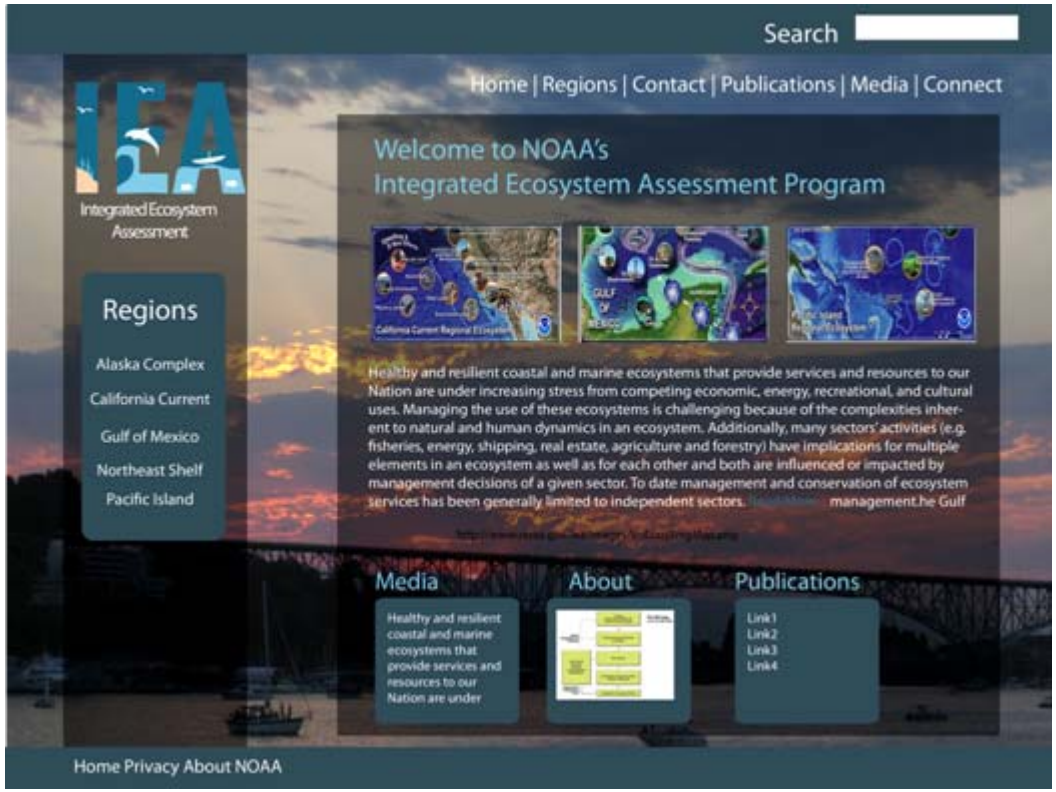
Ecosystem Indicators for the California current: A quantitative approach

PICES – W1

Hiroshima, Japan

12 October 2012

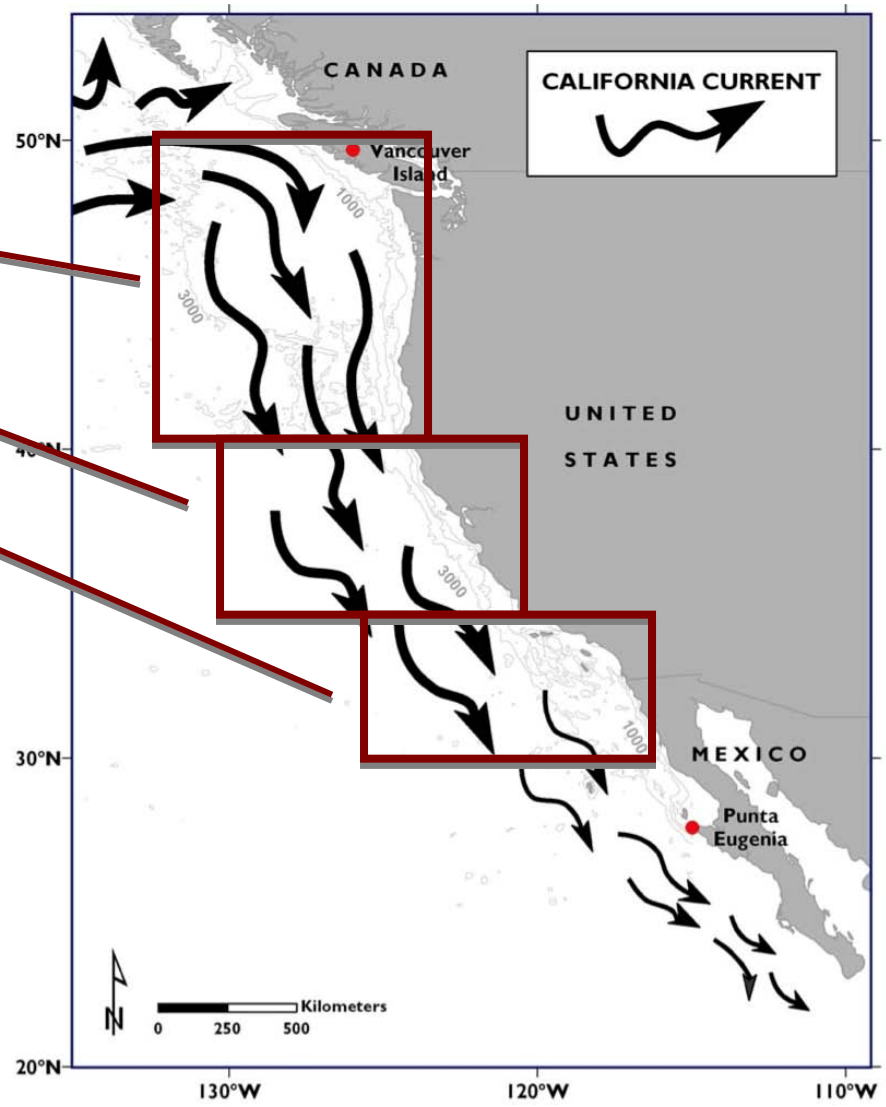
9:00 am – 6:00 pm



Elliott L. Hazen, Jameal F. Samhouri, Isaac D. Schroeder, Brian K. Wells, Steven J. Bograd, David G. Foley, Nick Tolmieri, Phillip S. Levin, Greg Williams, Kelly Andrews, Sam McClatchie, William T. Peterson, Jay Peterson, John C. Field, Ric Brodeur and Kurt Fresh

