NOAA FISHERIES

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Evidence for Regime Shifts on the Northeast U.S. Continental Shelf

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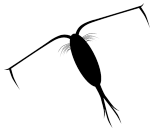
NEFSC Ecosystem and Climate Science Program Review

Climate Research Session

June , 2016

Talk outline

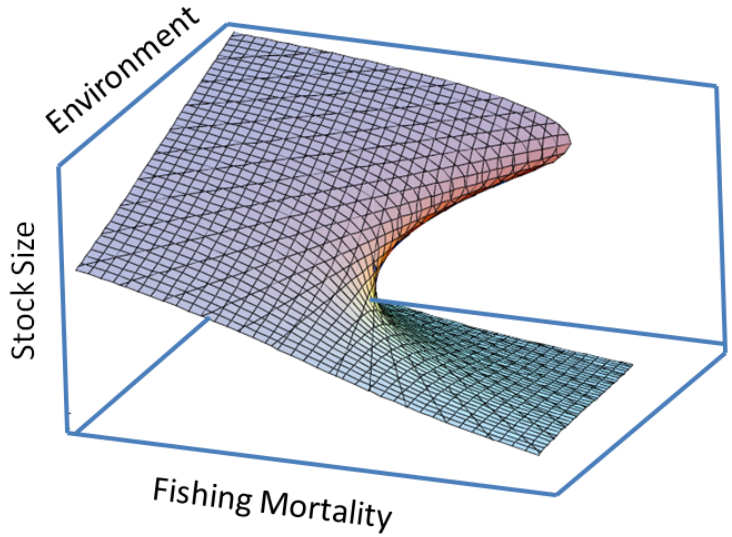
- Complex dynamics in marine ecosystems
- Groundfish recruitment phase shifts
- Fish condition phase shifts
- Zooplankton phase shifts 
- Broad-scale regime shifts on the NE Shelf

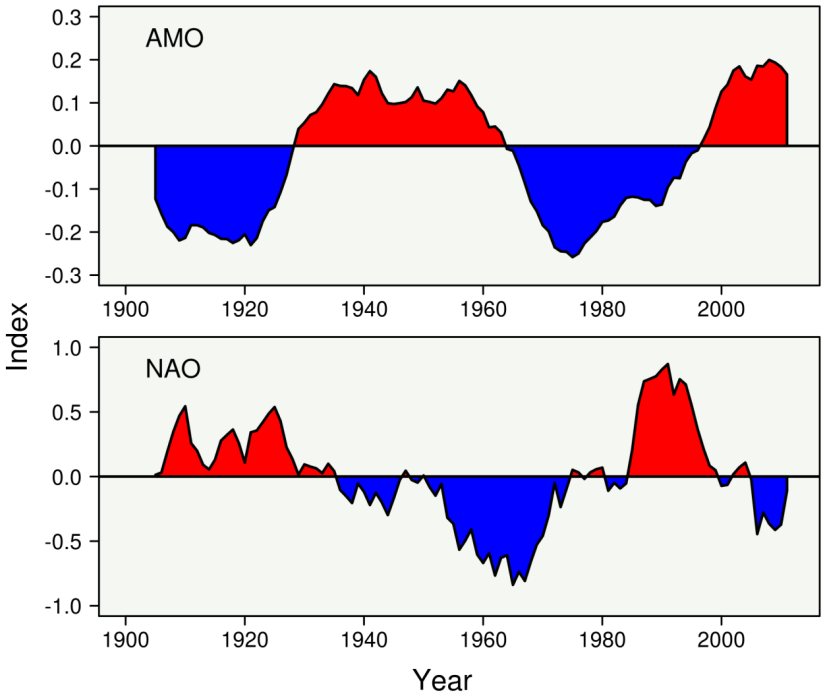
Regime shifts defined

- Bakun (2004) '…**a persistent radical shift** in typical levels of abundance or productivity of multiple important components of marine biological community structure, **occurring at multiple trophic levels** and on a geographical scale that is at least regional'.

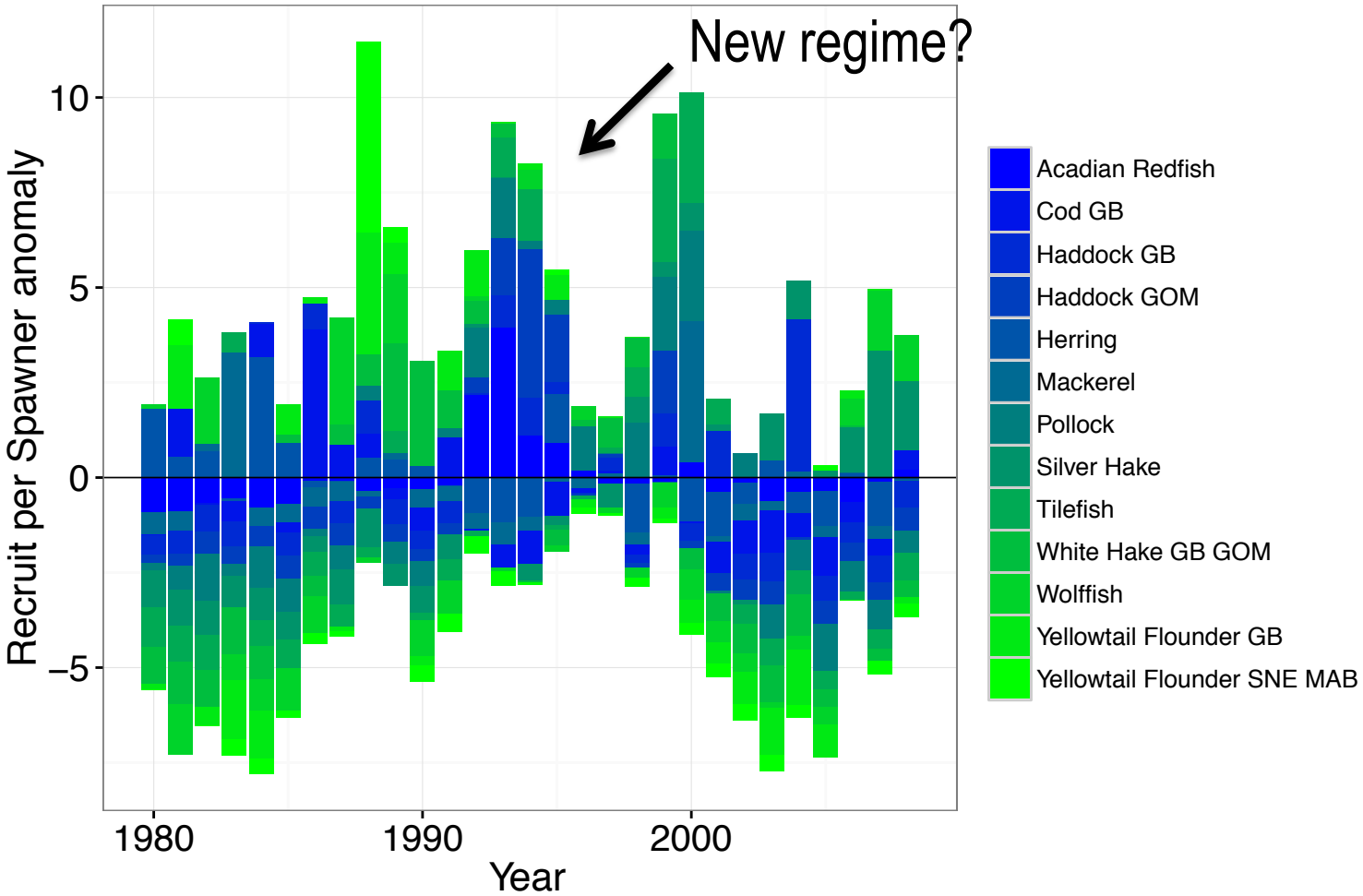
- Collie et al. (2004) '...a low frequency, high amplitude change in oceanic conditions that may propagate through several trophic levels and be especially pronounced in biological variables.

