The Future of Fisheries Observations with a focus on the CA Current.

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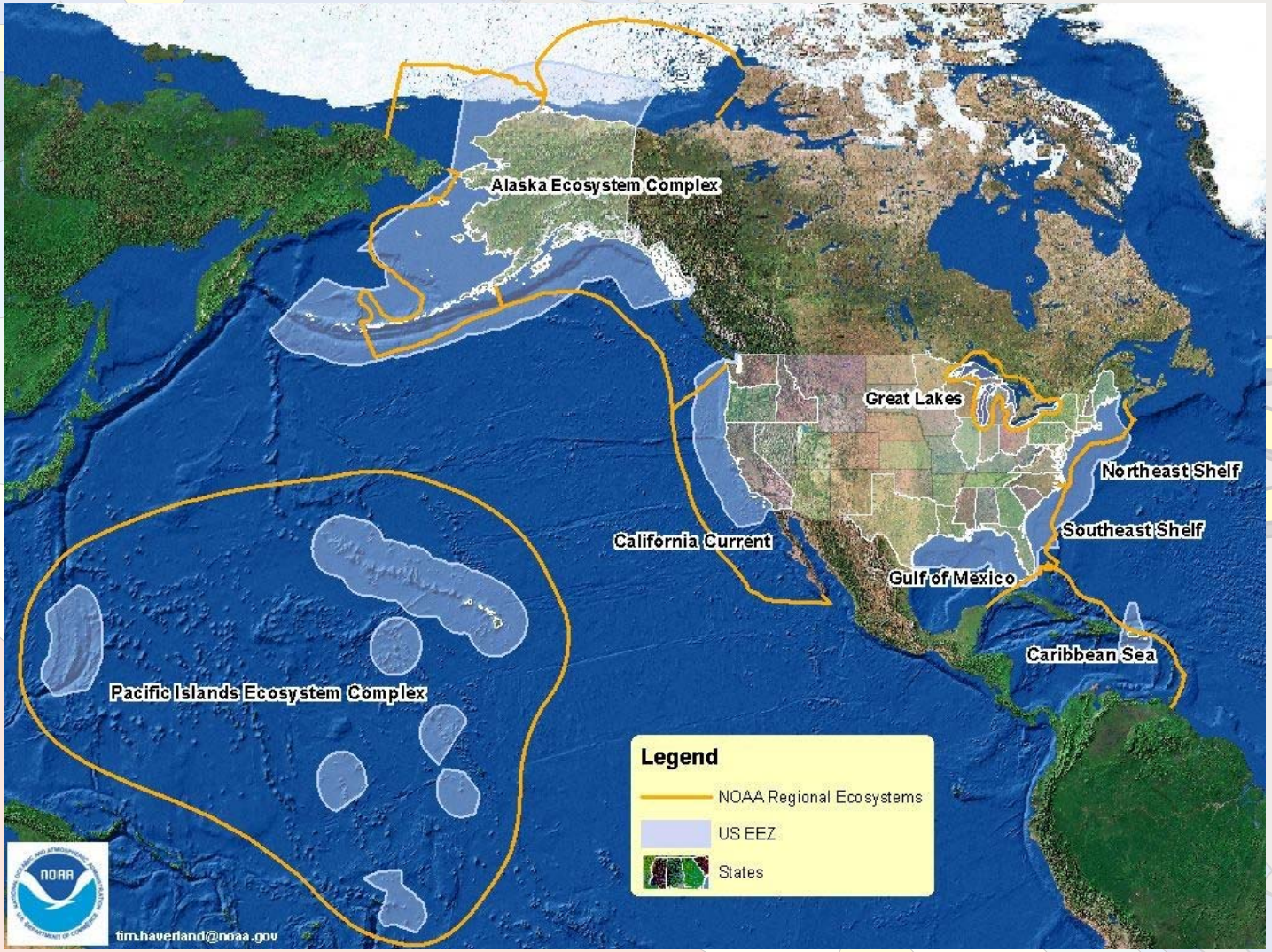
IPCC Models and Fisheries

Objectives

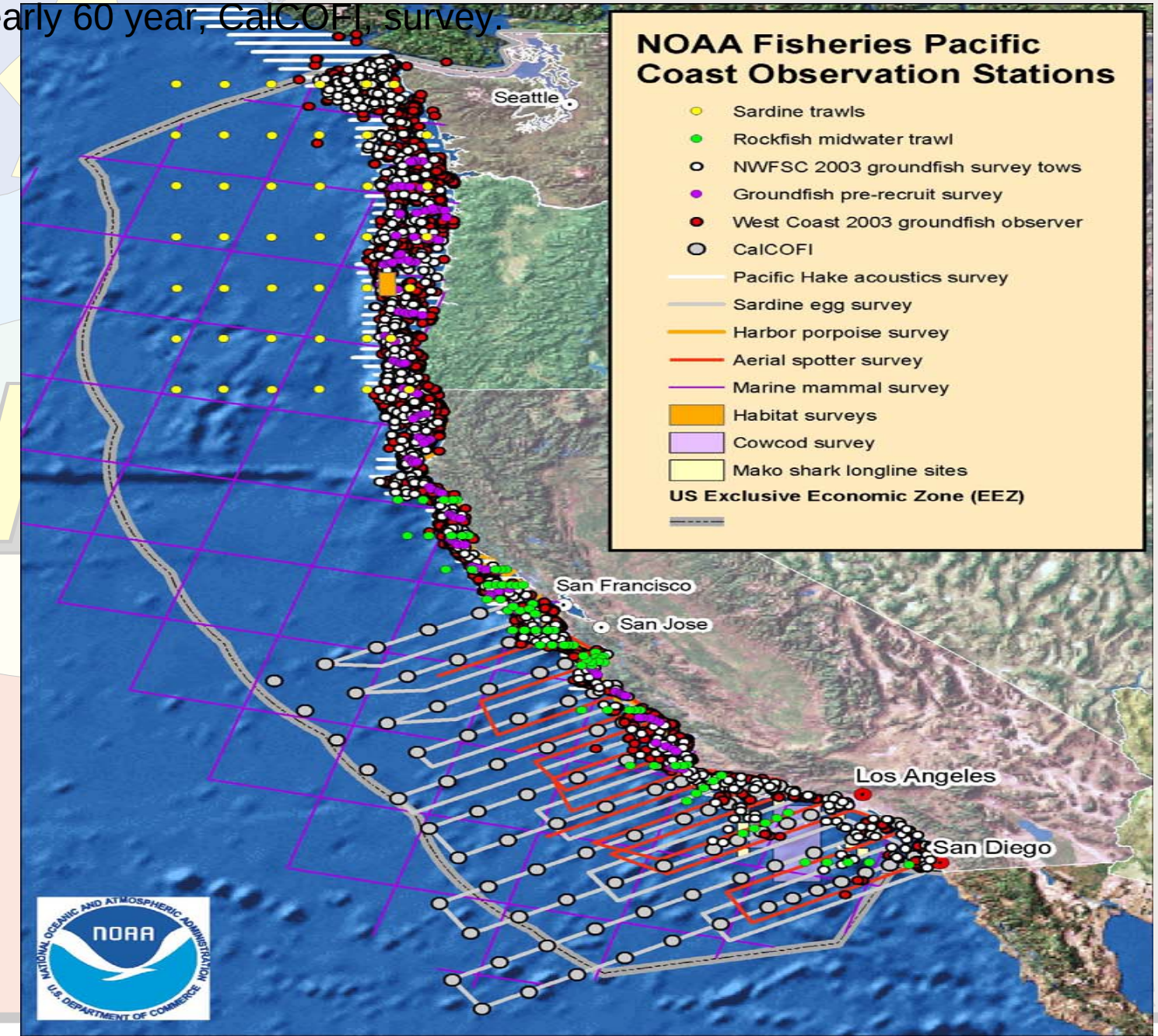
- Highlight present fisheries surveys focusing on the CA Current Large Marine Ecosystem (CCLME).
- Discuss advance technology in gliders and AUV's for fisheries and climate
- Future direction of climate and ecosystems in the CCLME

NOAA Fisheries Stock Assessments and Ecosystem Science is focused at a Regional (LME) level

