Challenges and Opportunities for understanding environmental controls on stock productivity

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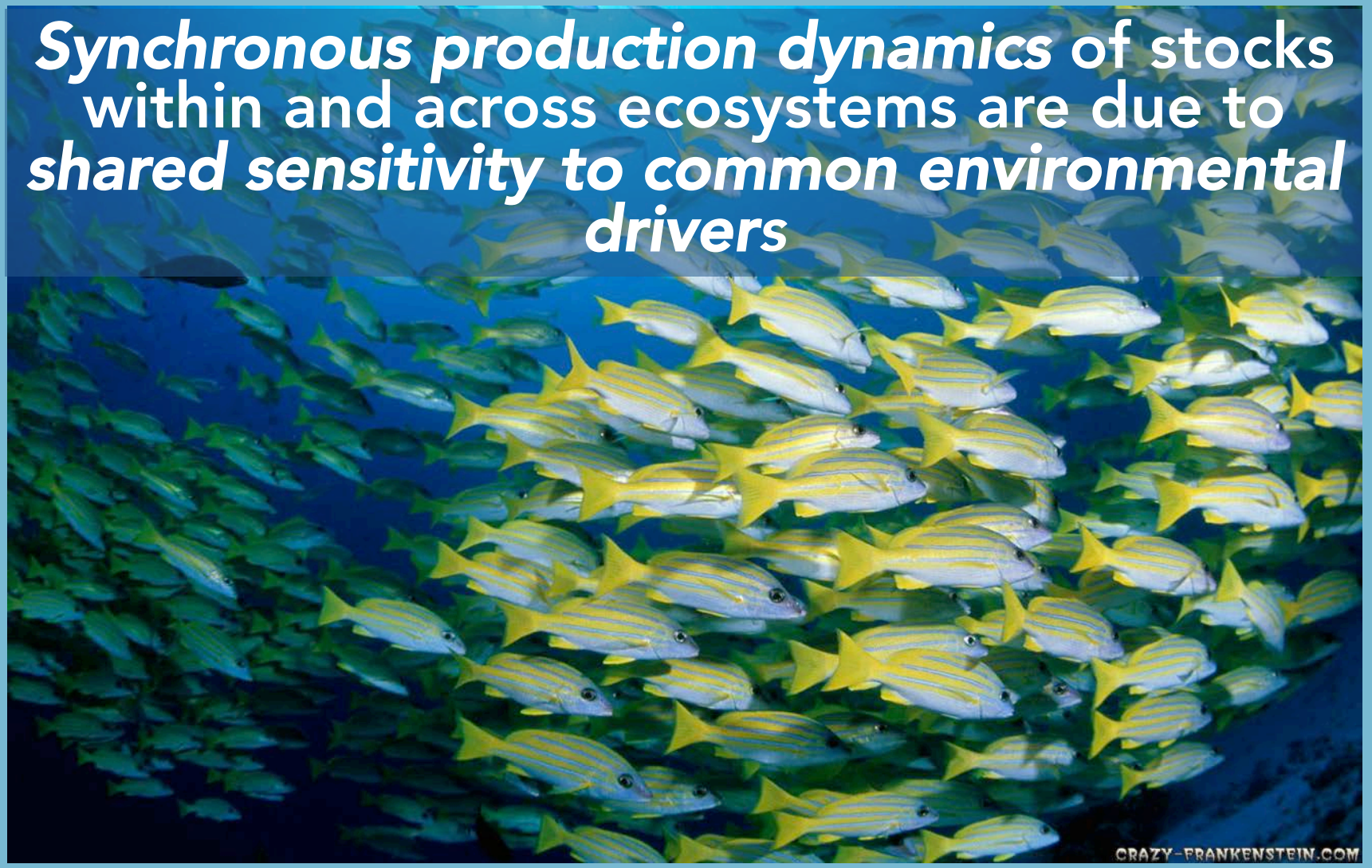
Background

- Spurious Environmental Correlations
- Synchrony in production dynamics
- Prediction for data poor species
  - Hierarchical models "borrows strength from the ensemble"

Central idea

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



Approach

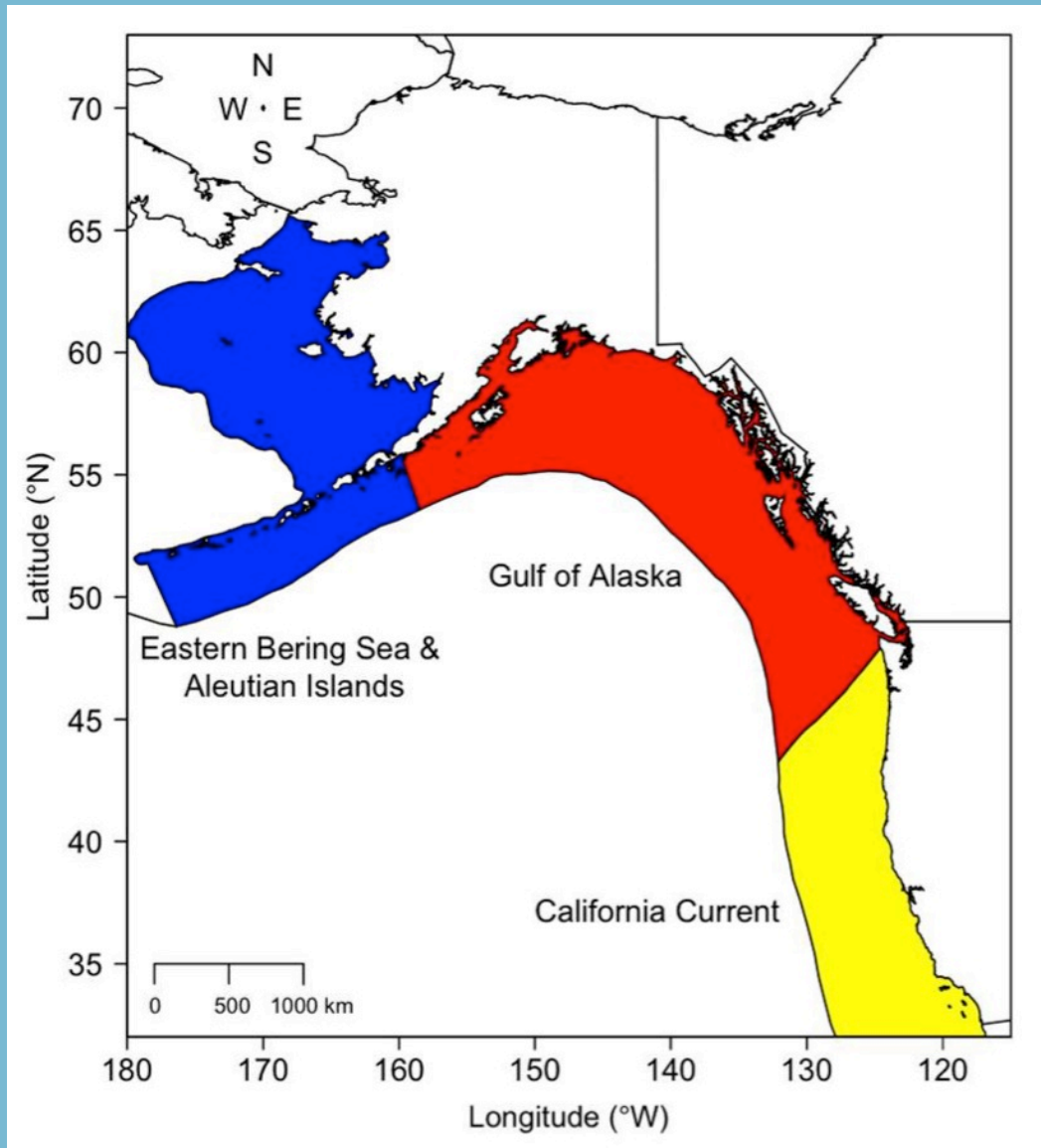
1. **Group** stocks based on life history processes
2. **Evaluate** group synchrony
3. **Identify** putative environmental drivers
4. **Estimate** effects of environment

