REASONS for classifying/comparing ecosystems

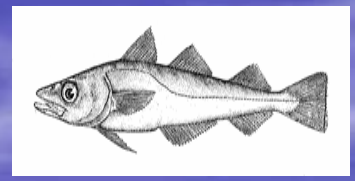
- “Predictability” of species response to perturbation (natural or anthropogenic) is both species-specific (e.g. life-history, mechanism) but also ecosystem specific.

- For example, resilience or stability may result from interplay of food web structure and climate variables.

- Individual mechanisms (climate -> species) may interact between species to give rise to “ecosystem” interactions.

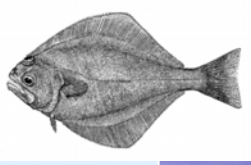
- Need “integrated” indicators.

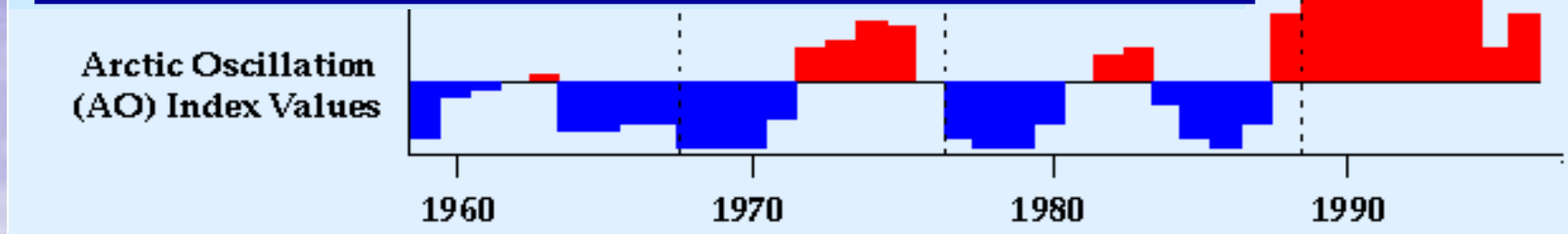
Bering Sea oscillating control hypothesis (OuCH) for Pollock



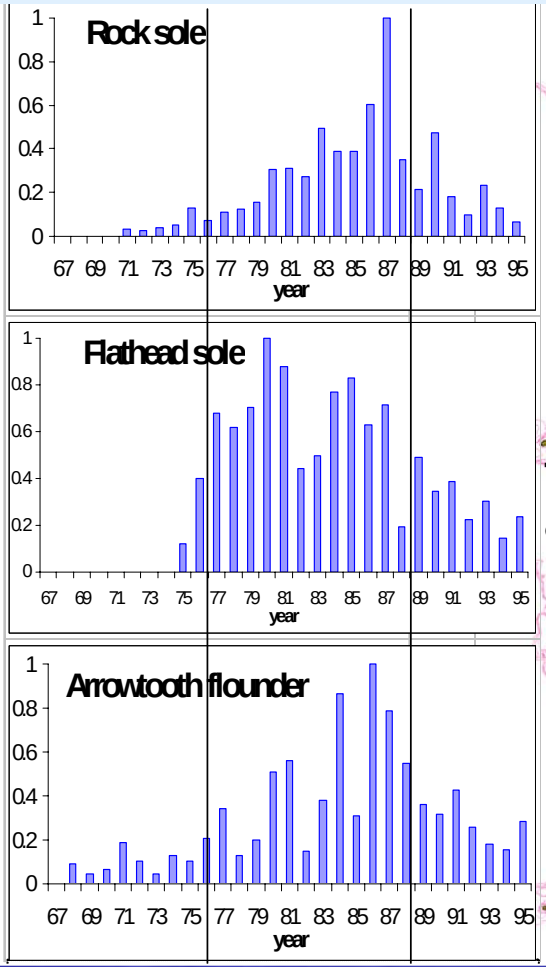
- Timing of spring sea ice retreat determines whether there will be an early, ice-associated bloom in cold water, or a late-spring, open water bloom in warm water.
- Copepods are sensitive to temperature, so production is greater in warm years.
- There is evidence that copepods are in high demand and there is food limitation for fish. In warm years, pollock survival is better.
- EXCEPT, after a few warm years, cannibalism becomes limiting, so good year classes are prevented by top-down control.
- Then when the cold years come again, go back to start.