Nonlinear processes and regime shifts





Recruitment regimes

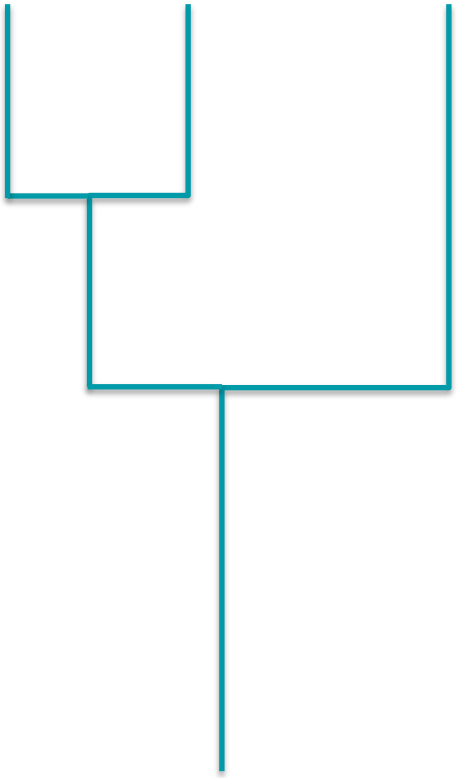


Regime shift detection methods

- Chronological clustering with temporal contiguity constraint (Legendre & Legendre 2012)
  - Explicitly multivariate
  - Regression tree approach
  - Regimes chosen to minimize cross-validated prediction error

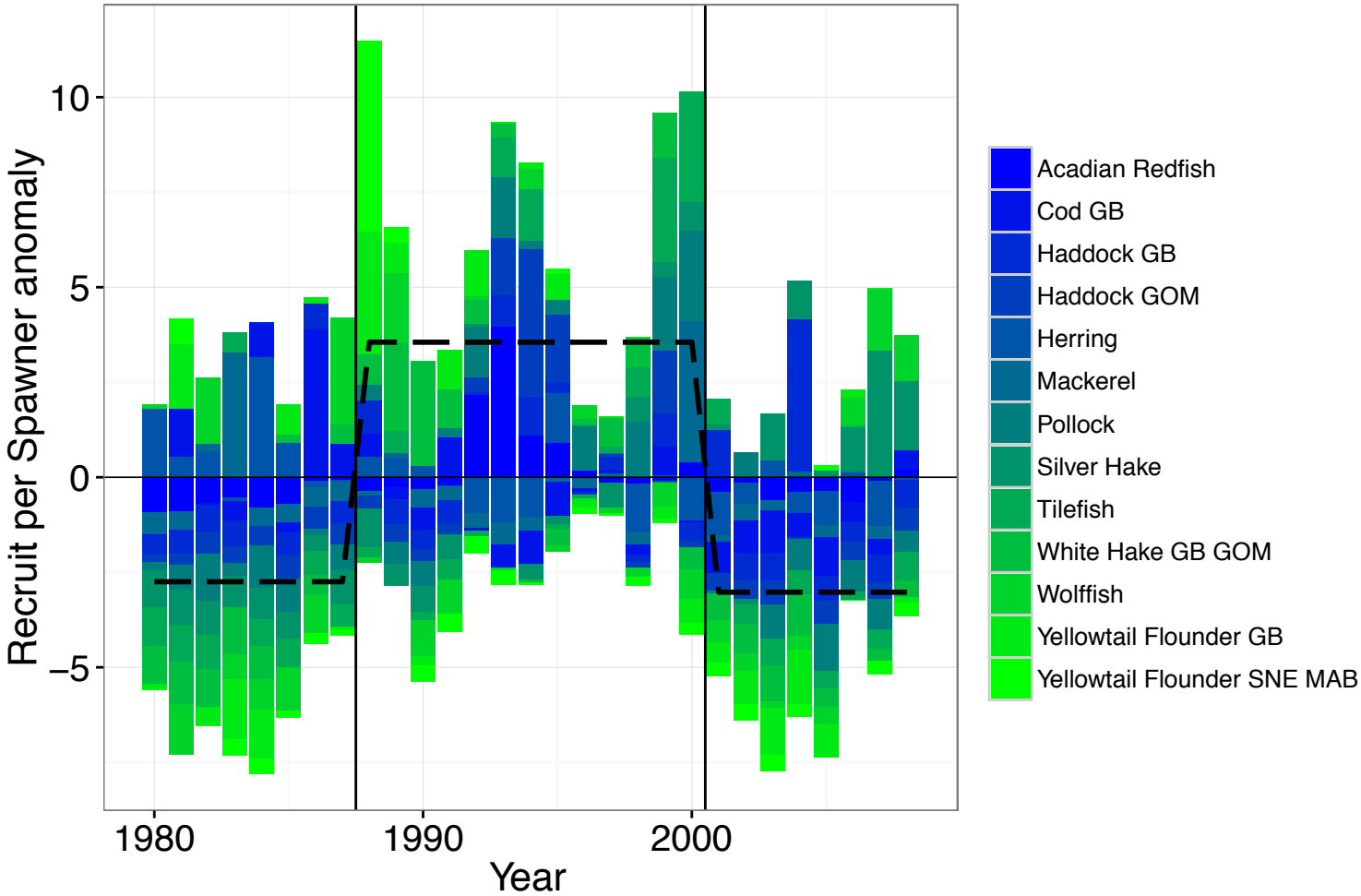
- Sequential T-Test Analysis of Regime Shifts (STARS)

- Nonparametric changepoint detection algorithm



Recruitment regimes

Stock assessments 1980 - 2008



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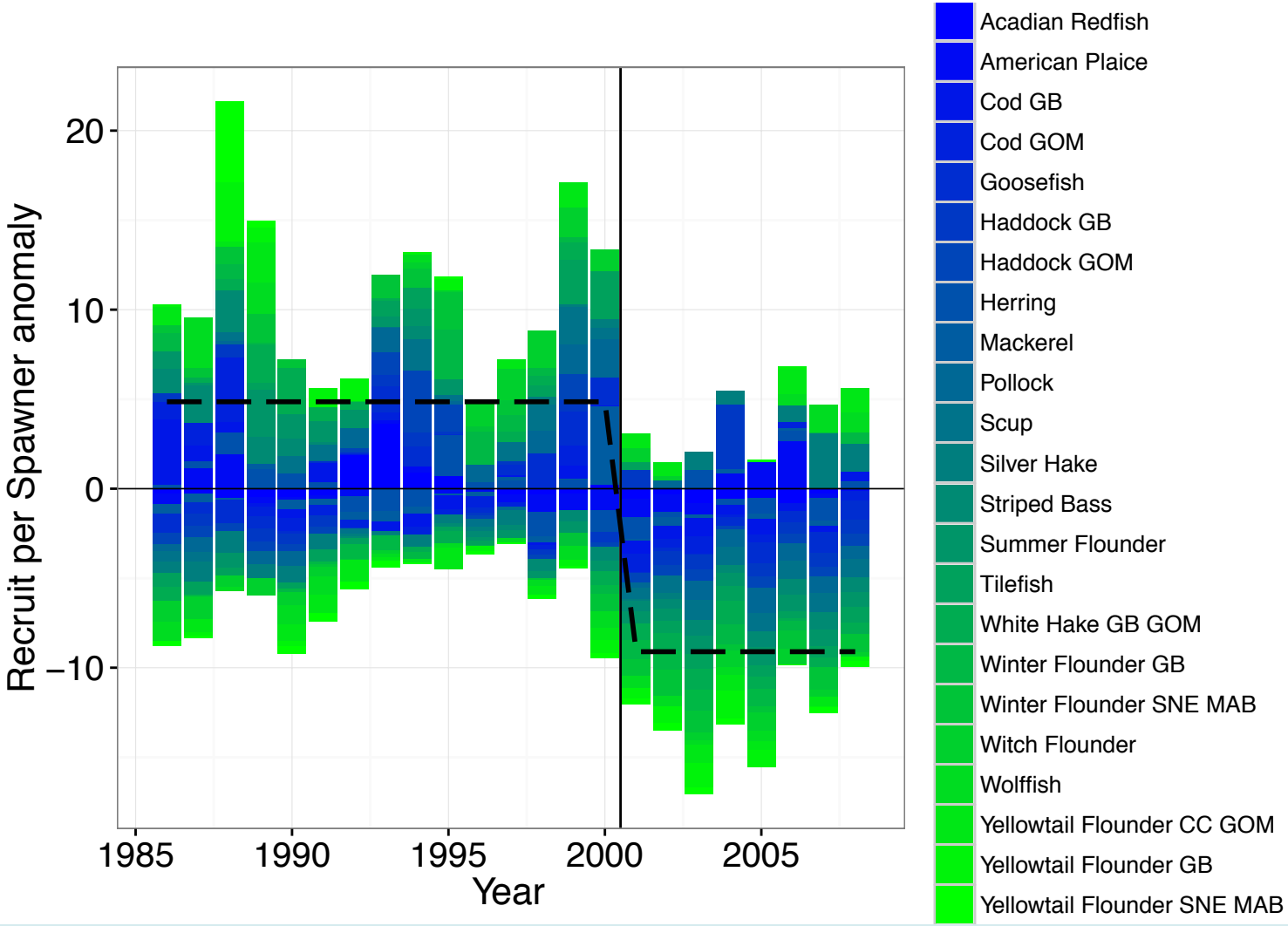
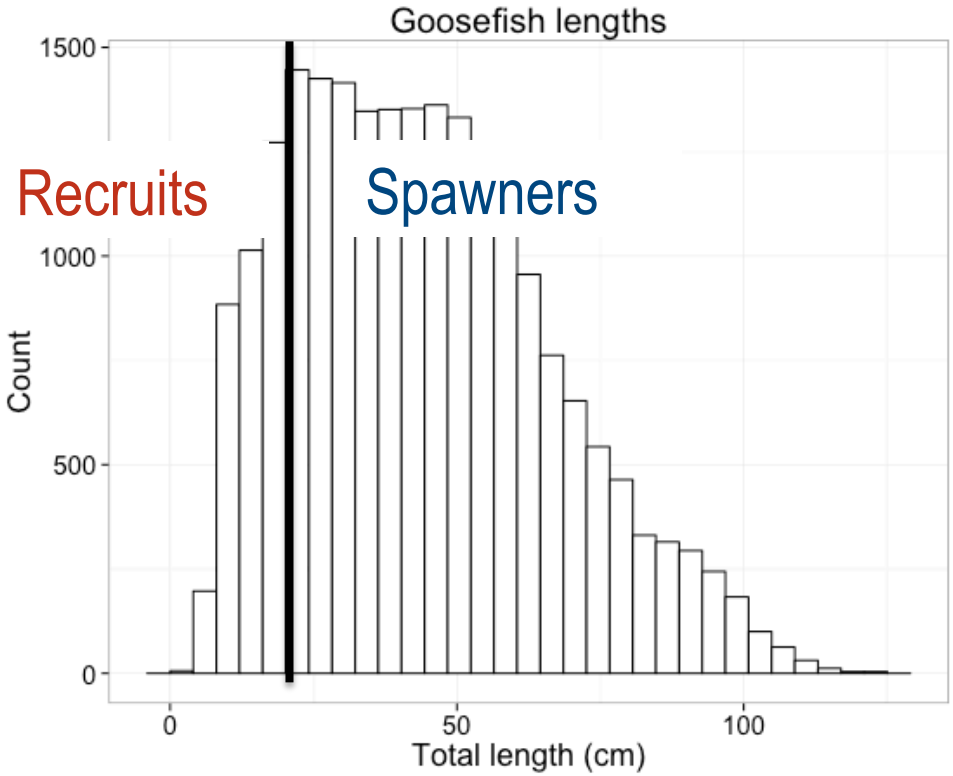


