



**NOAA
FISHERIES**

California Current IEA

Pacific Fishery Management Council



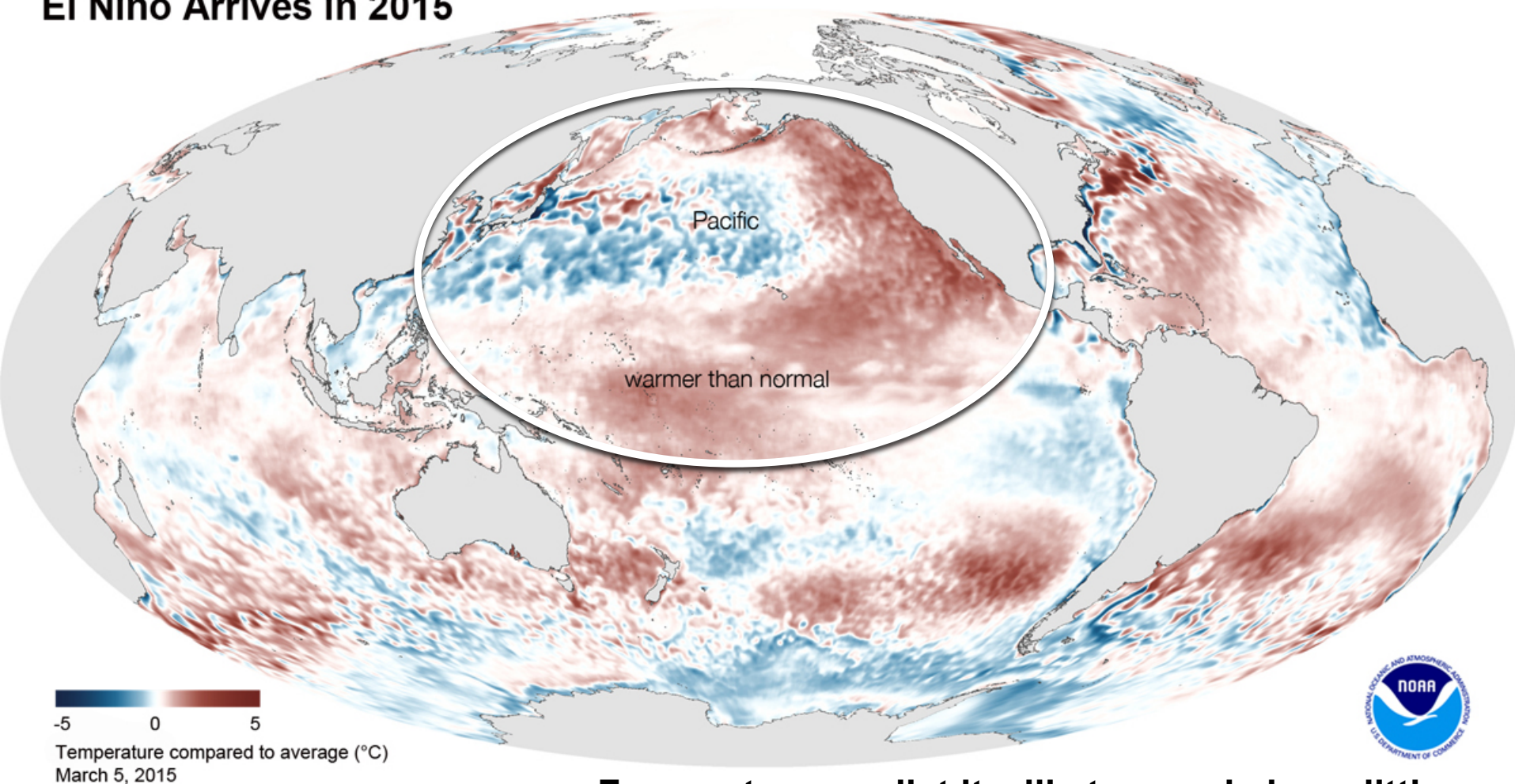
**John Stein
Northwest Fisheries
Science Center**

**Cisco Werner
Southwest Fisheries
Science Center**

March 2015

El Niño and a positive phase of the PDO (Pacific Decadal Oscillation)

El Niño Arrives in 2015



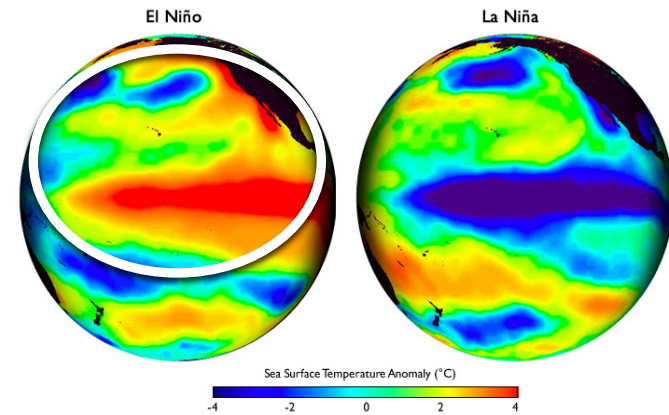
Forecasters predict it will stay weak, have little influence on weather and climate