Improve understanding of Climate effects on FISH RECRUITMENT (Wilderbuer et al.)



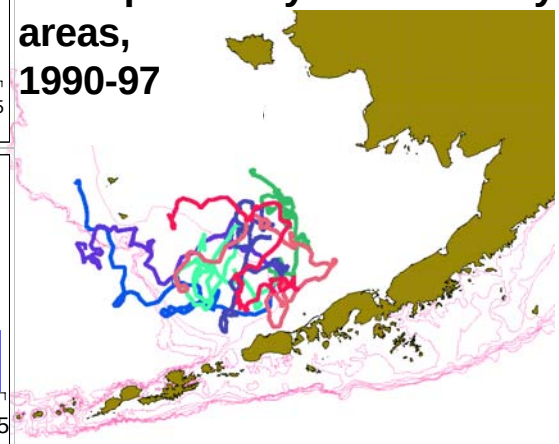


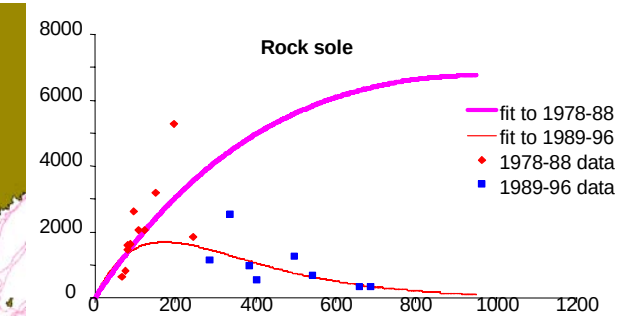
Relative Recruitment

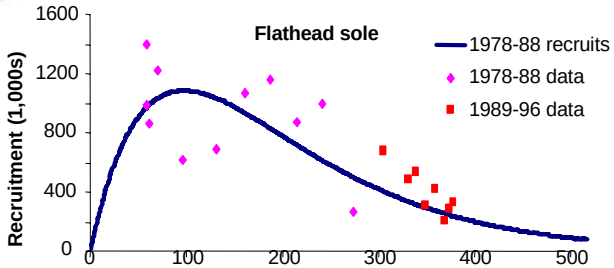


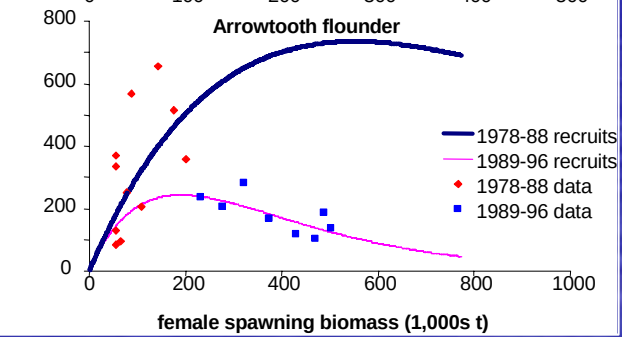
Transport to nursery areas, 1980-89

