Emerging trends, trials and triumphs in the California Current ecosystem status report

Elliott Hazen, SWFSC
Chris Harvey, NWFSC

Goals and objectives

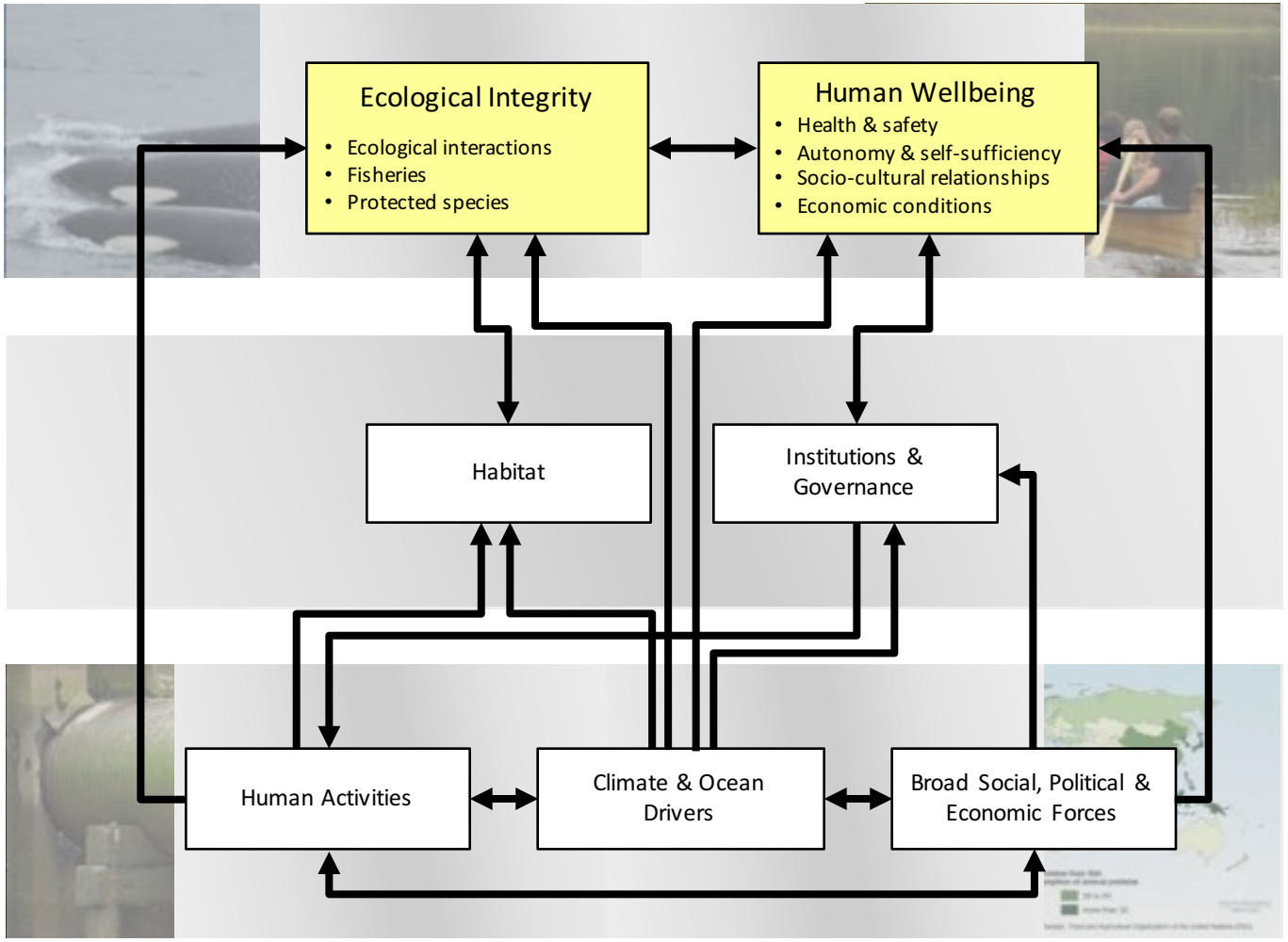
- Thus far, the goal for the ESR of the California Current has been to inform the Pacific Fishery Management Council of the status, trends and variability of key physical, chemical, biological and social indicators, in support of EBFM
- We are working toward supporting other end users through ESRs, in particular National Marine Sanctuaries
- Our long-range objective is to evolve from generating a 1x/year, static ESR to a more real-time, customizable, web-based ESR

IEA Background

Focal Ecosystem Components

Mediating Components

Drivers and Pressures



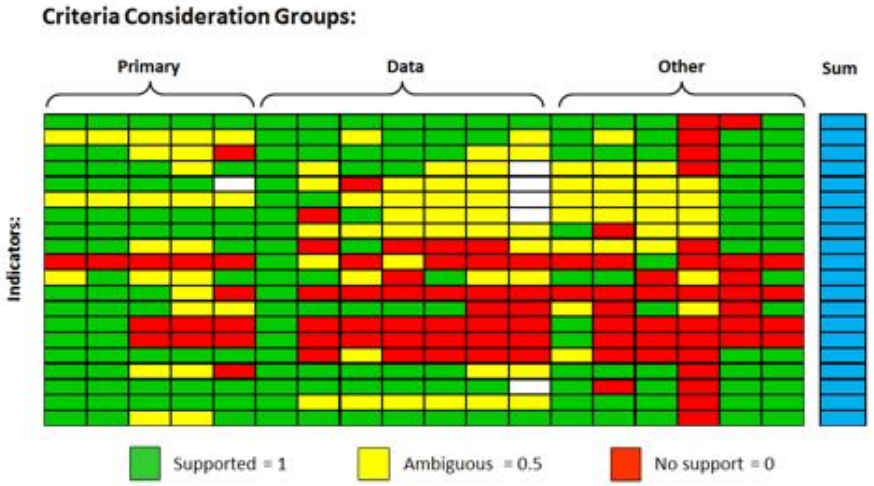
Production

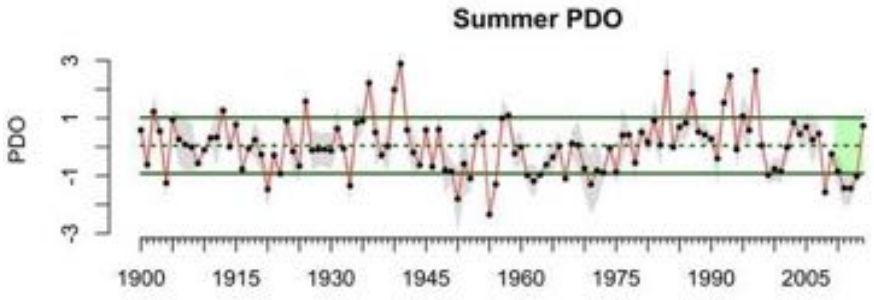
- Per a formal request from 2013, the CCIEA team provides the Pacific Fishery Management Council with an ESR each March
  - 20-page report with appendices
  - Presentation to Council and advisory bodies at annual March meeting
- ESR focuses on a broad suite of indicators related to:
  - 5 Climate/physical oceanography attributes
  - 2 Ocean chemistry attributes
  - 6 Biological/ecological attributes
  - 6 Socioeconomic attributes
- Indicators summarized across many spatiotemporal scales