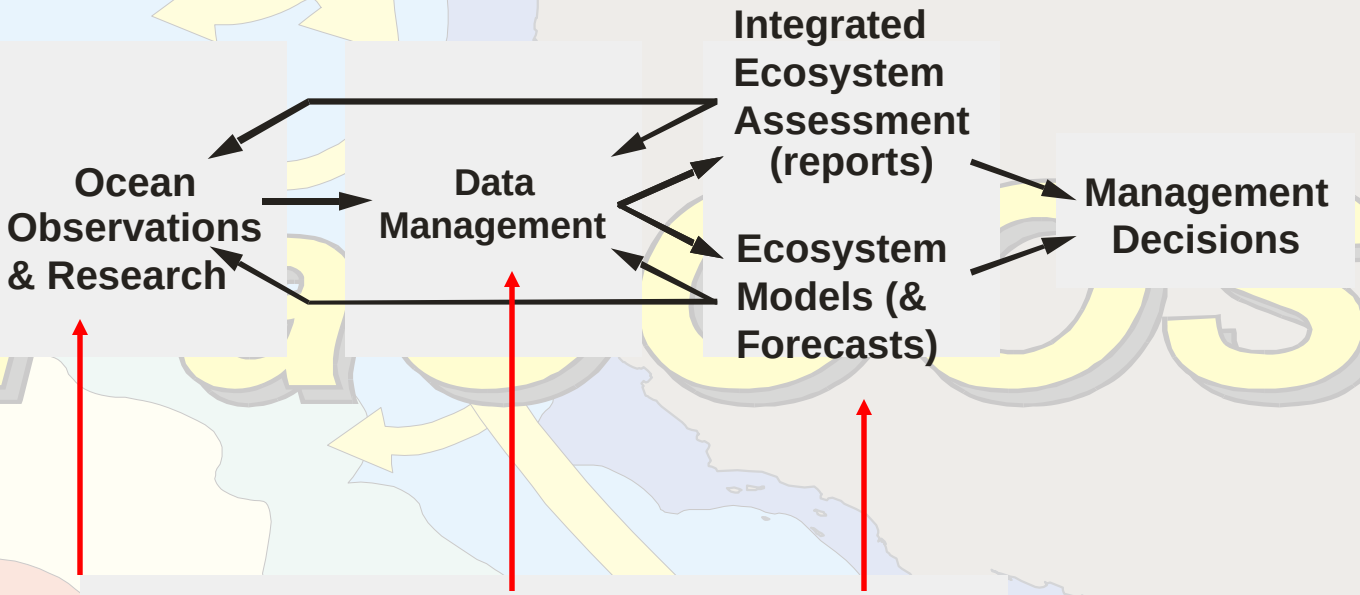


**Regional Ecosystem inland boundaries include the coastal watershed and the inland extent of the diadromous fish habitat see details at http://ecosystems.noaa.gov/workshops_&_meetings.htm

California Current LME has extensive climate and ecosystem data including the nearly 60 year, CalCOFI, survey.



IDEAL Chronology for developing a survey program for an ecosystem



Cool and Expensive Surveys

Funding opportunity for PaCOOS in 2005-08

Start Here

Ocean Observing

Data Infrastructure

Products

Present fisheries surveys are primarily ship based

Fisheries Surveys have the same technologies for years- towing nets off ships

R/V David Starr Jordan
1964-2009

Fisheries Survey Vessels (R/V Oscar Dyson at AFSC)

Two on West Coast by 2014

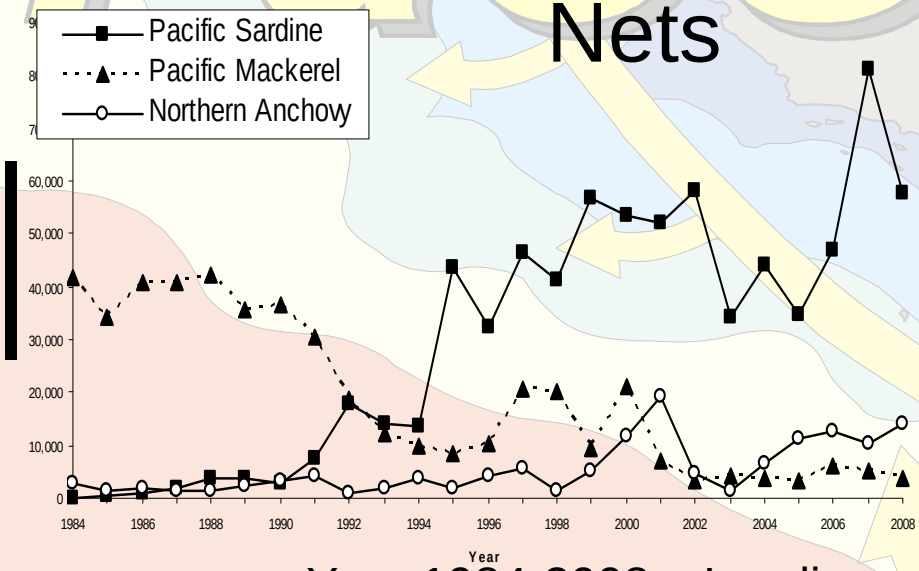
208 Ft

Crew 19; Scientists 19

“acoustic quieting technology”

Traditional fisheries data is collected to derive a population biomass for a single species

Nets



(0-70 MT) Year 1984-2008 Landings (CA DFG)

Addition data:

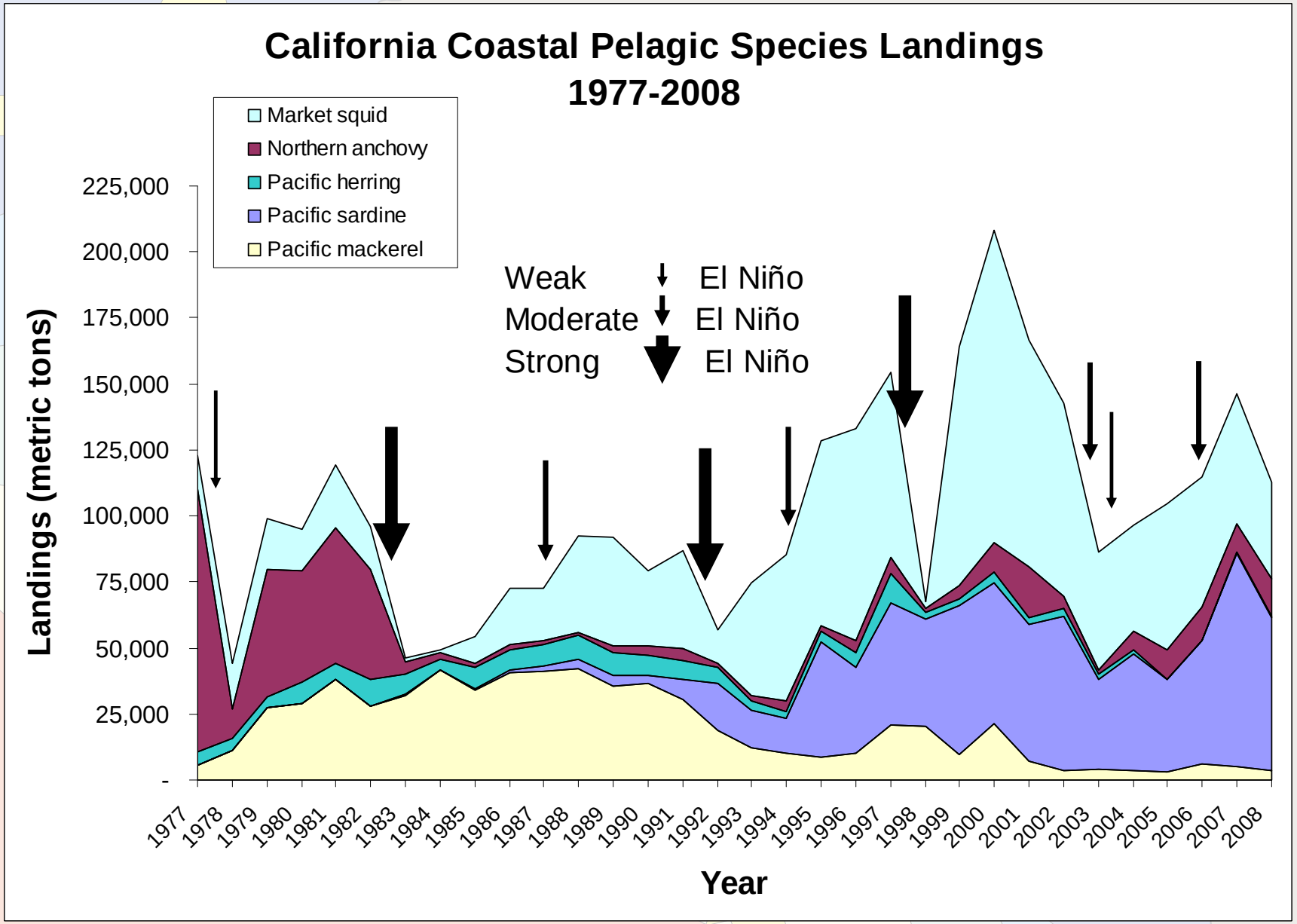
Age of population

Bycatch

<u>But</u>

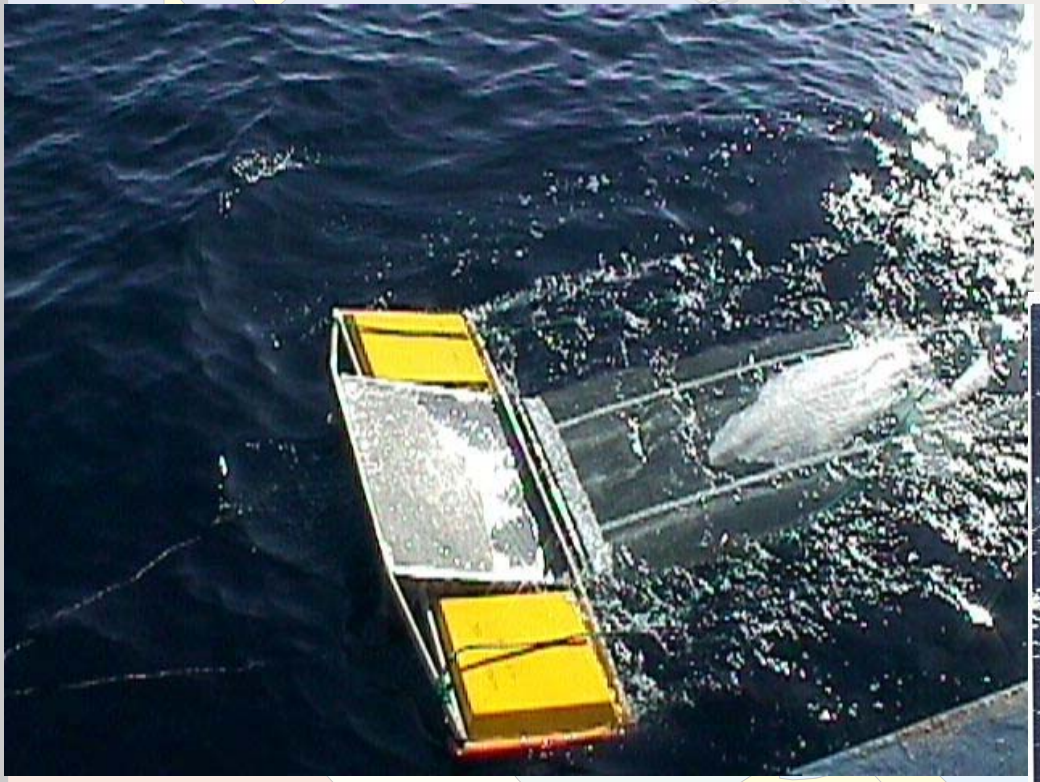
No environmental data is used in the present Fish Stock Assessment models.

