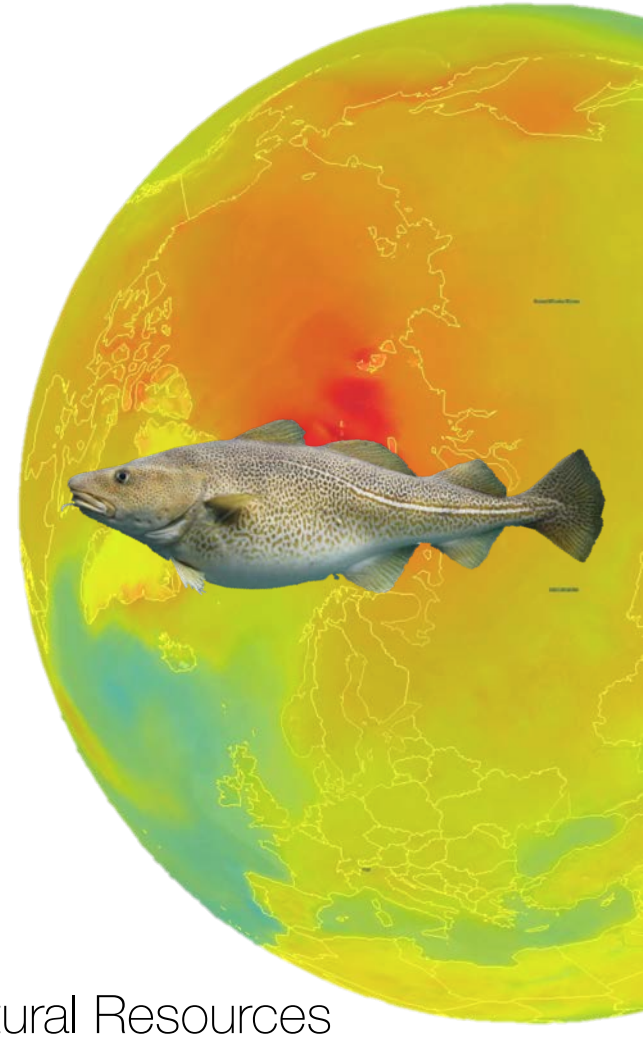
Can we adapt to species on the move?

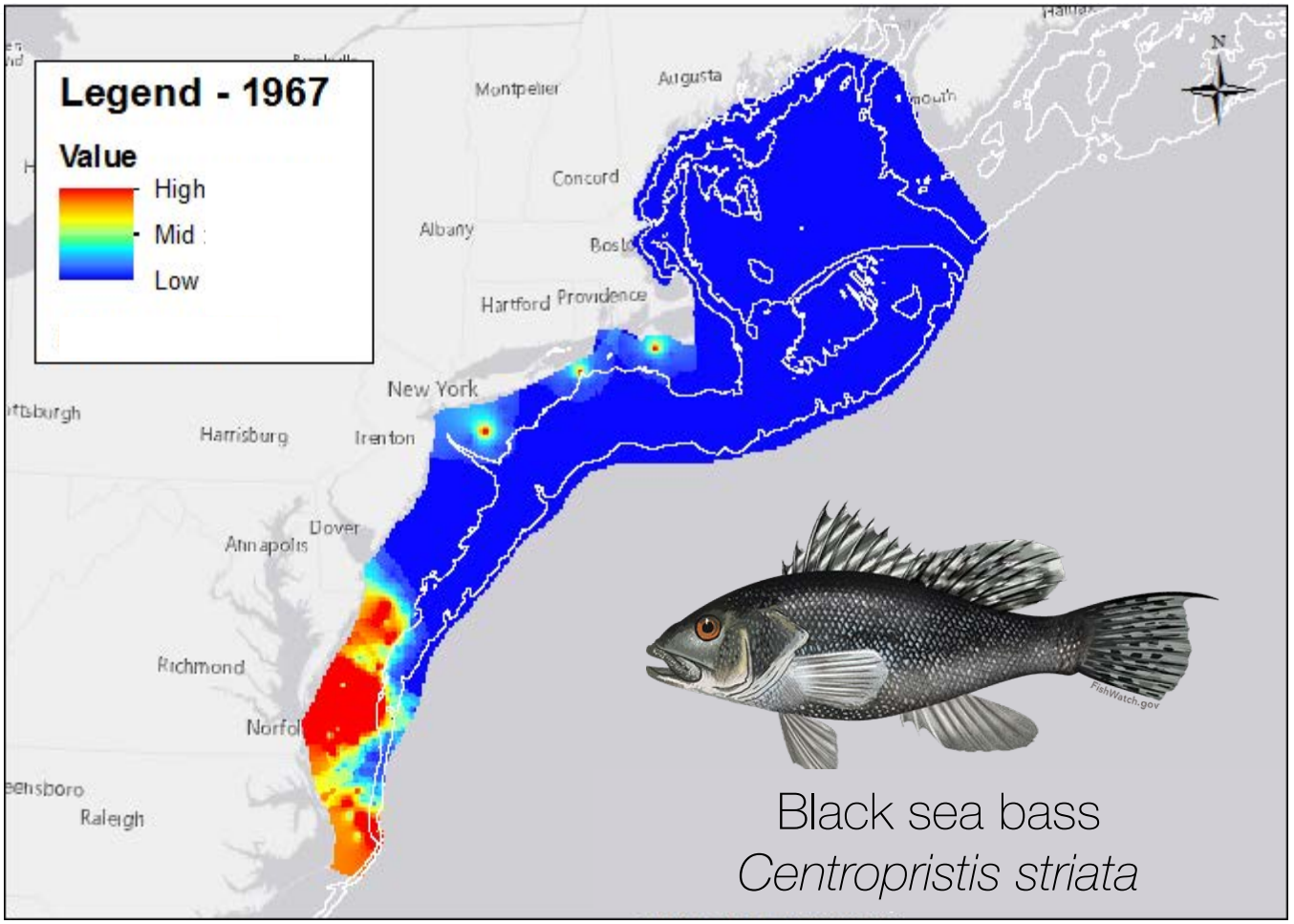


Malin Pinsky

Department of Ecology, Evolution, and Natural Resources

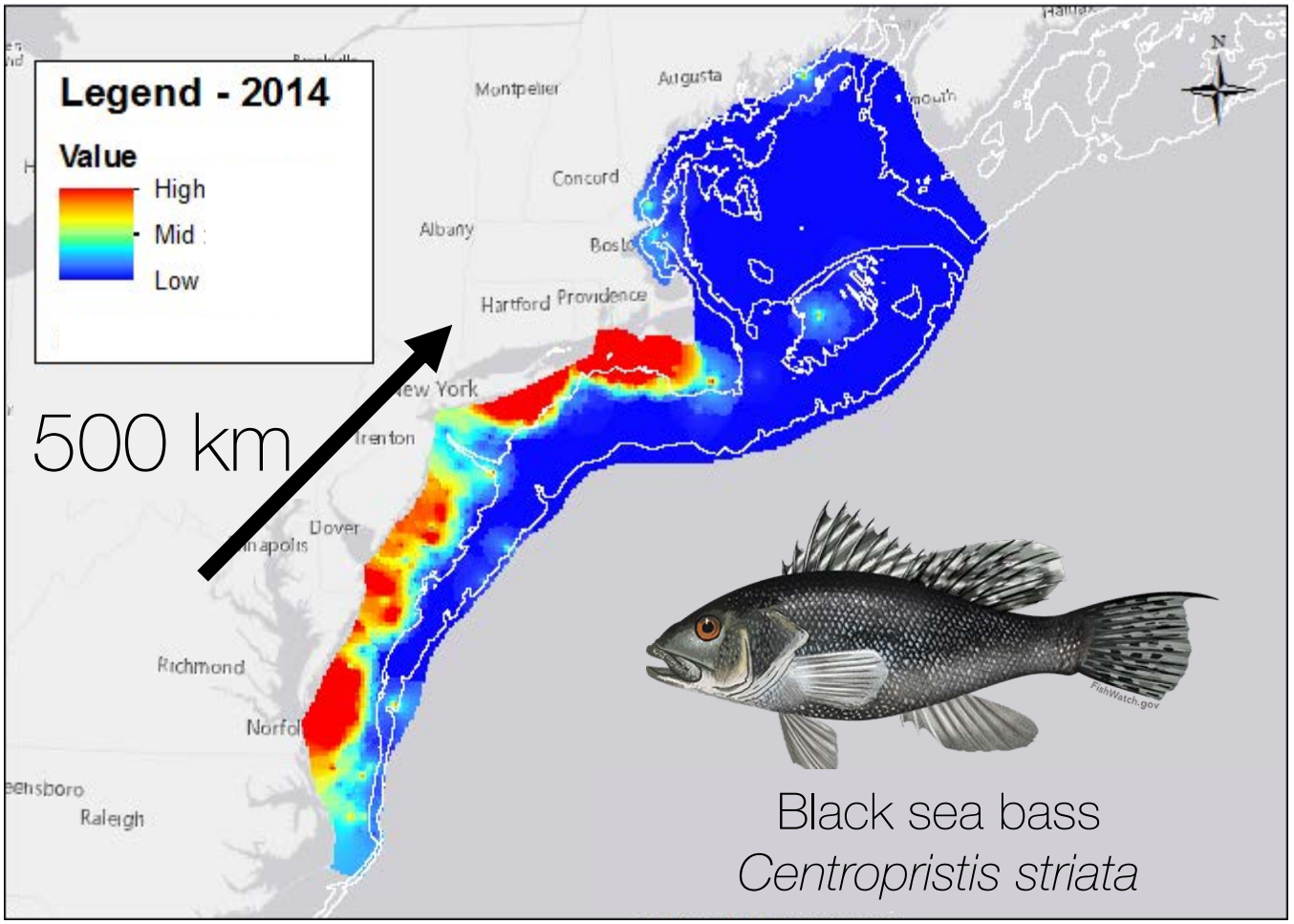
Institute of Earth, Ocean, and Atmospheric Sciences

Shifting distributions 1967



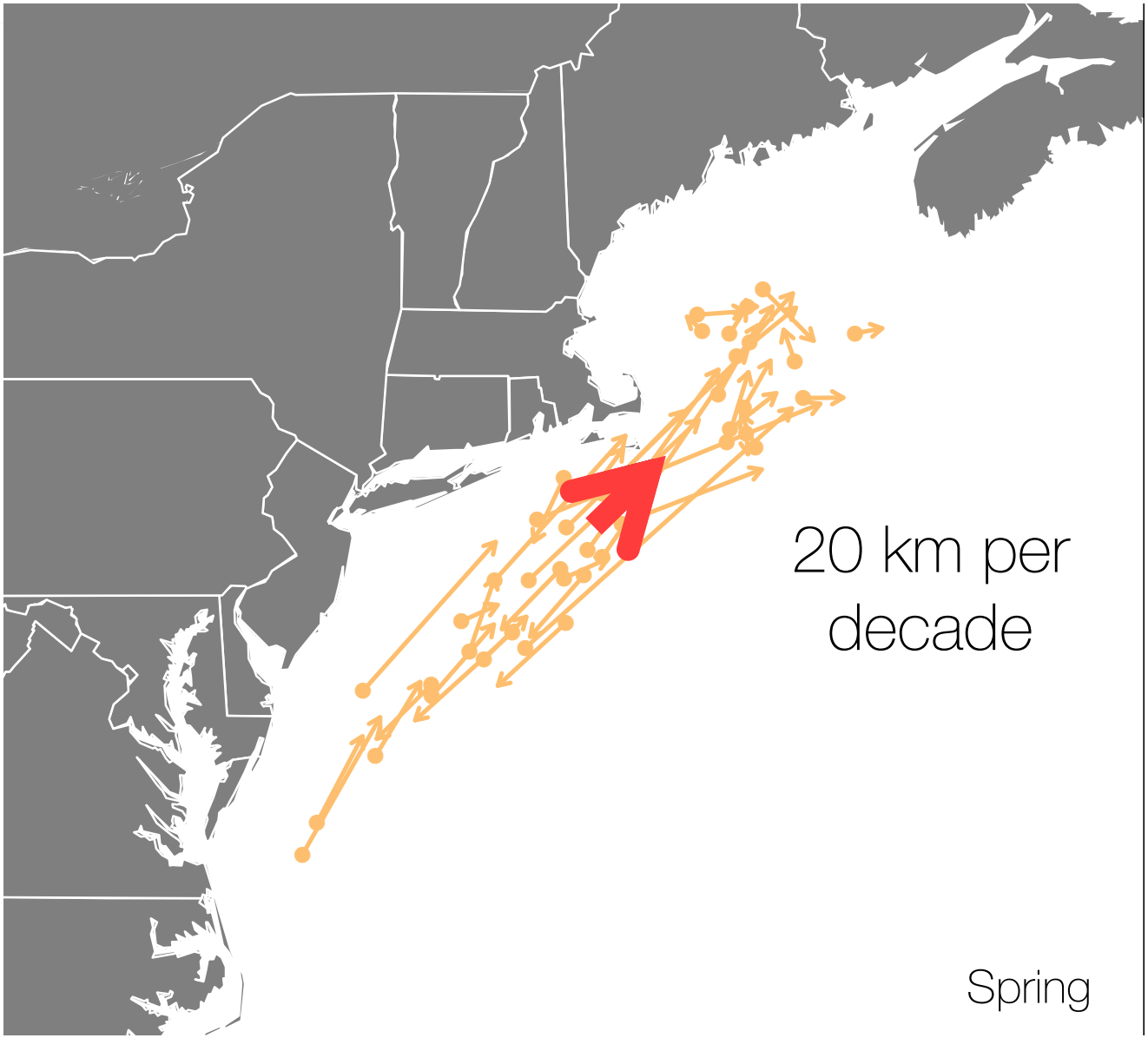
Pinsky *et al.* 2013 *Science*
http://oceanadapt.rutgers.edu