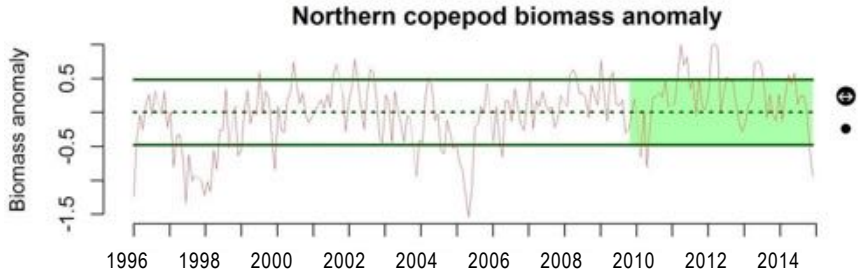
CCIEA Toolkit: Indicators

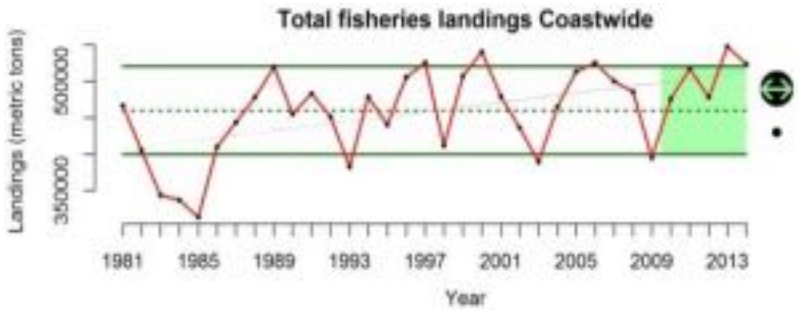
- Indicator screening process from Kershner et al. (2011, *PLoS One*)
- Candidate indicator list developed
- Each indicator related to ecosystem goal(s) and attribute(s)
- Indicators subjected to 18 screening criteria
  - Theoretical considerations (5 criteria)
    - Example: responds predictably, sensitive to management action
  - Data considerations (7 criteria)
    - Example: directly measurable
  - Other considerations (6 criteria)
    - Examples: cost-effective to measure; resonates with public
- Objective: complementary indicator portfolio, developed via transparent, repeatable, defensible process