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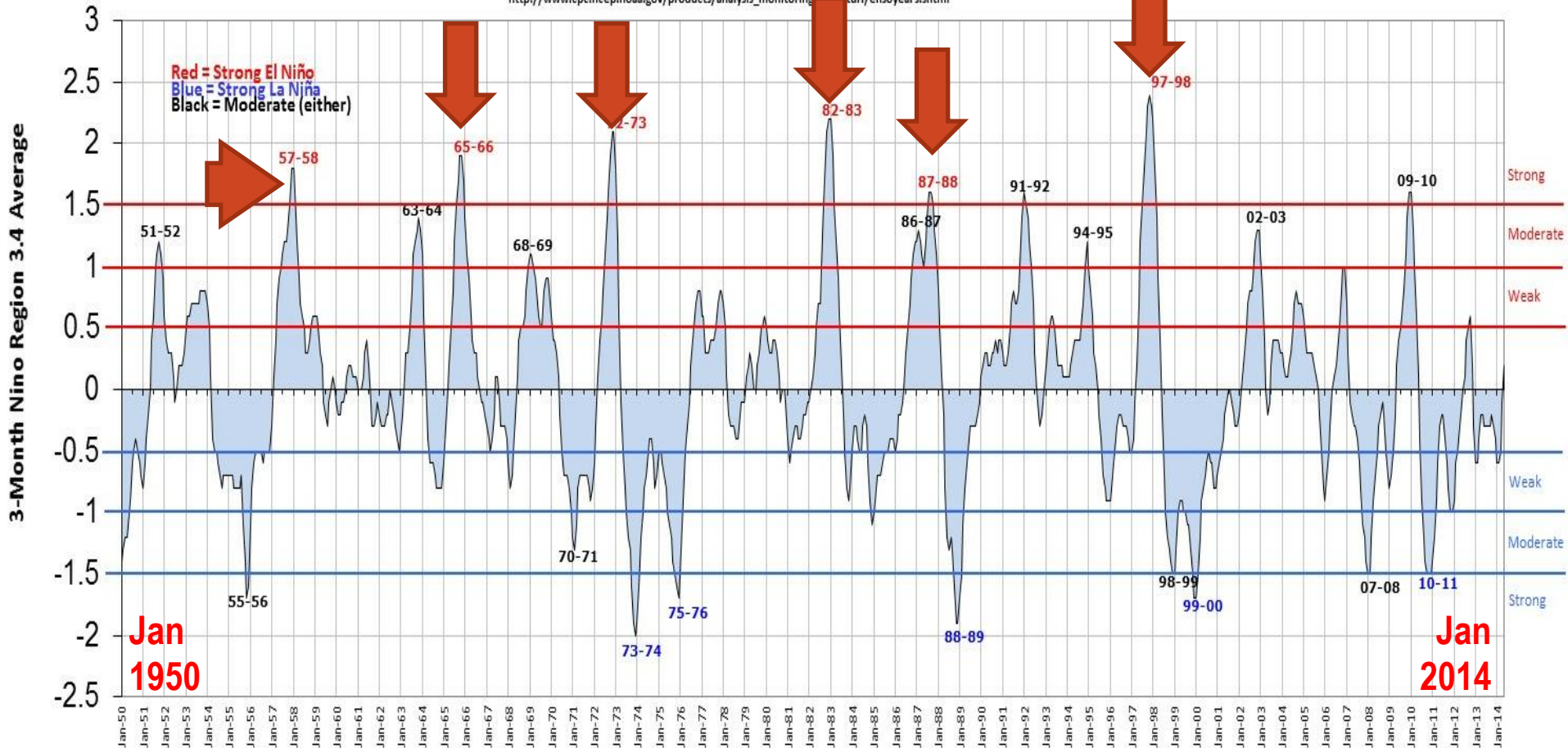
El Niño/La Niña occurrences since 1950

Six “strong” and eight “moderate” *El Niños*
And five “strong” and four “moderate” *La Niñas*



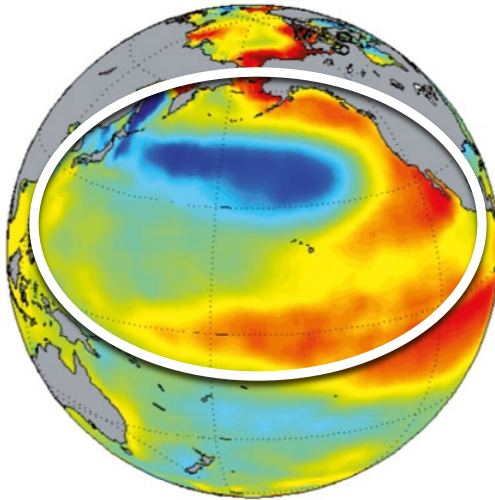
Oceanic Niño Index (ONI)

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml



Pacific Decadal Oscillation (PDO)

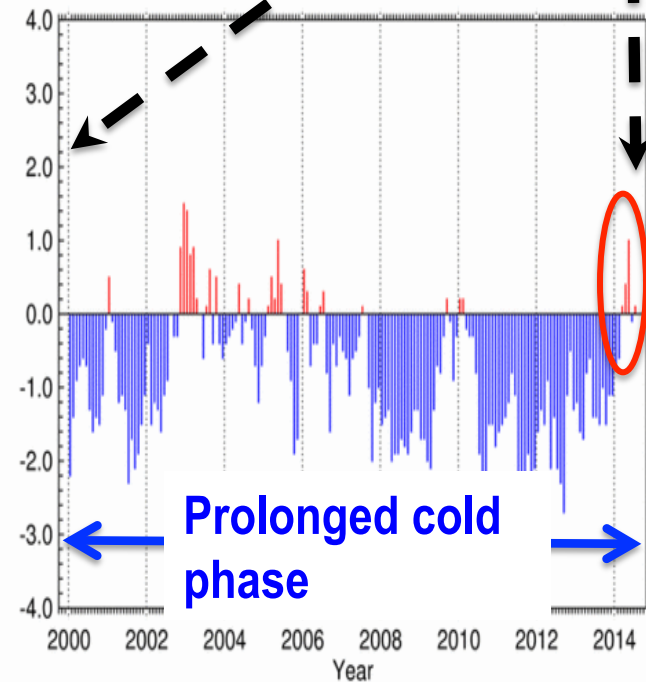
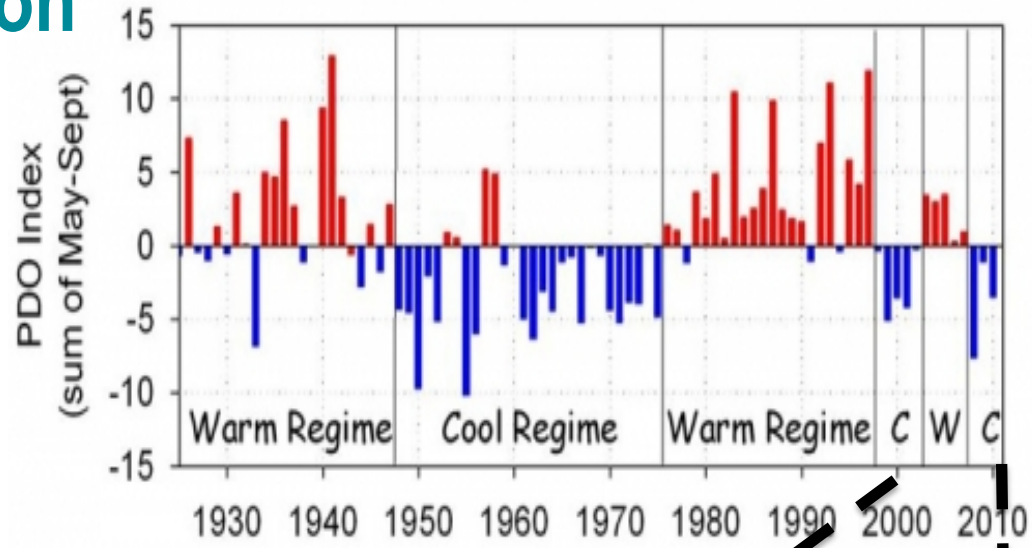
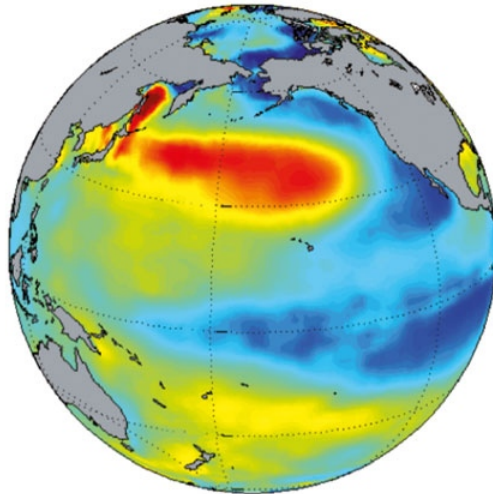
Warm
(Positive)
Phase