Shifting distributions 1967-2014



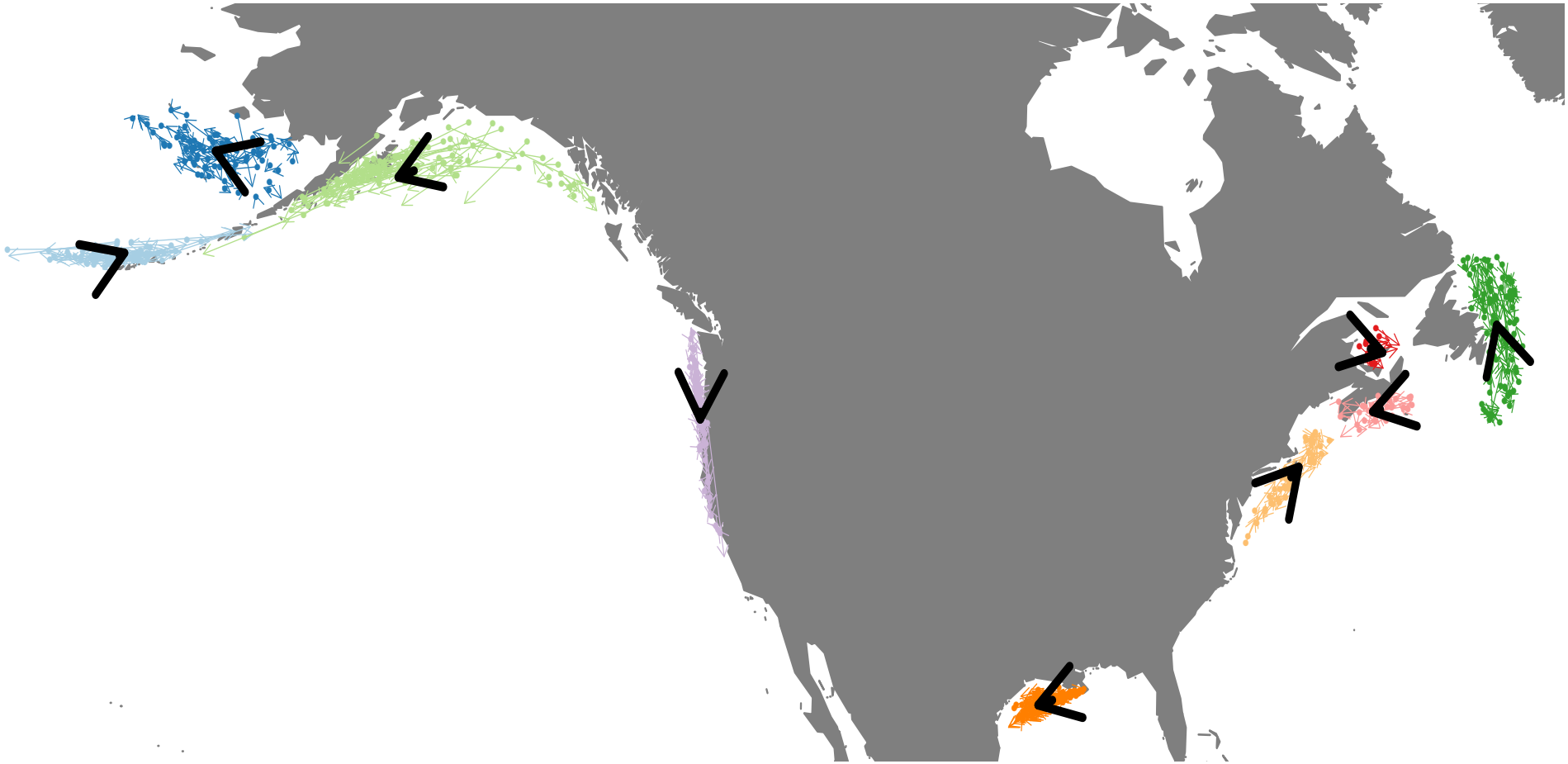
Pinsky *et al.* 2013 *Science*
http://oceanadapt.rutgers.edu

Many species, many directions



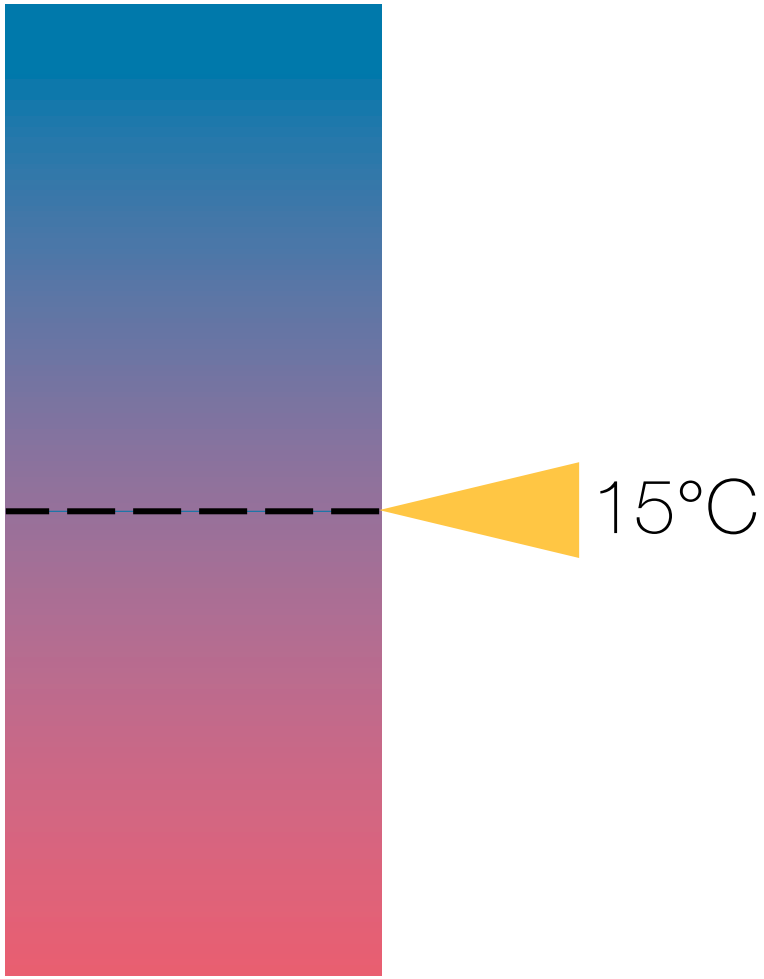
Pinsky *et al.*
2013 *Science*

Many species, many directions



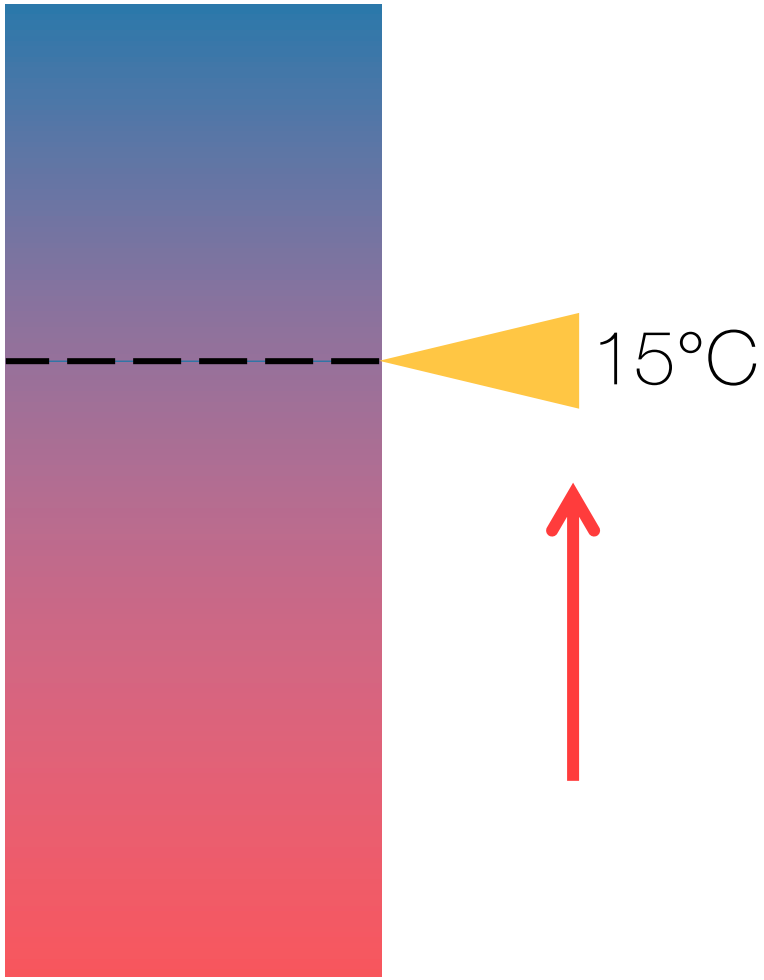
Pinsky et al. 2013 Science

Climate velocity helps explain shifts



Pinsky *et al.*
2013 *Science*

Climate velocity helps explain shifts



Pinsky *et al.*
2013 *Science*

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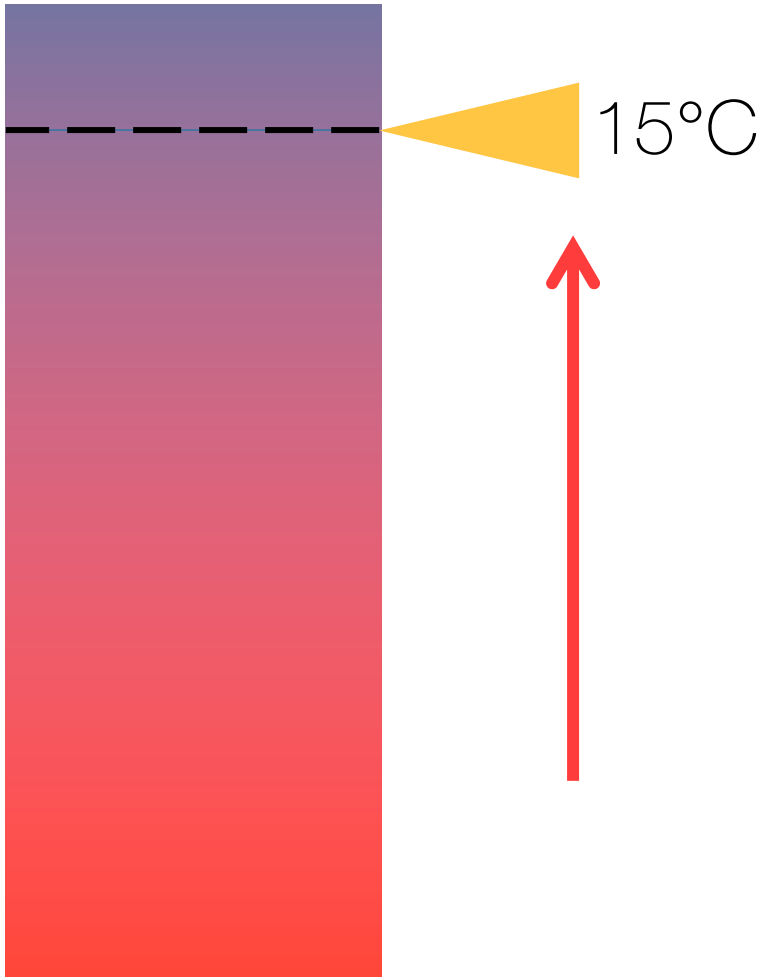

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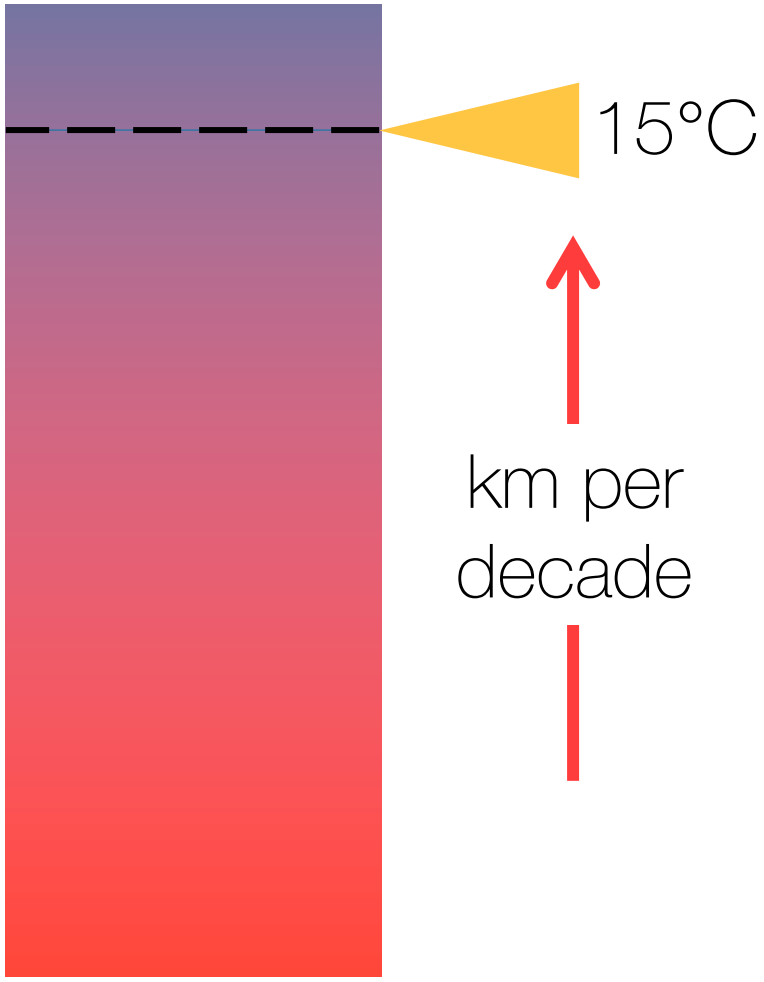
Climate velocity helps explain shifts



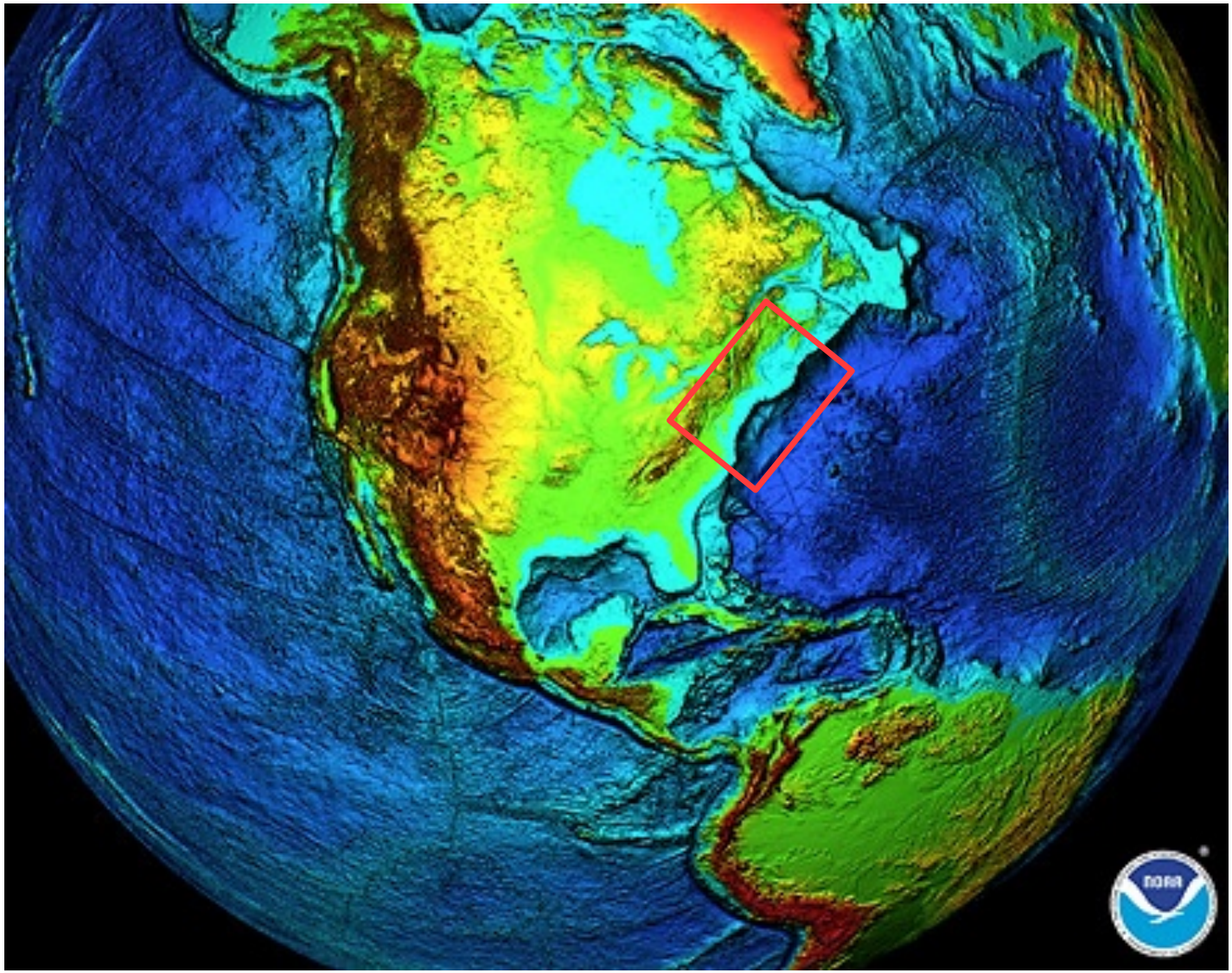
Pinsky *et al.*
2013 *Science*

To hear more about climate impacts

Synchrony
Joyce Ong
today
S7 posters

Depth constraints
Hailey Conrad
11:00 am
Friday
S11

Fishery responses



Bottom-up fishery adaptation

- Travel further

Bottom-up fishery adaptation

- Travel further
- Switch ports

Bottom-up fishery adaptation

- Travel further
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Bottom-up fishery adaptation