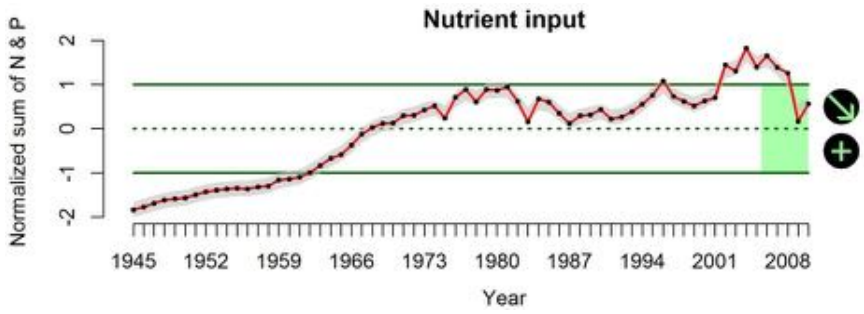
CCIEA Toolkit: Indicators





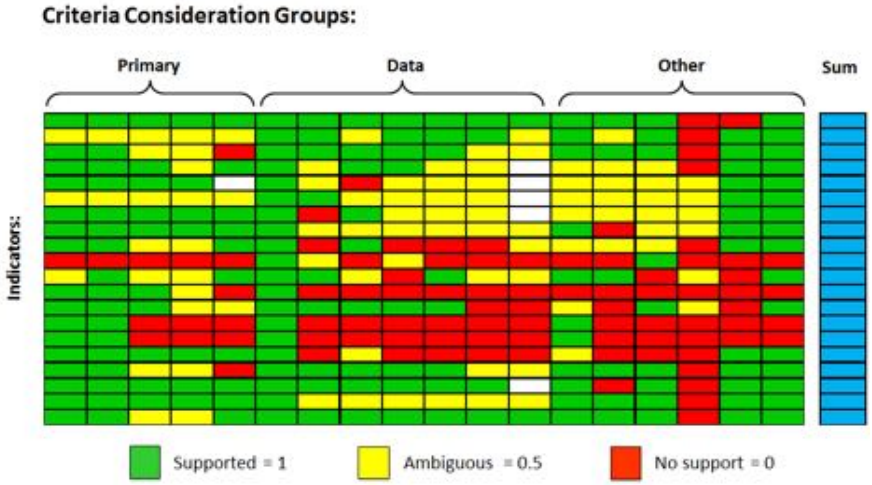


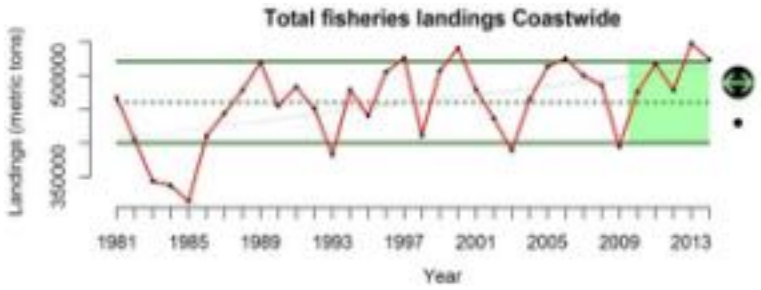


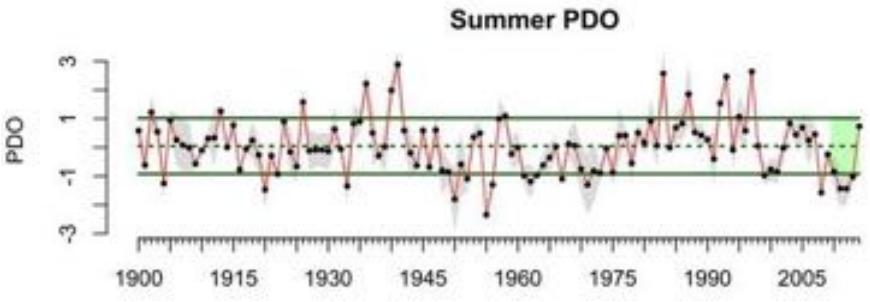


174 indicators have been selected as of earlier this year

CCIEA Toolkit: Indicators

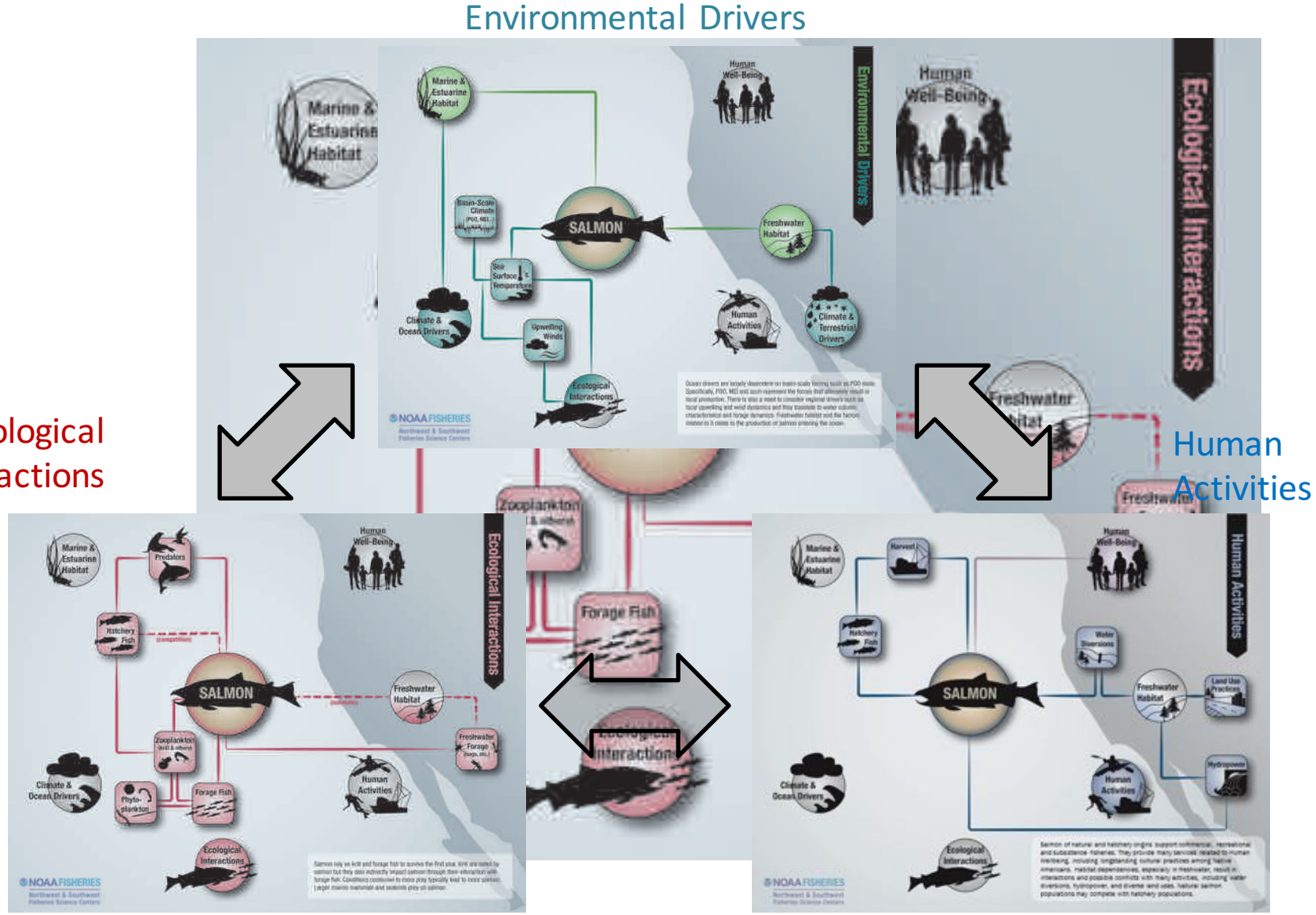






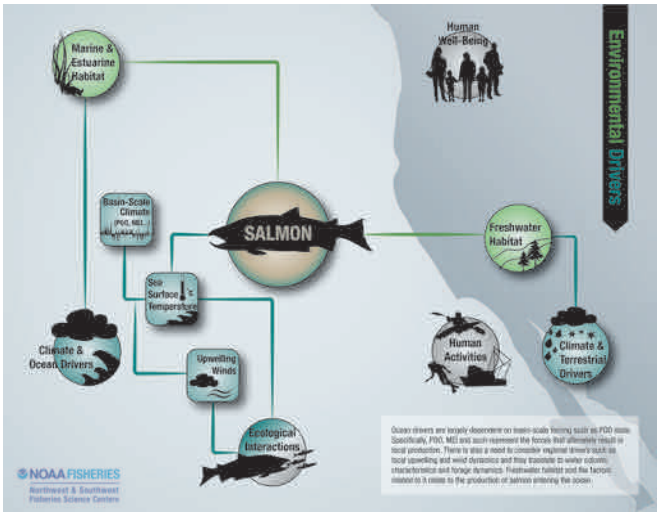
- **With rigorously screened and conceptually valid indicators, we can provide stakeholders with status updates ("report cards")**

The California Current IEA team created hierarchical, species-centered conceptual models in a long, iterative, consensus-based development effort