Departures from average ocean temperatures (°C) associated with the warm and cool phases of the PDO

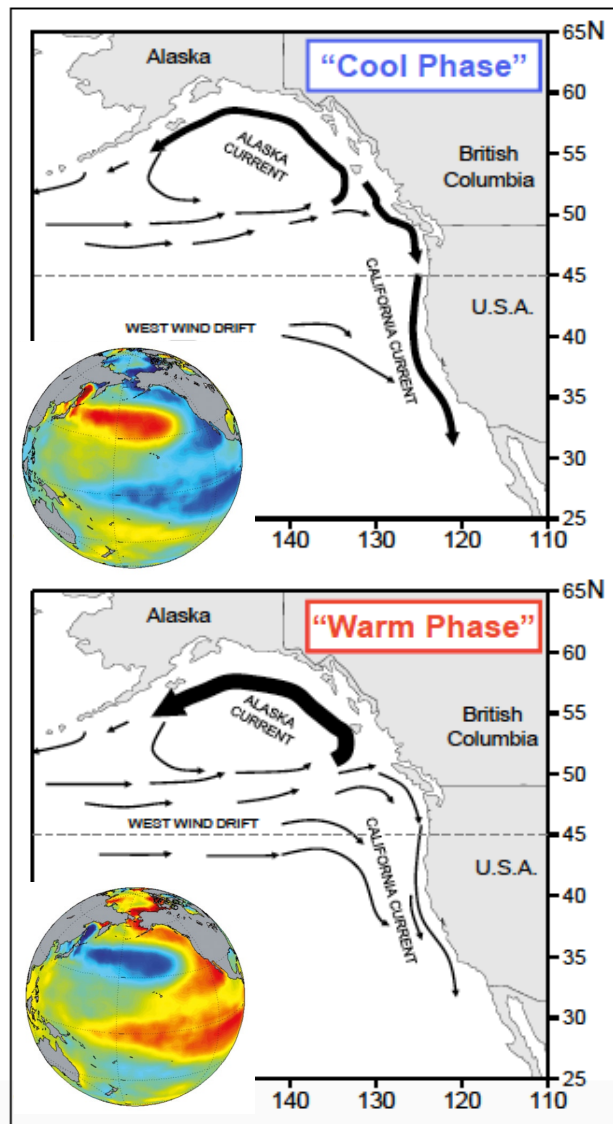
-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8

Cold
(Negative)
Phase



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Juvenile salmon ... biological and physical processes



Cool Phase of PDO=High Survival

- Flow from the North
- Cold water – Lipid-rich copepods
- Low number of large predators