California Current Ecosystem

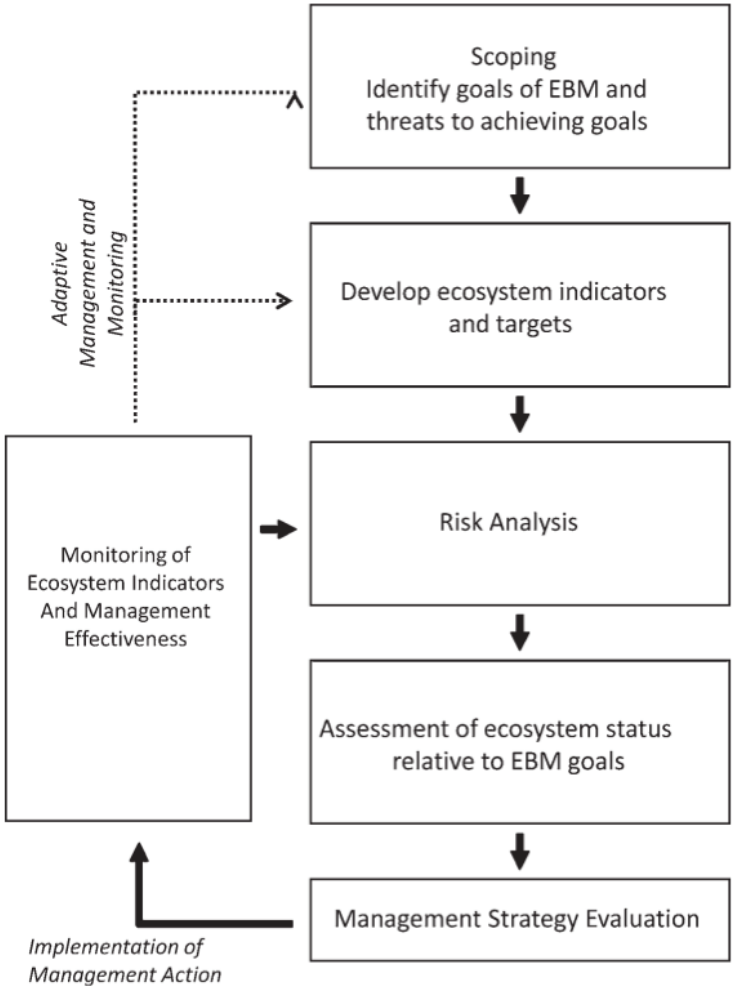
- Three regions
  - Northern
  - Central
  - Southern
- Dominated by bottom-up forcing e.g. upwelling processes



What is an Integrated Ecosystem Assessment?

- a framework for organizing science in order to inform decisions in marine EBM at multiple scales and across sectors.
- "IEA as a formal synthesis and quantitative analysis of information on relevant natural and socioeconomic factors, in relation to specified ecosystem management objectives. It is an incremental approach, in which integrated scientific understanding feeds into management choices and receives feedback from changing ecosystem objectives."

  Levin et al. 2009



Levin et al. 2009

Translating the IEA

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Policy Question	IEA Step
What does a healthy ecosystem look like?	Objectives, indicators / targets
What is the health of the ecosystem?	Current status, risk assessment
What action should be considered?	Generate alternative management options
Where should we start?	Management strategy evaluation

Key attribute

Indicator

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- *Key attributes* are the characteristics that define the structure, composition, and function of focal ecosystem components
  - Harwell, M. A., V. Myers, et al. (1999). "A framework for an ecosystem integrity report card." Bioscience **49**(7): 543-556.

- *Quantitative measurements that serve as proxies for characterizing key attributes of natural and socioeconomic systems*
  - Heinz Center (2008). The State of the Nation's Ecosystems 2008: Measuring the Lands, Waters, and Living Resources of the United States, Island Press.

Indicator Selection Criteria

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Primary considerations	Data Considerations	Other
Theoretically sound	Concrete	Understood by public & policy makers
Relevant to management goals	Historical data available	History of reporting
Responds to changes in attributes	Operationally simple	Cost-effective
Responds to changes in management actions	Numerical	Anticipatory or leading indicator
Linkable to management reference points	Spatial and temporal variation understood	Nationally /internationally compatible
	High signal-to-noise ratio	

Indicator concerns

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- What are the goal(s)?
  - E.g. indicators that describe a unique portion of the ecosystem or those that describe the ecosystem as a whole?
- Methods for gaps in data & disparate time series
- There are multiple indicator selection / analysis methods – how do you select the best?
  - Detect trends e.g. regression analyses
  - Redundancy among indicators
  - Expert opinion

Selection criteria

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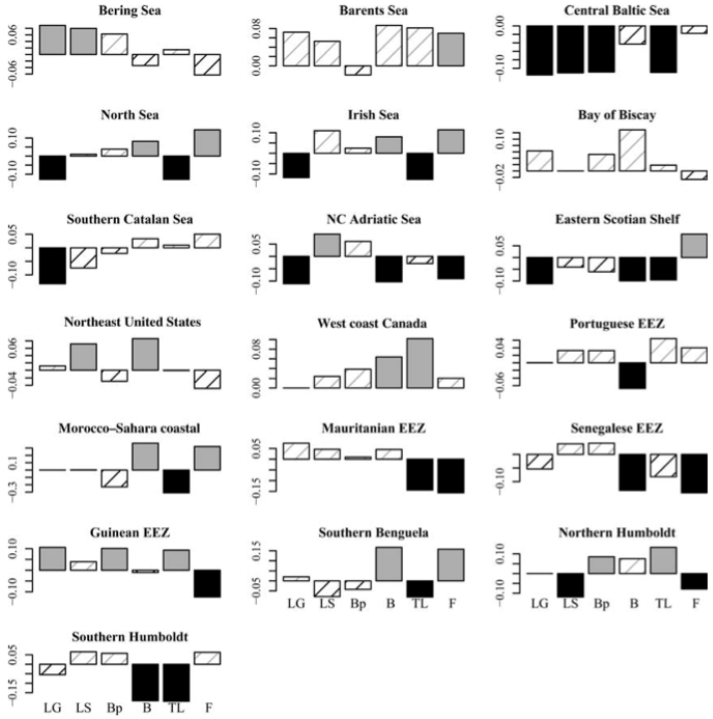
- Many successful examples exist:
  - Indiseas (e.g. Blanchard et al. 2011)