Recruitment regimes

Survey data



Recruitment regimes

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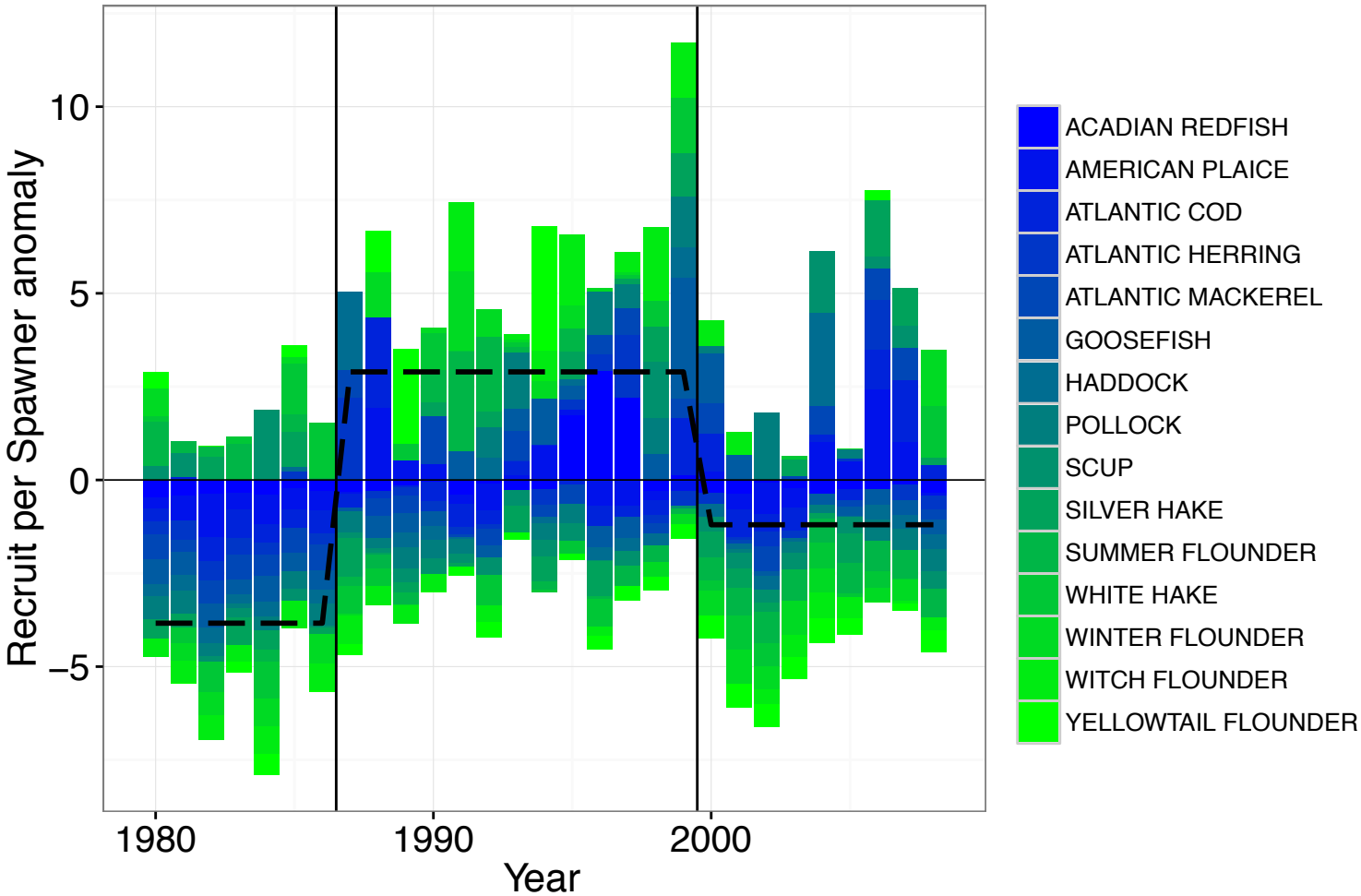
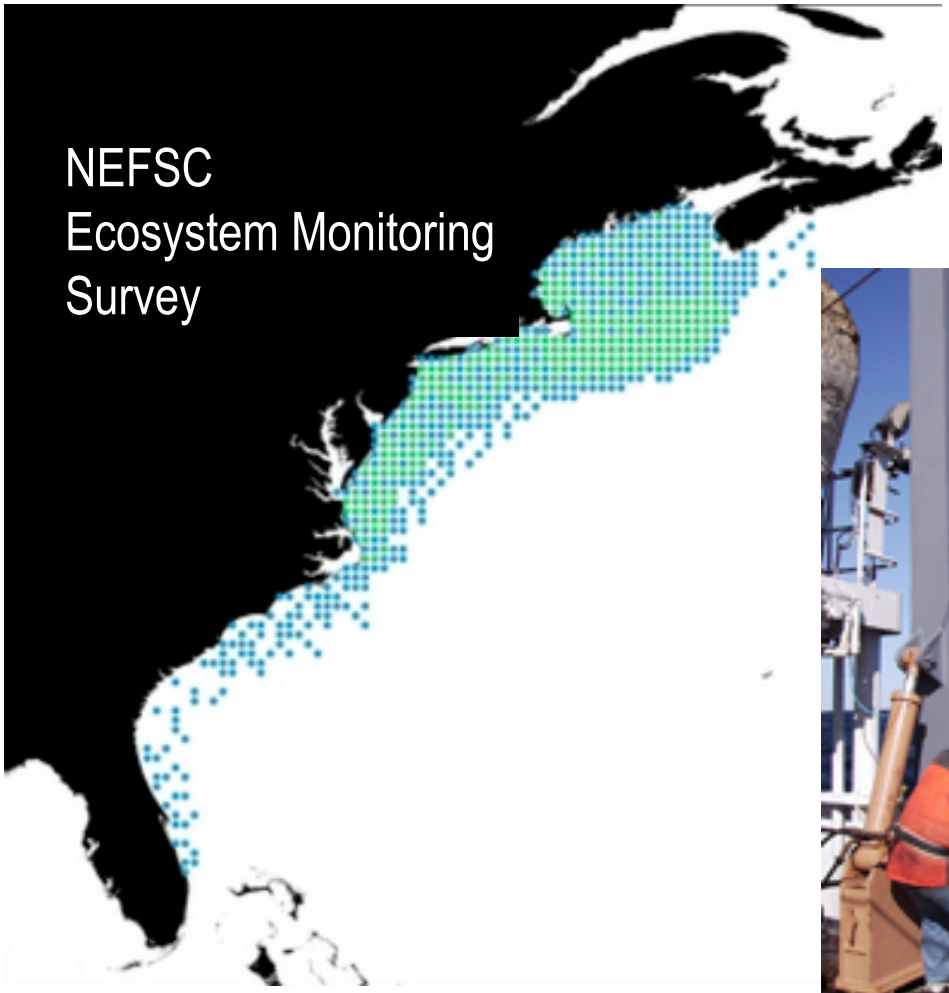
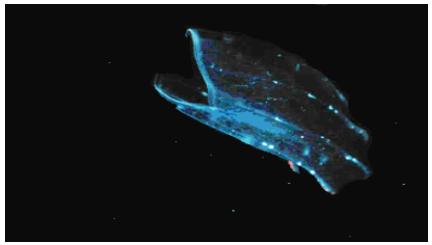
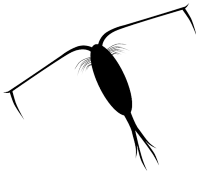


