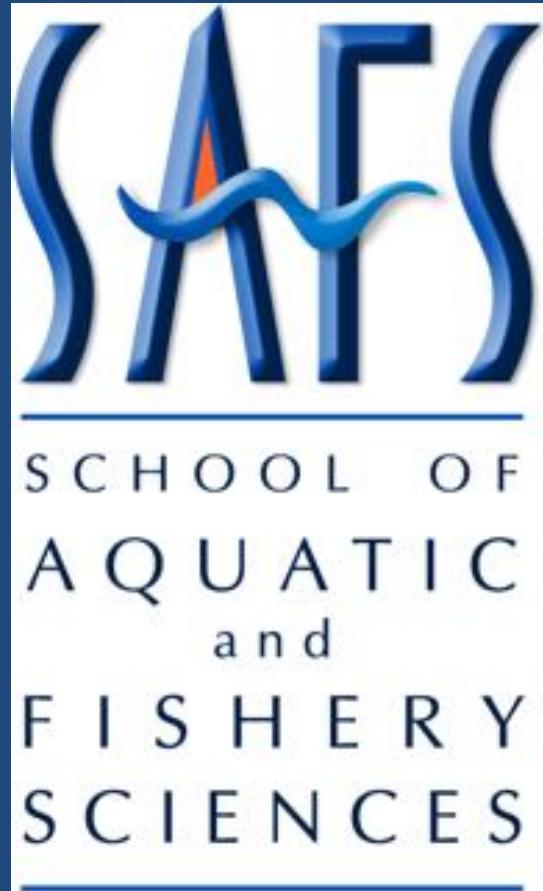


Linking Northeast Pacific recruitment synchrony to environmental variability

Megan Stachura, Tim Essington, Nate
Mantua, Anne Hollowed, Melissa
Haltuch, Paul Spencer, Trevor Branch,
and Miriam Doyle

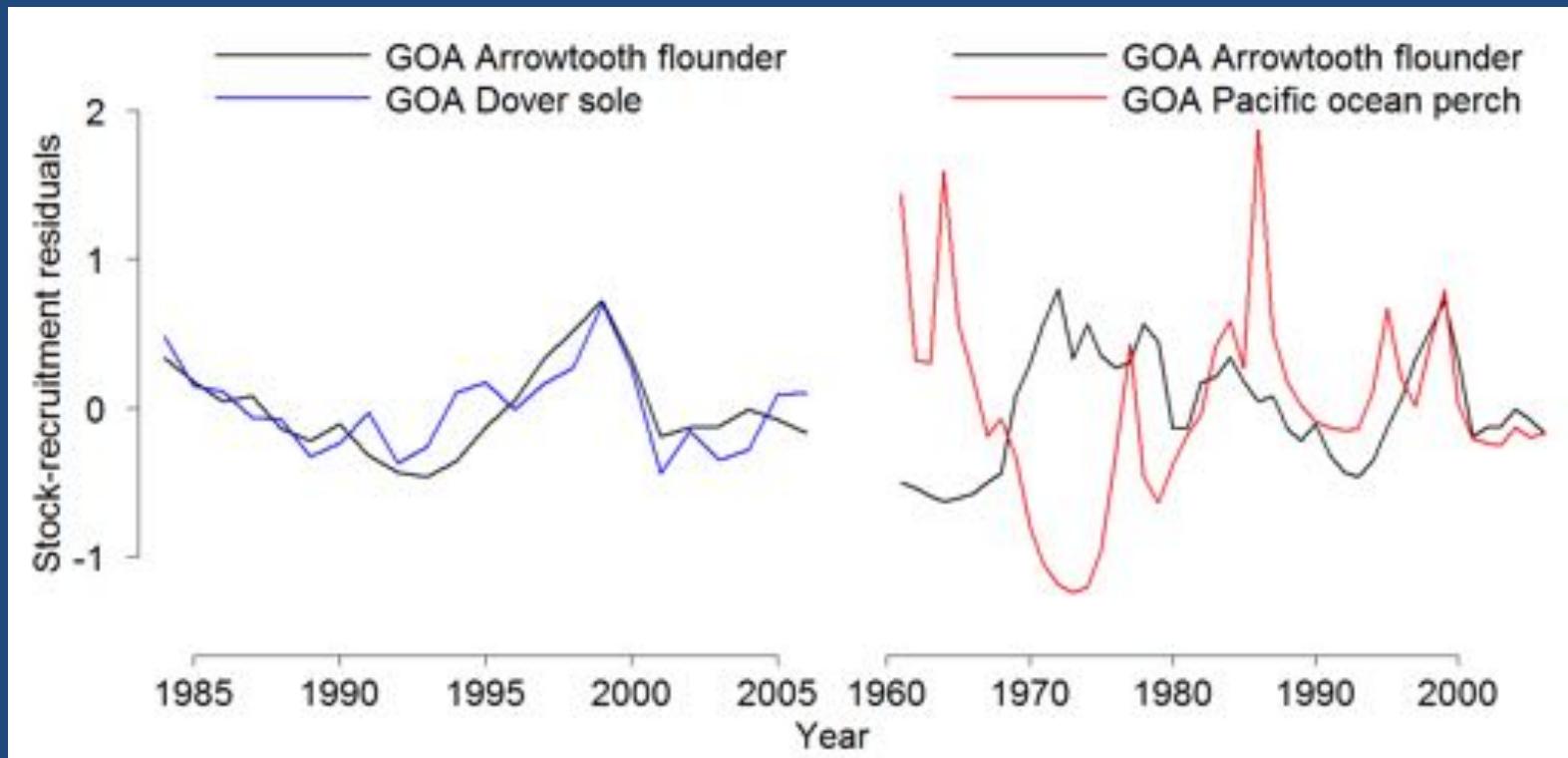


Fisheries and the
Environment (FATE)



Recruitment Synchrony

- Synchrony in Northeast Pacific marine fish recruitment (Hollowed et al., 1987; Mueter et al., 2007)
- Ecosystem-wide associations between environmental and biological variability (Hare and Mantua, 2000)



Hypothesis

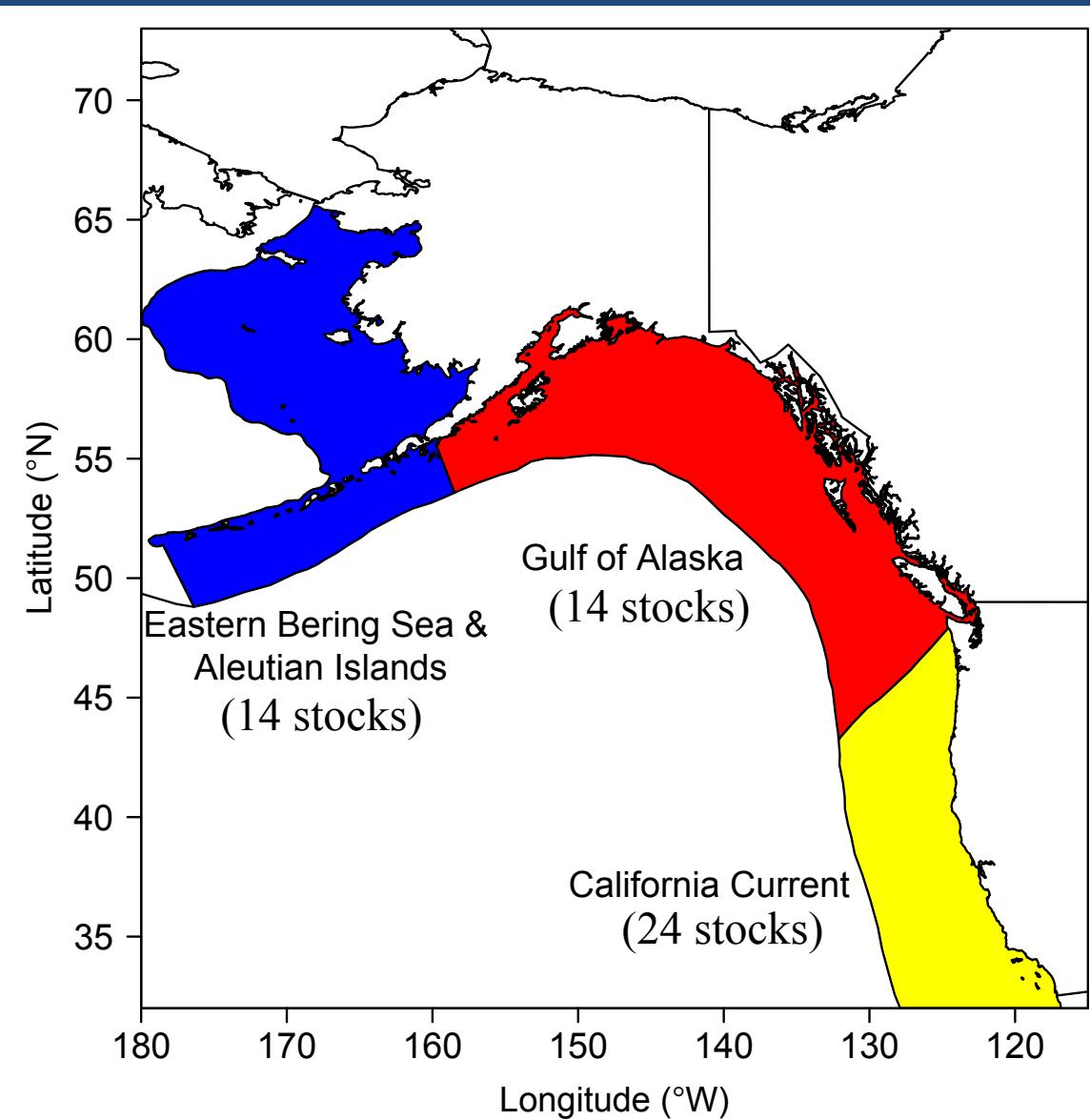
Synchronous production dynamics of stocks within ecosystems are due to *shared sensitivity to common environmental drivers*



