Ocean Warming and Marine Fisheries in the Northeast U. S.

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Gulf of Maine Research Institute

Northeast Monthly Climate Update
November 30, 2017

Outline

- Warming on the Northeast Shelf
- Impacts on species and fisheries
- Resilience and adaptation in fisheries

Acknowledgements:

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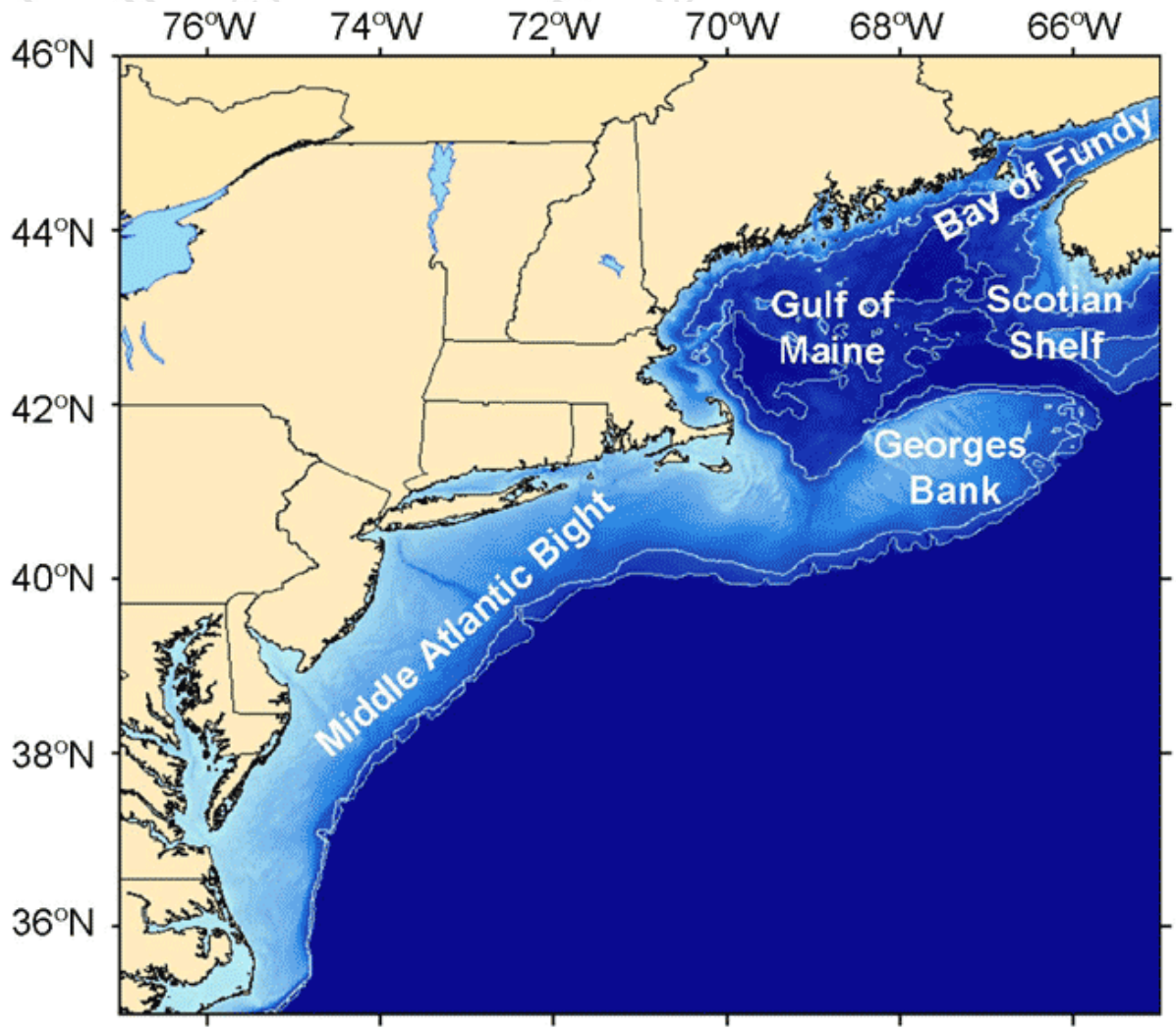
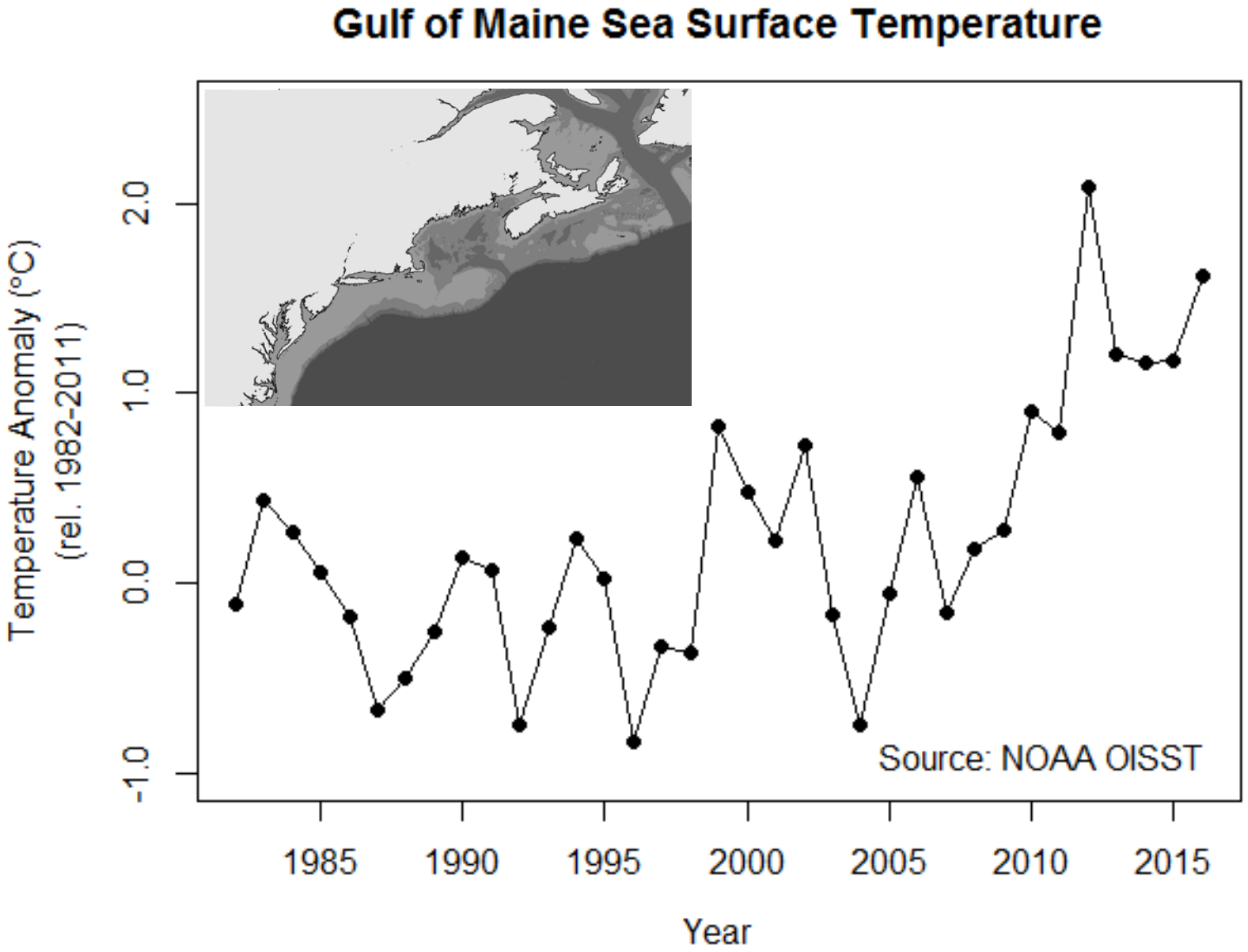
Northeast U. S. Shelf



(NEFSC 2015)

