

# Macroecological patterns of trophic structure and community stability in marine ecosystems

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# Outline

## Background

## Spatial patterns and predictors

- Data & methods
- Results
- Emergent questions

## Time-varying patterns (*in progress*)

- Approach & preliminary findings

## Community stability (*in progress*)

- Approach & preliminary findings

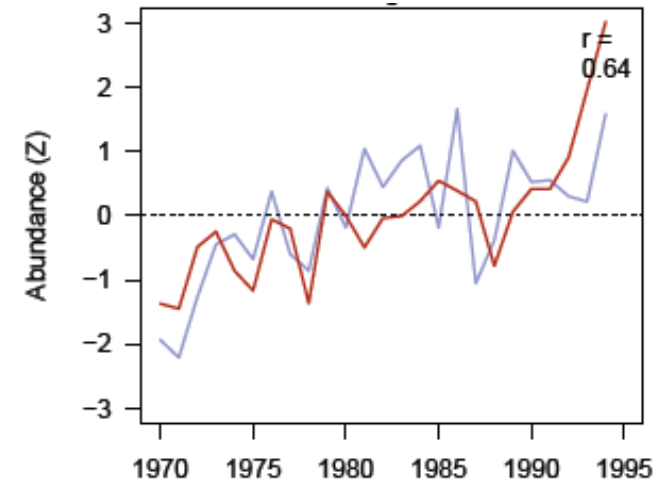
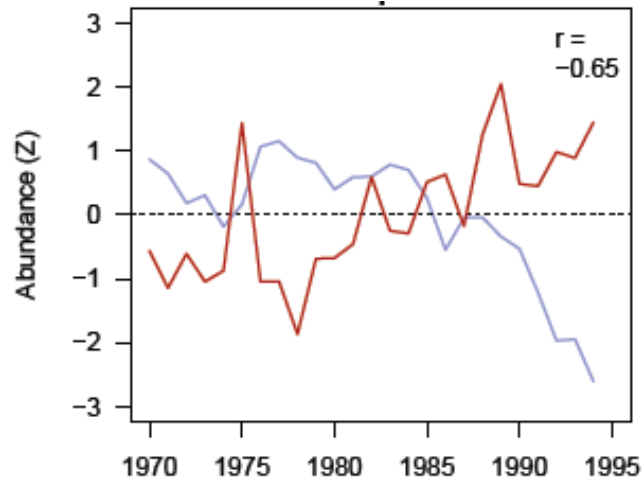
## Summary



# Trophic control

Trophic control: population regulation through resource control or predation pressure