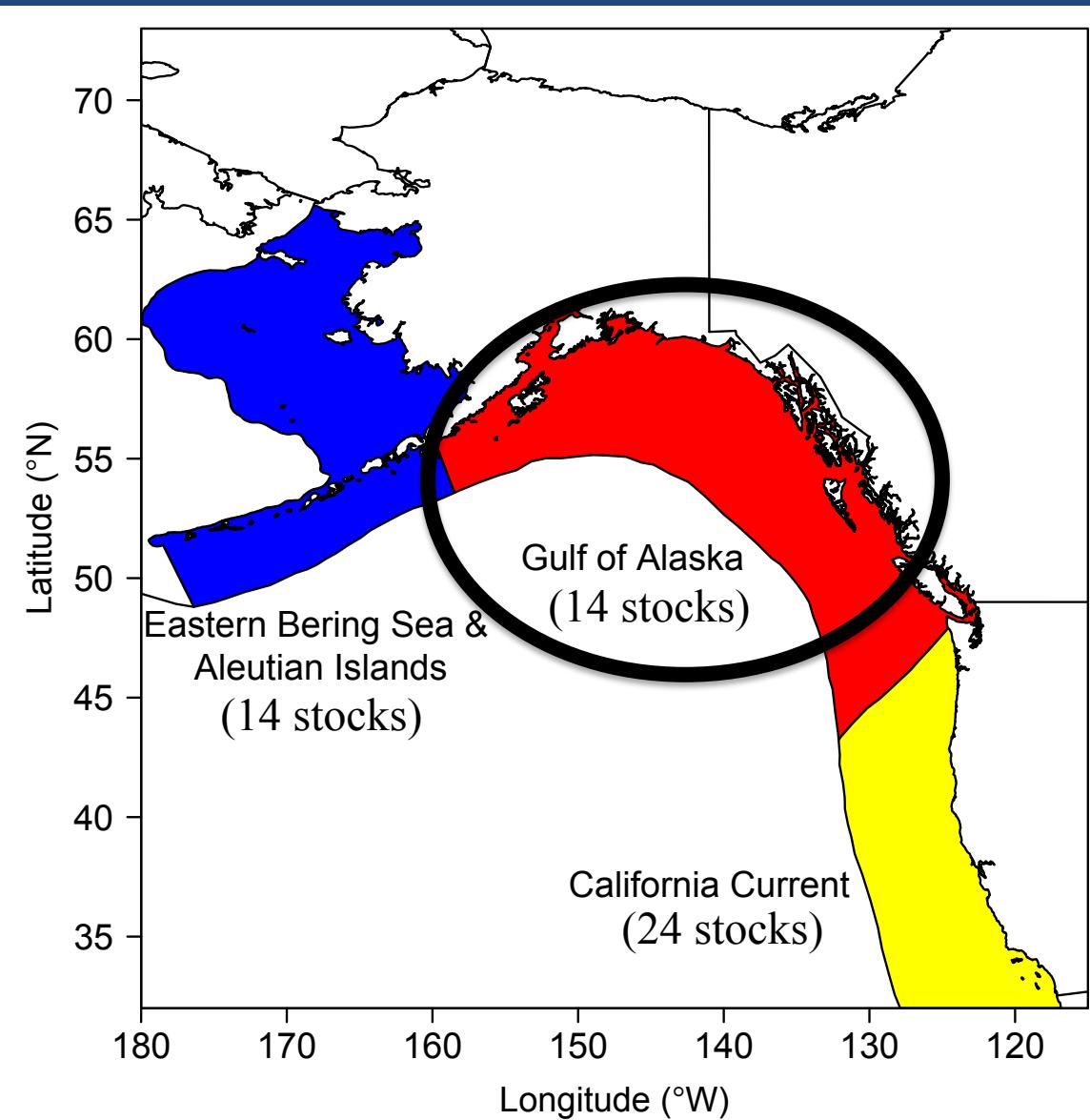
Approach

1. Evaluate recruitment synchrony within ecosystems
2. Identify stocks with similar susceptibility to environmental processes
3. Identify important environmental processes
4. Hierarchical modeling