Rapid warming trend



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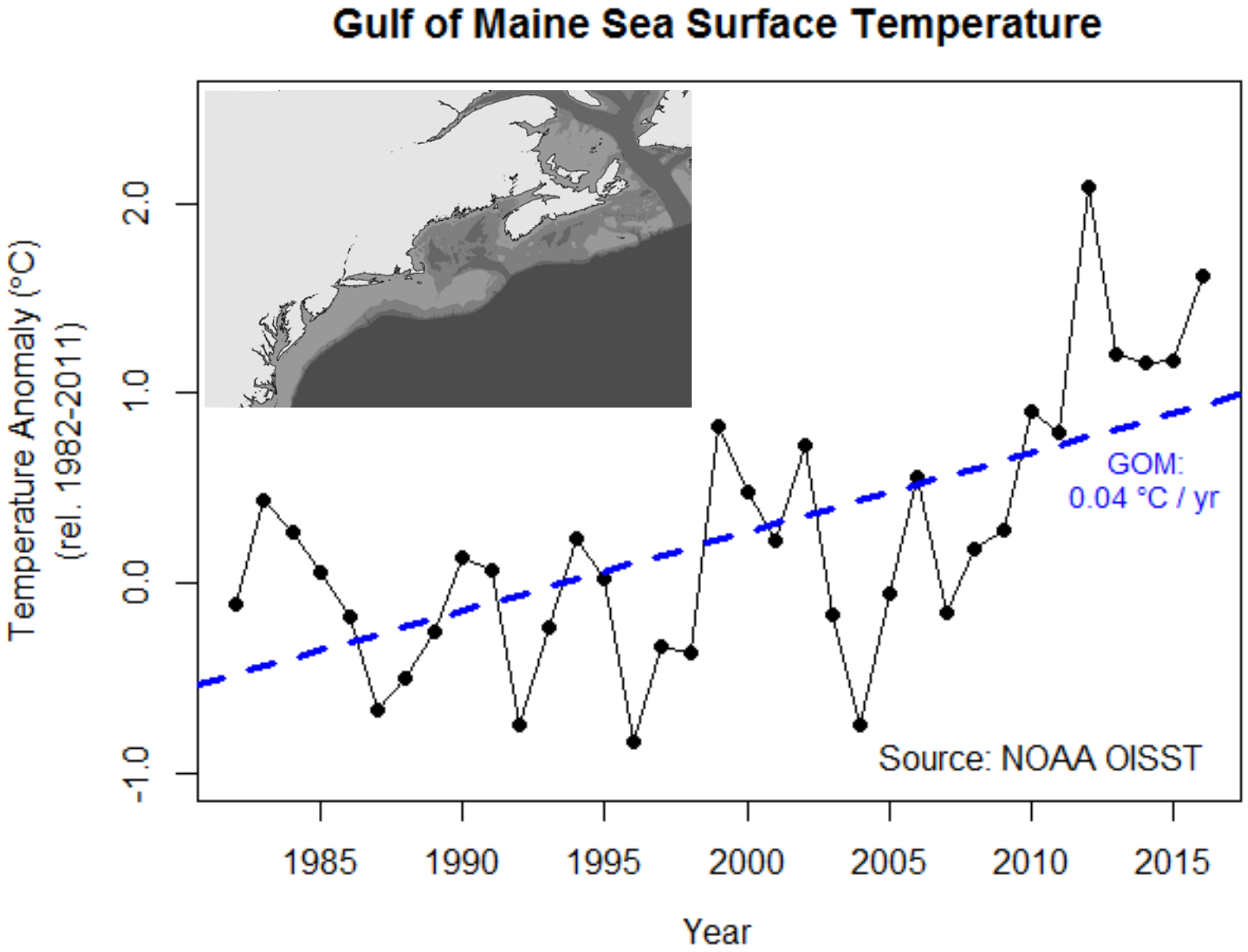

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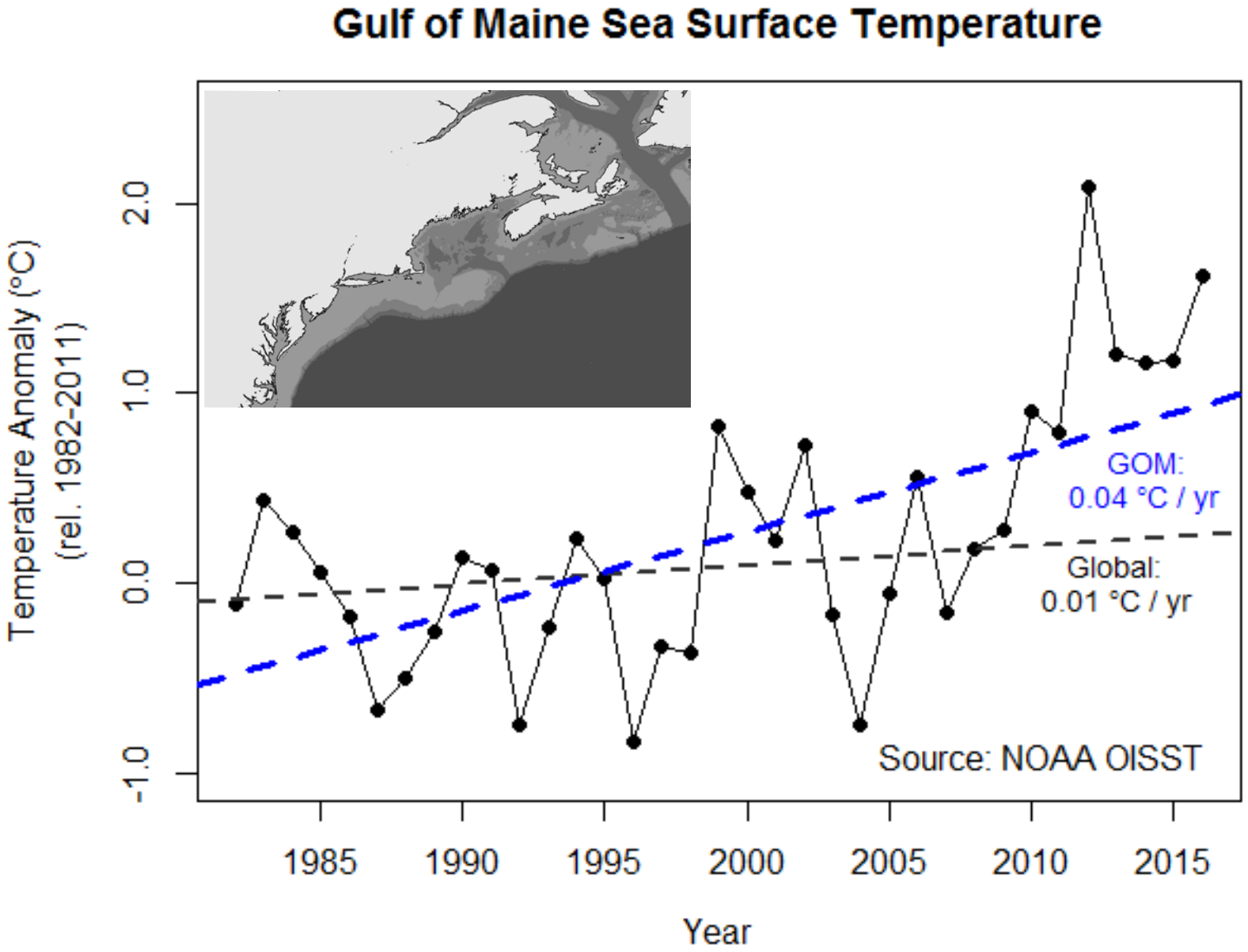

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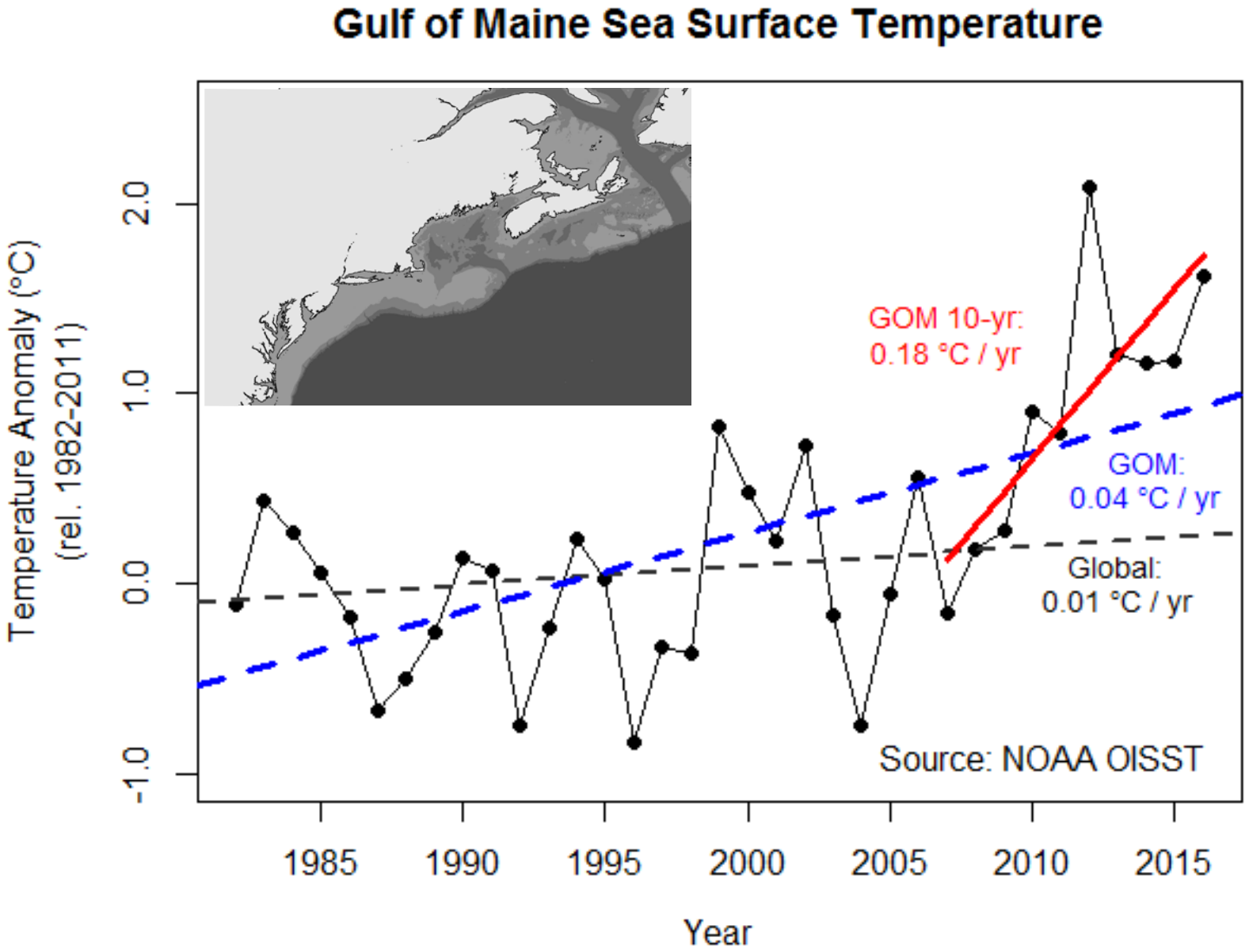

