

March 2015 PFMC meeting, Vancouver, WA  
Agenda Item E.1.b

**Agenda Item E.1.b Supplemental  
IEA PowerPoint 2  
(Electronic Only)  
March 2015**

# 2015 State of the California Current Ecosystem Report

NOAA California Current IEA Team

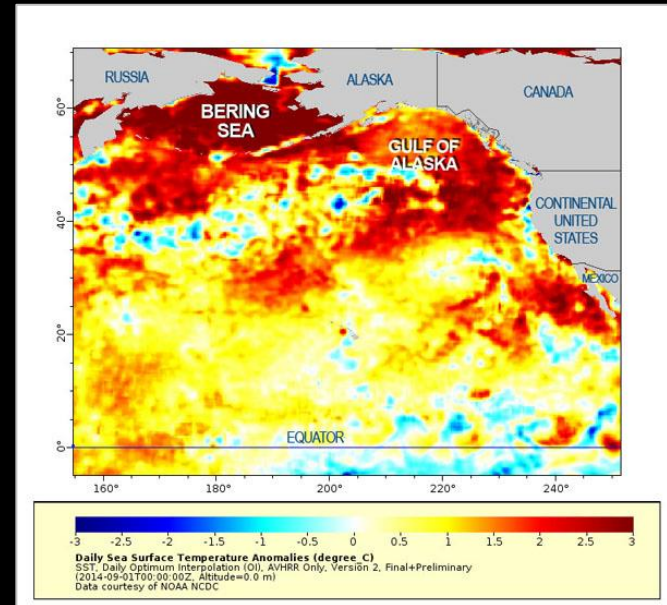


# Environmental Highlights

- **The Northeast Pacific was dominated by the “warm blob,”** record high sea surface temperatures that developed in the Gulf of Alaska and spread to the coast and southward.
- Basin-wide indices trended from ENSO-neutral to mild El Niño in the MEI, and the PDO and NPGO both shifted from conditions promoting high primary productivity to **less productive conditions**.
- After a record strong year of **coastal upwelling, conditions in 2014 returned to average** or slightly below average upwelling. Coupled with the basin scale indices, this would suggest lower primary productivity.
- After several relatively productive years, **biomass of energy-rich northern copepod species declined sharply in the fall of 2014**.
- May be causing significant **mortality of Cassin’s auklets and California sea lion pups**.

# Ecological and Human Dimensions Highlights

- Several components of the forage base stable or increasing, 2013-2014; **unknown how forage base will respond to recent oceanographic changes.**
- Central Valley and Lower Columbia **Chinook salmon** have negative escapement trends, while trends elsewhere are stable or positive; **low snow pack could be a problem.**
- Only 3 assessed groundfish are in an “overfished” status and **no recent indication of overfishing on groundfish.**
- **Commercial fishery landings remain relatively high**, driven largely by Pacific hake and coastal pelagic species; crab and shrimp landings also increased.
- **Diversification of fishing vessels continued a long-term decline** throughout the fleet, which may indicate greater risk of highly variable annual revenue.
- Evidence that catch shares program has **increased vessel safety in the fixed gear sablefish fleet.**



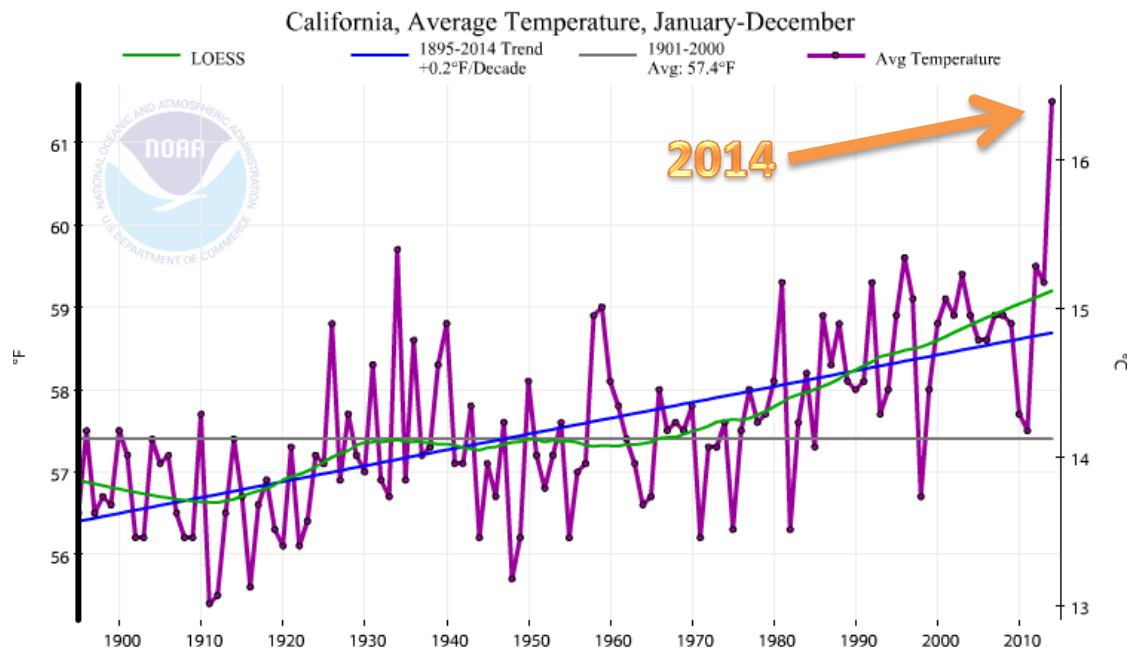
Sea surface temperature anomalies, Sept. 1, 2014  
(NOAA National Climate Data Center)

# 1. Unprecedented physical conditions: the “warm blob”

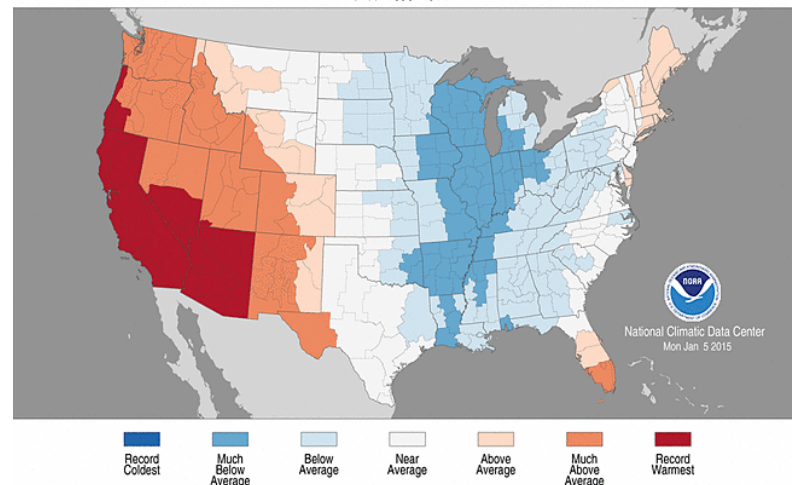


Sure 2014 was dry,  
but it was also  
extraordinarily hot in  
California

- Surface air temperature record was almost off the charts,  $\sim 1^{\circ}\text{C}$  warmer than the previous record
- Extraordinary warmth was confined to the southwest, centered in California

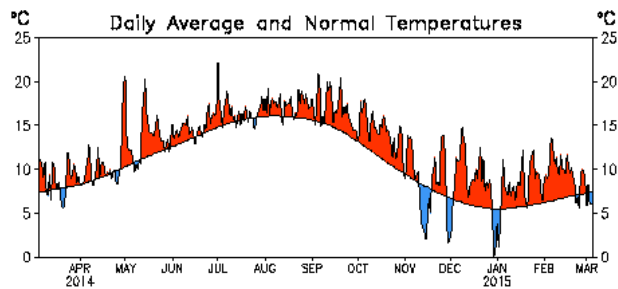


Divisional Average Temperature Ranks  
January-December 2014  
Period: 1895-2014

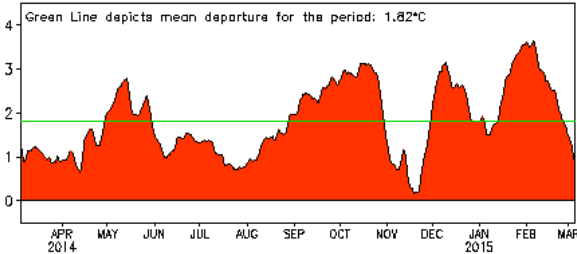


# All but a few days in 2014 were warmer than average in most west coast locations

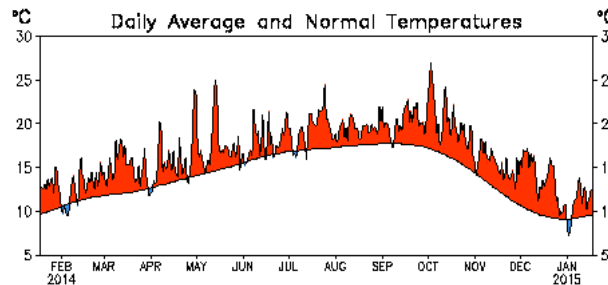
ASTORIA, OREGON



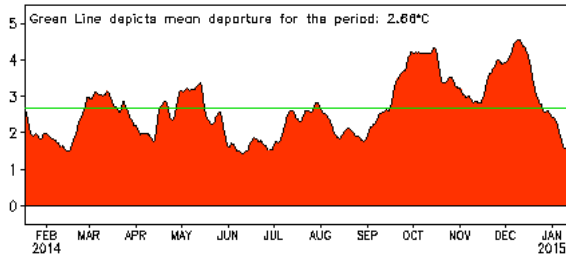
31-Day Running Mean of Daily Temperature Departures



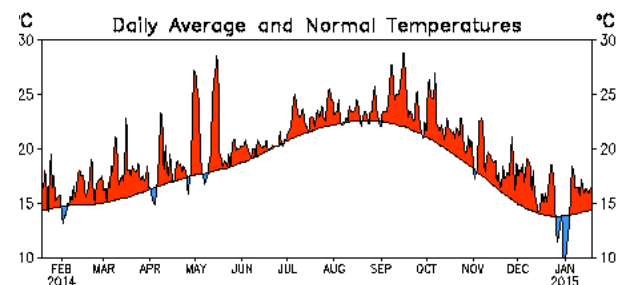
SAN FRANCISCO, CALIFORNIA



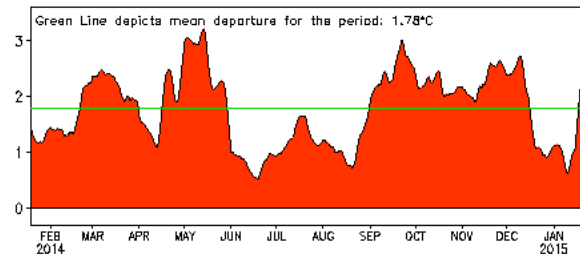
31-Day Running Mean of Daily Temperature Departures