Recruitment Data

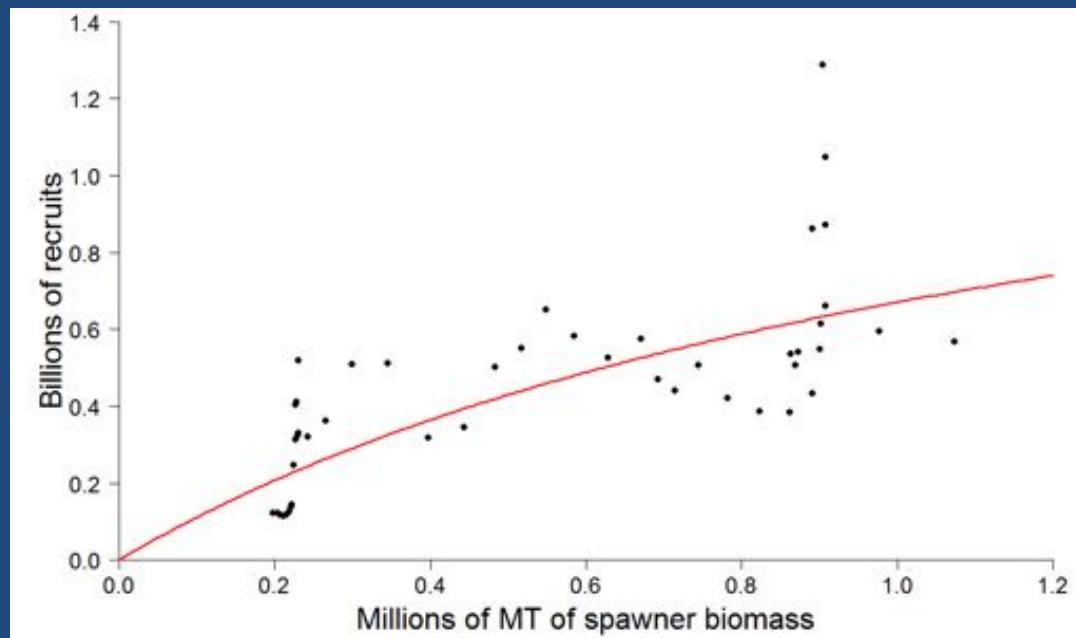


Recruitment Data



Recruitment Data

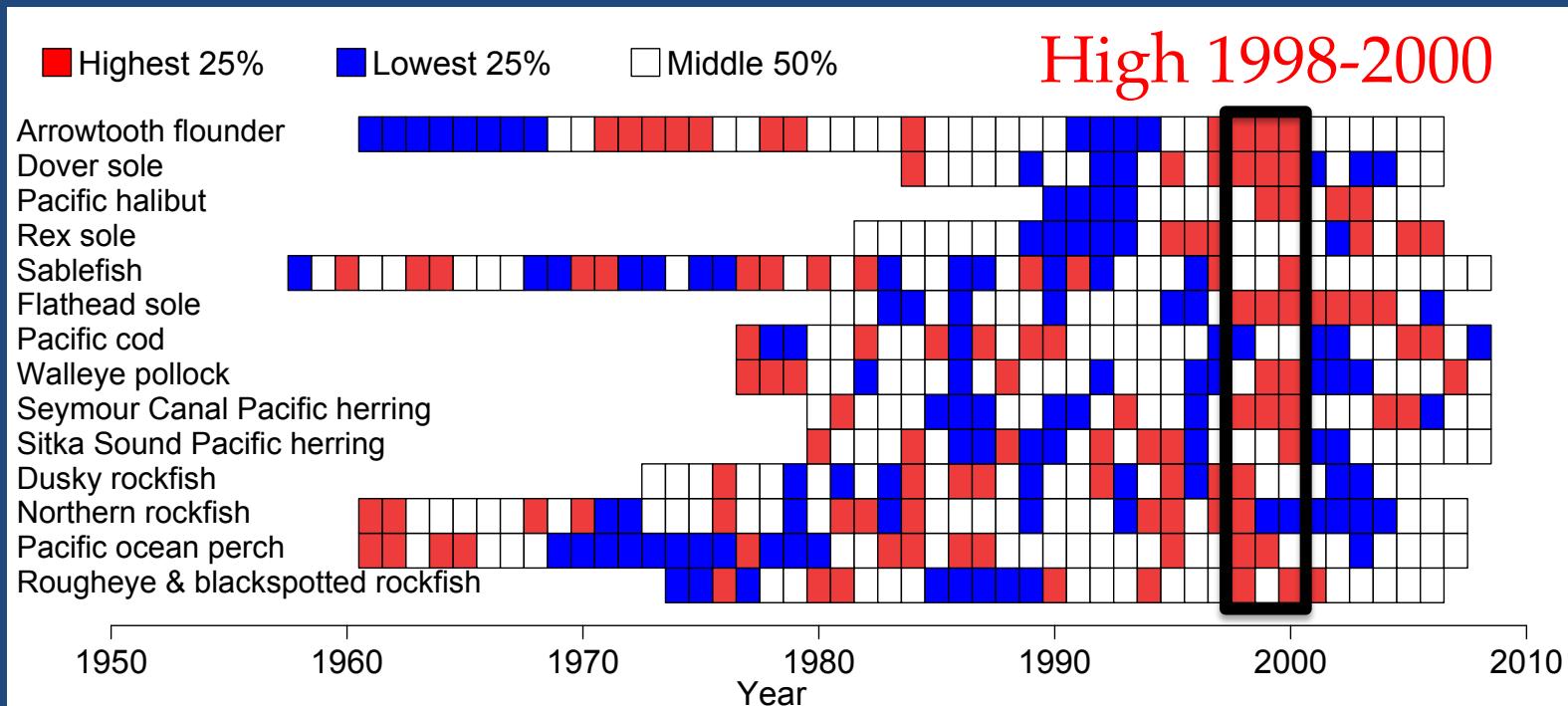
- Removed effects of spawner biomass
- Used stock-recruitment residuals for all analyses



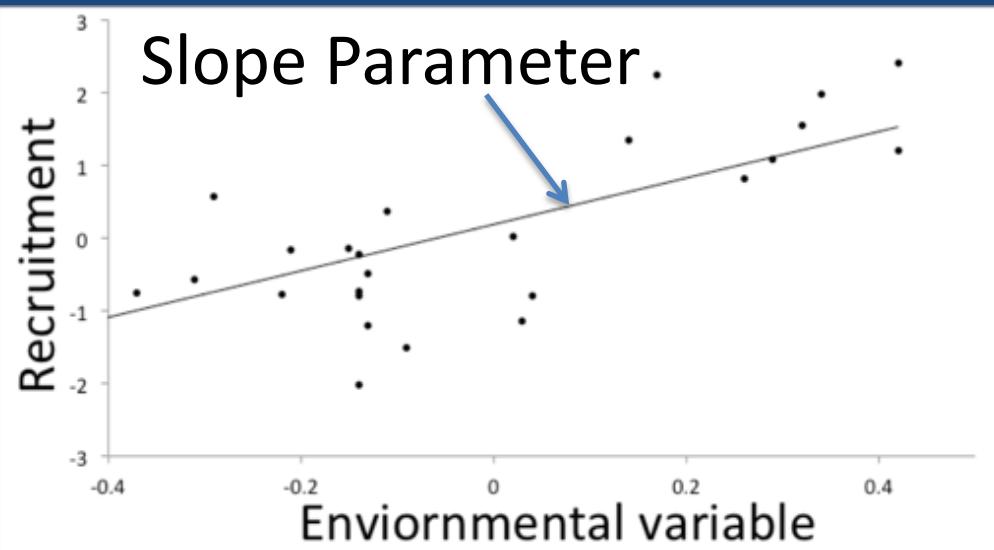
GOA arrowtooth flounder Beverton-Holt model fit

Recruitment Synchrony

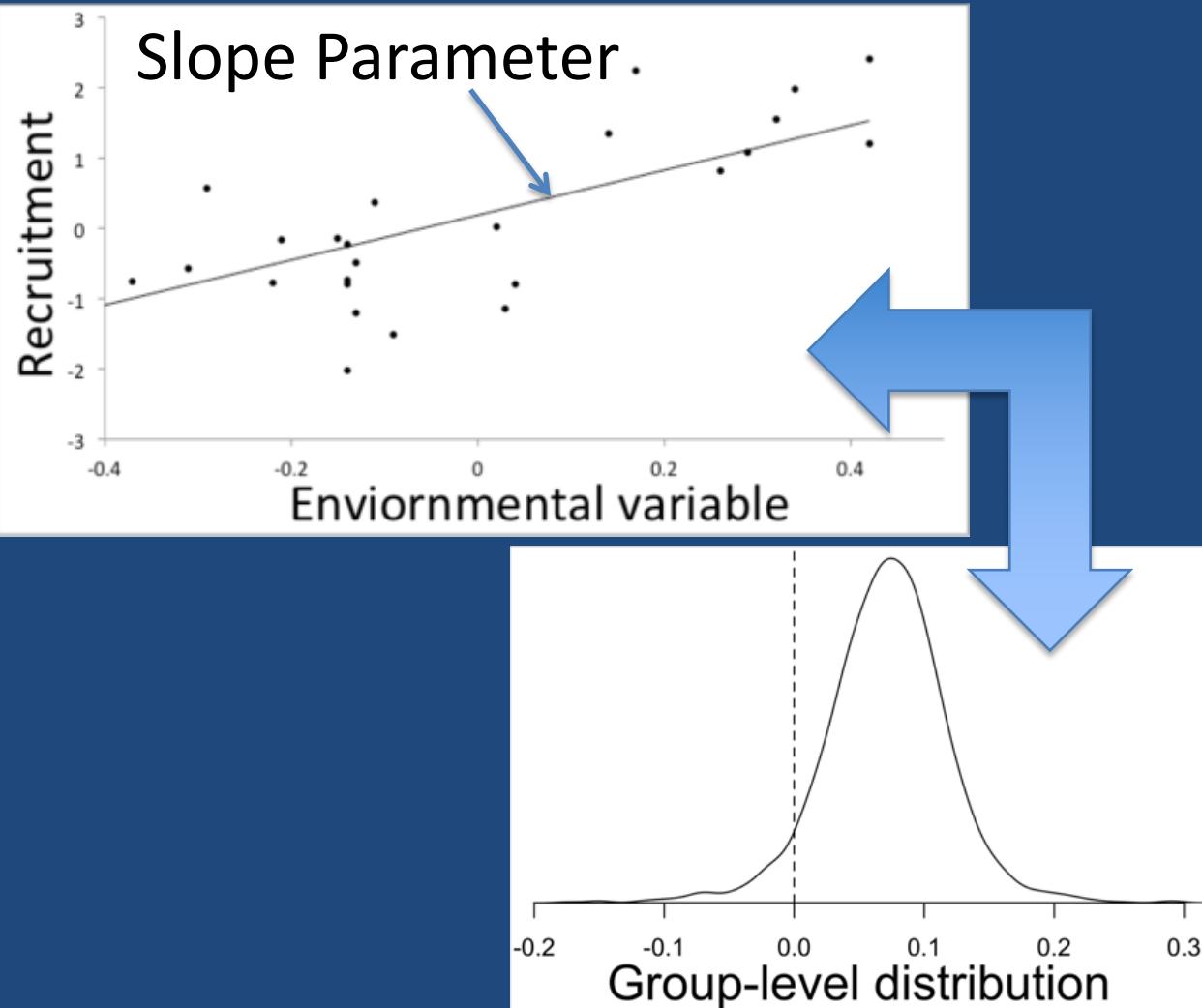
- Synchrony in extreme recruitment events
- Correlation in recruitment between stocks