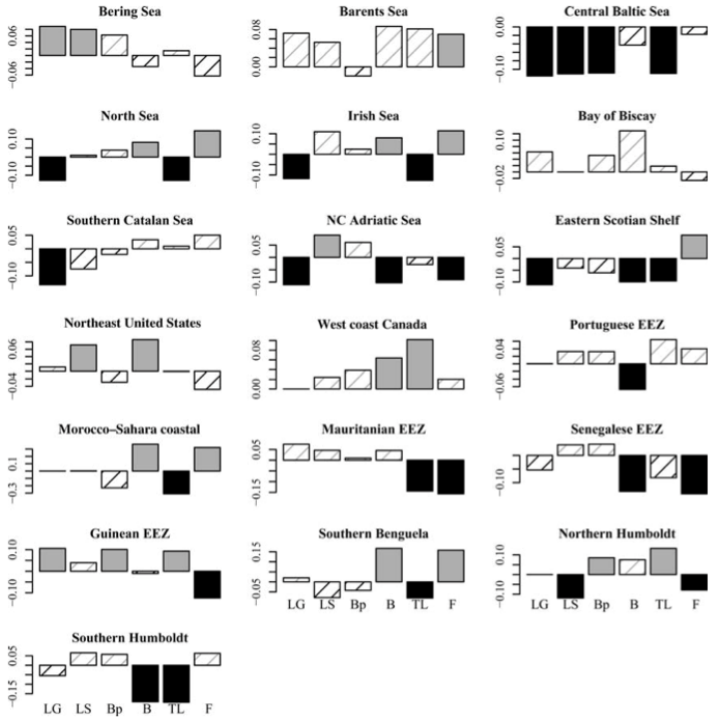
Trends:



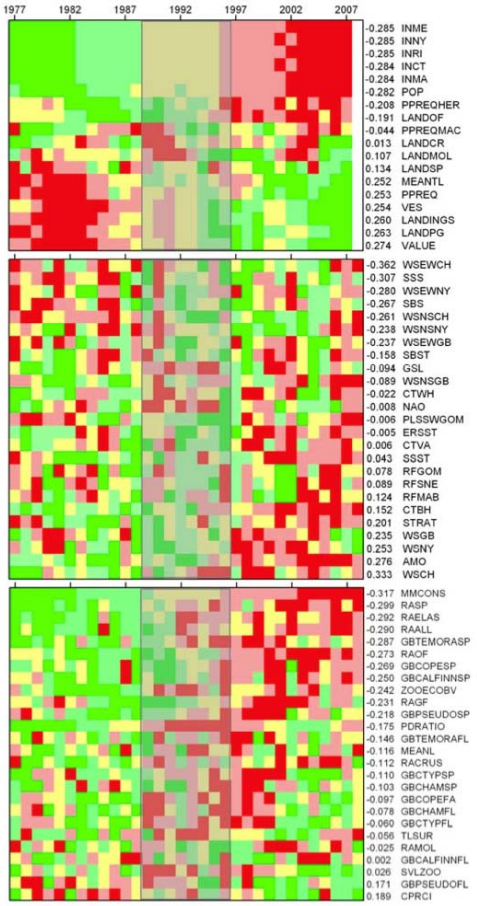
Selection criteria

- Many successful examples exist:
  - Indiseas (e.g. Blanchard et al. 2011)
  - NEFSC Ecosystem Status Report

Trends:



Eigenvalues:



IEA Approach

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- Aggregate and normalize data
  - Pressures, Coastal Pelagics, Salmon
- Interpolate gaps using 5-year moving window
- Explore orthogonality and interconnectedness of both trends and variability
  - Principle Component Analyses for each grouping to identify unique trends
  - Cross Correlation Functions to examine indicator ecosystem applicability (similar goal to Mutual-information analysis)

Time Series Data

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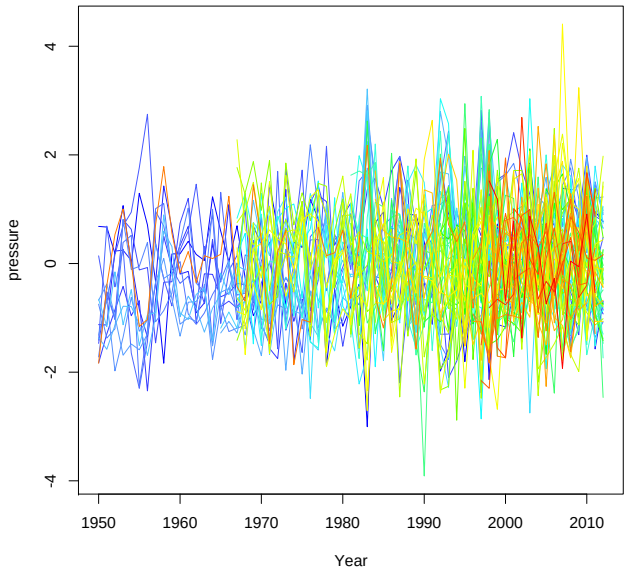
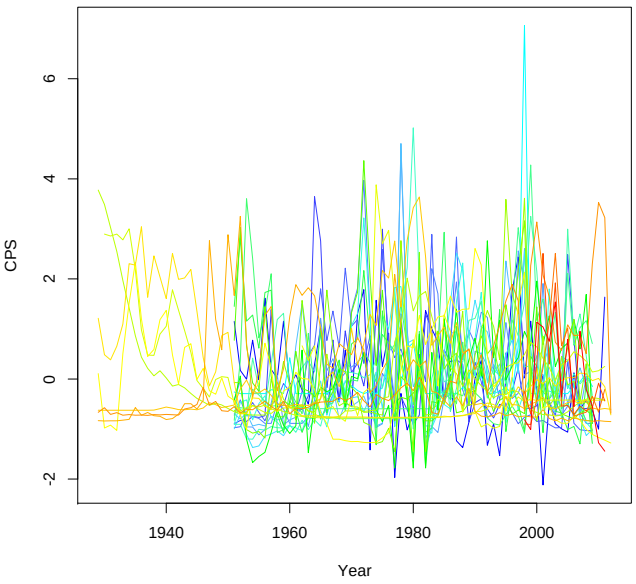
Pressures