Growth and recruitment

- *Part 1.* Synchrony in recruitment dynamics
- *Part 2:* Methods to quantify growth dynamics

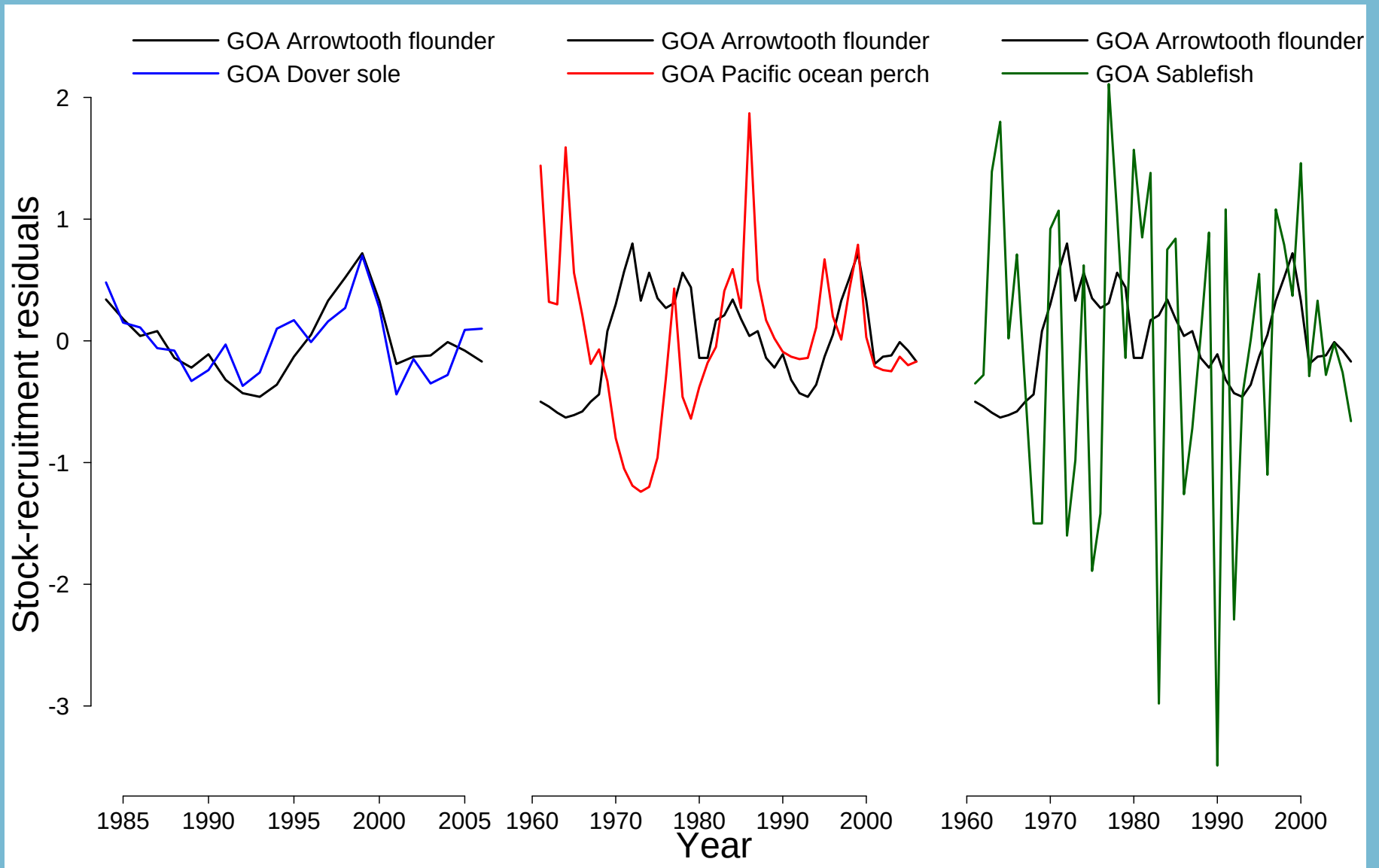
Study area

- 51 stocks across three ecosystems
  - Eastern Bering Sea & Aleutian Islands
  - Gulf of Alaska
  - California Current