Statistical state indicator: predator-prey interaction



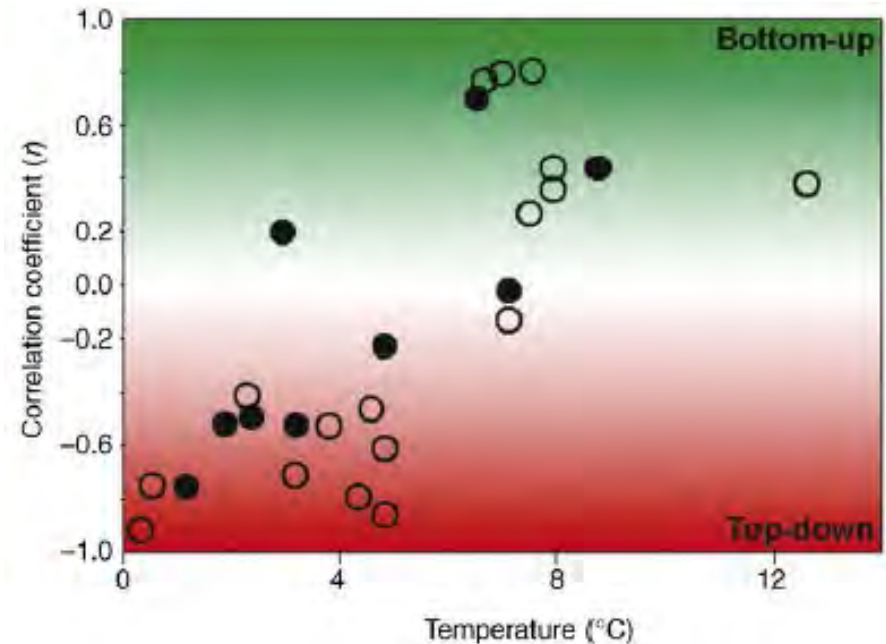
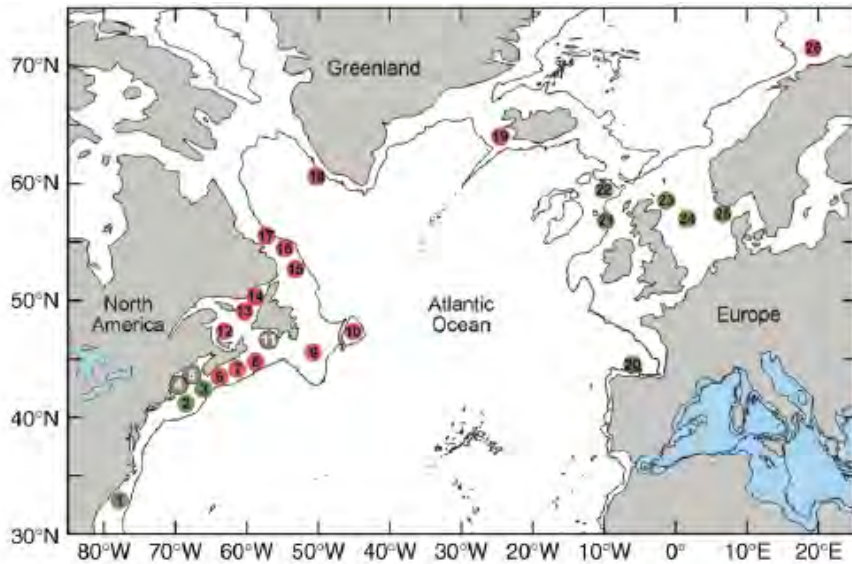
# Trophic control: Macroecological scales

Micheli 1999: n=24

- Consumer control dissipates through the foodweb

Frank et al. 2005, 2006, 2007; Petrie et al. 2009: n=23

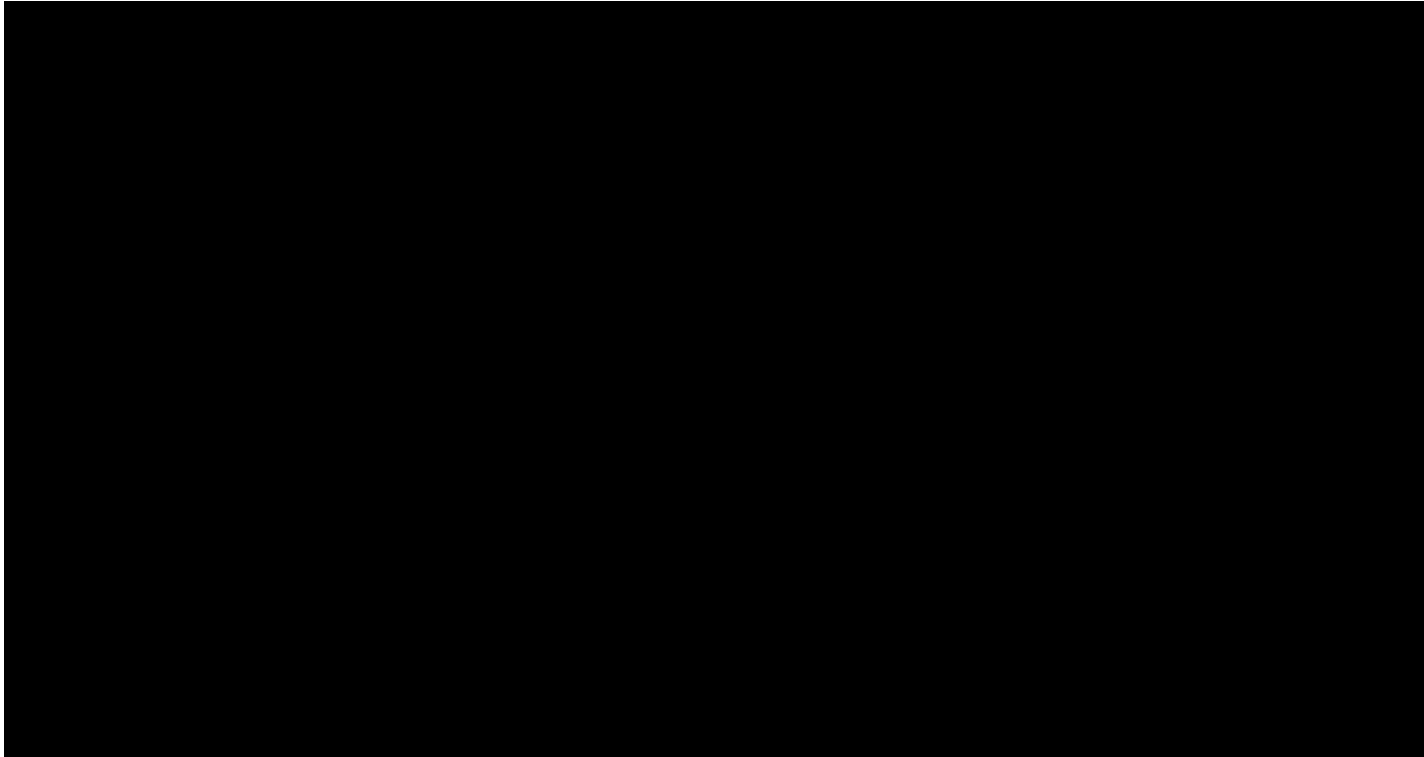
- Temperature, species richness, exploitation