Climate signal such as ENSO are seen in the landings data



CA Dept Fish and Game

Other sampling for zooplankton & icthyoplankton

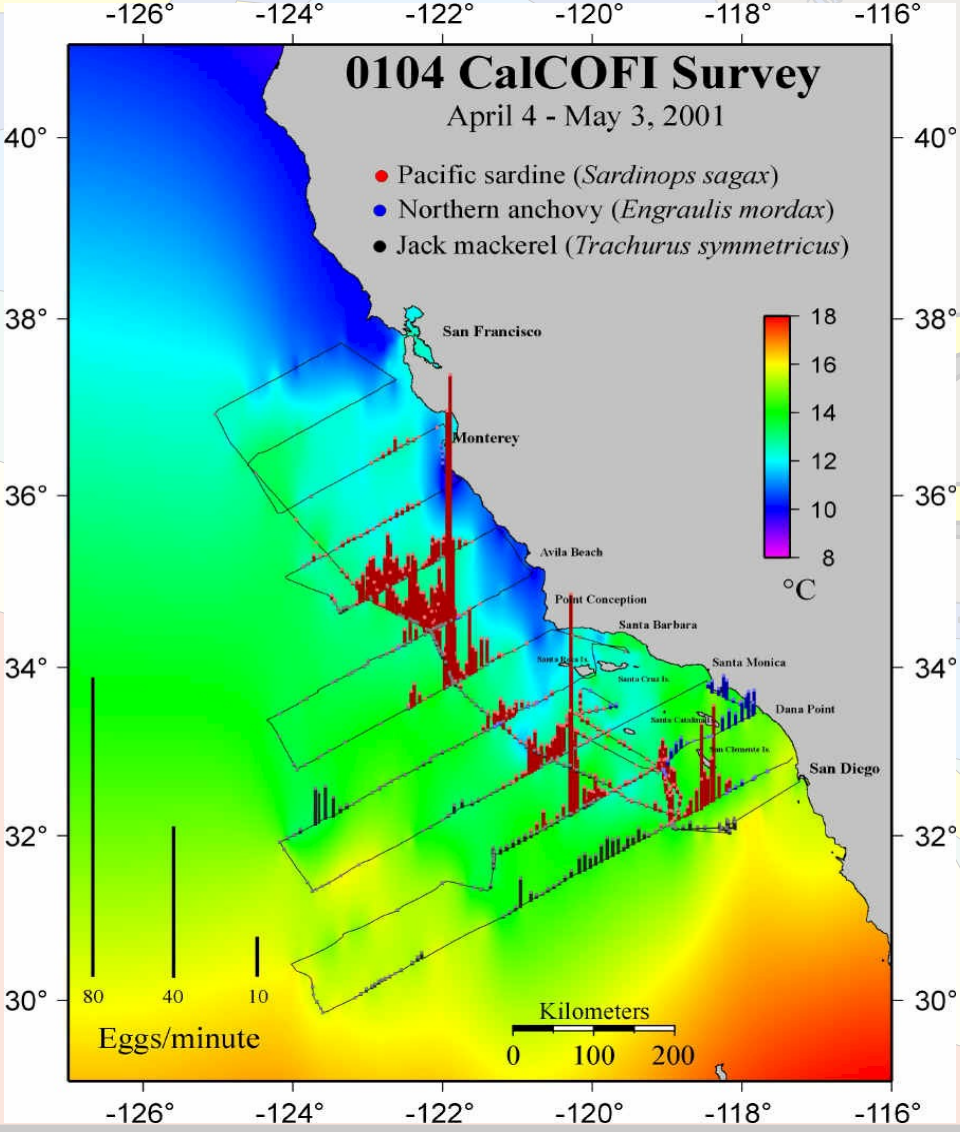


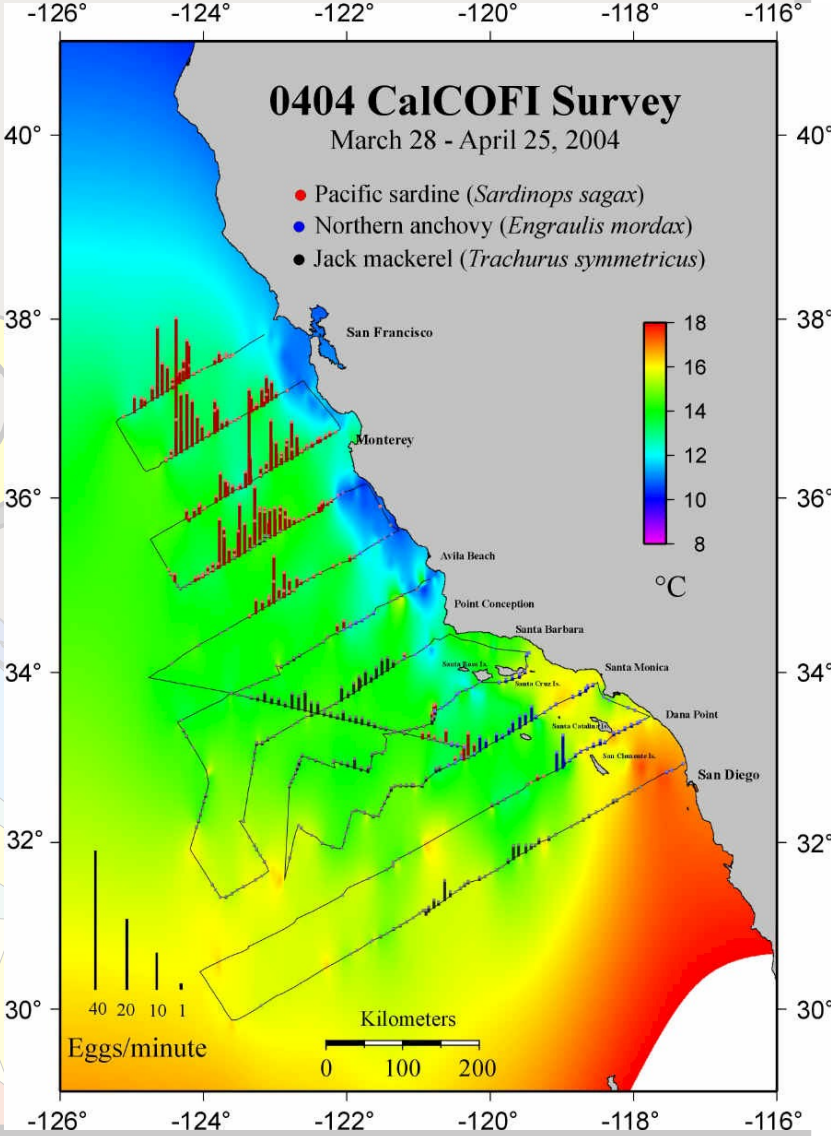
Manta Tow

Bongo Nets

CUFES- Continuous Underway Fish Egg Survey

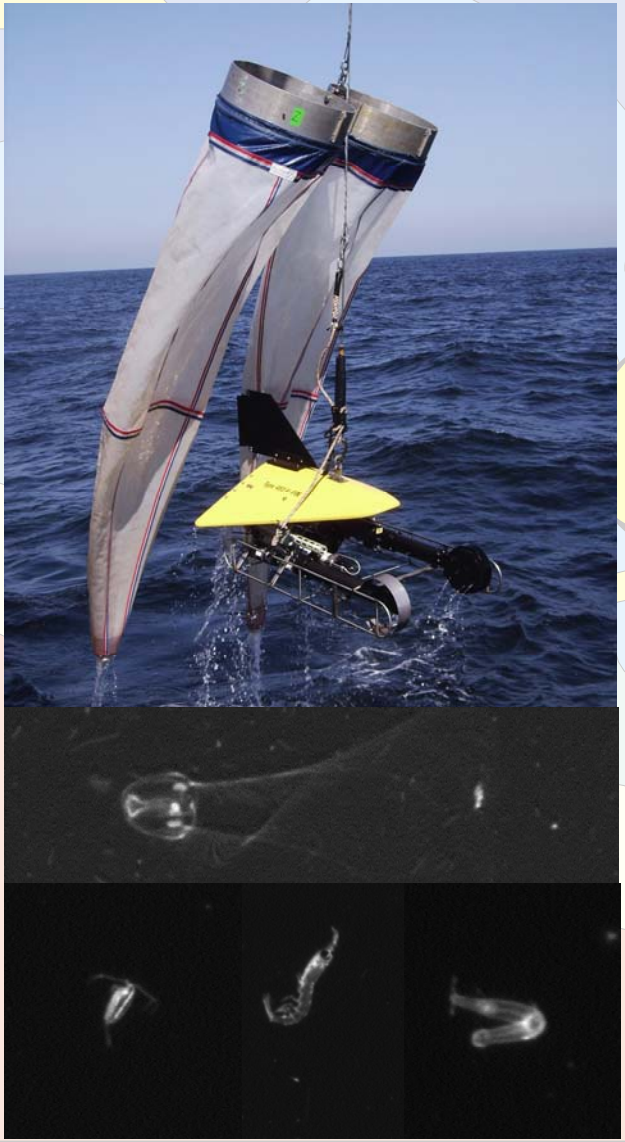
samples icthyoplankton at 3 m depth (NMFS SWFSC)



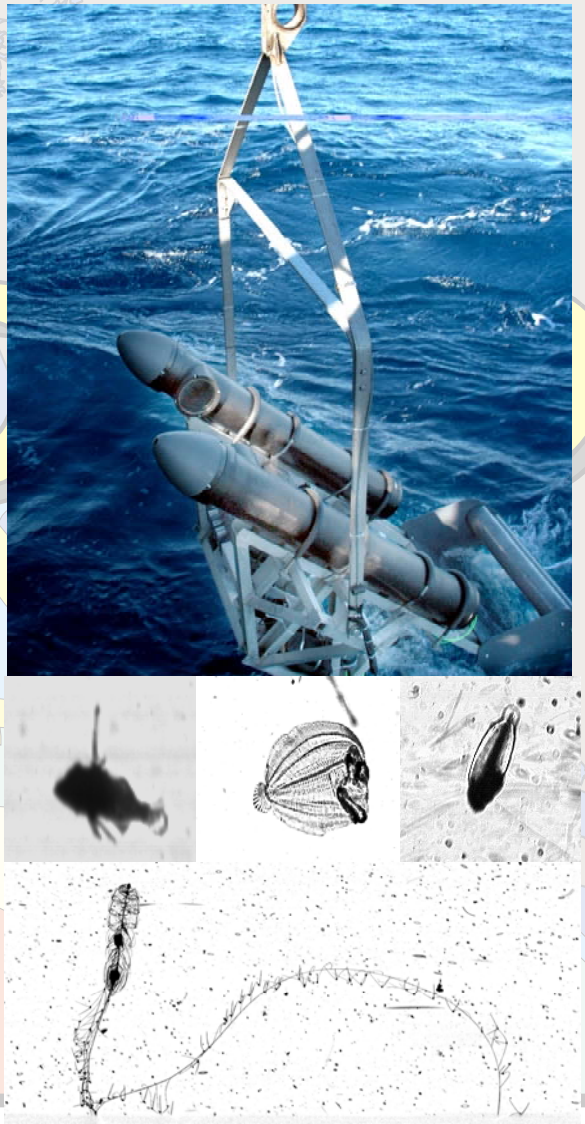


Optical Plankton Enumeration (Jon Hare NMFS NEFSC)

Video Plankton Recorder (2L s^{-1})



In Situ Ichthyoplankton Imaging System (70L s^{-1})



Developed to support zooplankton and ichthyoplankton research and monitoring

Automatic target recognition

Automated taxa identification (still in development)

Can also provide data on gelatinous zooplankton

Video benthic surveyor (Jon Hare NMFS NEFSC)

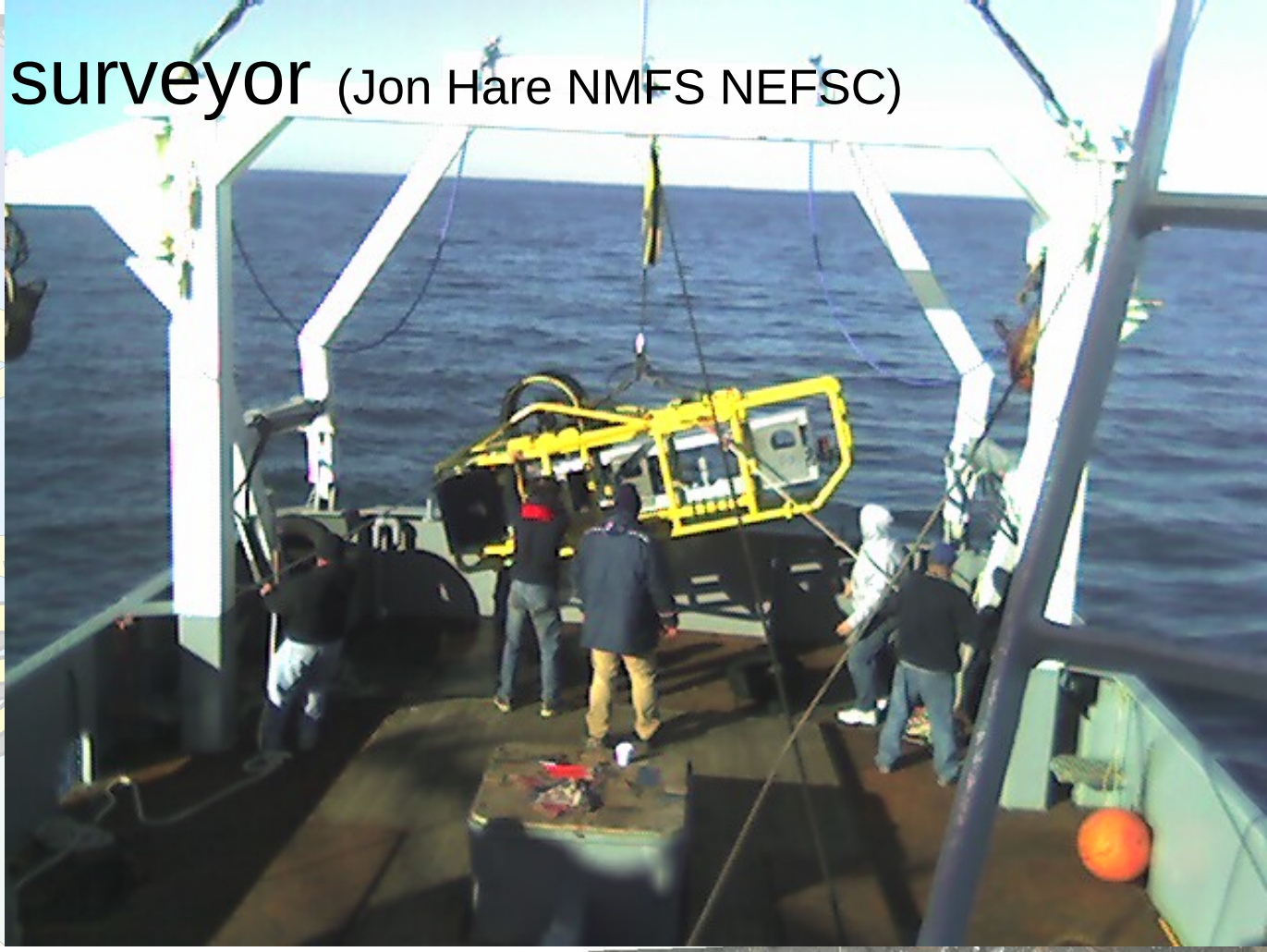
Gallagher et al. (http://nebo.whoi.edu/)

Developed to support scallop assessment

Automatic image mosaicing

Planned automated image processing (in development)

A lot of benthic information can be extracted from imagery



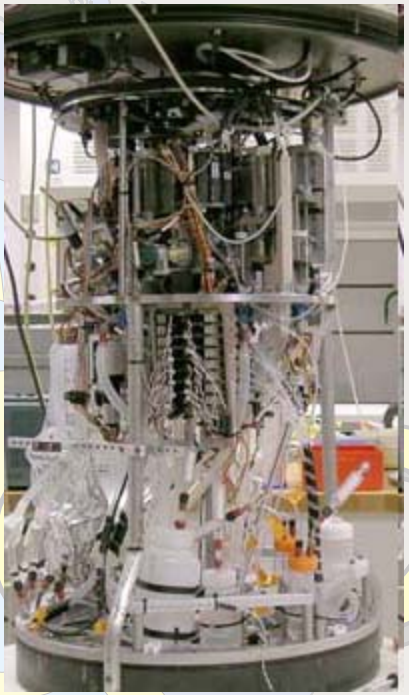
Environmental Sample Processor (Jon Hare NMFS NEFSC)

http://www.mbari.org/ESP/default.htm

allows remote application of molecular probe technology to identify target species

