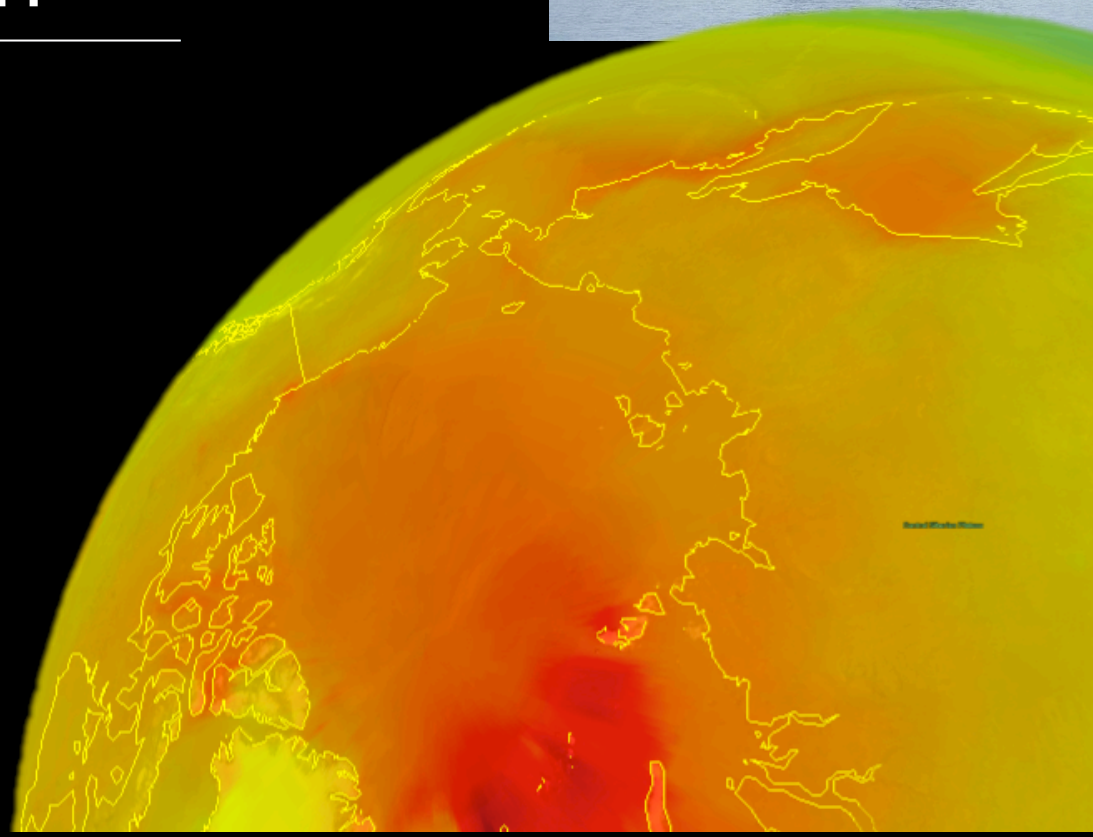
Adaptation approaches for climate-ready fisheries management



Malin Pinsky

Rutgers University

Fishery

Fish

Fishery

Habitat

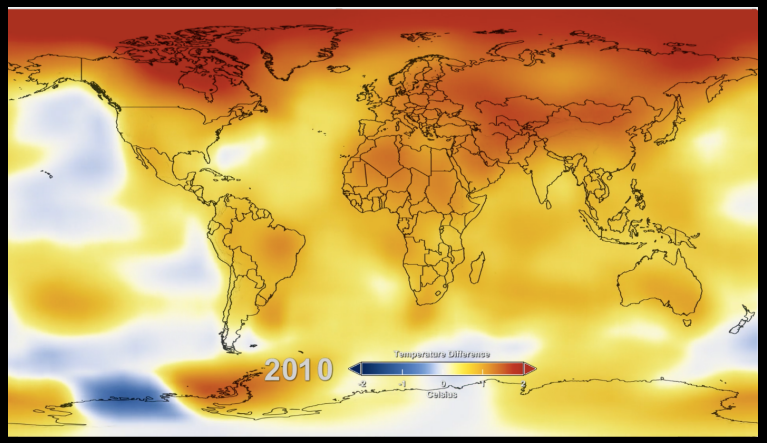
Species interactions

Fishery

Habitat

Climate

Species interactions

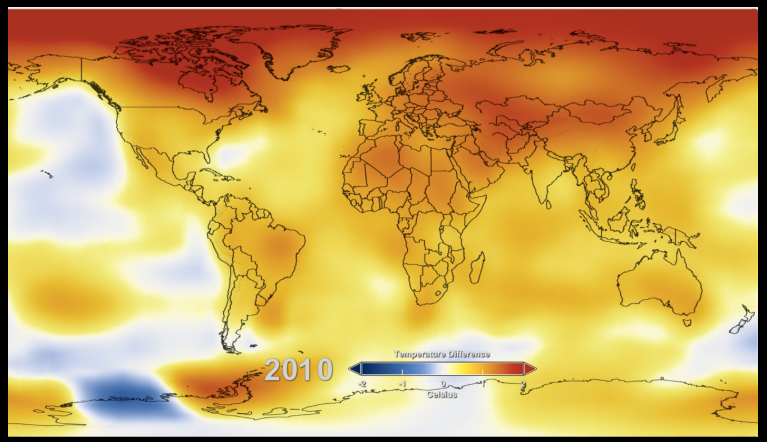


Fishery

Habitat

Climate

Species interactions



Fishery

Habitat

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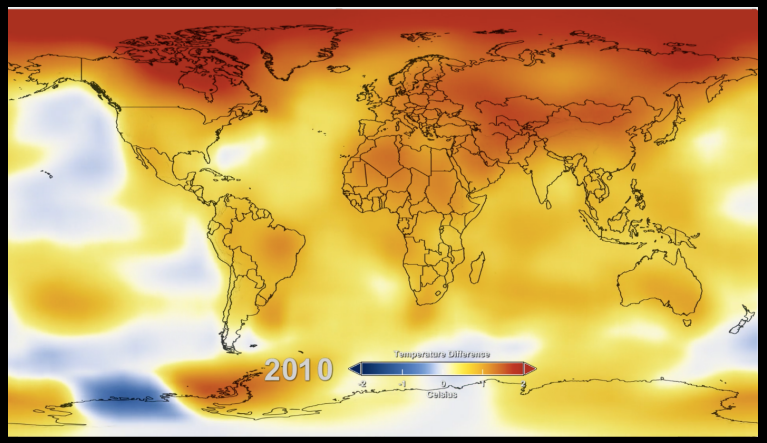
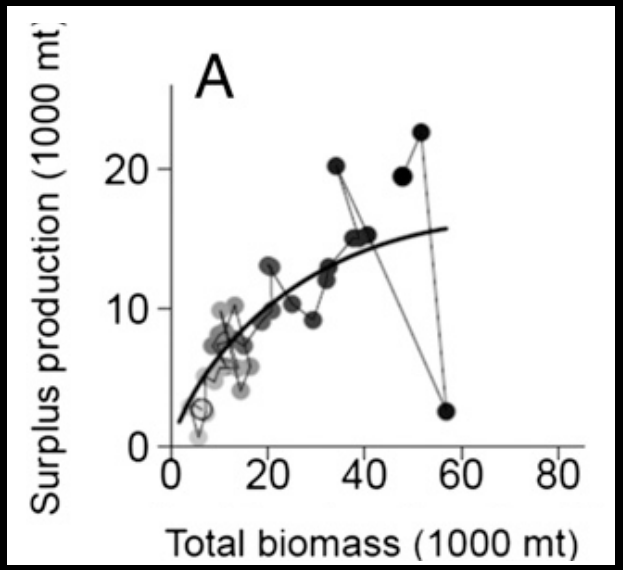
Species interactions