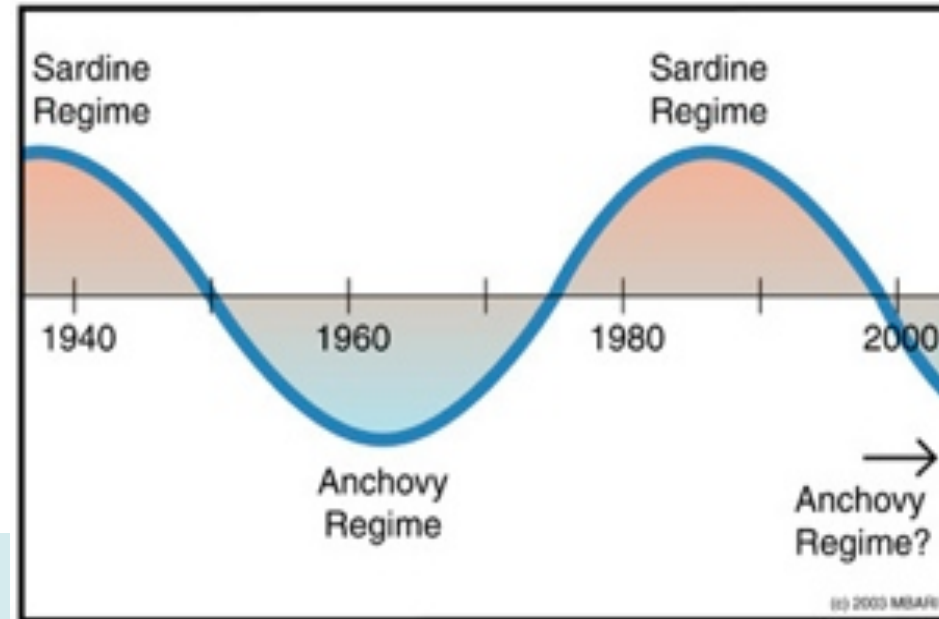
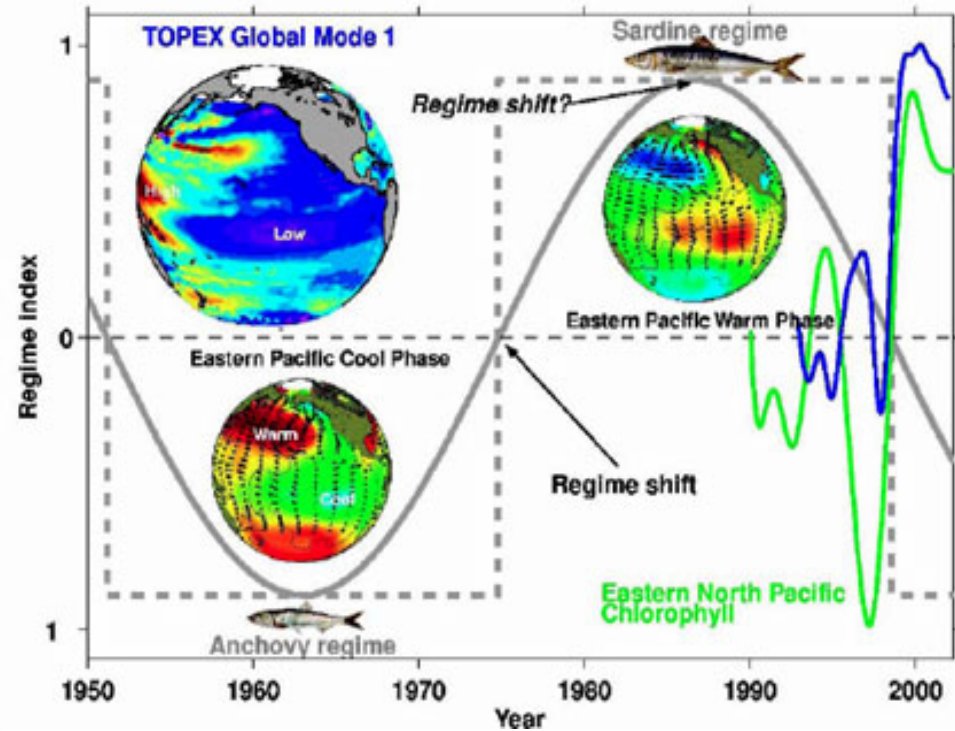
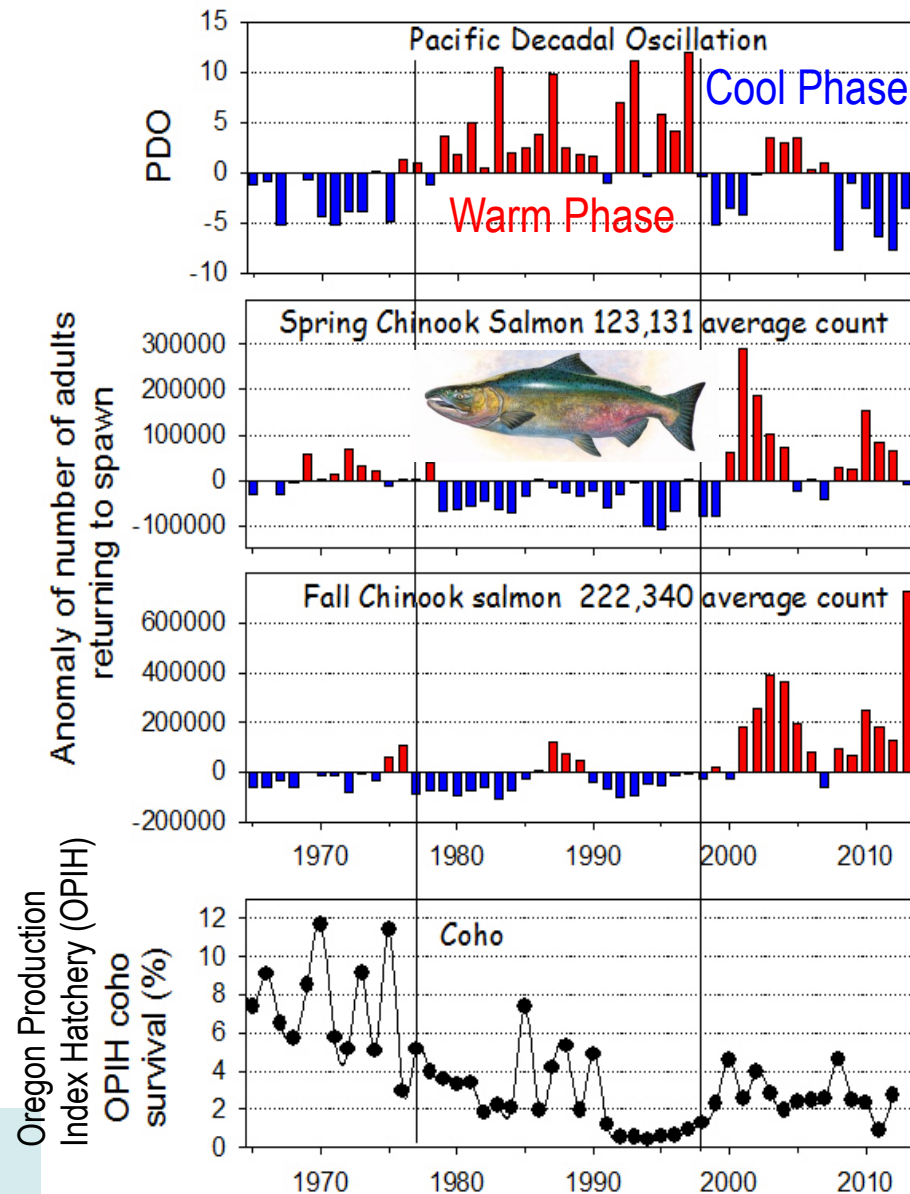
Warm Phase of PDO=Low Survival