# Methods: trophic data

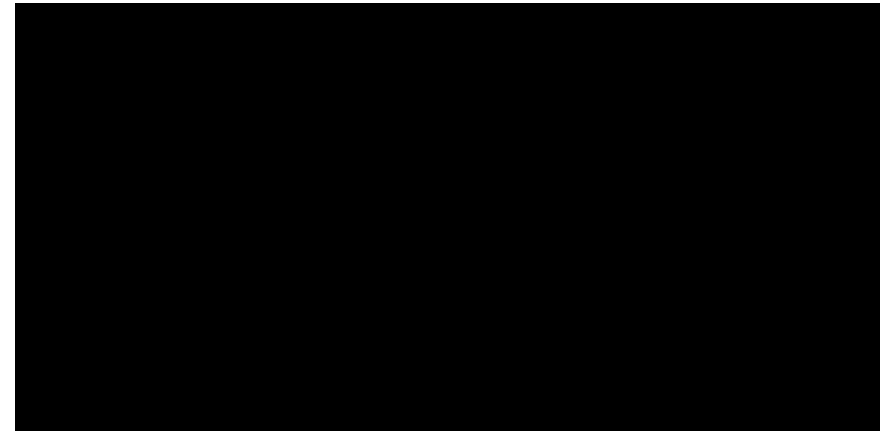
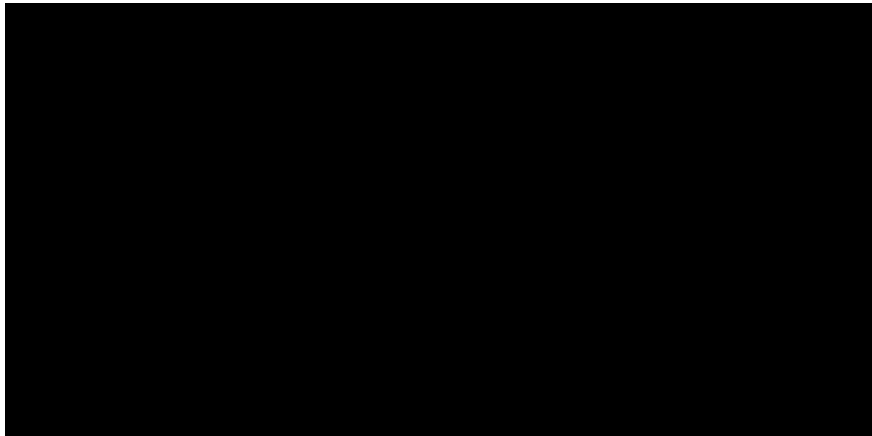
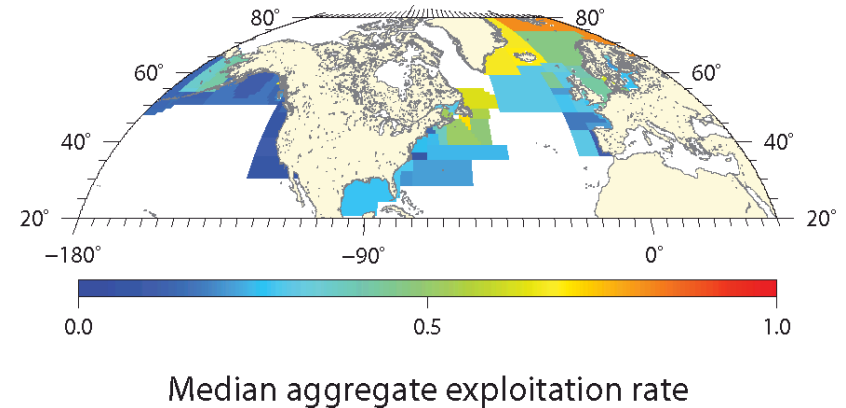
Published studies conducted in marine pelagic zone:

- 155 r values; 52 studies
- 1950 to 2010
- TLs 1-5



# Methods: environmental data

- N=45 biophysical variables: according to 9 leading hypotheses
- Spatially merged with trophic database



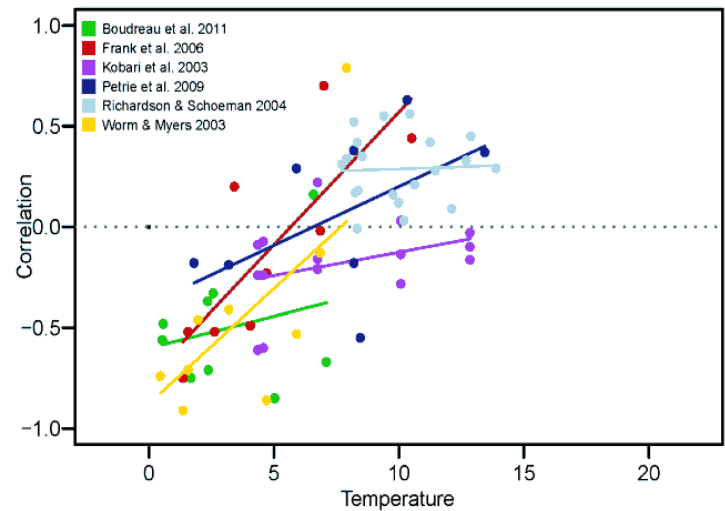
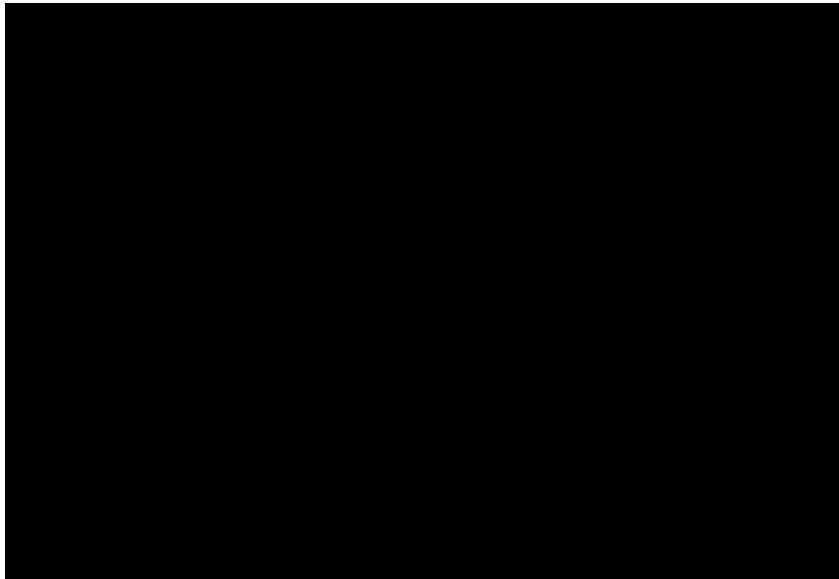
# Results: predictors of trophic control