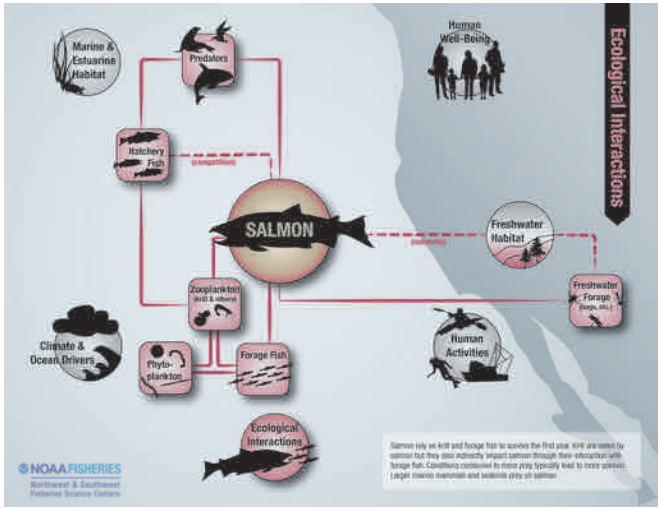


- Organizing framework: each element has one or more *high-priority* indicators or attributes associated with it

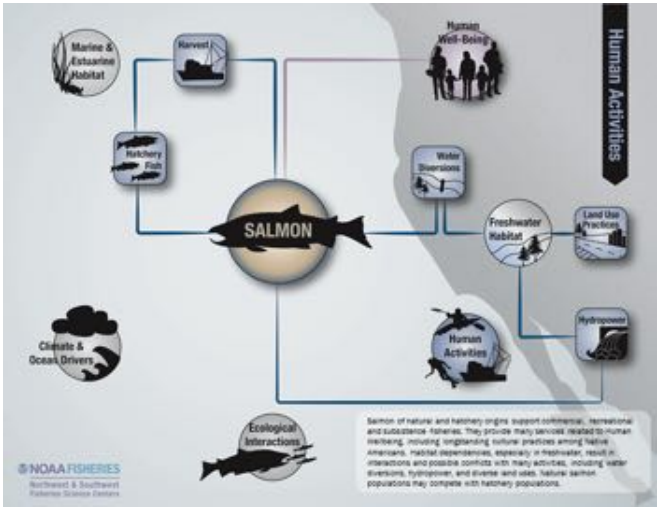
Environmental Drivers



Ecological Interactions

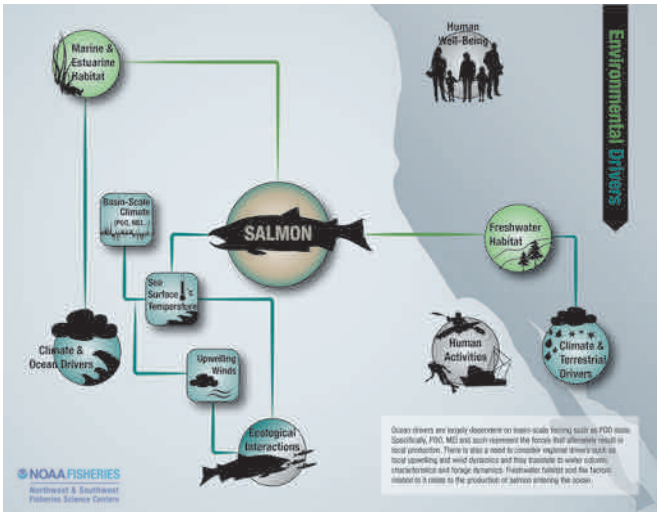


Human Activities



- These have also proven to be excellent engagement tools

Environmental Drivers



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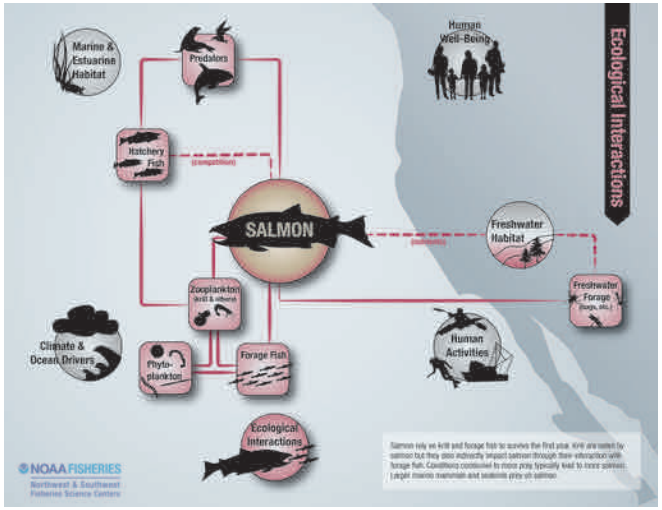
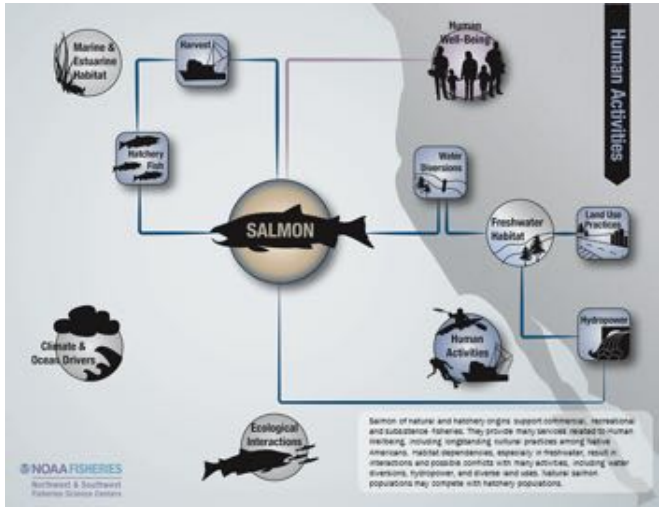
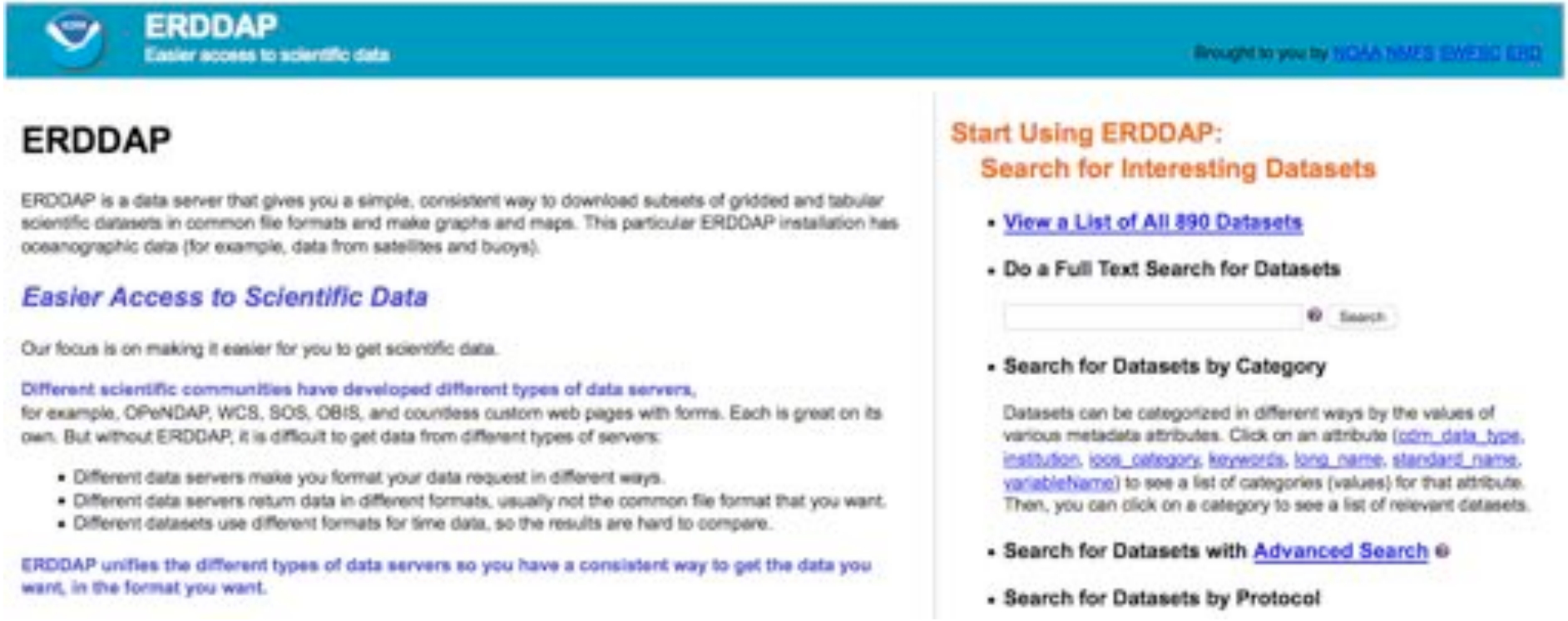