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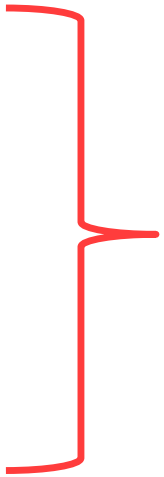
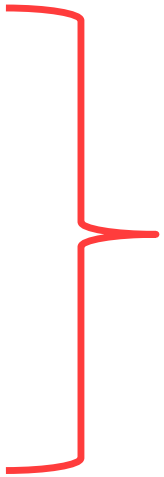


Regulations
Economics
Technology

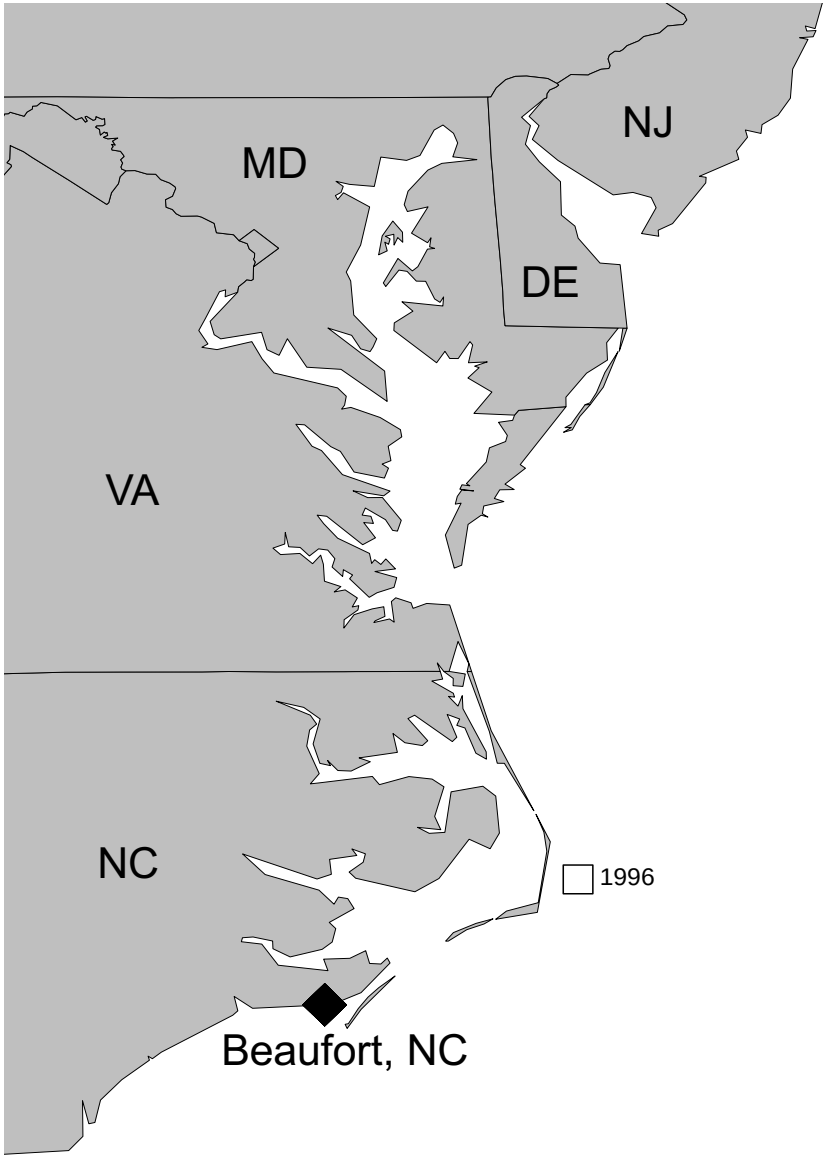
Bottom-up fishery adaptation

- Travel further
- Switch ports
- Switch species
- Leave fishing



Regulations
Economics
Technology

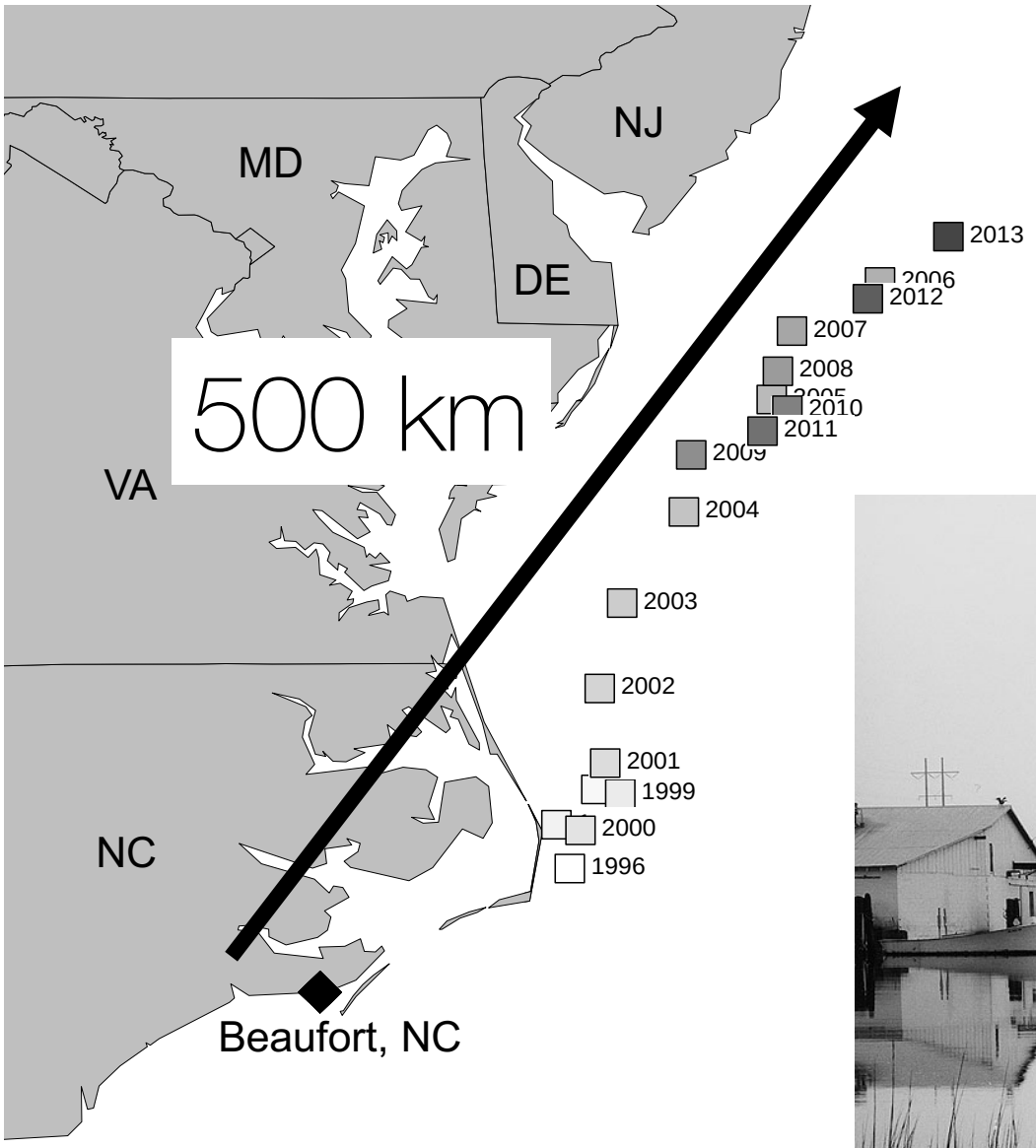
Longer fishing trips



1996

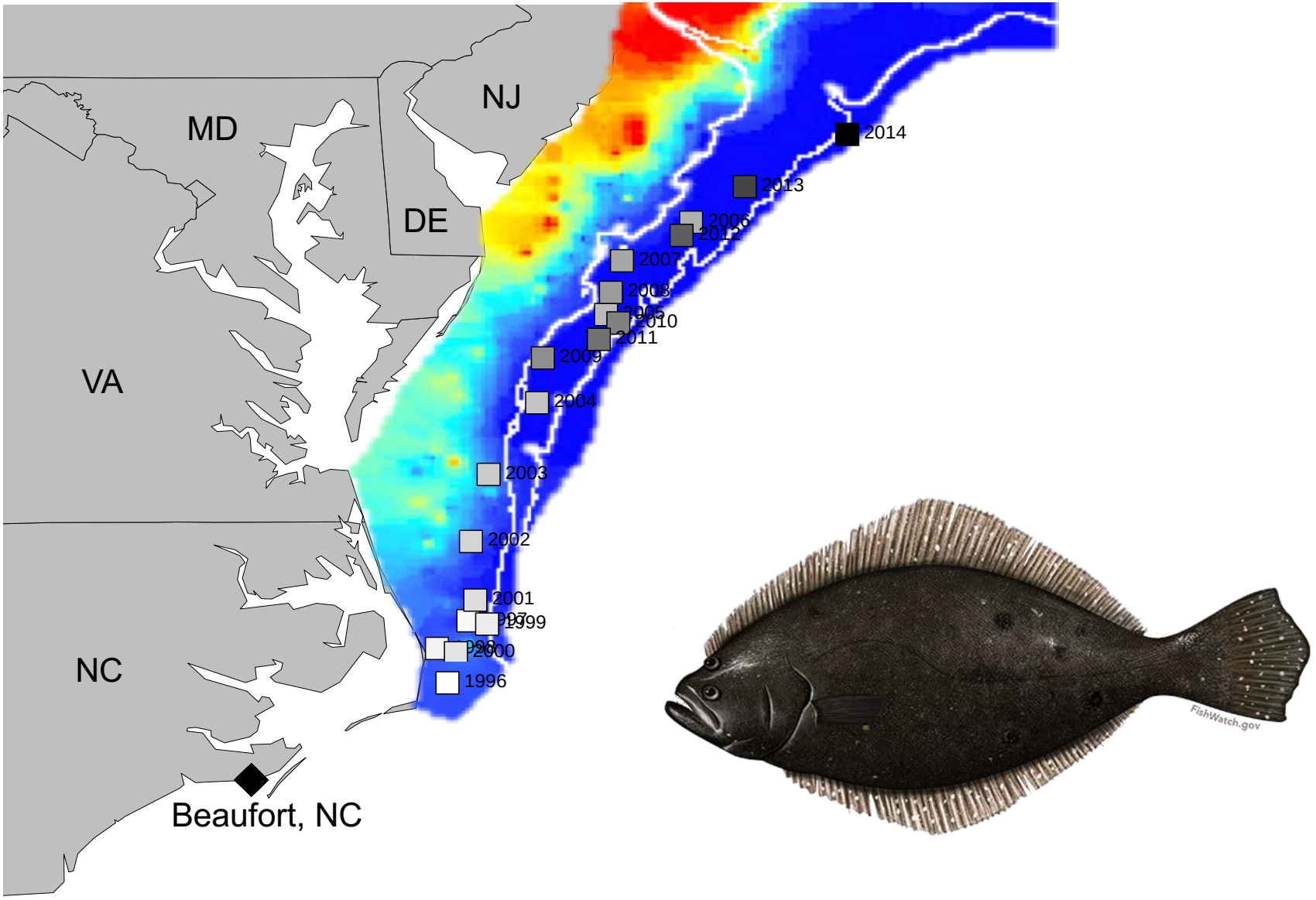
From Vessel Trip Reports

Longer fishing trips

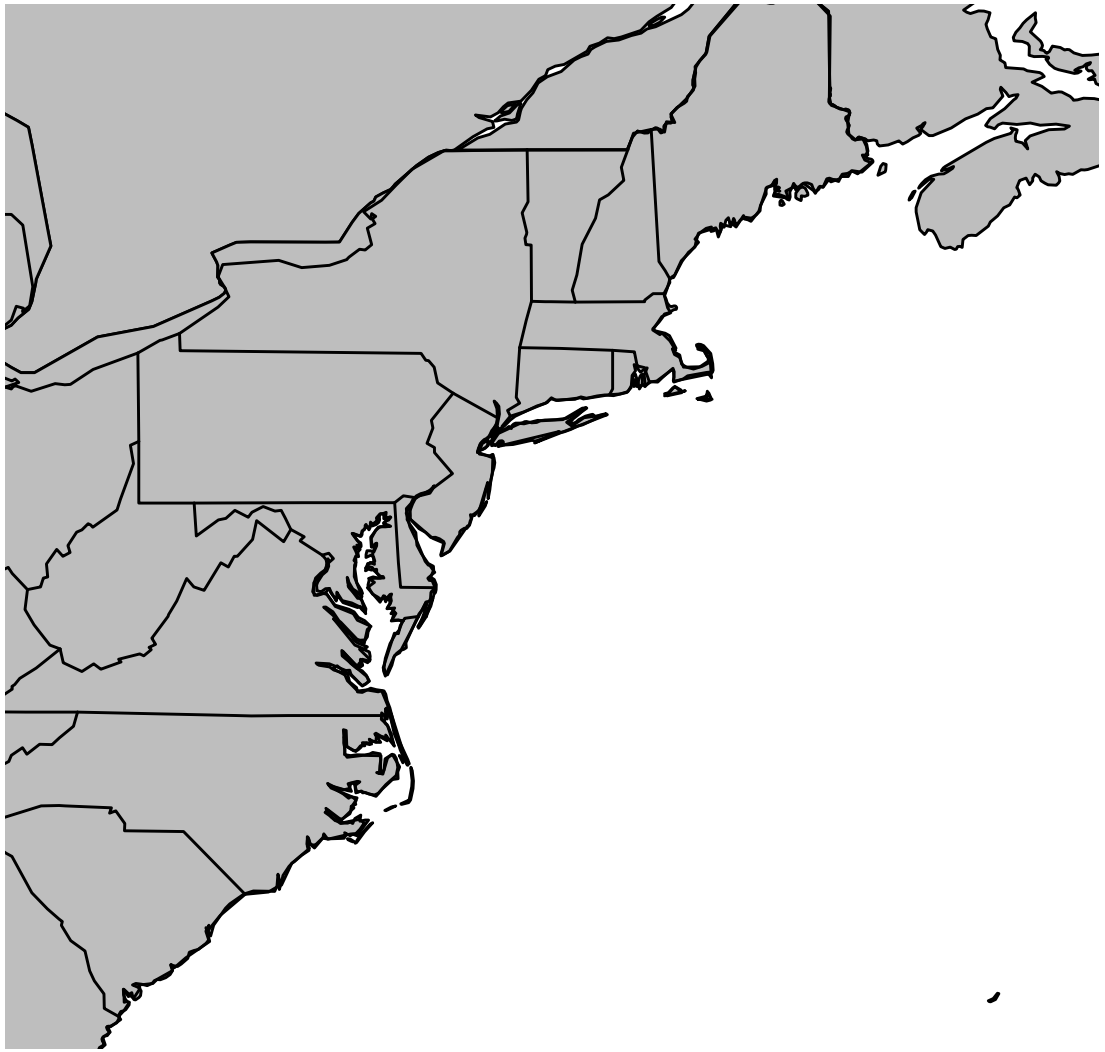


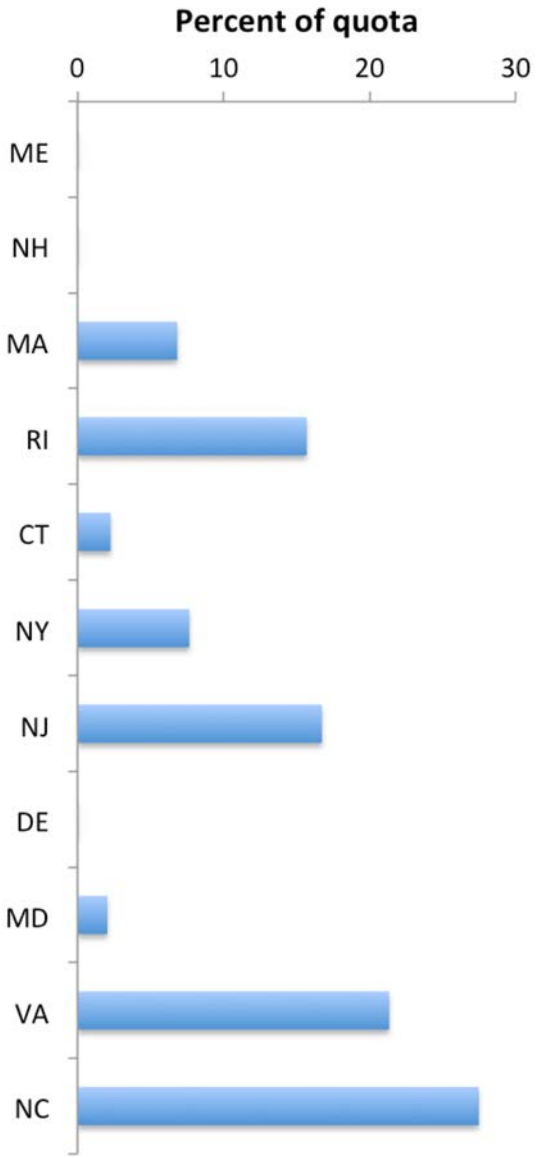
From Vessel Trip Reports