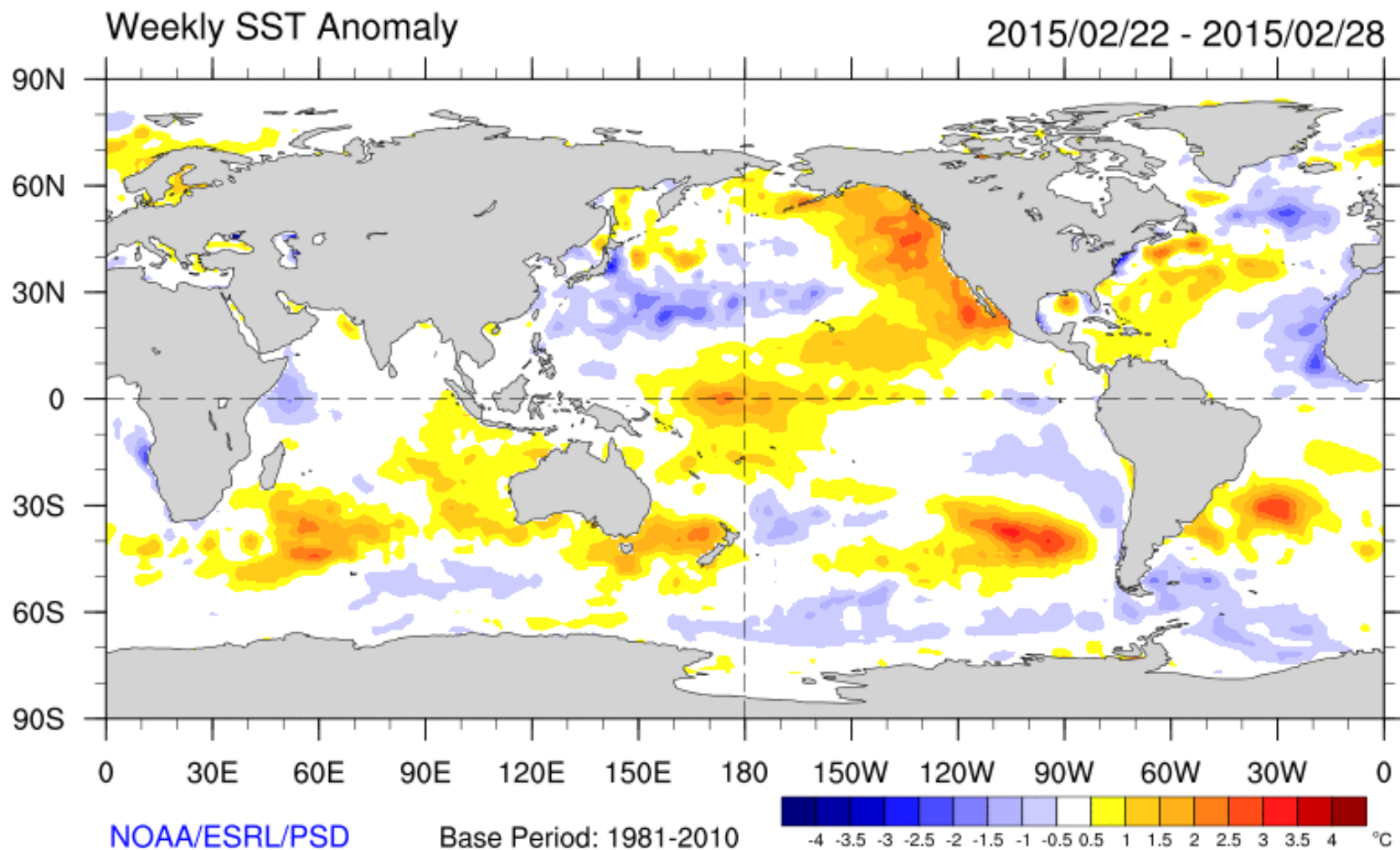
SAN DIEGO/LINDBERGH, CALIFORNIA



31-Day Running Mean of Daily Temperature Departures

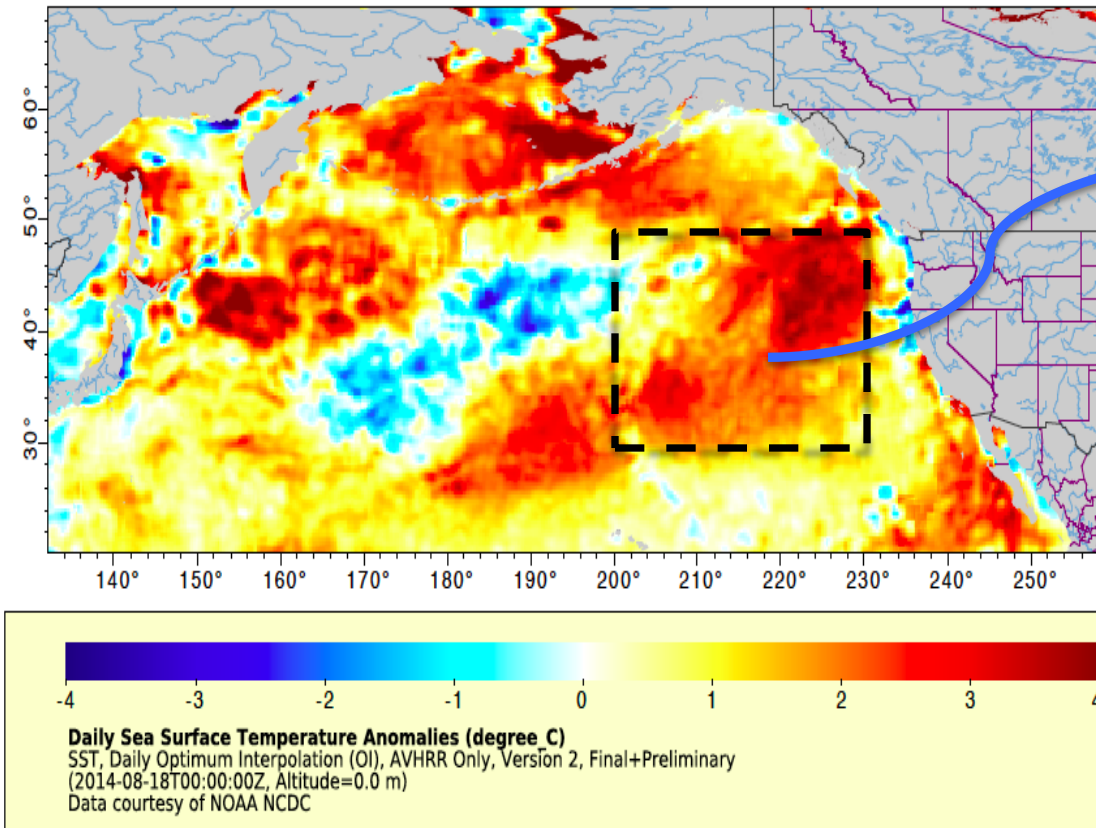


# SST anomalies in 2014-15

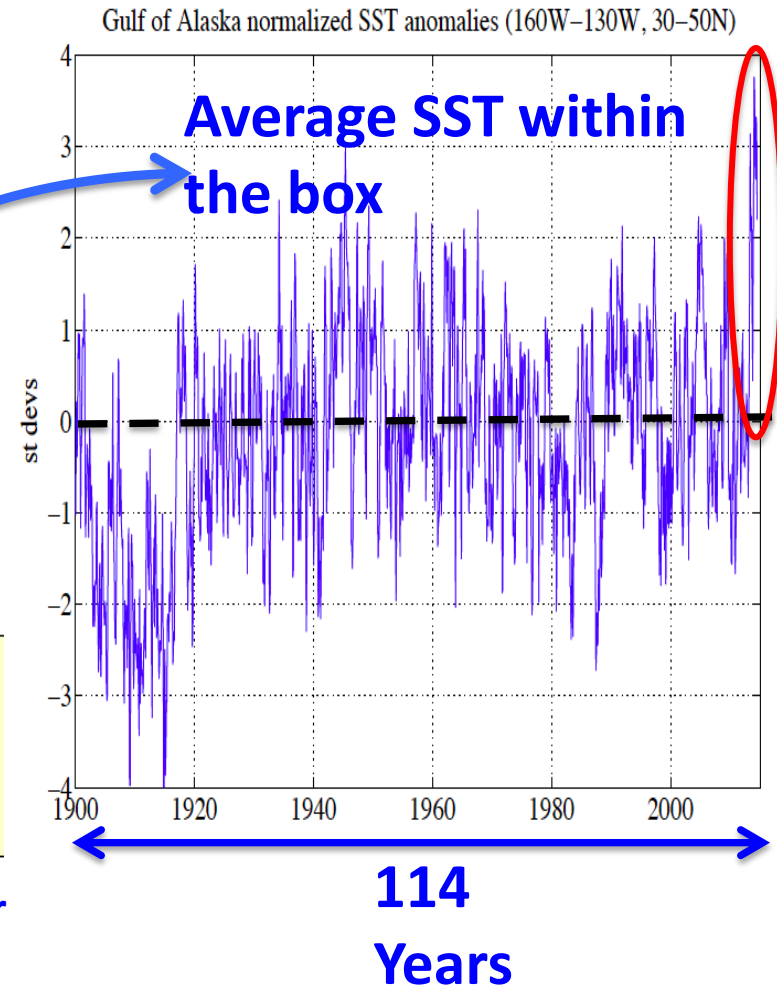


# Present state and ~100-year time series of SST

*"There's something happening here, what it is ain't exactly clear..."* (Buffalo Springfield)

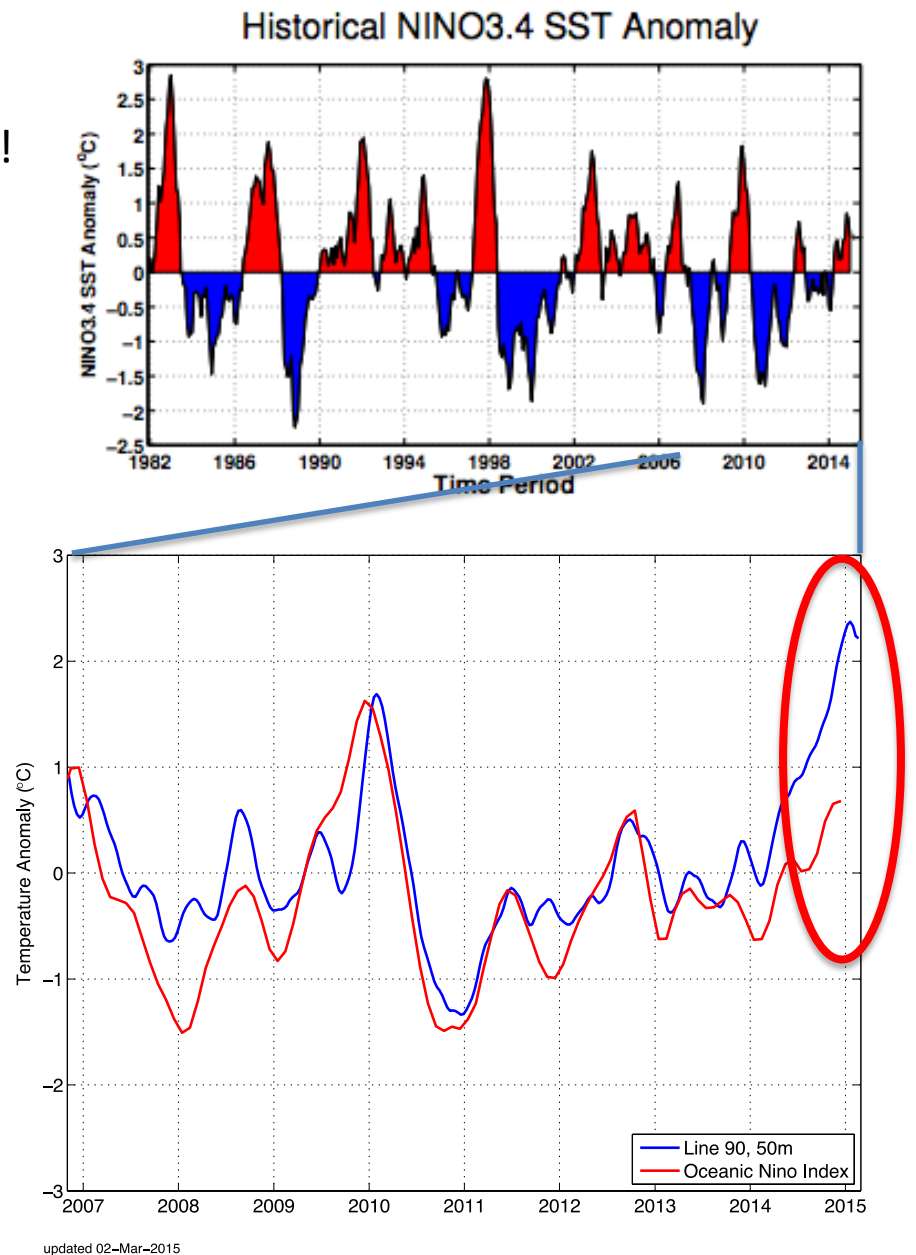
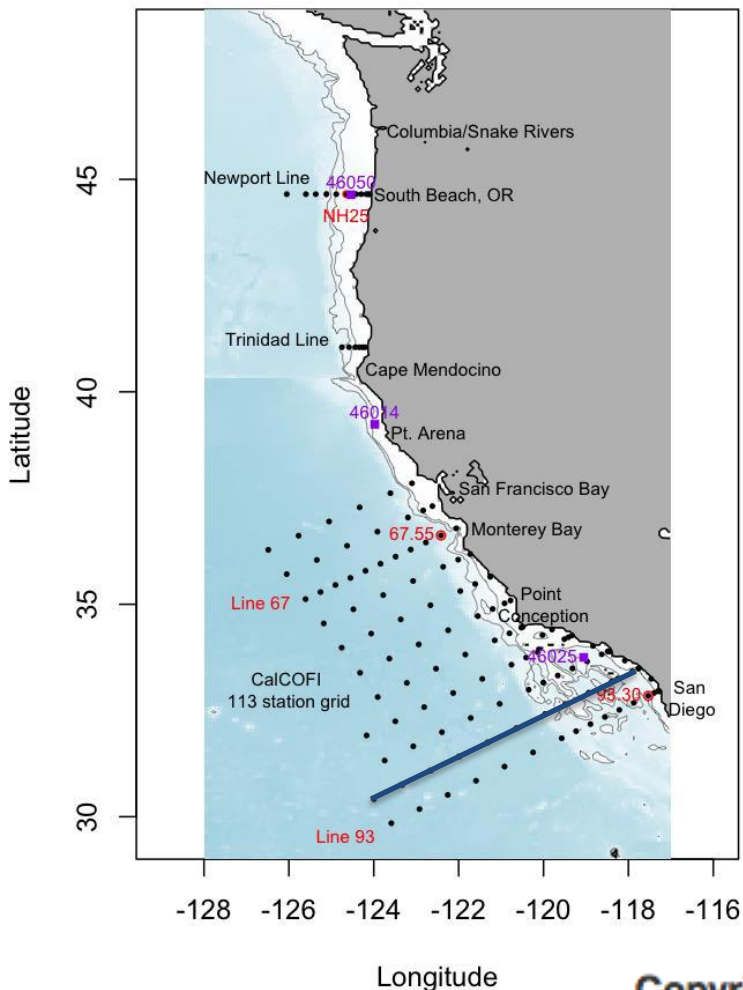


**Daily SST anomaly (18 Aug 2014) relative to the 30-year (1982-2010) climatology**





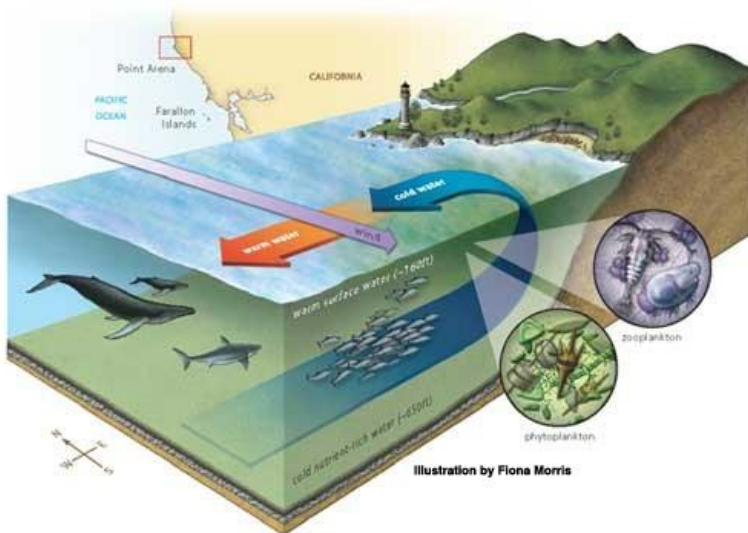
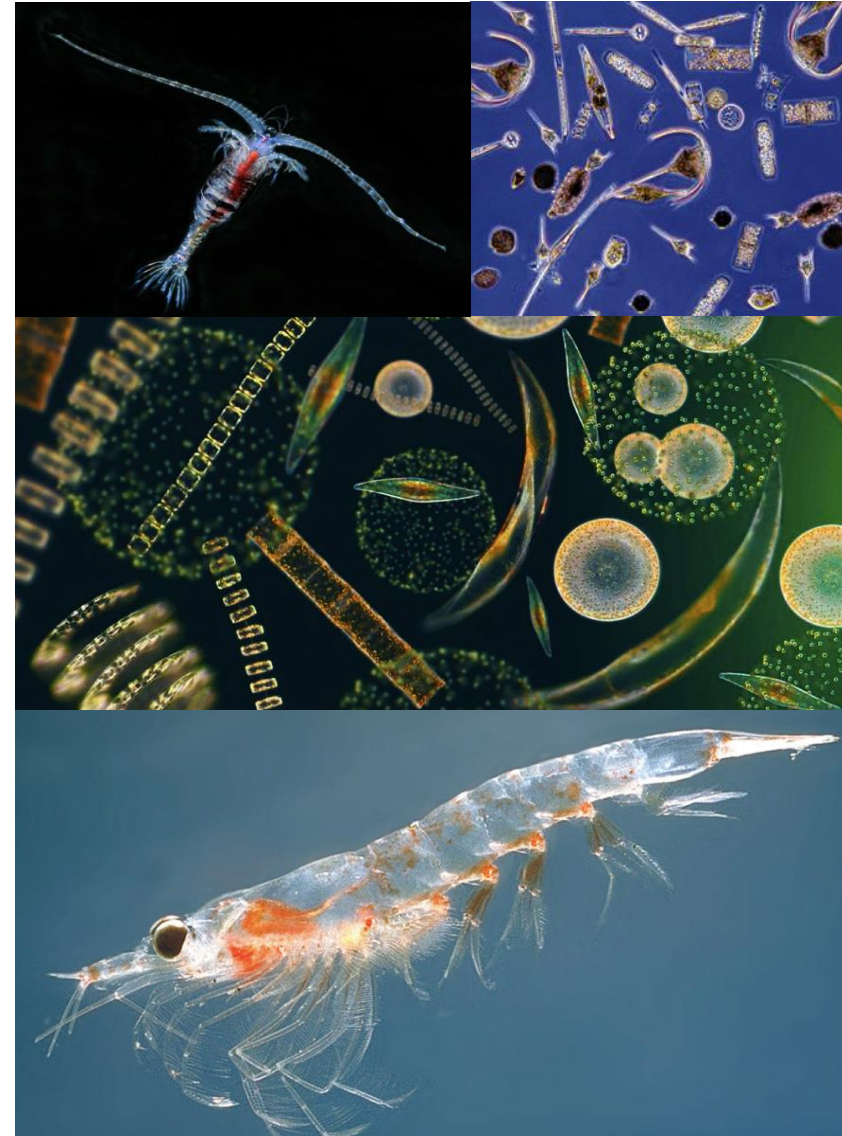
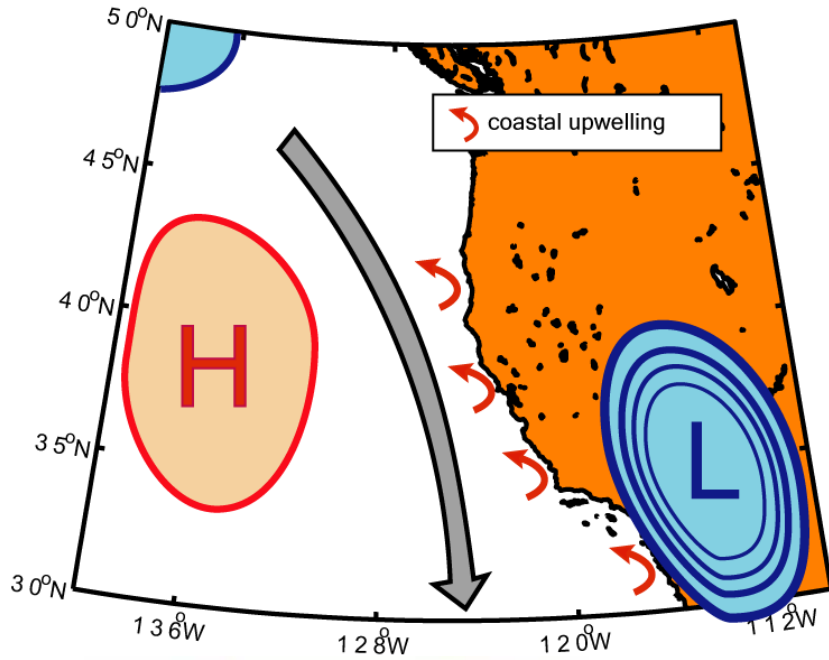
Beginning in 2007, 50 m averaged temperature anomalies along CalCOFI line 90 (blue line below) have tracked with the El Niño index. Note how different 2014 is from previous years!