Human Activities



CCIEA
CALIFORNIA CURRENT INTEGRATED ECOSYSTEM ASSESSMENT

Online-only IEA?



ERDDAP
Easier access to scientific data

Brought to you by NOAA NMFS SWFSC ERD

ERDDAP

ERDDAP is a data server that gives you a simple, consistent way to download subsets of gridded and tabular scientific datasets in common file formats and make graphs and maps. This particular ERDDAP installation has oceanographic data (for example, data from satellites and buoys).

Easier Access to Scientific Data

Our focus is on making it easier for you to get scientific data.

Different scientific communities have developed different types of data servers,
for example, OPeNDAP, WCS, SOS, OBIS, and countless custom web pages with forms. Each is great on its own. But without ERDDAP, it is difficult to get data from different types of servers:

- Different data servers make you format your data request in different ways.
- Different data servers return data in different formats, usually not the common file format that you want.
- Different datasets use different formats for time data, so the results are hard to compare.

ERDDAP unifies the different types of data servers so you have a consistent way to get the data you want, in the format you want.

Start Using ERDDAP:
Search for Interesting Datasets

- View a List of All 890 Datasets
- **Do a Full Text Search for Datasets**

  Search

- **Search for Datasets by Category**

  Datasets can be categorized in different ways by the values of various metadata attributes. Click on an attribute (cdm_data_type, institution, ioos_category, keywords, long_name, standard_name, variableName) to see a list of categories (values) for that attribute. Then, you can click on a category to see a list of relevant datasets.

- **Search for Datasets with Advanced Search**
- **Search for Datasets by Protocol**