Environmental impacts are common

Abundance

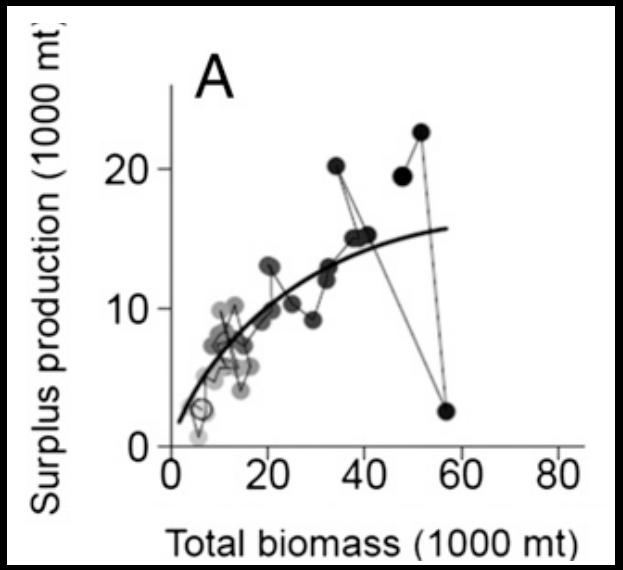


Atlantic cod
Norway

Vert pre et al. 2013 PNAS

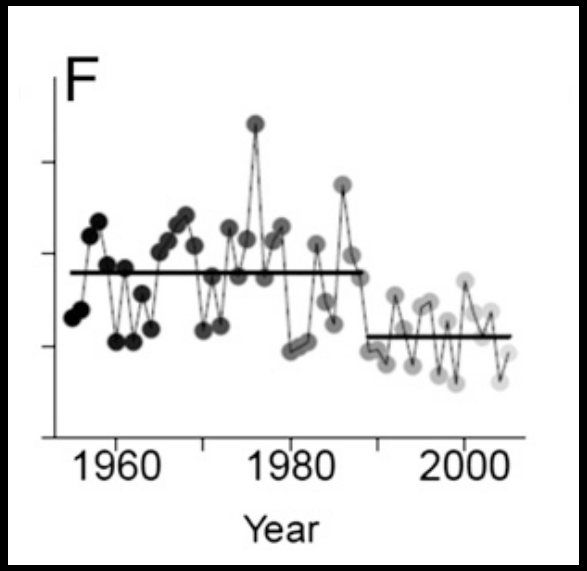
Environmental impacts are common

Abundance



Atlantic cod
Norway

Environment

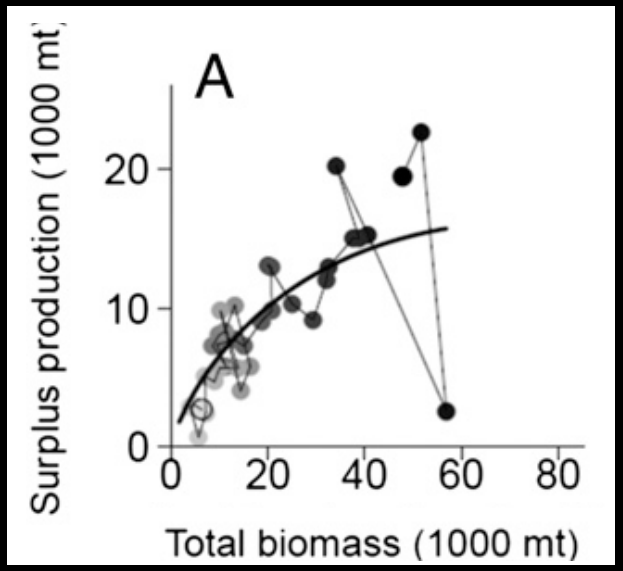


Atlantic cod
Iceland

Vert pre et al. 2013 PNAS

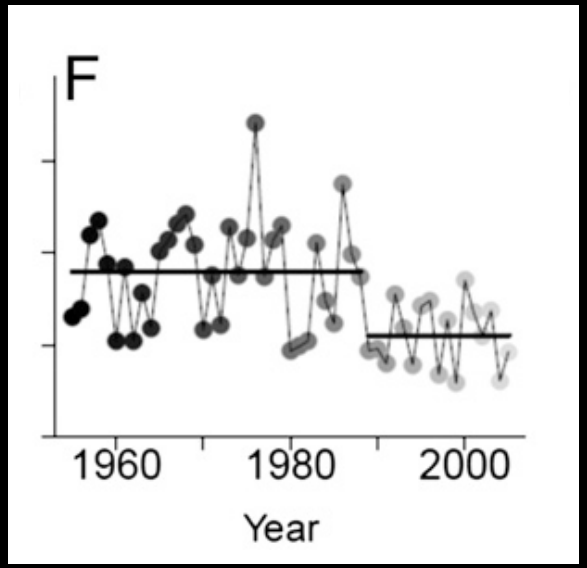
Environmental impacts are common

Abundance



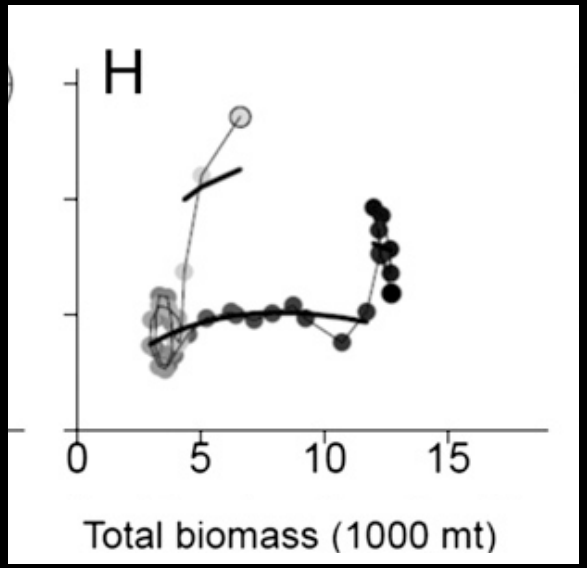
Atlantic cod
Norway

Environment



Atlantic cod
Iceland

Abundance + Environment



Petrale sole
California

Vert pre et al. 2013 PNAS

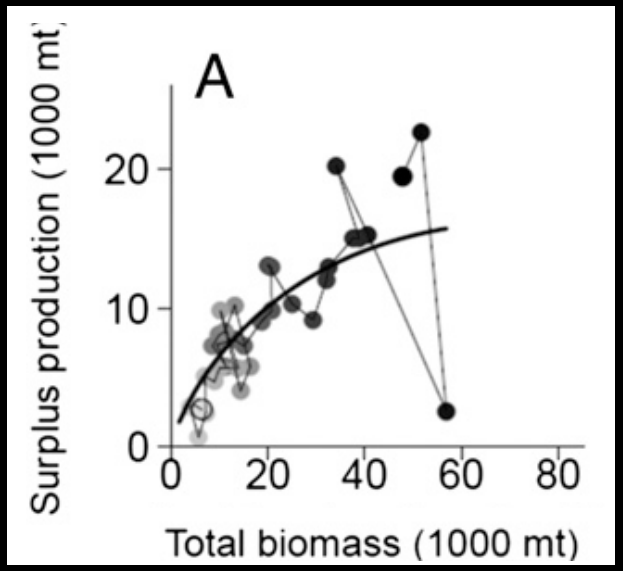
Environmental impacts are common

72%

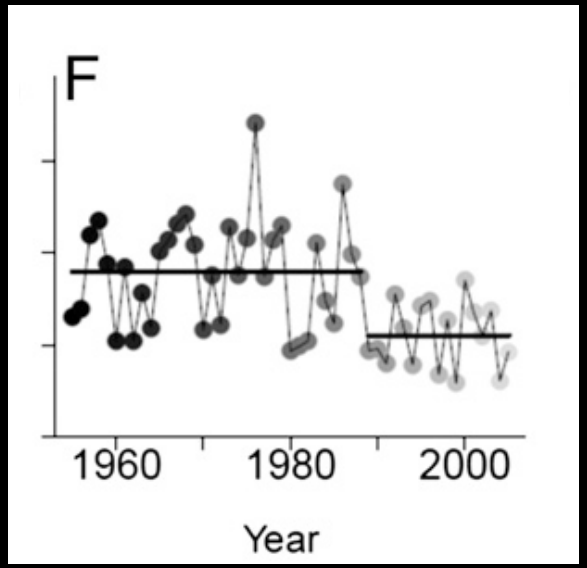
Abundance

Environment

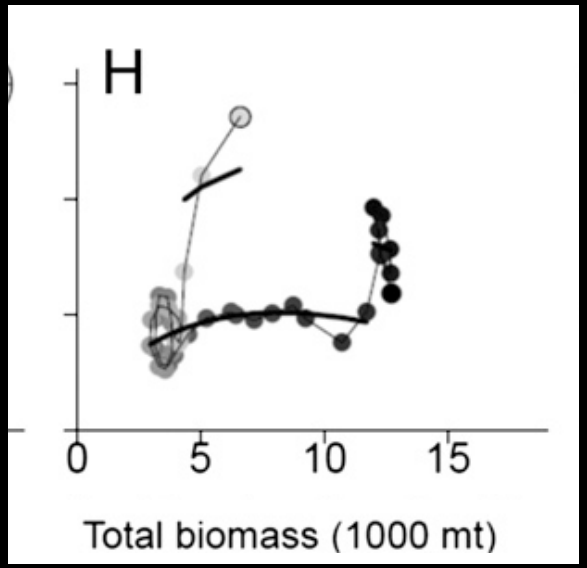
Abundance + Environment



Atlantic cod
Norway



Atlantic cod
Iceland



Petrale sole
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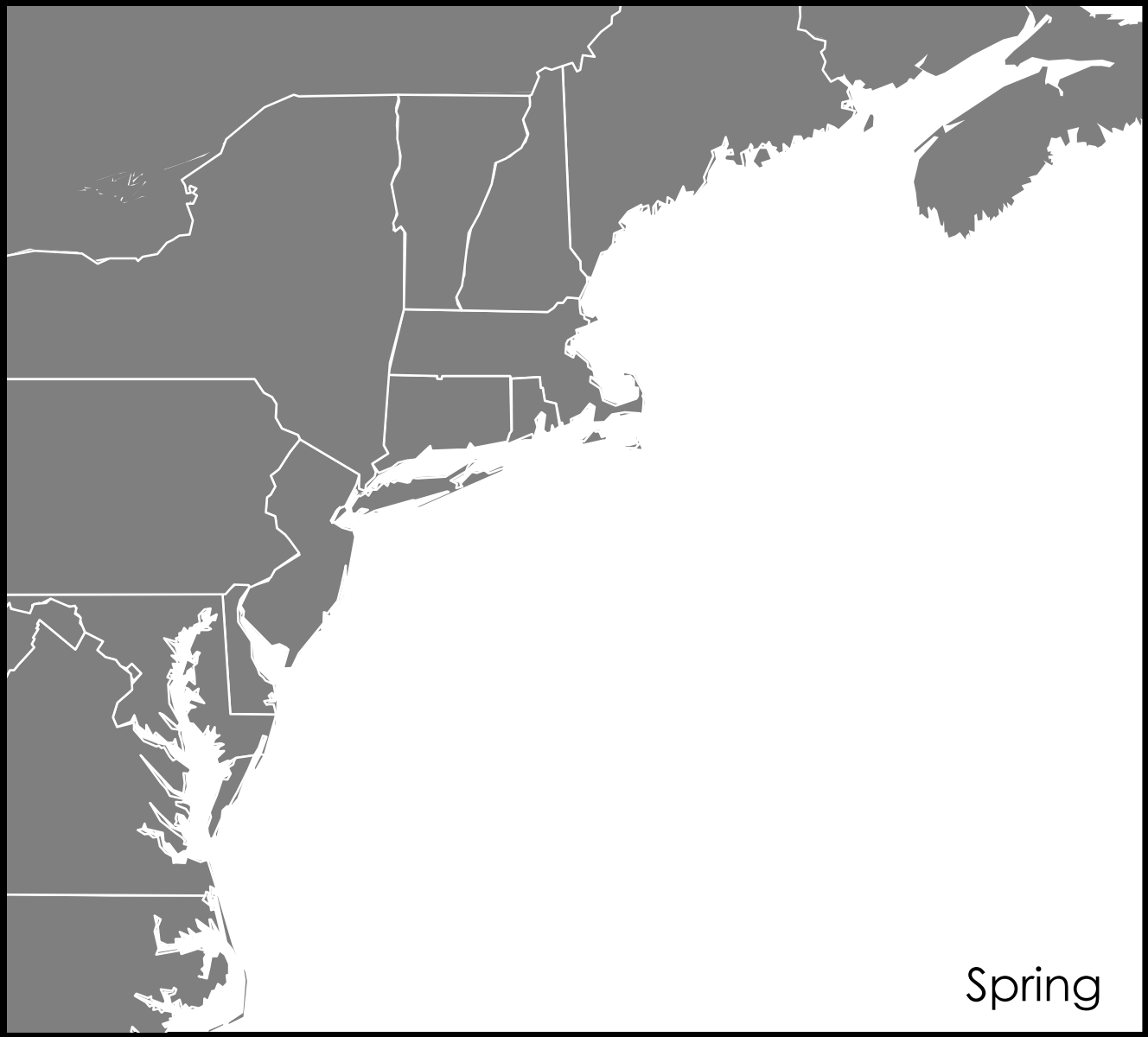
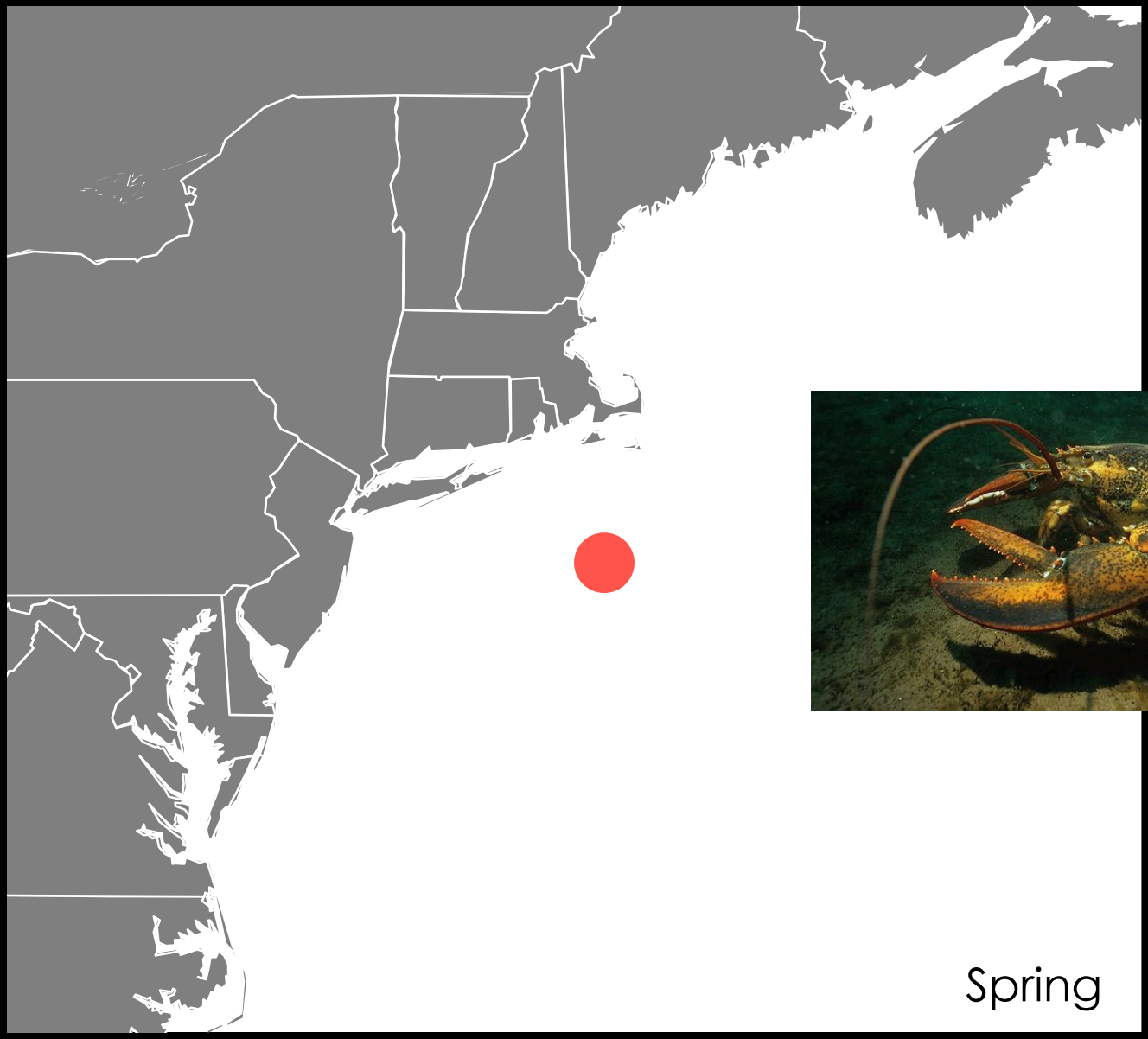
Vert pre et al. 2013 PNAS

Distribution shifts 1968-2008



Distribution shifts 1968-2008



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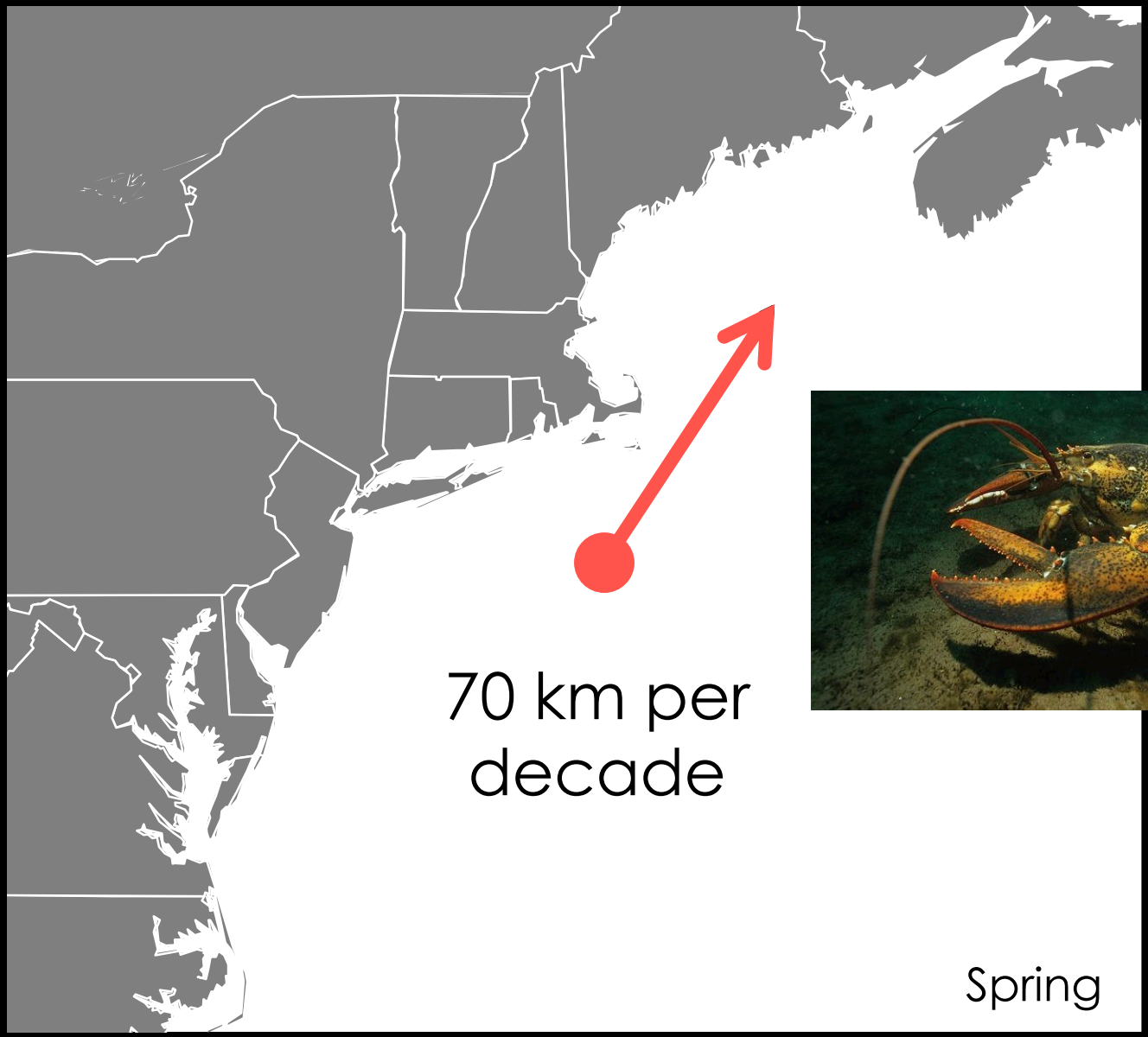

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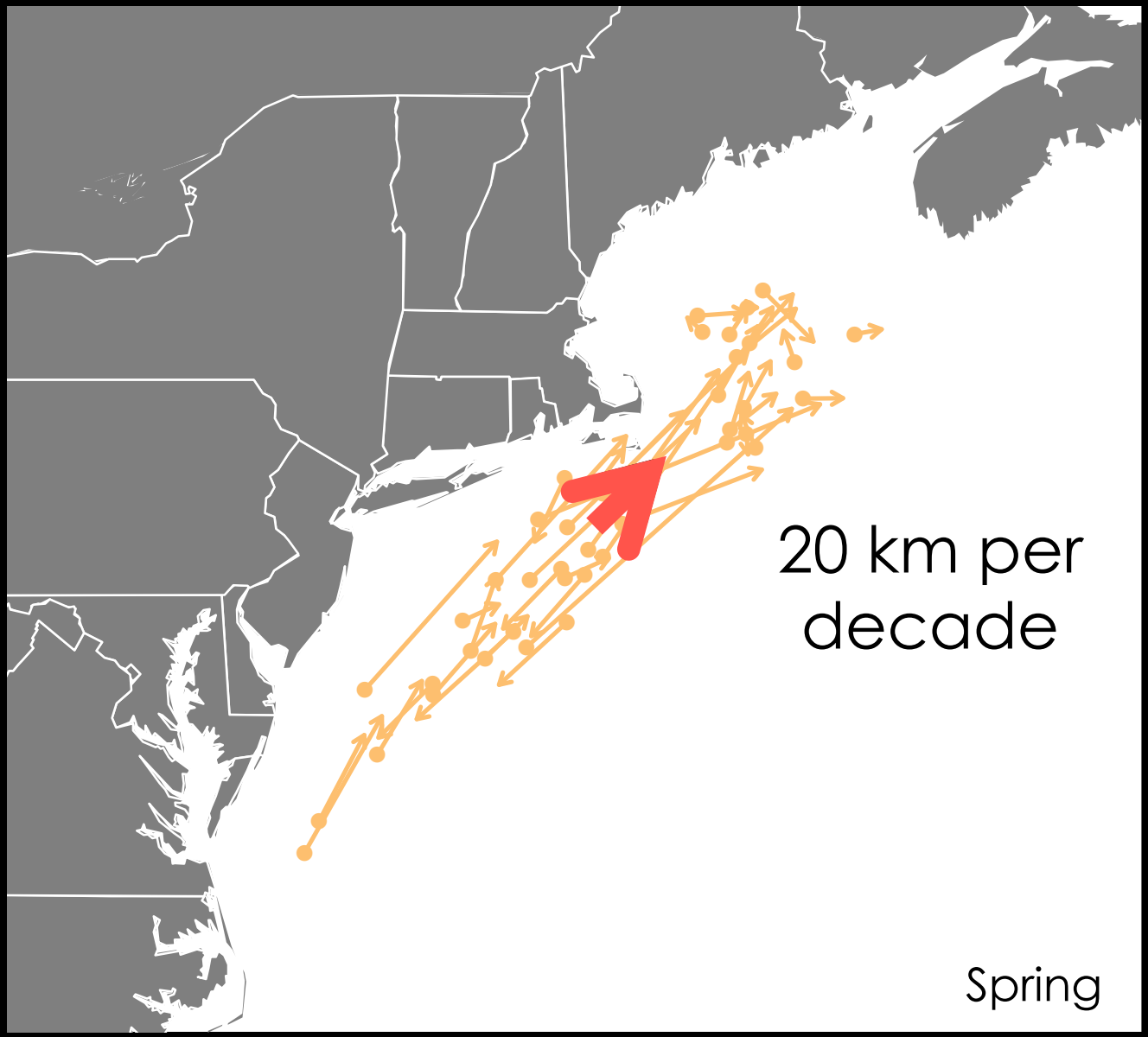
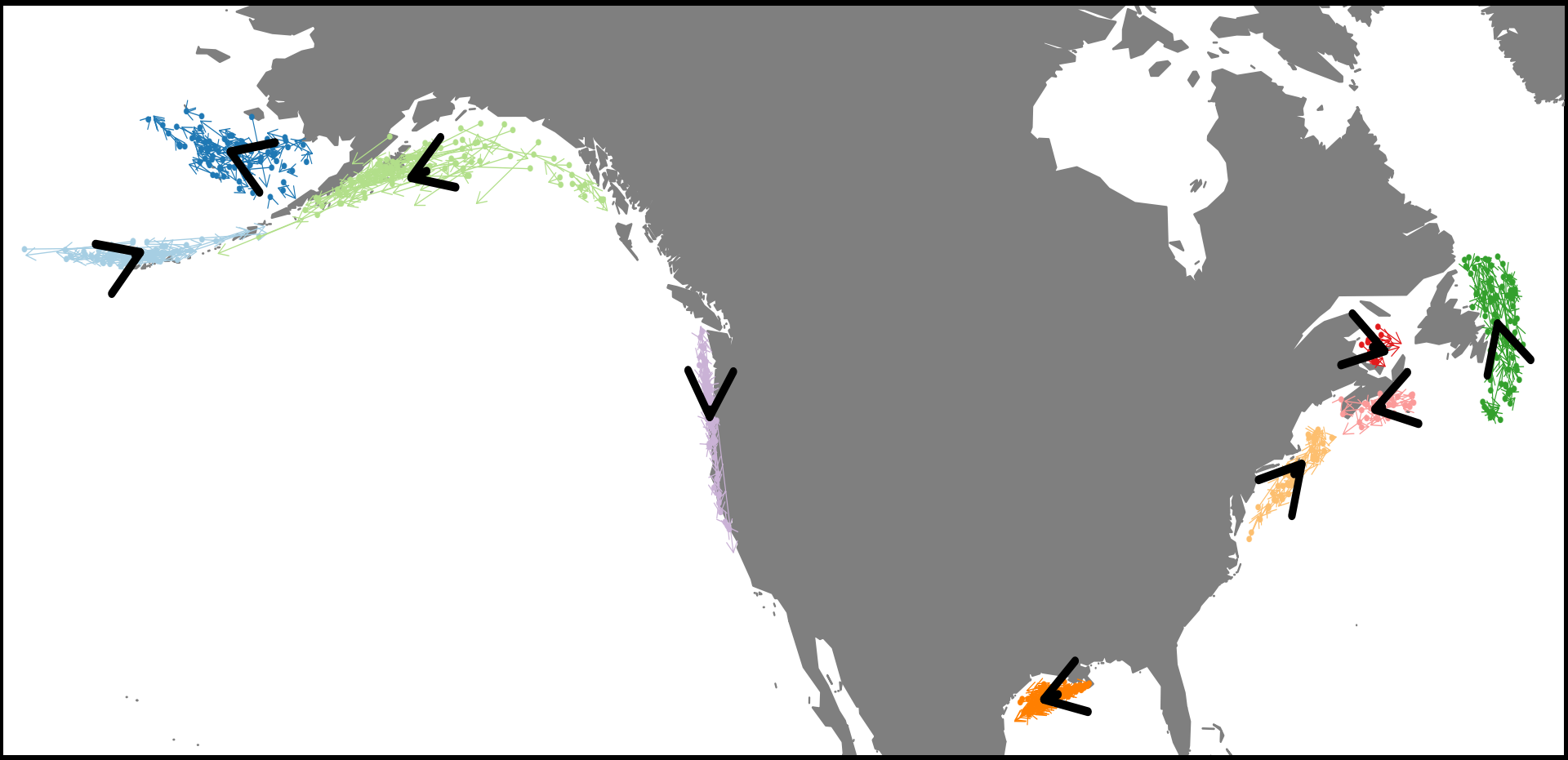


Fish follow climate velocity (20-40 yrs)



Pinsky *et al.* 2013 *Science*

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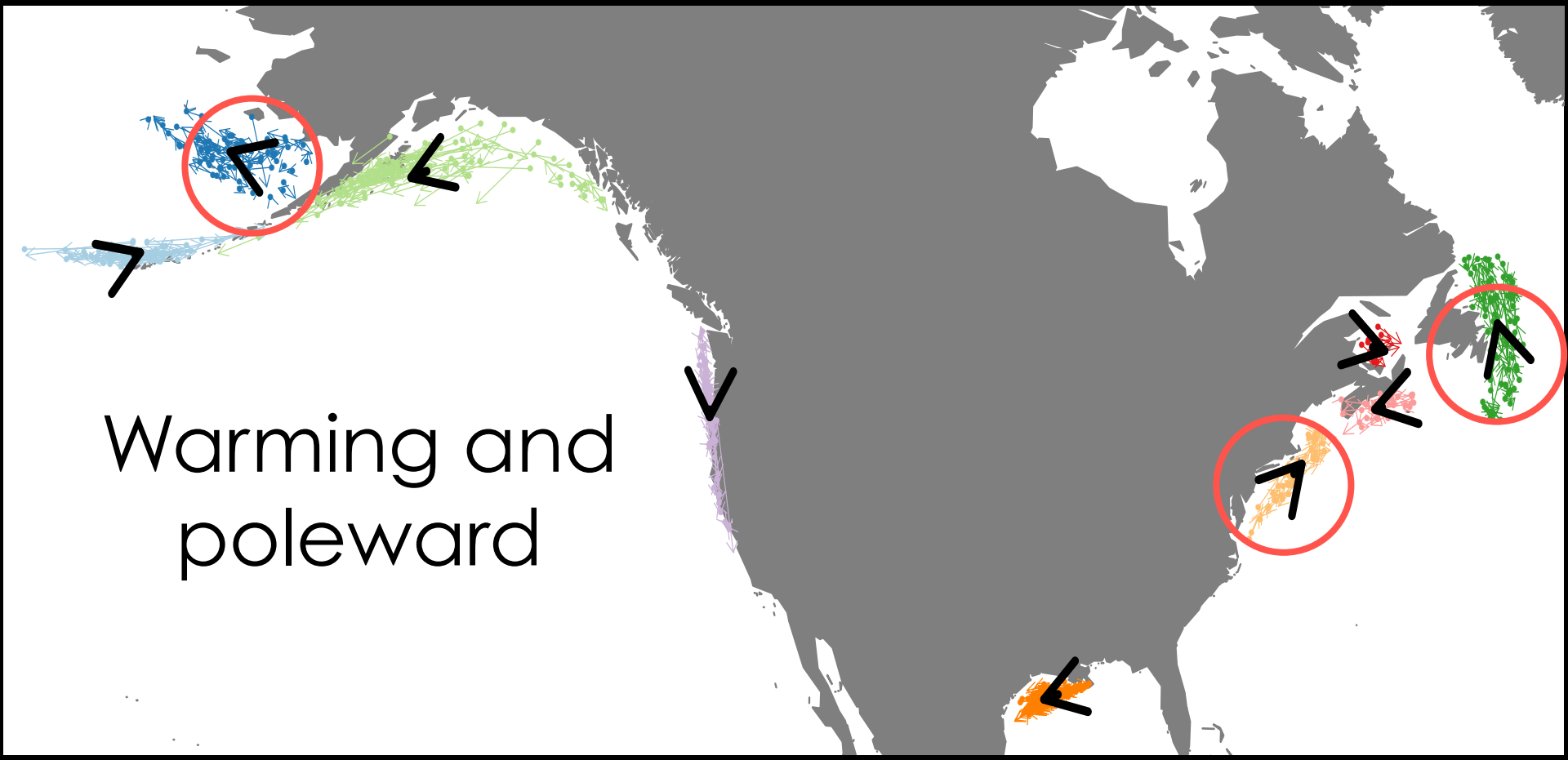