Used for HAB, bacteria, and invert larvae

Currently deployed from moorings, other platforms possible



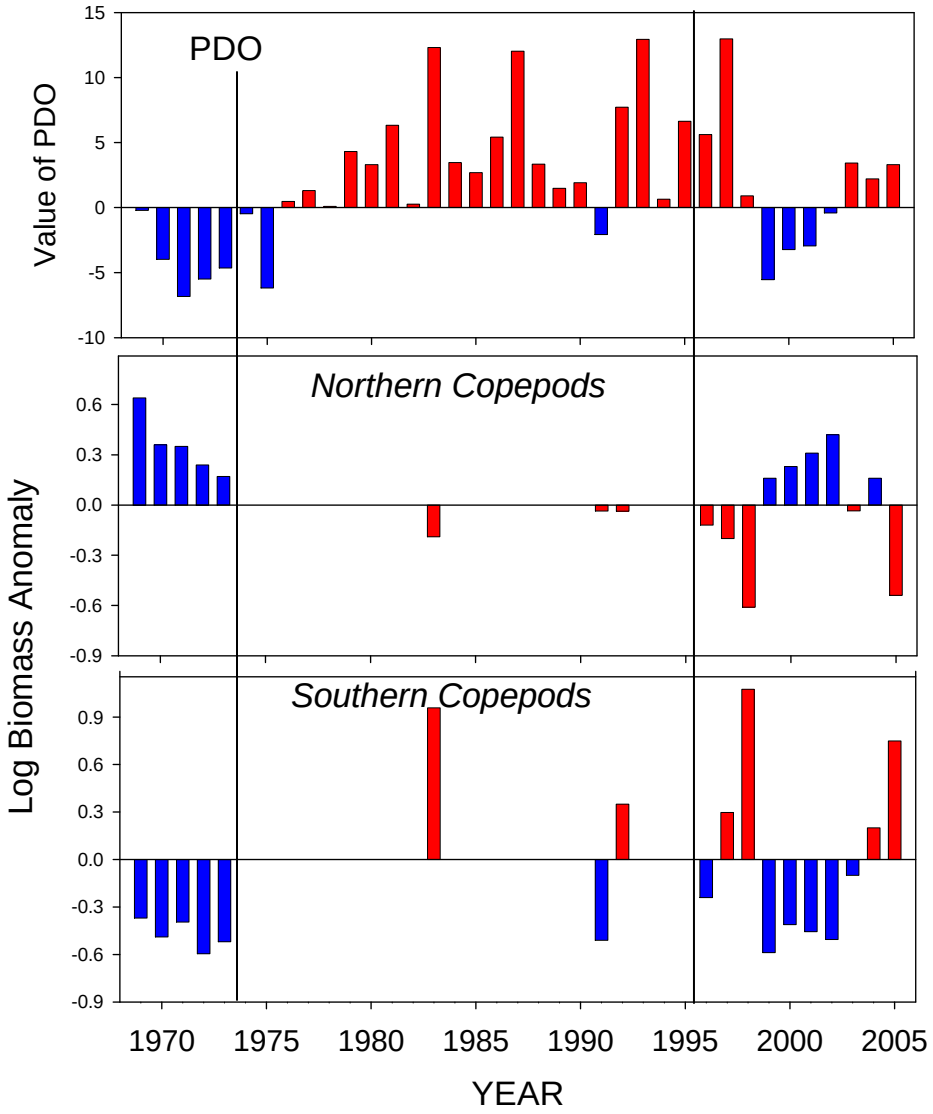
Limitations of Ship based surveys

- Expensive- >$15K/ day
- Weather limited in many areas of North Coast of CCLME
- Limited spatial and temporal resolution (e.g. Quarterly CalCOFI, Monterey Lines)

But West Coast Continental Shelf is narrow (~12 miles)

- For zooplankton and oceanographic data, Bill Peterson has demonstrated the value of a monthly one day survey.

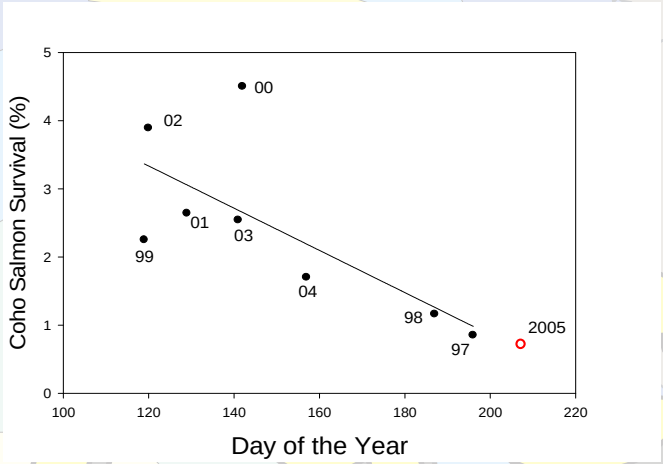
PDO v Northern and Southern copepod biomass anomalies (PaCOOS-Newport Line Bill Peterson NMFS)



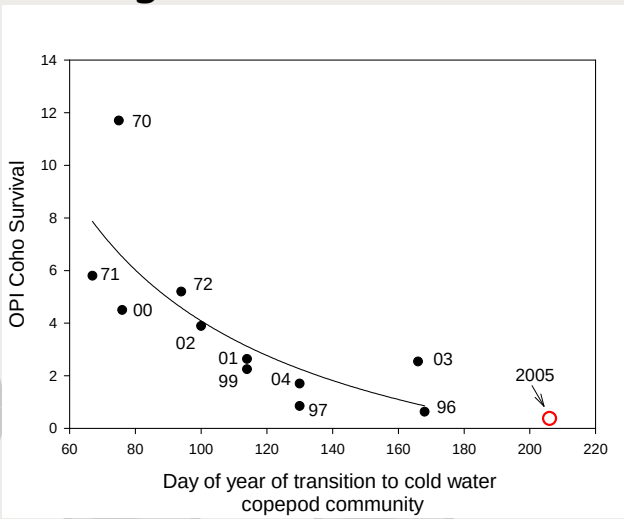
- Strong positive anomalies of Northern species when PDO is negative;
- Strong positive anomalies of southern species when PDO positive and during El Niño events (83, 97/98);
- 2005 especially anomalous with regards to copepod species, looking very "El Niño like"!
- These observations are the result of ddvection of different water types brings to Oregon a different zooplankton fauna

Ecological Forecast Example- Coho salmon returns in the Columbia River (Bill Peterson NMFS) KEEP IT SIMPLE