- Flow from offshore & South
- Warm water – Low lipid copepods
- High number of large predators

PDO=Pacific Decadal Oscillation

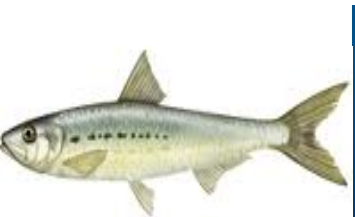
(K. Fresh)

PDO and fisheries



Broader Effects of El Niño in the California Current

- Warmer, more subtropical, ocean conditions; reduced primary and secondary production
- Improved growth and recruitment for some species, such as sardines; reduced recruitment for rockfish, squid, anchovies, etc.
- Anchovy, market squid and CA sea lion populations in So. California decline; whiting and sardines migrate further north, into Canadian waters
- Tropical fish like mahimahi, swordfish, and marlin, and subtropical fish like Albacore and Pacific bonito, move north/onshore



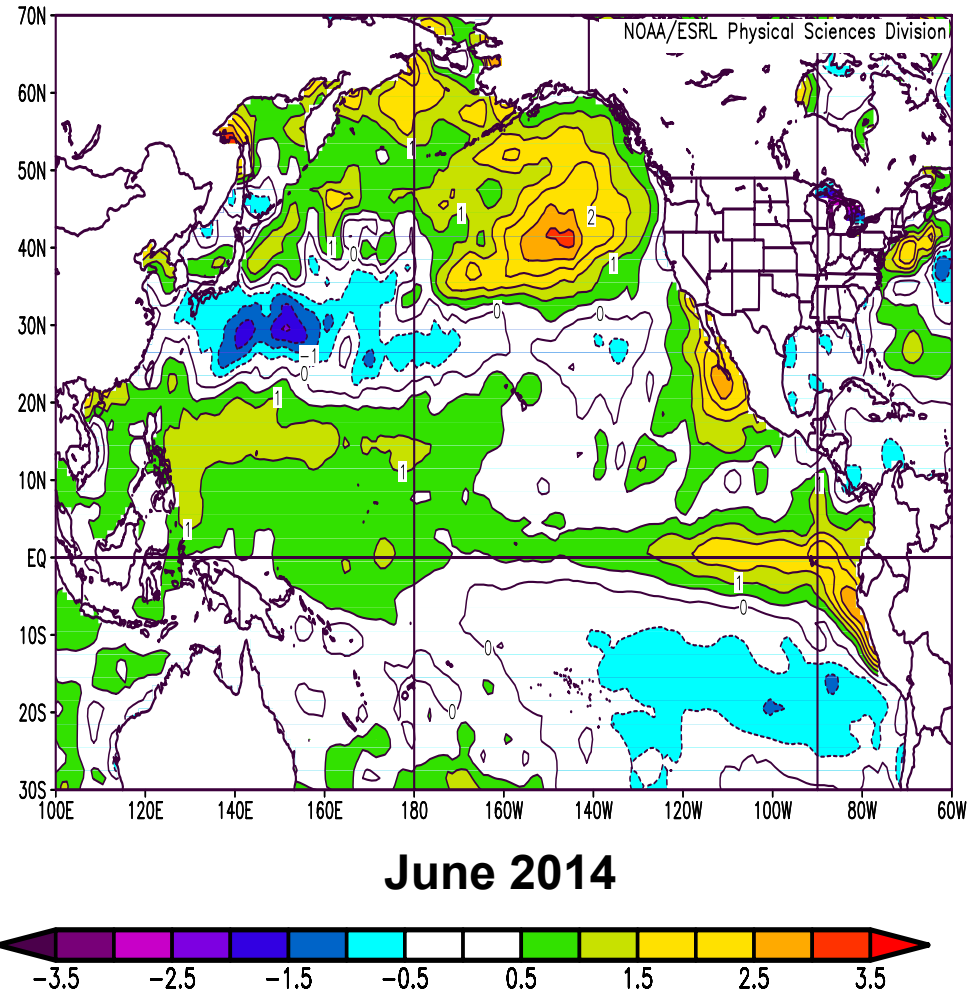
But – Northeast Pacific warmed before the Eastern Tropical Pacific warmed

- Gulf of Alaska has been extremely warm for the **past year and a half** (weak winter conditions)
- Baja and So. California near-shore have been warm **since June 2014** (local winds – not remotely-forced ENSO conditions)



False Killer Whales, 24 Feb 2015; Photo: M. Robbins

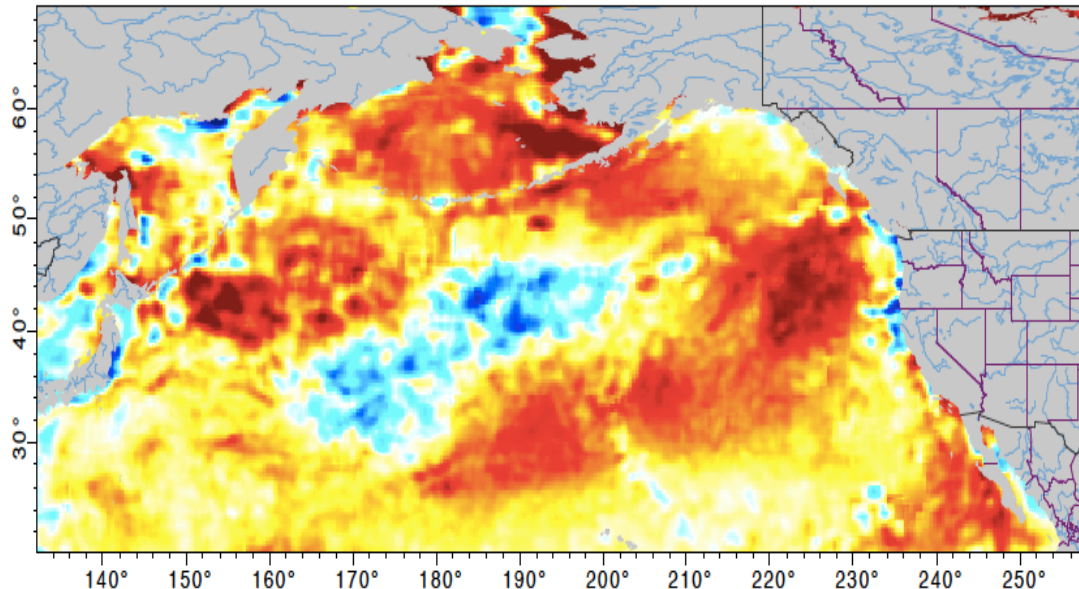
Sea Surface Temperature Anomaly (relative to 1981-2010)