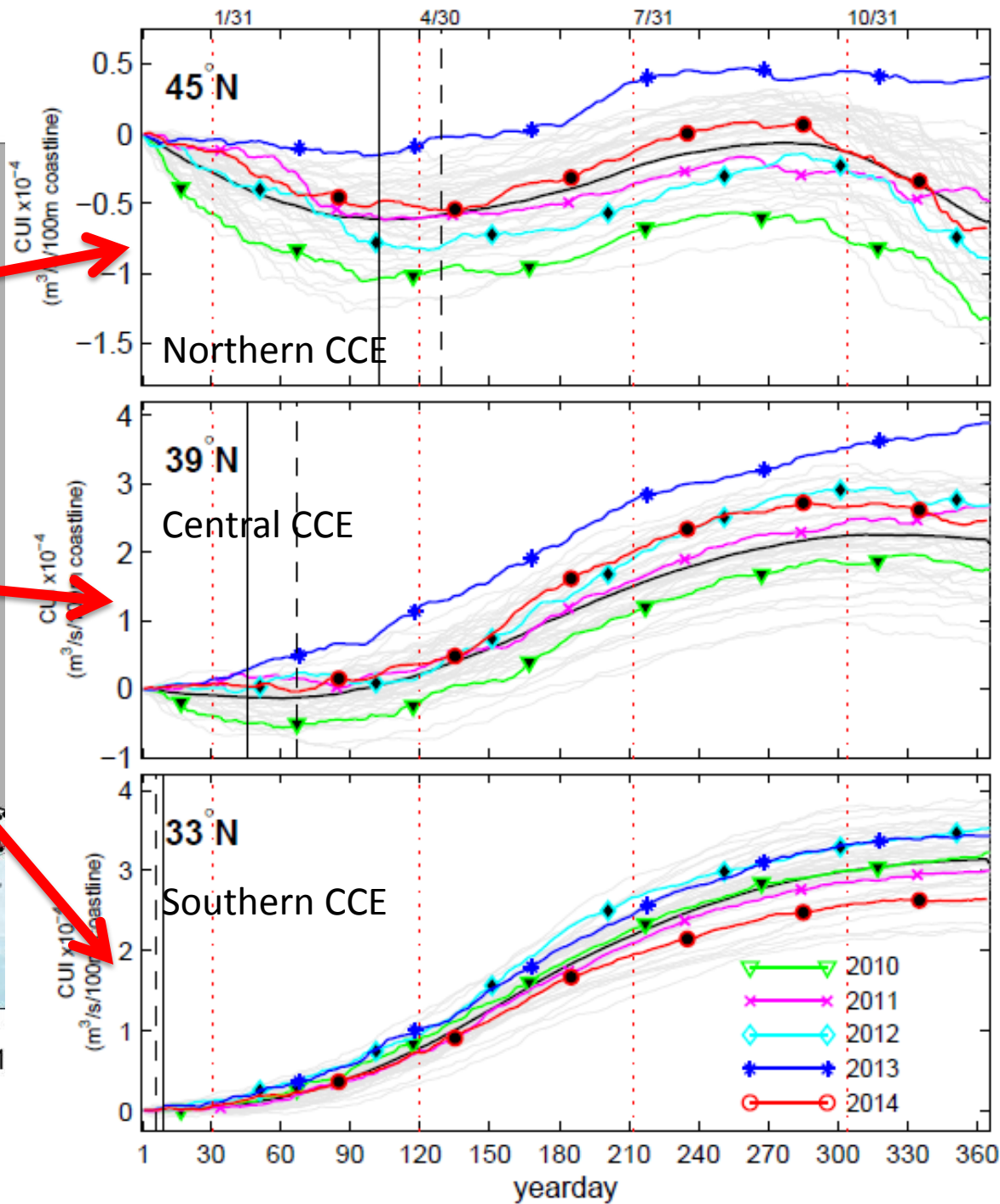
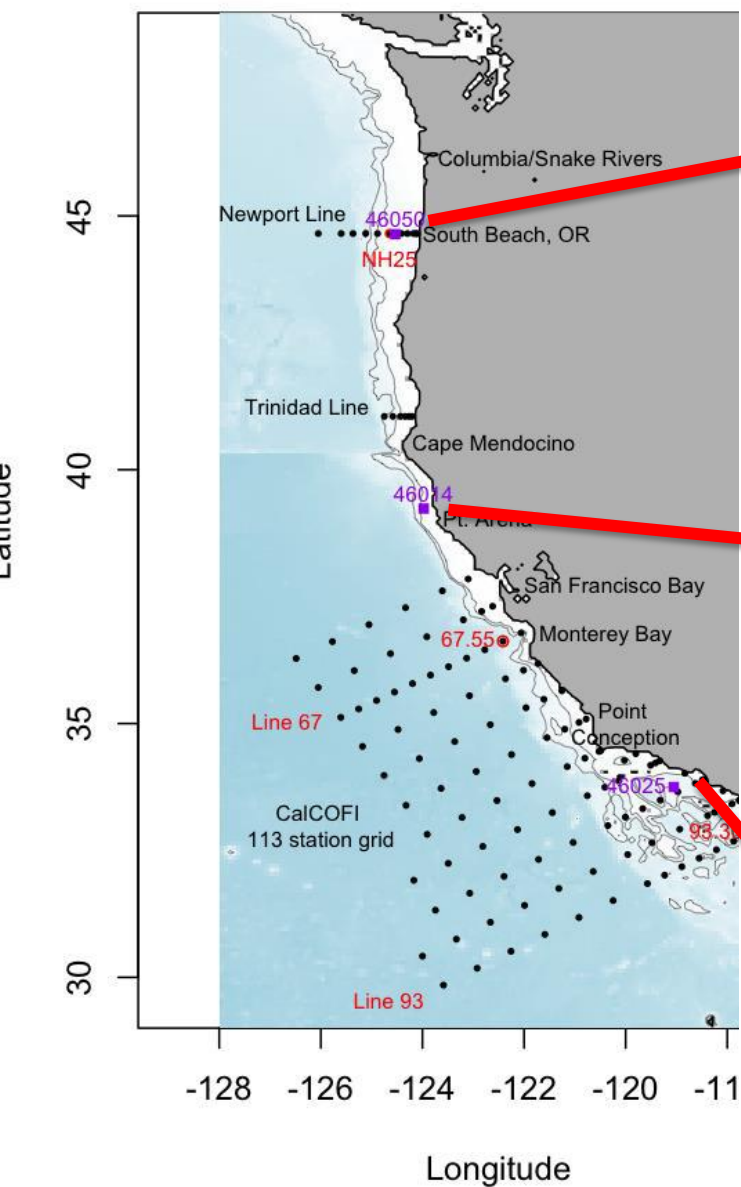
updated 02-Mar-2015

## CALIFORNIA CURRENT FOOD WEB DEPENDS ON UPWELLING

The source waters and upwelling strength determine the primary productivity

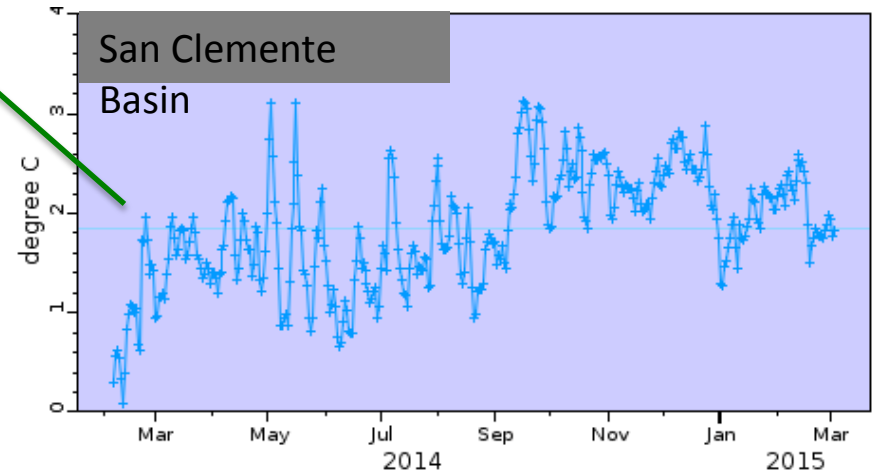
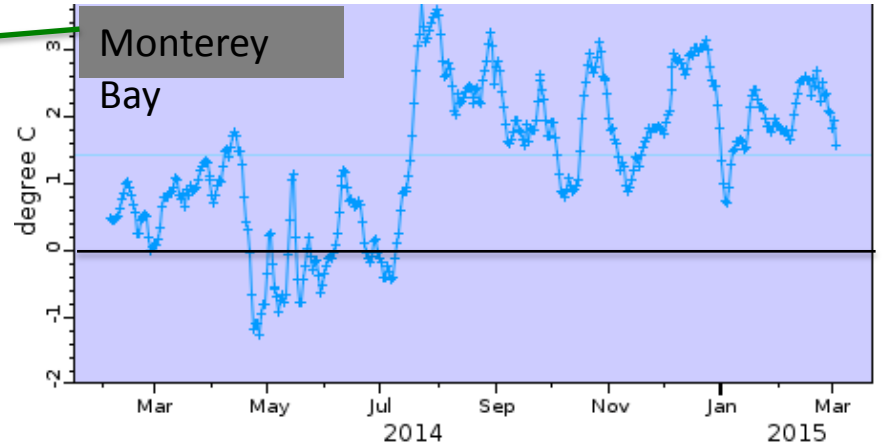
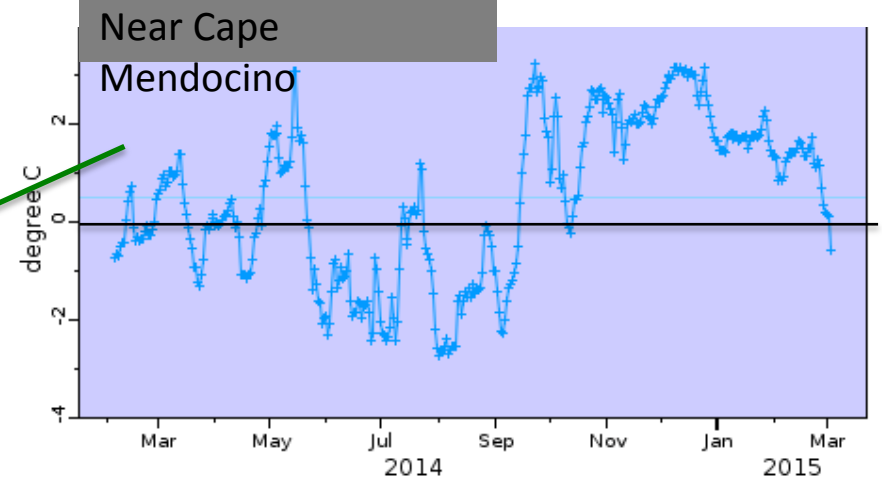
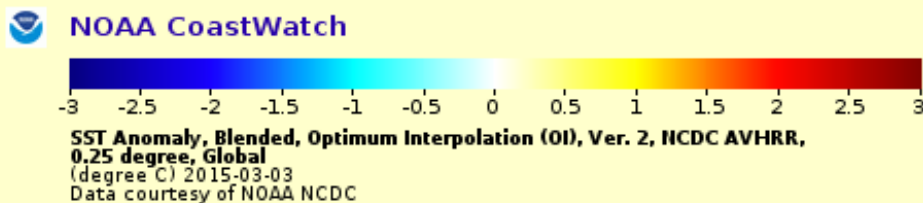
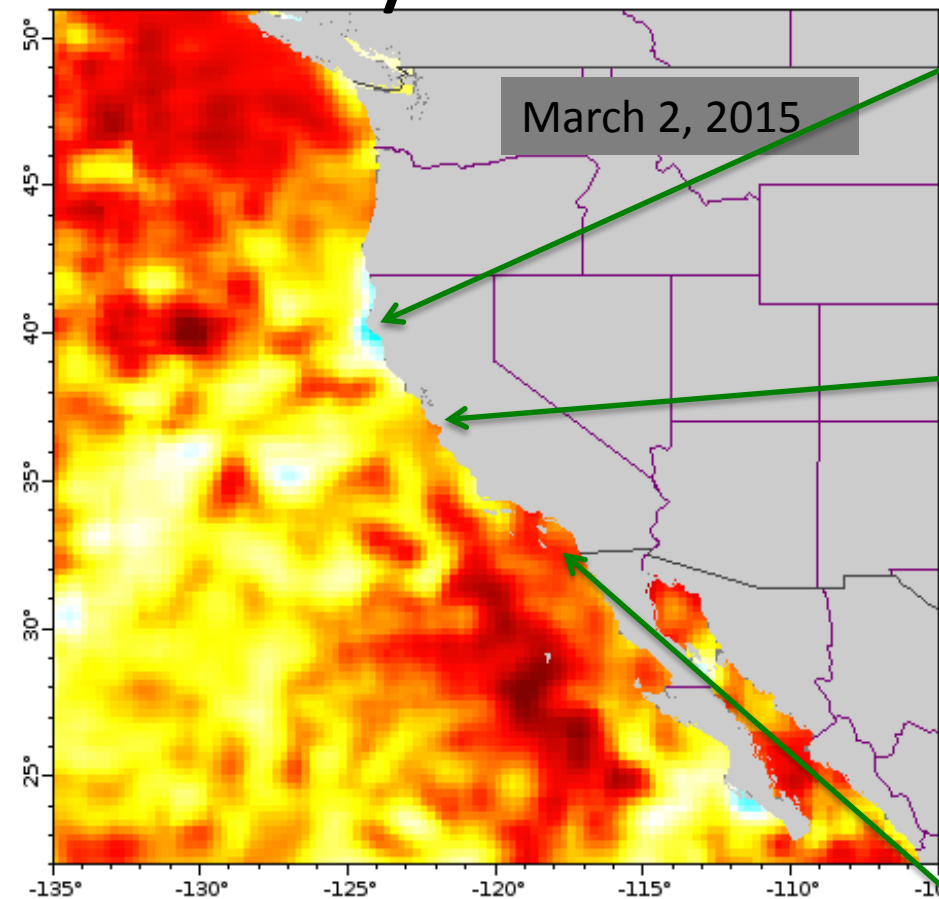


Upwelling provides an important measure of ecosystem variability.