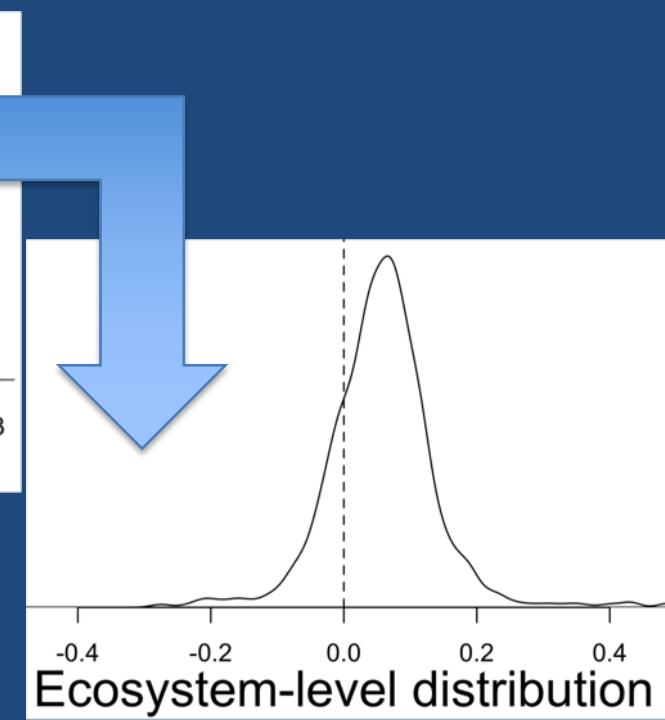
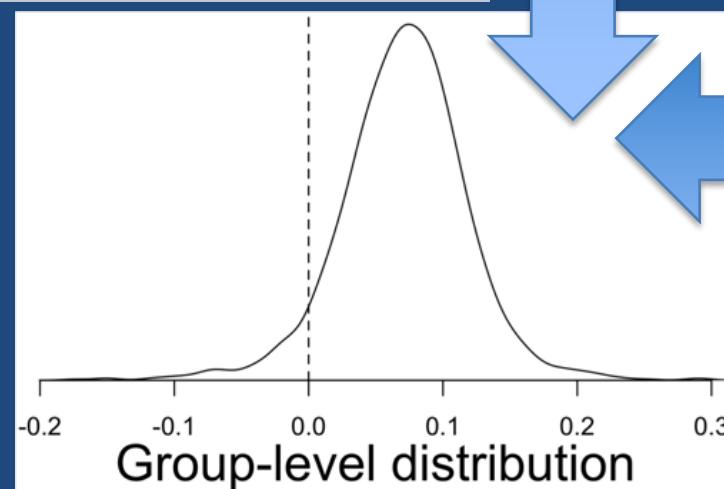
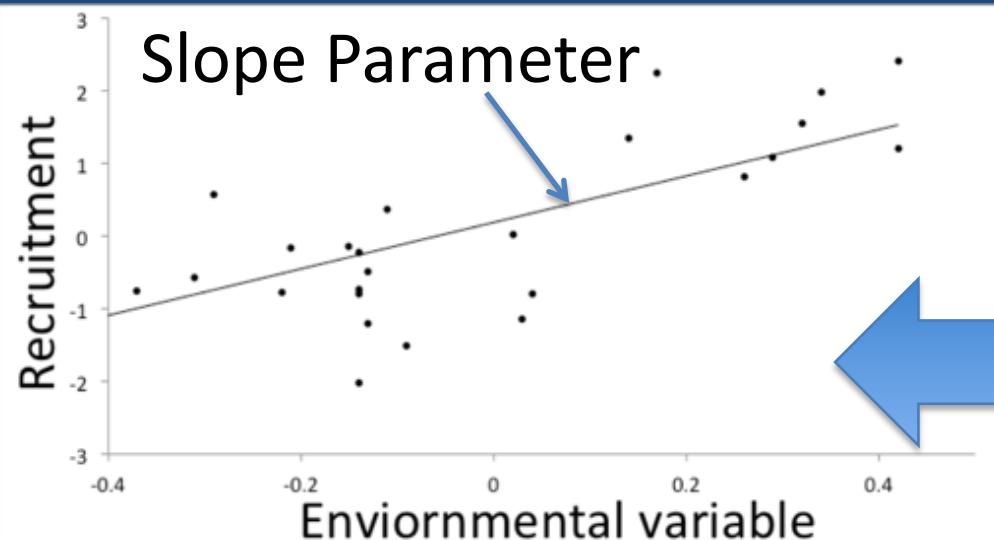
Bayesian Hierarchical Modeling