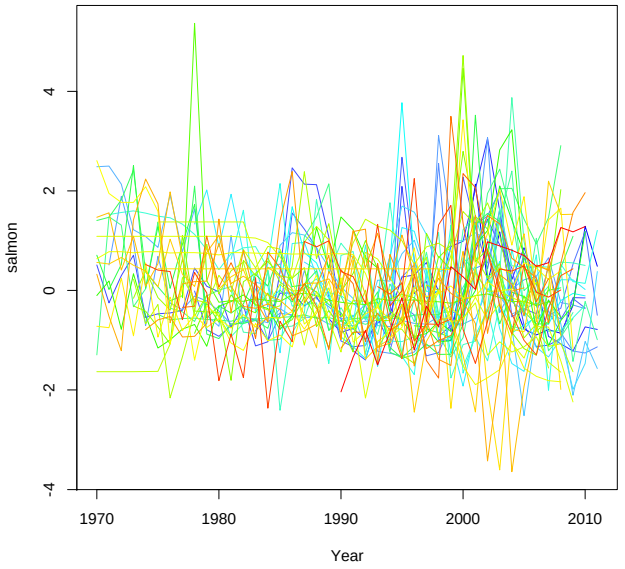
E.g. Broad scale indices, Satellite Measurements, Buoy data