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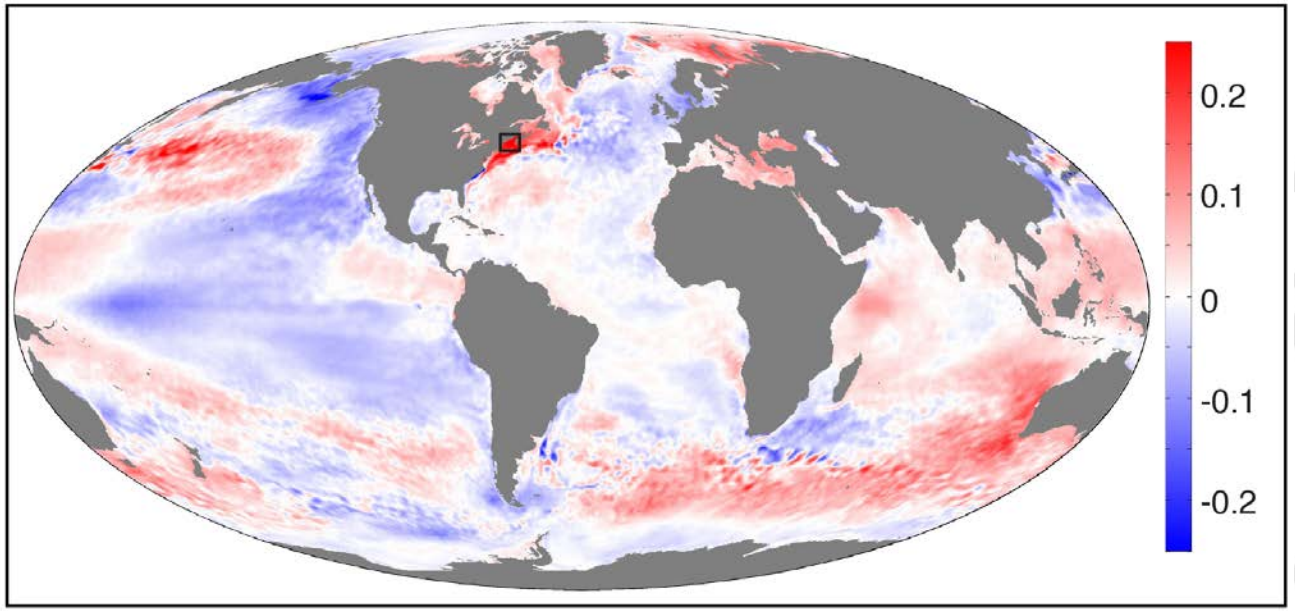
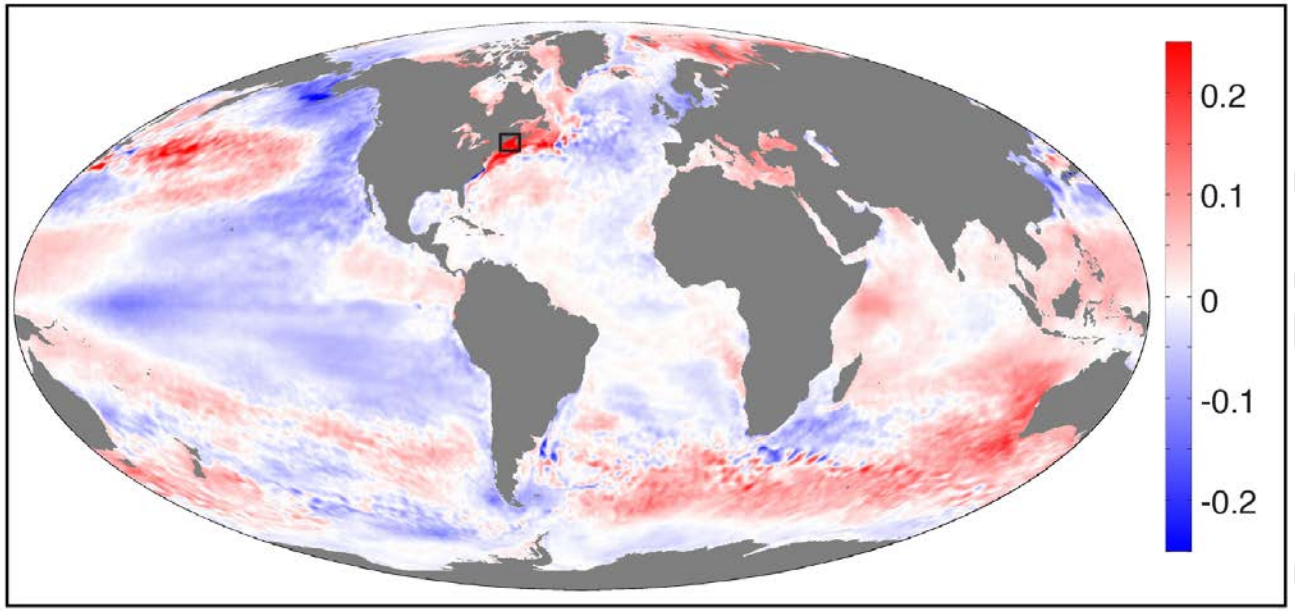
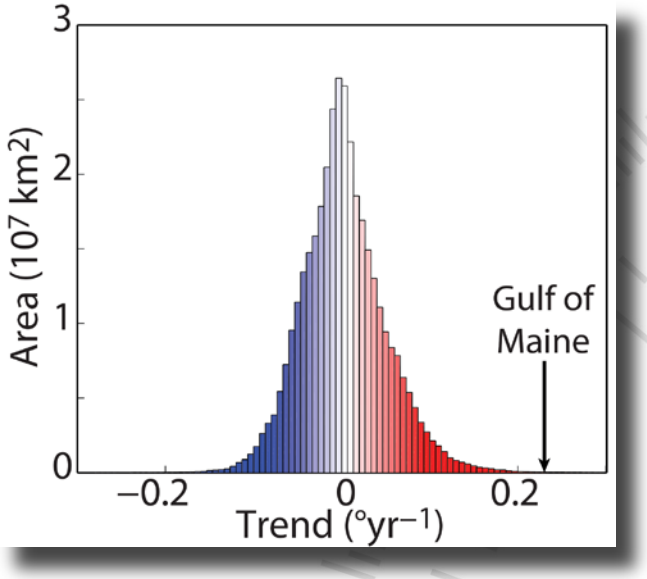


(Pershing et al. 2015)