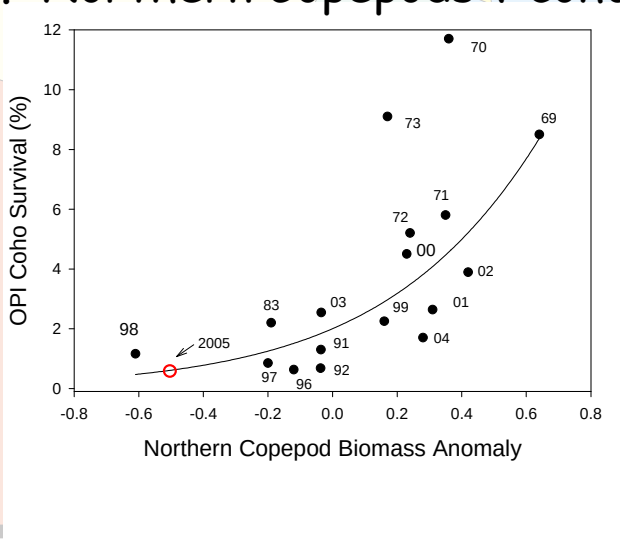
1. Hydrographic spring transition



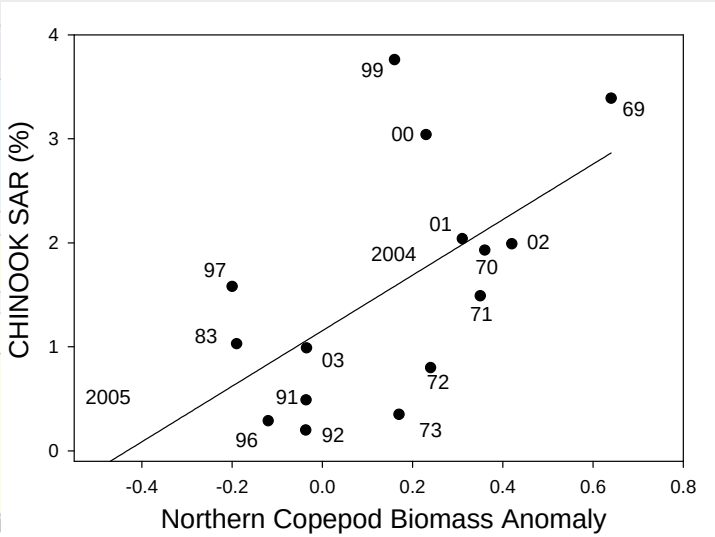
2. Biological transition v. coho

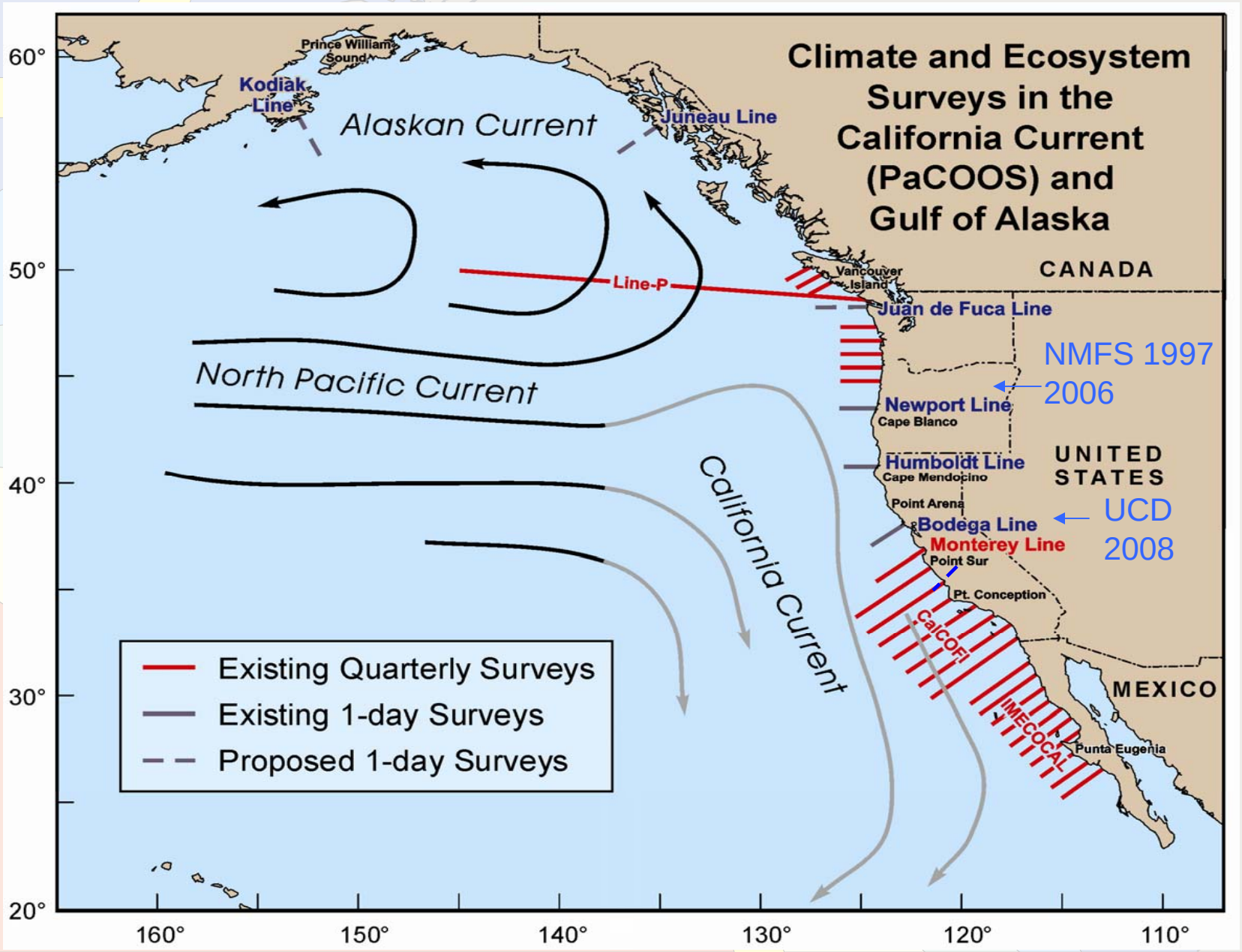


3. Northern Copepods v coho



4. Northern Copepods v Chinook




Climate and Ecosystem Surveys in the California Current (PaCOOS) and Gulf of Alaska
Prince William Sound
Kodiak Line
Alaskan Current
Juneau Line
Line-P
North Pacific Current
California Current
Vancouver Island
CANADA
Juan de Fuca Line
NMFS 1997
2006
Newport Line
Cape Blanco
Humboldt Line
Cape Mendocino
UNITED STATES
Point Arena
Bodega Line
UCD
2008
Monterey Line
Point Sur
Pt. Conception
CalCOFI
IMECOCAL
MEXICO
Punta Eugenia
Existing Quarterly Surveys
Existing 1-day Surveys
Proposed 1-day Surveys
60°
50°
40°
30°
20°
160°
150°
140°
130°
120°
110°

Glider and Mooring Time Series in the CCLME

(Russ Davis SIO)

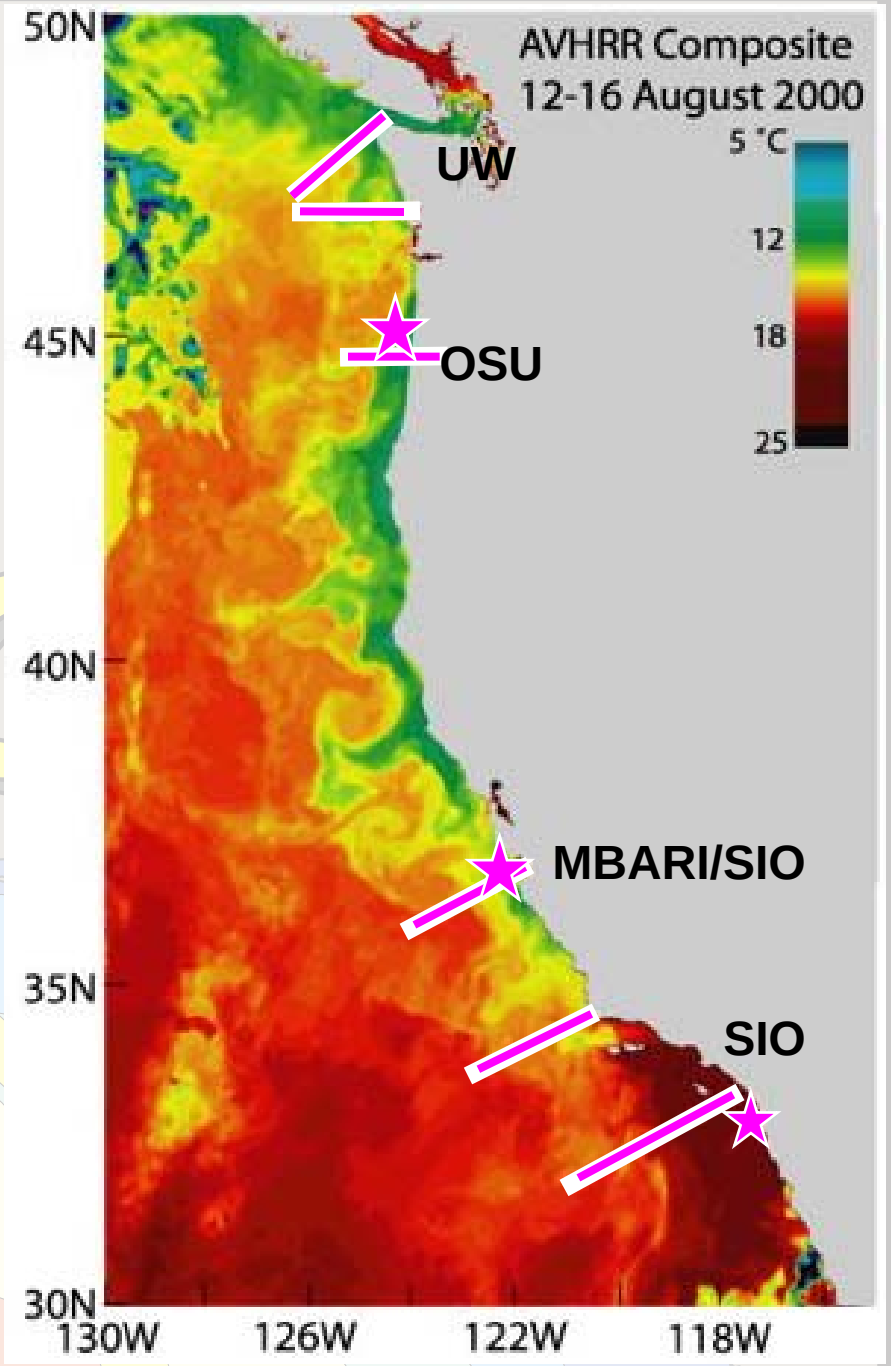
glider lines — and moorings ★

- **supported through NSF, IOOS, Climate Obs, regional associations etc.**
- **all have physical measurements & chlorophyll**
- **some have bio-acoustics, oxygen**
- **continued operation not guaranteed**