Multivariate model:  $r^2=0.48$

$$r = \beta_0 + \beta_1 SST + \beta_2 SST^2 + \beta_3 Diversity + \beta_4 Diversity^2 + \beta_5 Turnover + \beta_6 Diameter + \beta_7 TL + \epsilon$$

Univariate temperature model:  $r^2=34\%$

- Robust effects: TLs, locations, time, studies



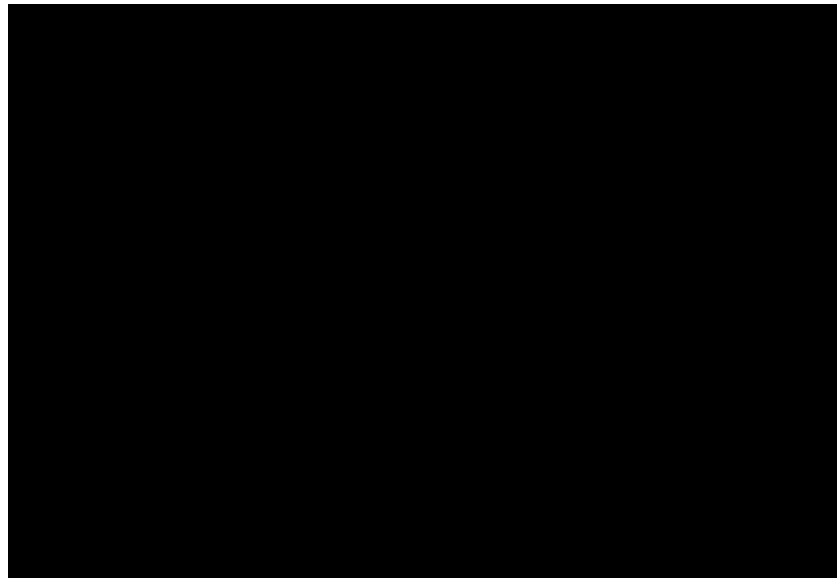
# Emergent questions

## **1) Trajectories of trophic control:**

- Does trophic control vary over time?

## **2) Community stability:**

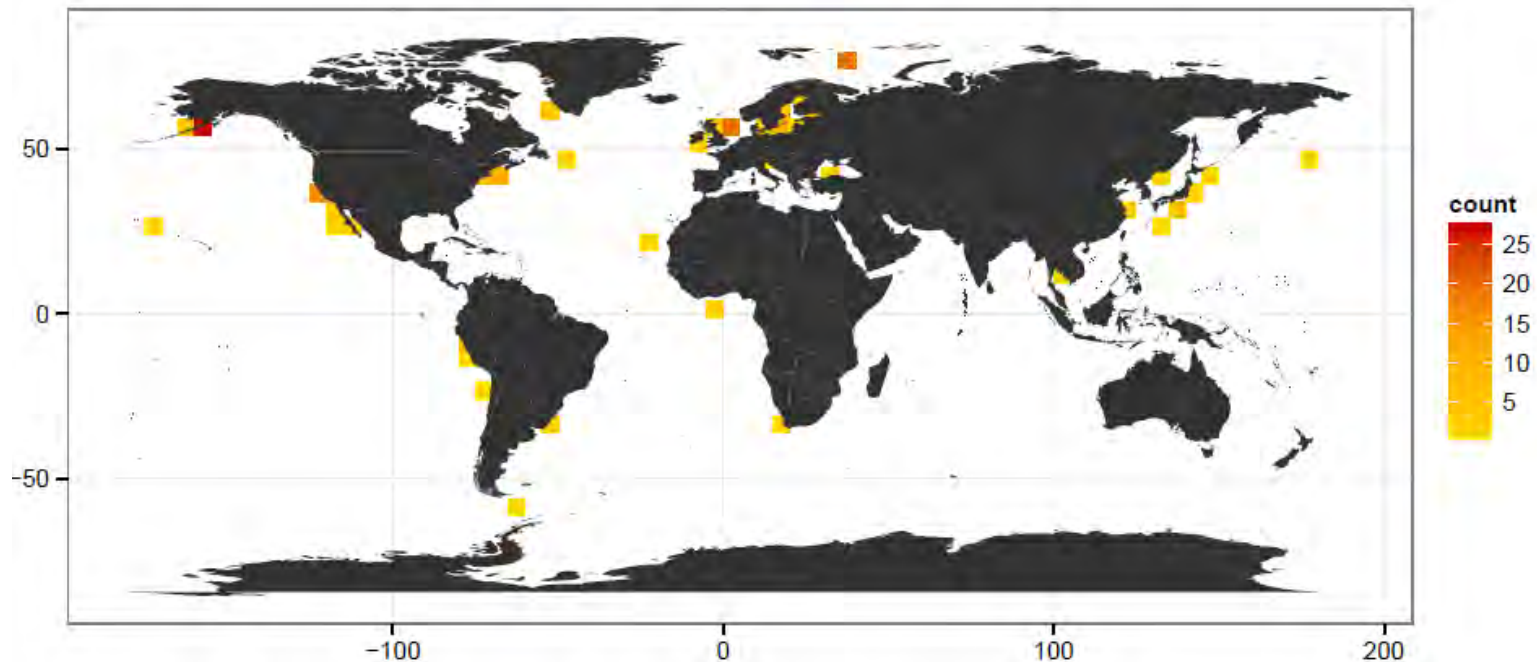
- Consumer-controlled systems in colder waters less stable?