Bayesian Hierarchical Modeling

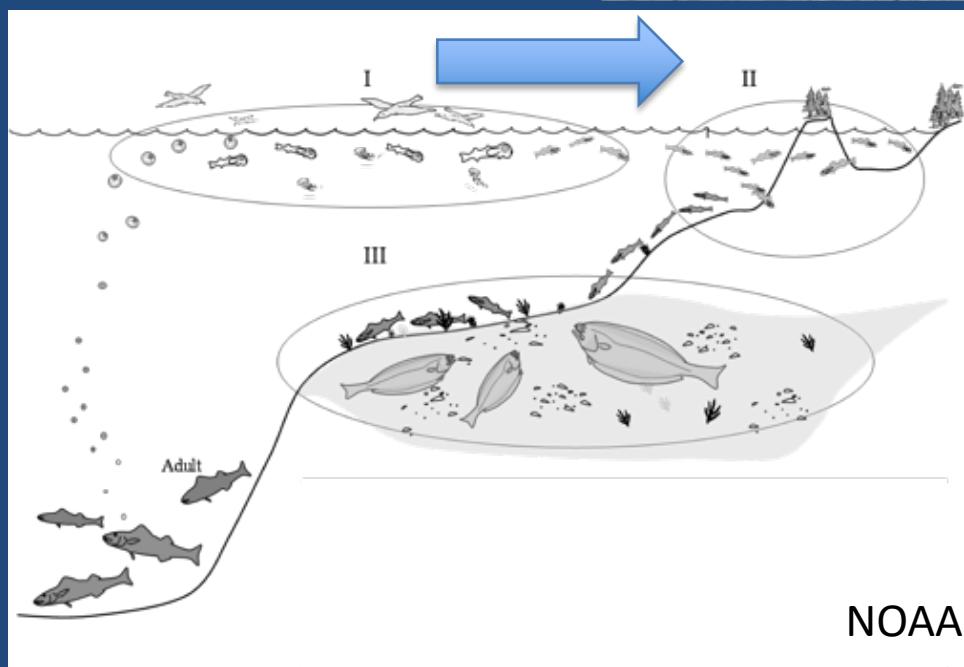


Bayesian Hierarchical Modeling



Cross-shelf transport group

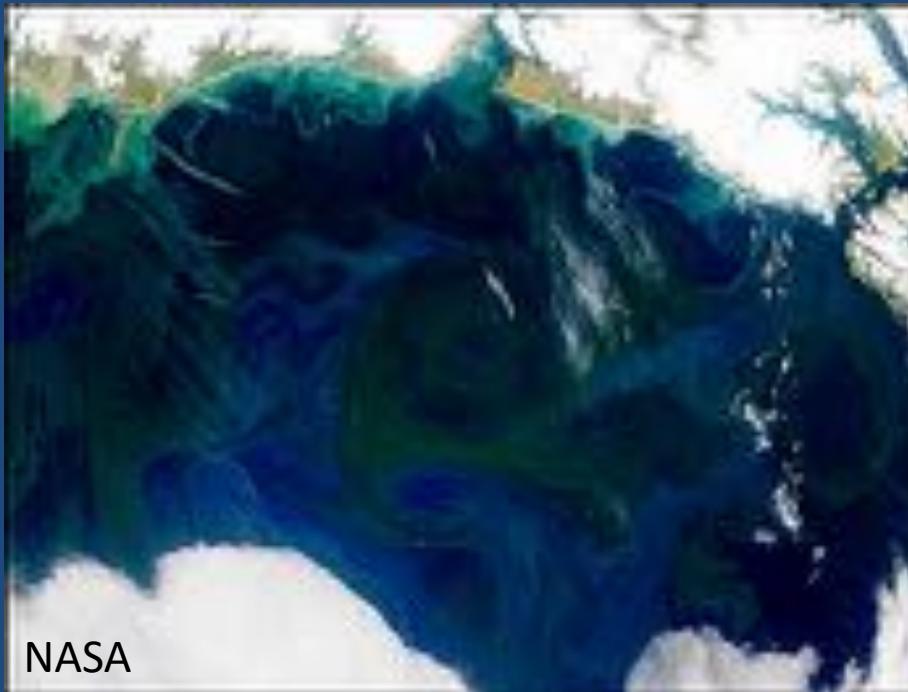
- Arrowtooth flounder
- Dover sole
- Pacific halibut
- Rex sole
- Sablefish



NOAA

Retention group

- Walleye pollock
- Pacific cod
- Flathead sole



Coastal group

- Seymour Canal Pacific herring
- Sitka Sound Pacific herring



Parental investment group

- Dusky rockfish
- Northern rockfish
- Pacific ocean perch
- Rougheye & blackspotted rockfish



Environmental Variables

Environmental Variables

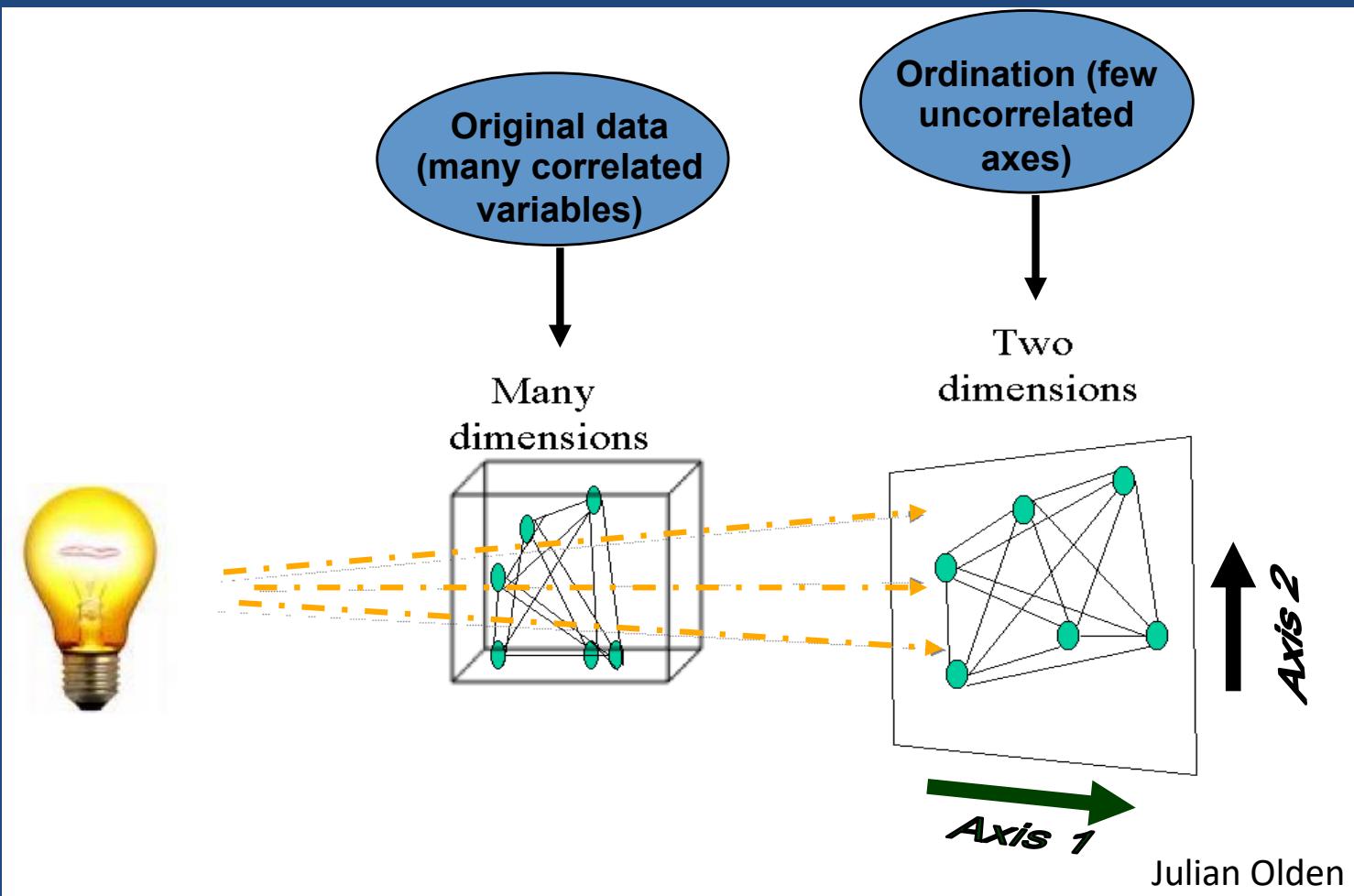
- GOA
 - Sea surface temperature (SST)
 - Upwelling
 - Freshwater discharge
 - Sea surface height (SSH)

Environmental Variables

- GOA
 - Sea surface temperature (SST)
 - Upwelling
 - Freshwater discharge
 - Sea surface height (SSH)
- Data for each variable across many locations and times

Environmental Variables

- Principal component analysis to explain a large portion of the variance as a smaller number of uncorrelated time series