Pinsky *et al.* 2013 *Science*

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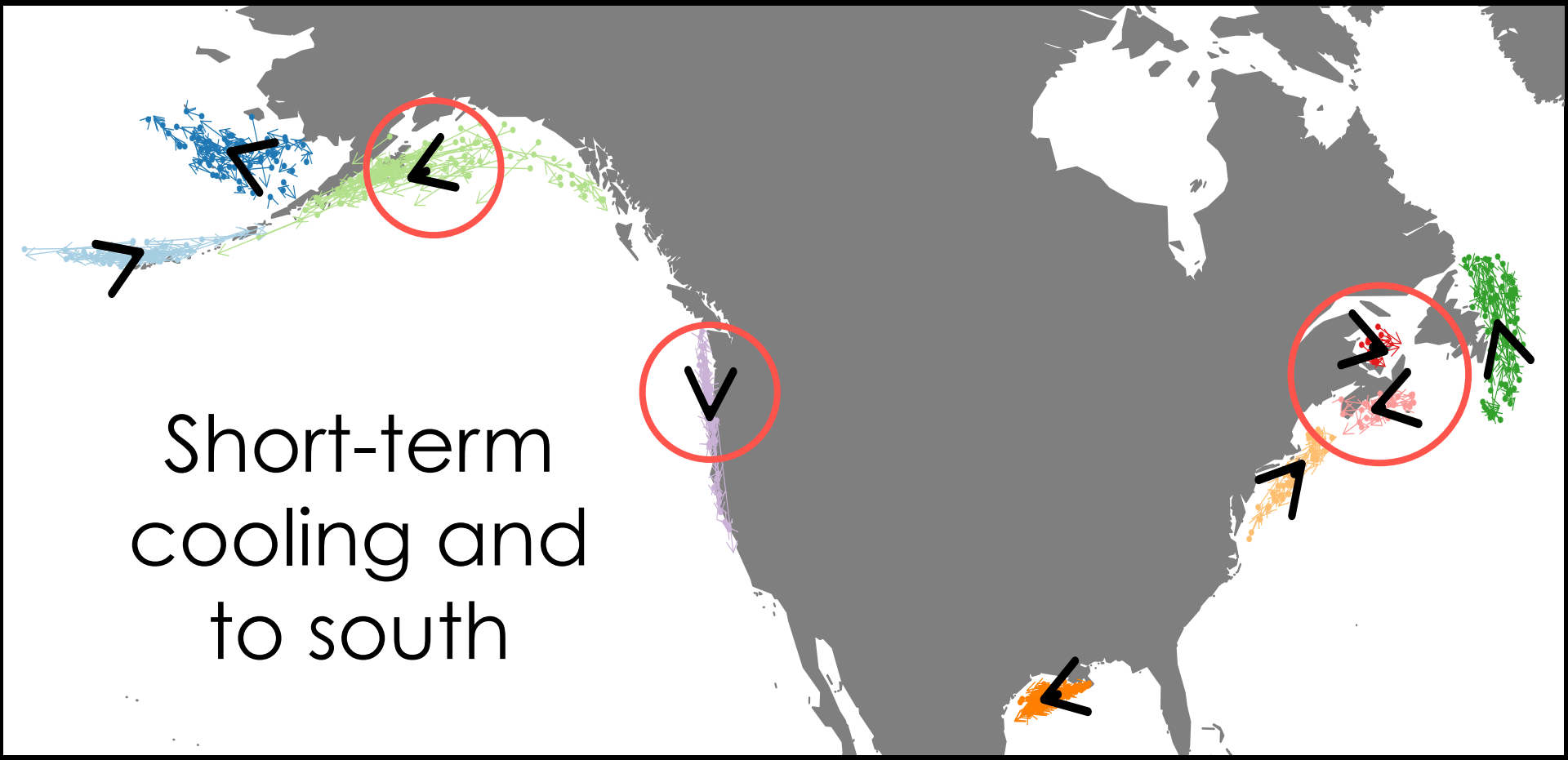
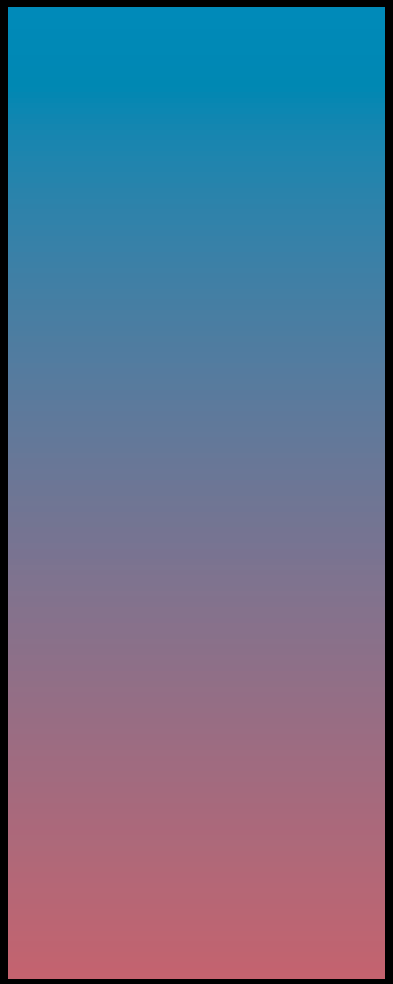


Pinsky *et al.* 2013 *Science*

Climate velocity



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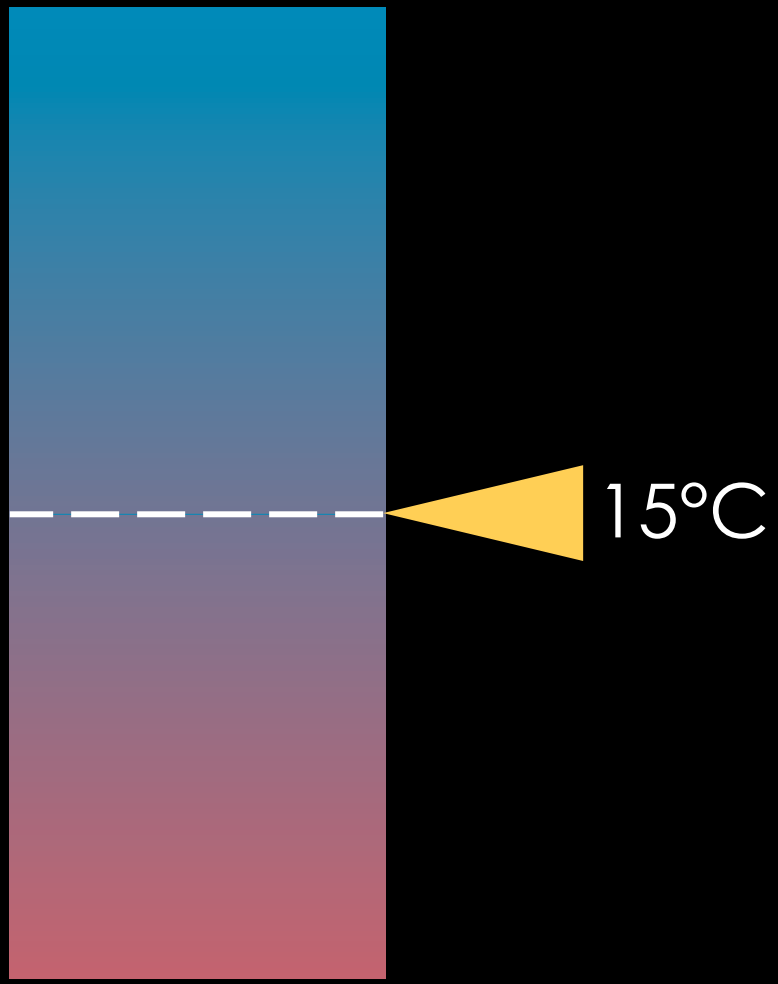

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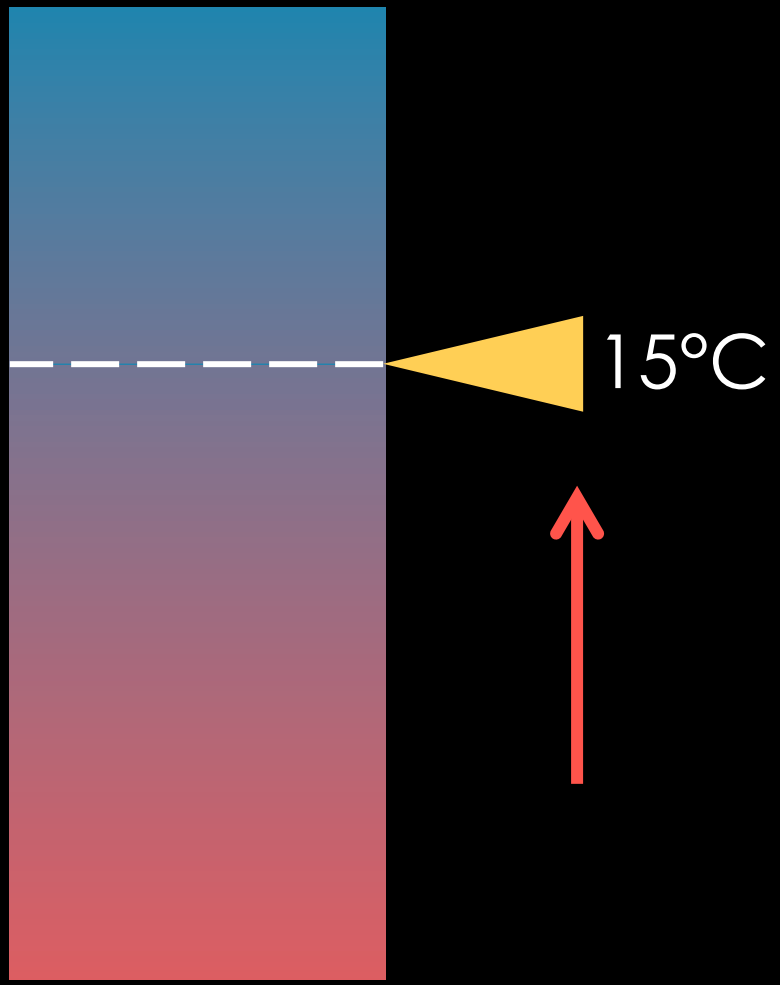

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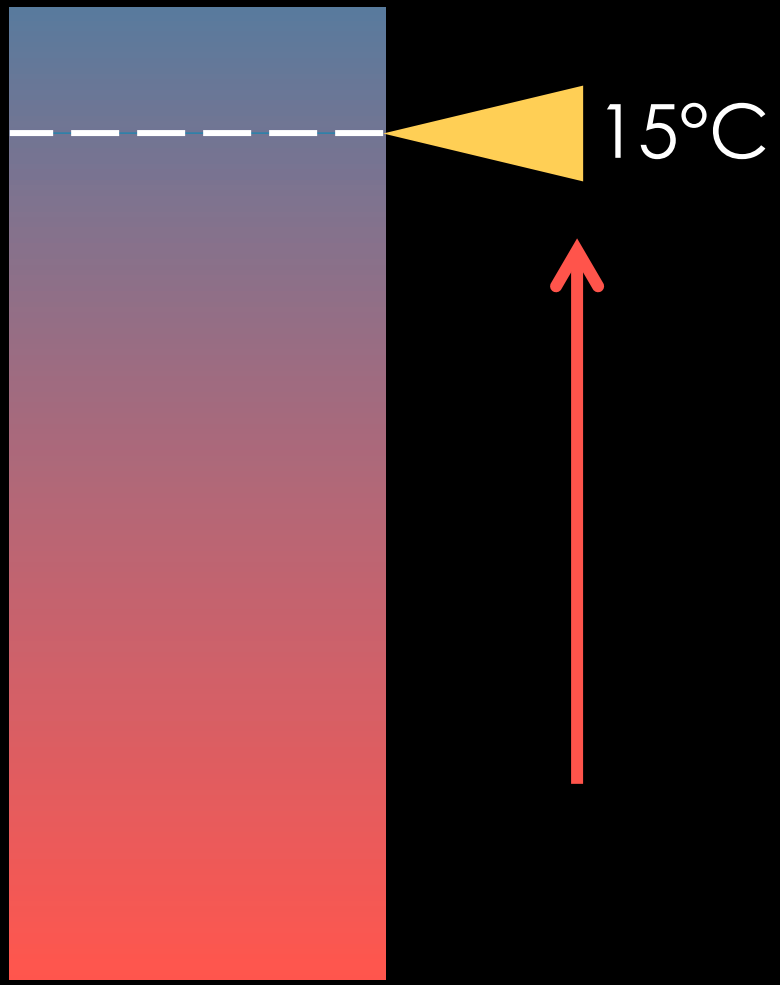
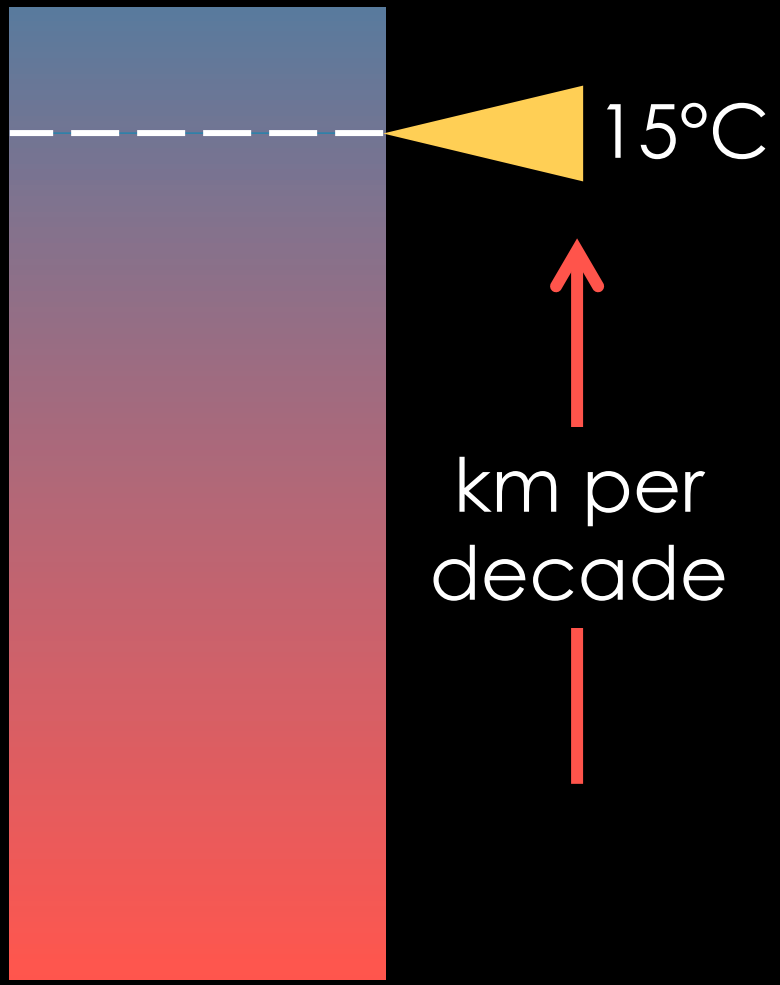
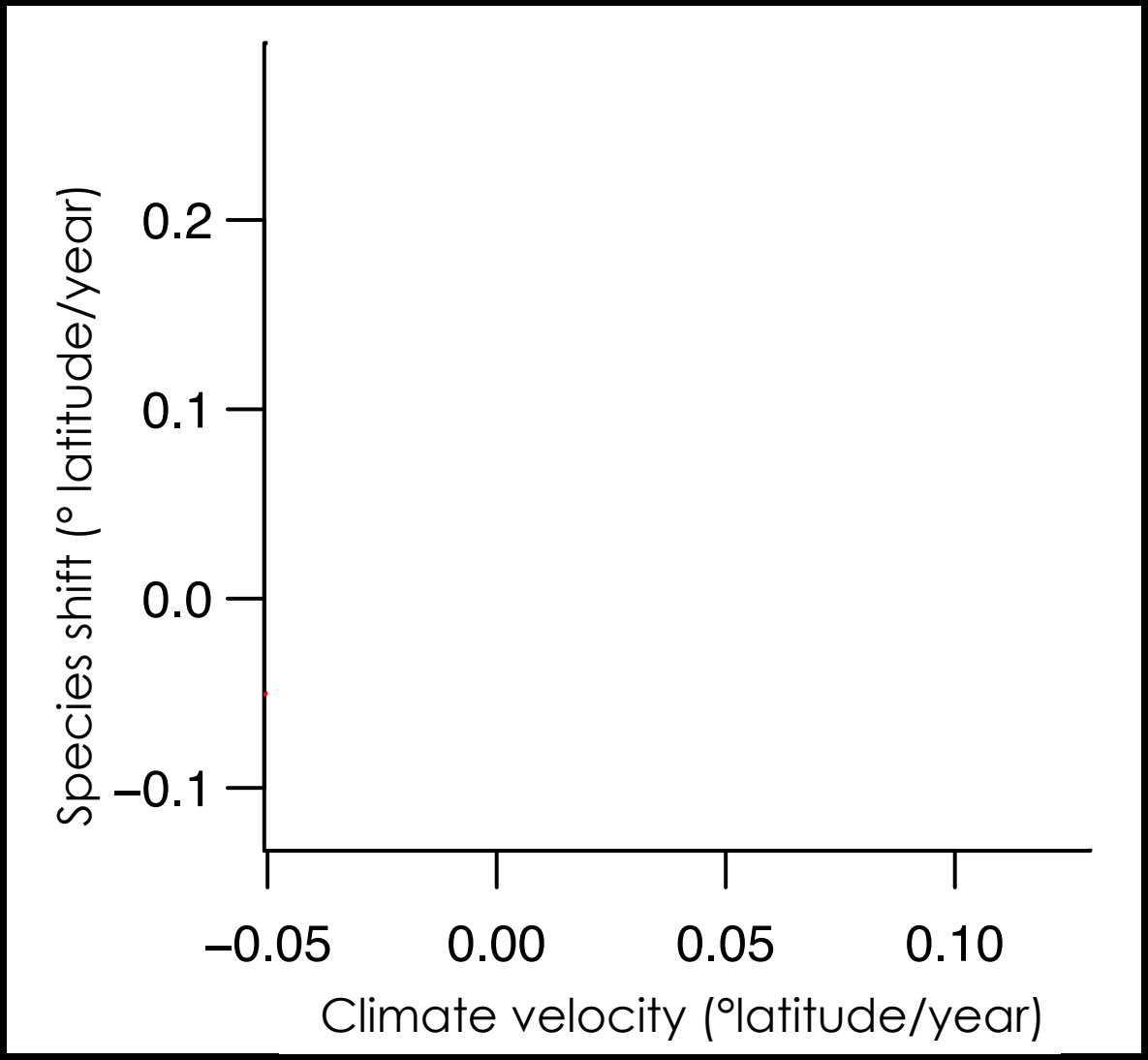


Climate velocity



Across 325 taxa...