Status of the Ecosystem

*“There's something happening here,
what it is ain't exactly clear...”*

(Buffalo Springfield)



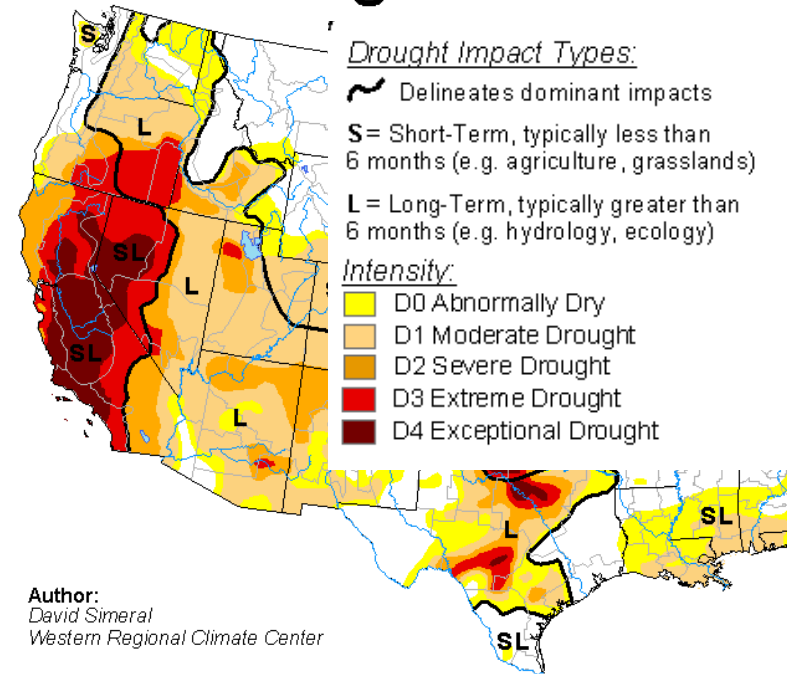
Daily Sea Surface Temperature Anomalies (degree C)
SST, Daily Optimum Interpolation (OI), AVHRR Only, Version 2, Final+Preliminary
(2014-08-18T00:00:00Z, Altitude=0.0 m)
Data courtesy of NOAA NCDC

March 3, 2015

(Released Thursday, Mar. 5, 2015)

Valid 7 a.m. EST

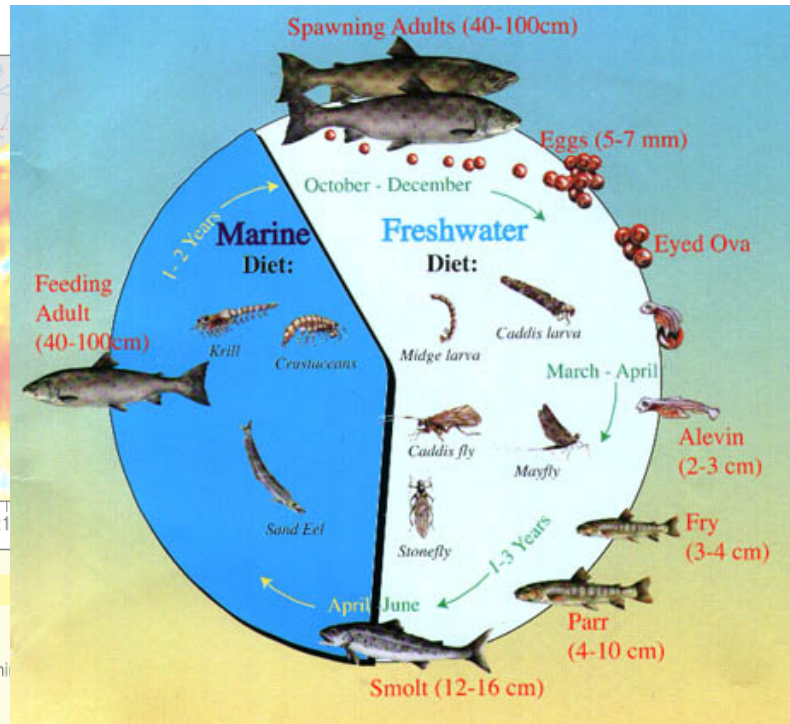
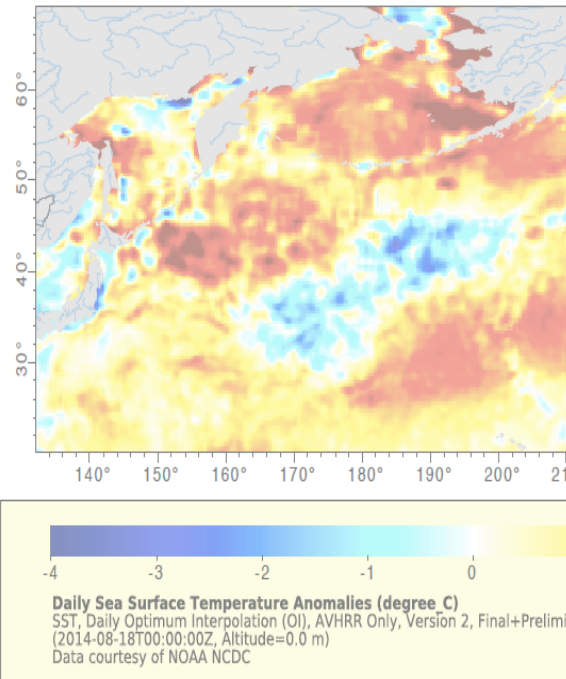
U.S. Drought Monitor



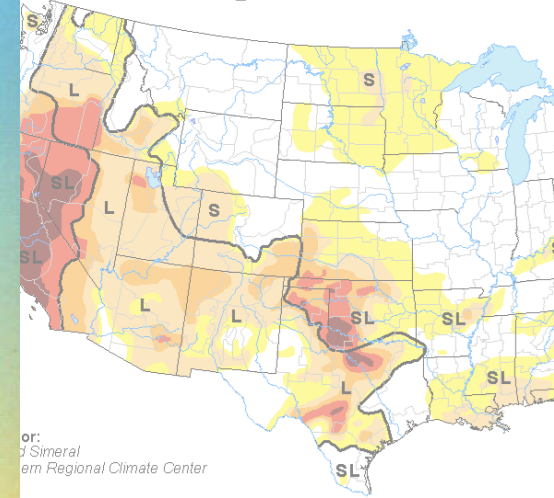
Author:
David Simeral
Western Regional Climate Center

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

We can't look at the ecosystem components in isolation – they are *integrated*...