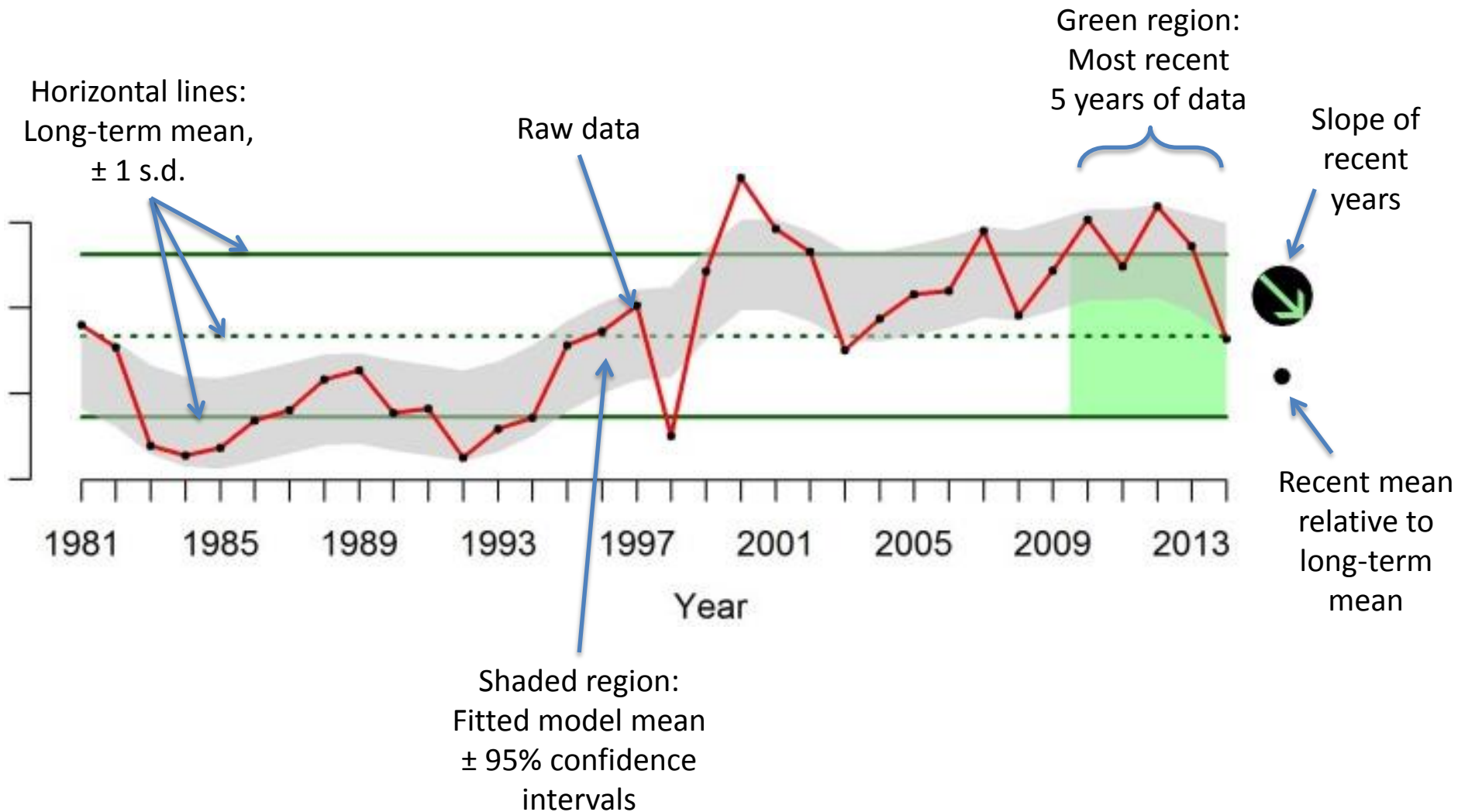




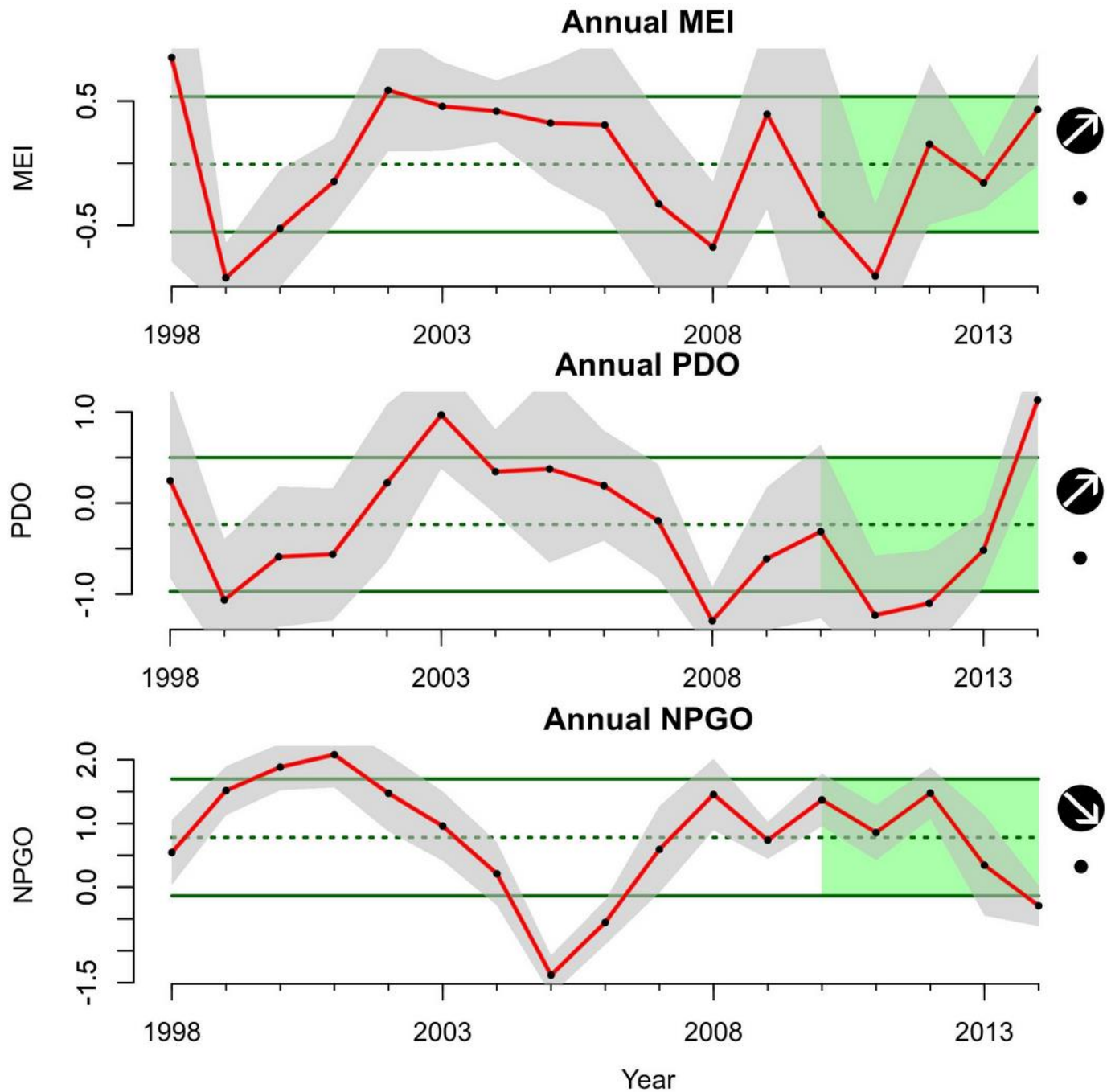
# 2014/15 SSTa



# Interpreting time series plots

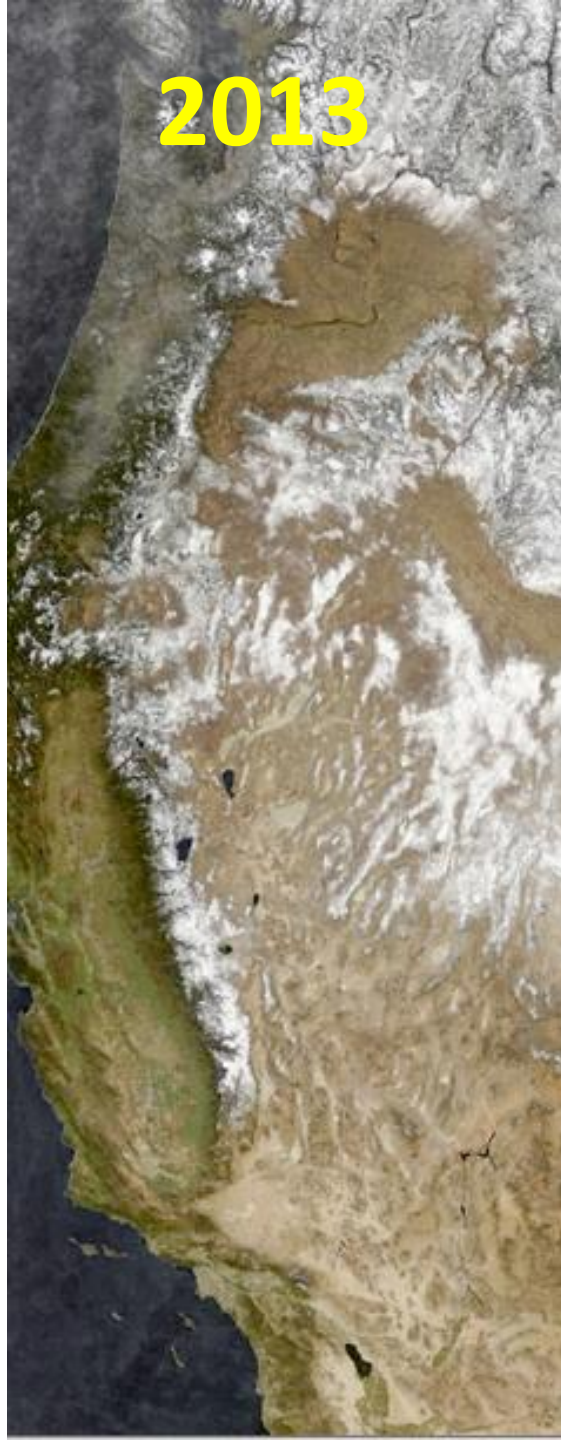


Environmental conditions:  
  
weak El Niño,  
positive PDO, and  
negative NPGO,  
  
all suggest less  
favorable conditions  
for shelf productivity  
in the California  
Current Ecosystem.  
  
The CCE is still in an  
unprecedented state  
of warm surface  
waters.

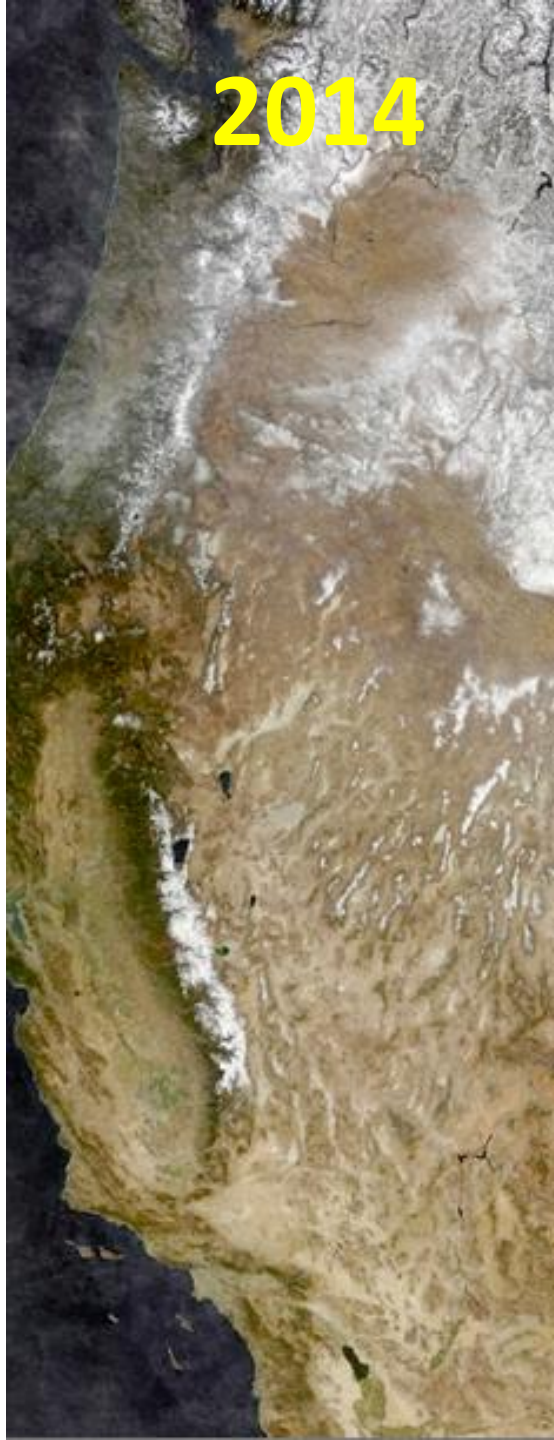




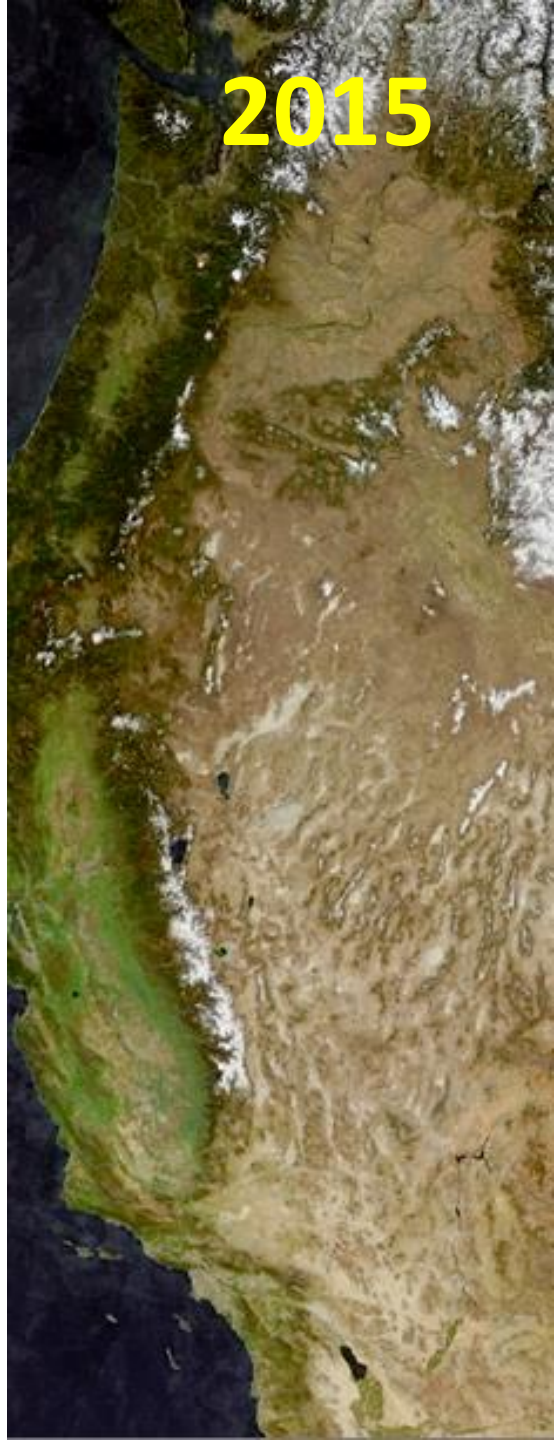
2013



2014

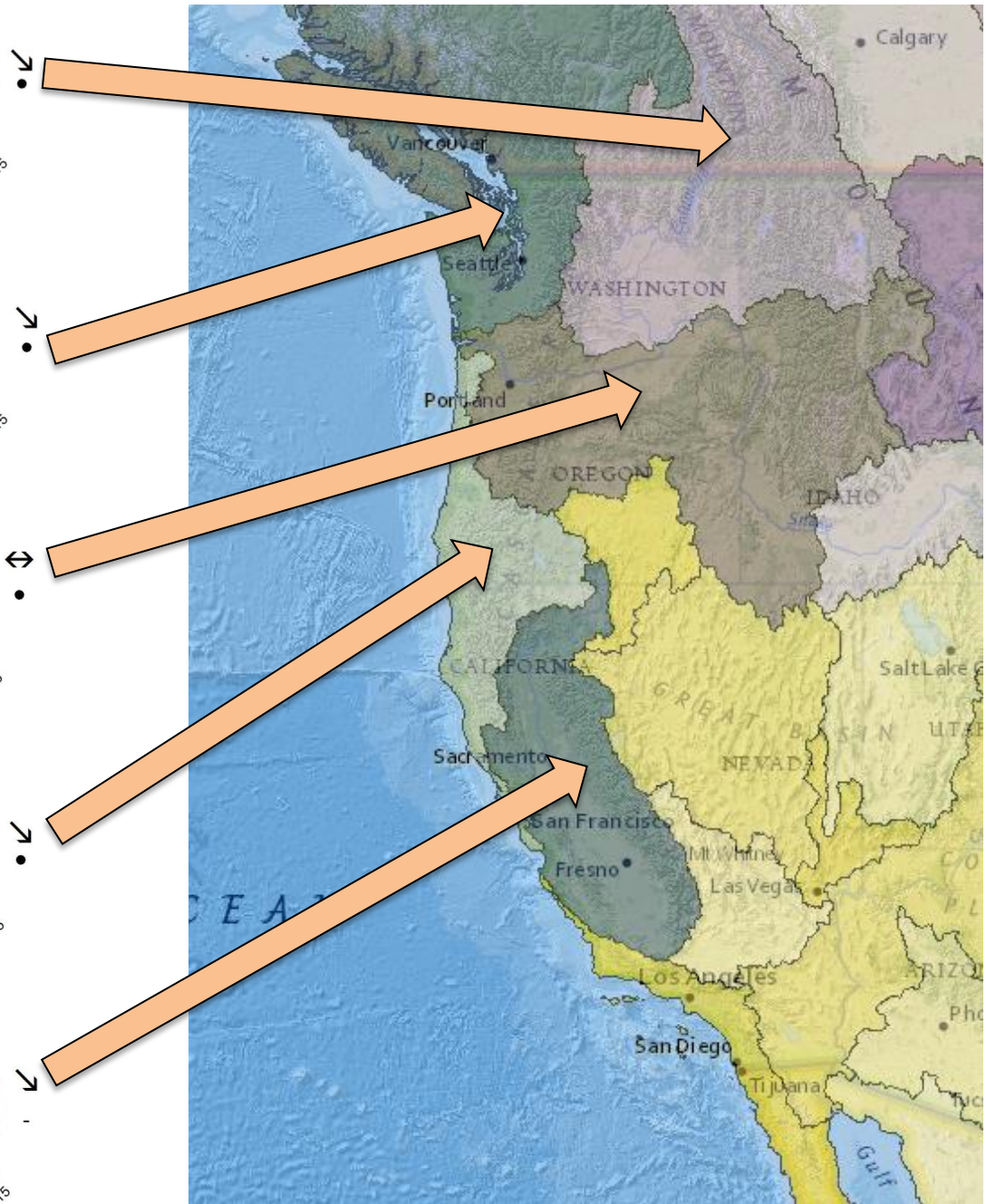
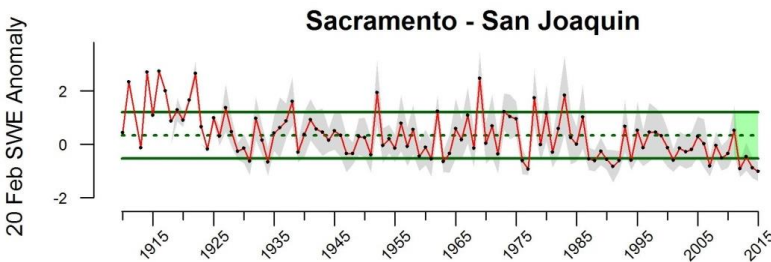
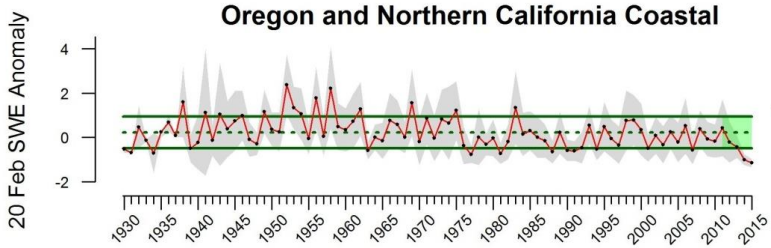
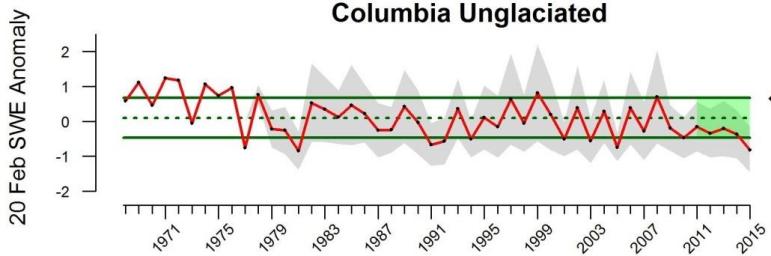
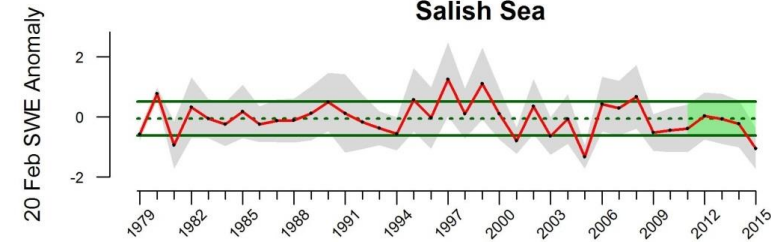
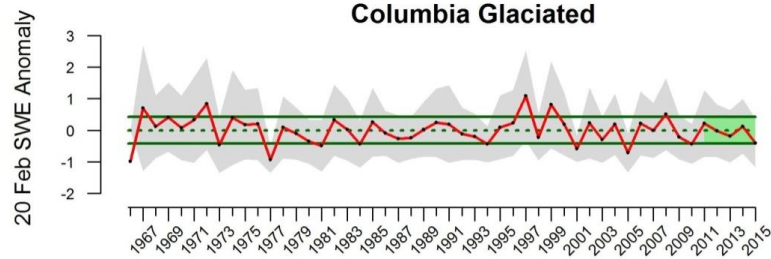