Pinsky *et al.* 2013 *Science*

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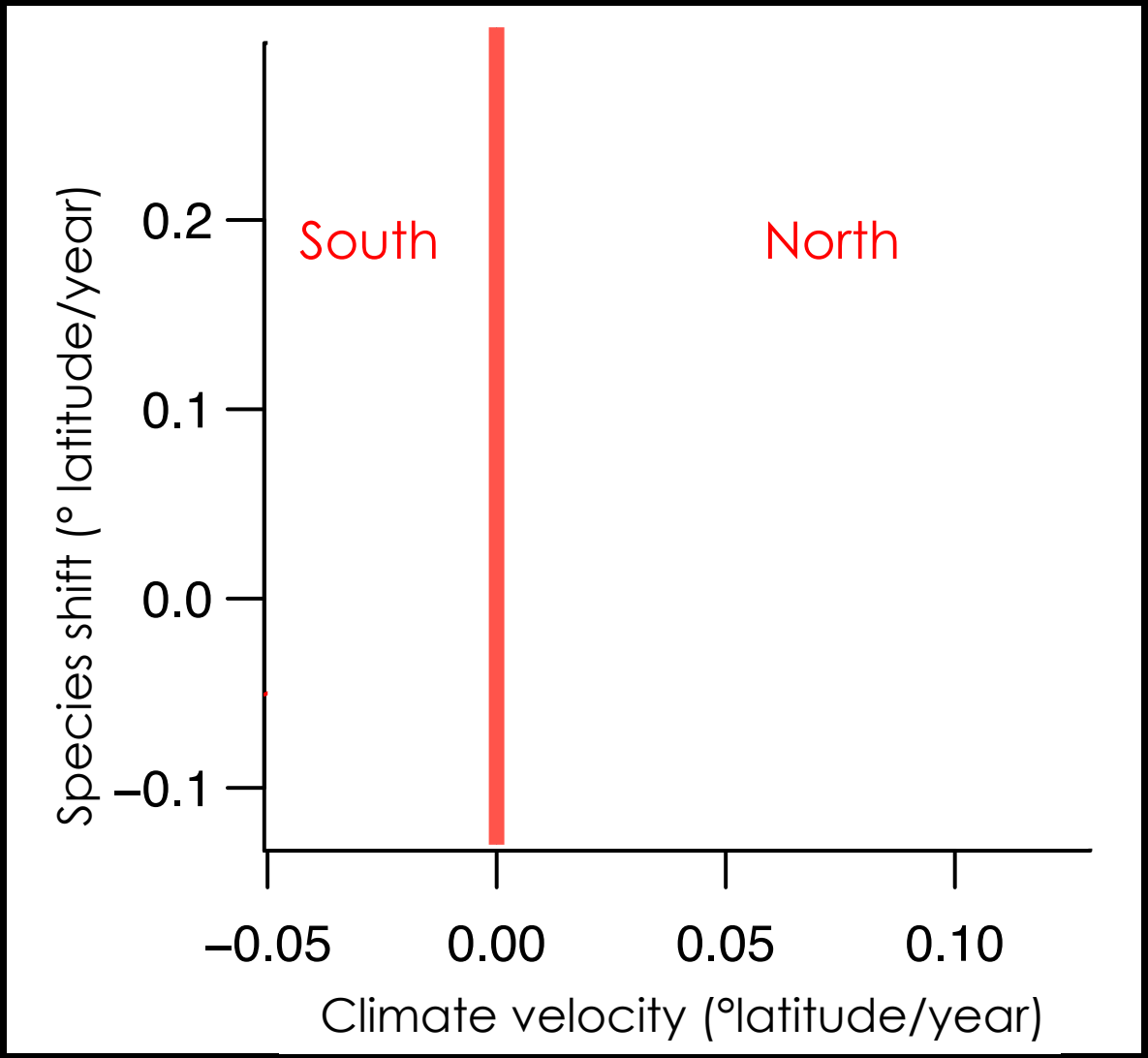

Pinsky *et al.* 2013 *Science*

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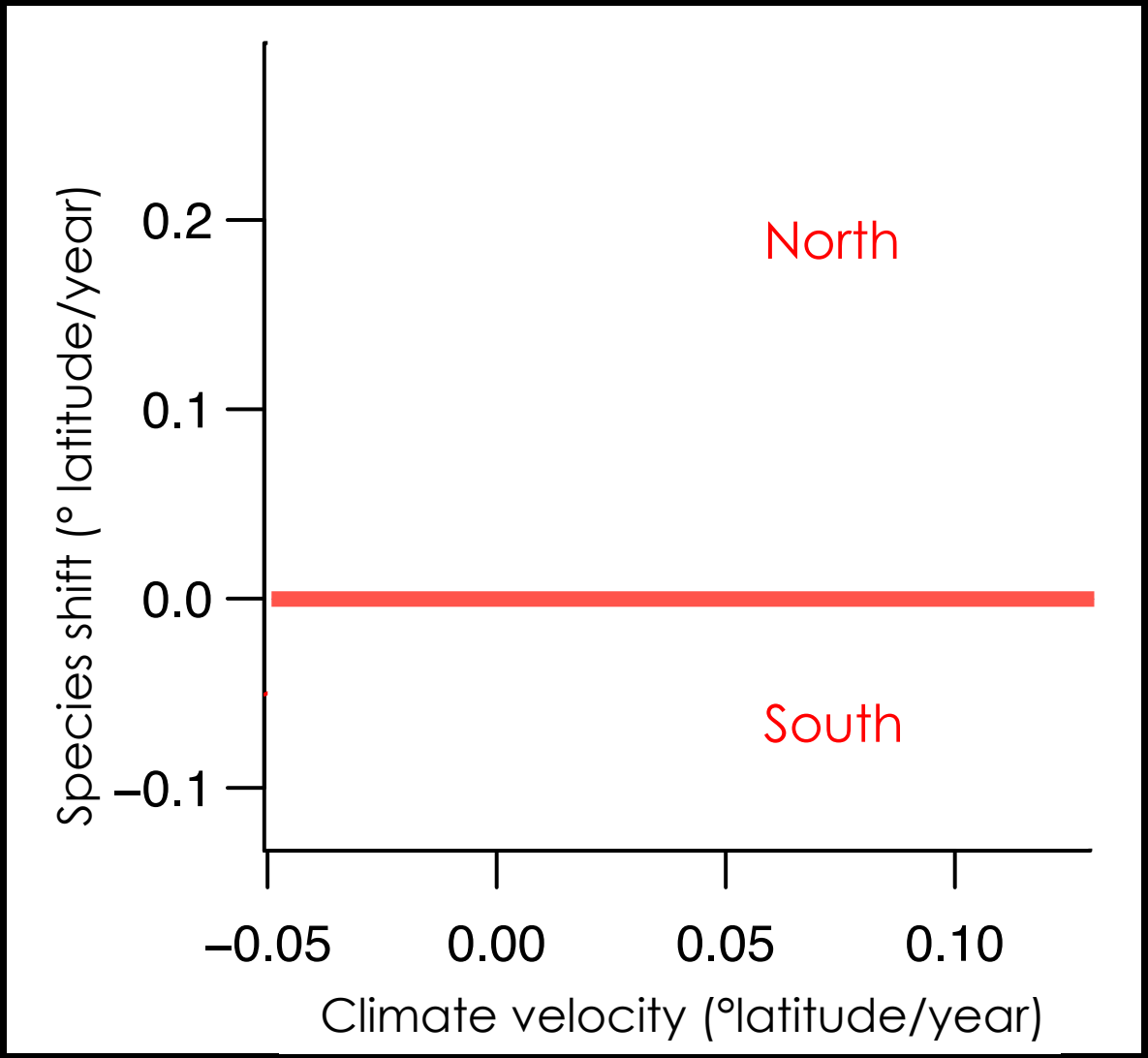
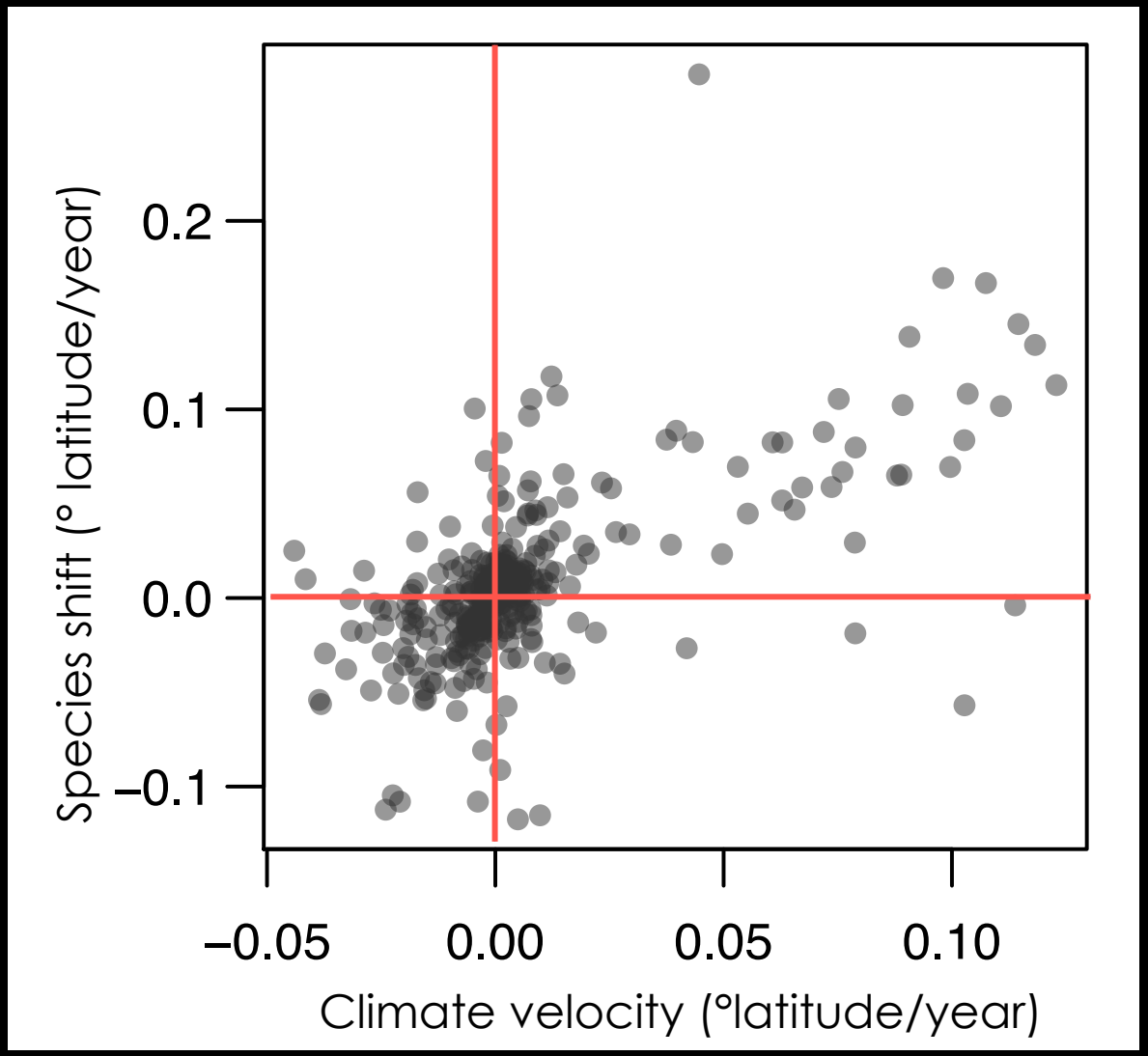


Pinsky *et al.* 2013 *Science*

Species follow climate velocity



Pinsky *et al.* 2013 *Science*

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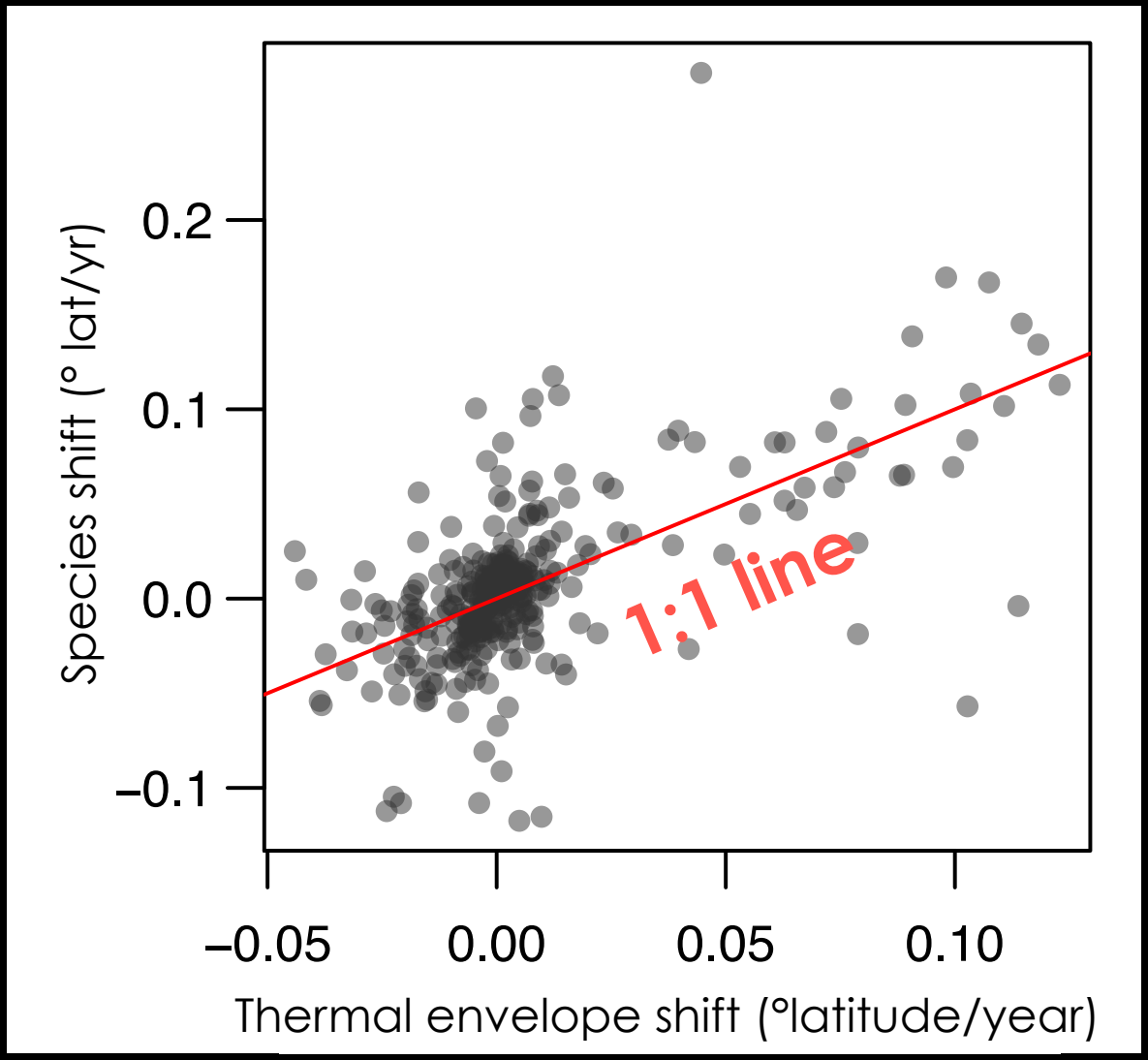

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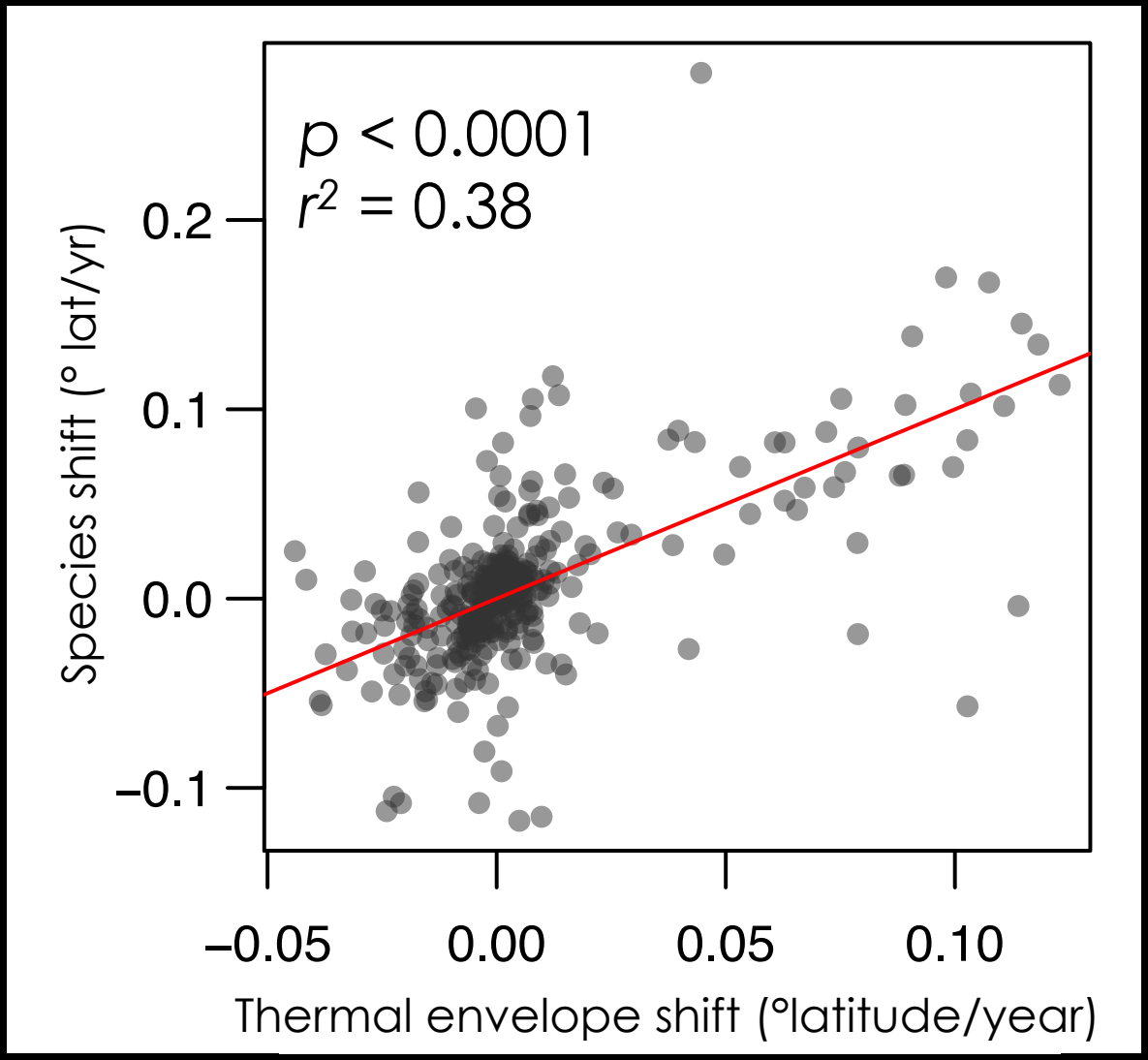

Pinsky *et al.* 2013 *Science*

Cautionary note

Reviews in Fish Biology and Fisheries **8**, 285–305 (1998)

When do environment–recruitment correlations work?