U.S. Drought Monitor



NEED FOR **I**NTEGRATED **E**COSYSTEM **A**SSESSMENTS (**IEA**s)

IEAs provide *‘a synthesis and integration of information on relevant physical, chemical, ecological, and human processes in relation to specified management objectives’*

IEAs draw on both the natural and human-dimension sciences

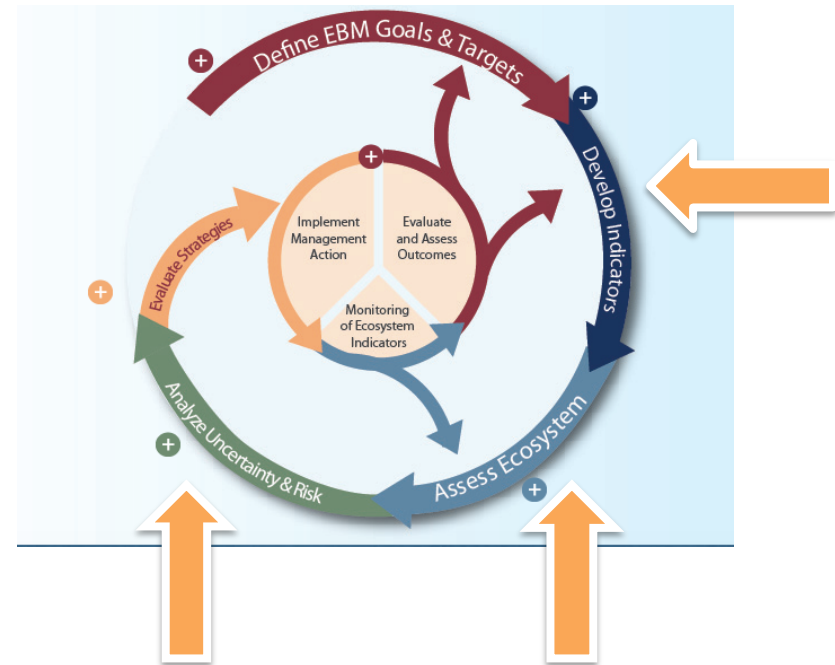
IEAs determine the status of coupled **Social-Ecological Systems** and to evaluate management options

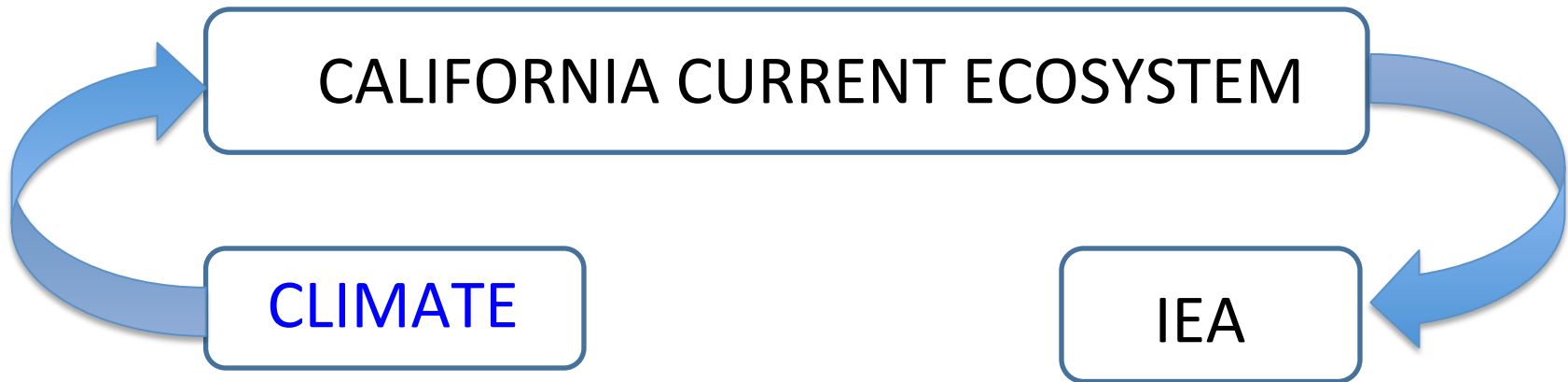
IEAs are both a process and products

CALIFORNIA CURRENT ECOSYSTEM

- Climate
- Energy
- Water quality
- Ship traffic
- Fisheries
- Economy
- Vibrant coastal communities

IEA





- What will happen to basin-scale circulation and regional-scale upwelling winds?
 - How will increases in stratification interact with changes in winds to alter the upwelling of cooler, nutrient-rich, carbon-rich, and oxygen poor waters?
 - Will El Niño's change in frequency or intensity in a warming climate?
 - How will ocean acidification interact with physical changes in ocean properties to impact ecosystems?
 - How will life history changes effect survival and distribution of species?
- Reference points for environmental and anthropogenic drivers
 - Analyses of climate effects on species, habitats, fisheries, communities
 - Short-term forecasts of distributions of sardines and other key target species
 - Ecosystem modeling scenarios of climate change effects on management of target species and protected species
 - Effects of climate variability on human wellbeing in West Coast communities