Coastal Pelagics

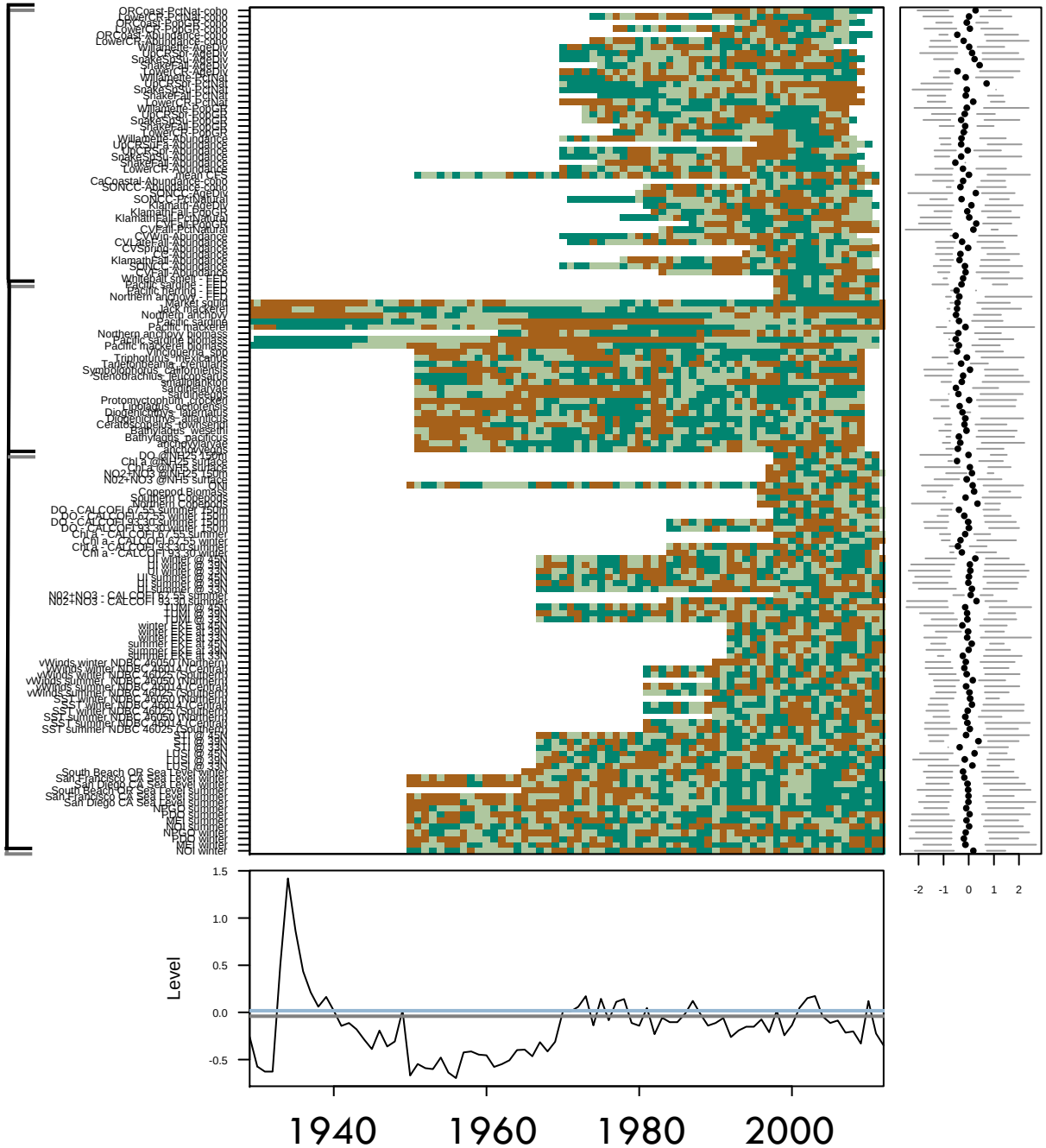


E.g. Landings data, Fisheries Surveys

Salmon Species



E.g. Fisheries Surveys, Hatchery v. Wild, Run Returns



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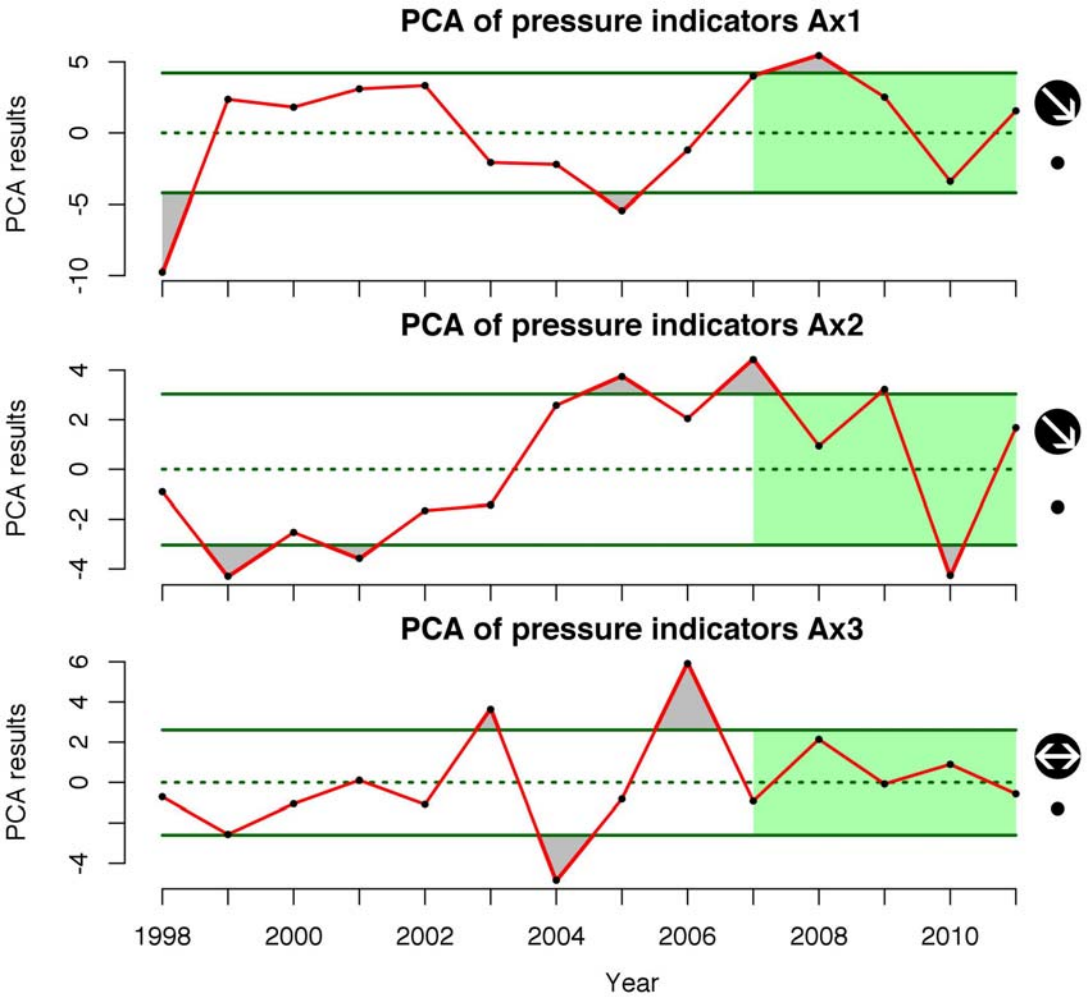
PCA for pressures



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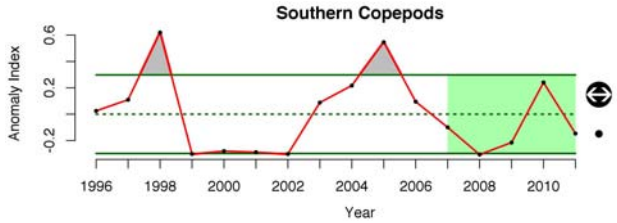

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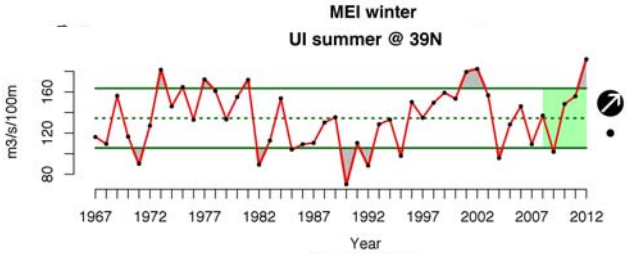
0.141



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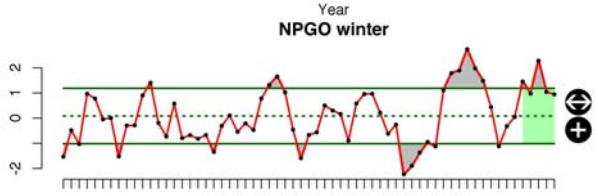

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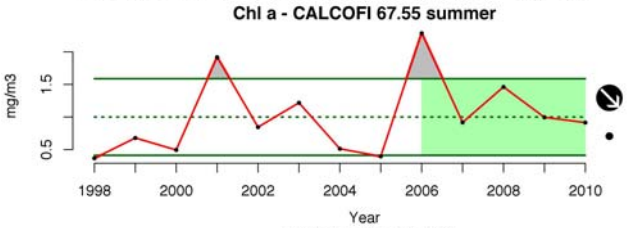

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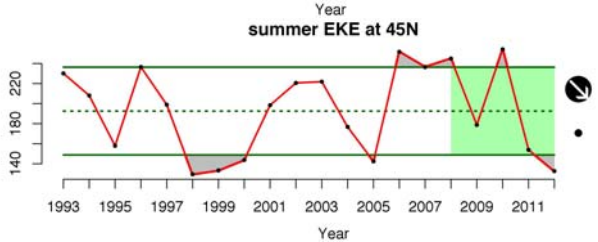