Transport away from nursery areas, 1990-97





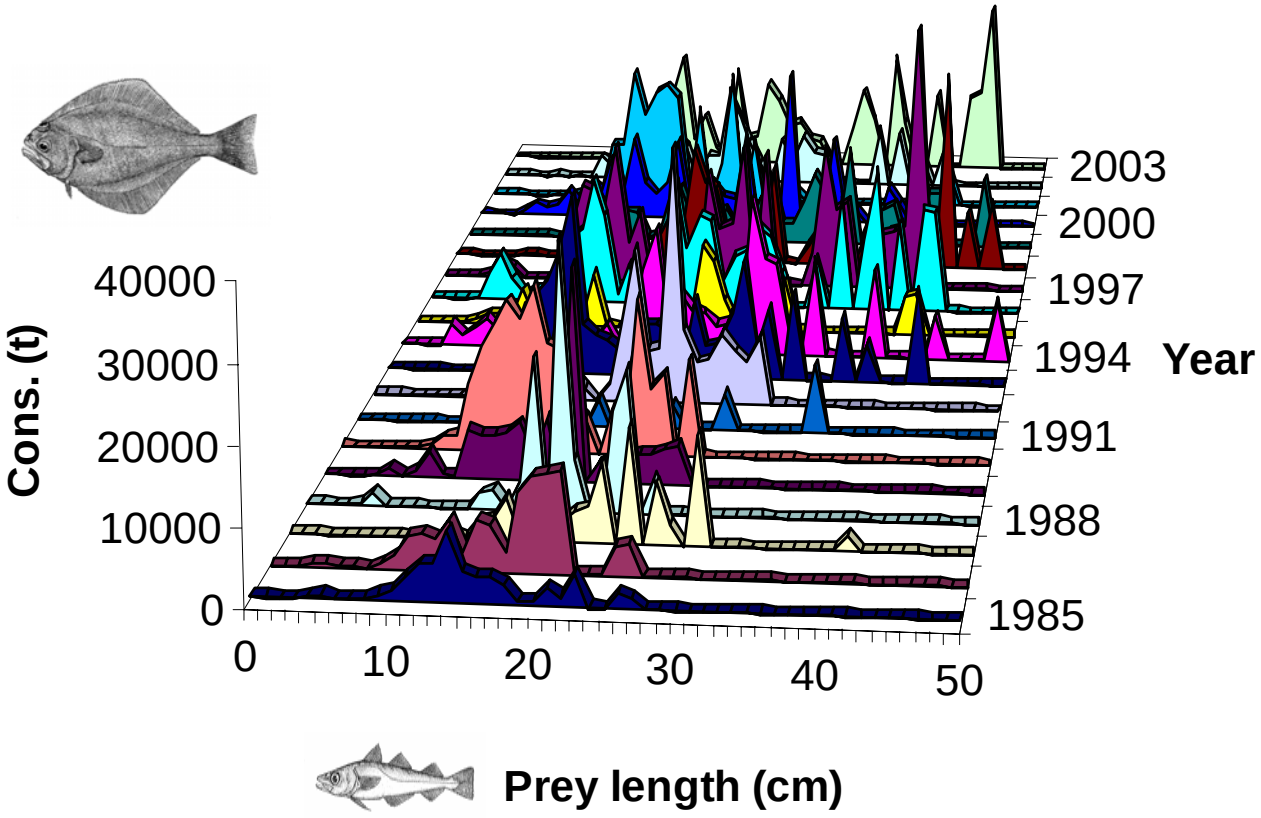




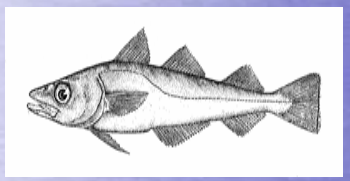
Recruitment (1,000s)

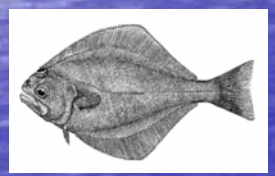
female spawning biomass (1,000s t)

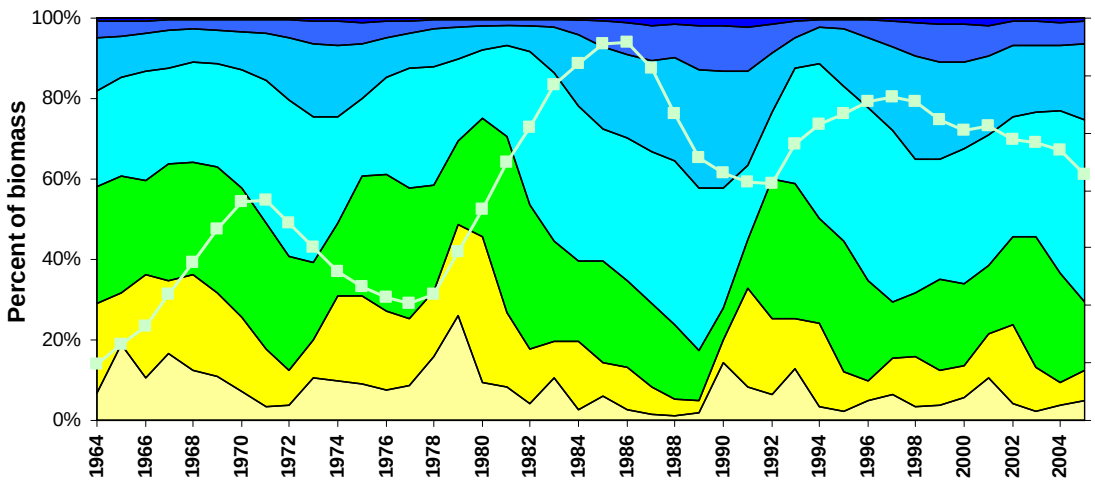
Arrowtooth summer consumption of pollock