Specialist fishers in a changing world



Summer flounder: allocation of landings





To hear more about fishery responses

West Coast
Becca Selden
16:20 pm
today
S10

East Coast interviews
Eva Papaioannou
11:00 am
Friday
S14

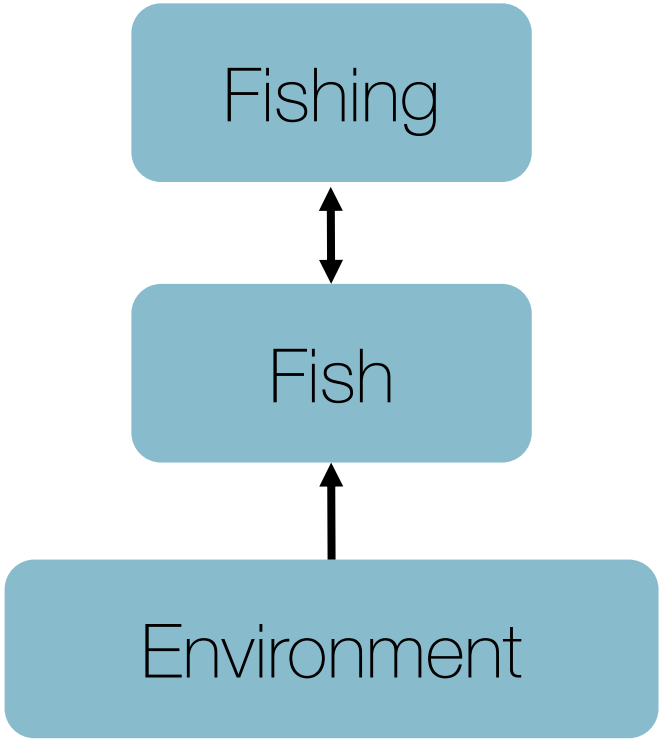
Adapting to species on the move

- Regulations incentivize fishery responses in unintended ways
- Where are there pitfalls?
- (How) can we adapt?

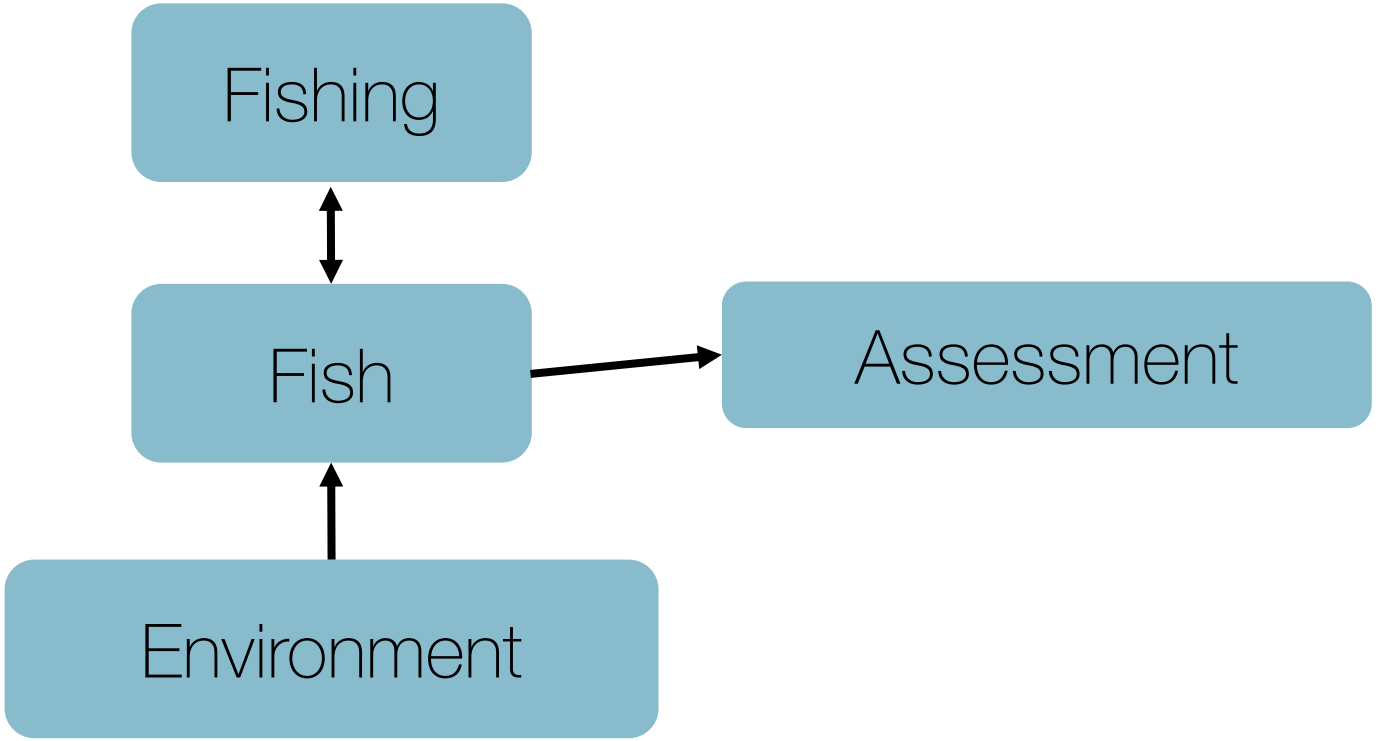
Adapting to species on the move

- Regulations incentivize fishery responses in unanticipated ways
- Where are there pitfalls?
- (How) can we adapt?