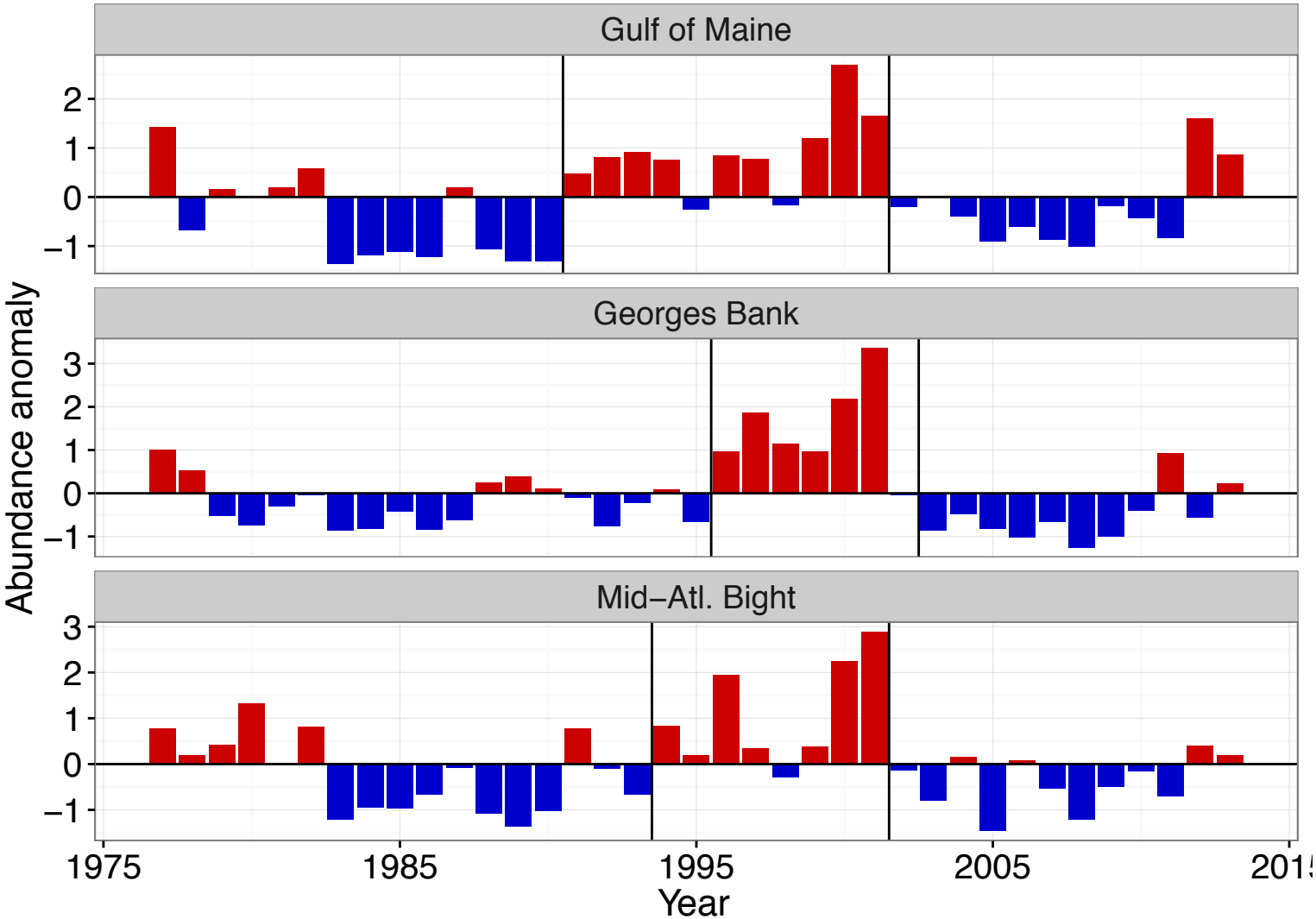
Copepod regimes



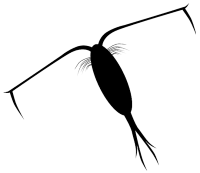


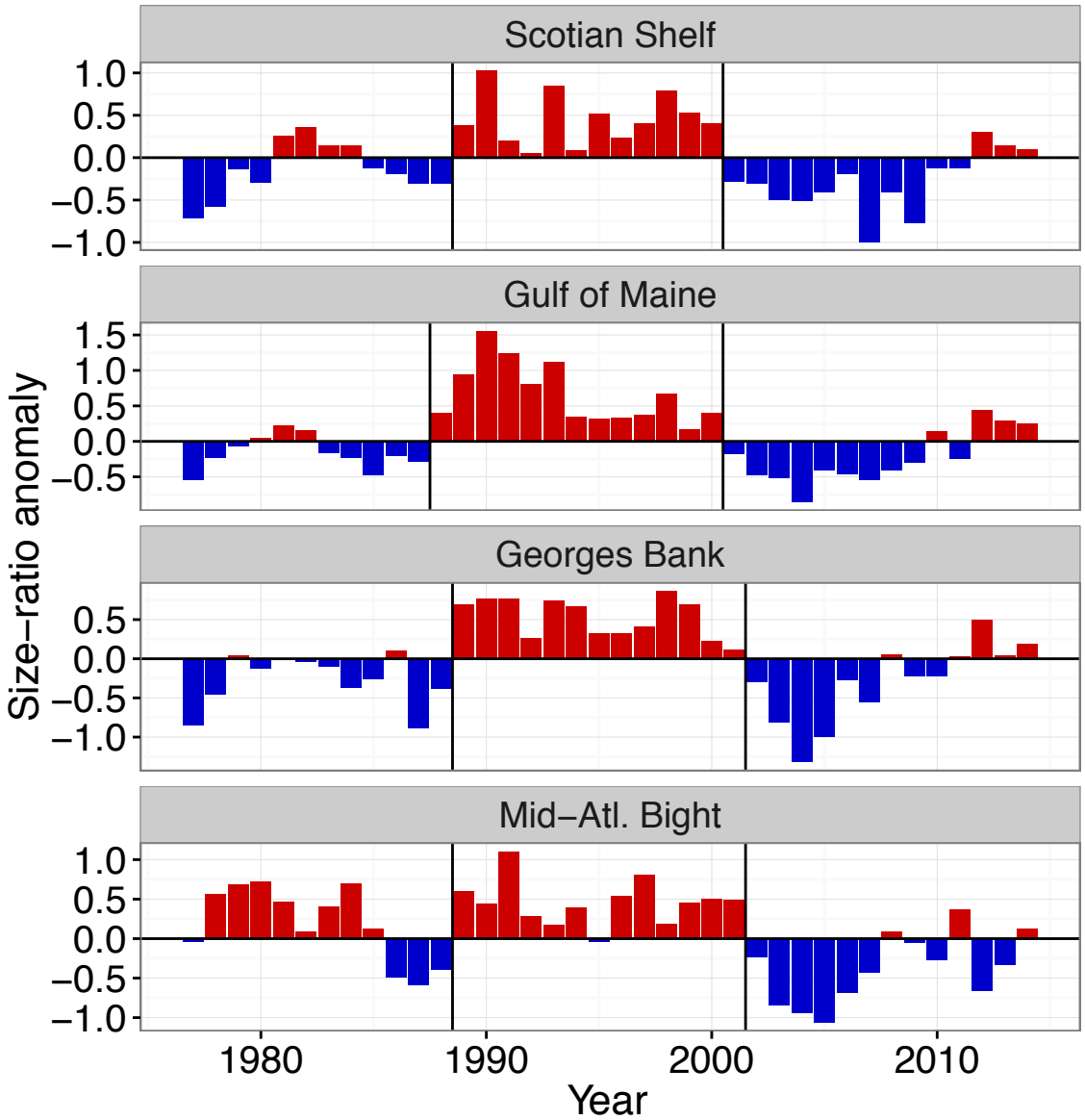
Copepod abundance regimes