2015





# Snow water equivalent (SWE)







*Emaciated California sea lion pup, San Nicolas Island, early 2015.  
(photo: Sharon Melin, NOAA)*

## 2. Ecological responses to “warm blob”



# Northern copepod biomass anomaly

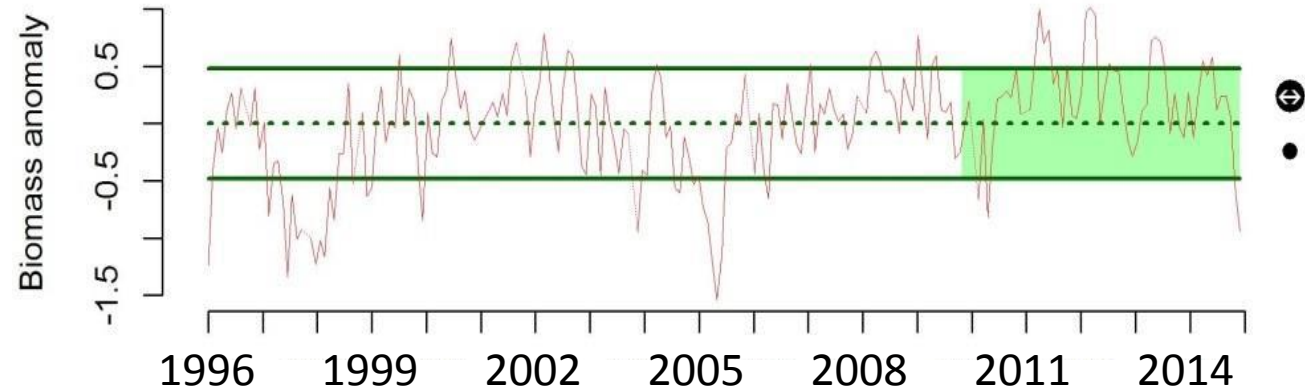
- “Northern” copepods are rich in lipids that support fish production
- Northern copepods associated with cooler waters, negative PDO signal
- Recent years off Newport, OR: Northern copepods have been abundant
- But, a major shift occurred in late 2014



≈



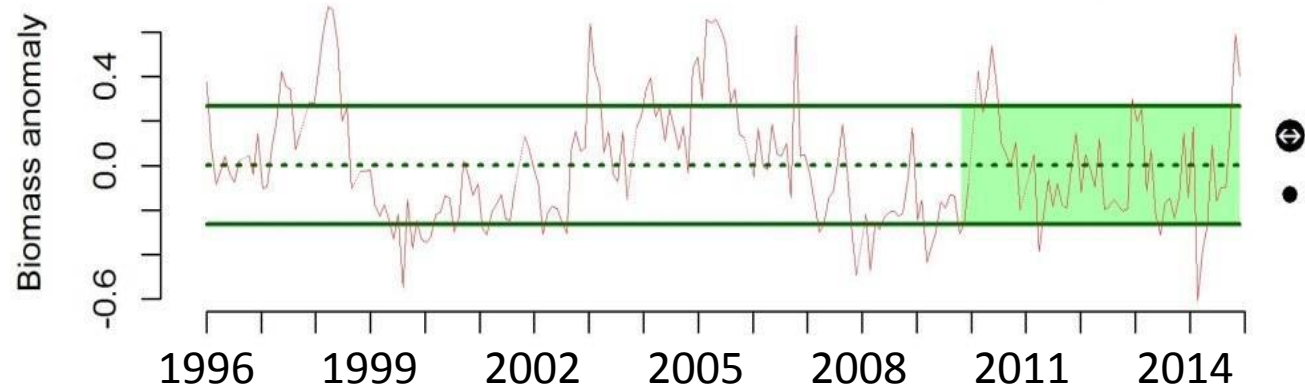
Northern copepod biomass anomaly



≈



Southern copepod biomass anomaly

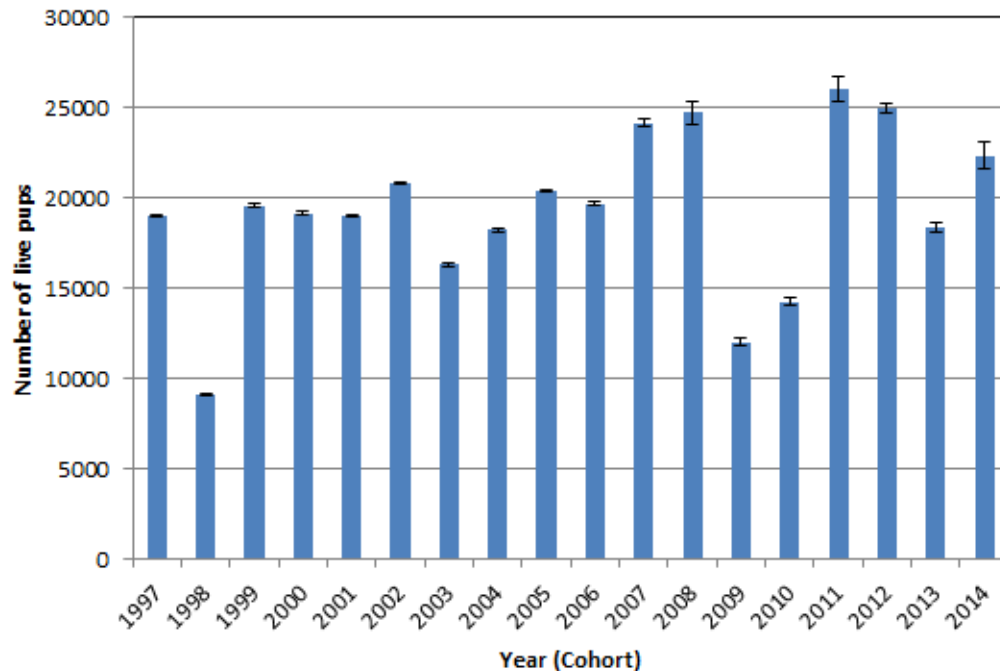


# California sea lion pups

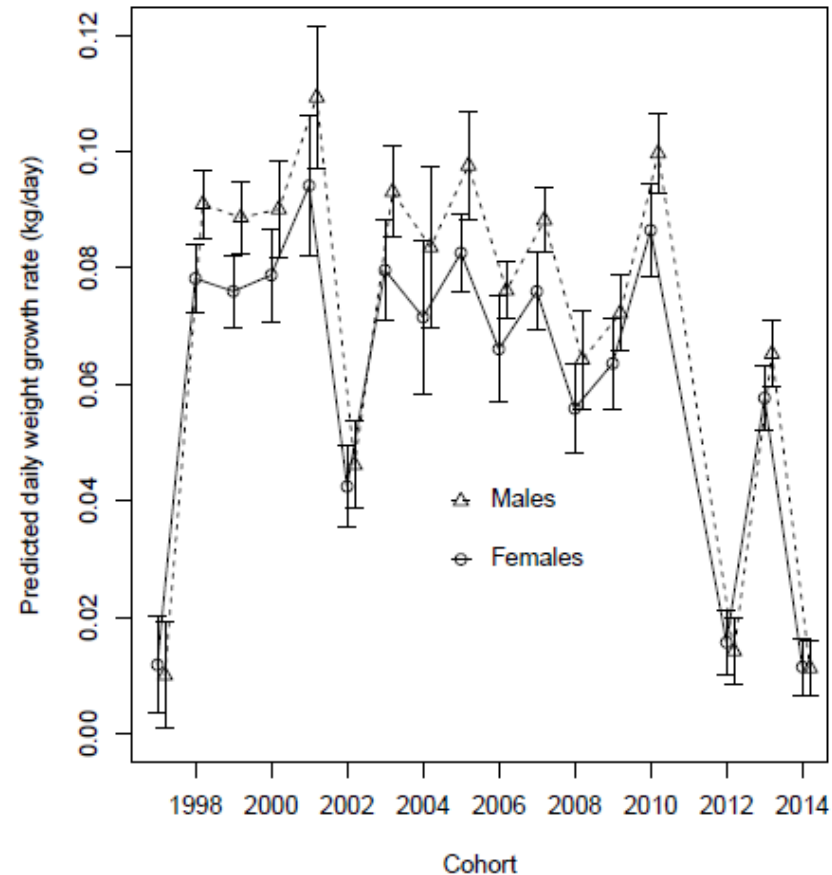
- Pup count for 2014 cohort was fairly normal
- But, pup growth is very poor and mortality likely will be ~70%
- Mothers producing poor quality milk, due to inadequate feeding conditions



Pup count at San Miguel Island



Pup growth at San Miguel Island

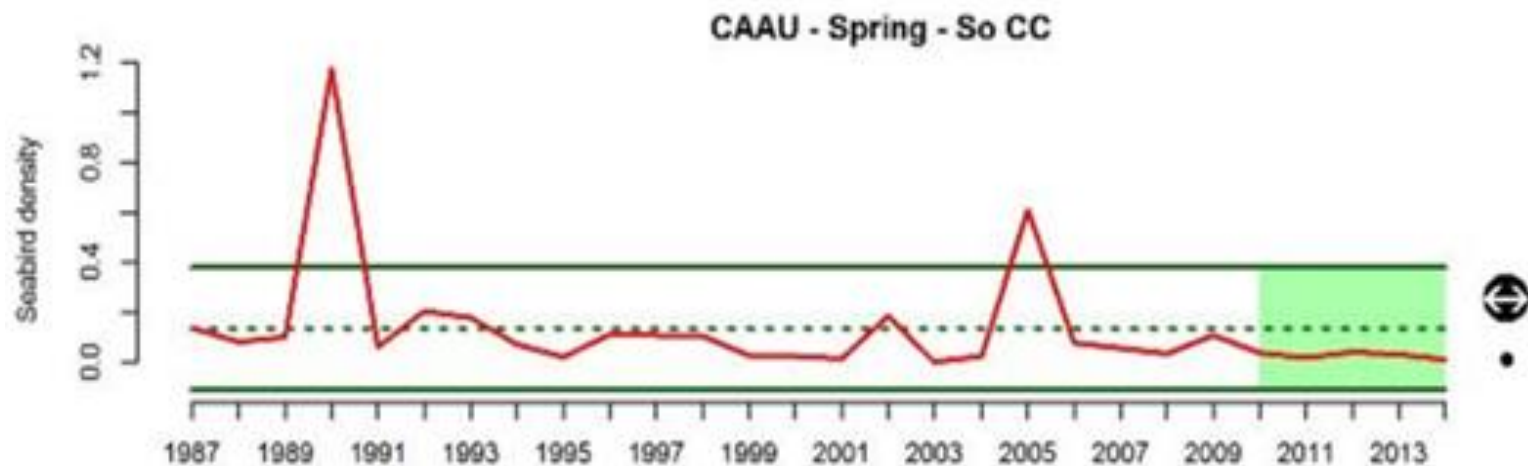


# Cassin's auklets

- Small diving seabird, mainly feeds on krill
- Numbers in the southern part of the California Current have been stable over the past few decades:



*Ron Levalley*

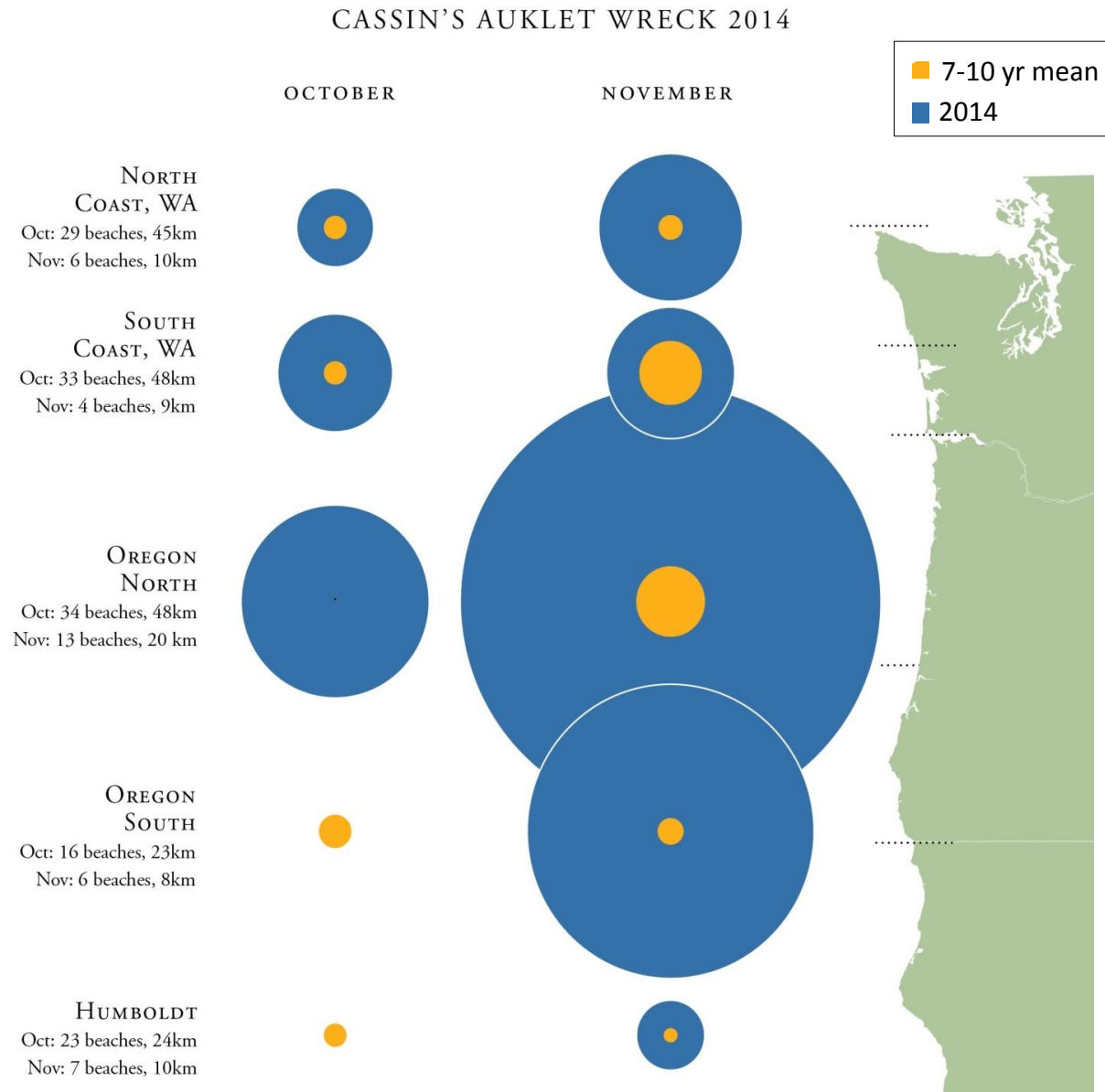




# Cassin's Auklet wreck, 2014-2015



- Since last fall, mortality rates of auklets are up to 100 times normal
- Juvenile auklets most affected
- Cause of die-off is still undetermined





*Rosy rockfish, corals, sponges and anemones on Cordell Bank.  
(Rick Starr, NOAA)*