PCA for CPS

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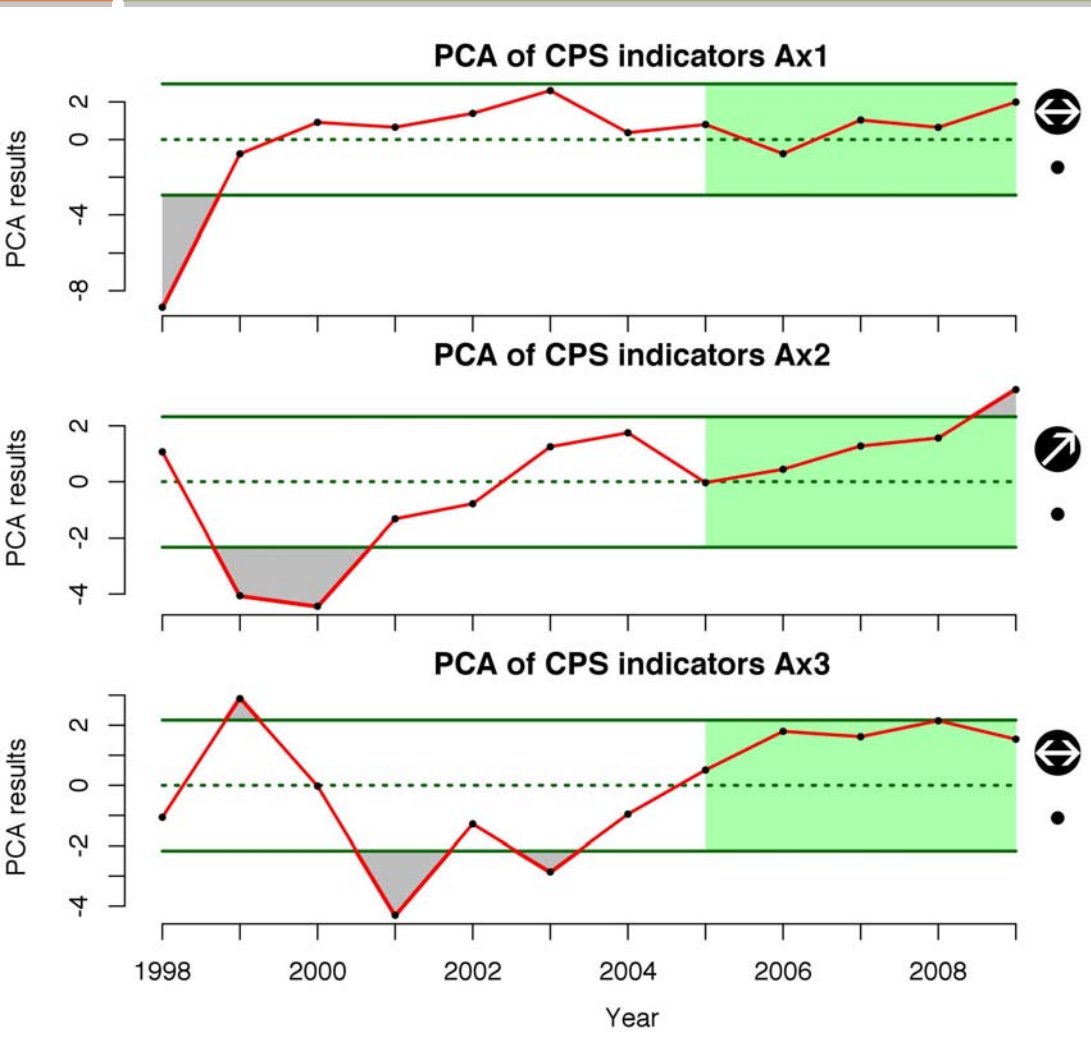