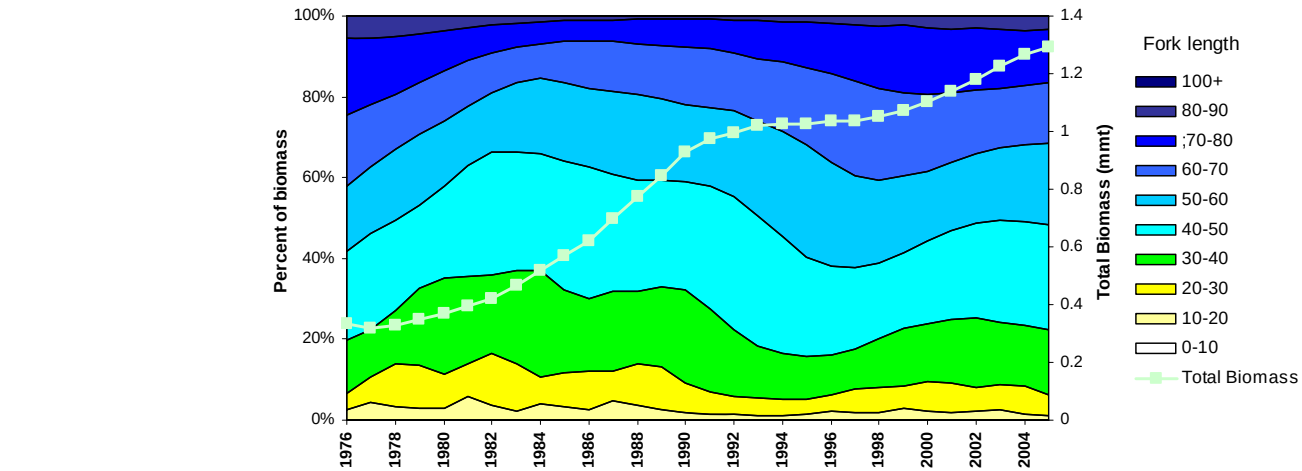


Interaction of mechanisms?