Rapid warming trend





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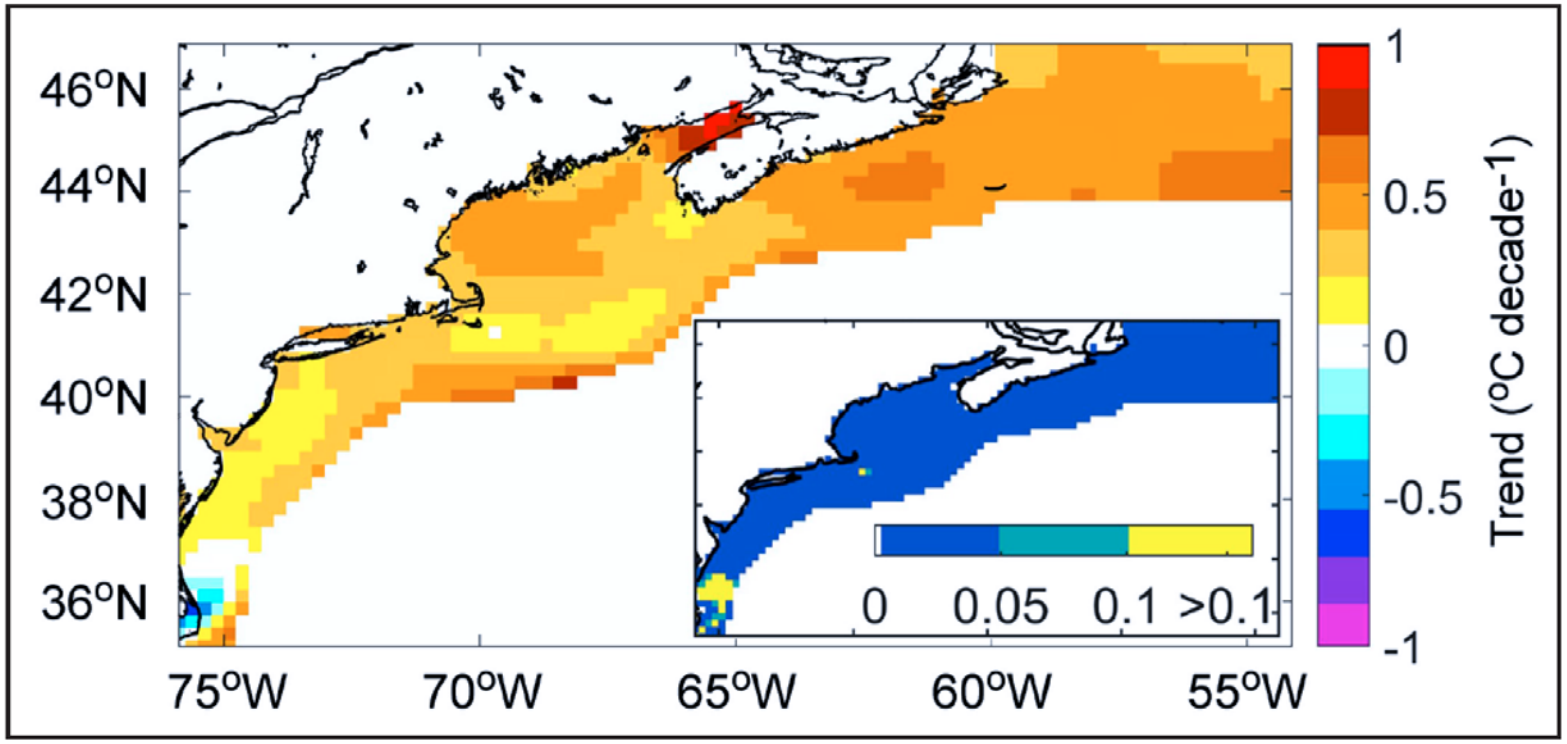
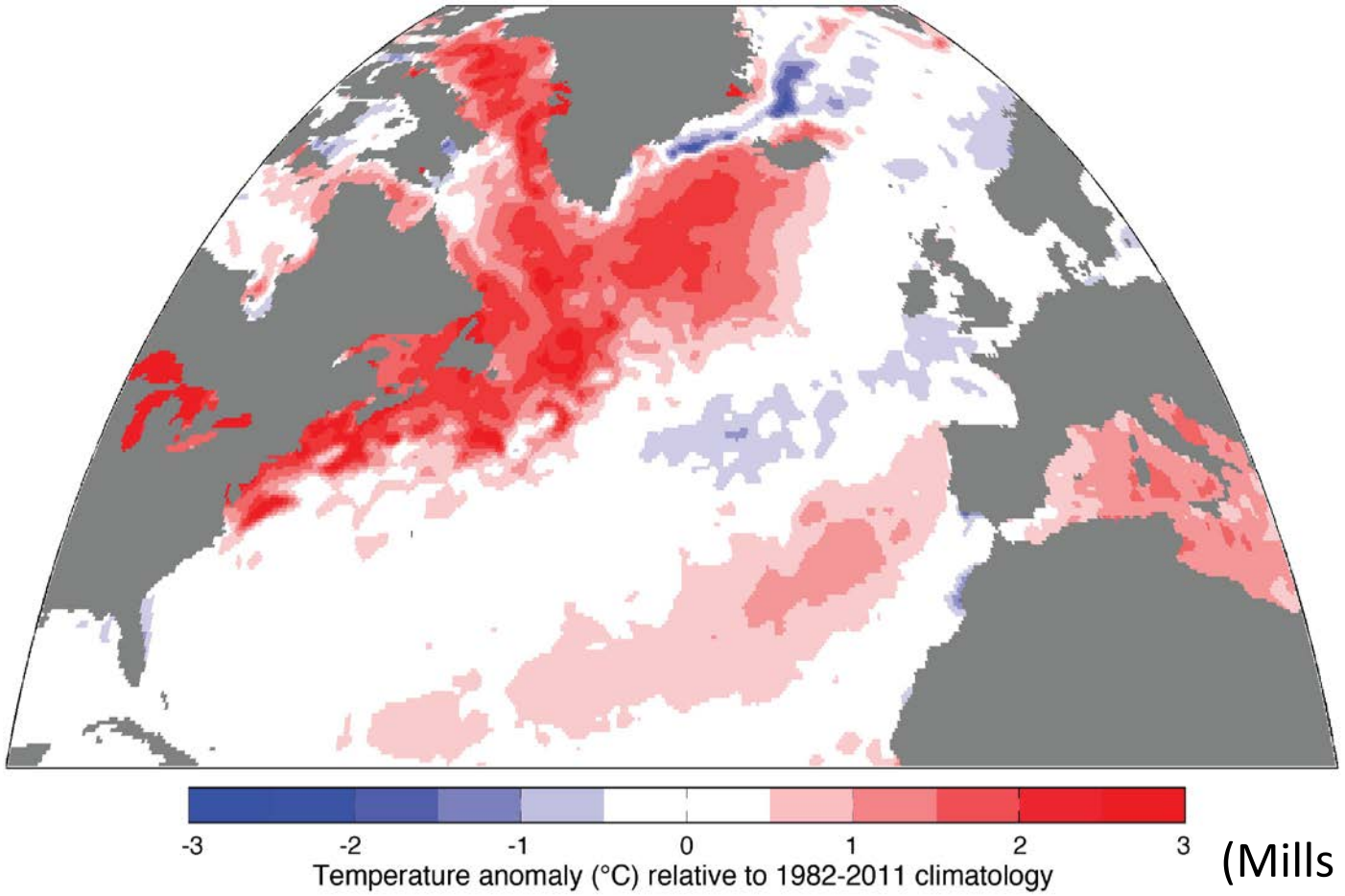
Rapid warming trend



(Thomas et al. 2017)

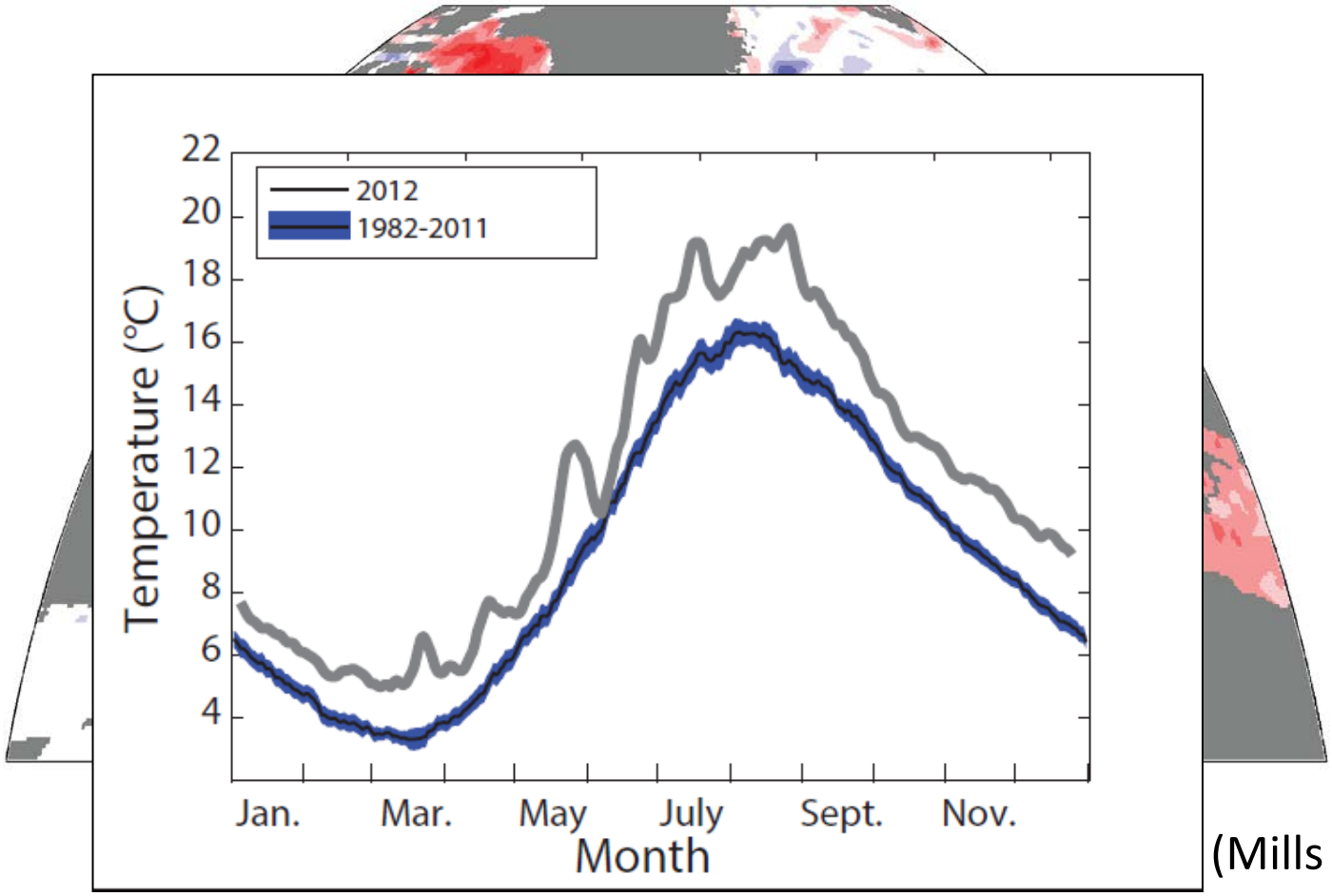
Warm events—2012 heat wave



(Mills et al. 2013)

- Largest, most intense SST anomaly ever in the North Atlantic
- Comparable in scale to El Nino
- Warming comparable to predictions for end of century

Warm events—2012 heat wave



(Mills et al. 2013)