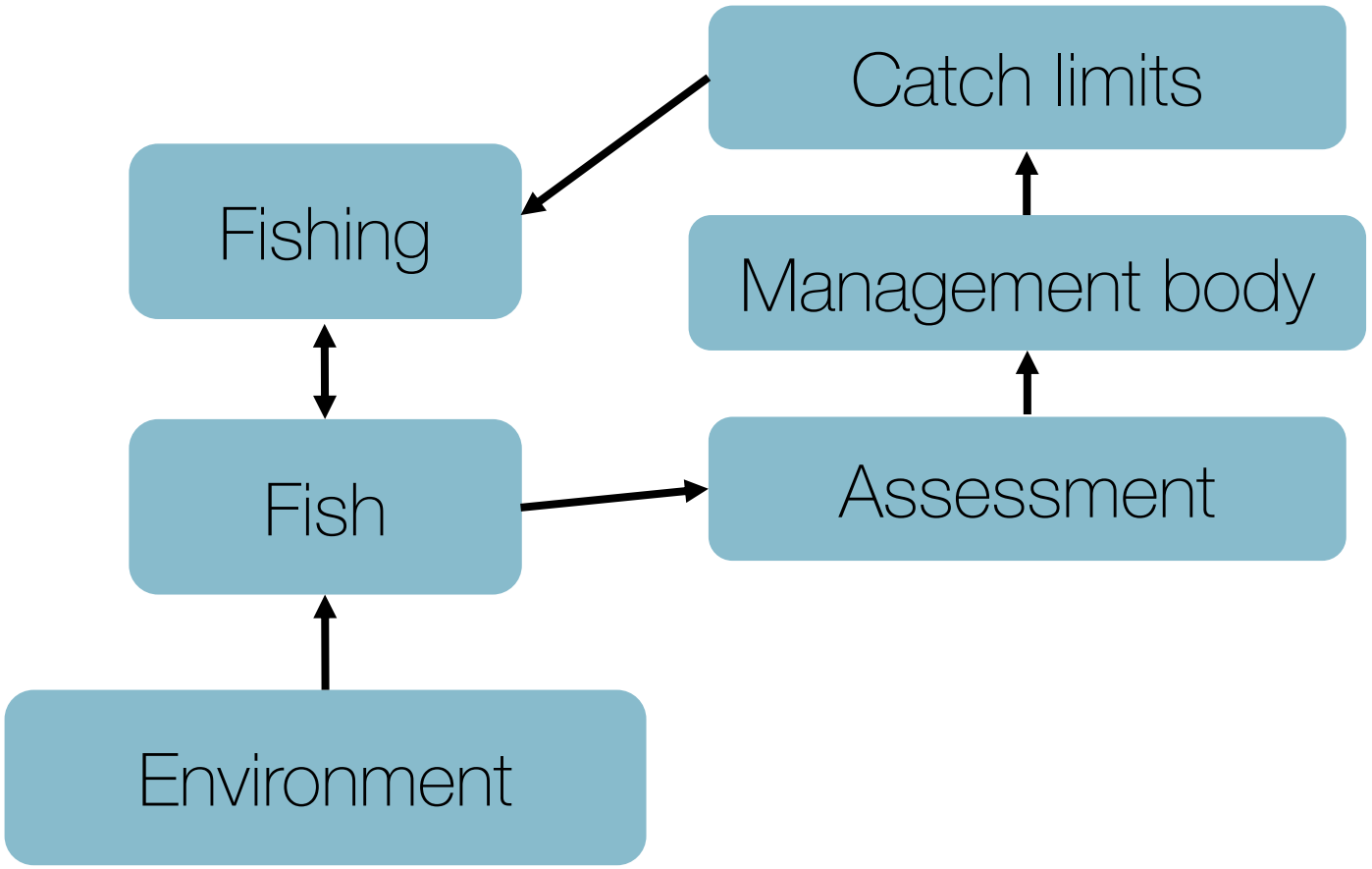
Standard model



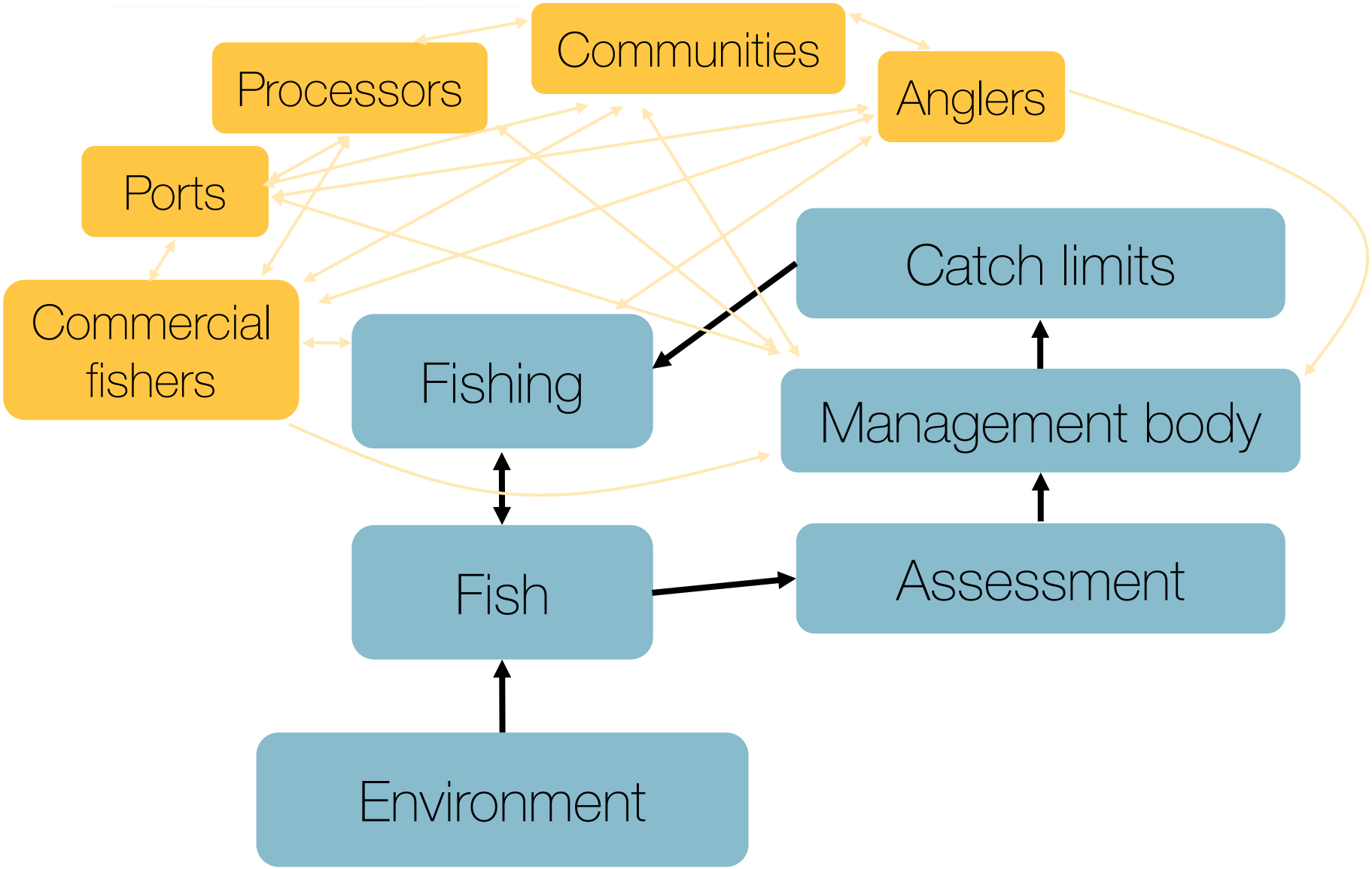
Standard model



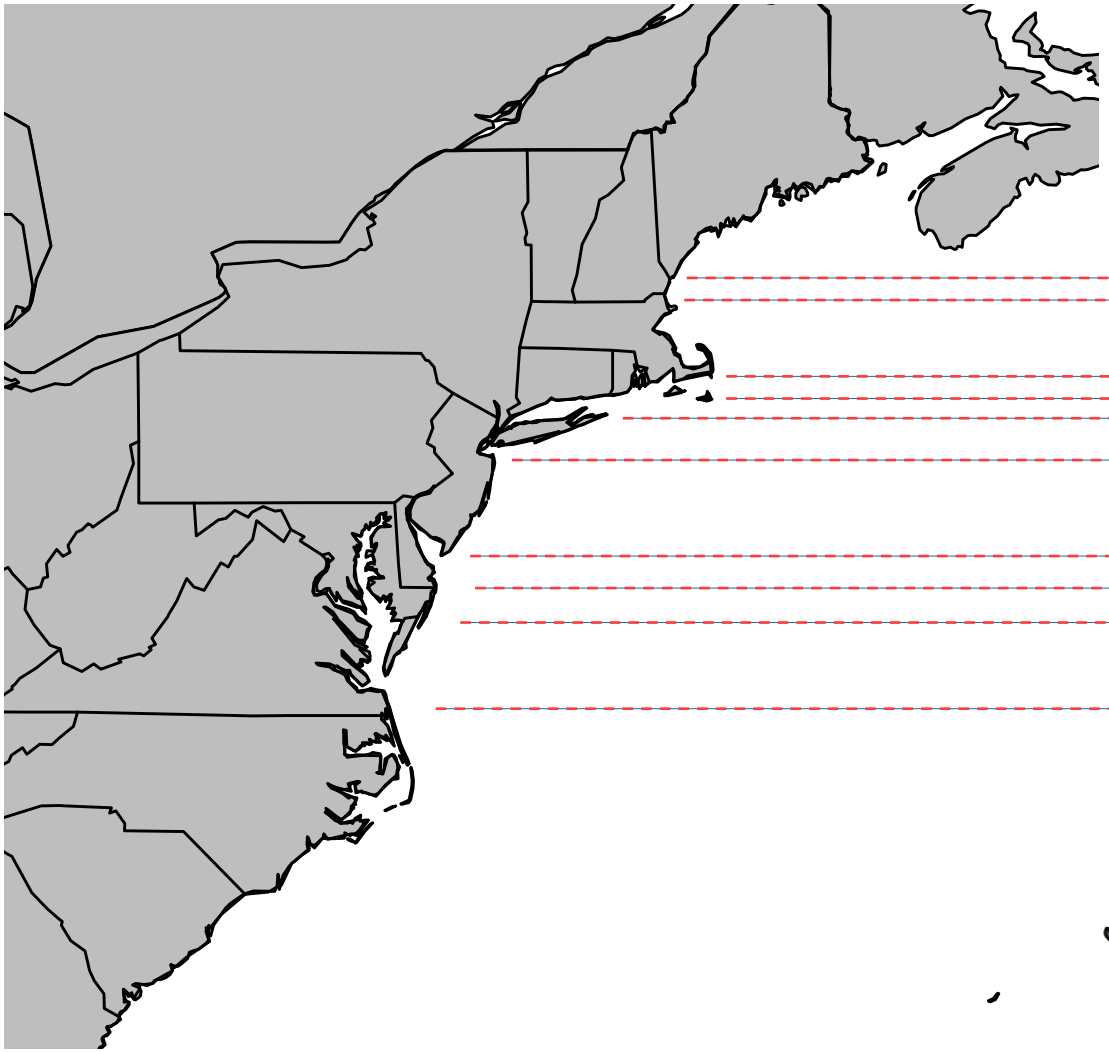
Standard model



Coupled social-ecological system

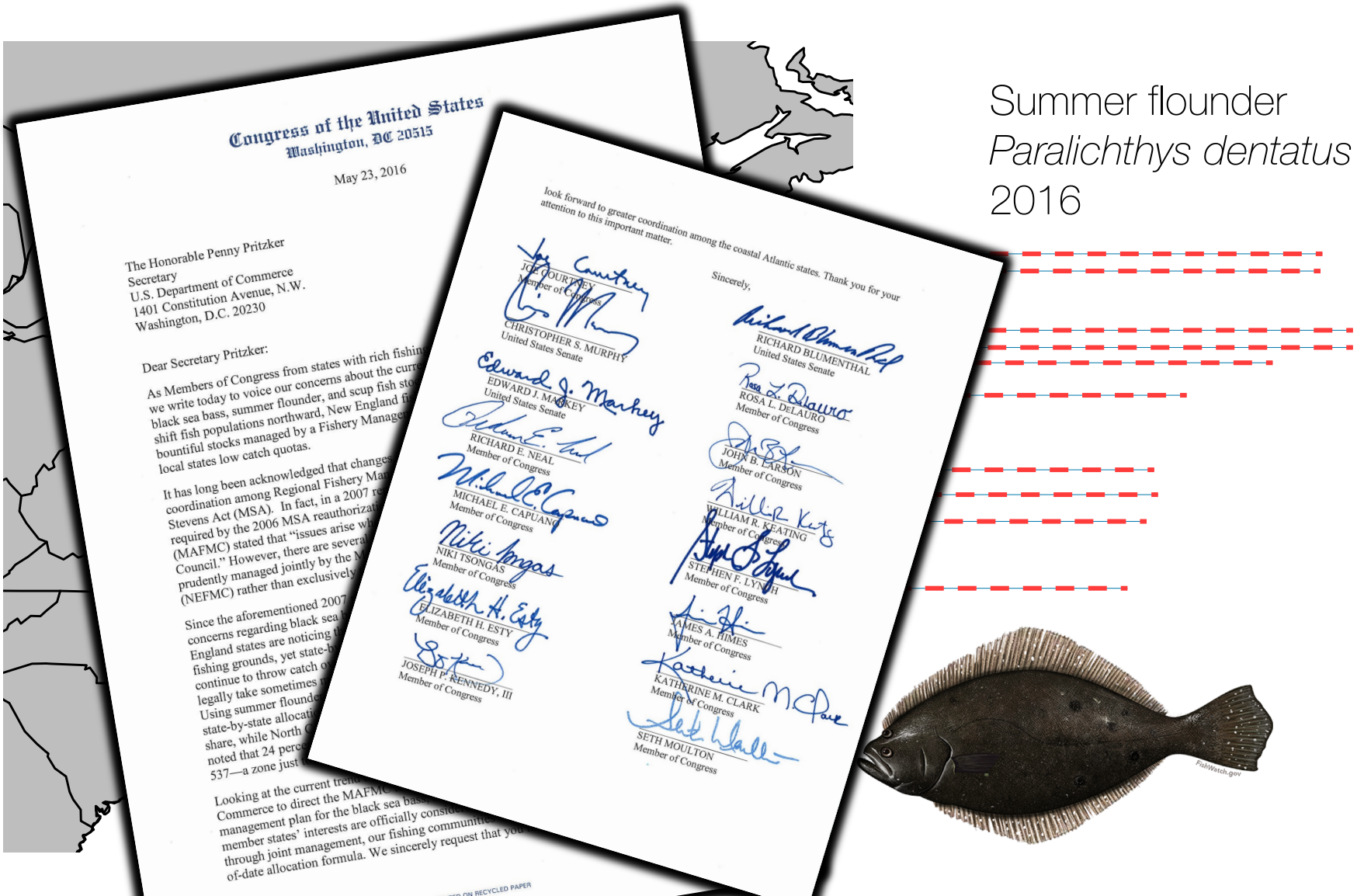


Challenges from crossing boundaries



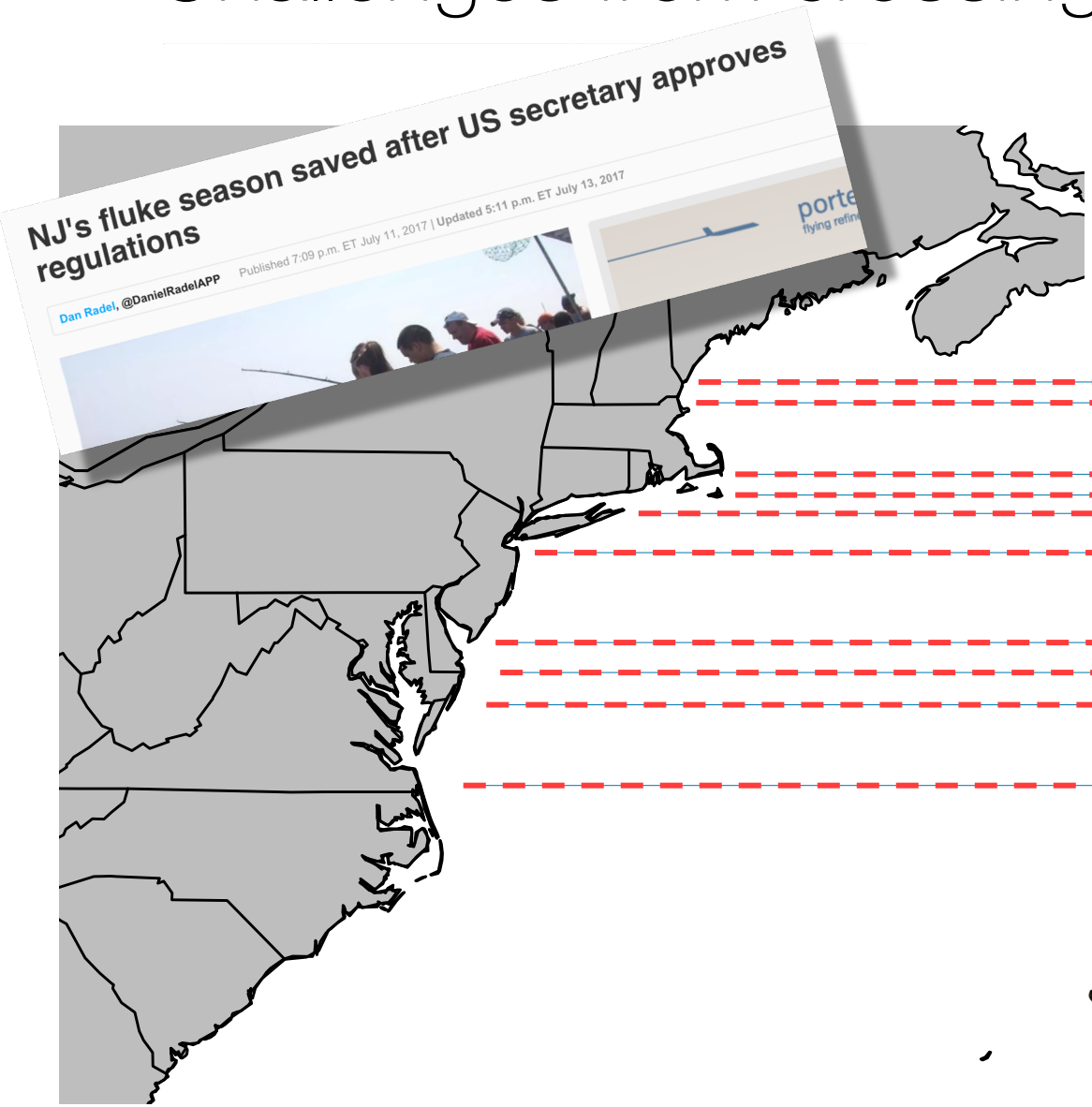
Summer flounder
Paralichthys dentatus

Challenges from crossing boundaries



Summer flounder
Paralichthys dentatus
2016

Challenges from crossing boundaries

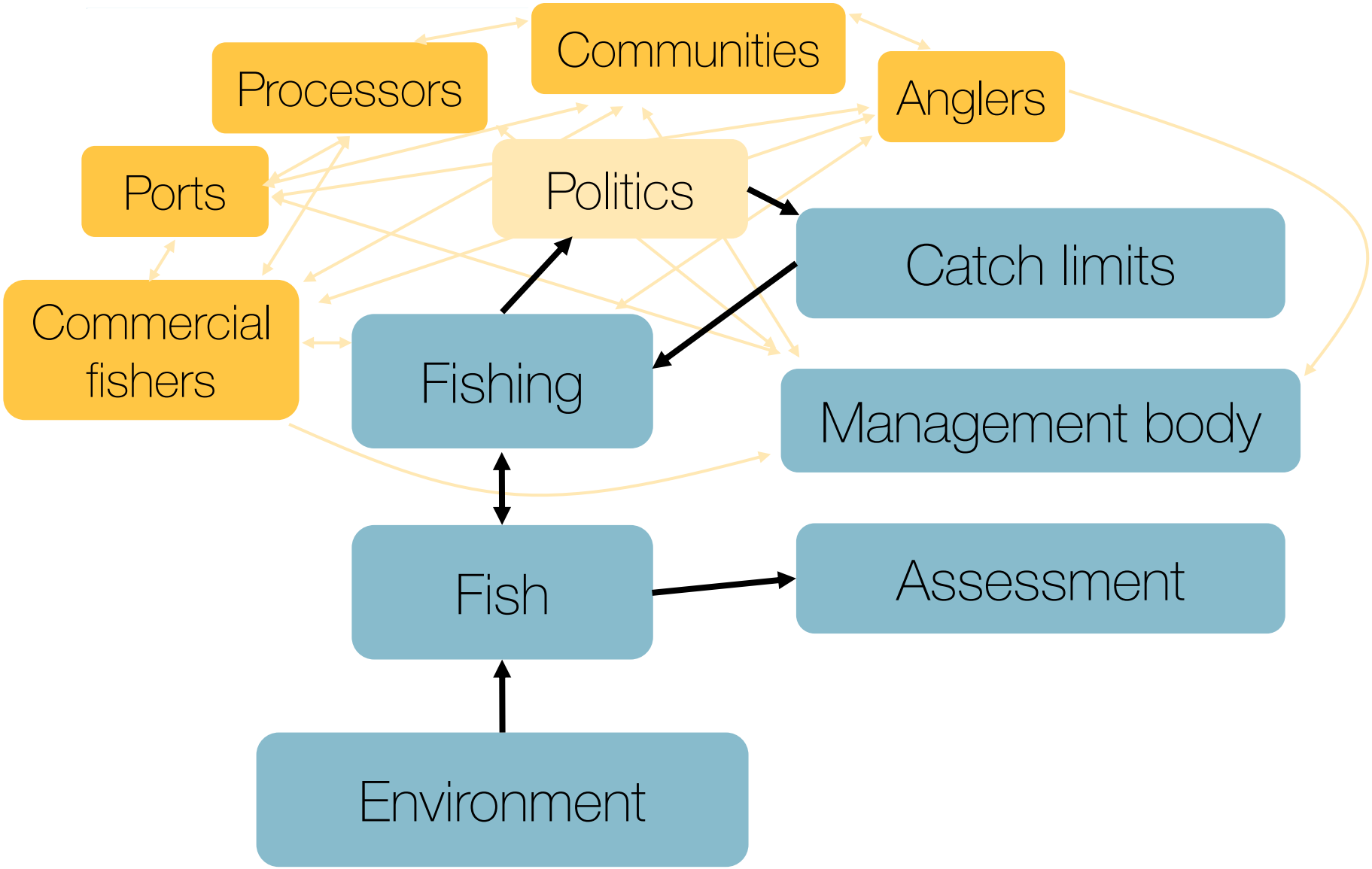


Summer flounder
Paralichthys dentatus
2017

Challenges from crossing boundaries

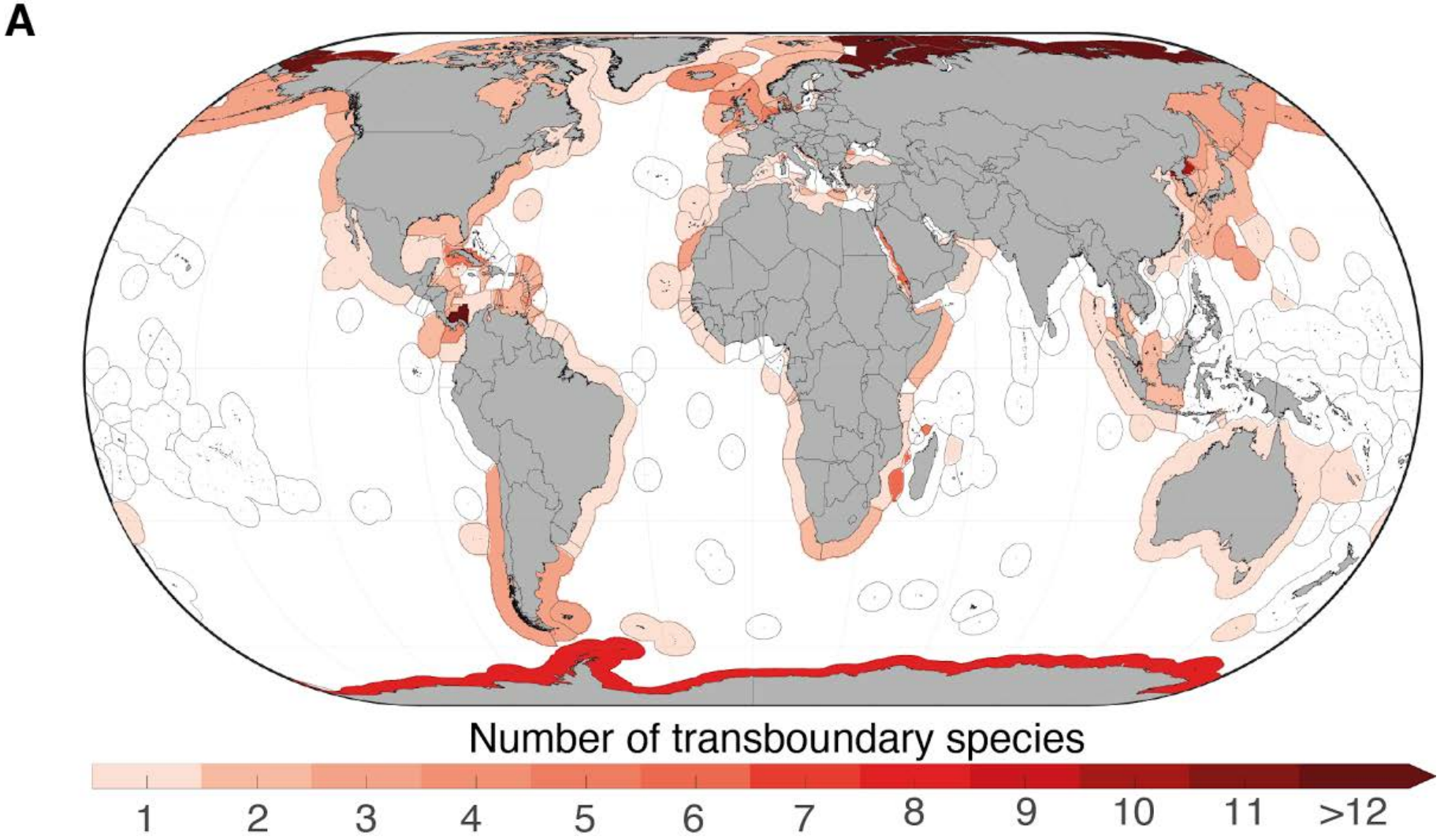
Summer flounder
Paralichthys dentatus
2017

Coupled social-ecological system



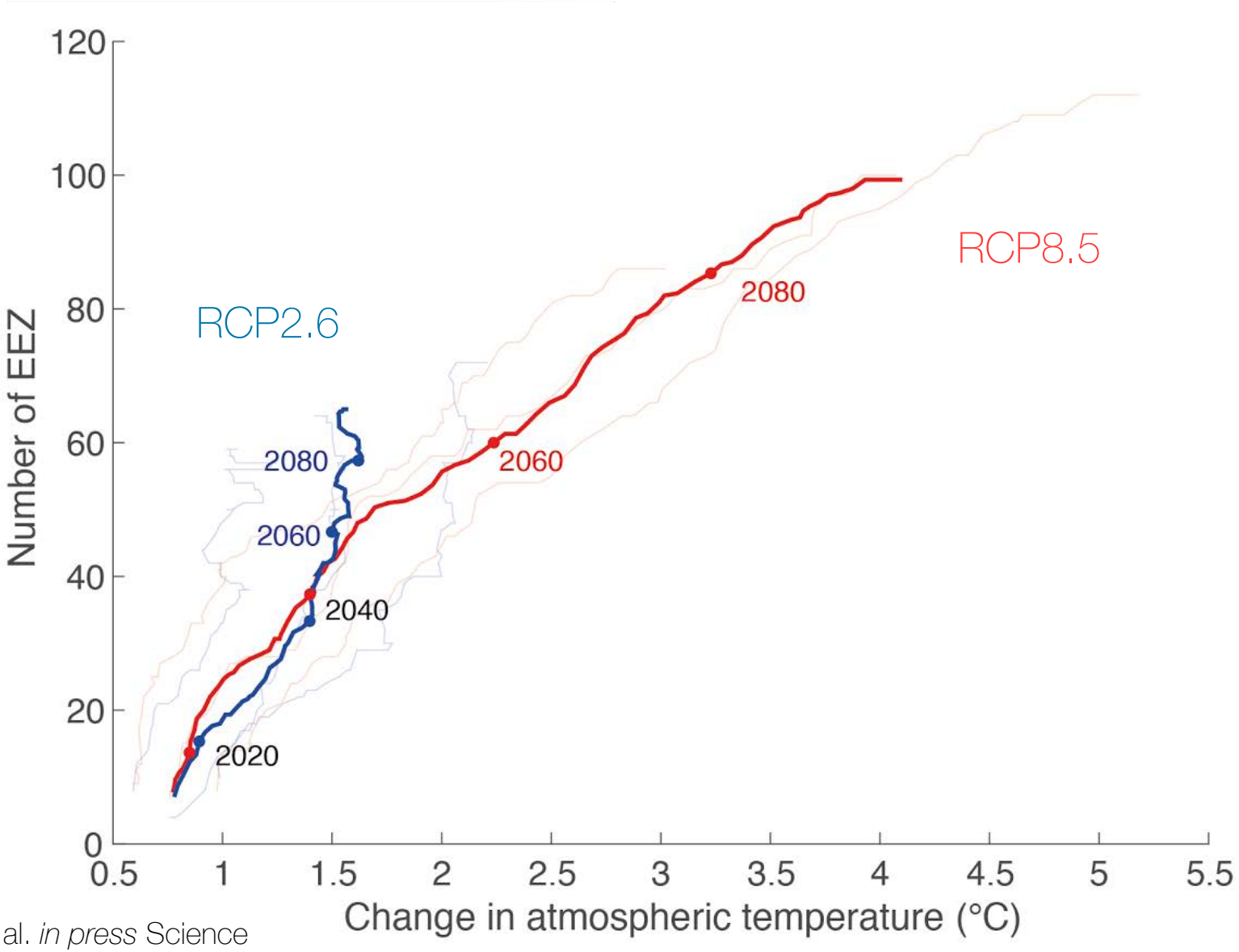
International: Mackerel wars

New transboundary stocks by 2100



Pinsky et al. *in press* Science

Less potential conflict with lower emissions



Pinsky et al. *in press* Science

Adapting to species on the move

- Regulations incentivize fishery responses in unintended ways
- We are not ready for species on the move across political boundaries