PART 1: RECRUITMENT

Mixed Evidence for synchrony: Gulf of Alaska



Grouping hypotheses: based on process

Cross-shelf transport
Arrowtooth flounder
Dover sole
Pacific halibut
Rex sole
Sablefish

Retention
Walleye pollock
Pacific cod
Flathead sole

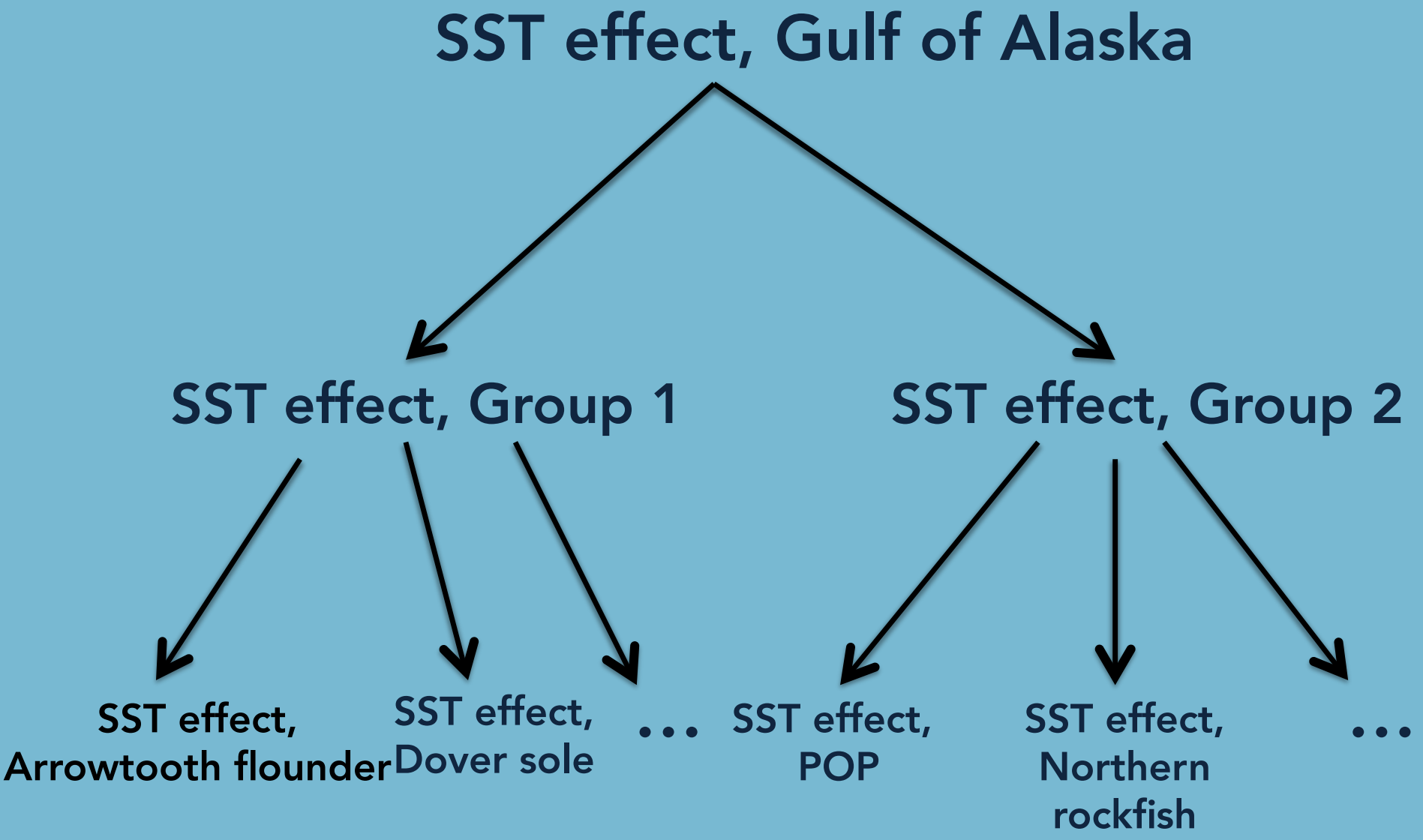
Coastal
Herring (Seymour canal, Sitka sound)

Parental investment
Rockfish
(Dusky, Northern, POP,
Rougheye & blackspotted)

