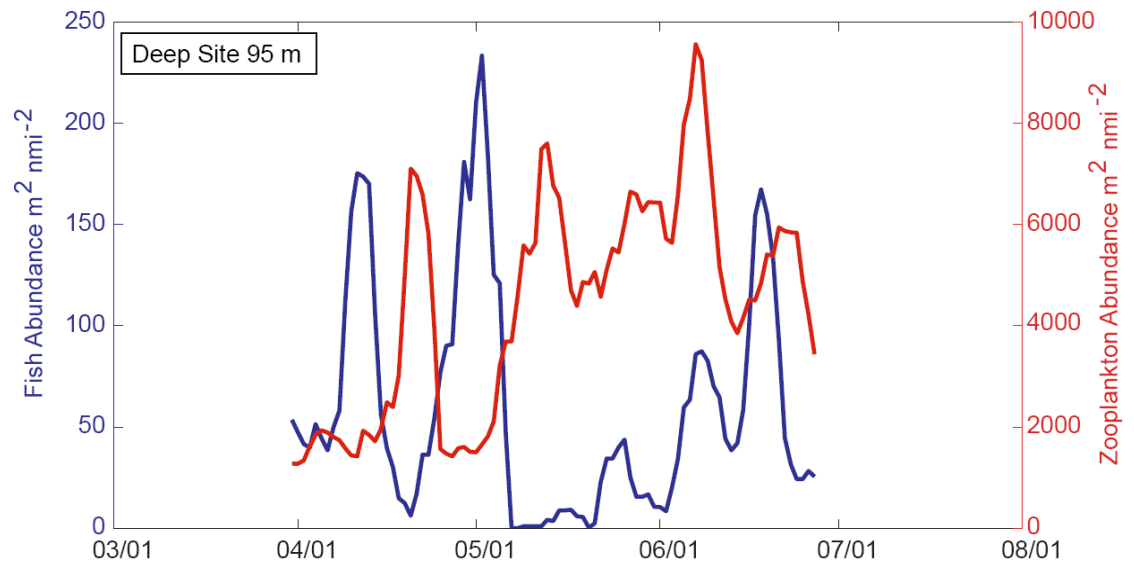
# Acoustic Moorings

- Bottom-mounted WCP moorings (200-kHz)
- Sampling interval once every 8 seconds, 1 m vertical bins



Total water column  
backscatter

Strong peaks early in  
the season, with  
gradual increase later.



# Ocean Conditions and Salmon Survival in the Northern California Current: Predicting Salmon Runs

[http://www.nwfsc.noaa.gov/features/predicting\\_salmon\\_runs.cfm](http://www.nwfsc.noaa.gov/features/predicting_salmon_runs.cfm)

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- The ocean is not stable. It changes annually, seasonally, weekly, daily.
- The Ocean does not compare to the terrestrial environment.
  - 1) Entire ocean habitats move
  - 2) Food webs are different

In the ocean everyone is a predator or prey during their life history. Even predators (salmon, hake, mackerel) are prey during their early stages..

In terrestrial environments  
wildebeests don't eat lions.





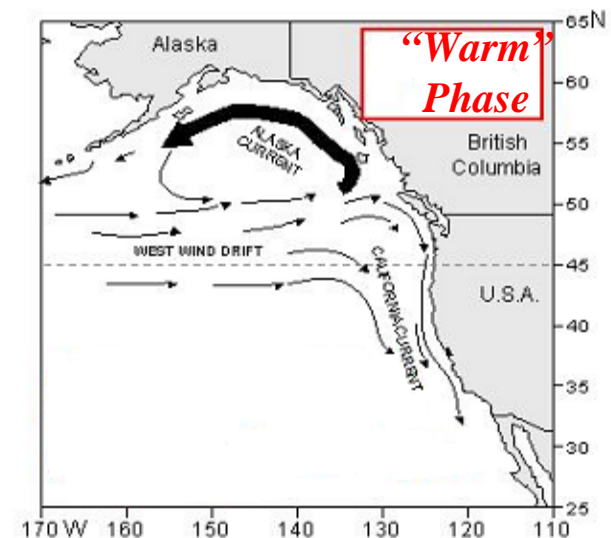
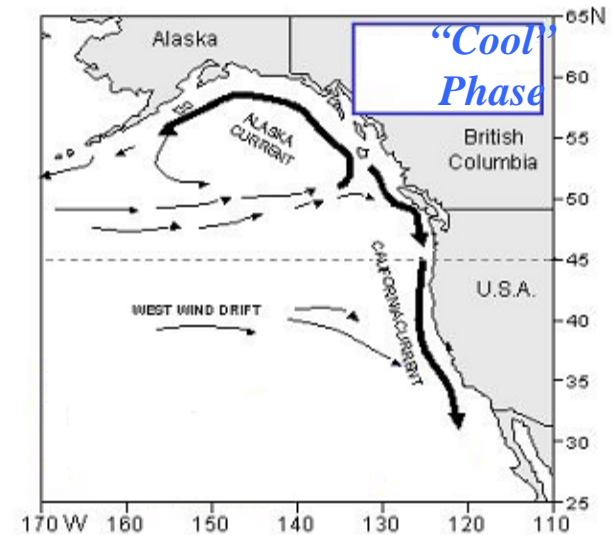
# *A working mechanistic hypothesis: source waters. . .*

**Cool Phase →**

Transport of boreal coastal copepods into NCC from Gulf of Alaska

**Warm Phase →**

Transport of sub-tropical copepods into NCC from Transition Zone offshore



# *Changes in the copepod community structure and chemical composition*

- **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) are **large** and store **wax esters** as an over-wintering strategy

Therefore, significantly different food chains may result from climate shifts;



# Sampling

- March 31 – June 27
  - 2 mooring deployments, swapped on May 13
- 2 bio-acoustic mooring stations
  - 40 & 95 m depth
  - forage fish abundance
  - mesozooplankton abundance
- NDBC oceanography mooring
  - SST
  - SSS
  - Wind velocity
- Columbia River flow (USGS Beaver Army Terminal, near Quincy, OR)