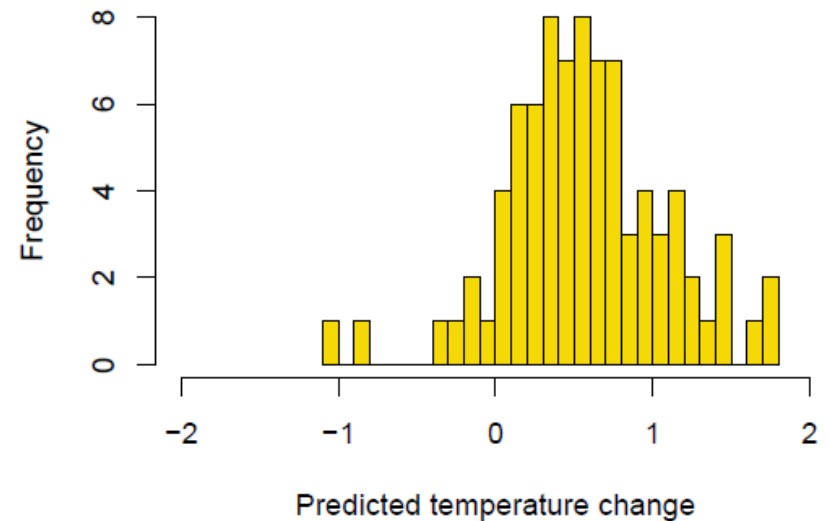
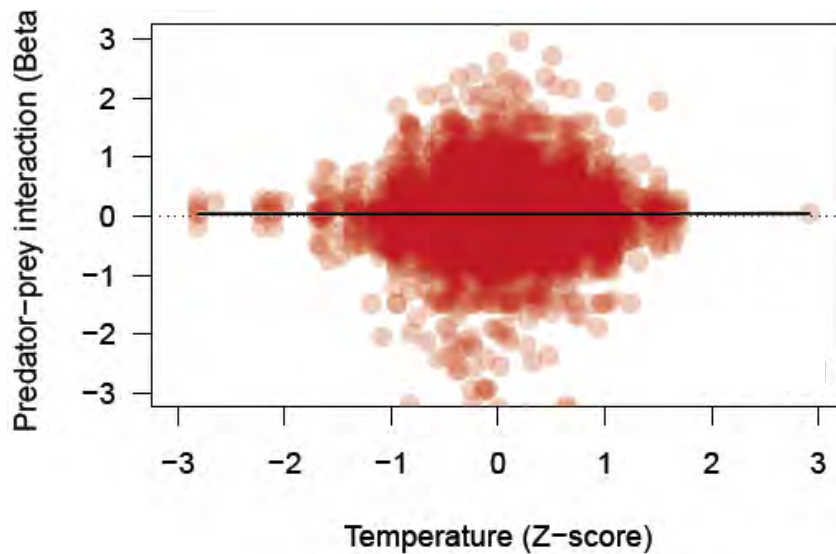
# Methods: time-series data (*in progress*)