UW lines have been discontinued

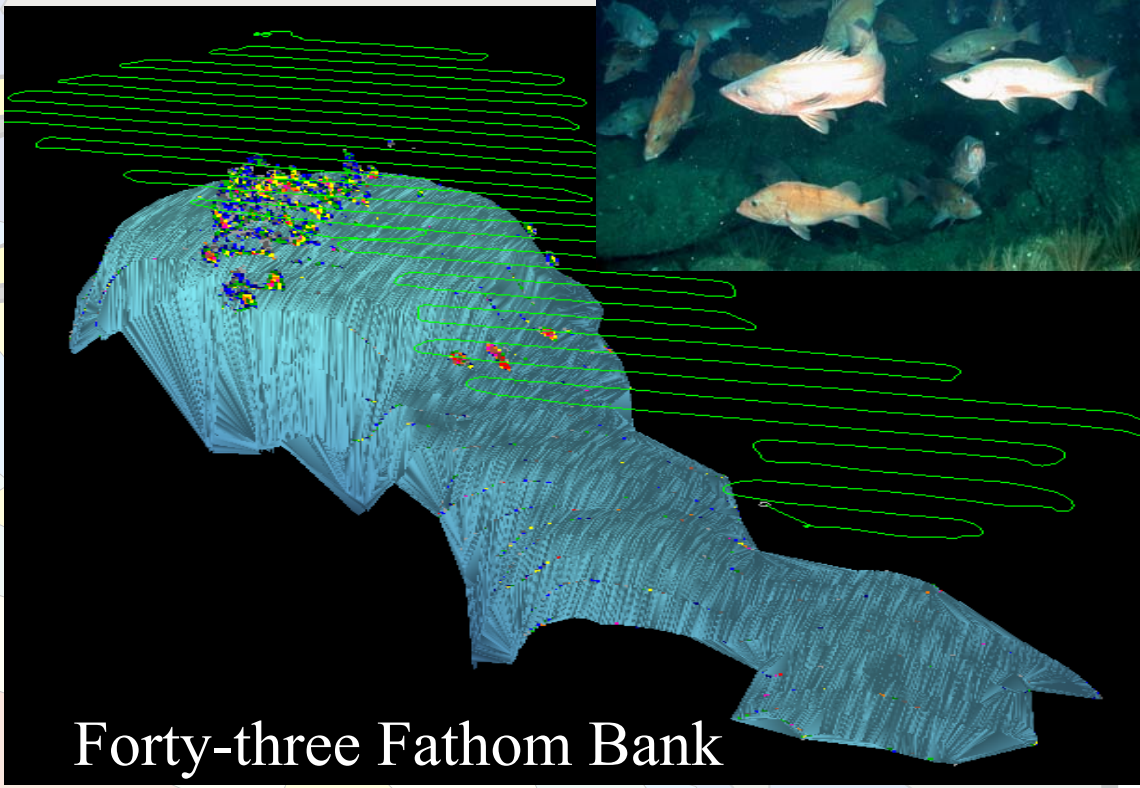
OSU line co-located with hydrographic and zooplankton sampling

Southern three lines coincide with CalCOFI Lines 67, 80 and 90. Dynamics, phytoplankton and zooplankton sampled. Continuously occupied since 2005.



New Technologies for fisheries surveys

AUV with Acoustic capabilities



Rockfish Survey off CA Coast- NMFS SWFSC

Broad bandwidth sound scattering from Coho, Steelhead and Chinook*

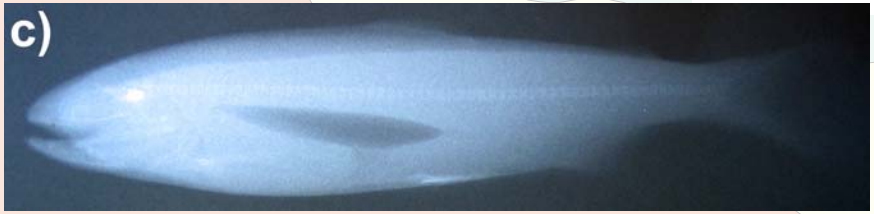
Josiah Renfree, Sean Hayes, Stéphane G. Conti and David A. Demer
Southwest Fisheries Science Center

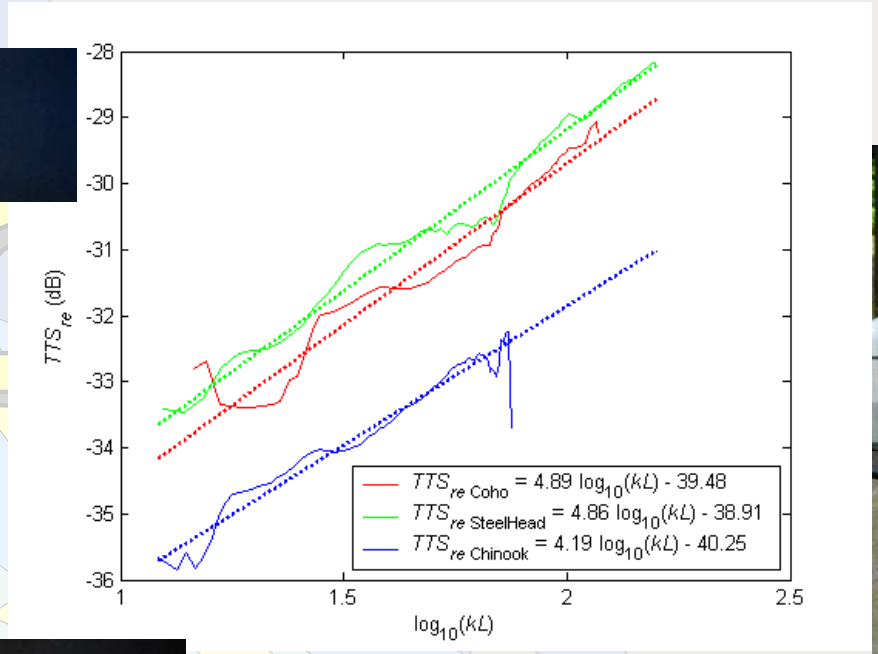
Advanced Survey Technologies
Southwest Fisheries Science Center

Coho

Steelhead

Chinook





* Manuscript in preparation

Unique scattering spectra result from morphological differences.

Future Direction for Ecosystem in the CCLME

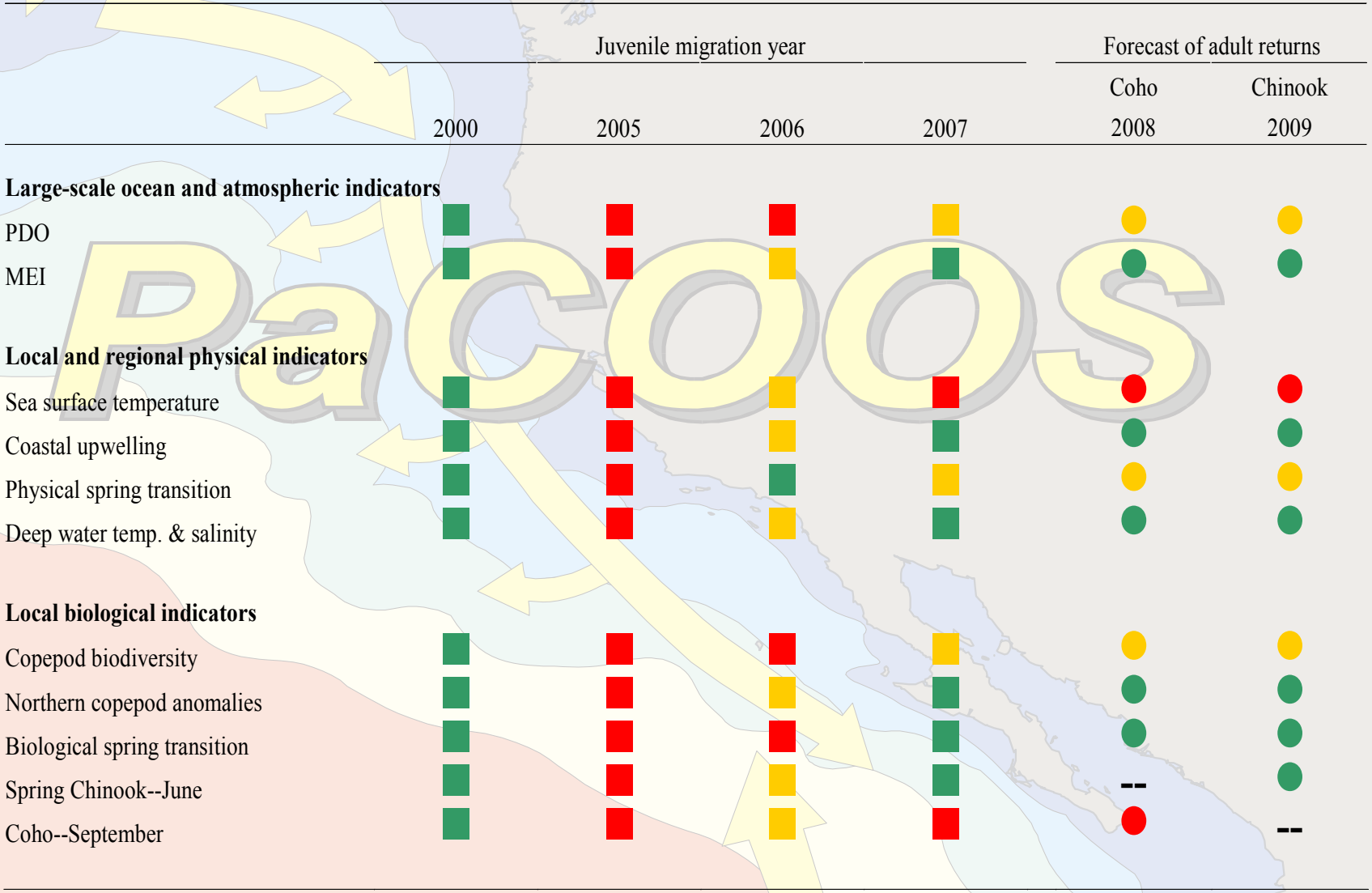
- Status Report for the Fisheries Management Council
  - Climatology of LME- Spring Transition, ENSO, PDO states.
  - Biological Indicators of climate change
  - Annual “Report Card”
- Integrated Ecosystem Assessment