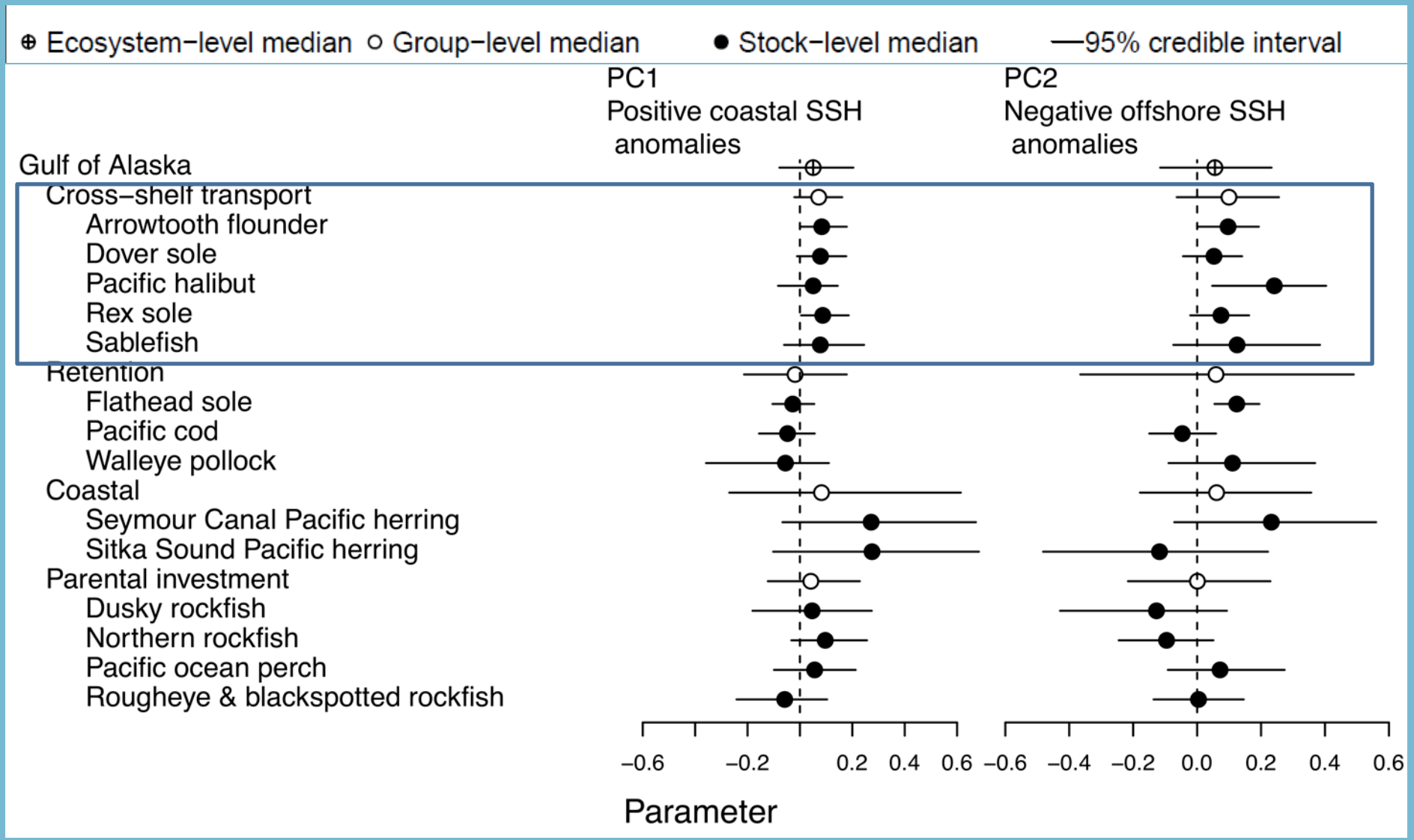
Environmental effects examined

- Gulf of Alaska:
  - Sea surface temperature (SST)
  - Upwelling
  - Freshwater discharge
  - Sea surface height (SSH)
- Principal component analysis