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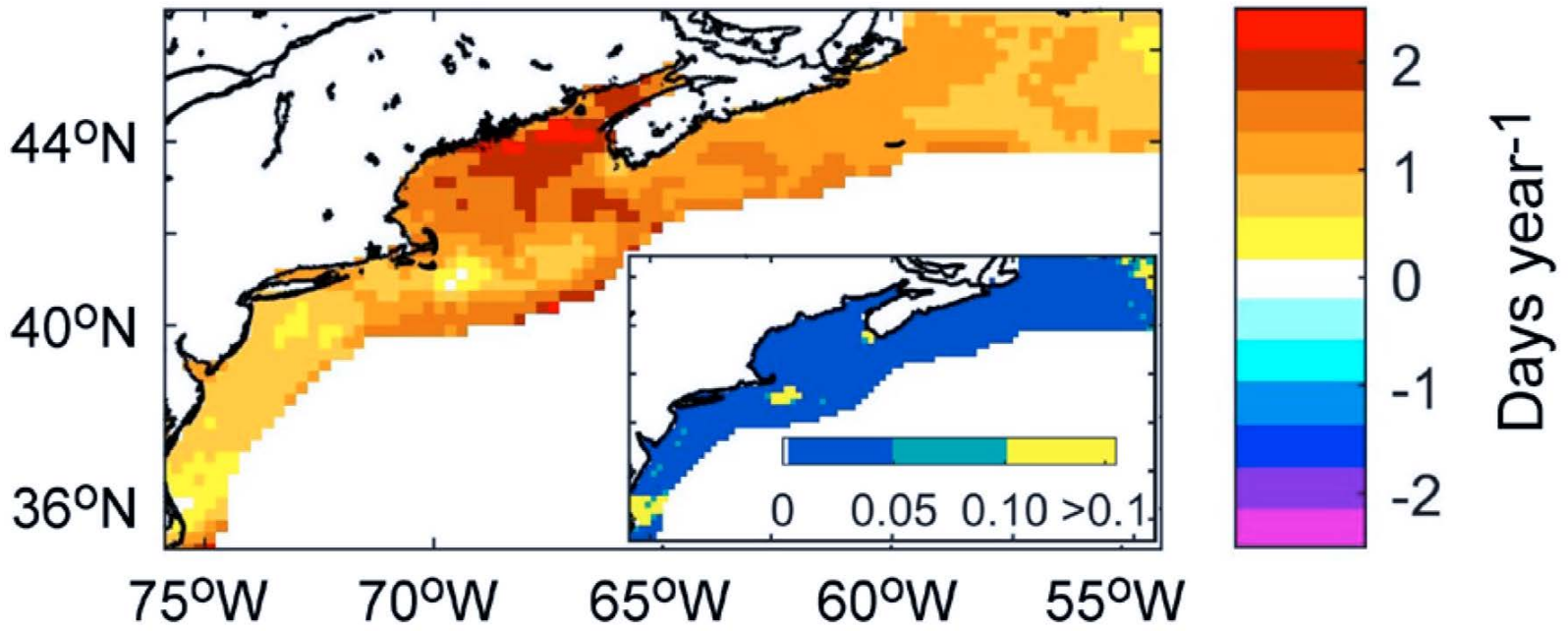
Changing seasonality

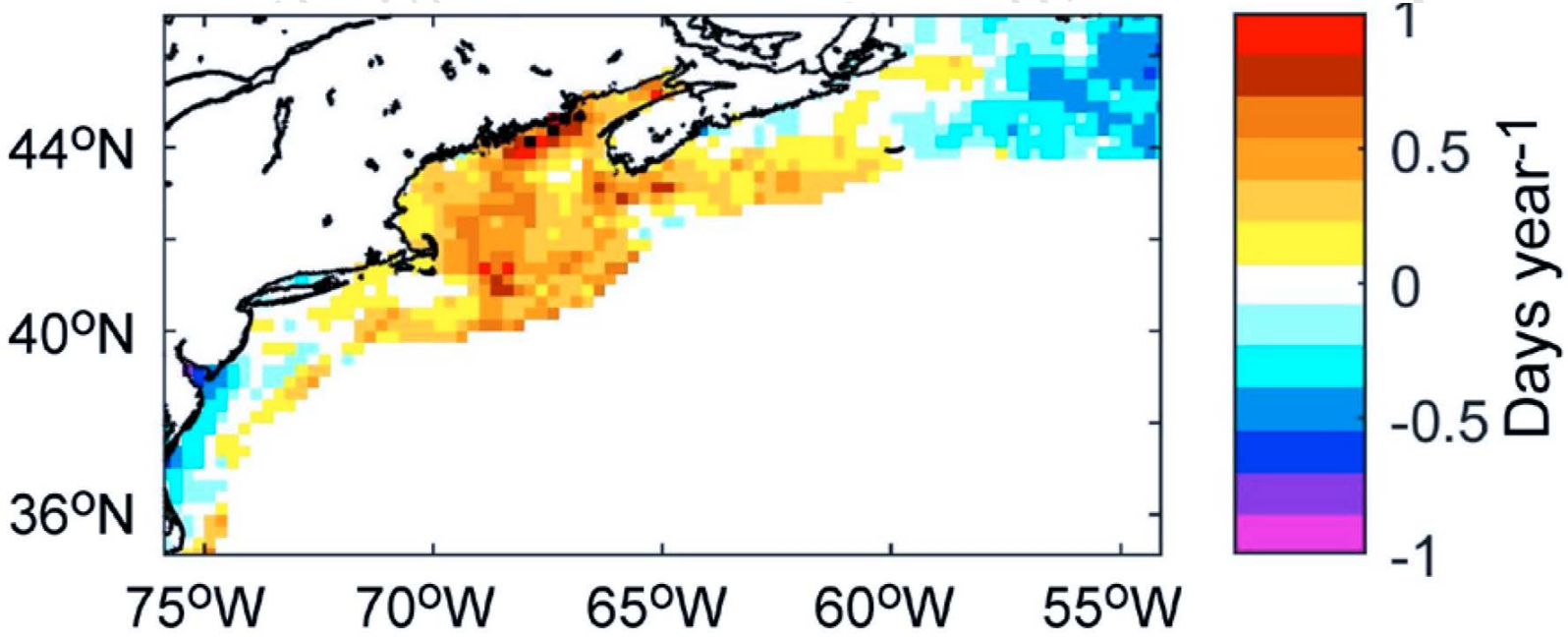
- Length of “summer” increasing
  - 2 days/yr in Gulf of Maine since 1982



(Thomas et al. 2017)

Changing seasonality

- Difference between end of summer and start of summer
  - “summer” lengthening due to later end for most of region
  - “summer” lengthening due to earlier start in mid-Atlantic



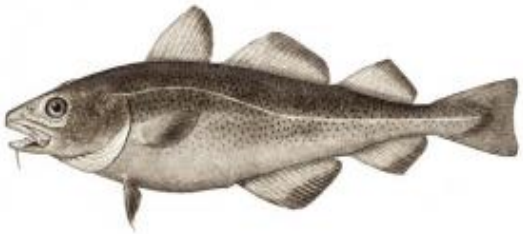
(Thomas et al. 2017)

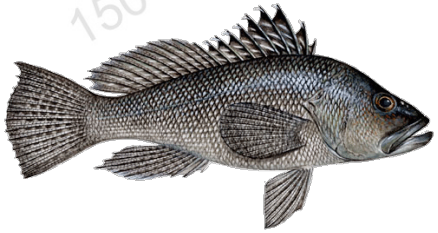
Outline

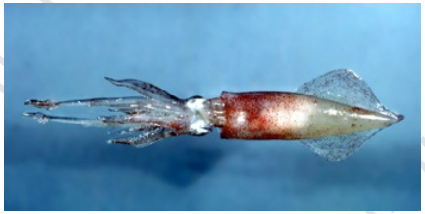
- Warming on the Northeast Shelf
- Impacts on species and fisheries
- Resilience and adaptation in fisheries

Ecological effects

- Changes in ecosystem and populations
  - Distribution
  - Productivity
  - Timing
  - Interactions