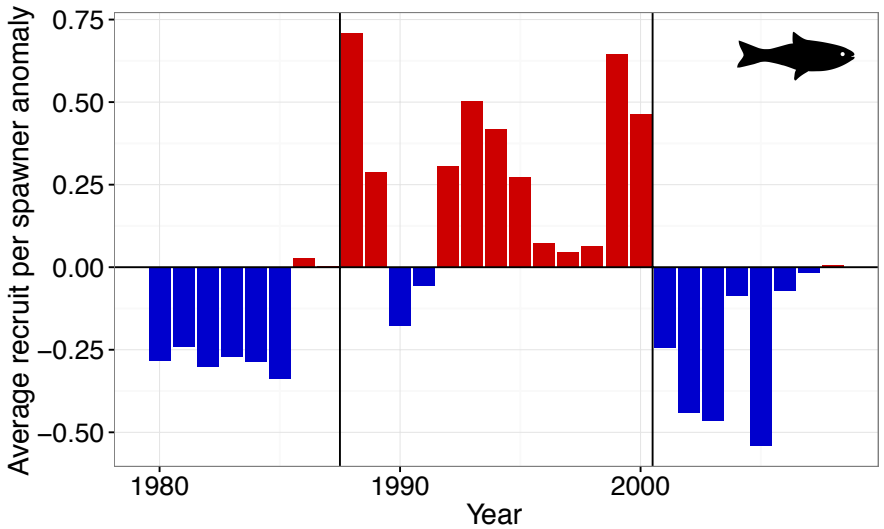


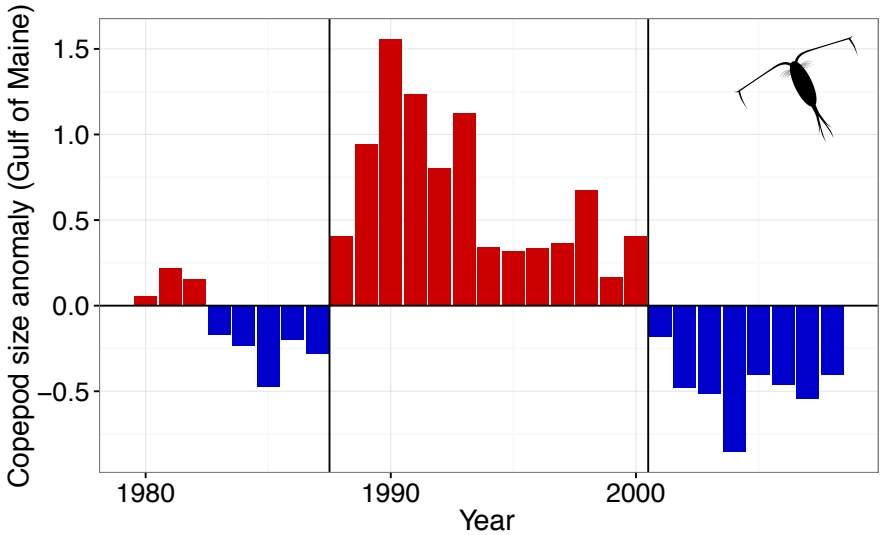
Copepod size regimes

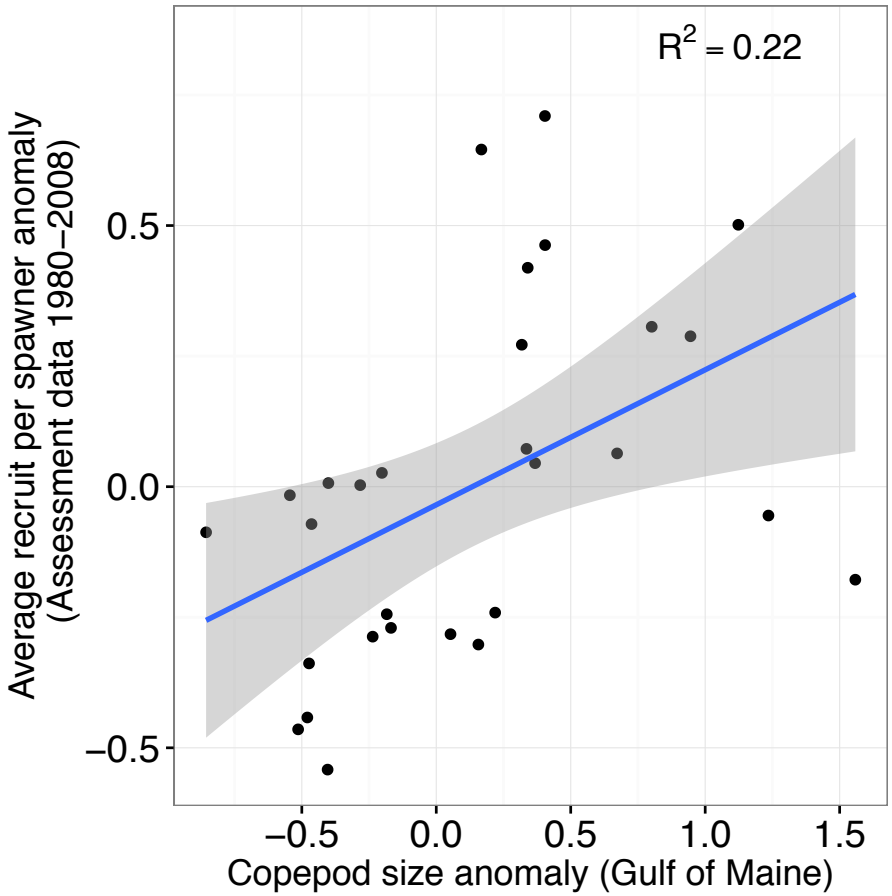




Do copepod regimes explain recruitment regimes?