Hierarchical model tested

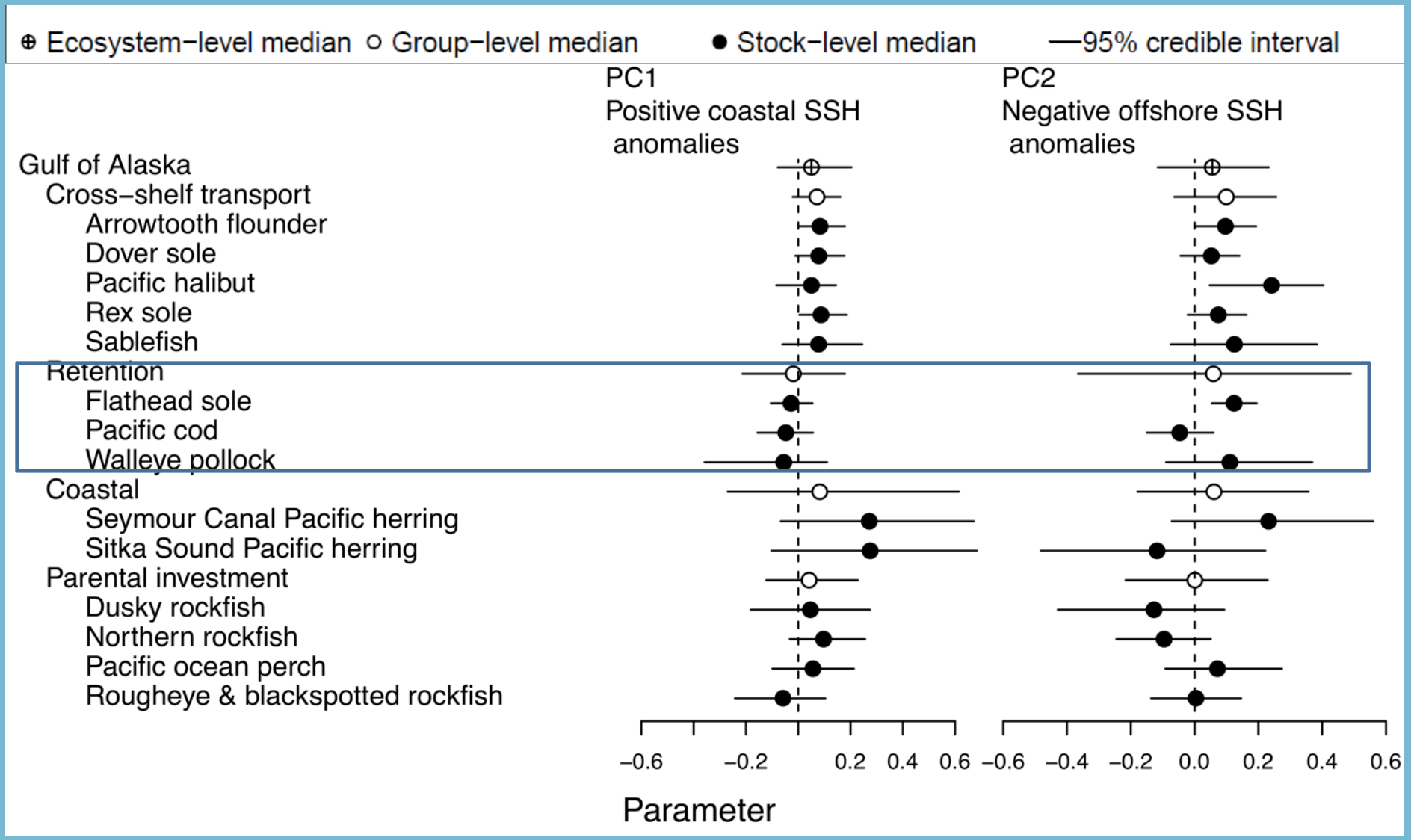


Mixed evidence for groupings



Stachura et al. 2014. Fisheries Oceanography

Mixed evidence for groupings



Stachura et al. 2014. Fisheries Oceanography

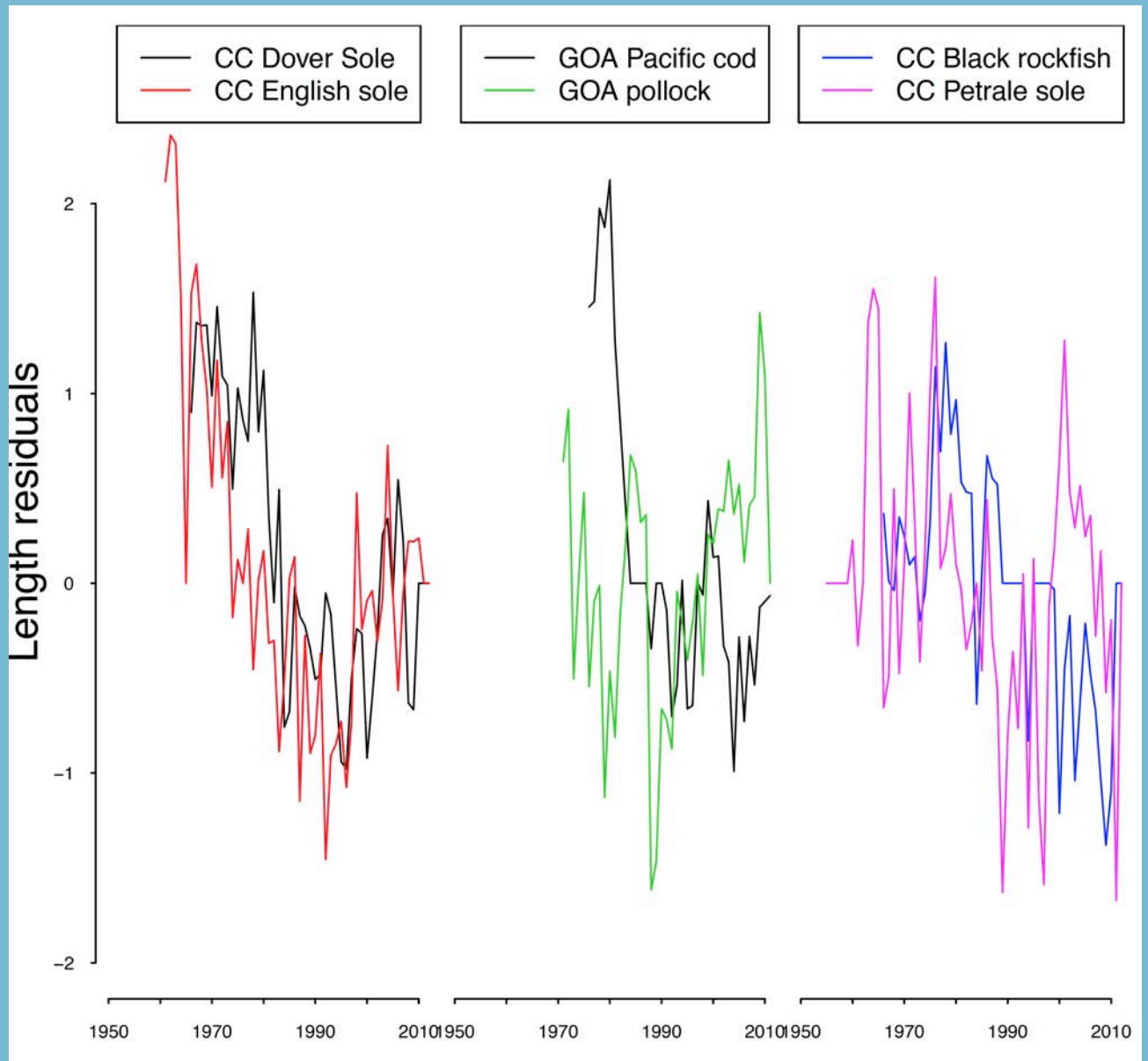
Recruitment summary

- Mixed evidence for synchrony within groups
- Identifying groups *a priori* was challenging
  - Regional vs. local scale drivers
- Shared sensitivity to physical variables at ecosystem scale
  - Gulf Of Alaska: sea surface height
  - California Current: sea level pressure
  - E Bering Sea Aluetian Islands:several variables