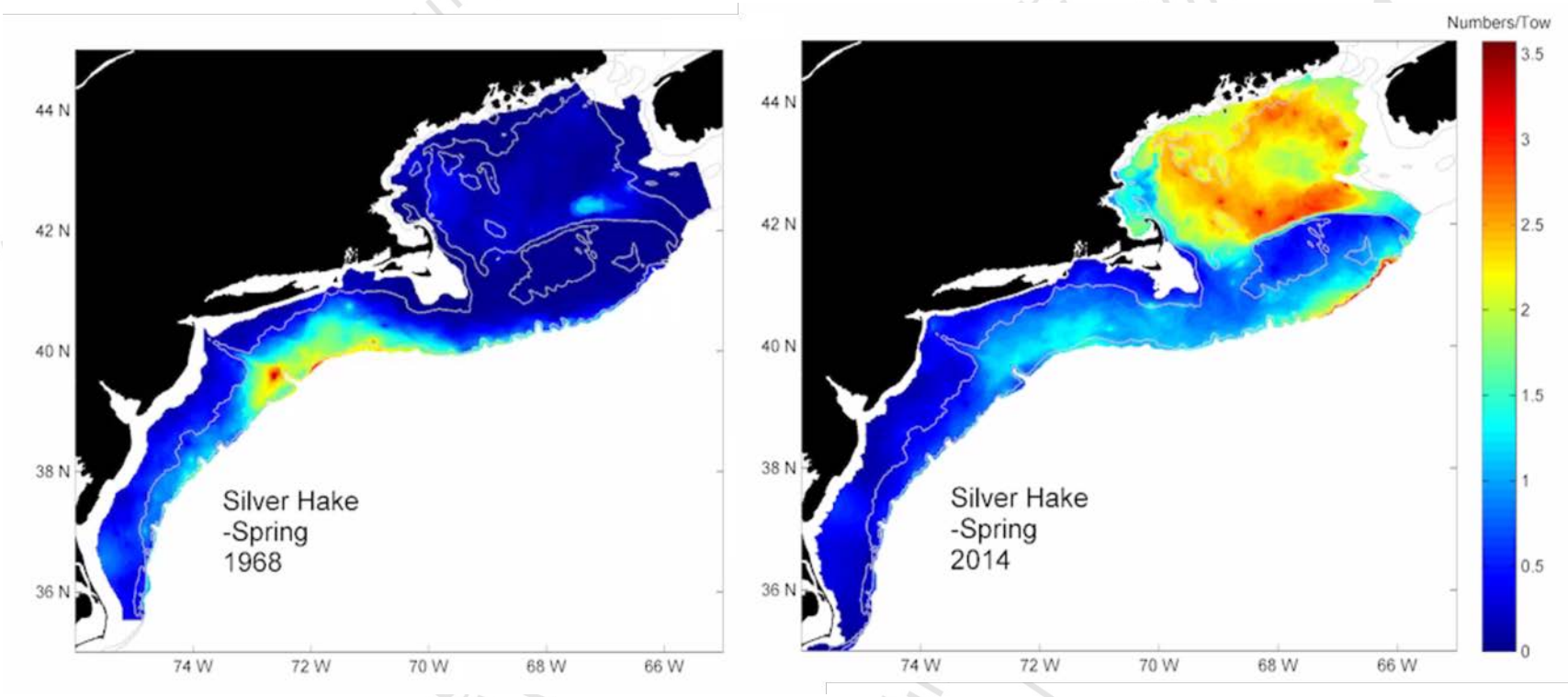




Spatial distribution

Many stocks moving poleward and to deeper depths

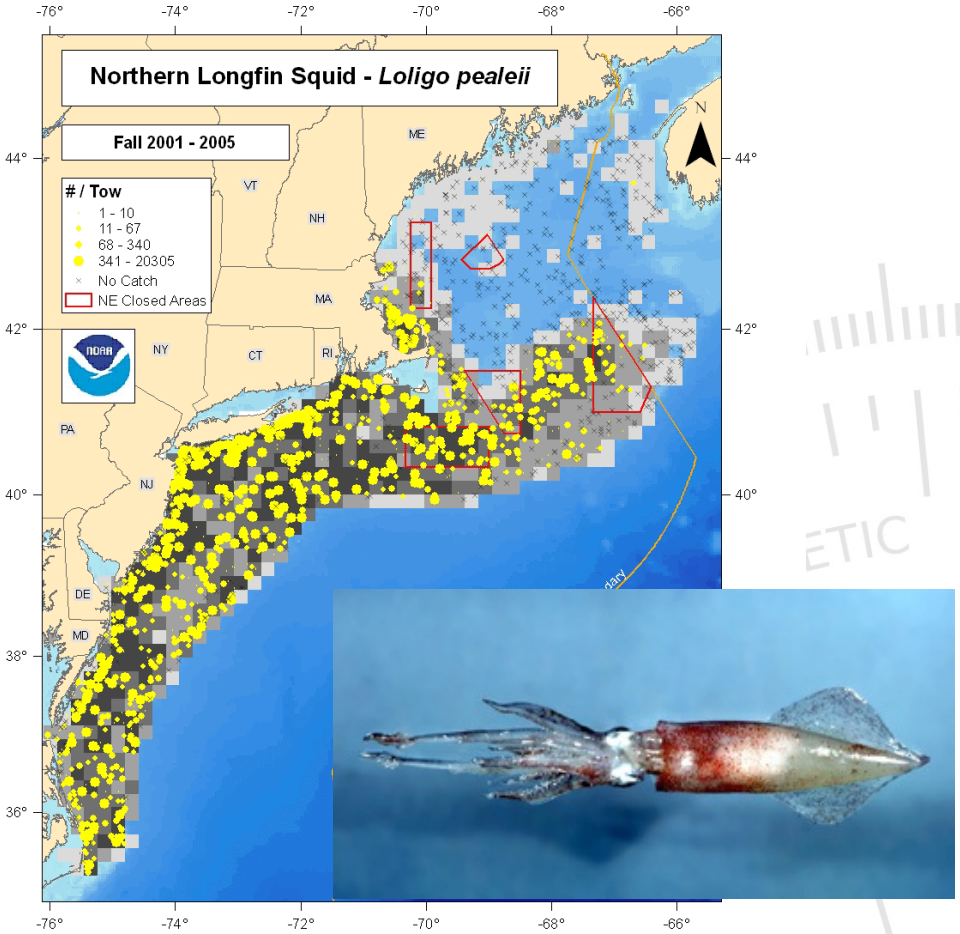
(Nye et al. 2009)



(NEFSC 2015)

Spatial distribution

Mid-Atlantic species moving into the Gulf of Maine



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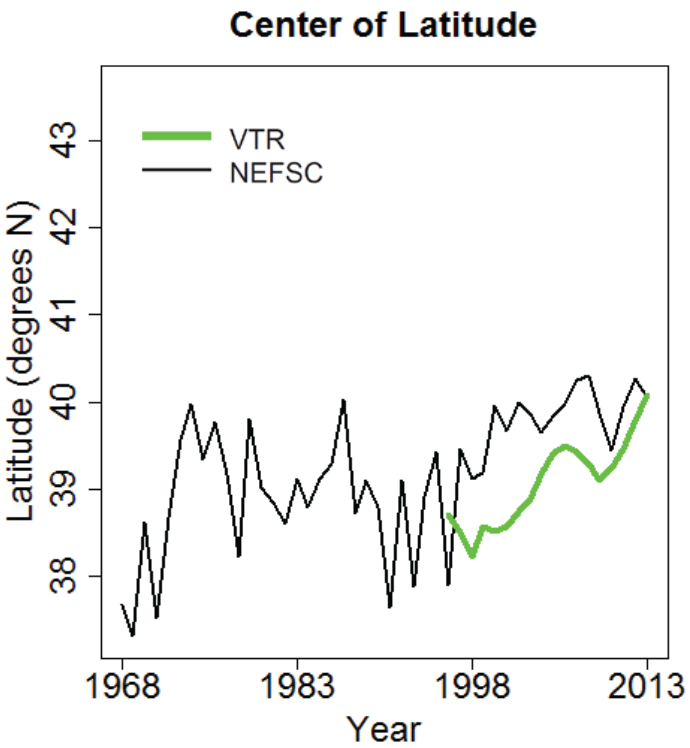
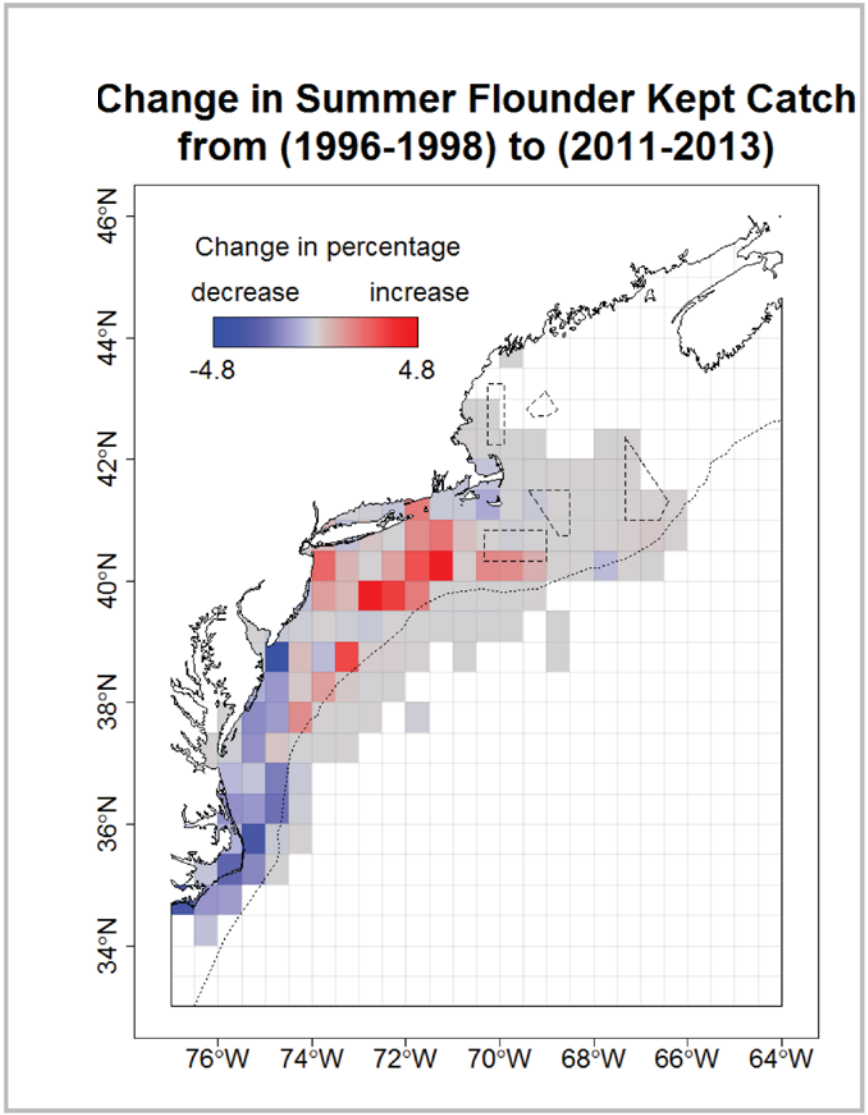