CCIEA Trials

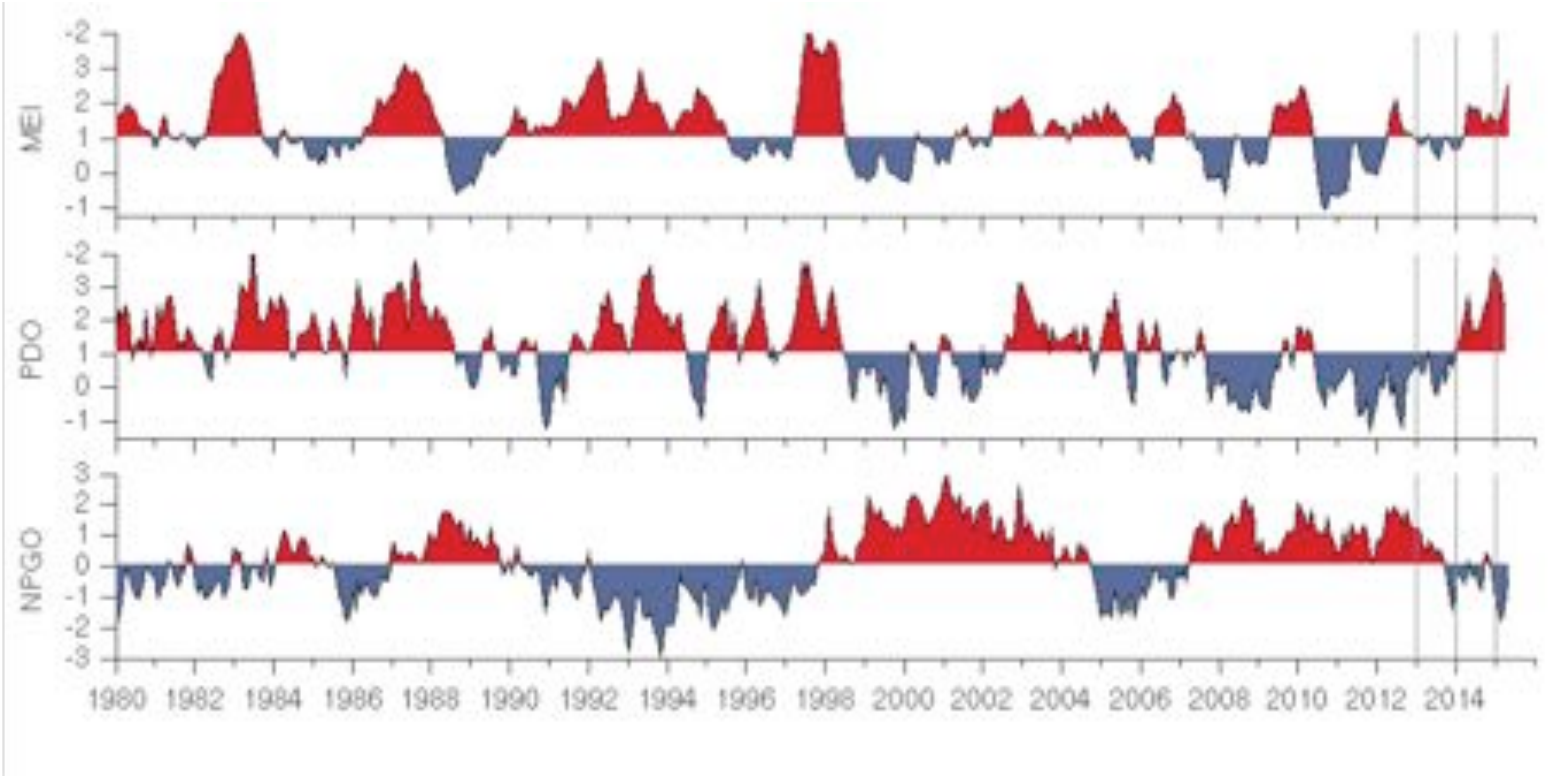
1) Resources are tight

Universally true, but we can highlight specific shortfalls:

- **Human dimensions staff**
- Recruiting post docs
- Other understaffed components
  - CPS & HMS
  - Seabirds
  - Marine mammals
  - MSE modeling
  - Data assimilation and visualization

CCIEA Trials

2) Variability of the California Current



May MEI value is the highest since February 2010.

May PDO value positive but trending down from the high in Dec. 2014.

May NPGO value is ~0, which is a large increase from the low in March 2015.

CCIEA Trials

3) Information overload

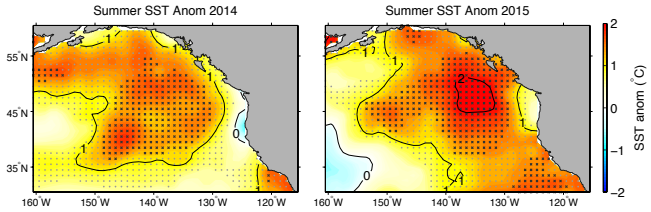
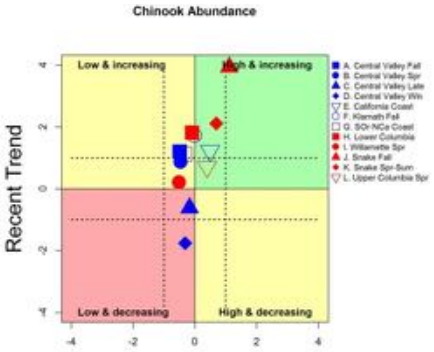
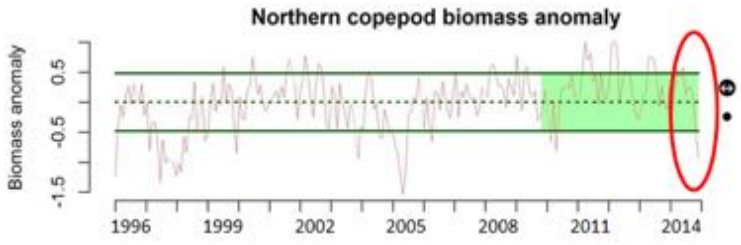
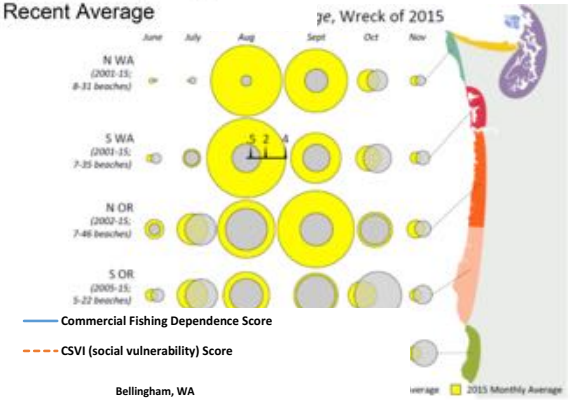
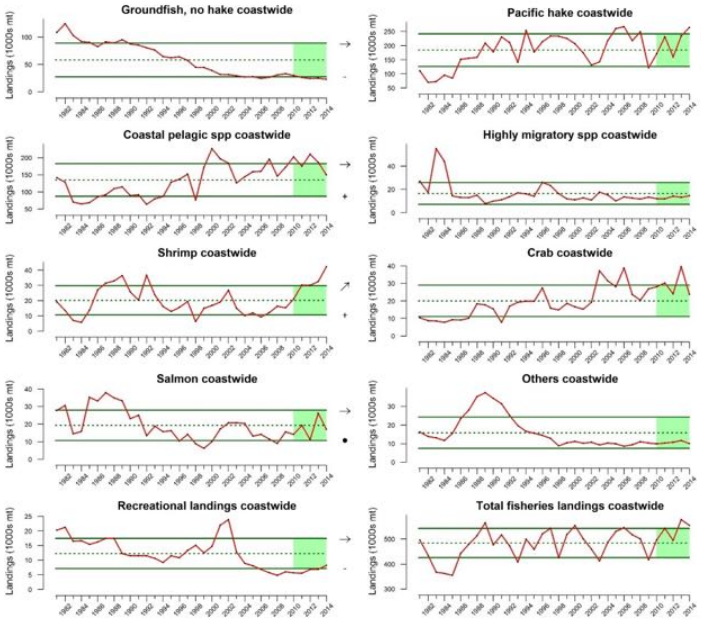


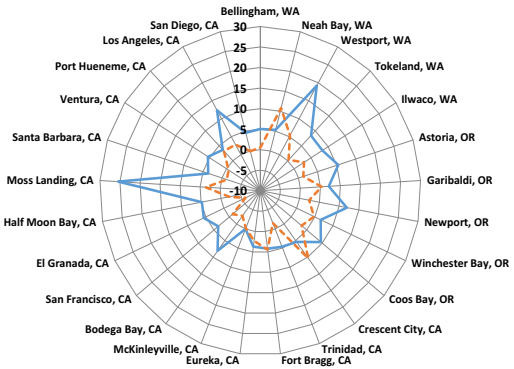
Figure 3.1.2: Sea surface temperature (SST) anomalies for the summer (Jun-Aug) of 2014 and 2015. The time series analyzed at each grid point started in 1982. The large warm anomaly in the upper center in 2014 is the "Warm Blob," with the southern anomaly off Baja California in the lower left. Gray circles mark grid cells where the anomaly was >1 s.d. above the long-term mean. Black x's mark grid cells where the anomaly was the highest of the time series.