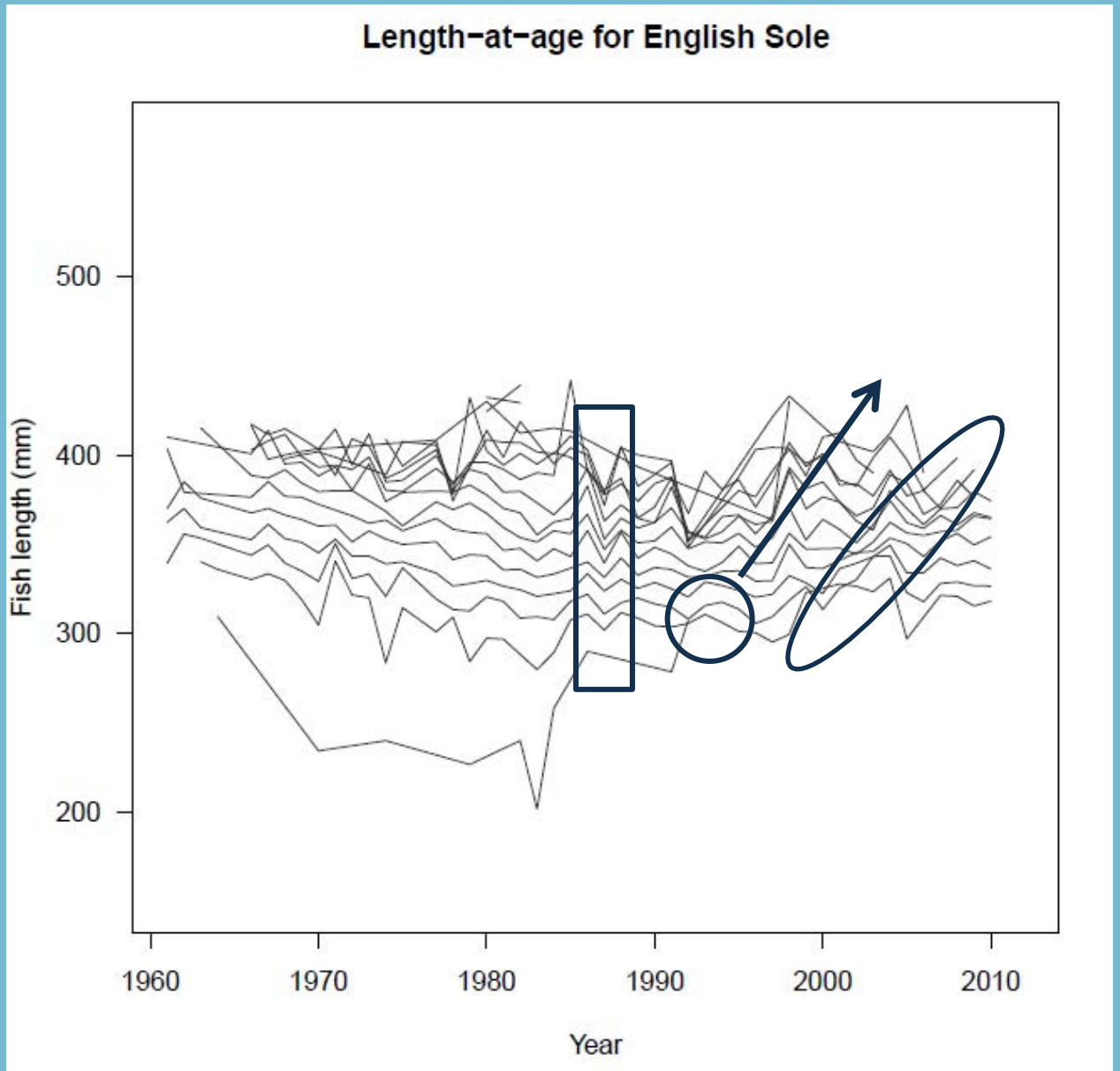
Stachura et al. 2014. Linking Northeast Pacific recruitment synchrony to environmental variability. Fisheries Oceanography