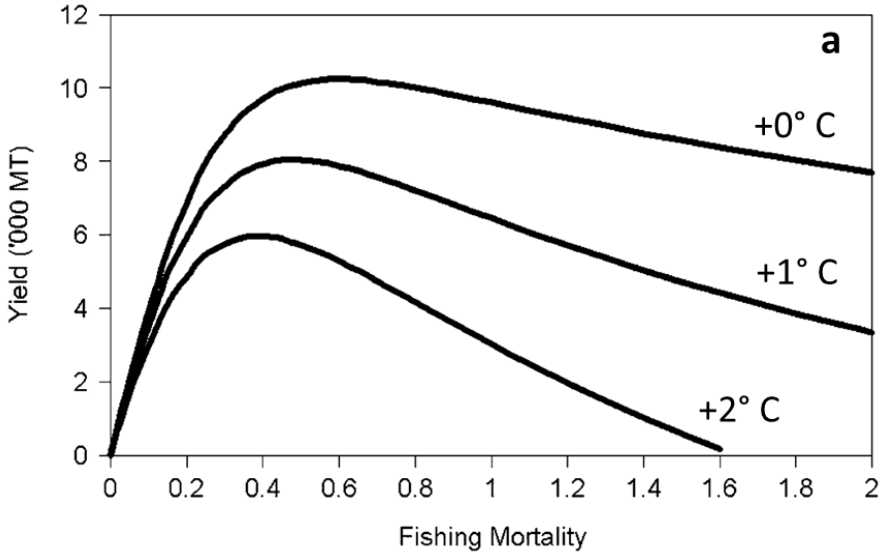
Population productivity

Many mechanisms and pathways :

e.g., temperature, pH, disease, predator-prey interactions

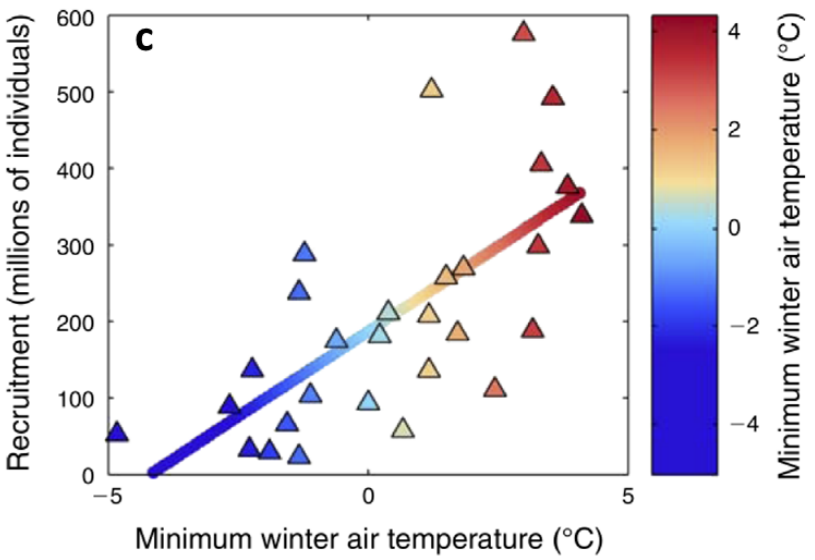
e.g., individual growth, reproduction, recruitment, mortality

Atlantic cod



(Fogarty et al. 2008)

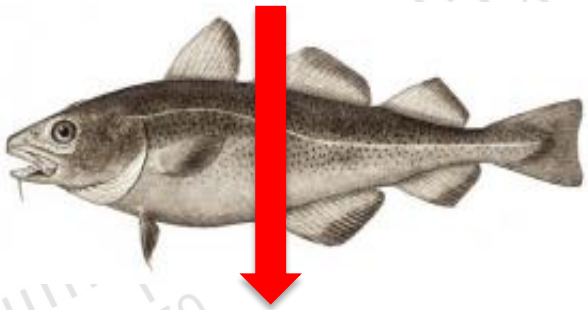
Atlantic croaker

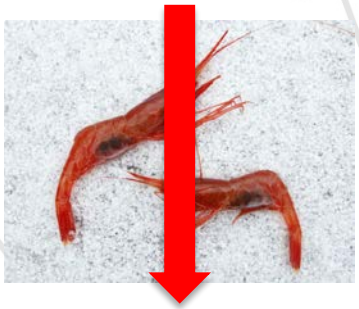


(Hare et al. 2010)

Population productivity

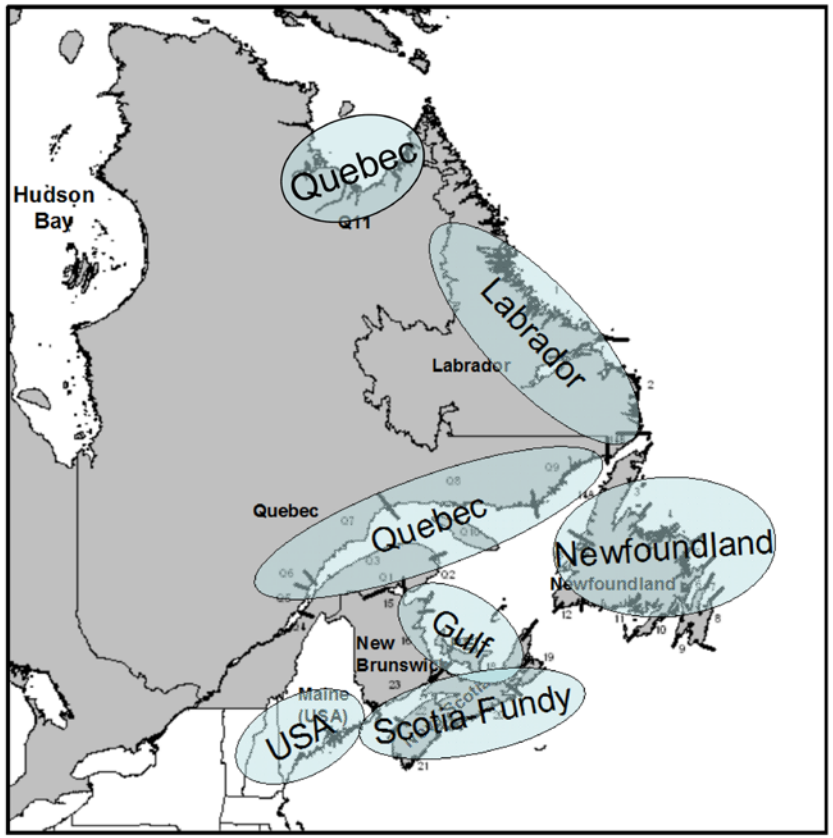
- Effects on commercially-targeted species

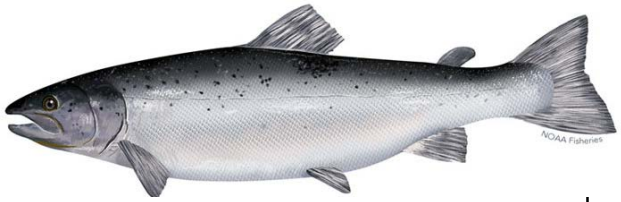


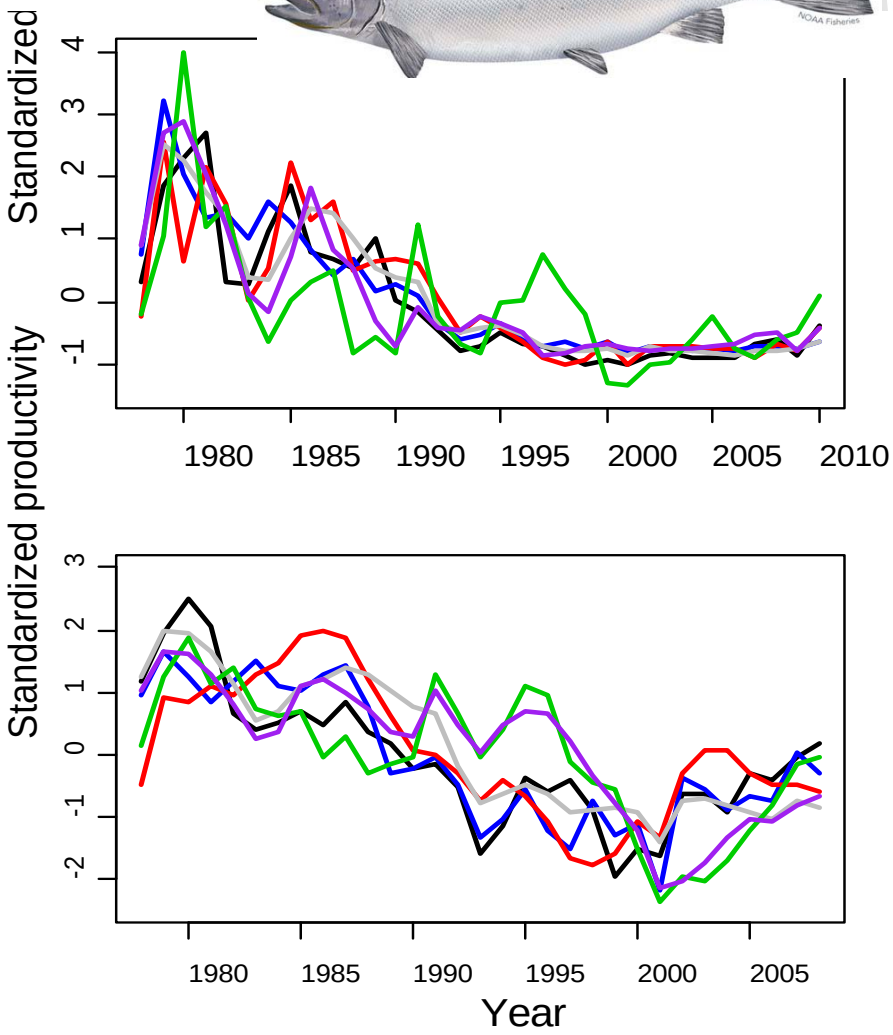


Population productivity

- Effects on protected species







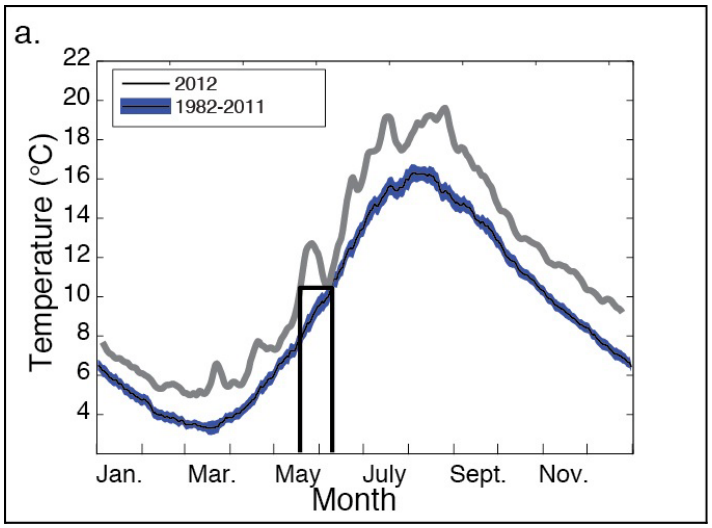
(Mills et al. 2013)