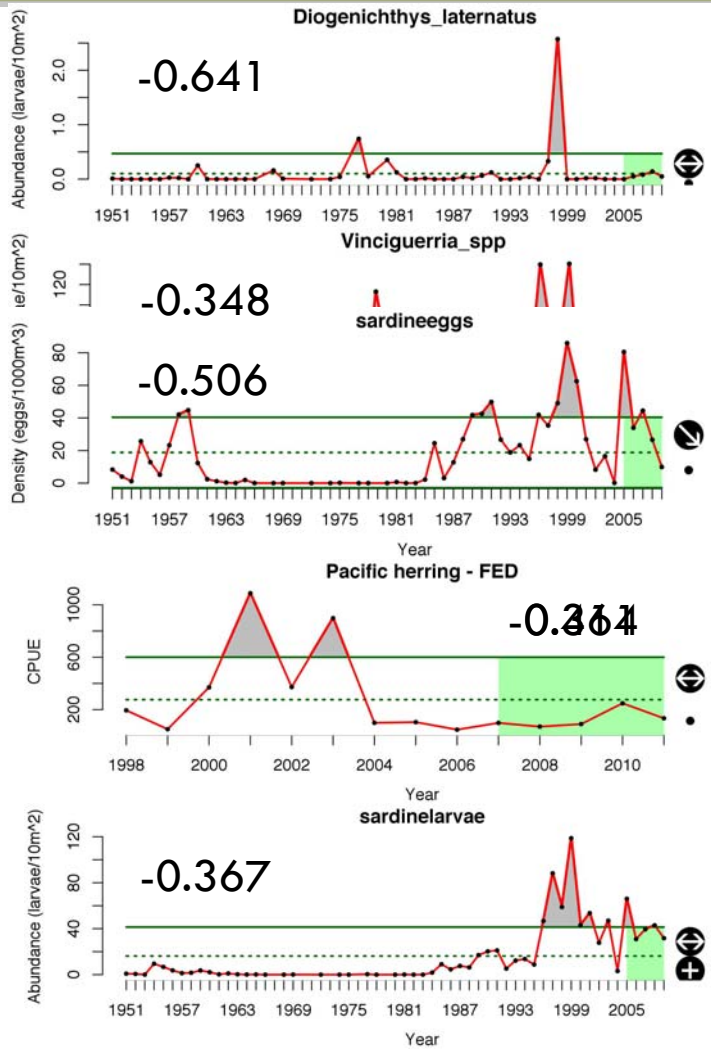
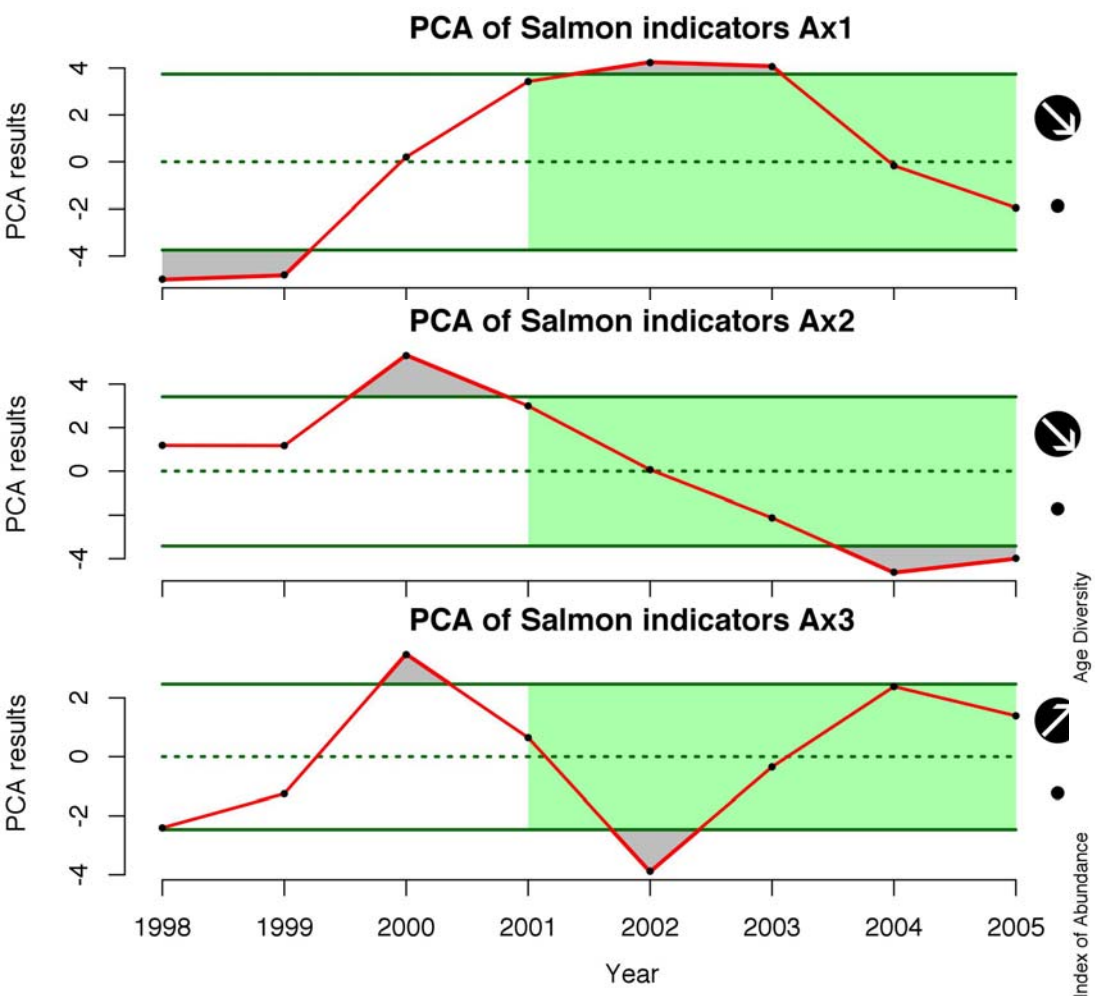
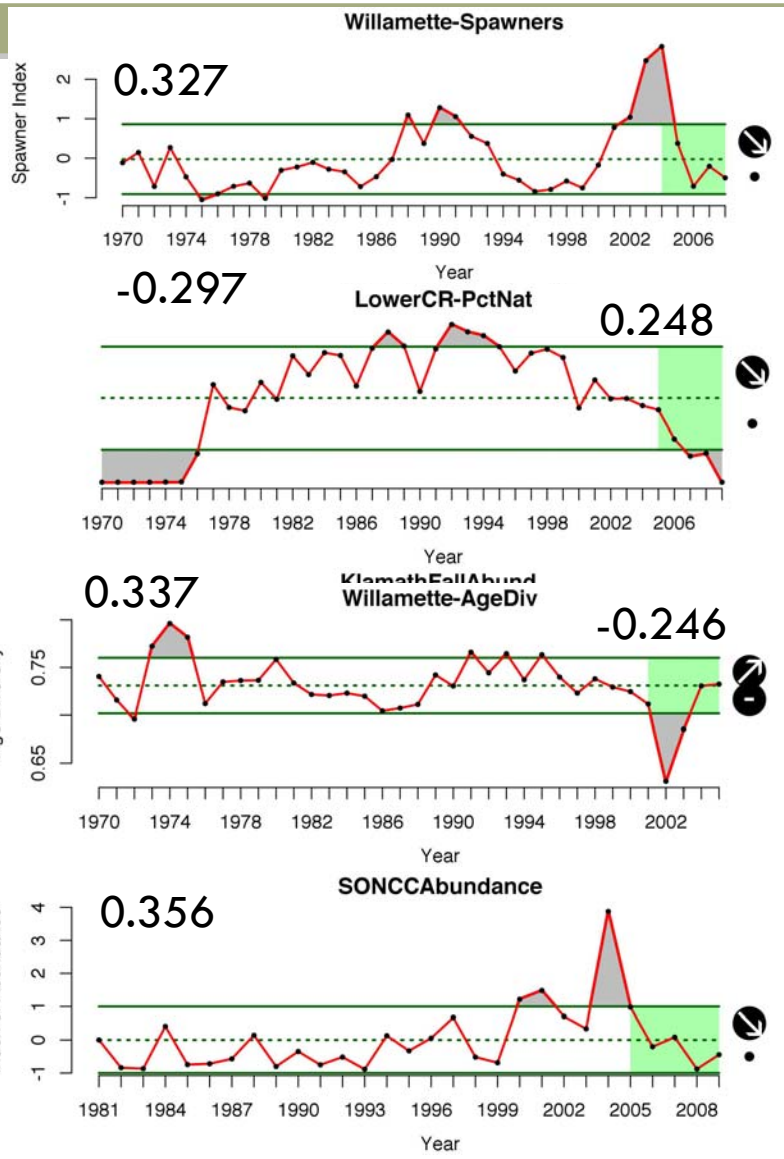