RANSOM A. MYERS

Cautionary note

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RANSOM A. MYERS

- 46 of 74 (62%) of environment-recruitment correlations failed upon re-test

Cautionary note

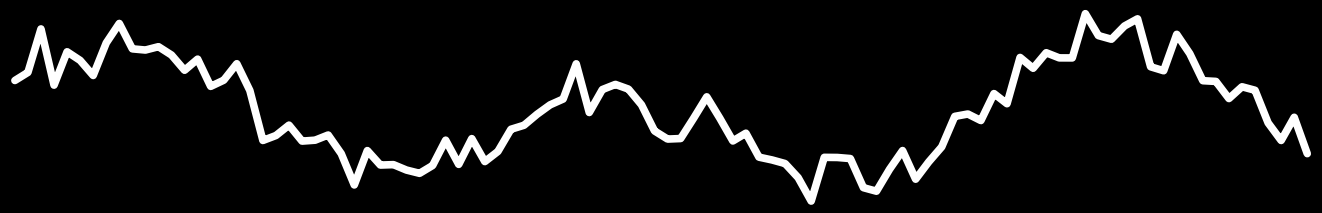
Reviews in Fish Biology and Fisheries **8**, 285–305 (1998)

When do environment–recruitment correlations work?

RANSOM A. MYERS

- 46 of 74 (62%) of environment-recruitment correlations failed upon re-test
- Correlations at range edges tended to hold

Stationary



Non-stationary

How might management adapt?

SPECIAL ISSUE ON FISHERIES OCEANOGRAPHY

Emerging Adaptation Approaches for Climate-Ready Fisheries Management

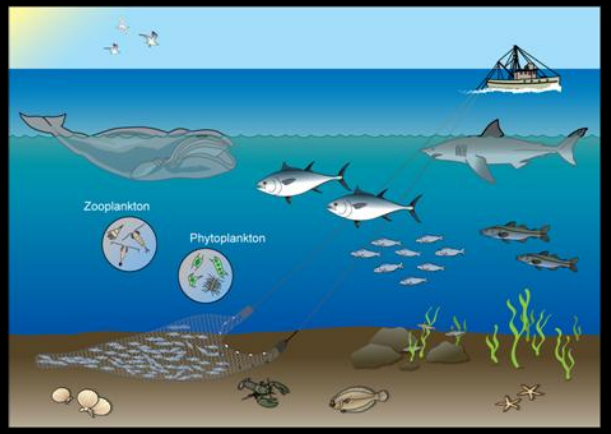
By Malin L. Pinsky and Nathan J. Mantua

Oceanography 27(4): 146-159

1. Address the basics

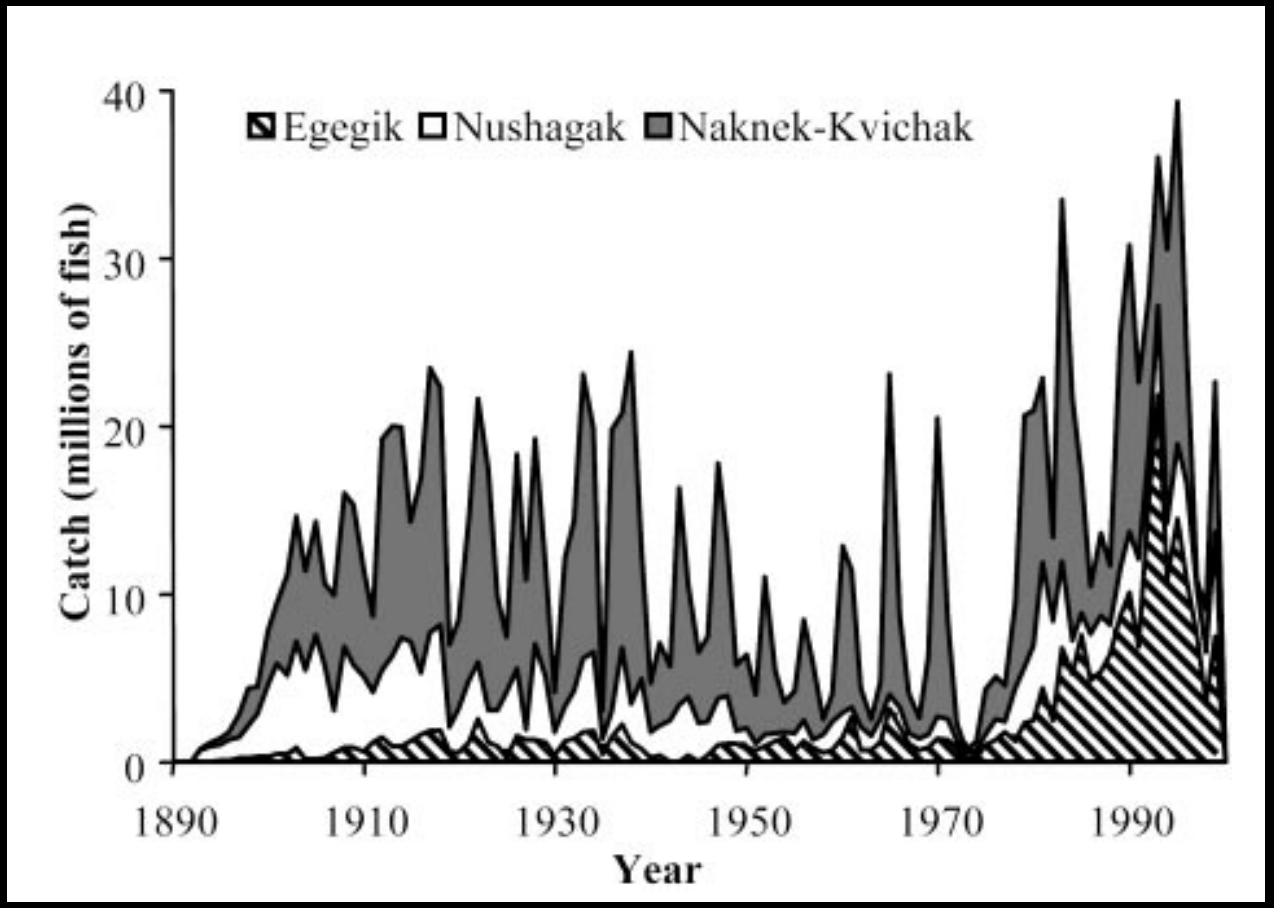
Intact habitat

Sustainable fishing



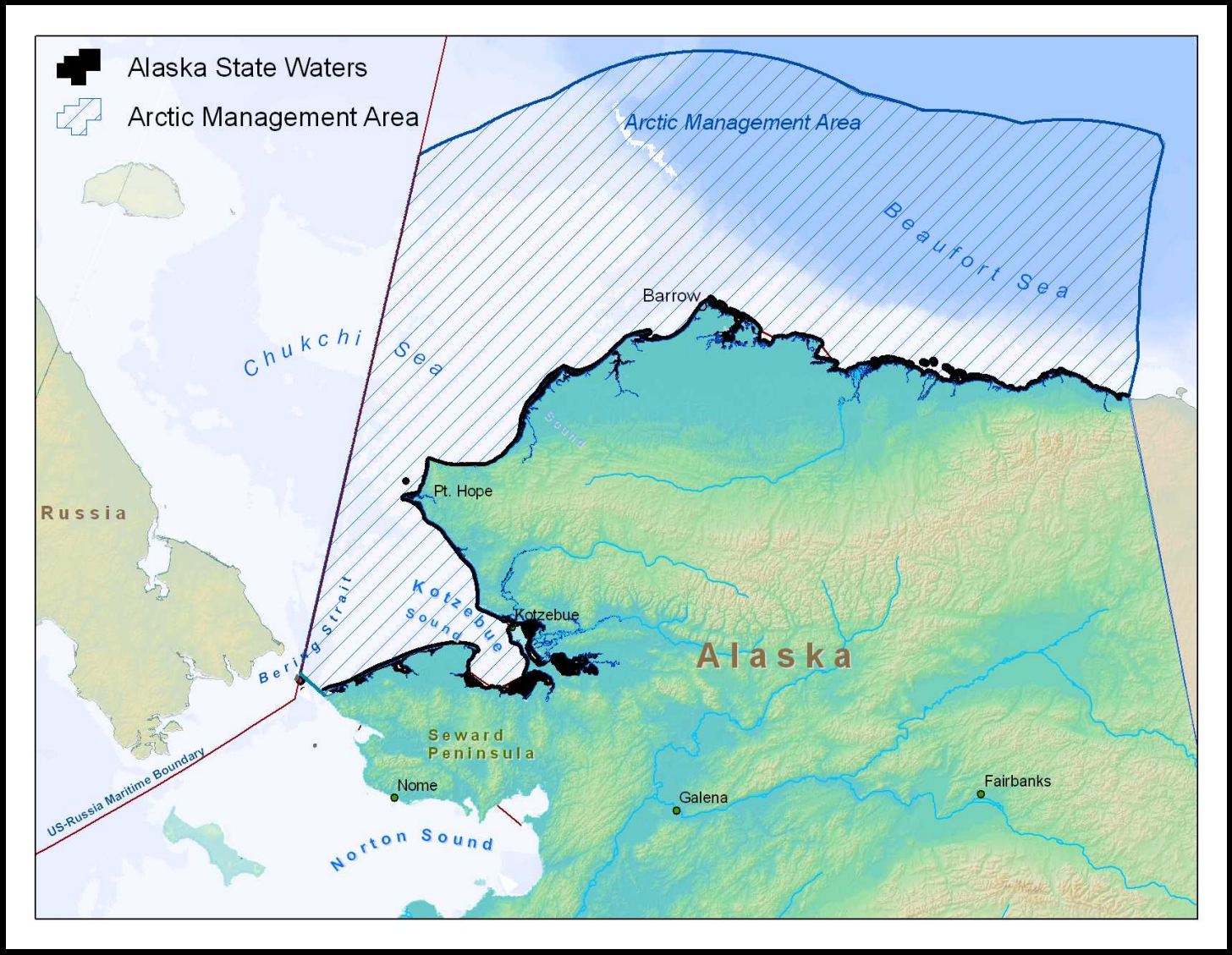
Healthy ecosystems/ abundant prey

Biocomplexity promotes stability



Hilborn et al. 2003 PNAS
Schindler et al. 2010 Nature

2. Prepare for emerging fisheries



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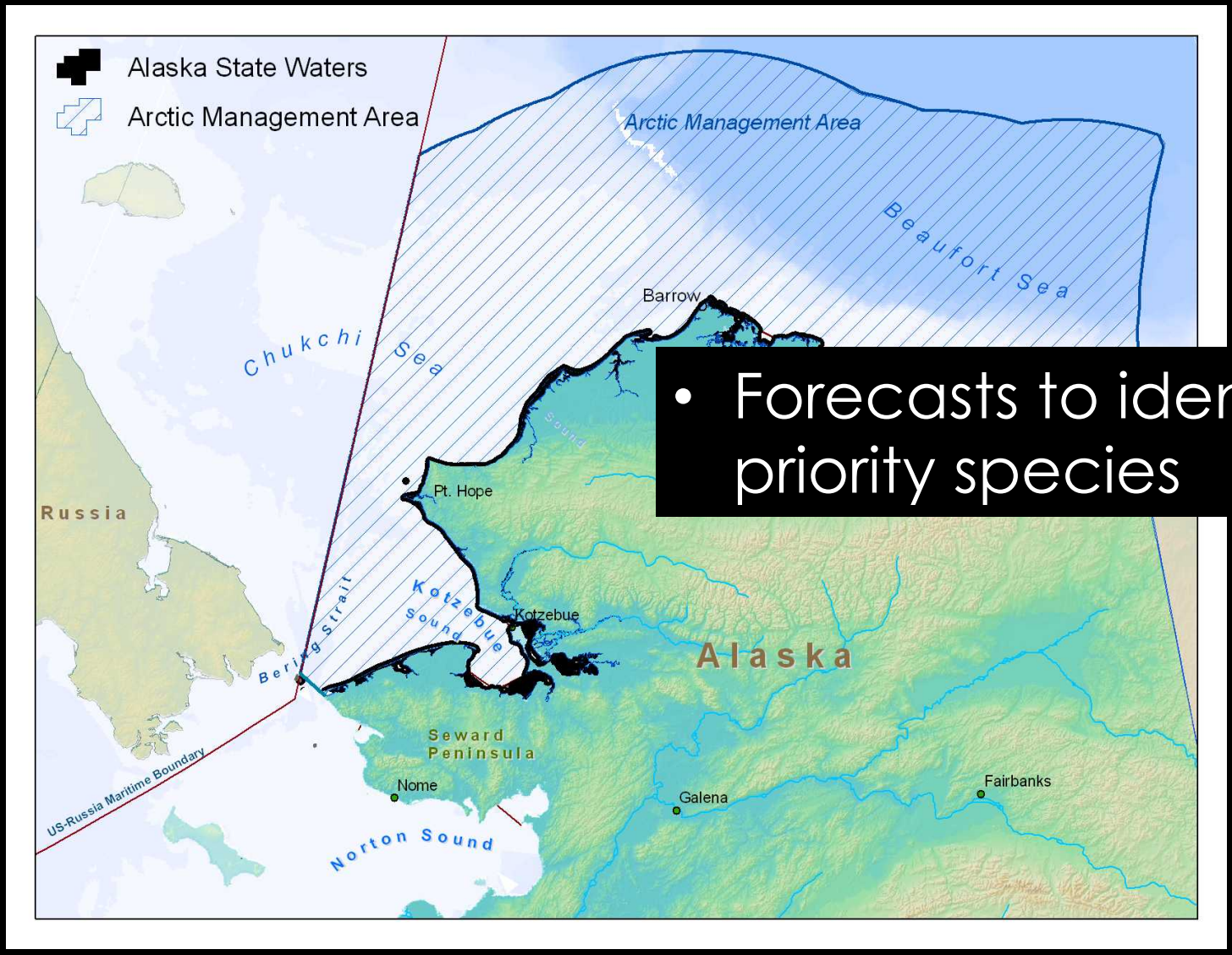

- Forecasts to identify priority species

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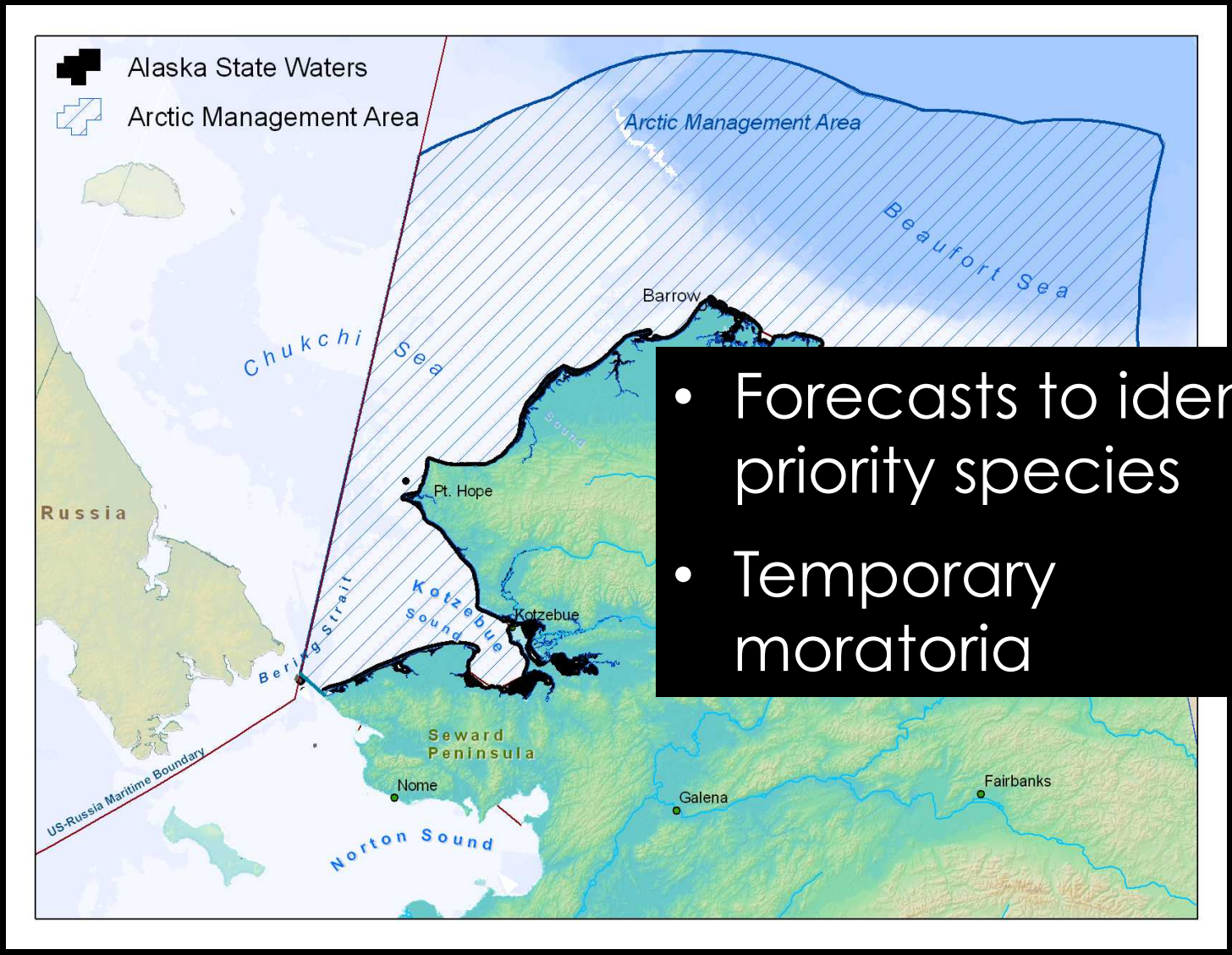