PART 2: GROWTH

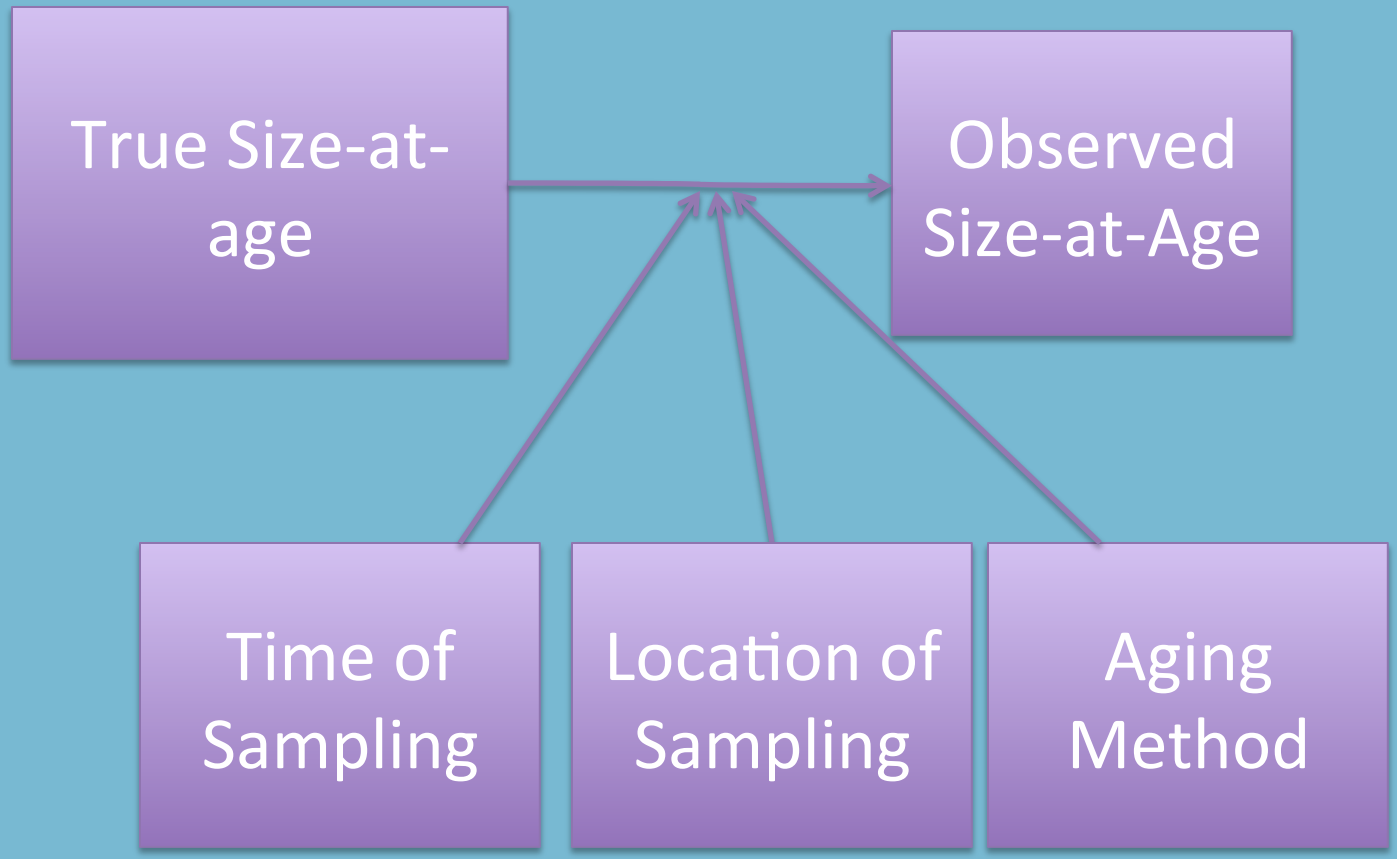
EVIDENCE FOR SYNCHRONY



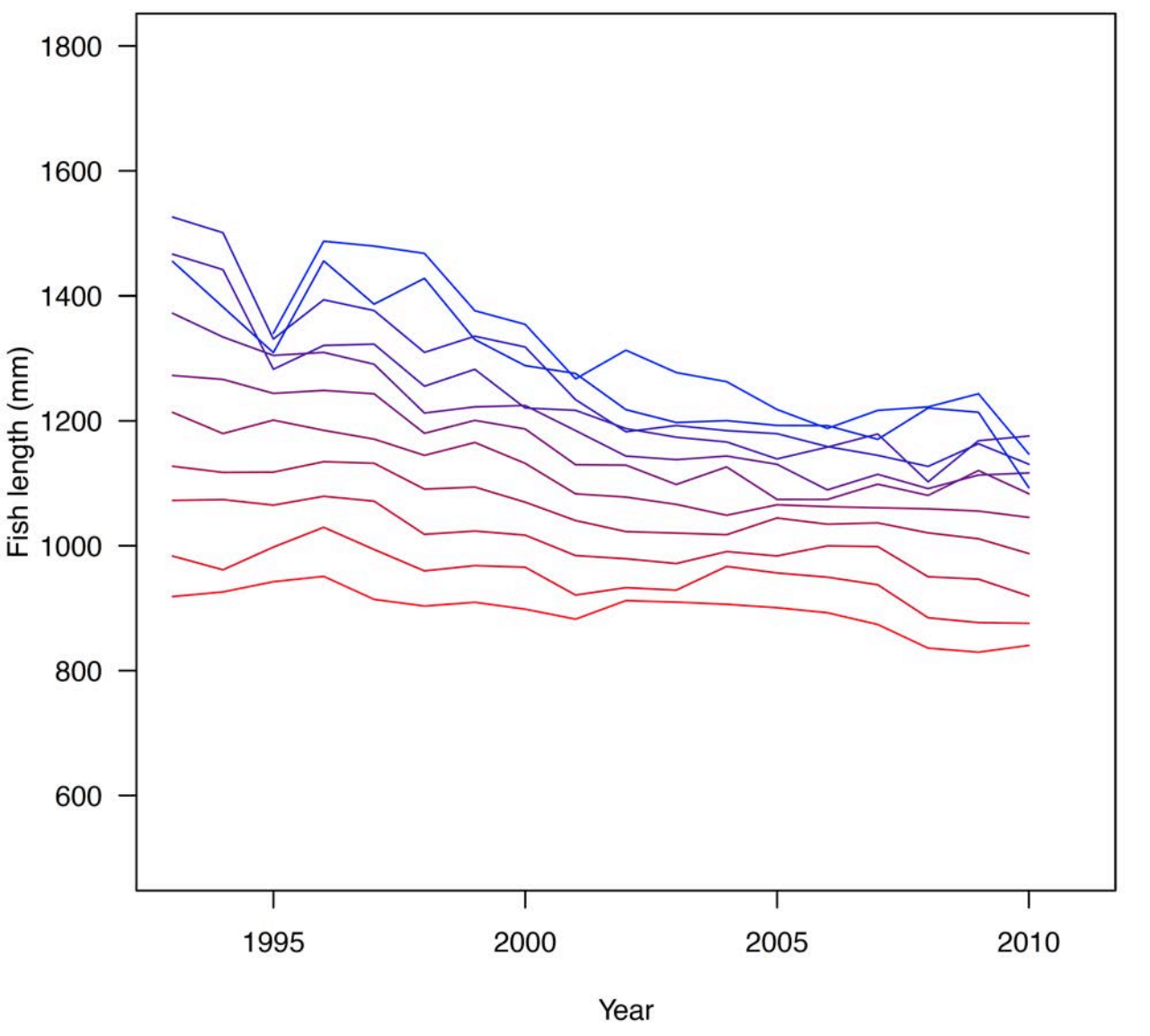
Hypotheses for growth variability



State-space model



An Example: Pacific Halibut



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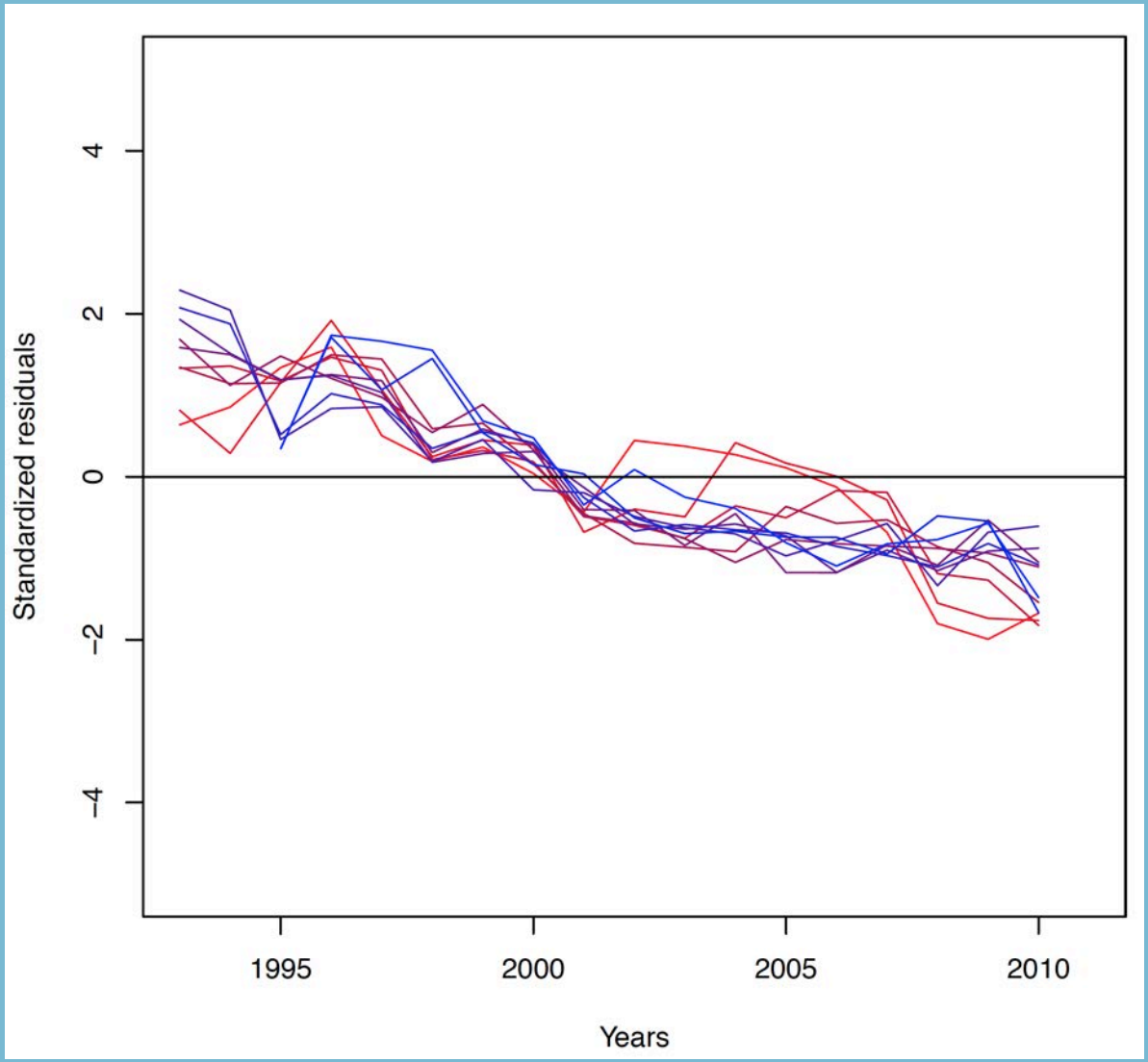

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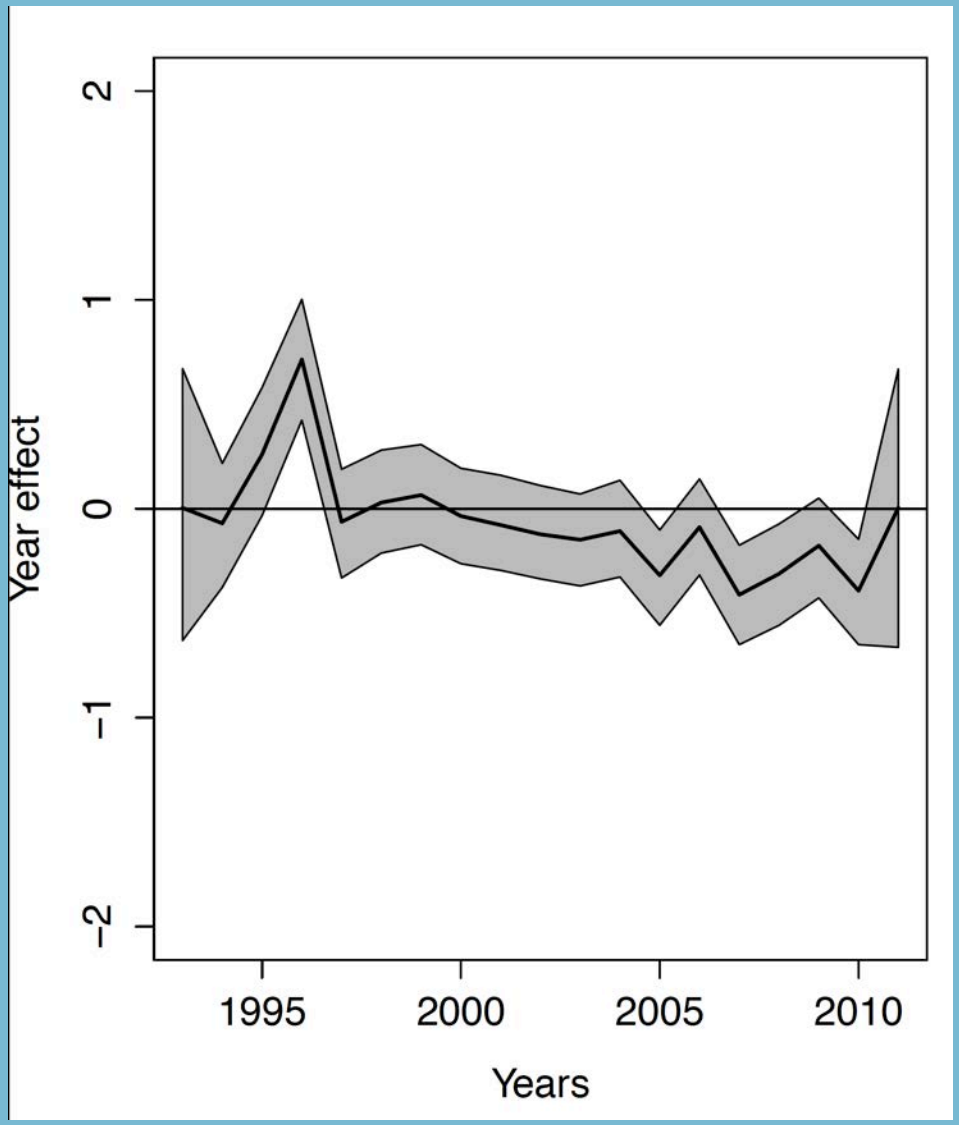

Growth summary

- Evidence for variation and synchrony
- Estimation framework working!

Next Steps:

- Group stocks
- Test for synchrony
- Environmental covariates

Challenges and Opportunities

- *Challenges:*
  - *A priori* prediction
  - Scale, size and interactions of Effects
- *Opportunities*
  - Technical capacity
  - Reduce the scope of problem
  - Strengthen evidence for regime shifts

Acknowledgments

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