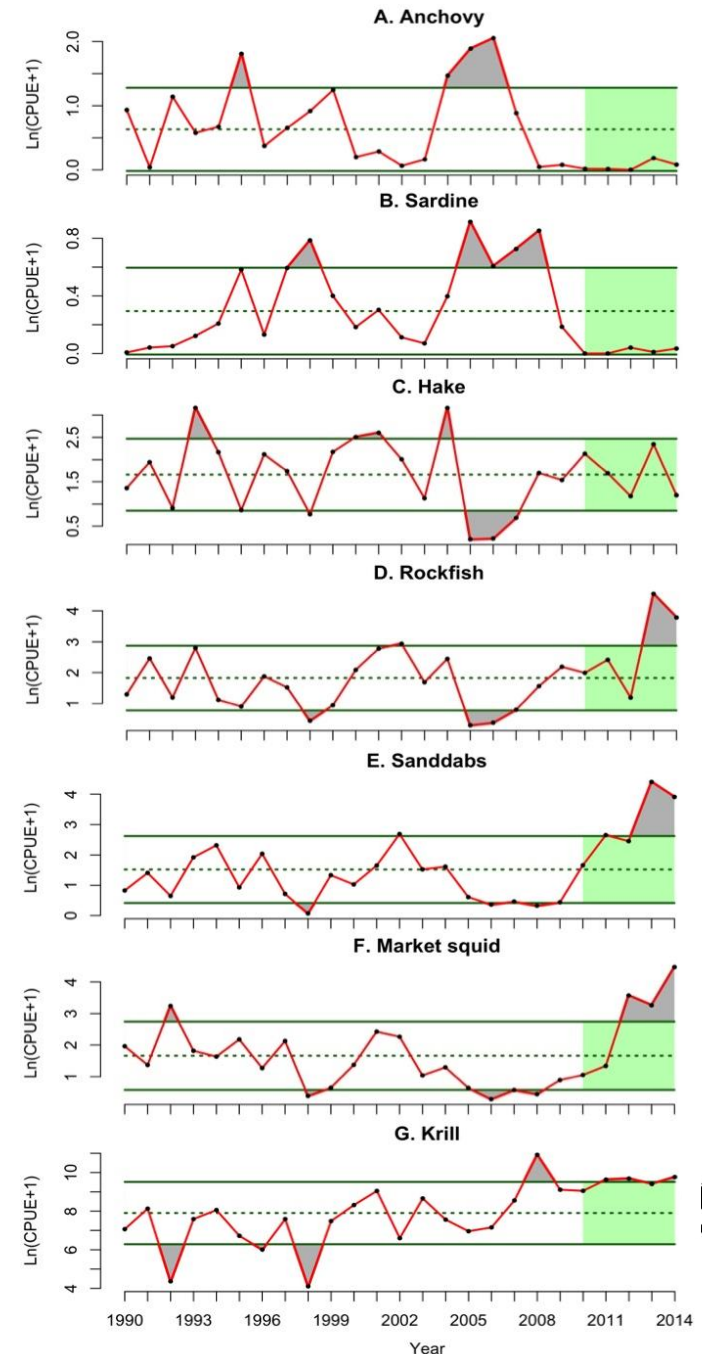
### 3. Indicators of ecological integrity



# Forage availability

- NOT the same as “CPS abundance”; not assessment results, but rather, assessment of presence of forage for predators (larger fish, birds, mammals)
- Largely juveniles or YOY of finfish groups
- Central California Current, through 2014:
  - Anchovy and sardine catches were relatively low
  - Relatively high catches of YOY rockfish, YOY sanddabs, market squid and adult krill
- ***How will forage groups such as these respond to the “warm blob”? We will have to wait and see what 2015 data tell us.***

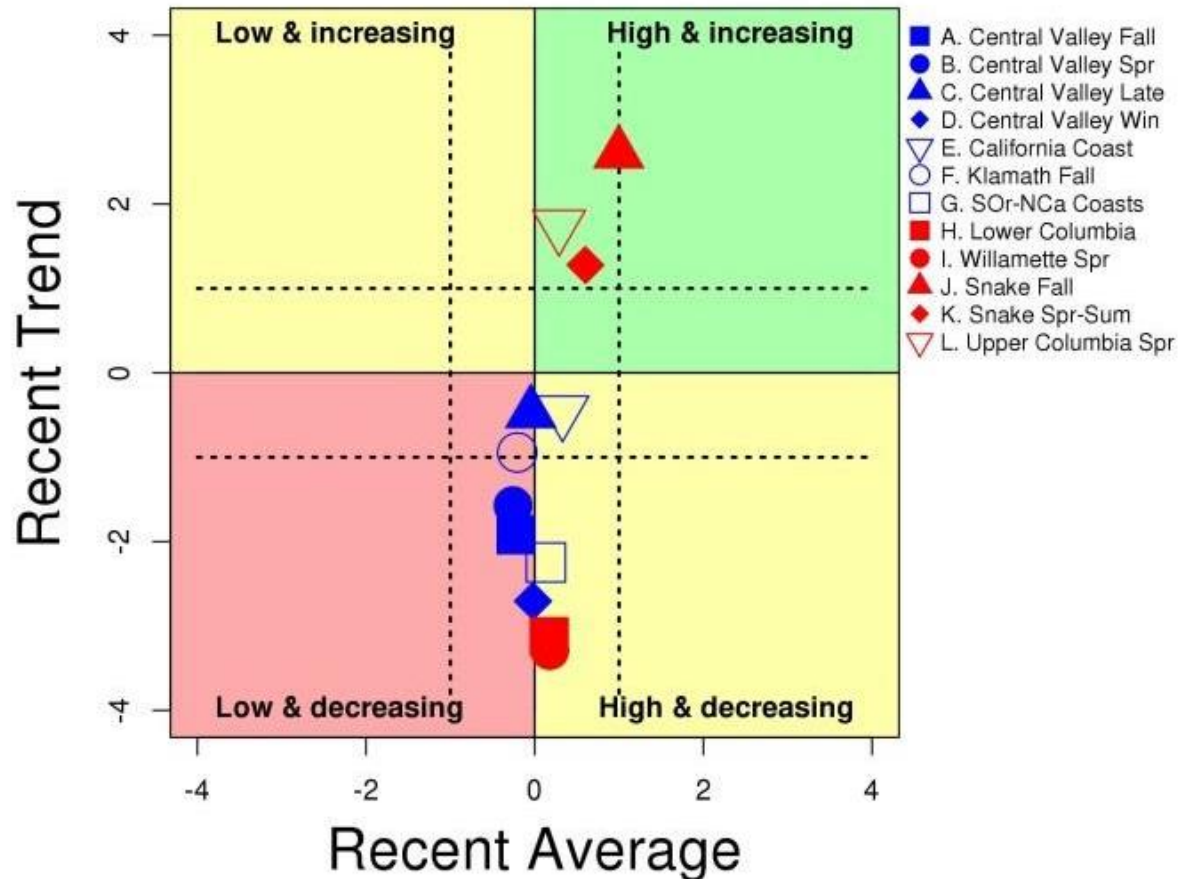
Central California Current



# Chinook salmon escapement status and trends

- *Escapement data available only through 2012*
- From 2003-2012, stocks were within “long-term” (20 to 30-yr) averages
- Several stocks have declining trends; returning to average levels following high escapements in early 2000s
- Some stocks with increasing trends

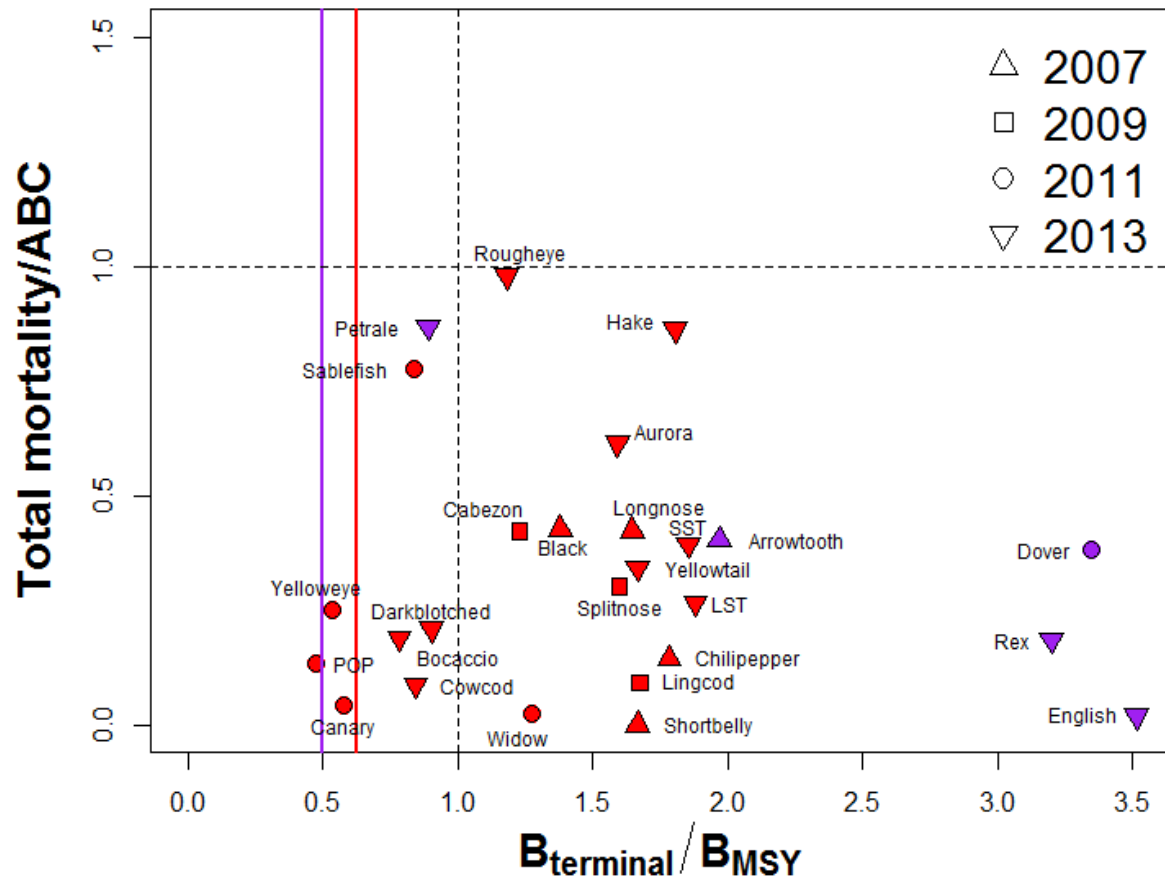
- ***How will salmon stocks be affected by low, warm stream flows and changes in nearshore marine conditions?***





# Groundfish

- *Based on recently assessed stocks; most recent assessments in 2013*
- Most populations are above biomass management thresholds, some considerably
- Three rockfish remain “overfished”
- All assessed stocks below or well below “overfishing” limit
- ***How will “warm blob” affect recruitment, growth, distribution and reproduction?***



## 4. Human activities

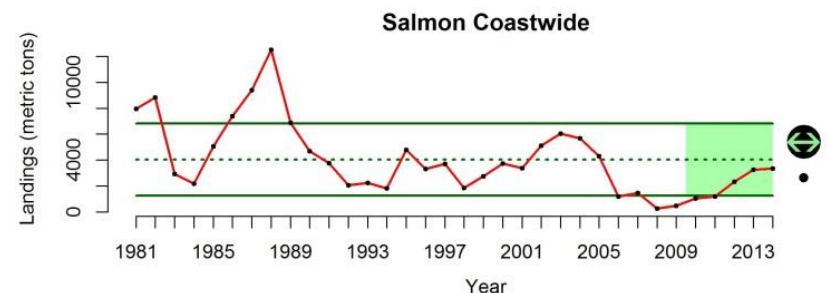
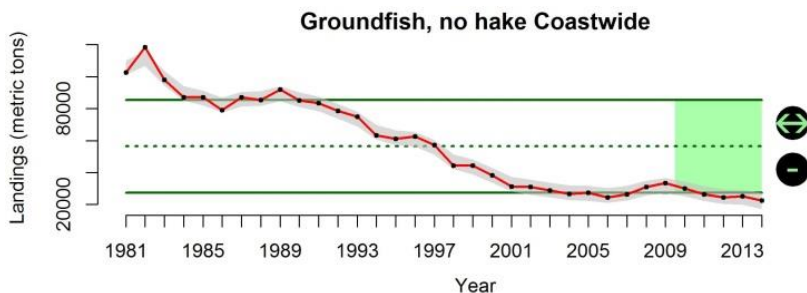
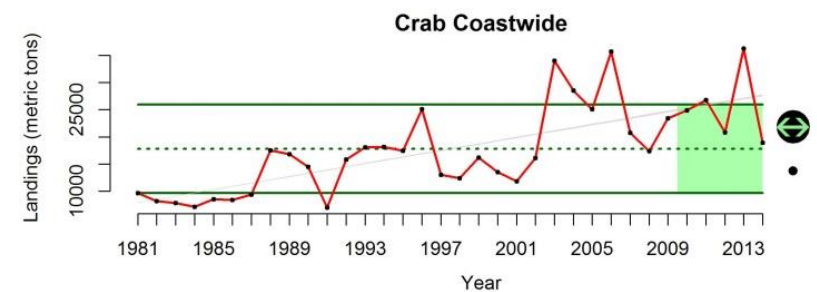
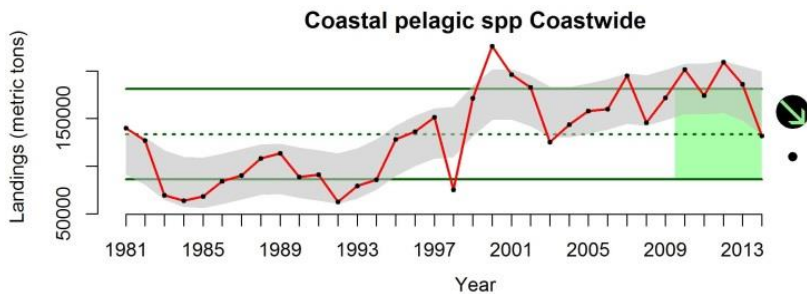
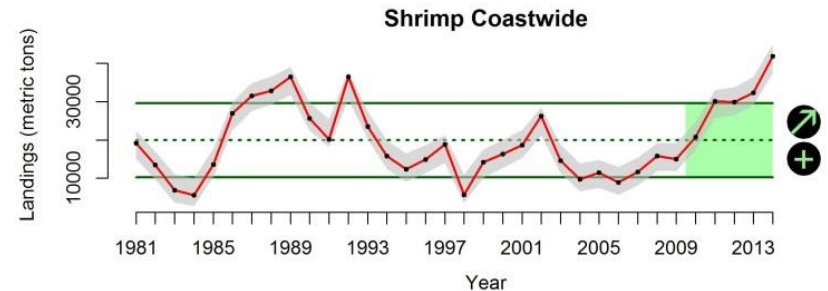
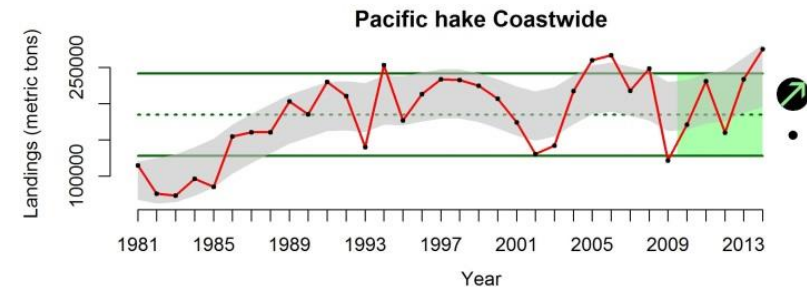
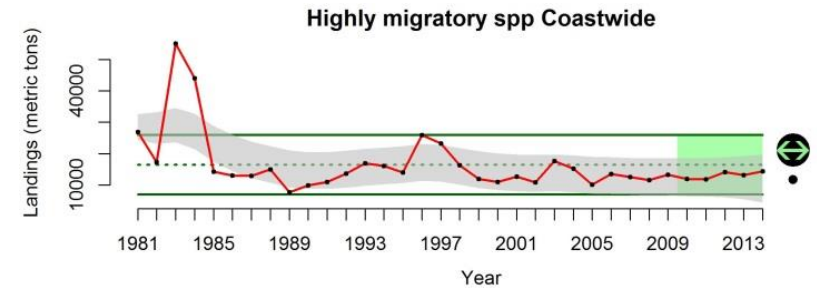
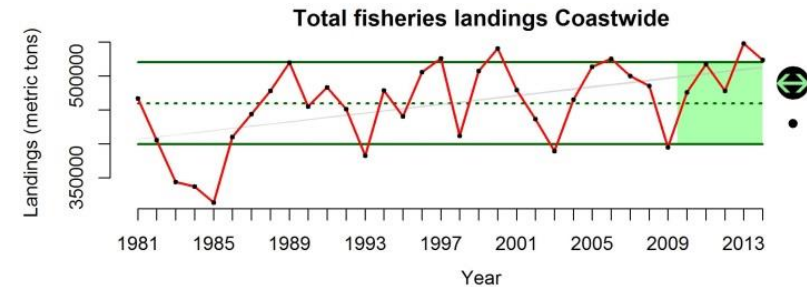


Commercial albacore fishing off Oregon.  
(Helena Aryafar, NOAA)