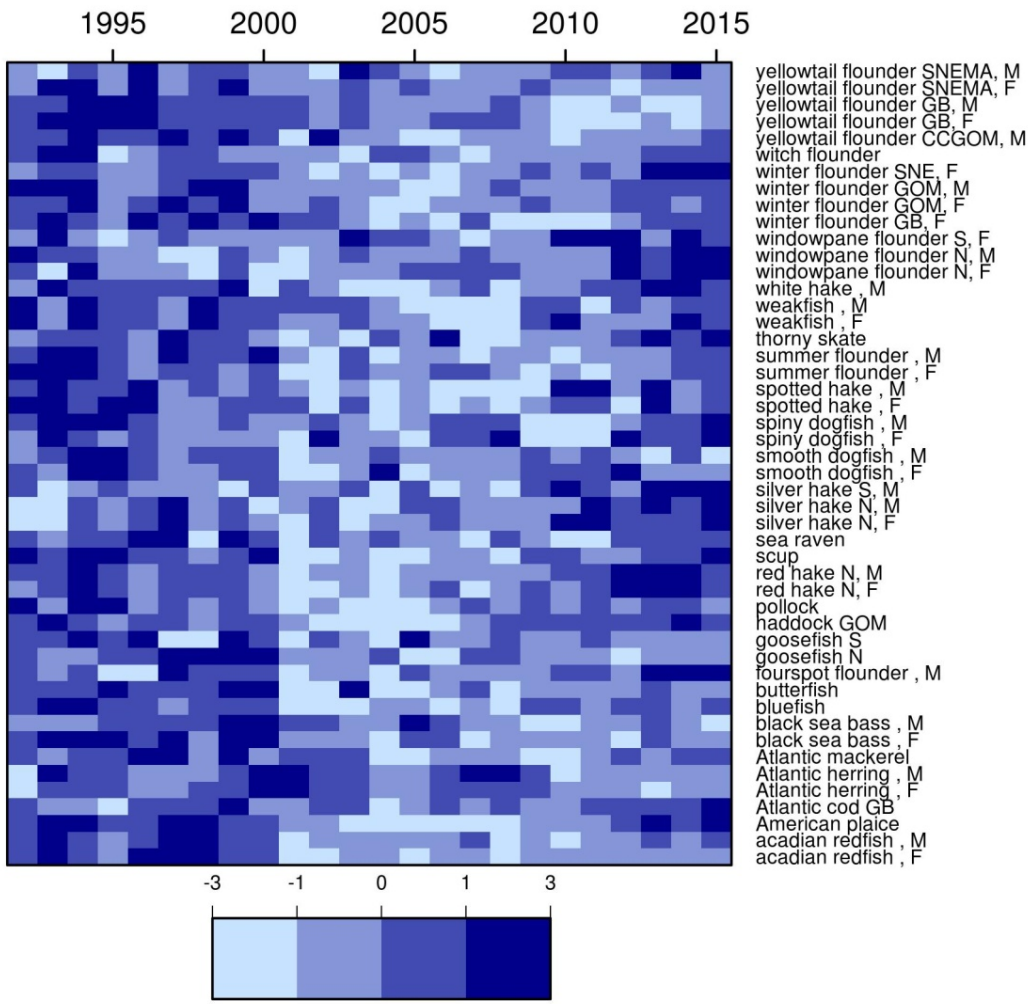




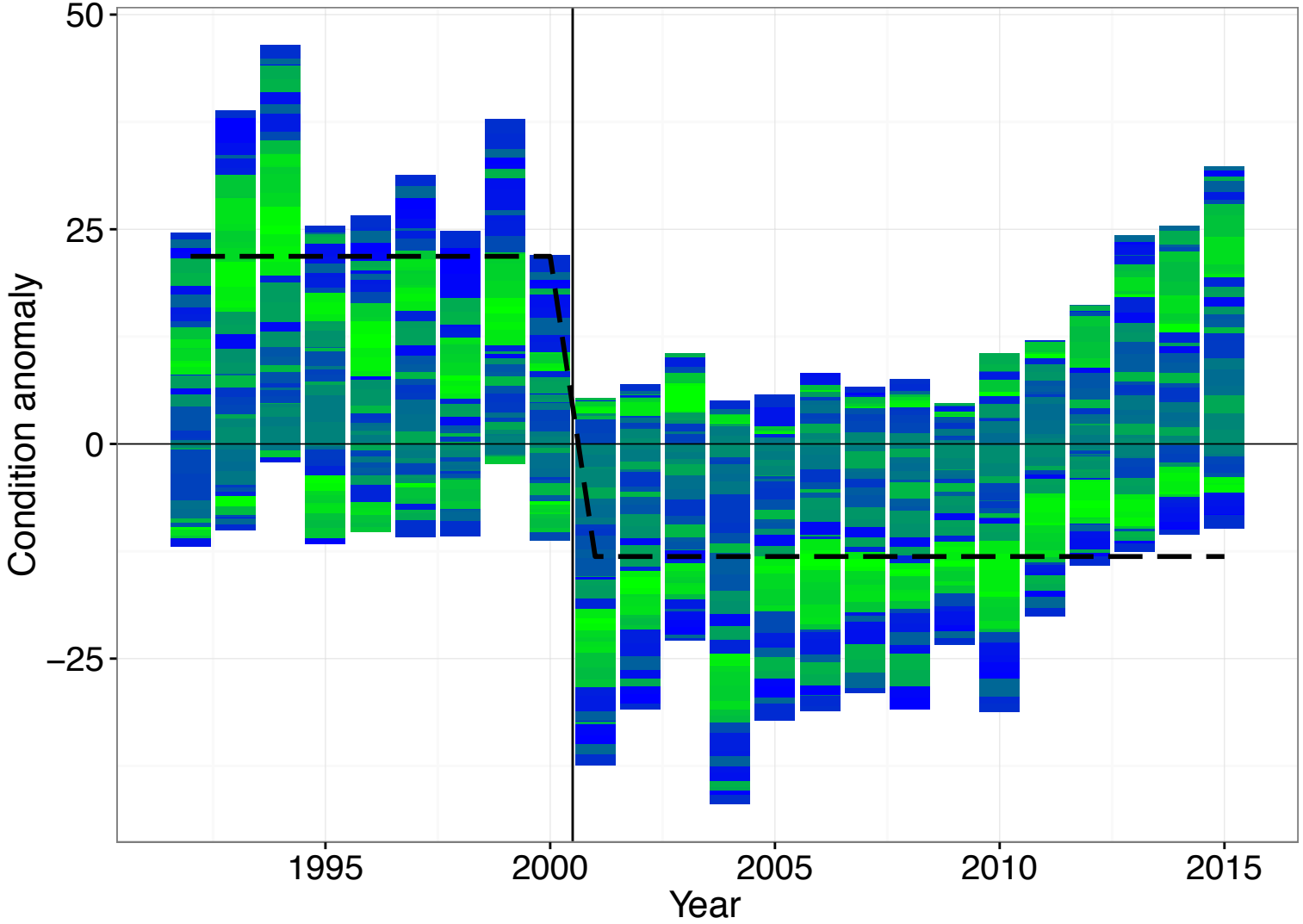


Fish condition

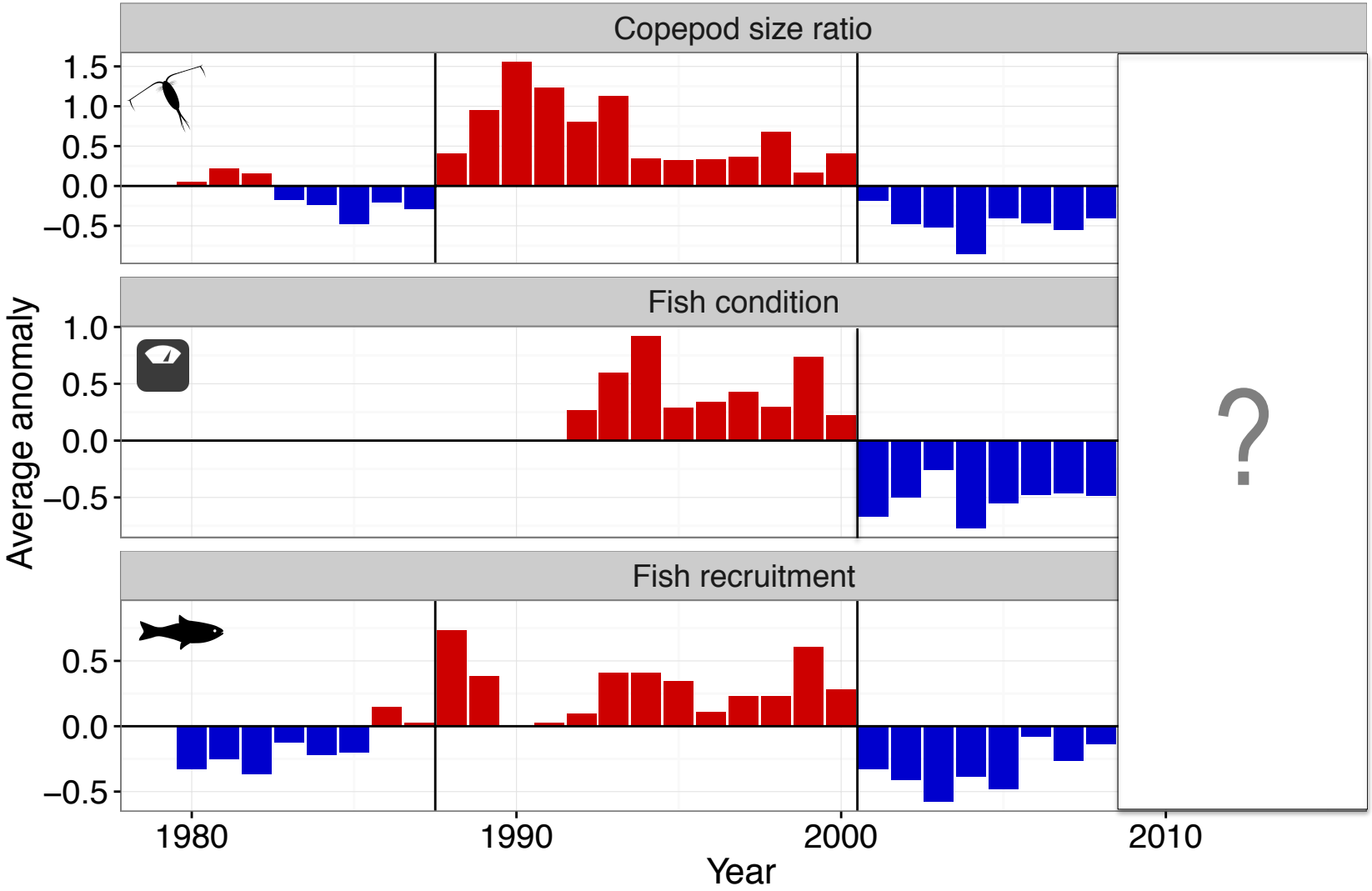