Going Forward

- The IEA provides the science framework for Ecosystem Based Fisheries Management
- NMFS Science Board will soon discuss strategy for building on the CC-IEA's results and implementing other *IEAs*
- Our Centers will deliver the ***Annual Report of the State of the California Current Ecosystem*** and contribute to the ***Fishery Ecosystem Plan*** (the ***FEP***)
- Continued engagement with the Council to increase the IEA's value and usability
 - Explore IEA team involvement in drafting ecosystem consideration section of stock assessments
- Key word in IEA is 'Integrated' and is the heaviest lift

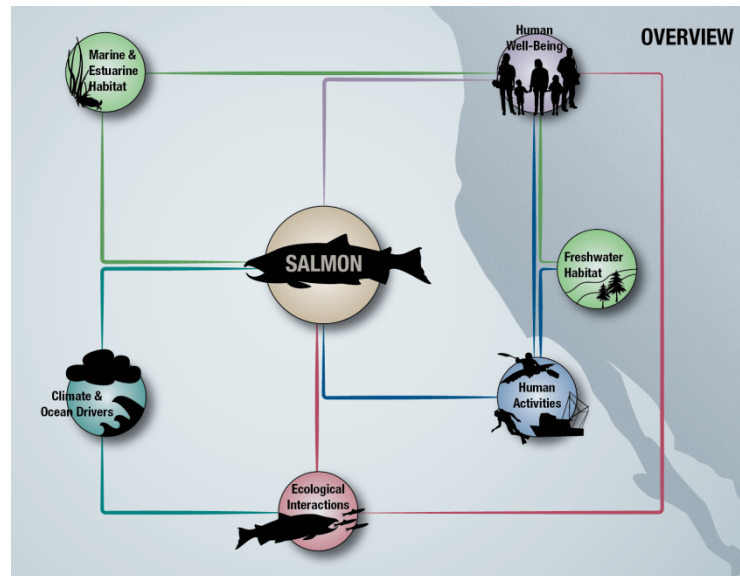
Conceptual Models

Management decisions (stock assessments, FEP, MSE)

Conceptual Models

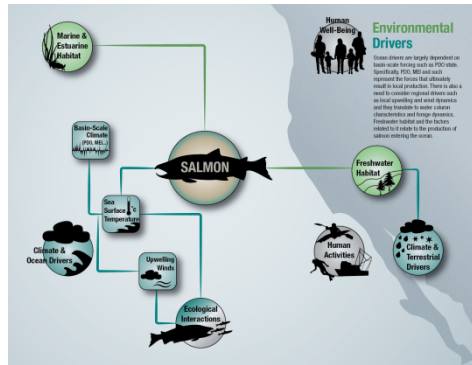
Improved Management decisions (stock assessments, FEP, MSE)

“Overview” model outlines links between species and key ecosystem drivers, components, and goals



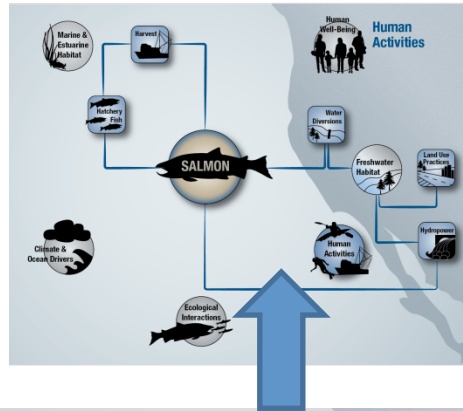
Conceptual Models

Environmental Drivers



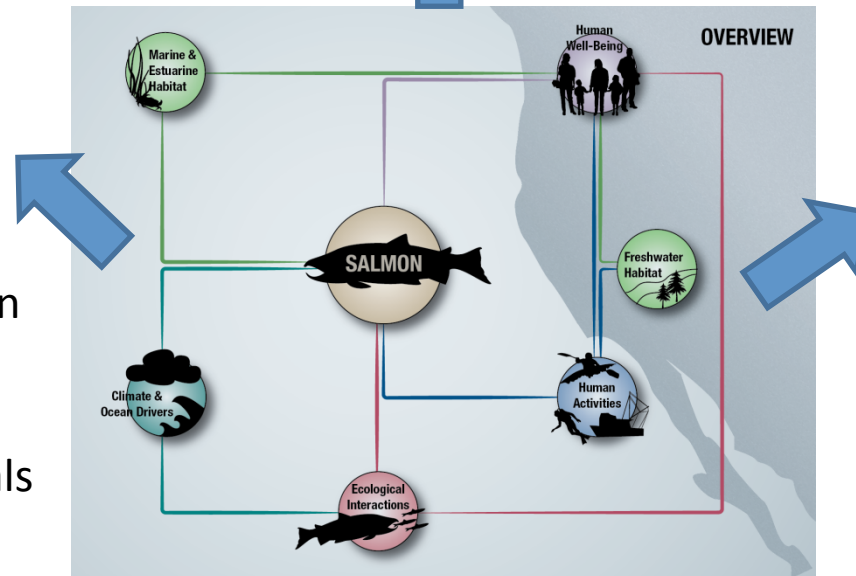
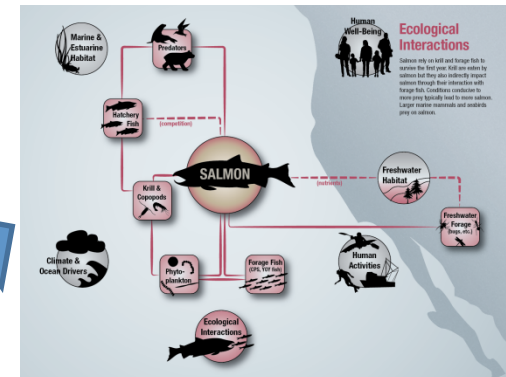
“Overview” model outlines links between species and key ecosystem drivers, components, and goals

Human Activities



Next-tier models flesh out key details

Ecological Interactions





CA Current IEA: Status and Trends

Strengths:

- Well-developed indicators for most components
- Monitoring in place through NOAA and partners
- Creative, robust methods and applications of risk assessment and management strategy evaluation
- Clear investment and innovation in human dimension
- Partnership on the west coast
- Commitment

Challenges:

- Elements of the IEA progressing at different rates
- “Taking the next step” with managers and policy makers
- Defining and quantifying ecosystem reference points
- Funds, staff, time... how sustainable are we?