- (How) can we adapt?

Adapting to species on the move

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Timescales of fishery decisions

Assessments
Reference points
Spatial regulations

Timescales of fishery decisions

Assessments
Reference points
Spatial regulations

Emerging fisheries

Annual

Decadal

Multi-decadal

Timescales of fishery decisions

Assessments
Reference points
Spatial regulations

Emerging fisheries

Investment

Annual

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Multi-decadal

Timescales of fishery decisions

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Reference points
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Cooperation
Stakeholder representation

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Timescales of fishery decisions

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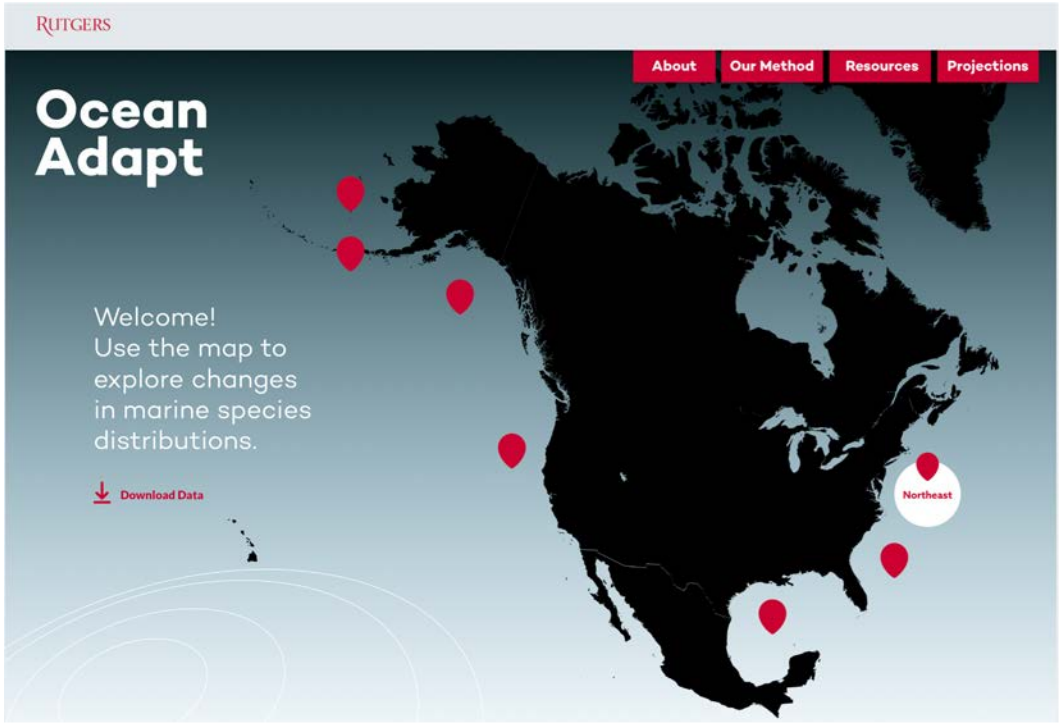
Current state and trends

http://oceanadapt.rutgers.edu



Current state and trends

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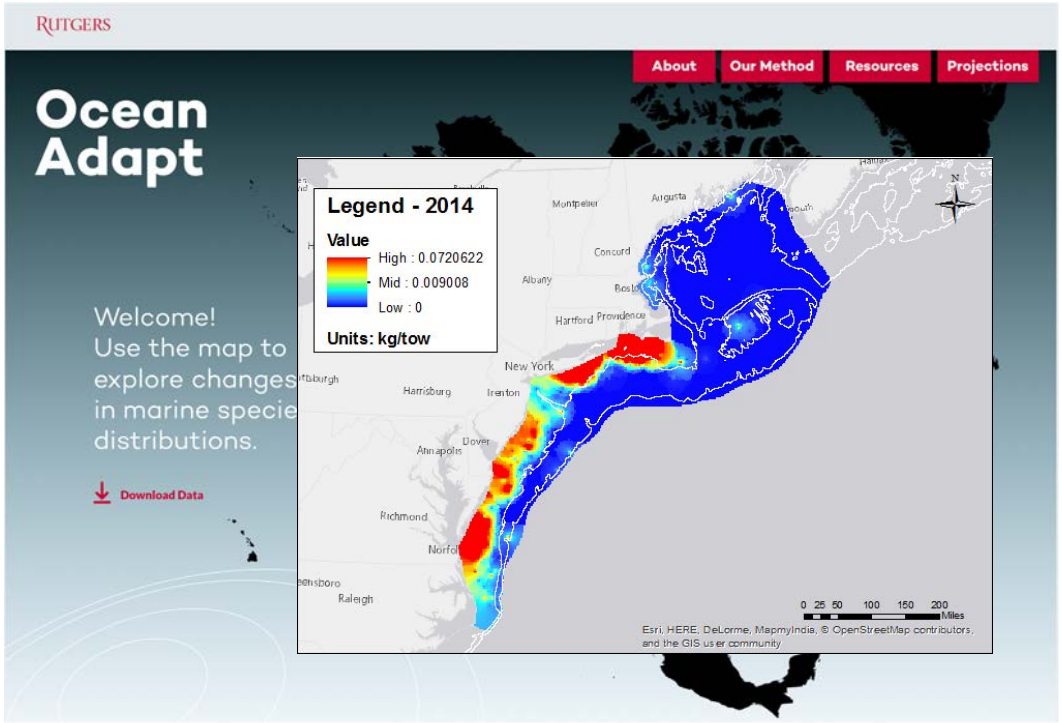