Fish condition



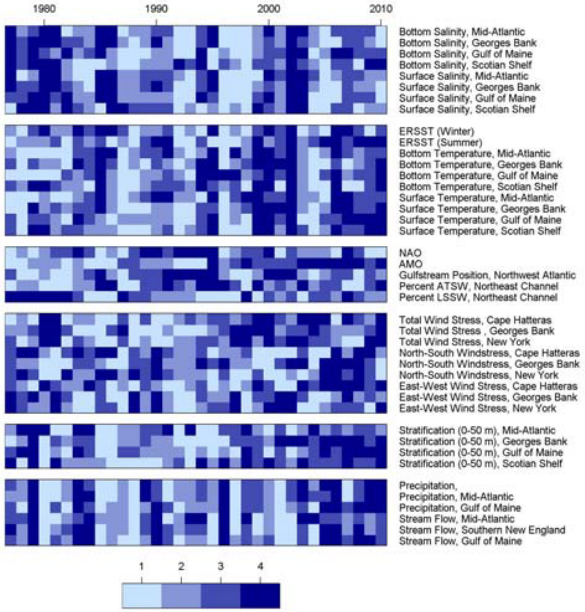
Fish condition regimes



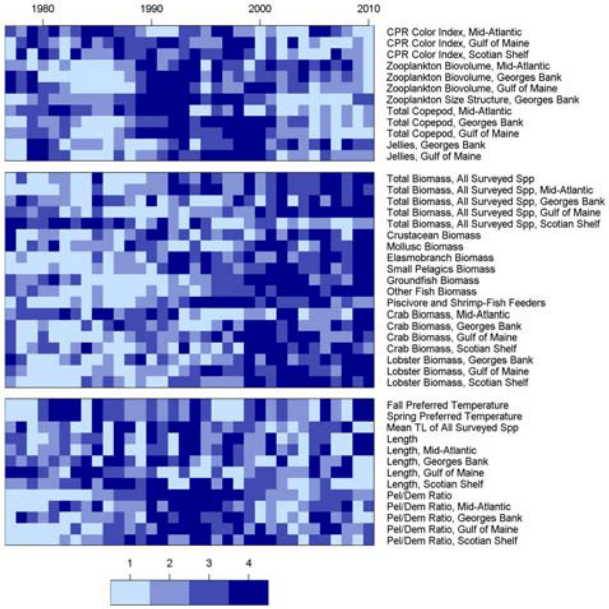
Do the relationships hold?