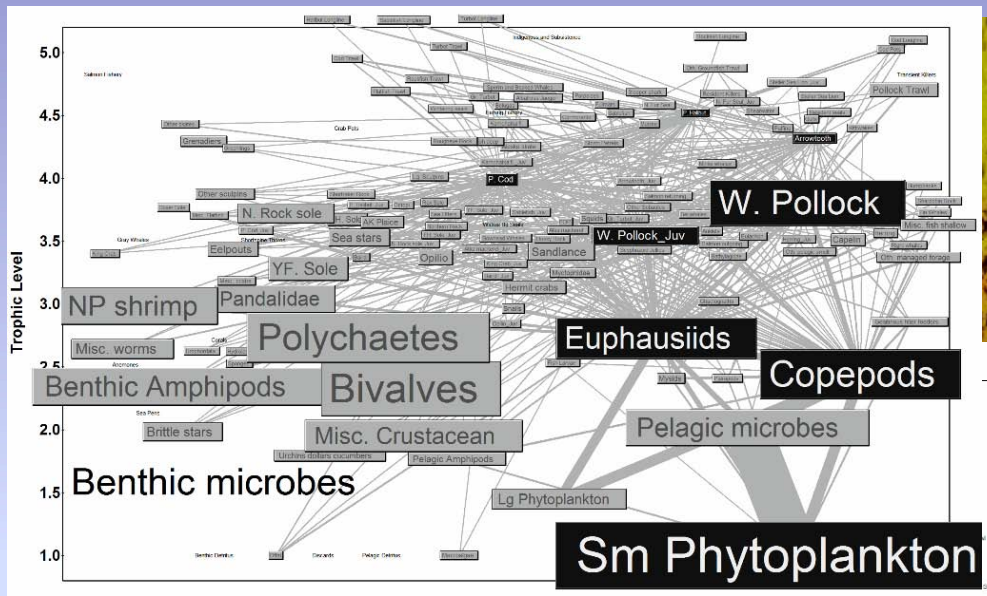


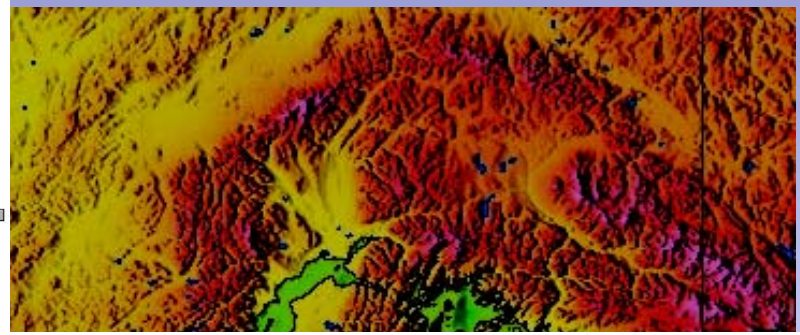


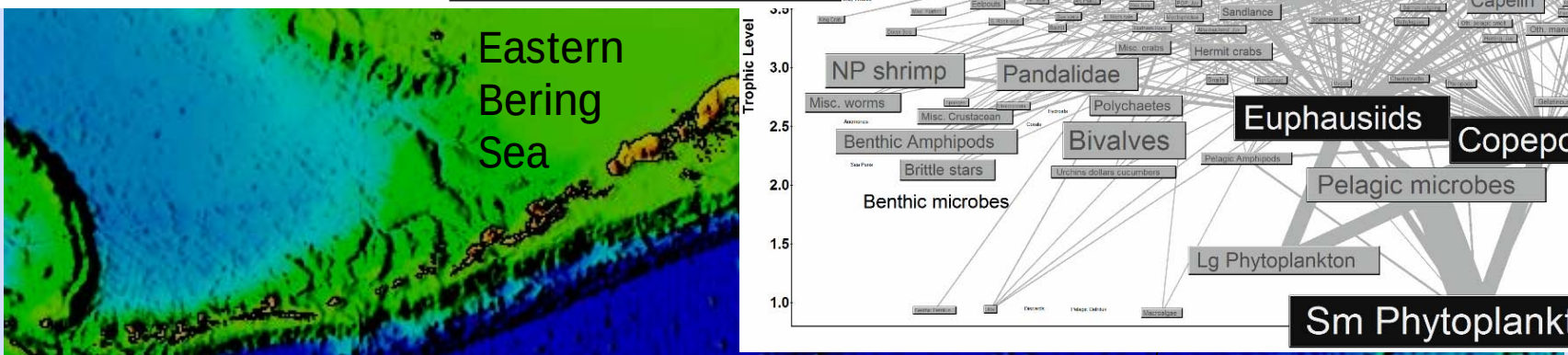


If the rules change, is there a larger pattern?