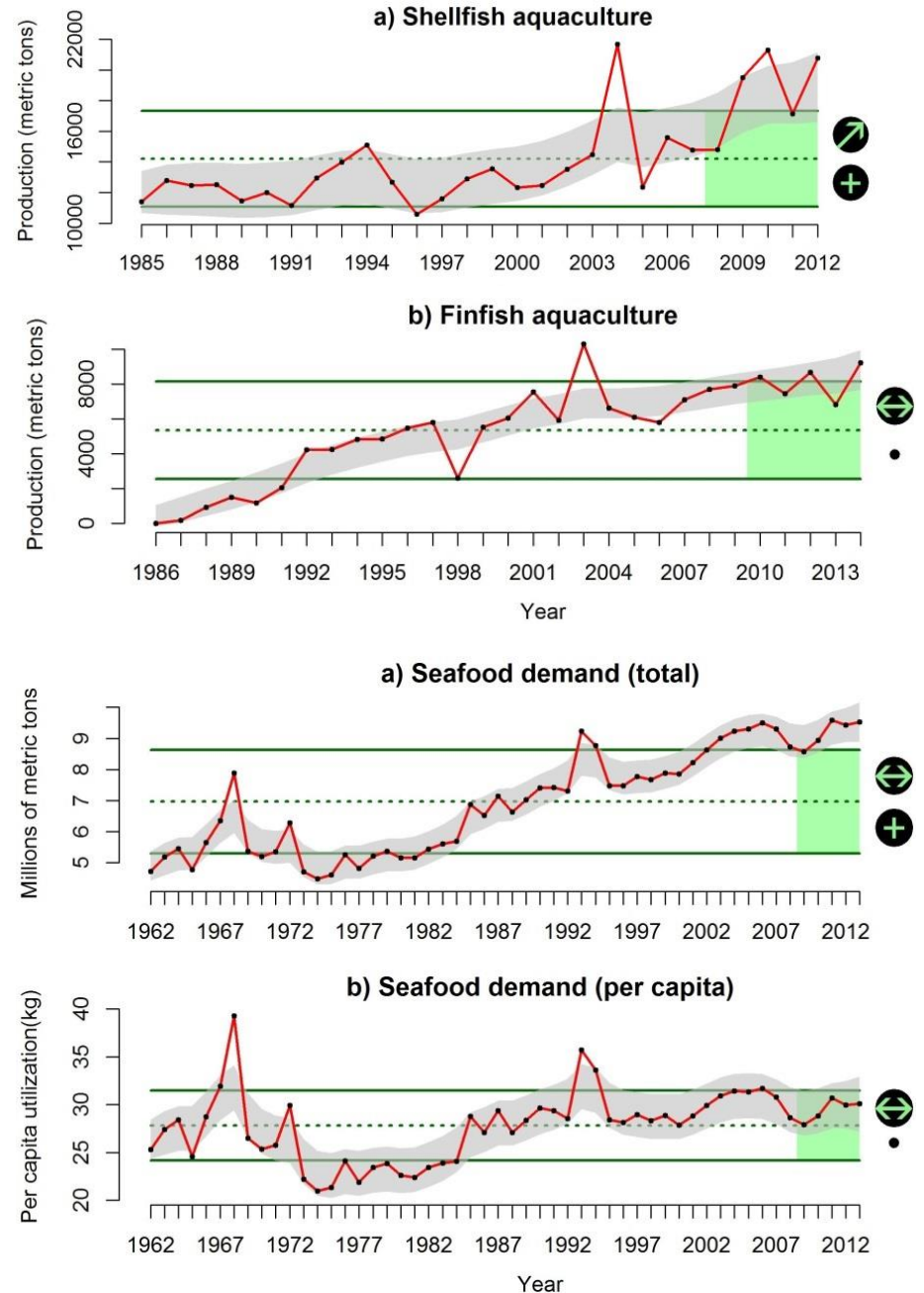
# Coastwide U.S. commercial fishery landings

- Total landings just updated; 1981 to 2014



# Other human activities

- **Continuing increases in sectors related to fisheries:**
  - West Coast shellfish aquaculture (through 2012)
  - West Coast finfish aquaculture (through 2014)
  - U.S. total seafood demand (through 2013)
- **Per capita U.S. seafood demand remains flat**
- **IEA is monitoring other human activities as well**





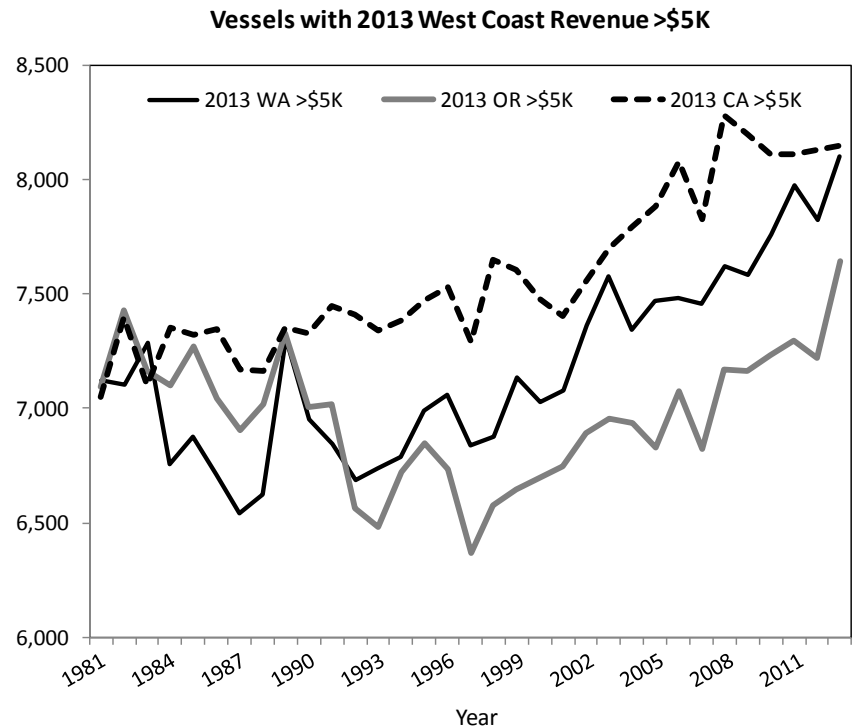
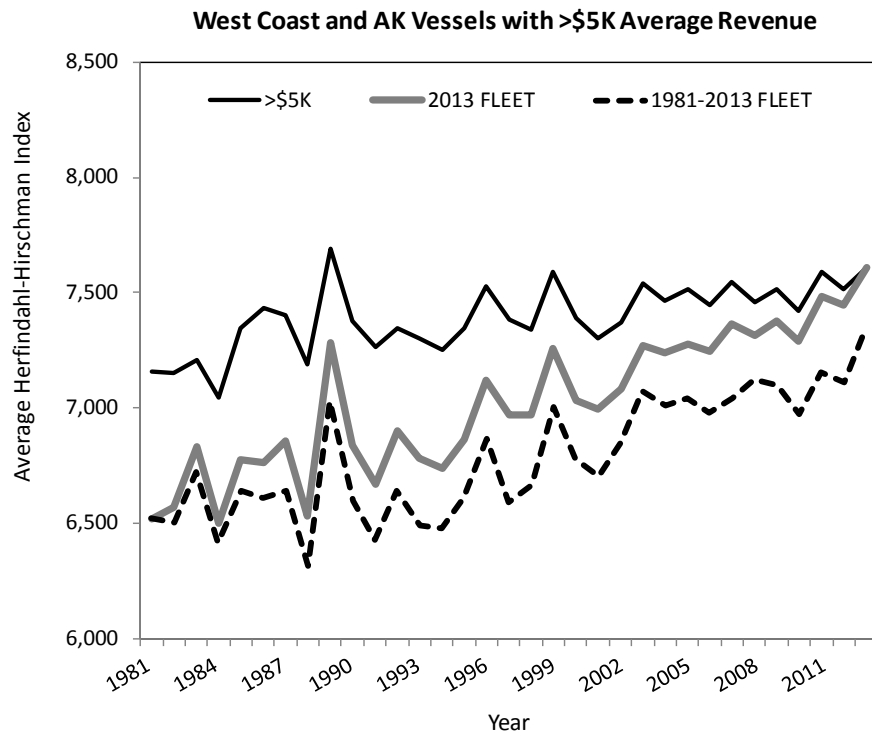
*Chumash Tomol 'Elye'wun paddlers near Santa Cruz Island.  
(Robert Schwemmer, NOAA)*

## 5. Human wellbeing



# Fleet diversity indices

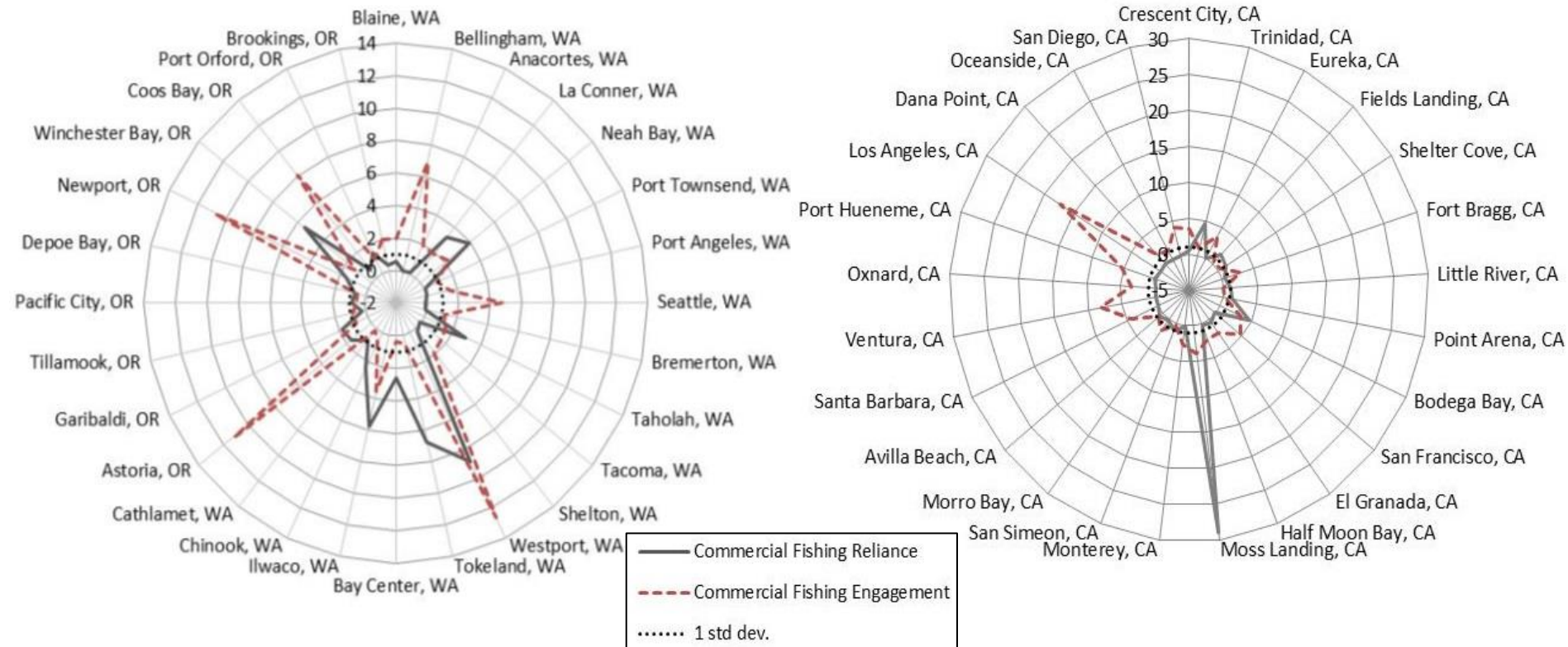
- More diversity for a vessel or port = greater revenue stability over time
- Herfindahl-Hirschman Index (HHI) is metric (*Lower HHI = greater diversity*)
- Declining diversity in all states and all vessel ages, sizes, revenue classes
- We are working to tease this apart; how changes in management and in abundance of species (e.g., crabs and shrimp) affect fishers' choices





# Community vulnerability indices

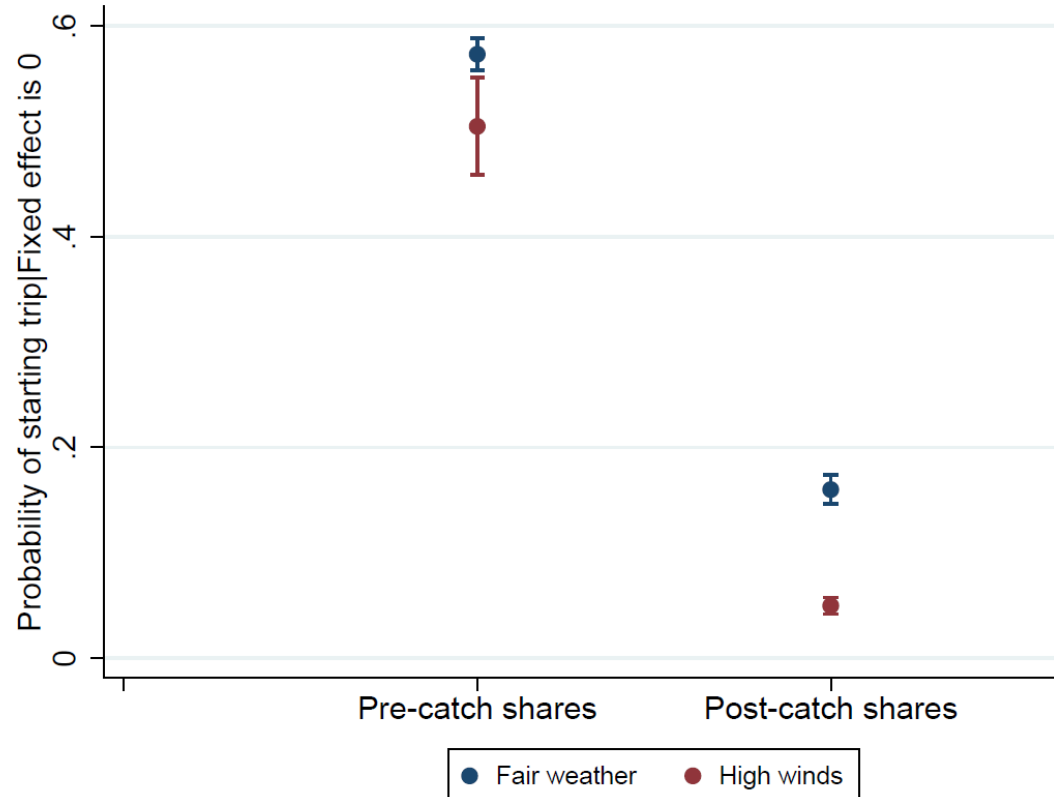
- Indicators of socioeconomic vulnerability to external changes
- First: update data on how dependent coastal communities are on fishing
  - Engagement = a measure of total commercial fishing activity in a community
  - Reliance = commercial fishing activity relative to the total size of the population
- Next step will be to link fishing dependence to socioeconomic vulnerability



# Effects of catch share program on vessel safety in the fixed-gear sablefish fleet

*(Pfeiffer and Gratz, in review)*

- Catch share program provides incentives for lower risk-taking, compared to derby fishery
- After catch shares (2001), vessels in this fleet 85% less likely to fish in stormy weather
- Season length went from 9 days to 213 days
- Safety improvements were greatest for vessels <50 ft

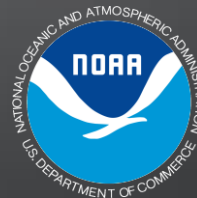






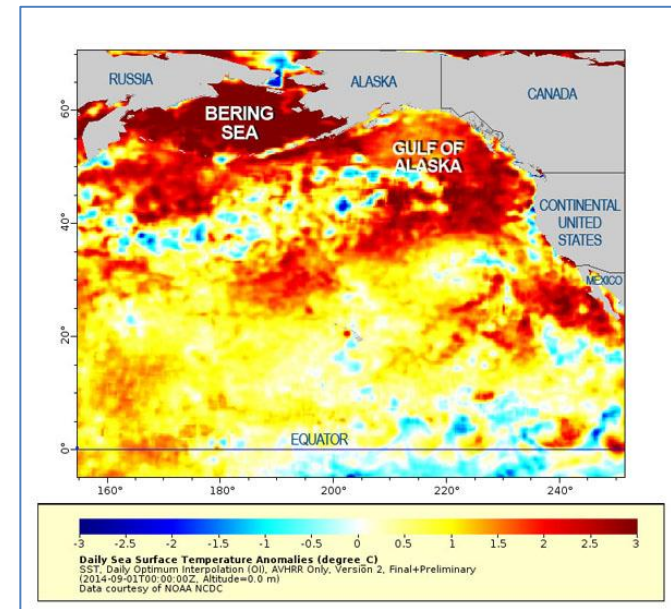
Canary rockfish in the Olympic Coast National Marine Sanctuary  
off the Washington coast (NOAA)

## 6. Synthesis



# We're in a strange and possibly transitional period

- NE Pacific dominated by the “warm blob”
- El Niño has arrived
- Basin scale indices are flipping to “poor”
  - This is uncharted territory for climate conditions
- Several leading indicators that the system is responding
  - Copepods shifting to less energy-rich “southern” species
  - Snow water equivalents near record lows in all major basins
  - Cassin’s auklets & California sea lion pups



Sea surface temperature anomalies, Sept. 1, 2014  
(NOAA National Climate Data Center)