PCA for Salmon





Cross Correlations

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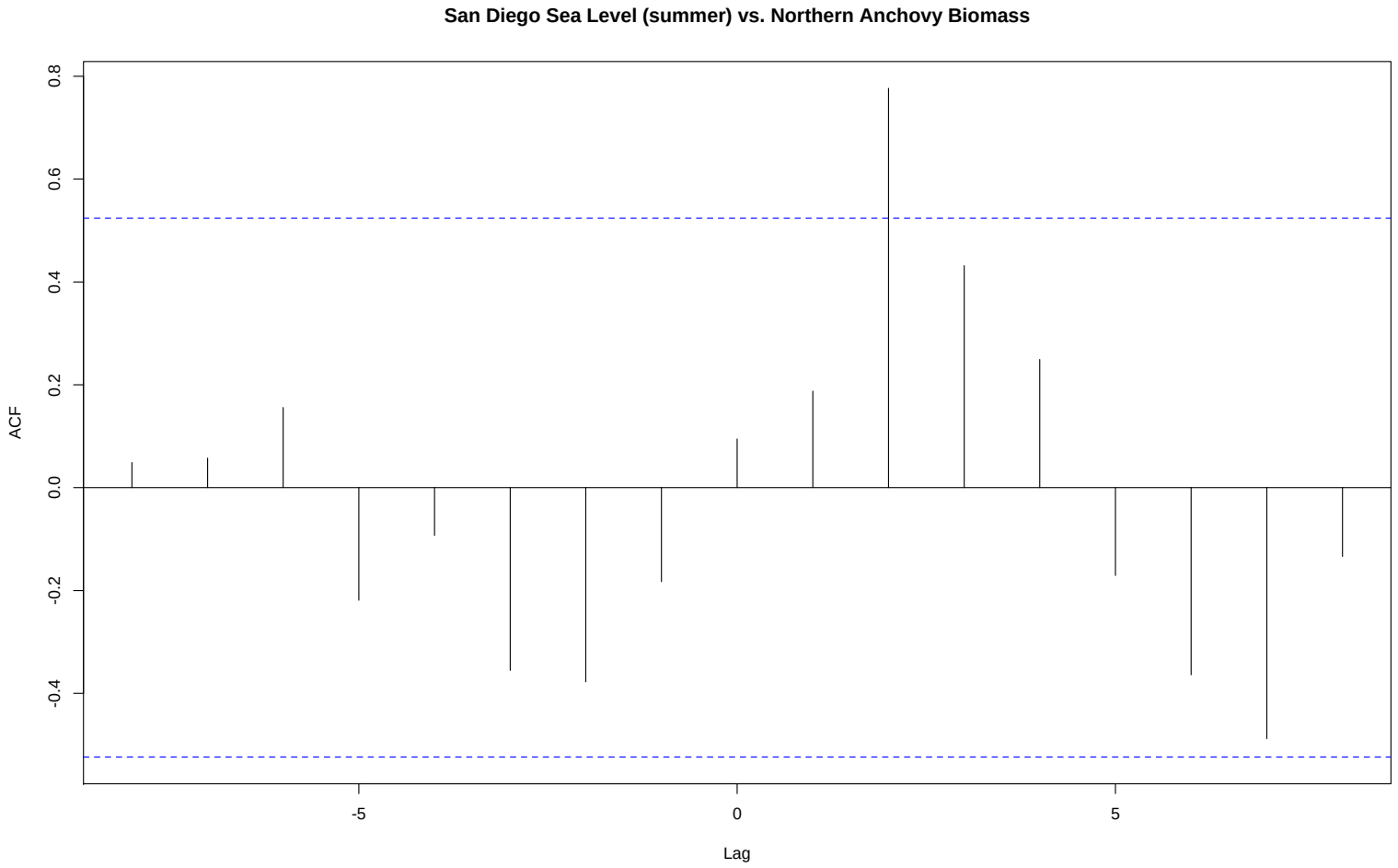

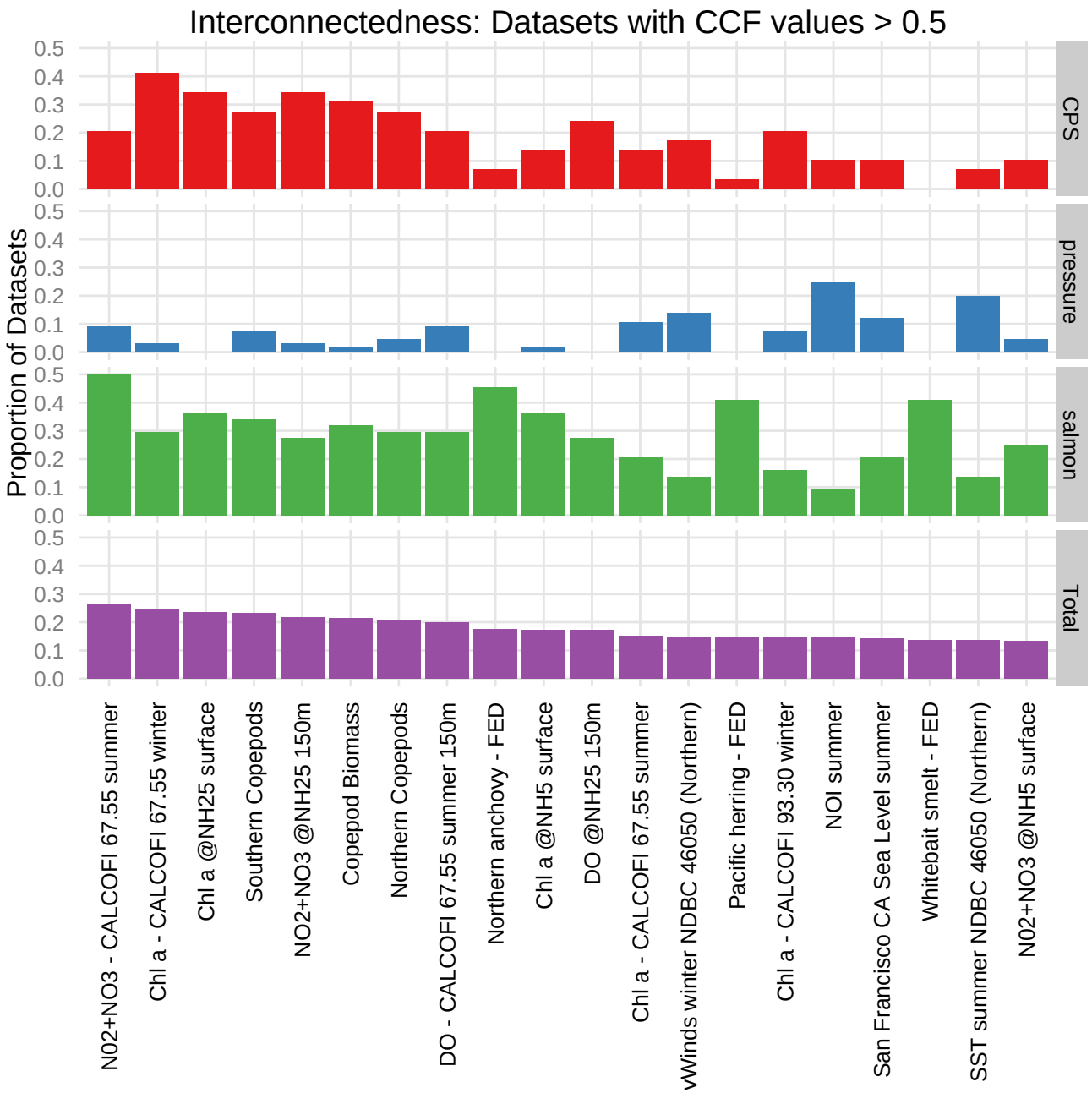

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To do

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- Additional datasets (fisheries, cruise data)
- Spatial separation and patterning (spatial correlations)
- Examine additional selection criteria
- Compare multiple approaches