Frequency-based indicators: The Two Ecosystems



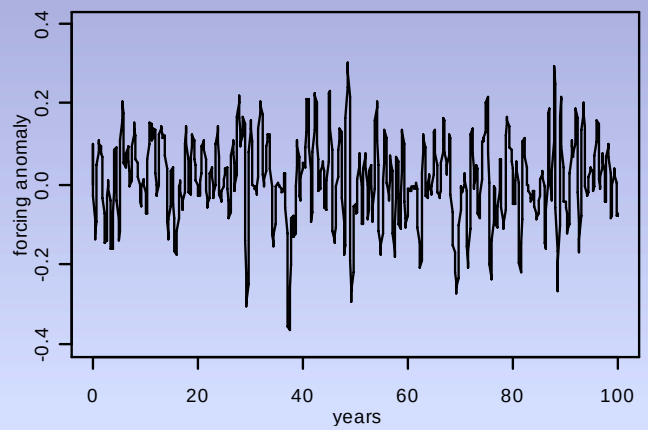




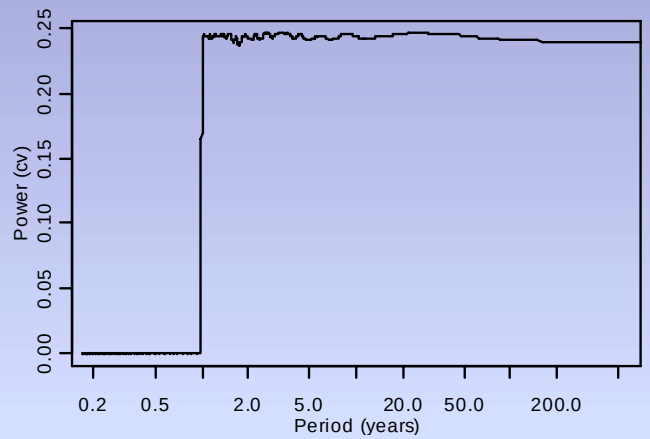
Structural type → Biological Regime: "Climate" forcing

$$dB/dt = P(Prey, B)_t - L(Predators, B)_t + \varepsilon(B,t)$$

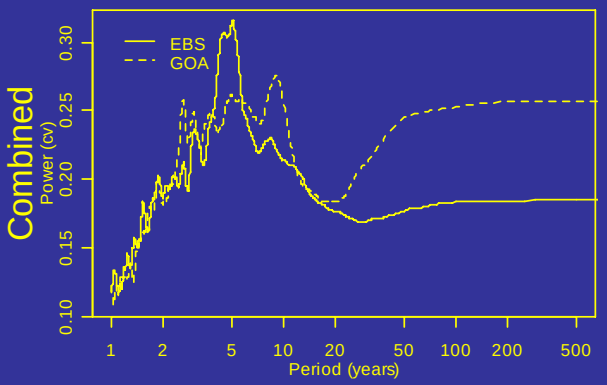
ε (time domain)



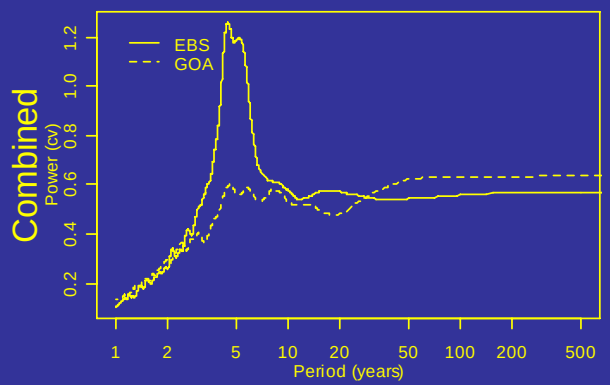
ε (1/frequency domain)



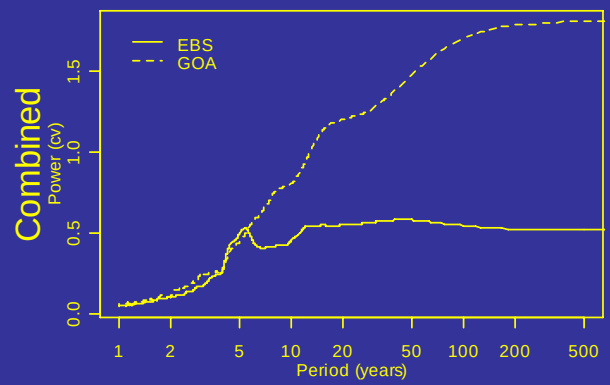
Euphausiids



Juvenile Pollock



Adult Pollock



Conclusions?

- Structure of a food web may determine how predictable a system is under perturbation.
- This result is model-dependent but data-driven. (Same model for each system, but different data). If there is no/wrong model, can data and indicators tell us the same message?
- What if climate noise is not “white” (e.g. regimes) and dominant responding species are adapted to the regime type?
- This is independent of MECHANISM. What about mechanism species-by-species mechanism? Or is this a good background over which to lay regime-specific mechanisms?