- 1) Stock assessments (n=500)
- 2) Surveys (n=15)
- 3) Published studies (n=112)
  - 50/112 studies entered; 293 PP pairs; 1950 to 2012



# Preliminary results: Time-varying patterns

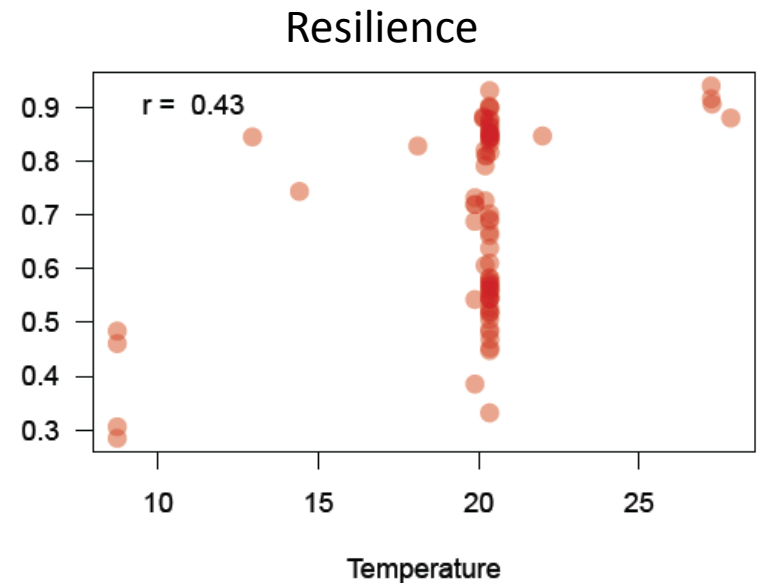
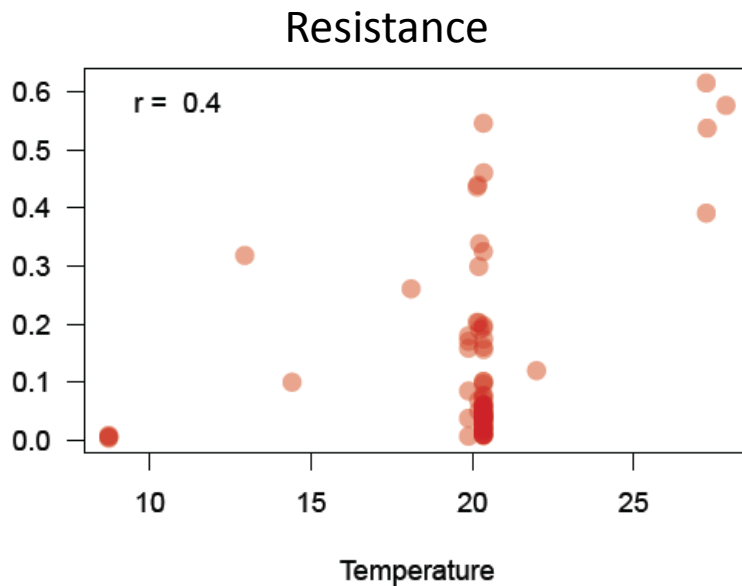
- Dynamic modeling: state-space
- Time-series of trophic interactions estimated at each location
- Spatial temperature range  $\sim 22$  °C; temporal range  $\sim 1.8$  °C



# Preliminary results: stability

Britten *et al.*, 2014: MAR(1) method: May, 1978, Ives *et al.* 2003

- Stability: resilience, resistance, reactivity
- Predator-prey time-series spanning >40 yrs: N=79



Warmer locations = higher diversity, resource control, increased stability

# Summary

Spatial: average water temperature related to spatial patterns of trophic control

\*Temporal: trends in trophic control unrelated to temperature (globally)

\*Stability: stability of trophic interactions related to average water temperature

# Acknowledgements

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