Indicator Development (CC)

(http://www.nwfsc.noaa.gov/research/divisions/fed/oeip/a-ecinhome.cfm)

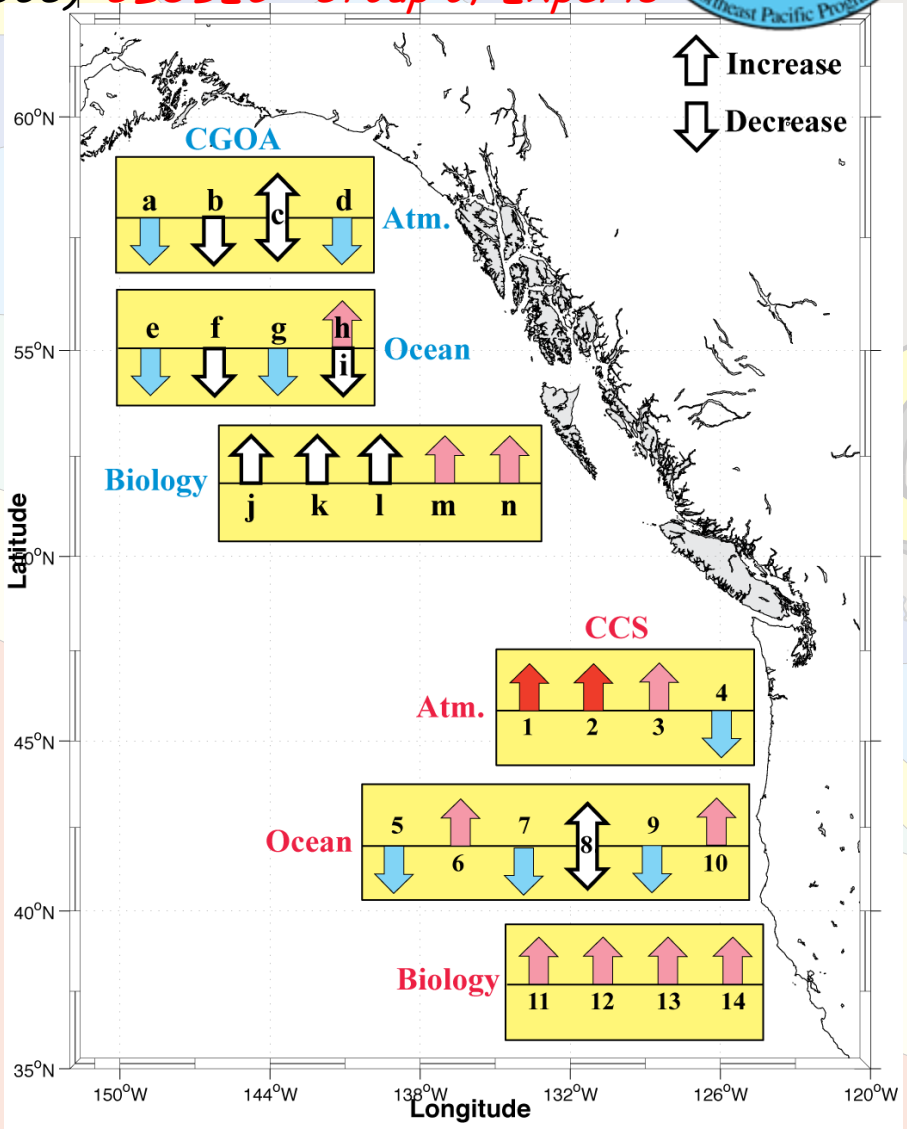
- Large–scale Ocean and Atmospheric Indicators: (a) PDO; (b) Multivariate El Nino Southern Oscillation (MEI); (c) Basin-scale winds.
- Local and Regional Physical Indicators: (a) sea surface temperature anomalies; (b) coastal upwelling; (c) spring transition; (d) deep-water temperature and salinity.
- Local Biological Indicators: (a) copepod biodiversity and community structure; (b) northern copepod anomalies; spring transition (biological); June Spring Chinook; Sept Coho; Zooplankton species.
- Indicators Under Development: 2nd mode of N Pac SST variation; phytoplankton biomass; euphausiid egg concentration, production, forage fish; Hake abundance; salmon predation index; Sea bird productivity (Sydeman)

"Report Card" or Ocean Index – Forecasting Future Salmon Returns www.nwfsc.noaa.gov (Bill Peterson NMFS NWFSC)



Expert Forecasts of NEP response to La Nina: Sep 2007:

Published in EOS, 89, 321-322 (2008) *GLOBEC - Group of Experts*



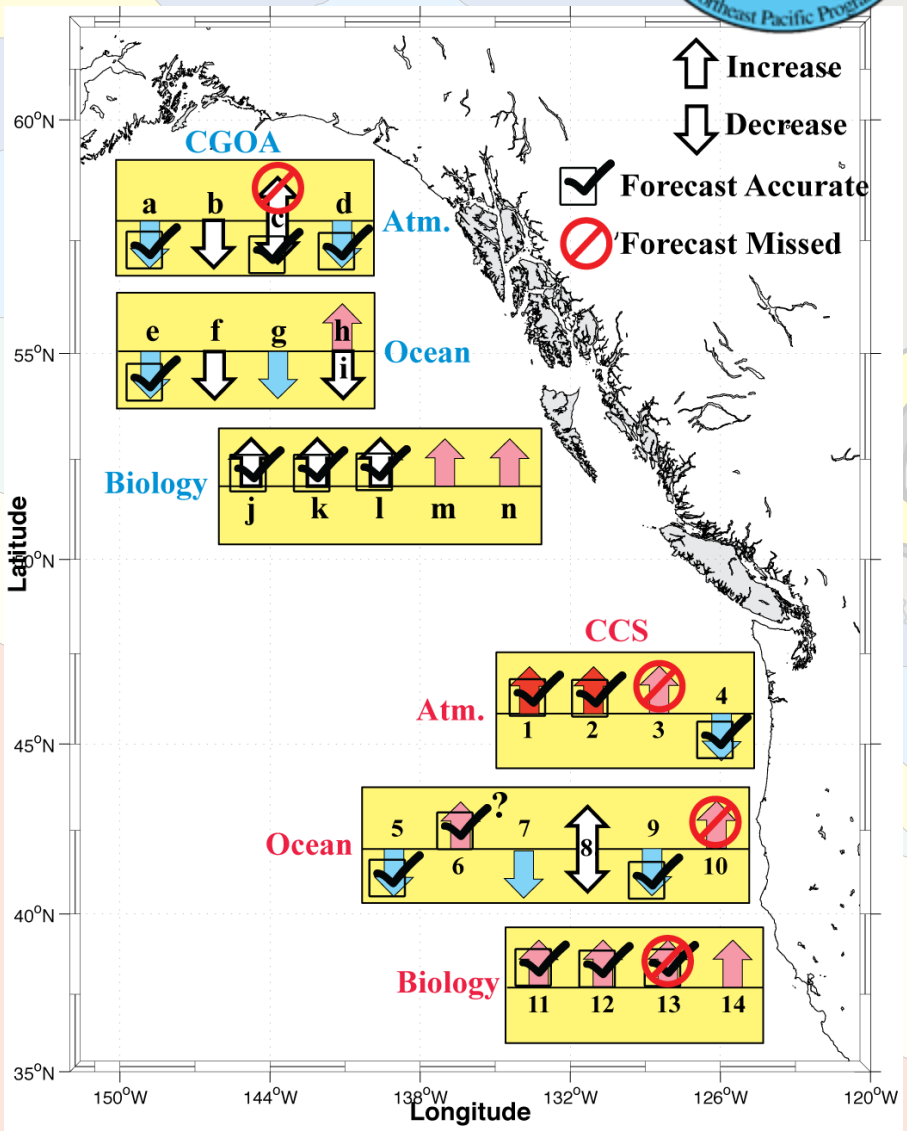
Key for CGOA Variables

a) Downwelling wind strength
b) Wind mixing intensity
c) Air Temp
d) Precipitation
e) SST
f) Stratification
g) ACC transport
h and i) Nitrate concentration
j) Spring bloom timing (incr=later)
k) Primary Production
l) Secondary (ZP) Production
m) Juvenile salmon survival
n) Adult Salmon Return

Key for CCS Variables

1) Offshore sea-level pressure
2) Upwelling wind strength
3) Precip (NCC); 4) Precip (SCC)
5) SST
6) CC southward transport
7) Stratification
8) Salinity (fresher N; saltier S)
9) Spring trans. Timing (decr=earlier)
10) Incid/severity of hypoxia NCC
11) Primary Production
12) ZP comm comp. (incr=more boreal)
13) Juvenile salmon survival
14) Adult salmon return in 09-10

Expert Forecasts
Assessment: Feb 2009



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Summary

- CC LME has 60 years of ecosystem and climate data. Other NMFS Science Centers have extensive data as well.
- Ship Surveys will continue to be an integral part of future fish surveys but costs may require that they are used more strategically.
- Acoustics are being incorporated into fish surveys. It can tell you organisms are present; just not who it is.
- Climate and ecosystem science is now being implemented into the Council process. The question is how to do so.