- Forecasts to identify priority species
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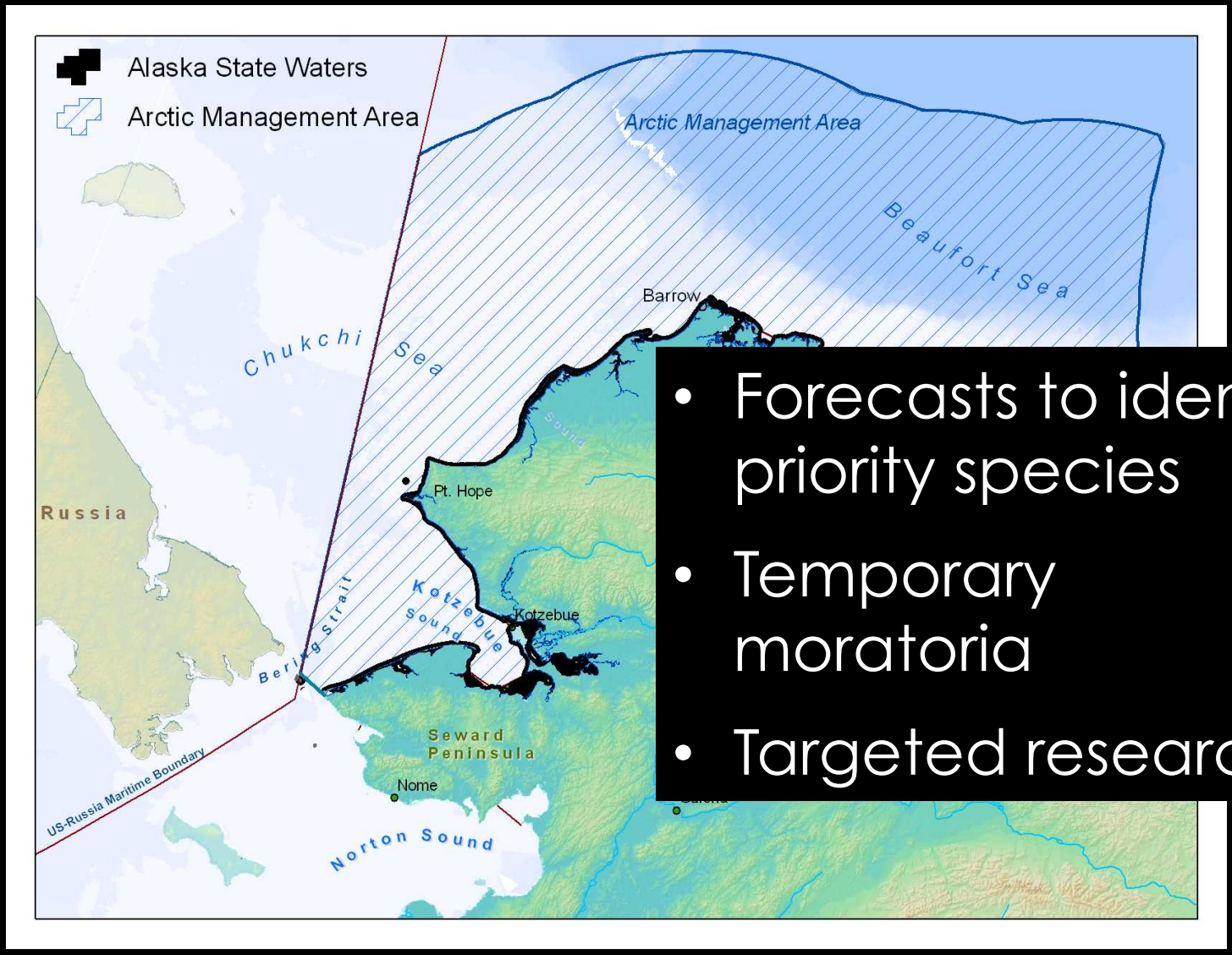

- Forecasts to identify priority species
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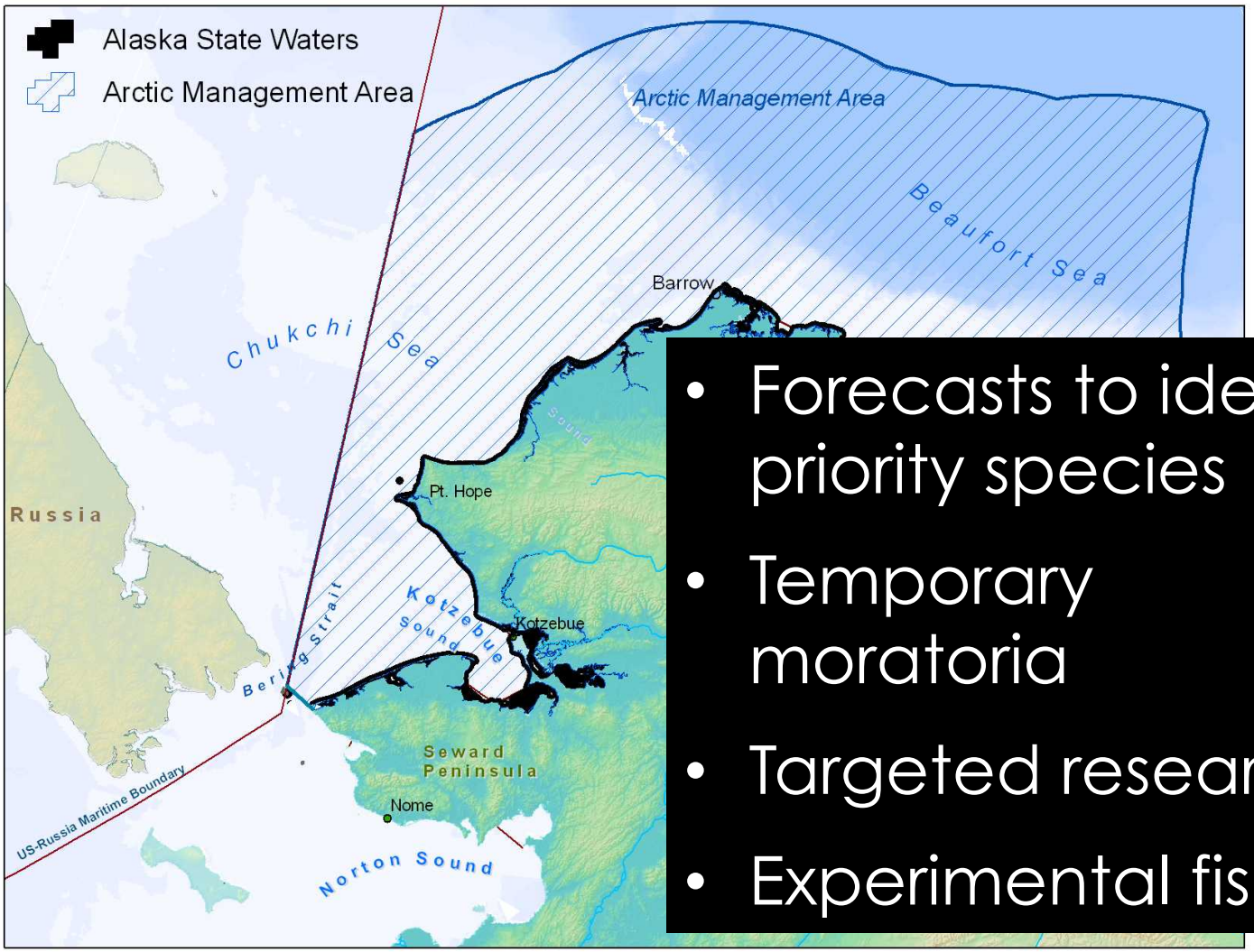
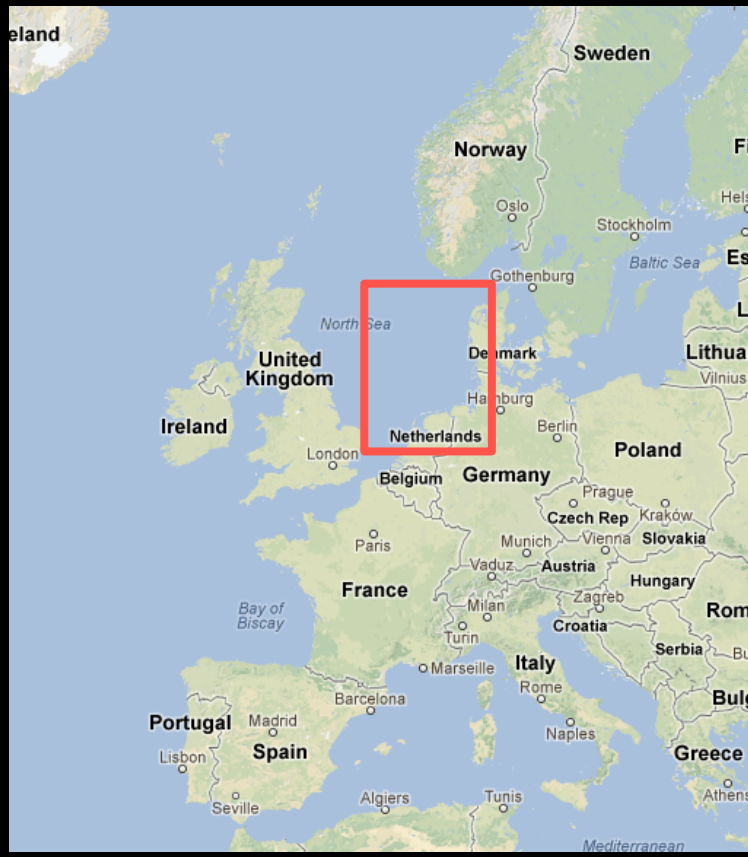


- Forecasts to identify priority species
- Temporary moratoria
- Targeted research
- Experimental fishing

3. Evaluate spatial boundaries

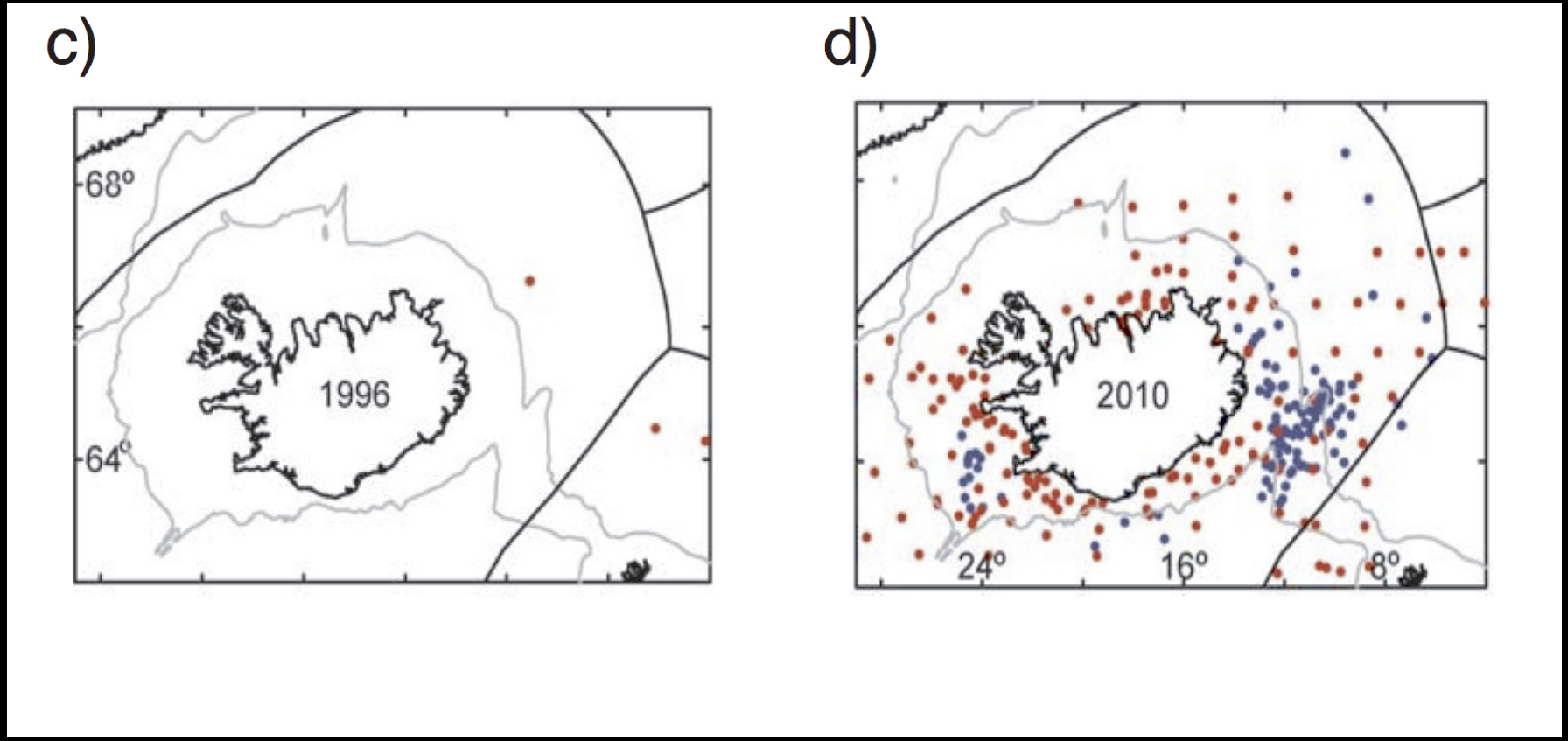


3. Evaluate spatial boundaries

but use network effects for broad-purpose areas

4. Prepare international agreements

mechanisms for cooperation and side-payments

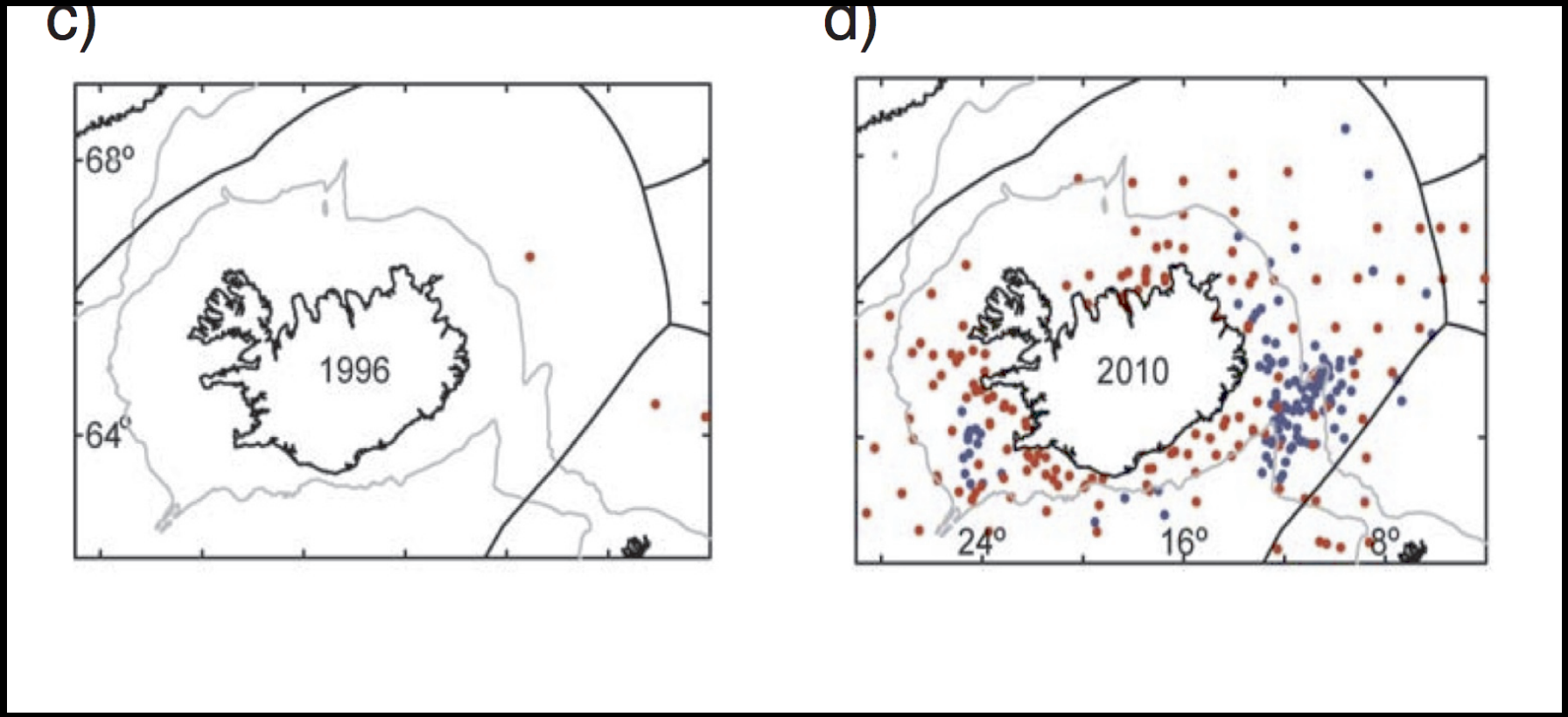


Astthorsson et al. 2012 ICES J Mar Sci

4. Prepare international agreements

mechanisms for cooperation and side-payments

Forecasts to identify priority species and boundaries



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5. Climate effects in assessments

Multiple approaches:

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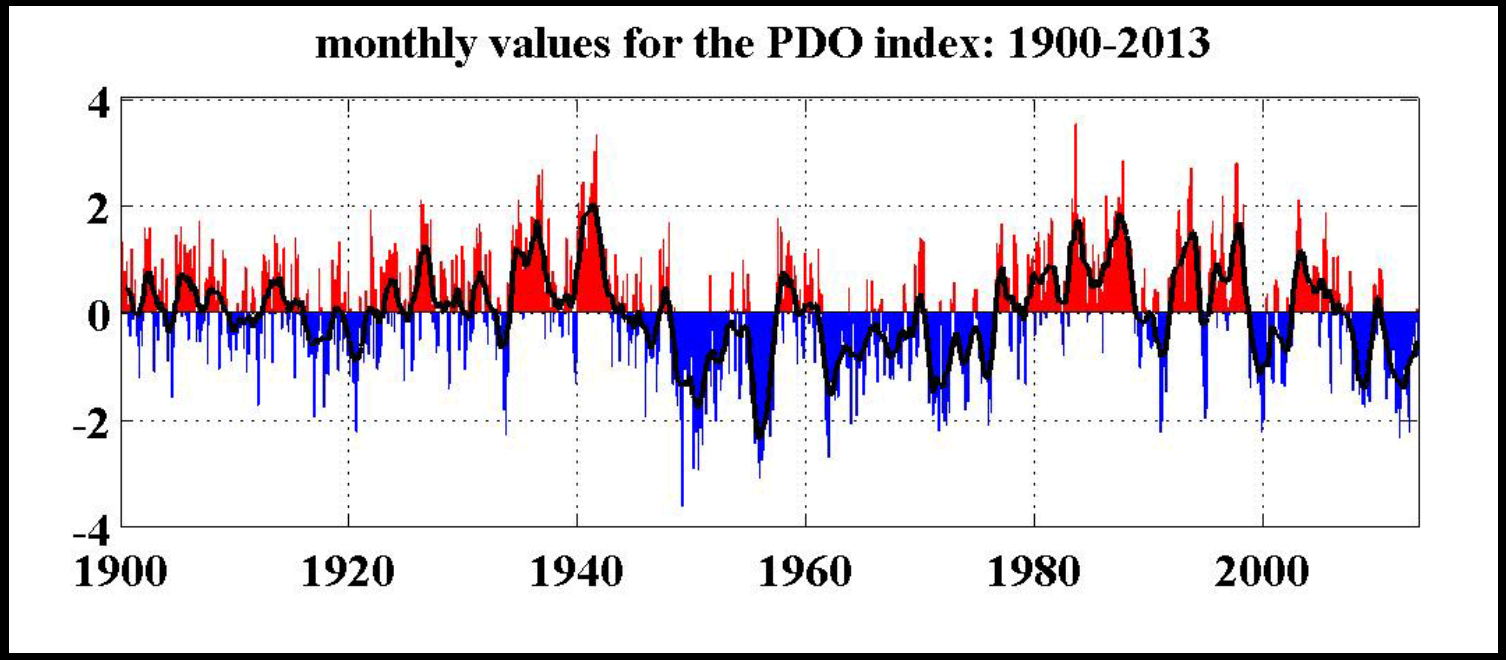
- Use data from current regime