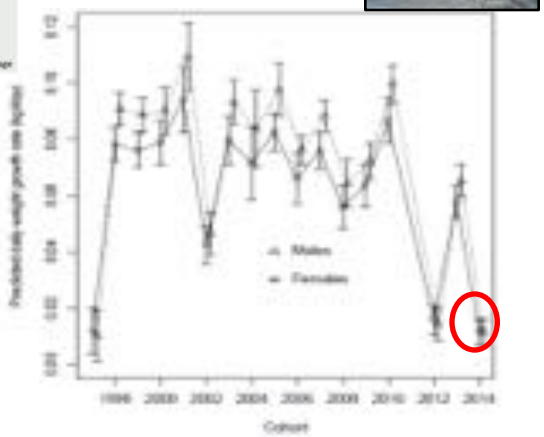








CA sea lion pup growth



CCIEA "Triumphs"

- First few ESRs to PFMC had frankly been pretty uninteresting
- Then came the March 2015 ESR: ***a clear narrative*** provided by the "Warm Blob"
- Potential effects of anomalous conditions, particularly on salmon, really got the Council's attention
- Aftermath:
  - Broad press coverage and attention
  - Briefings to Congressional staffers, senior NOAA & NMFS staff
  - **Increased Council and Regional Office interaction**
    - Ad hoc PFMC Ecosystem Working Group specifically focused on ESR
    - Working groups related to protected species

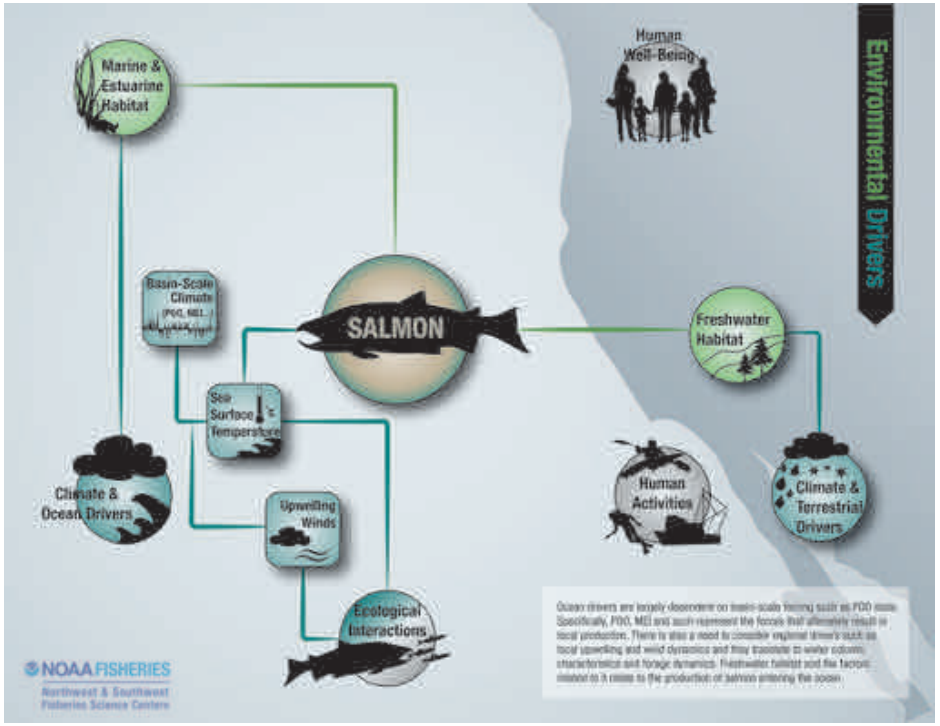
CCIEA "Triumphs"

- It's weird to say this, but this was an opportunity, and we seized it
  - Hopefully for the betterment of the science and the broader objectives

- Strong narrative

- Strong visuals

- Telling story ≥4 ways
  - Narrative
  - Conceptual model
  - Figures
  - Text



- Gradual introduction of integrated products

CCIEA
California Current Integrated Ecosystem Assessment

CCIEA online report

2013 >

Ecosystem Components (click title for more components)

Climate and Ocean Drivers

Trends and status of physical, chemical and climate indicators in the California Current system.

LEGEND

Indicator	Site	Monthly Trend	Monthly Status	Winter Trend	Winter Status	Summer Trend	Summer Status
Multivariate El Nino Index	basin-scale	↔	•	↔	•	↔	•
Northern Oscillation Index	basin-scale	↔	•	↗	•	↔	•
North Pacific Gyre Oscillation	basin-scale	↔	+	↔	•	↔	•
Pacific Decadal Oscillation	basin-scale	↔	•	↔	•	↔	•
Eddy Kinetic Energy	45N	↘	•	↔	•	↘	•
	39N	↔	•	↔	•	↔	•
	33N	↔	•	↔	•	↔	•
Upwelling Index	45N	↔	•	↔	•	↗	•
	39N	↔	•	↗	•	↗	•
	33N	↔	•	↔	•	↗	•
Sea Level Height	South Beach, OR	↔	•	↘	•	↔	•
	San Francisco	↔	•	↔	•	↔	•
	San Diego	↔	•	↔	•	↔	•
Sea Surface Temperature	NOAA Buoy 46050	↔	•	↔	•	↔	•
	NOAA Buoy 46014	↔	•	↘	•	↘	•
	NOAA Buoy 46025	↔	•	↔	•	↘	•
Meridional Winds	NOAA Buoy 46050	↔	•	↔	•	↔	•
	NOAA Buoy 46014	↔	•	↘	•	↘	•
	NOAA Buoy 46025	↔	•	↔	•	↘	•

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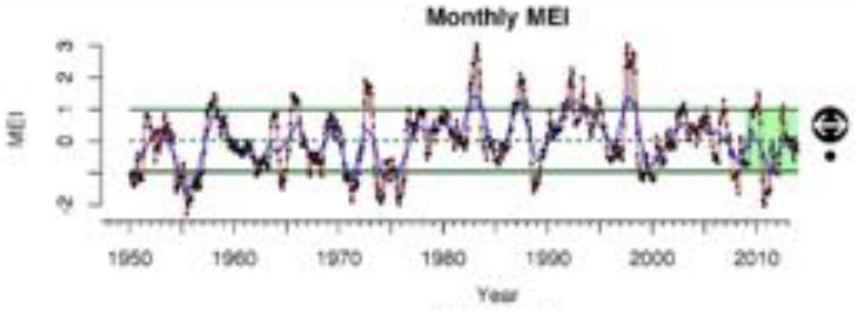