SST

PCA

2 PCs

Upwelling

PCA

2 PCs

Freshwater
discharge

PCA

2 PCs

SSH

PCA

2 PCs

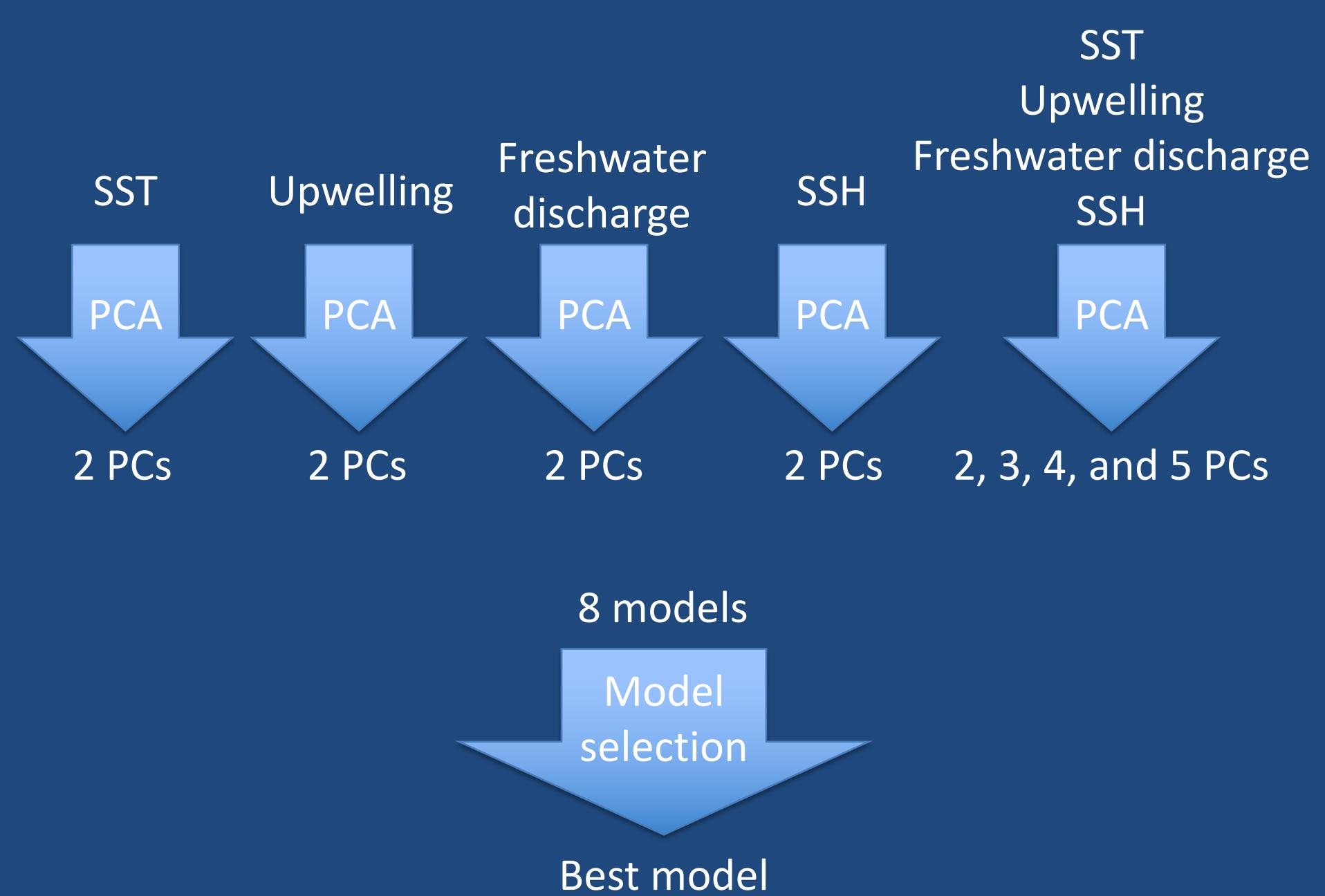
SST
Upwelling

Freshwater discharge

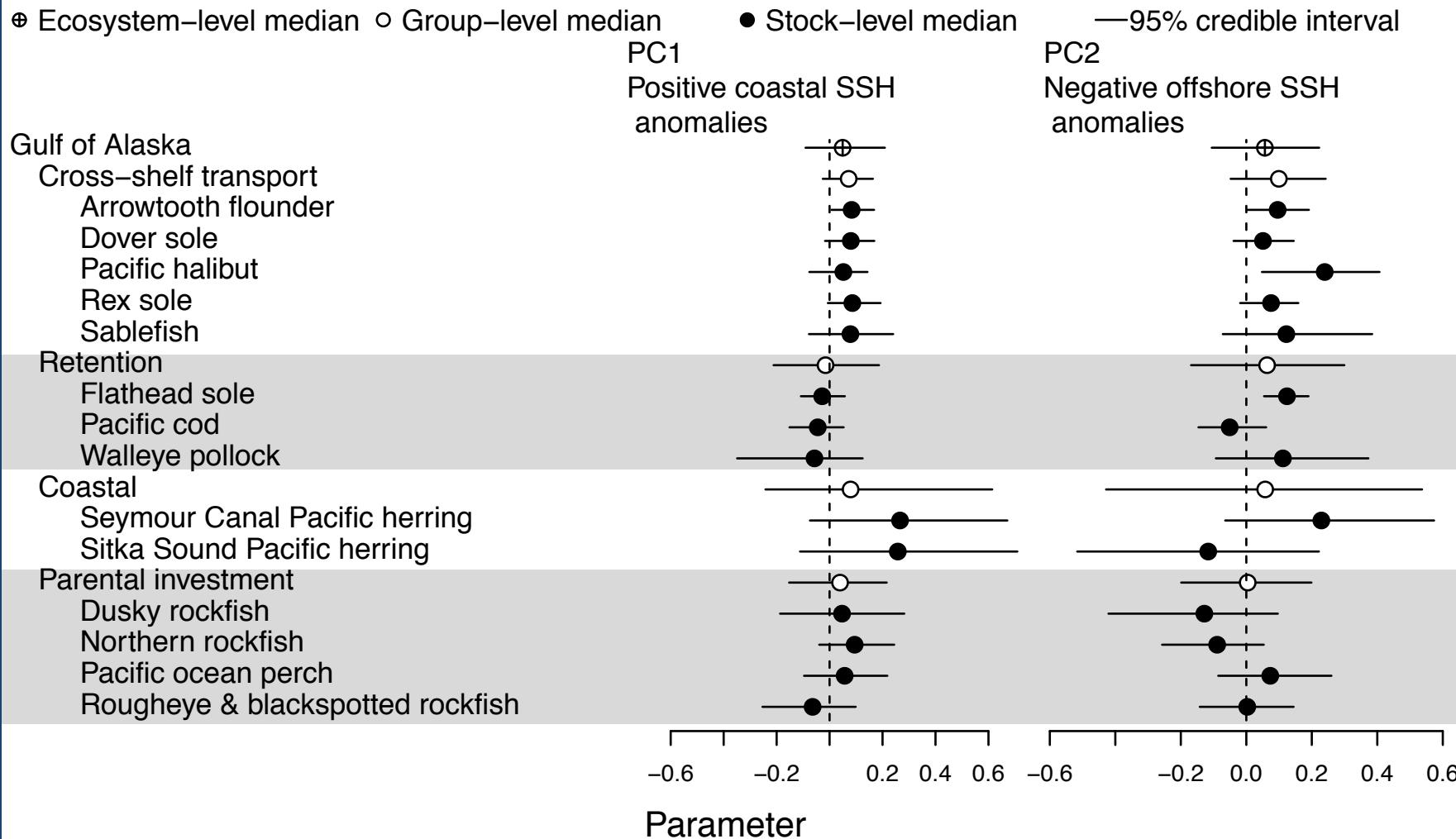
SSH

PCA

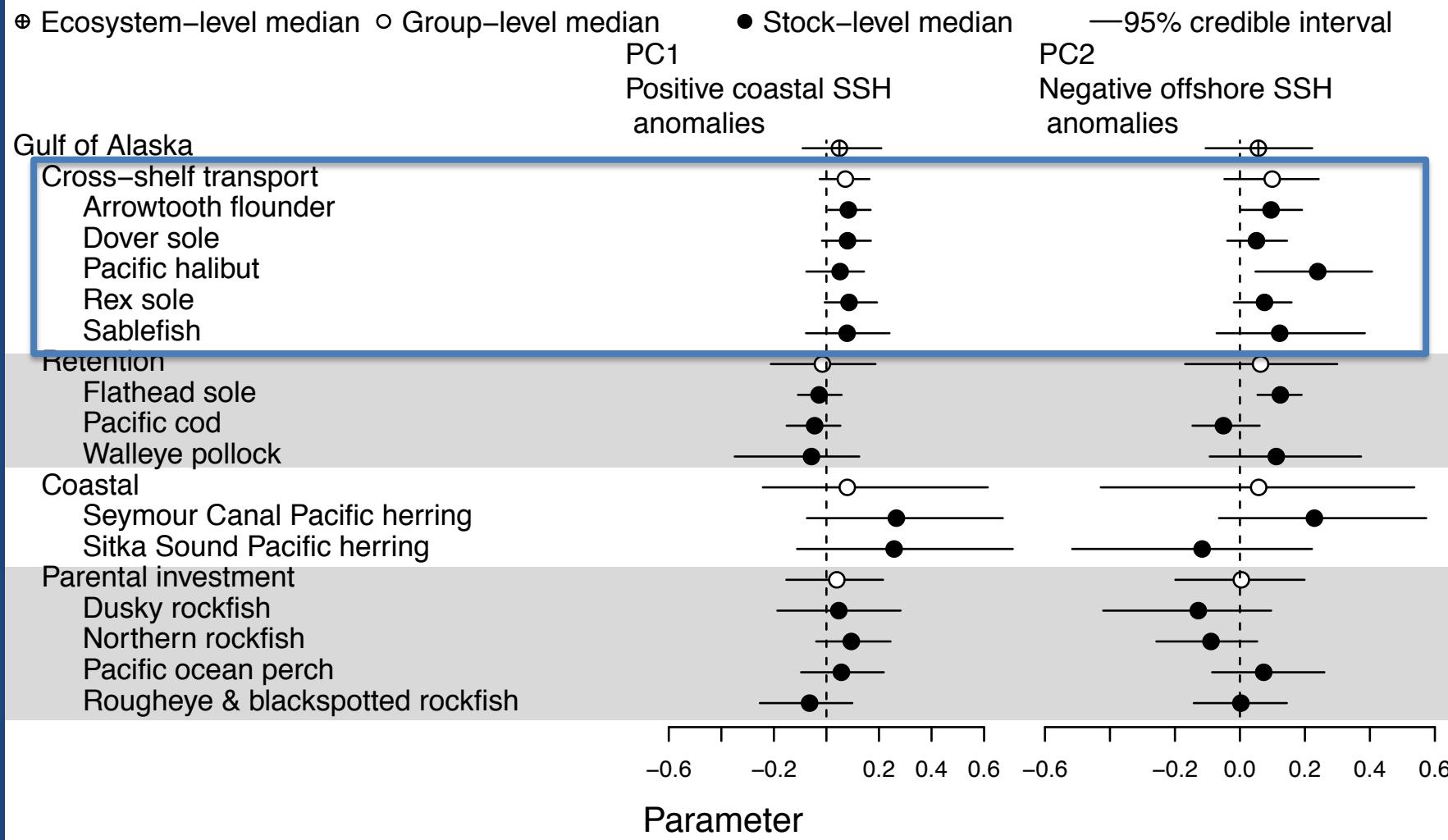
2, 3, 4, and 5 PCs



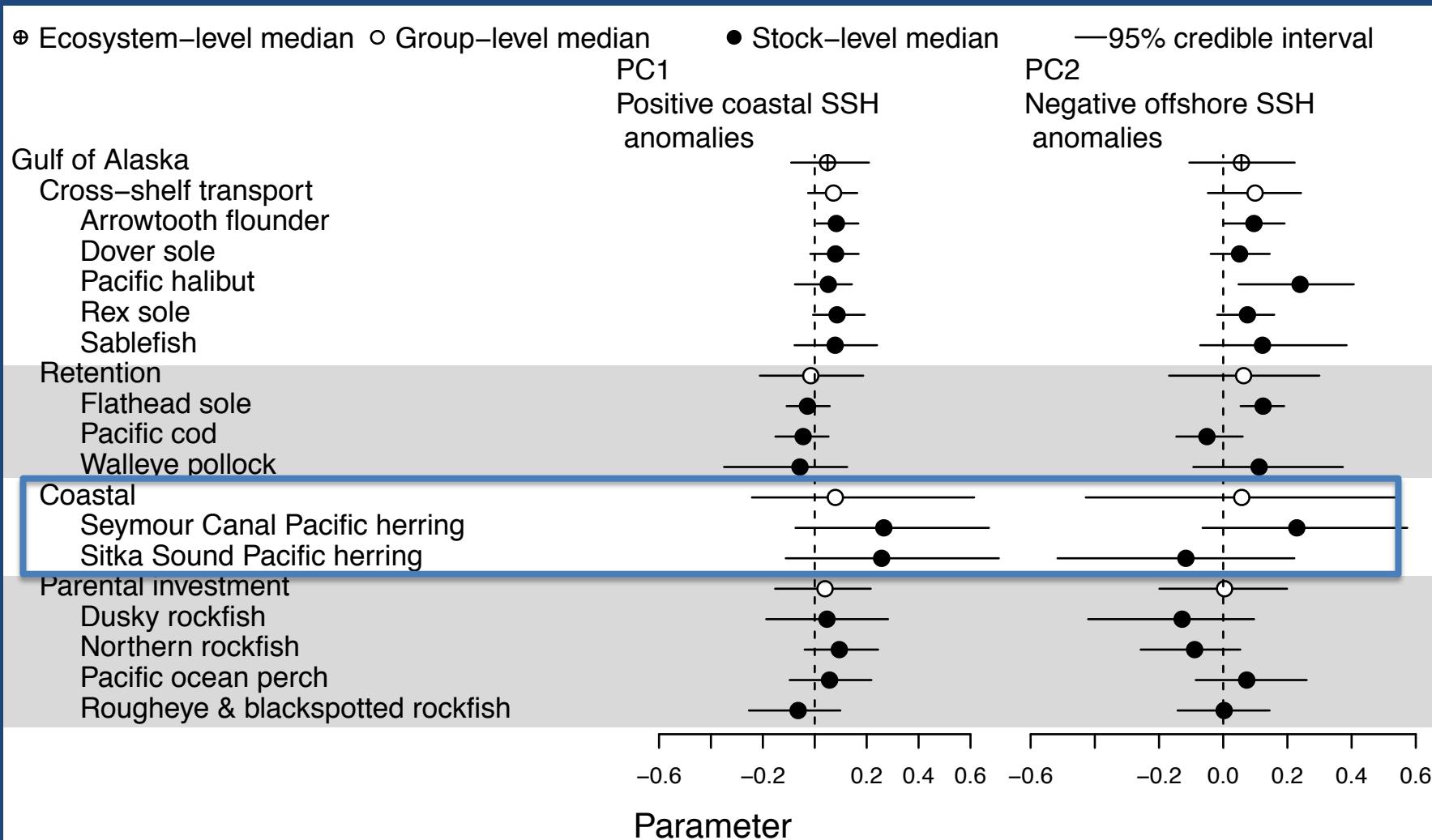
GOA Best Model: Sea Surface Height



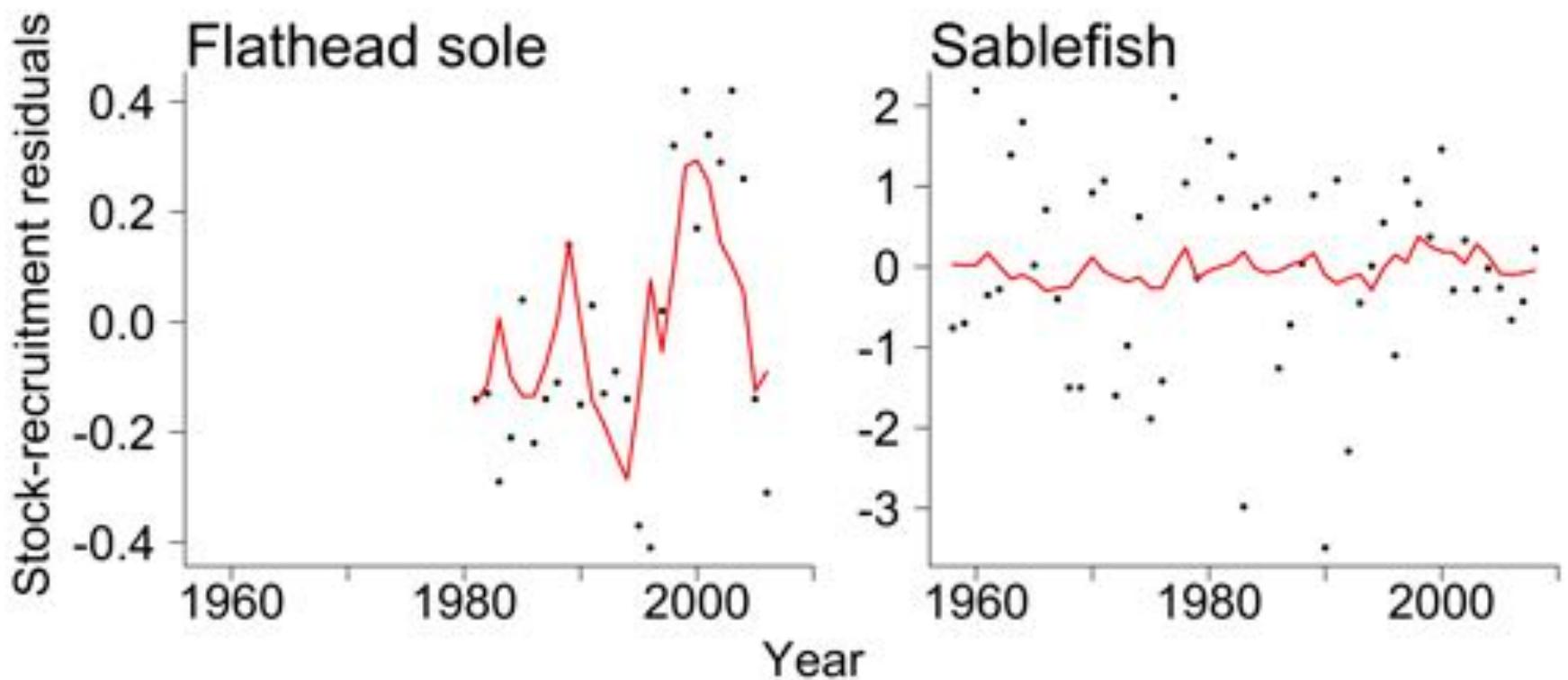
GOA Best Model: Sea Surface Height



GOA Best Model: Sea Surface Height