Current state and trends

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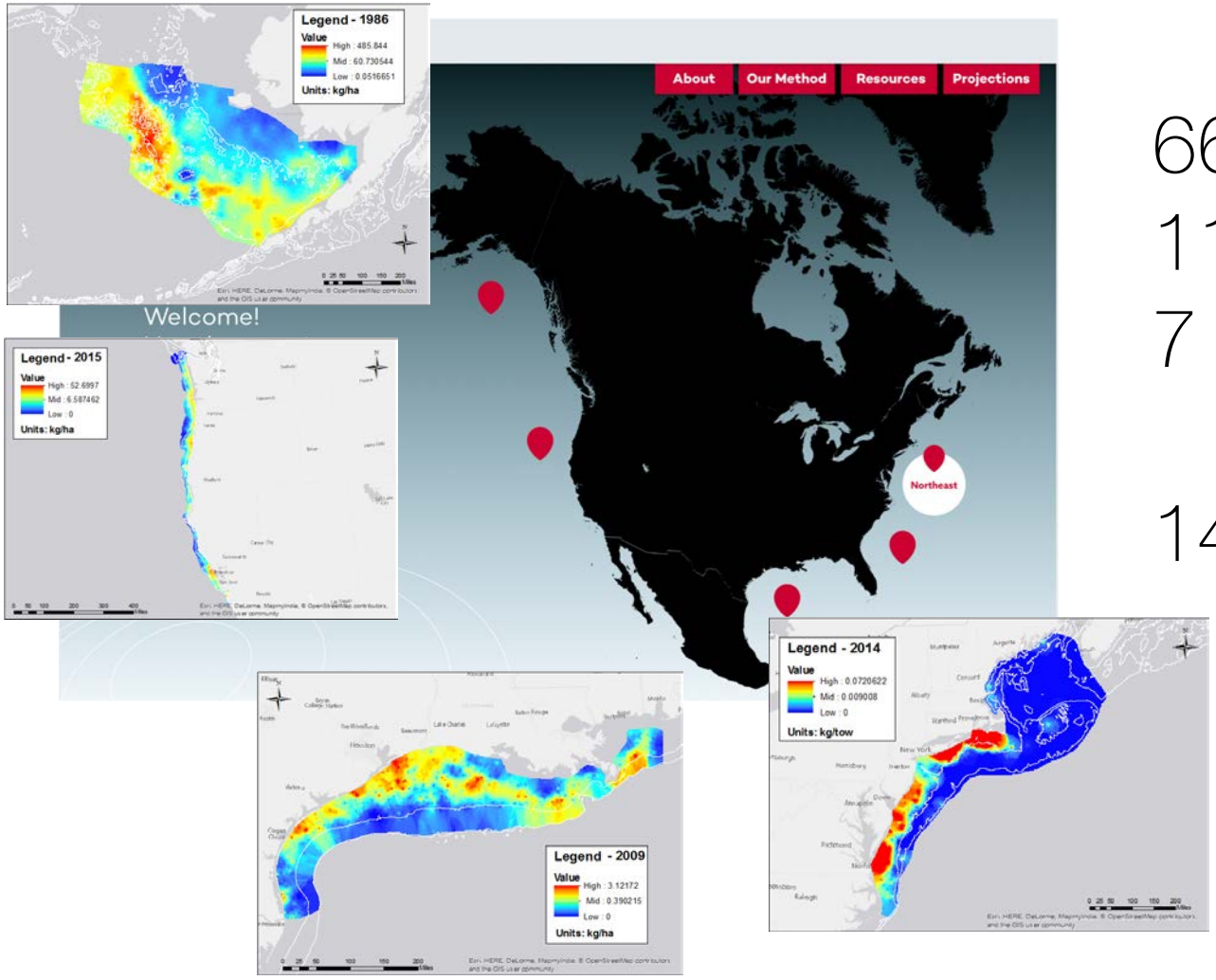
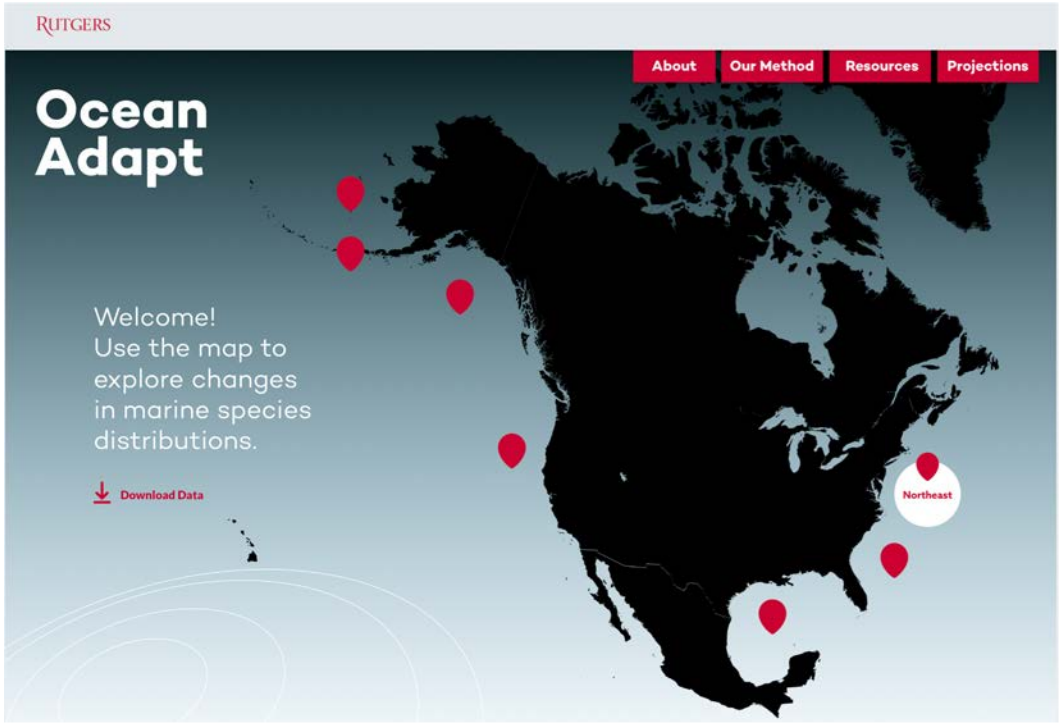


665 species
11 surveys
7 regions

1433 maps

Current state and trends

http://oceanadapt.rutgers.edu



Timescales of fishery decisions

Assessments
Reference points
Spatial regulations

Cooperation
Stakeholder representation

Emerging fisheries

Investment

Annual

Decadal

Multi-decadal

PLOS ONE

RESEARCH ARTICLE

Projecting shifts in thermal habitat for 686 species on the North American continental shelf

James W. Morley[1¤]*, Rebecca L. Selden[1], Robert J. Latour[2], Thomas L. Frölicher[3,4], Richard J. Seagraves[5], Malin L. Pinsky[1]

Jim Morley

RESEARCH ARTICLE

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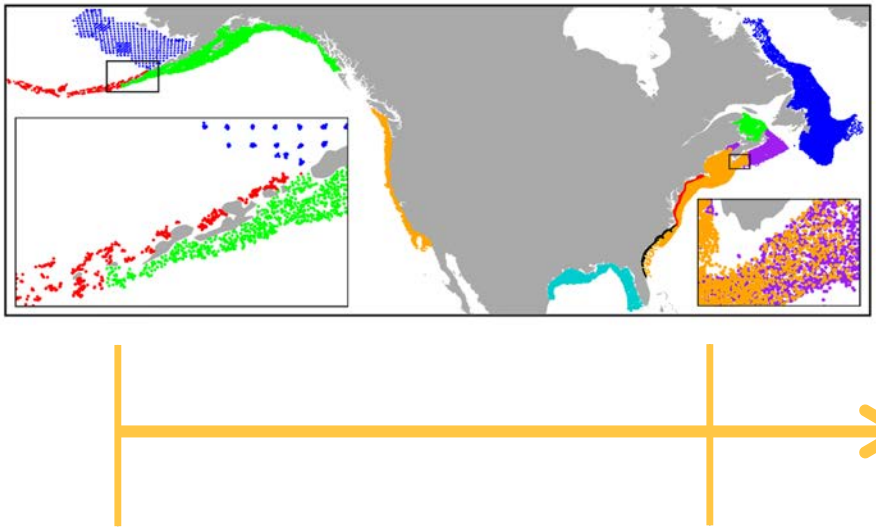

136,044 tows
686 species

Morley *et al.* 2018 *PLOS ONE*

RESEARCH ARTICLE

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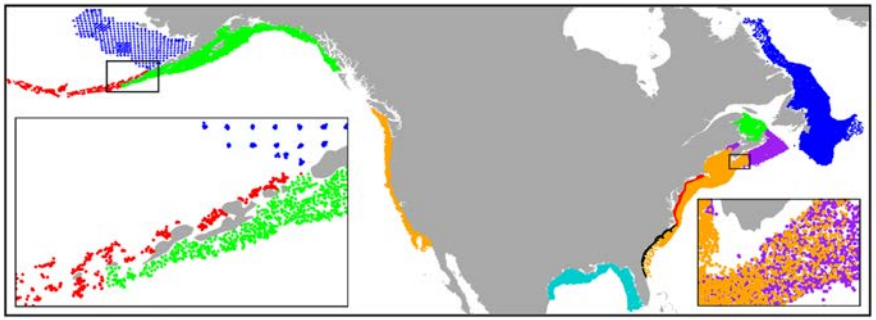
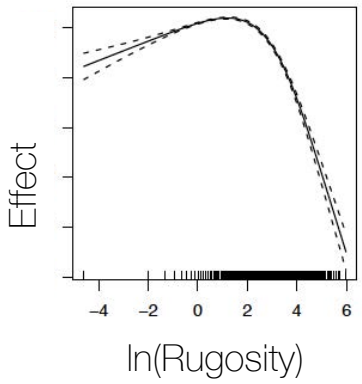
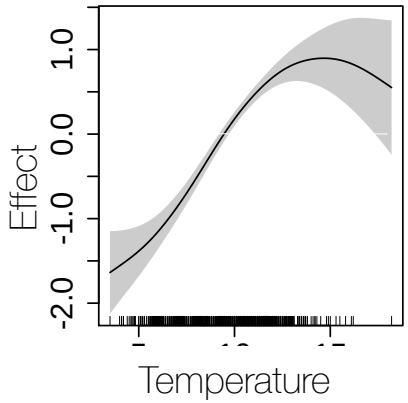


Seasonal surface temperature
Previous summer surface max
Previous winter surface min
Same for bottom temperatures
Seafloor rugosity
Sediment grain size





Morley *et al.* 2018 *PLOS ONE*

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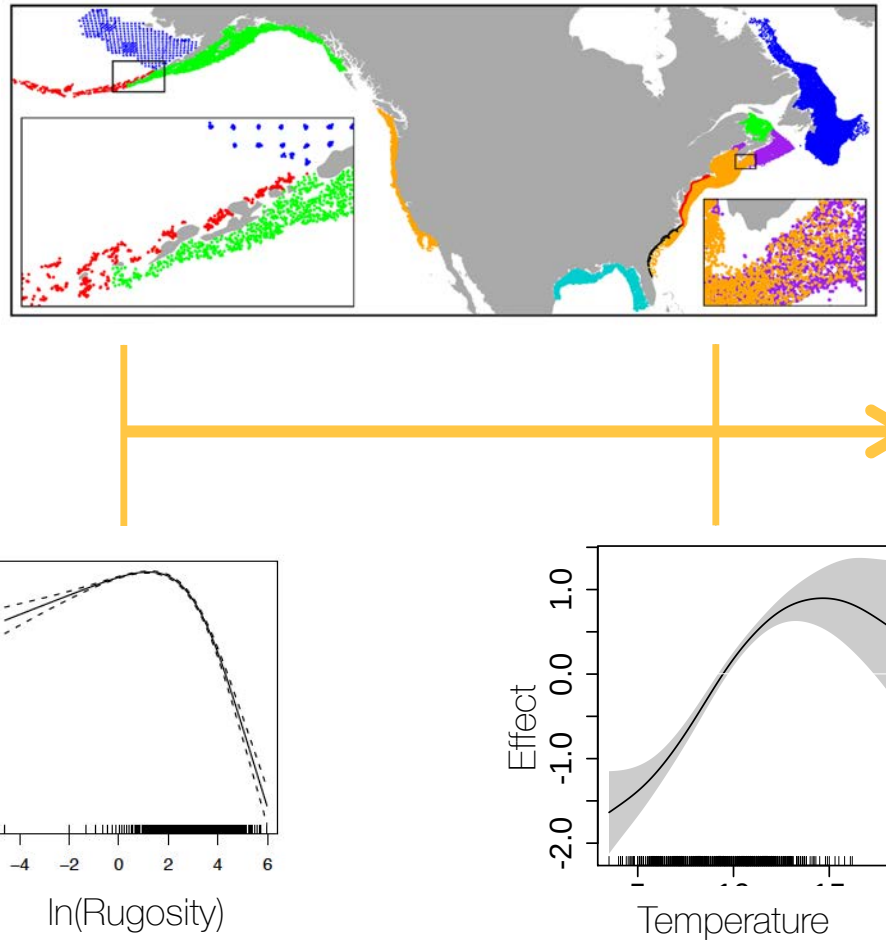

Seasonal surface temperature
Previous summer surface max
Previous winter surface min
Same for bottom temperatures
Seafloor rugosity
Sediment grain size

GAMs
Out-of-sample testing

Morley *et al.* 2018 *PLOS ONE*

RESEARCH ARTICLE

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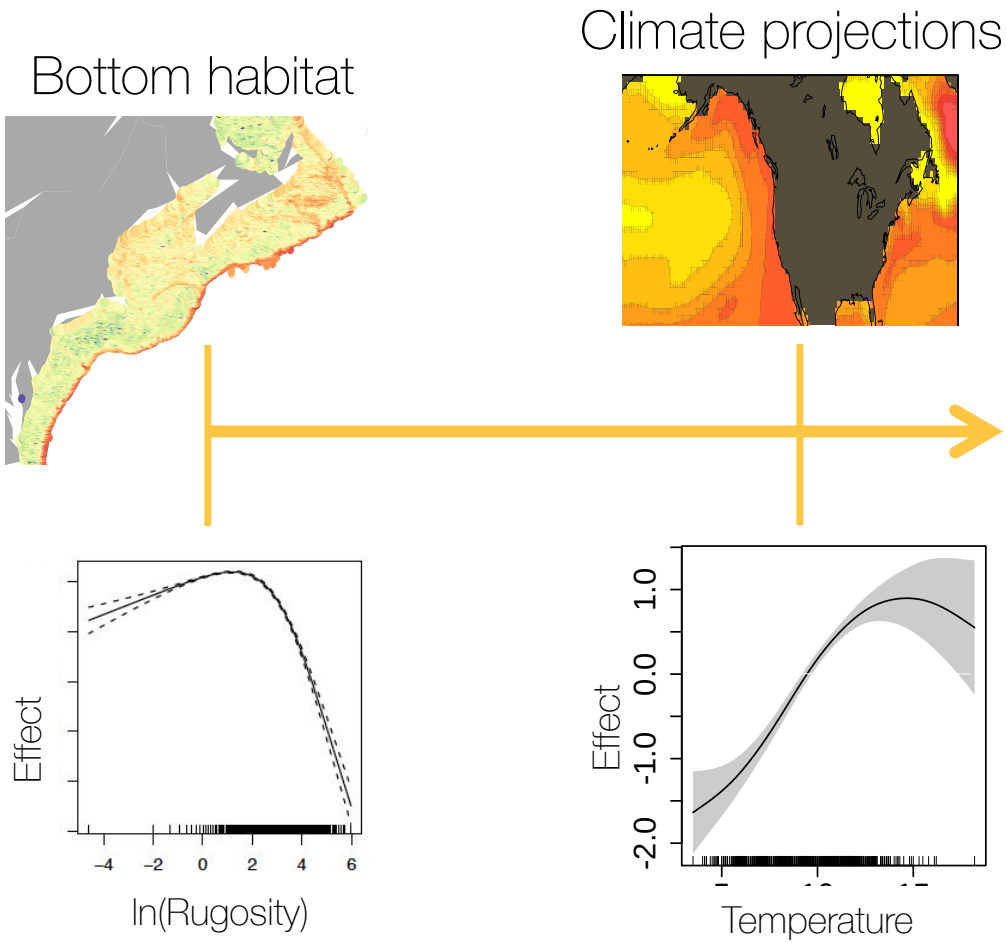