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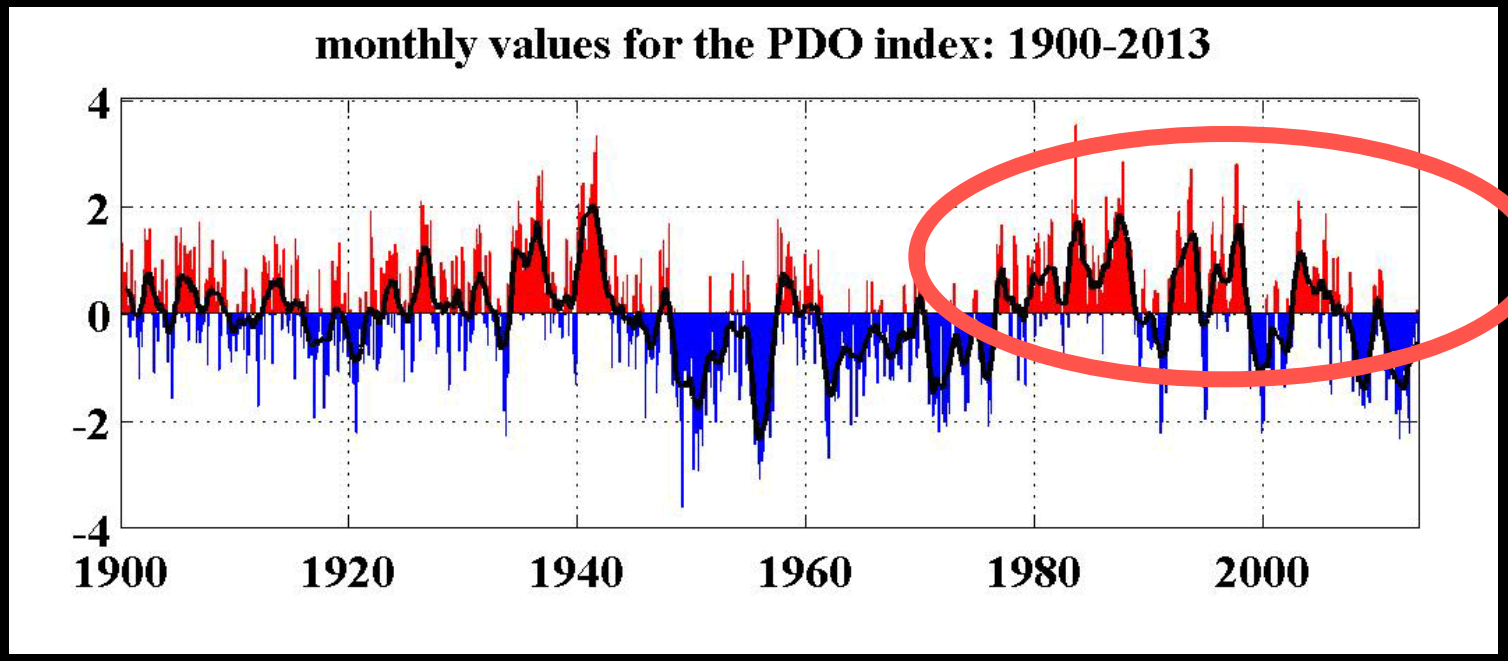

5. Climate effects in assessments

Multiple approaches:

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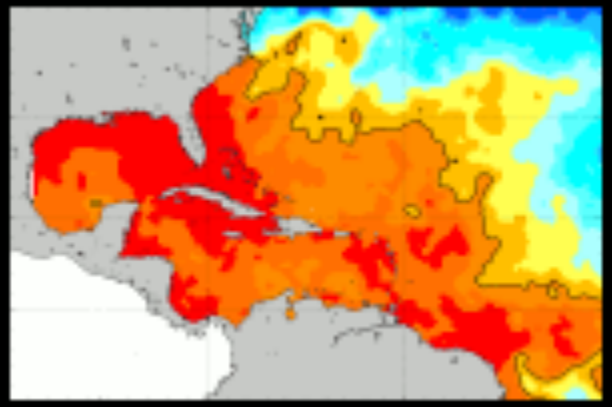
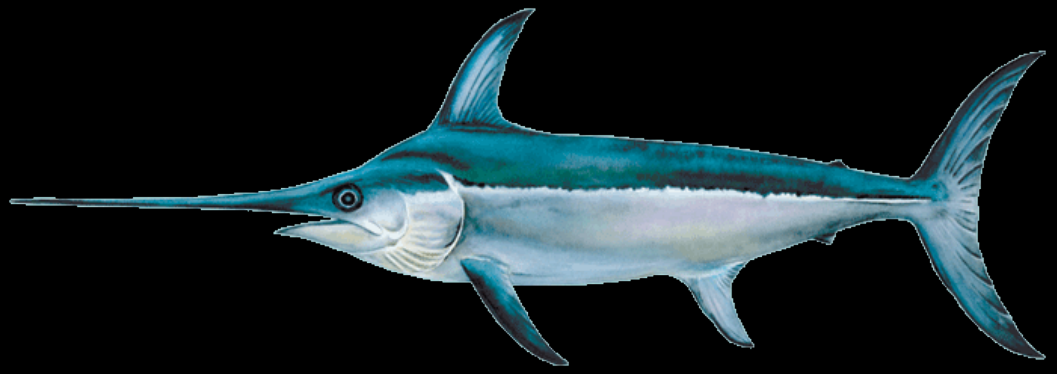
- Use an environmental covariate





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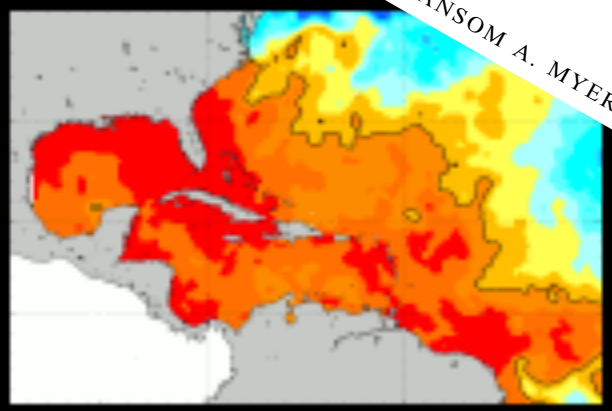
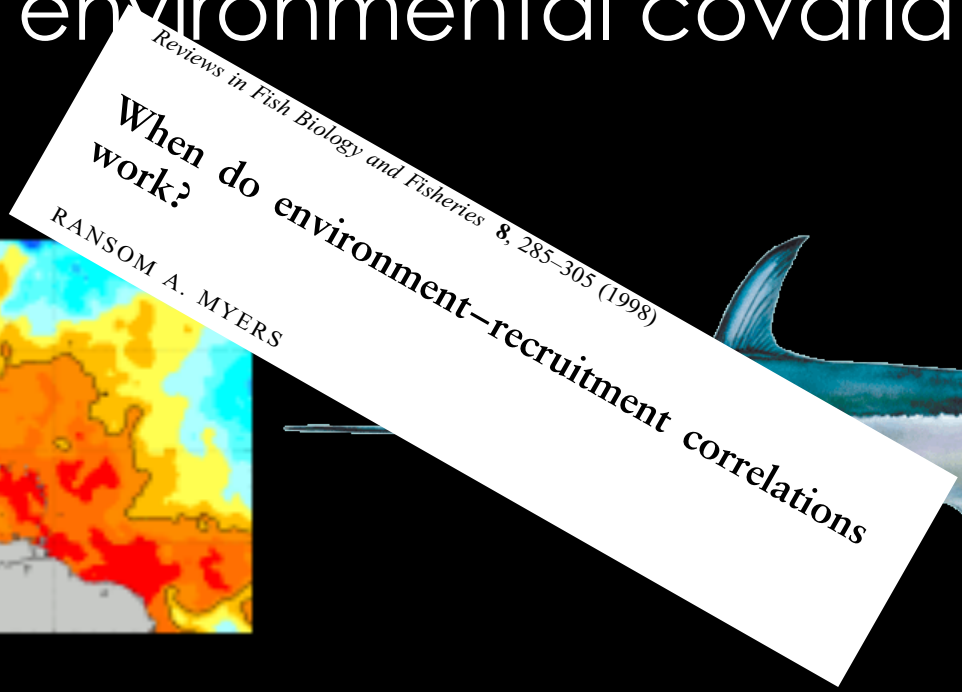
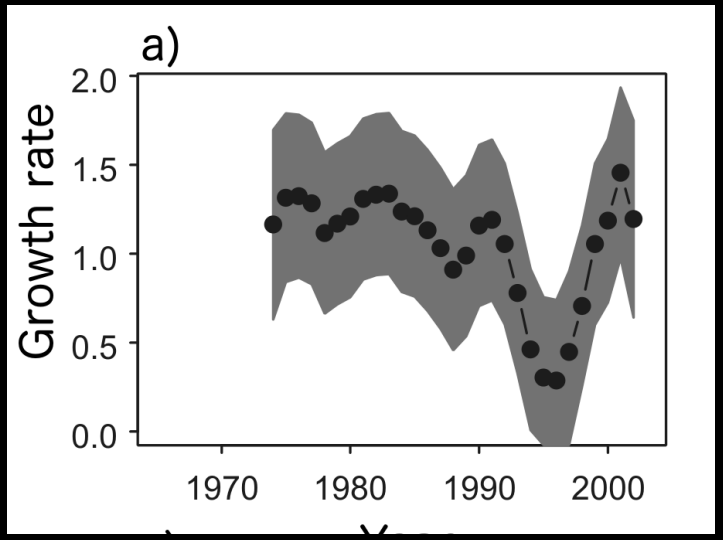




5. Climate effects in assessments

Multiple approaches:

- Use data from current regime
- Use an environmental covariate
- Empirical methods



Collie et al. 2012 CJFAS

5. Climate effects in assessments

Multiple approaches:

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- Use an environmental covariate
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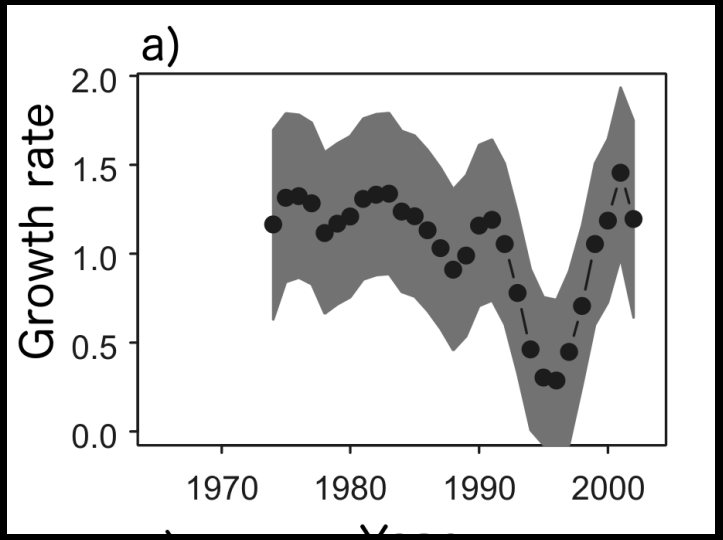
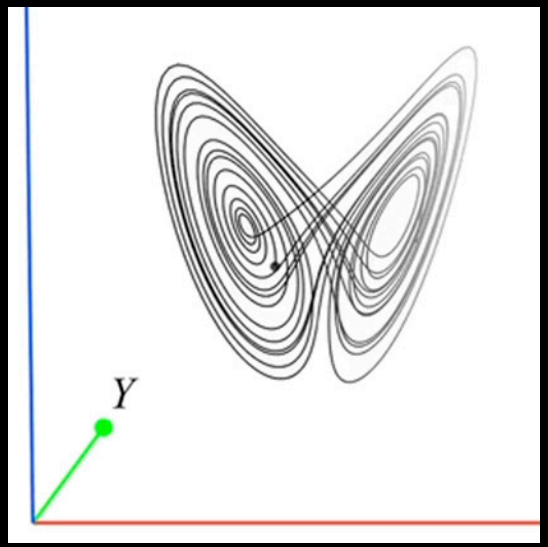




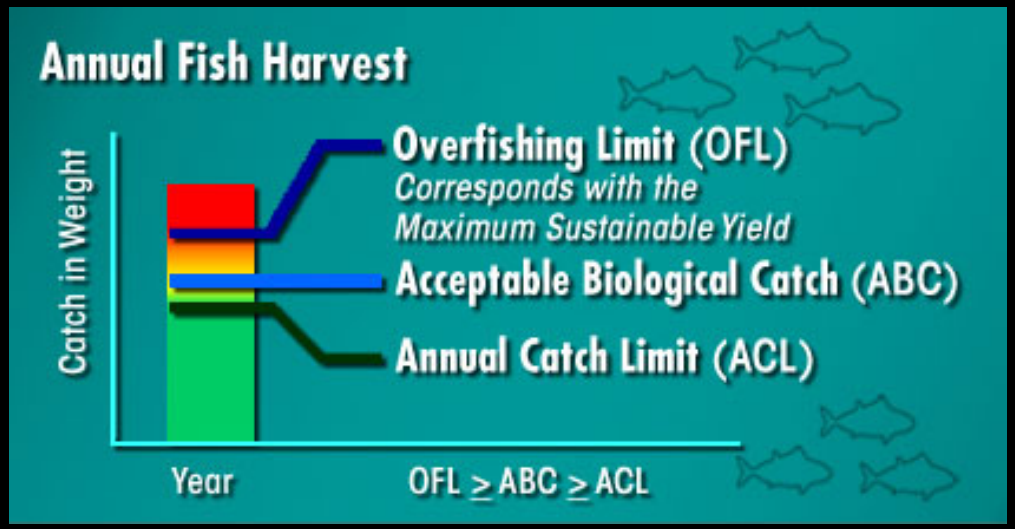
Collie et al. 2012 CJFAS

Ye et al. 2015 PNAS

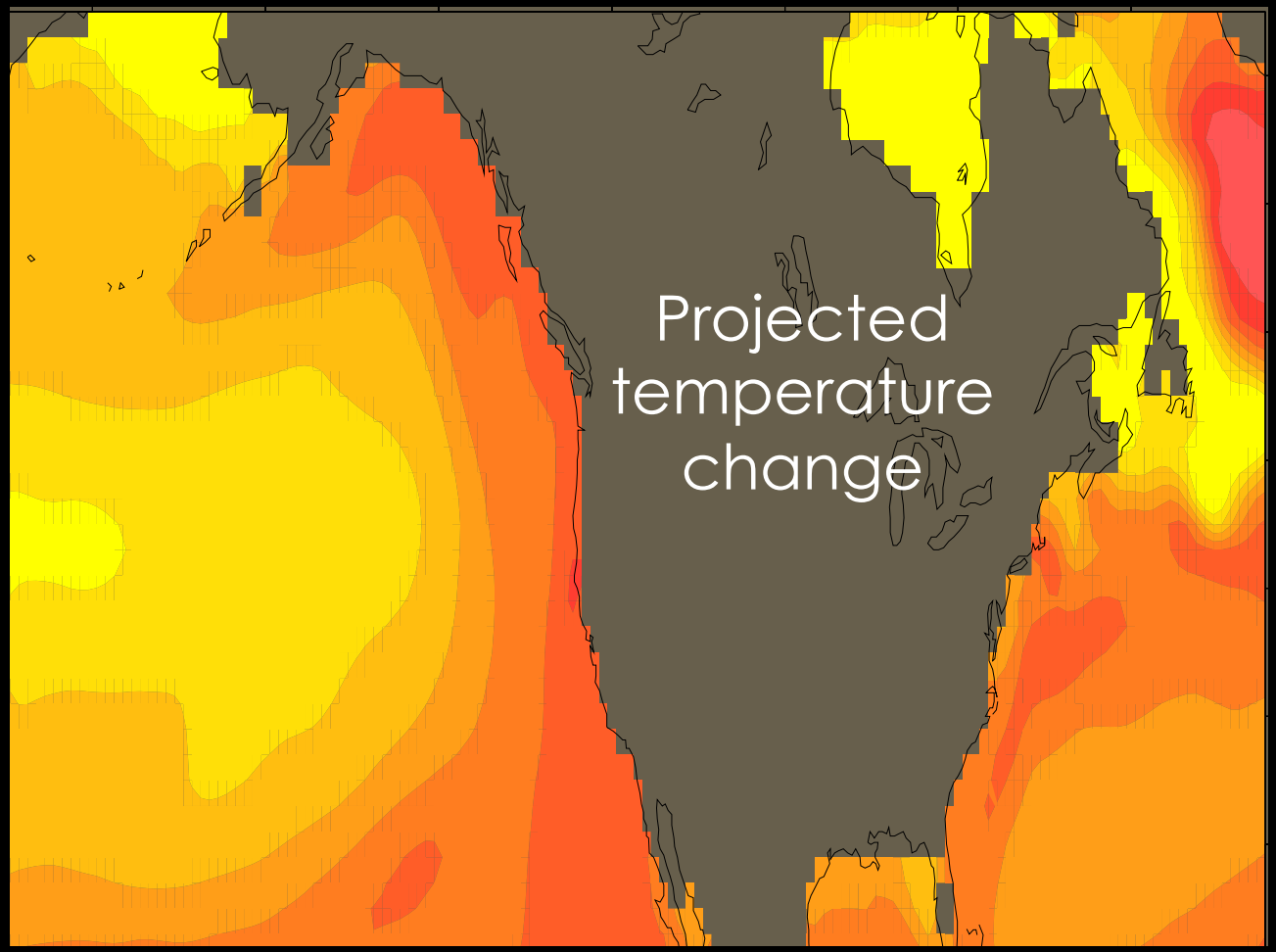
5. Climate effects in assessments

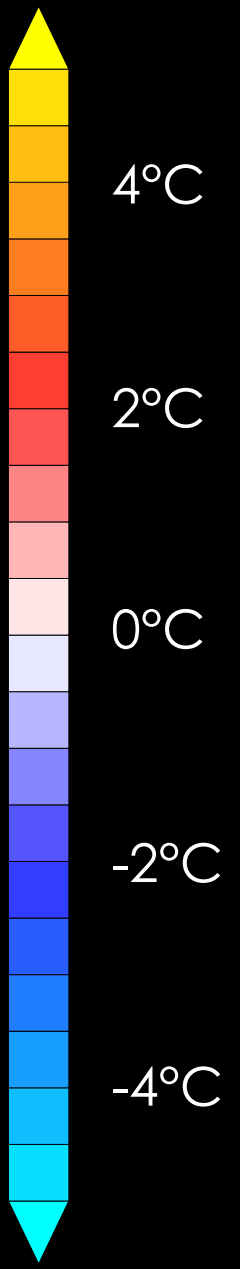
Multiple approaches:

- Use data from current regime
- Use an environmental covariate
- Empirical methods
- Add a precautionary buffer