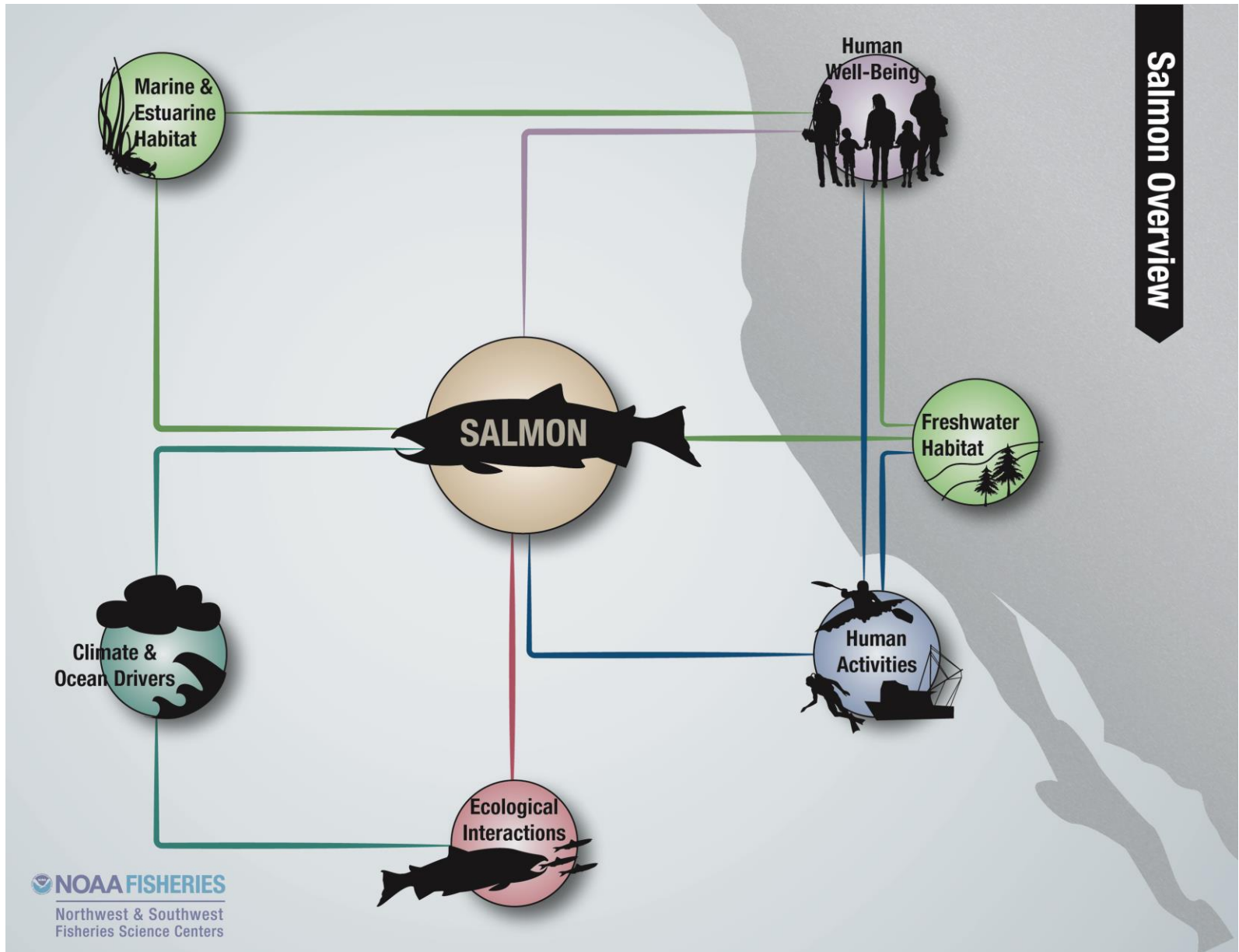
# Other indicators we are following:

- Forage, salmon escapement, and groundfish biomass: not much new to report
- Commercial landings high and stable, fueled by hake, CPS, shrimp, crabs
- Fishery diversification still declining
- Coastal community vulnerability, related to National Standard 8
- Catch share program may be improving fishery safety: less risk-taking

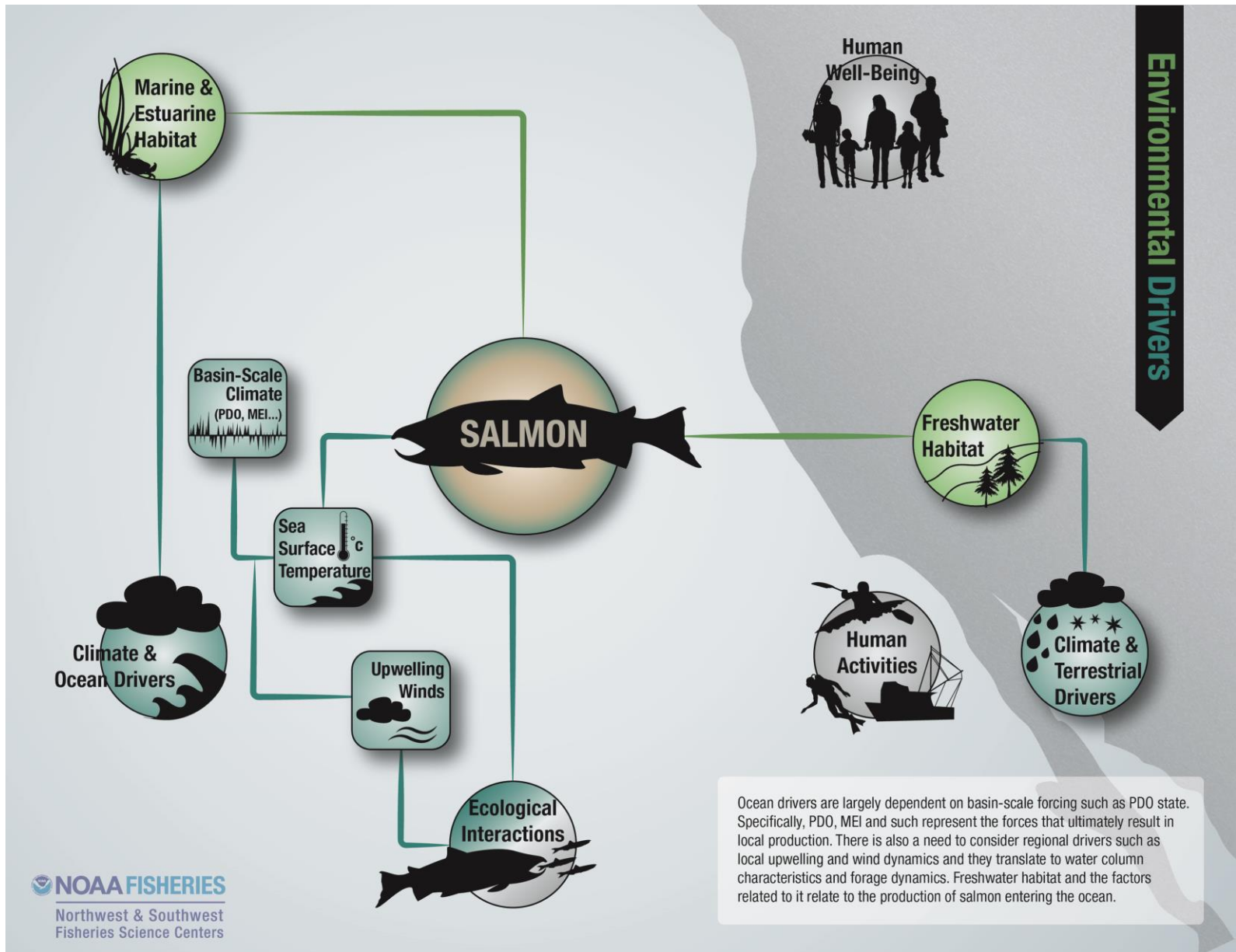


*Chinook salmon*  
(NOAA)

# Conceptual models

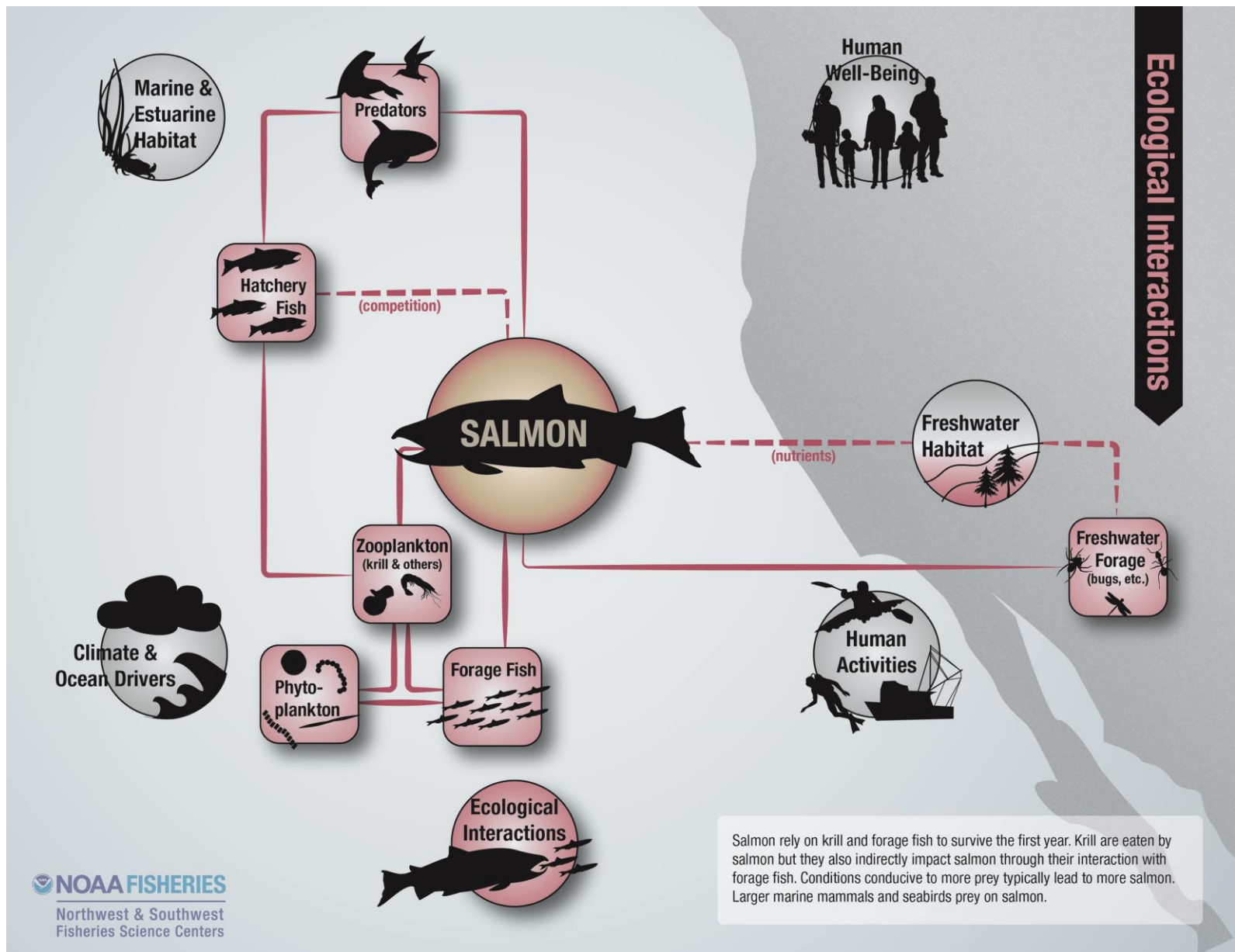


# Conceptual models

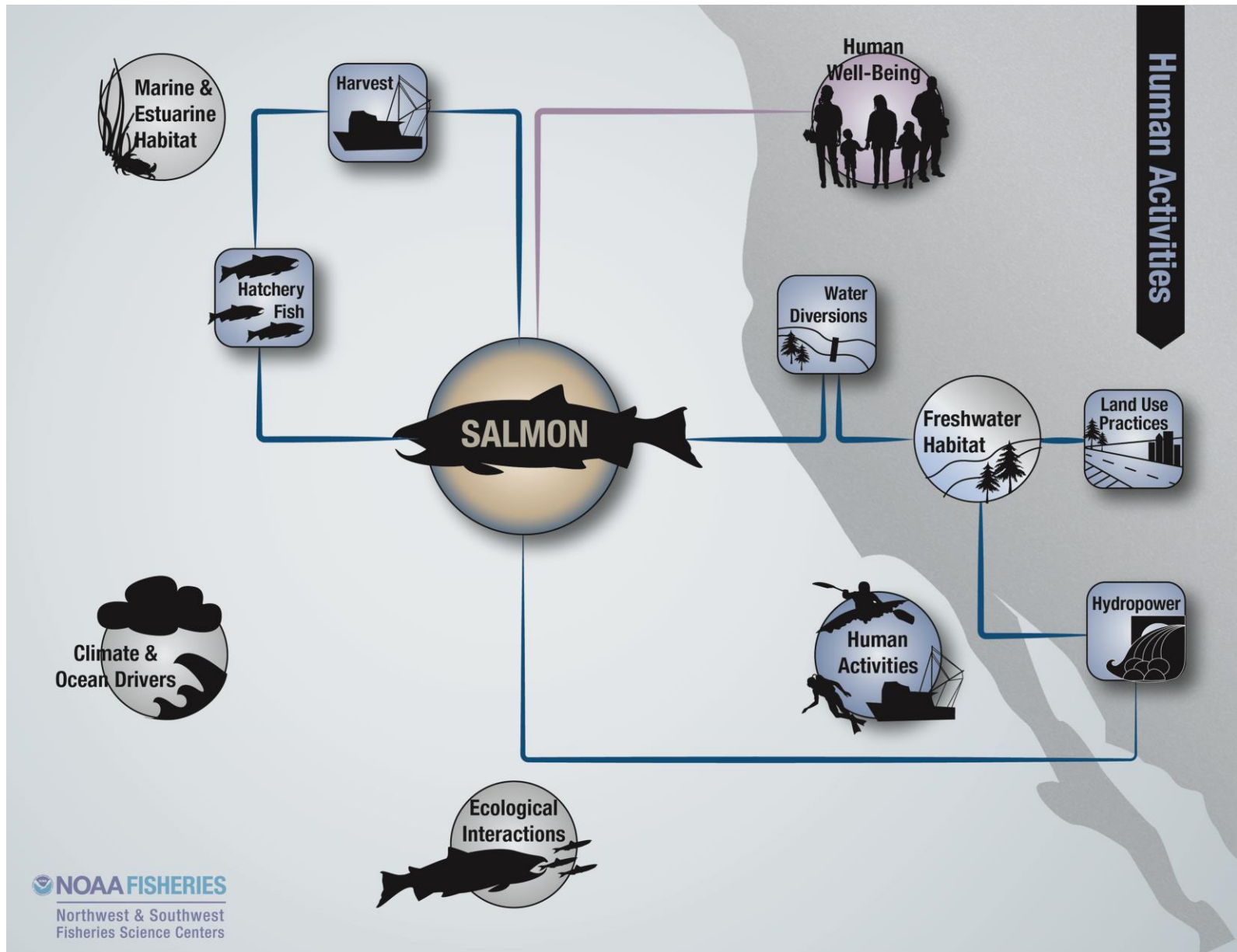


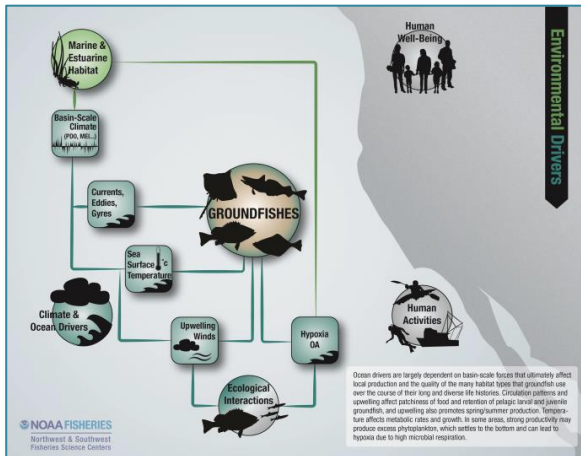


# Conceptual models

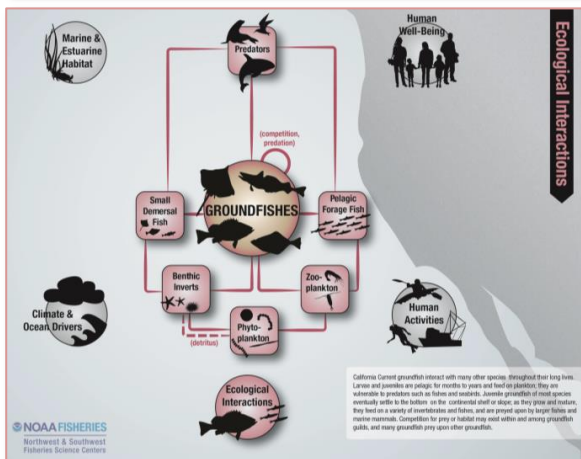


# Conceptual models

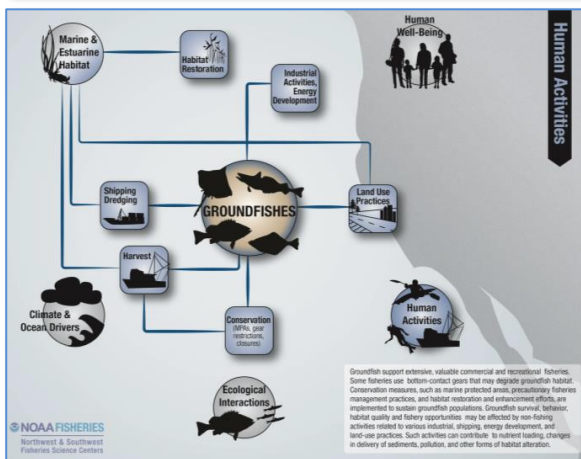




Environmental Drivers



Ecological Interactions



Human Activities

Ecosystem considerations section of a groundfish stock assessment, including status and trends of key pressures as identified in conceptual models and quantitative ecological risk assessments.



# 7. Questions and Discussion