Morley *et al.* 2018 *PLOS ONE*

RESEARCH ARTICLE

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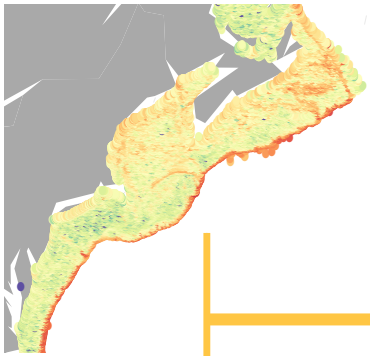
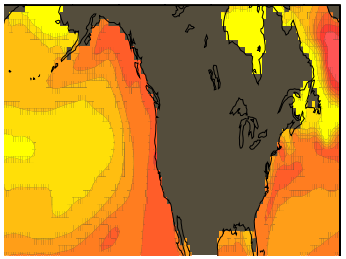
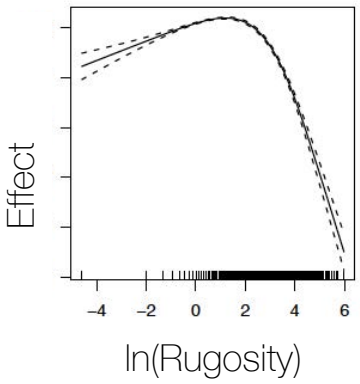
Bottom habitat

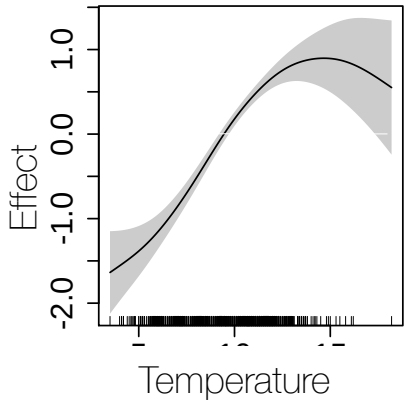


Climate projections



RCP2.6 and 8.5
16 climate models





Morley *et al.* 2018 *PLOS ONE*

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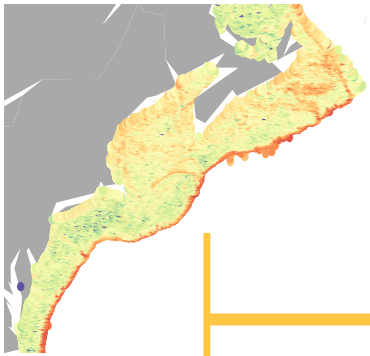

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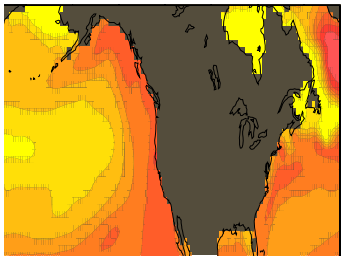
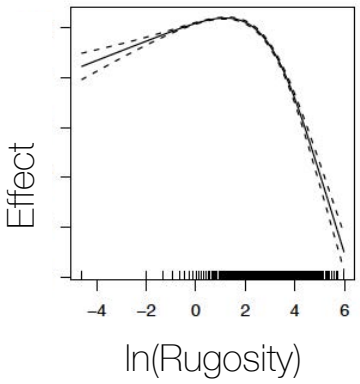
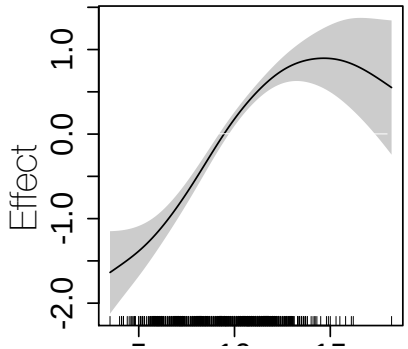
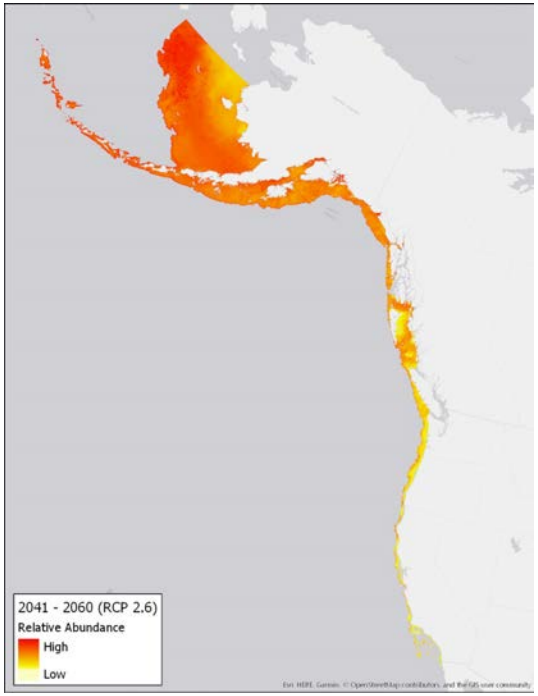






109,760 Species Habitat Projections



How to use them?

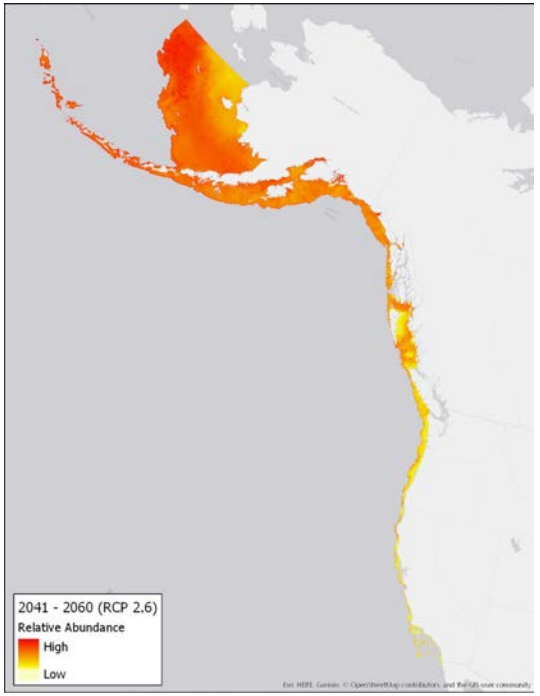
RESEARCH ARTICLE

Projecting shifts in thermal habitat for 686 species on the North American continental shelf

- Projections all online
- Maps on OceanAdapt

  http://oceanadapt.rutgers.edu

109,760
Species Habitat
Projections



Morley *et al.* 2018 *PLOS ONE*

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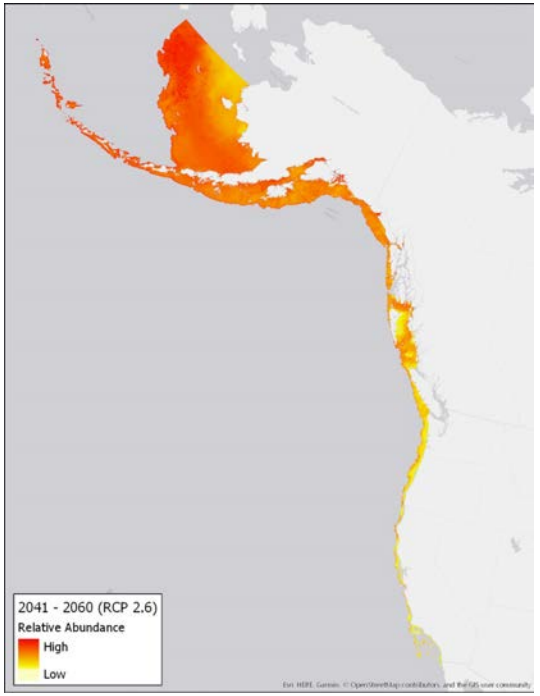
109,760
Species Habitat
Projections



Morley *et al.* 2018 *PLOS ONE*

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RESEARCH ARTICLE

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- Projections all online
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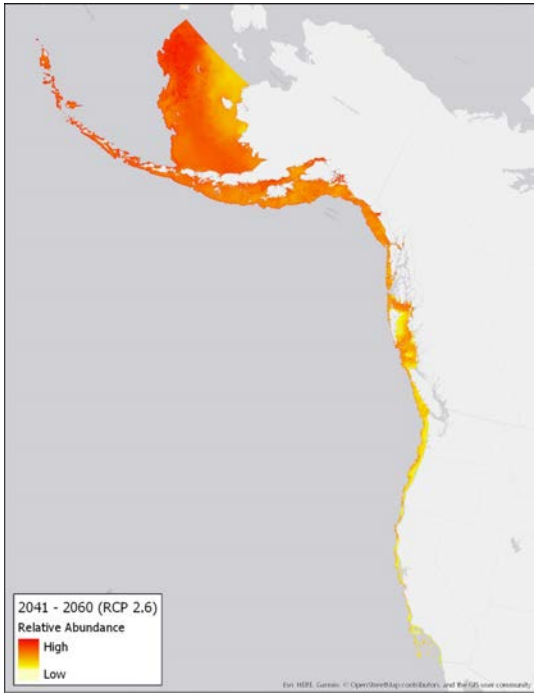
- Emerging fisheries
  - Dungeness crab in Alaska?
  - Summer flounder in New England?
  - Many others…

109,760
Species Habitat
Projections



Morley *et al.* 2018 *PLOS ONE*

To hear more about emerging fisheries

Emily Moberg
Poster
today
S10

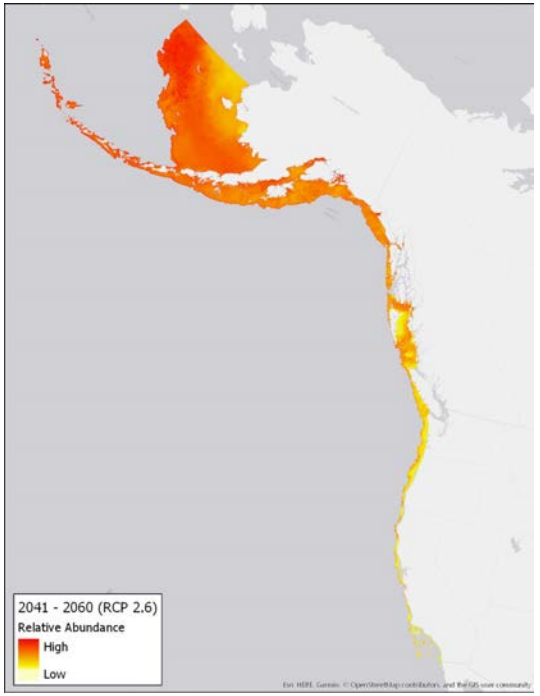
PLOS ONE

RESEARCH ARTICLE

Projecting shifts in thermal habitat for 686 species on the North American continental shelf

- Projections all online
- Maps on OceanAdapt
- Emerging fisheries
- Future shared fisheries

109,760
Species Habitat
Projections



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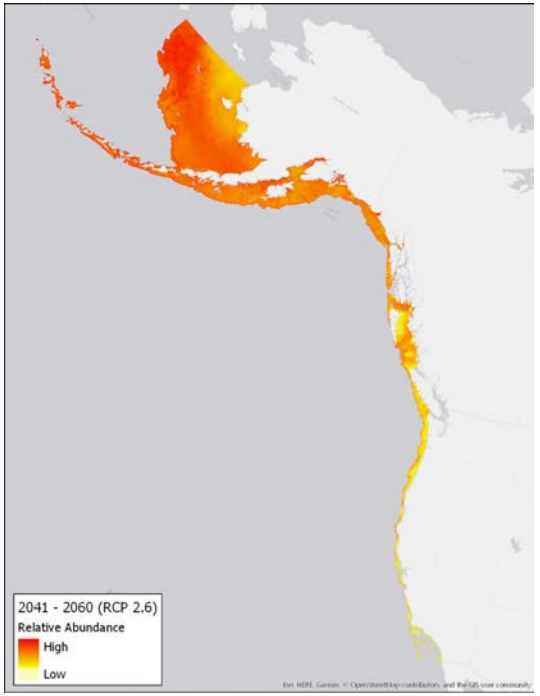
RESEARCH ARTICLE

Projecting shifts in thermal habitat for 686 species on the North American continental shelf

- Projections all online
- Maps on OceanAdapt
- Emerging fisheries
- Future shared fisheries
  - US-Canada
  - Mid-Atlantic to New England
  - Etc.

109,760
Species Habitat
Projections



Morley *et al.* 2018 *PLOS ONE*

Sharing stocks

- Cooperate on shared knowledge

Sharing stocks

- Cooperate on shared knowledge
- Mechanisms for reciprocity
  - Side payments
  - Tradeable permits

Next steps

- Uncertainty in the habitat projections
- Process-based species distribution models
- Planning for fishing and other ocean uses (EBM)

Summary

- Underprepared for species on the move across political boundaries

Summary

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- Motivate adaptation with open data and tools

Summary

- Underprepared for species on the move across political boundaries
- Motivate adaptation with open data and tools
- Projections to identify slower activities, like emerging fisheries or shared stocks

Acknowledgments

Jim Morley
William Cheung
Gabriel Reygondeu
Juliano Palacios-Abrantes
Jessica Spijkers
Richard Caddell
Talia Young
Emma Fuller
Becca Selden
Thomas Frölicher
Rob Latour
Rich Seagraves
Eli Fenichel
Kevin St. Martin
Eva Papaioannou
Kaycee Coleman
Mikaela Provost

Pinsky Lab

NSF
NOAA
Alfred P. Sloan Foundation 1934
Sea Grant
Society for Conservation Biology
The Pew Charitable Trusts
Gordon and Betty Moore Foundation

Summary

- Underprepared for species on the move across political boundaries
- Motivate adaptation with open data and tools
- Projections to identify slower activities, like emerging fisheries or shared stocks