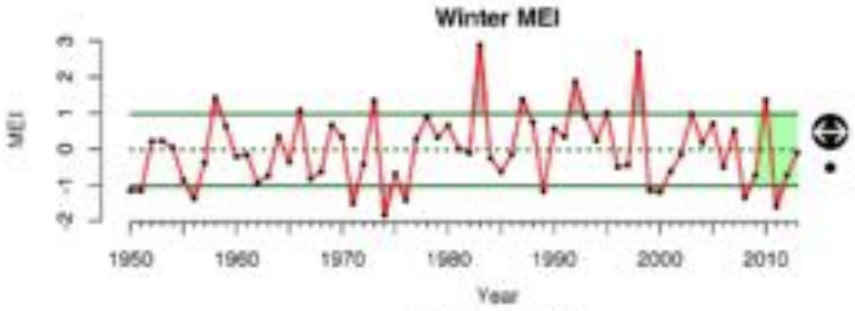

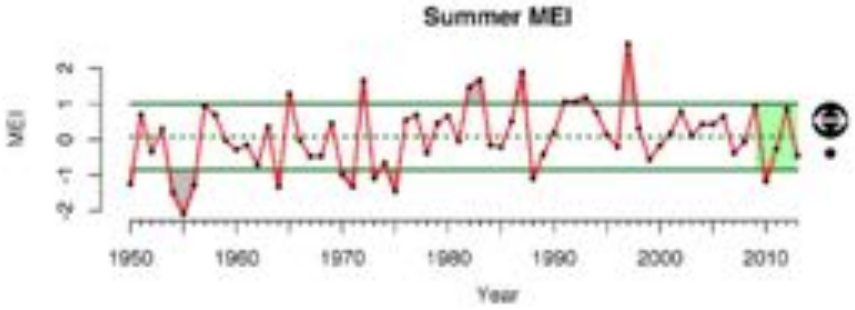

Multivariate El Nino Index

Monthly, winter and summer values of the Multivariate El Niño Index (MEI) from 1950-2013. The MEI describes El Niño and La Niña conditions that result from ocean-atmosphere coupling in the equatorial Pacific. An El Niño event has varying influences on the CCLME, but usually they are associated with warmer surface water temperatures and weaker upwelling winds. Positive values of the MEI represent El Niño conditions while negative values represent La Niña conditions. Monthly values are included to show seasonal cycles and a continuous time series, and the blue line shows a running annual average.

Implications

The summer of 2012 saw higher values of the MEI, with average to low values of the MEI in the following summer and winters of 2013. Based on these recent MEI values, 2013 was not an El Niño year, which is supported by the relatively lower SSTs also observed during 2013.

CCIEA web plotting

What's Next

- We are still working on how to formally "use" the ESR in decision-support
- We need to better define PFMC goals and targets related to EBM
  - i.e., the thing we were supposed to start with!
  - Conversations with managers, stakeholders in Council, Regional Office, Sanctuaries, States, Tribes, Industries, experts in other fields and marine ecosystem uses
  - Companion analyses on where ecosystem thresholds might exist, to provide some context for goal/target setting
- The Council's Fishery Ecosystem Plan (FEP) will likely be the mechanism through which this iterative process takes place

What's Next

- The "I" in "IEA"
  - Integrative products—products that are more than the sum of the parts
  - Balancing these integrative products with the indicators that the Council wants to see
- Supporting Sanctuaries
  - Their 5-yr Condition Reports are essentially ESRs at the Sanctuary scale
  - Condition Reports are historically qualitative in nature
  - Moving toward quantitative, indicator-driven format
- But we are spread pretty thin...

Room for improvement?

- EBM in the California Current is a science priority (reinforced by CVA, EBFM Road Map, etc.)
- Both Centers support this in principle
- However, ESR in support of EBFM, EBM could be improved by more strategic research planning
  - NWFSC has more institutional buy-in, particularly in ecological and socioeconomic areas
  - Both Centers have been slow to take up IEA-related work in performance plans

Page 16 of the NWFSC Strategic Science Plan, 2013

Summary

- California Current ESR is presently a 1x/yr written doc and presentation from climate/physical drivers up to socioeconomics that is intended to provide an ecosystem status backdrop to the PFMC, for assistance in decision-making

- IEA ESR continues to try to bring responsive science to address stakeholder needs. This includes environmental drivers of sablefish recruitment, ecosystem impacts of the "blob," spatially-explicit risk analyses through dynamic ocean management.

- Complications include inherent variability and complexity of system, and levels of resource commitment

- Progress will be made through tailored, web-based ESRs and more effective scoping with end-users (ESR workshop)

2017 CALIFORNIA CURRENT ECOSYSTEM STATUS REPORT

DELIVERED TO THE PACIFIC FISHERY MANAGEMENT COUNCIL, MARCH 8, 2017, VANCOUVER, WA

NOAA California Current IEA Team

SUMMARY

- **Climate drivers rebounding from the major warm events**
  - One of the largest El Niño events of the past 100 years occurred in 2015-2016; yet its impacts on the West Coast were remarkably small
  - Following the climate "stress test" of very warm water, the El Niño and low productivity, most of the large-scale climate indices for the Northeast Pacific (ONI, PDO and NPGO) returned to relatively neutral values in 2016
  - Upwelling in 2016 ranged from average (north) to above-average (south)
  - Precipitation increased from record lows and drought in 2015 to average levels last year; on pace for even greater rainfall and snowpack in 2016-2017

SUMMARY, CONTINUED

- **Ecology of the system lagging behind climate shifts**
  - Copepods off of Newport remain dominated by energy-poor species
  - Forage community was diverse (again) in 2016. Poor survey catches of sardine, squid, krill; large but patchy survey catches of juvenile rockfish, juvenile hake, anchovy
  - We remain concerned about environmental conditions for Chinook and coho salmon that went to sea over the past several years
  - California sea lions at San Miguel had poor foraging conditions in 2015; preliminary evidence suggests improvements in 2016
- **Changes in fisheries**
  - Commercial landings and revenues declined markedly in 2015, driven by hake, CPS, crabs*
  - Recreational removals have been near historic lows, but show signs of increasing in some areas and target species since 2008
  - Gear contact with seafloor in 2015 was historically low, due to reduced bottom trawling