System-Wide Indicators

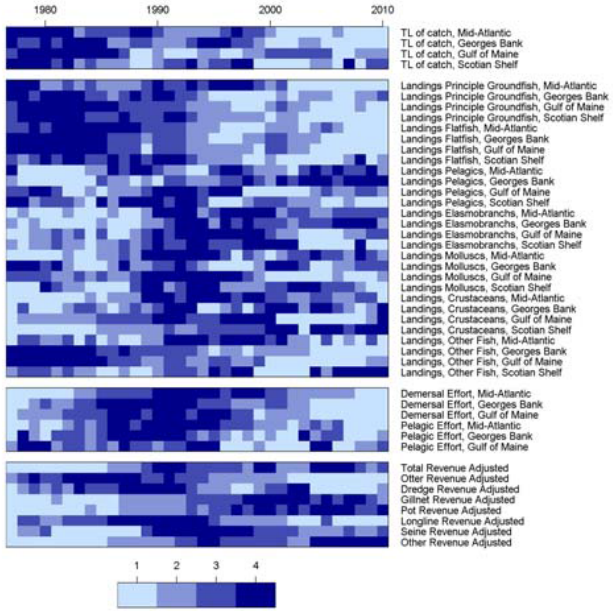


Physical variables

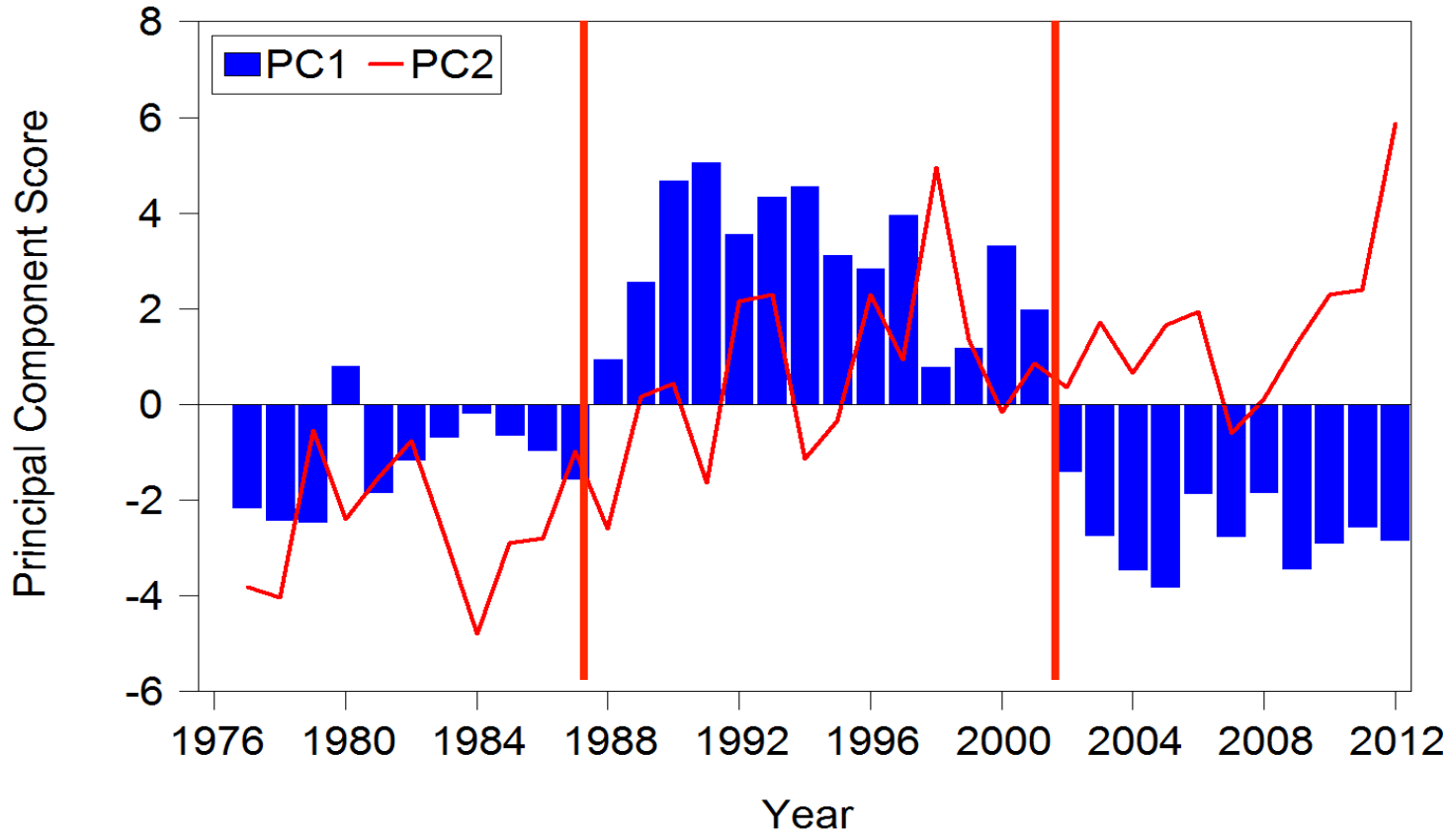


Ecological variables

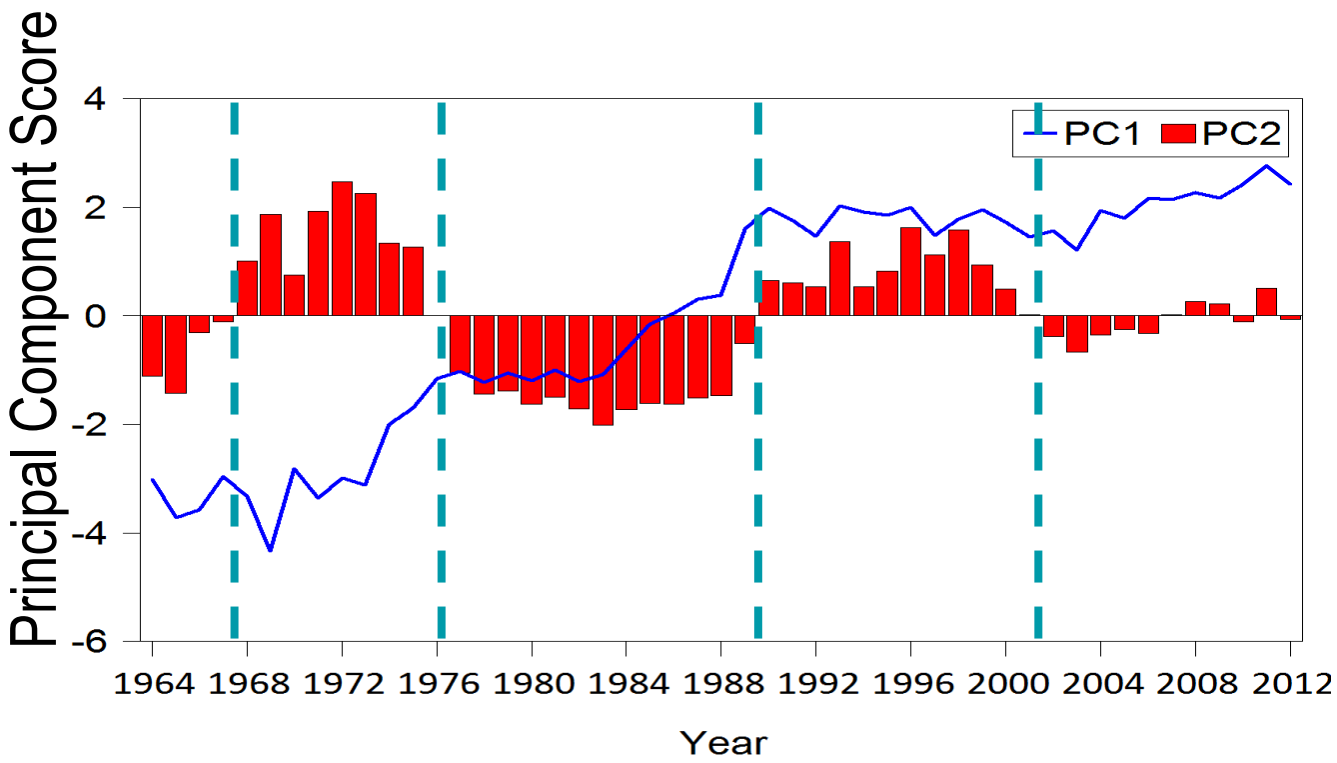
Human variables



A composite index for the Northeast Shelf: Physical & ecological data



A composite index for the Northeast Shelf: Catch composition data



Summary

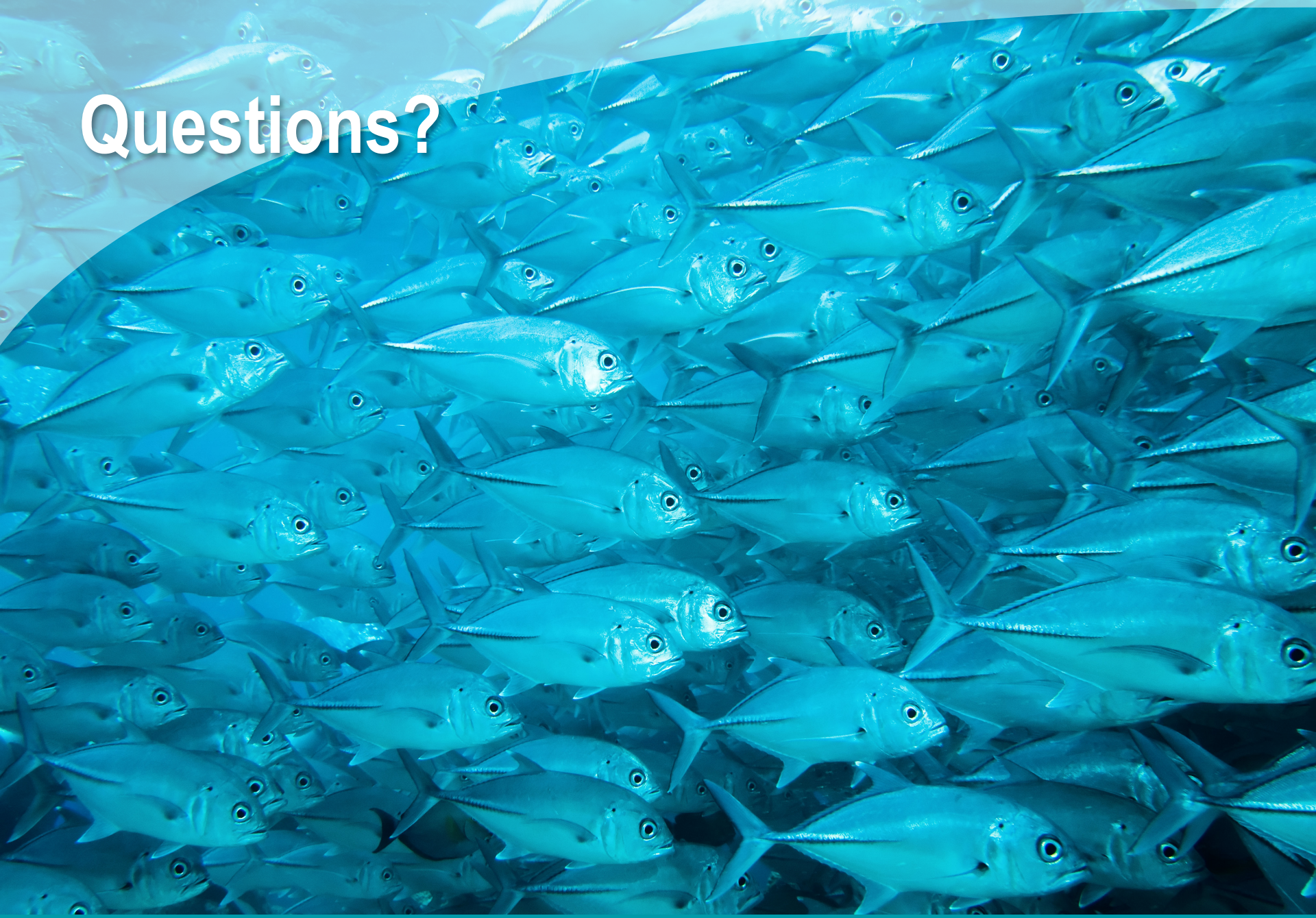
Two main points:

- Strong evidence for regimes on the NE Shelf.
- Regimes difficult to detect in any single species, but clear when looking at many species.

Two open questions:

- What drives these regimes?
- Are our management strategies robust to regimes?

Collaborators

- Mike Fogarty
- Laurel Smith
- Ryan Morse
- Sean Lucey
- NEFSC Climate, Ecosystems, and Habitat Study Group
- Regime Shift Working Group

Questions?