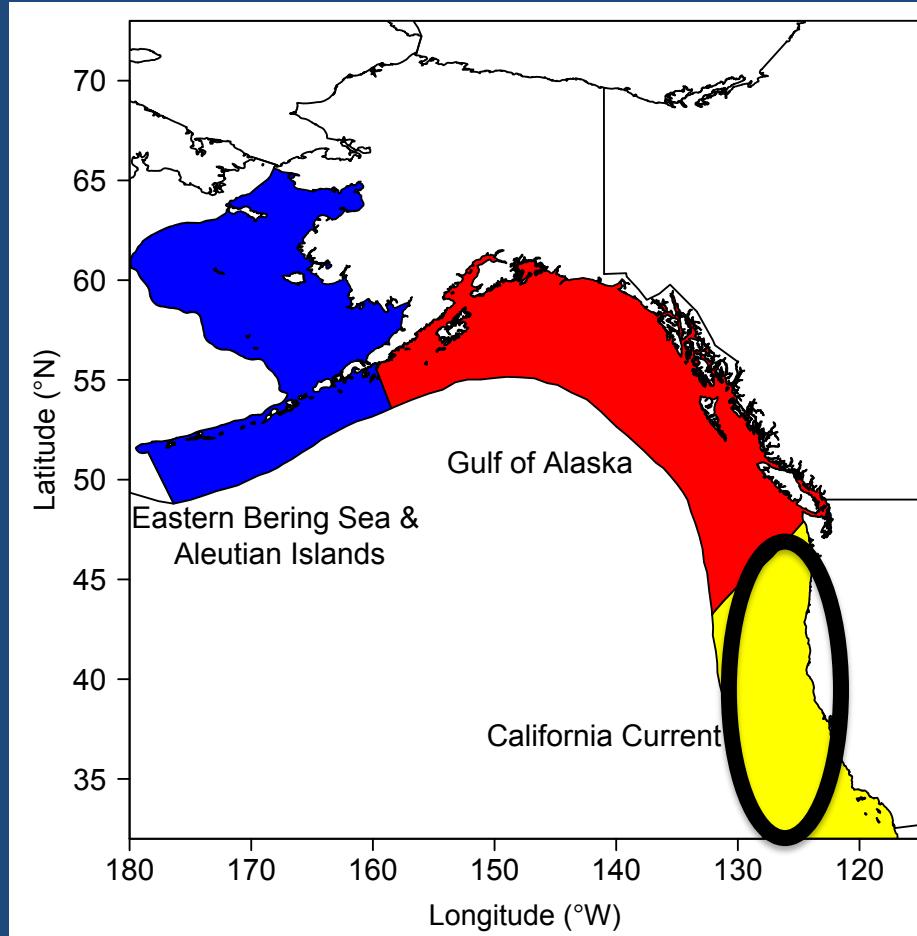


GOA Sea Surface Height Model Fits



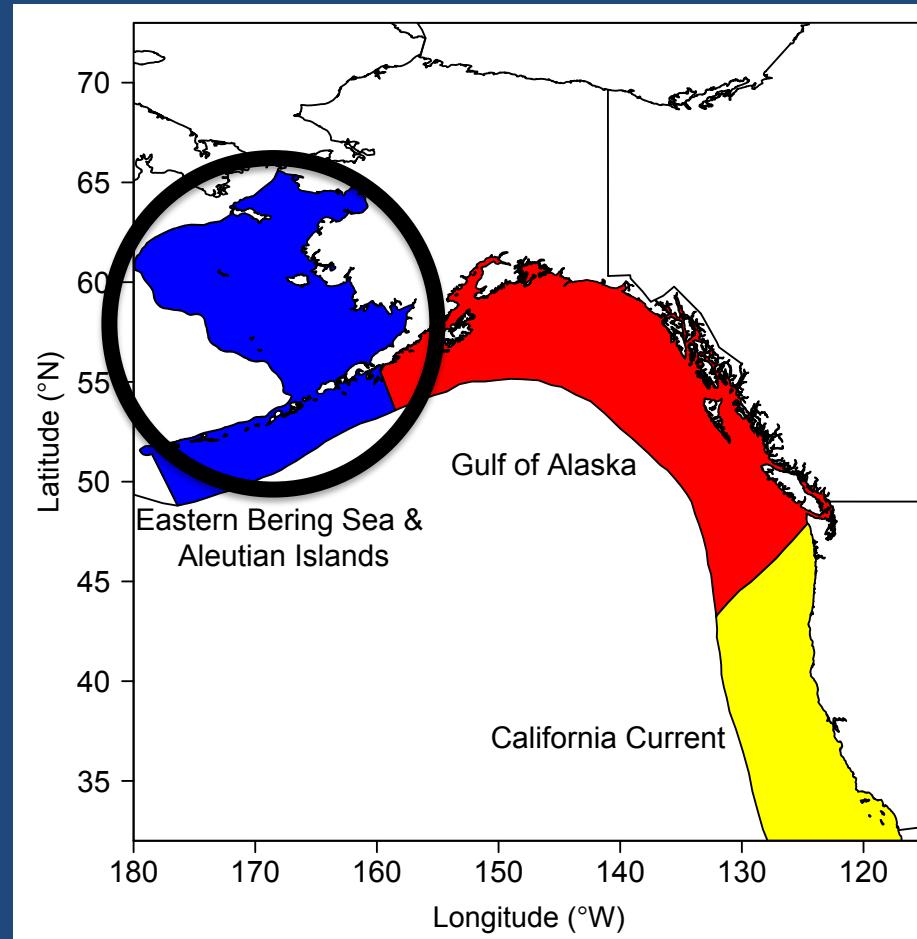
California Current

- Best model: sea level
- High recruitment associated with:
 - High upwelling the year of spawning
 - Low upwelling the year before spawning



Eastern Bering Sea and Aleutian Islands

- Best model: all environmental variables considered
- Not simple to separate out the driving processes



Evaluating Stock Grouping

- Tested best model without separate groups
 - Support for grouped model in the BSAI, support not as strong in the GOA and CC
- Other grouping structures may improve the fit
 - More early life history information

Conclusions

- Synchrony in Northeast Pacific recruitment
 - Use methods that draw strength from this synchrony
- Some evidence for similar environmental influences within defined groups
- Environmental variables showed common influence on recruitment for several stocks
 - GOA: sea surface height
 - CC: sea level