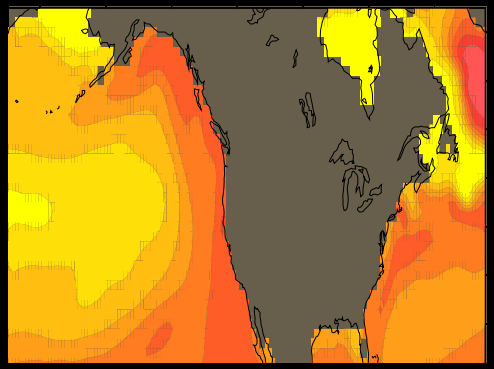
6. Scenario evaluation



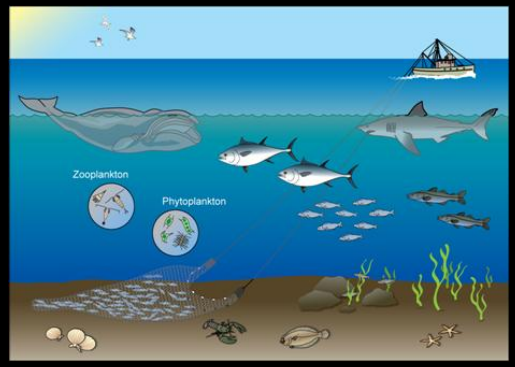


GFDL CM3 model RCP8.5

6. Scenario evaluation

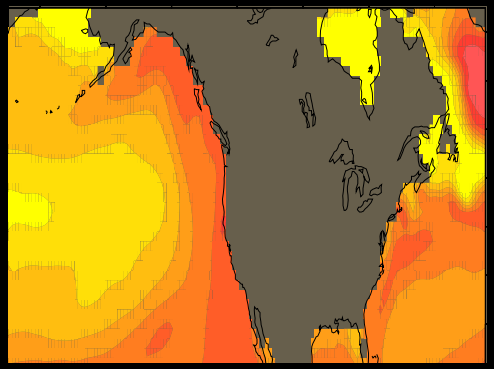


Climate

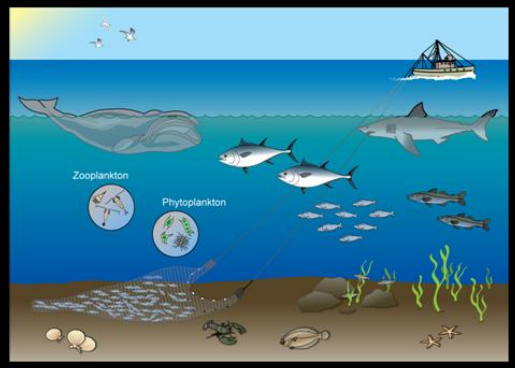


Ecosystem

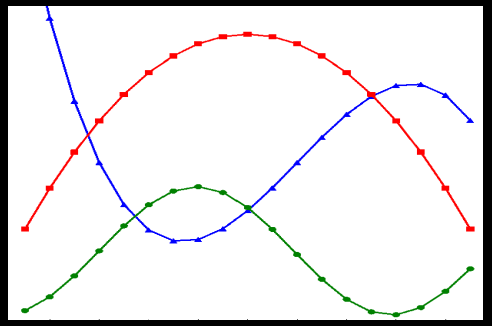
6. Scenario evaluation



Climate

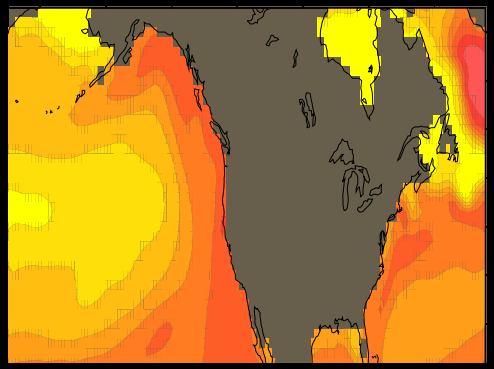


Ecosystem



Observations

6. Scenario evaluation



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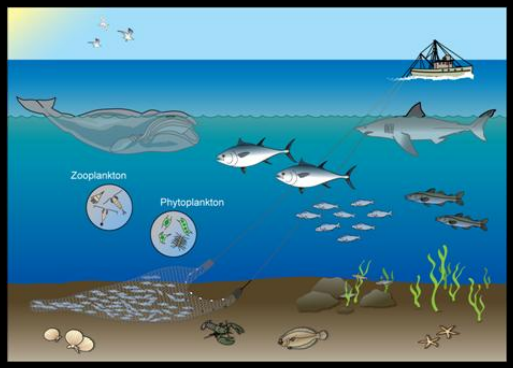
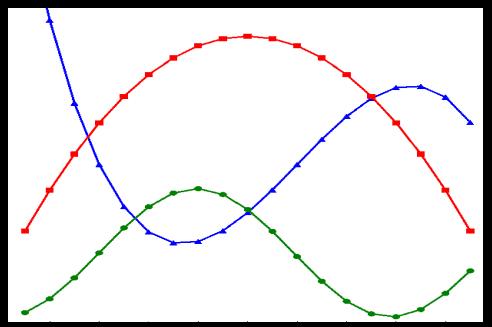


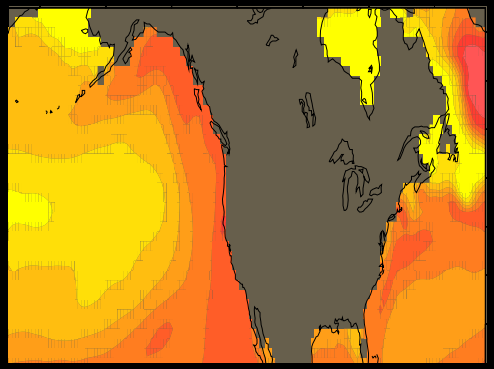
Ecosystem



Observations

Management choices

6. Scenario evaluation



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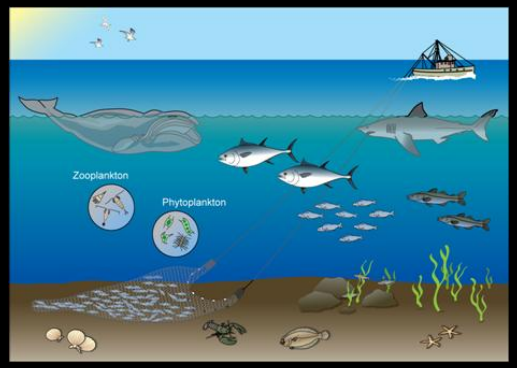
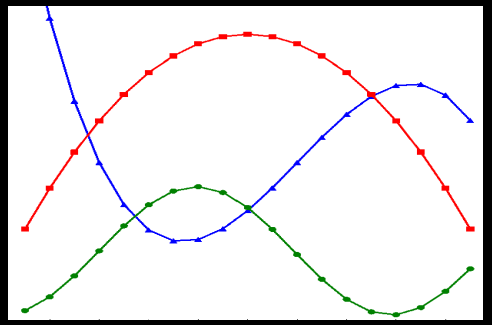


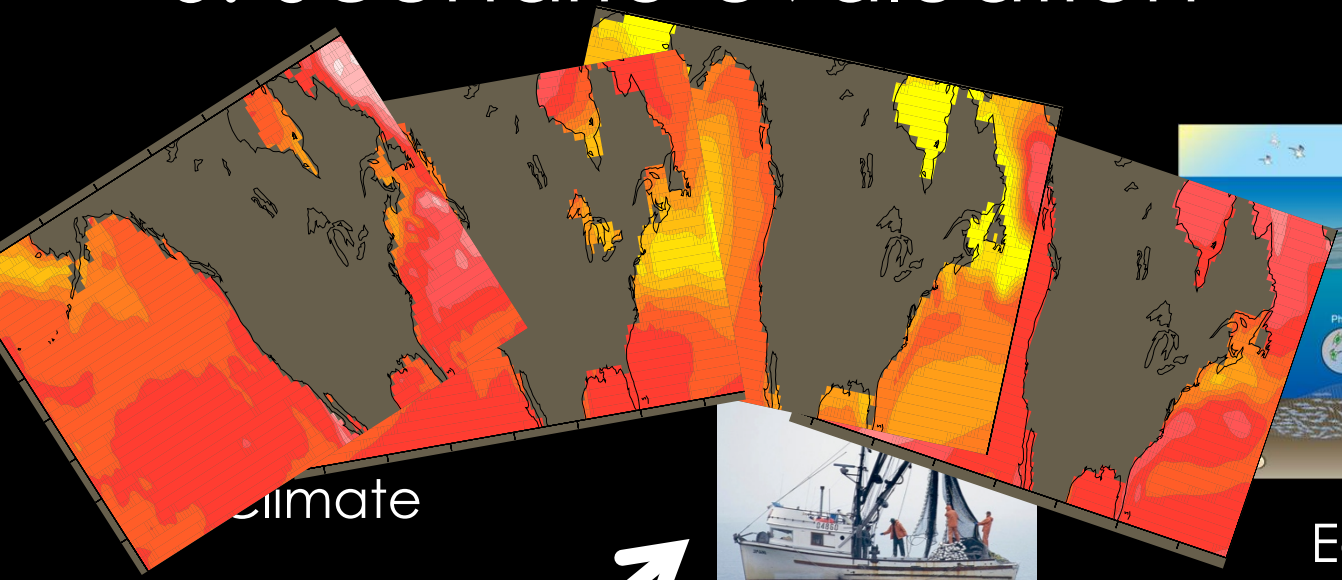
Ecosystem



Observations

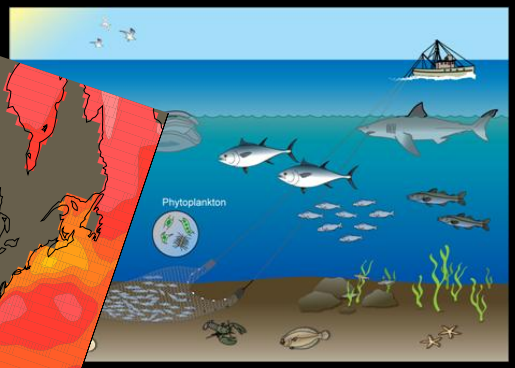
Management choices

6. Scenario evaluation

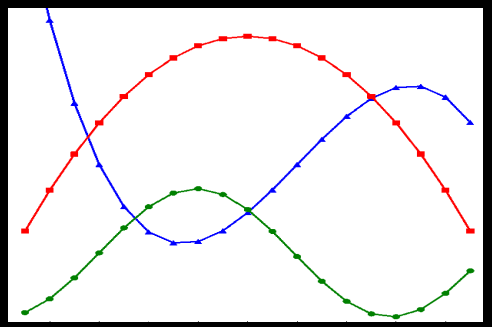


Climate

Implementation



Ecosystem



Observations

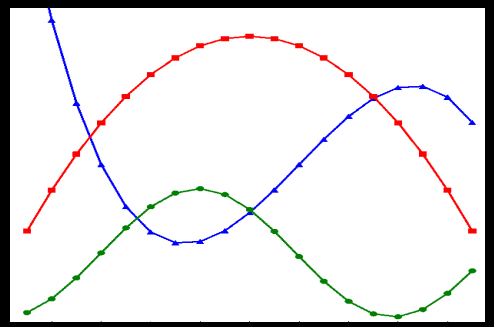
Management choices

6. Scenario evaluation

Climate

Ecosystem

Implementation



Observations

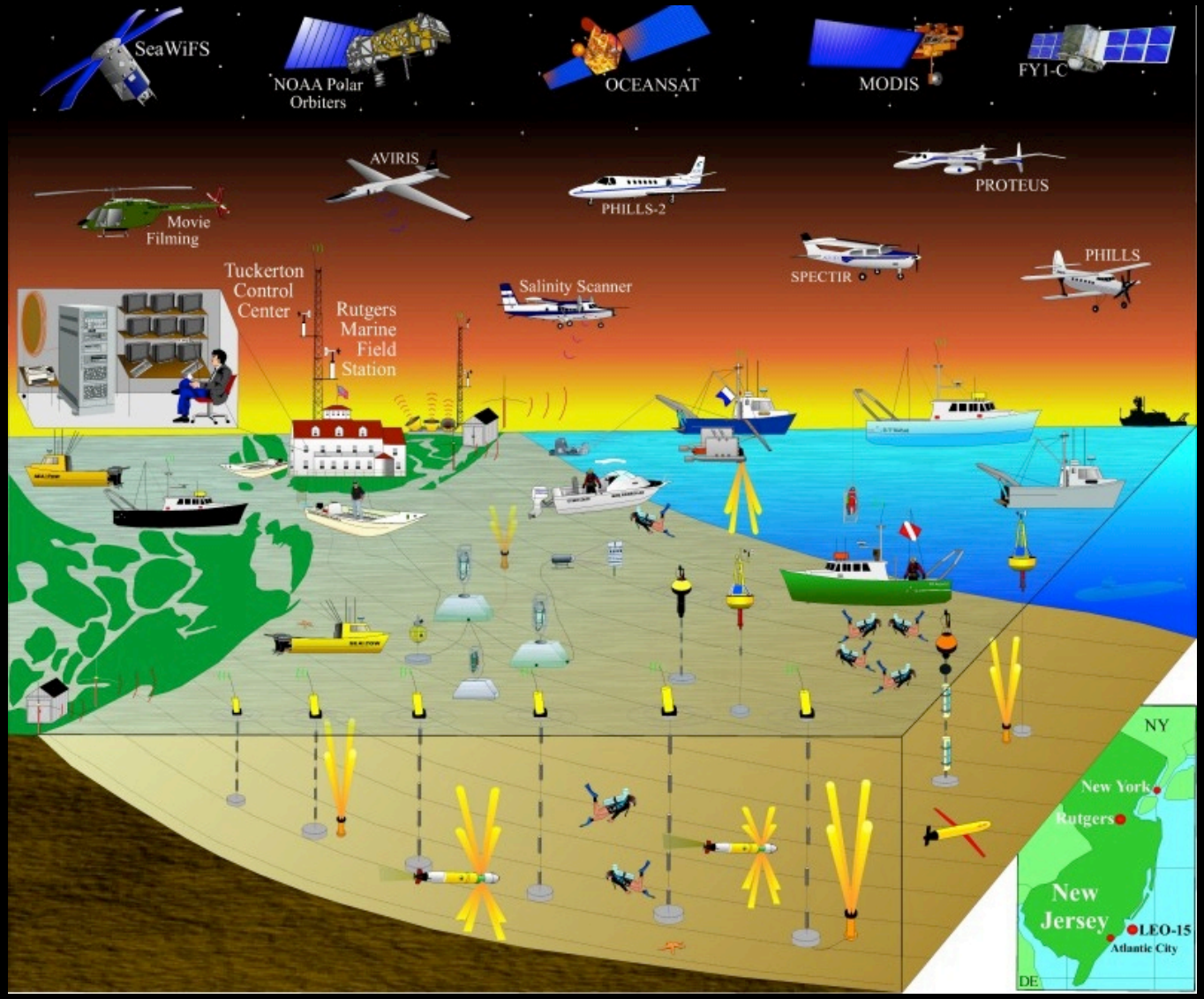
Management choices

6. Scenario evaluation

Forecasts to identify

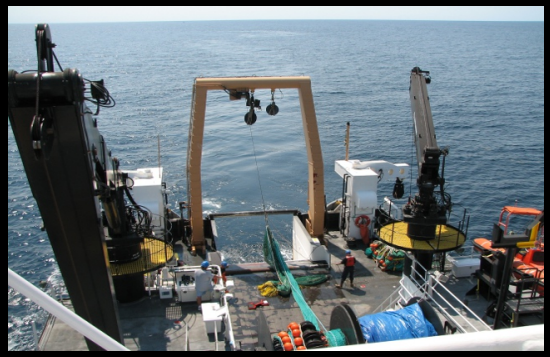
- Robust harvest control rules
- "Climate ready" marine spatial plans
- Emerging fisheries
- Vulnerable species
- International conflict species

7. Monitor for surprises & respond



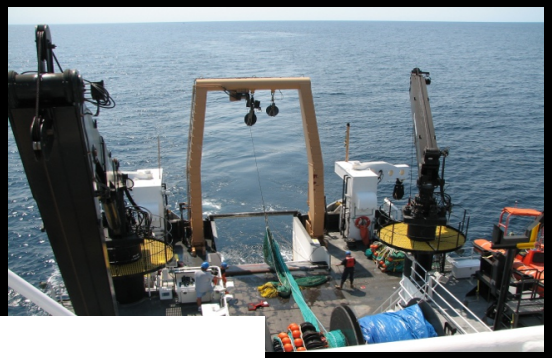
7. Monitor for surprises & respond

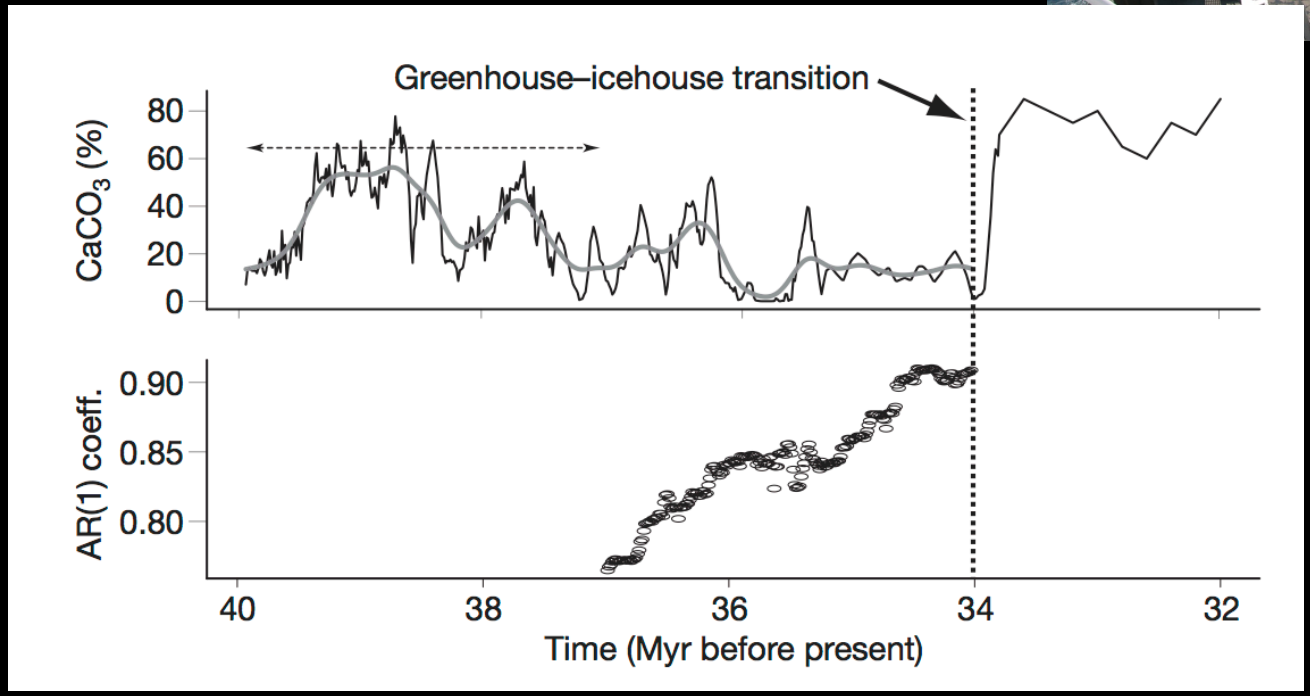
- Survey year-class strength



7. Monitor for surprises & respond

- Survey year-class strength
- Early warning signals





Scheffer et al. 2009 Nature

8. Consider barriers to adaptation

Outline

- Climate has widespread impacts on fish populations

Outline

- Climate has widespread impacts on fish populations
- We have a range of tools to adapt management

Outline

- Climate has widespread impacts on fish populations
- We have a range of tools to adapt management
- Forecasts can play an important role

Acknowledgments

Collaborators

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Advocates for Wild, Healthy Oceans

Society for Conservation Biology

A “toolbox” of approaches

1. Address the basics
2. Prepare for emerging fisheries
3. Evaluate spatial boundaries
4. Prepare international agreement
5. Include climate effects in assessments
6. Evaluate scenarios
7. Monitor for surprises & respond
8. Consider barriers to adaptation