Phenology

New England's lobster fishery

- Valued at over $617 M in 2015
- Most valuable species fished in U.S. since 2014
- Accounts for 88% of NH's landed value and 80% of Maine's

Phenology



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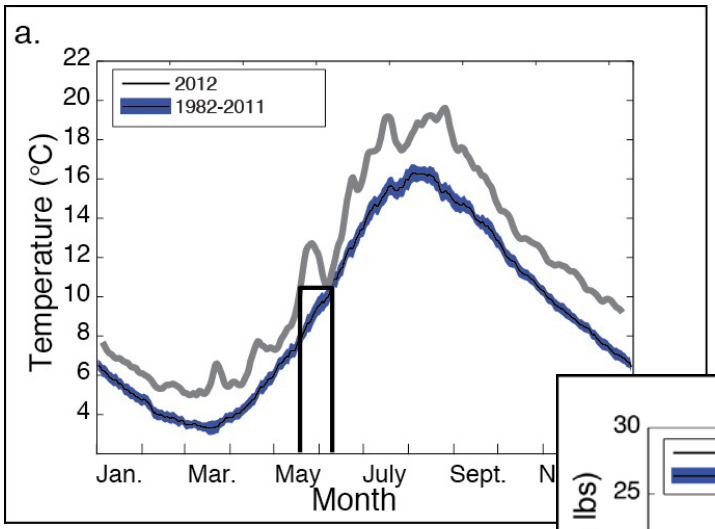

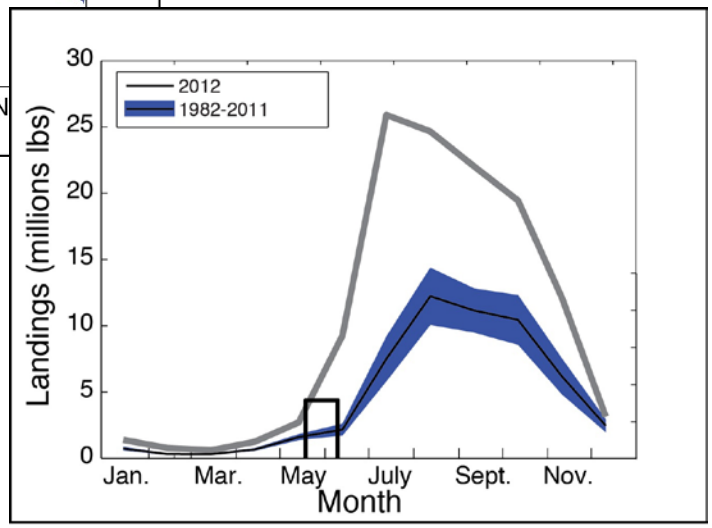

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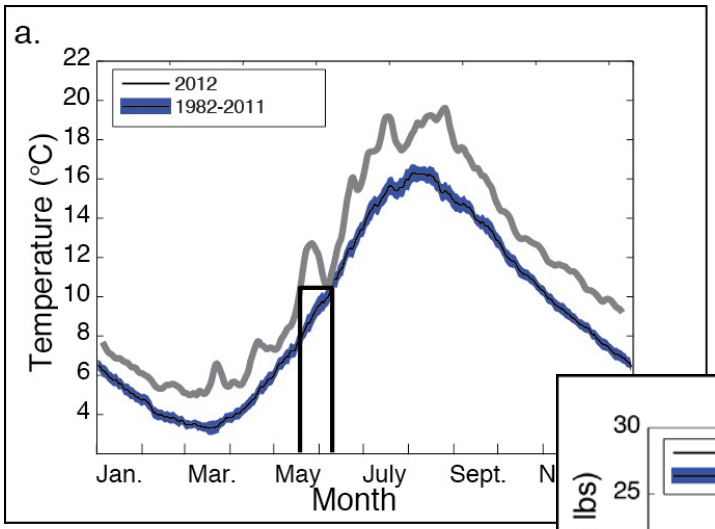

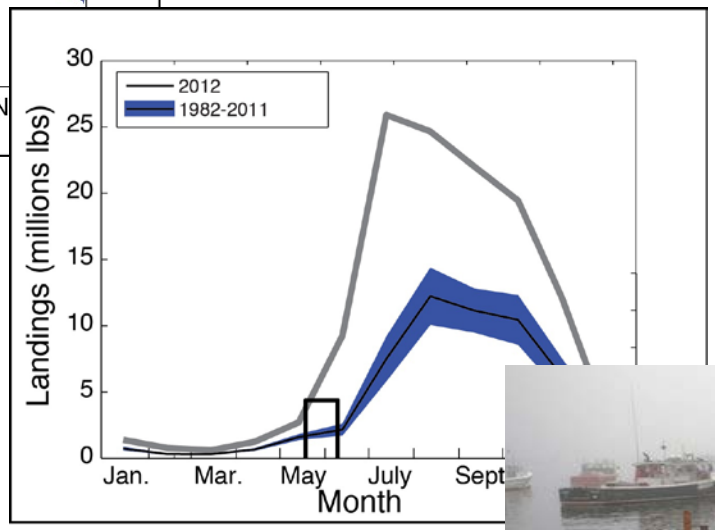

(Mills et al. 2013)

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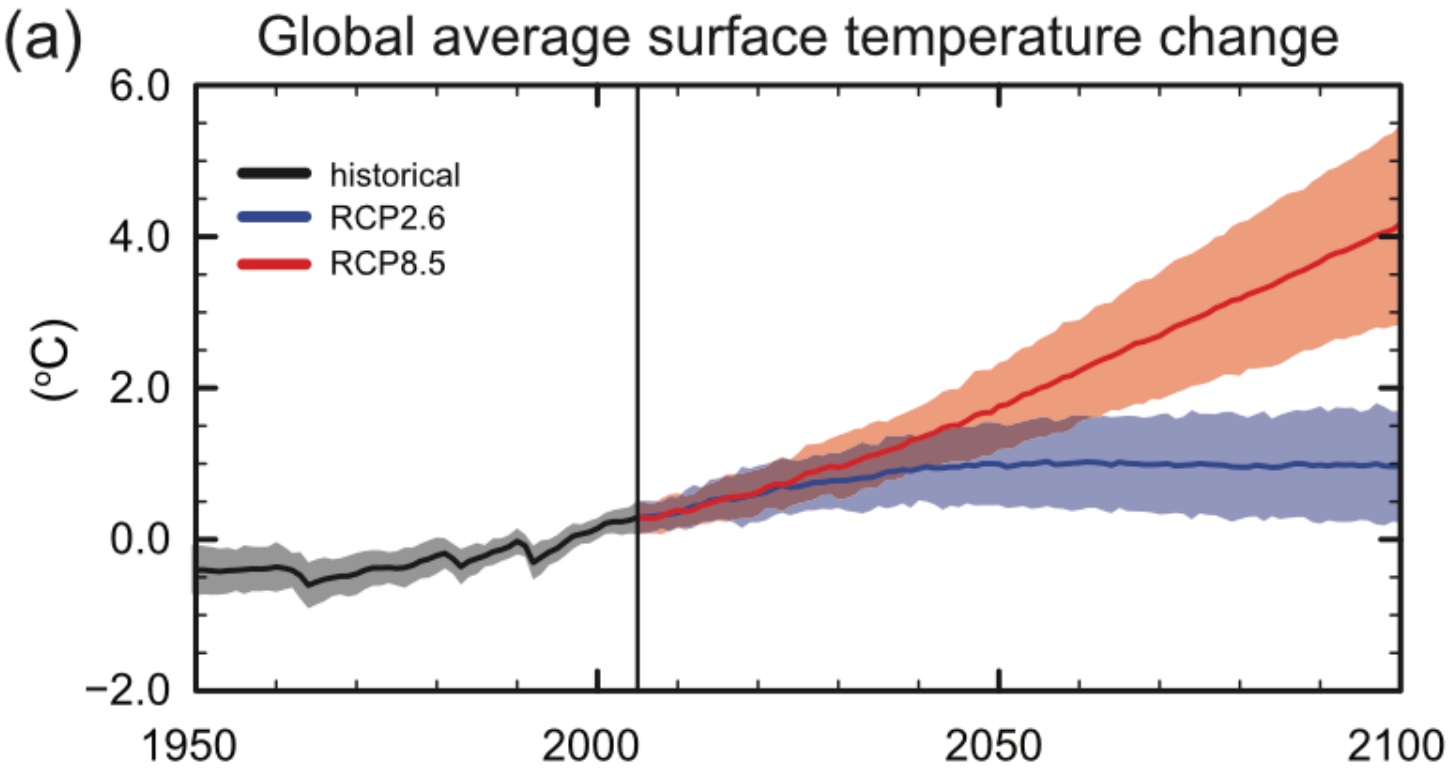
Climate resilience and adaptation

Gulf of Maine Research Institute

Challenges:

- Moving beyond historical analogues
- Differential response rates (biological and human)
- Changing social, economic, institutional contexts

Climate resilience and adaptation

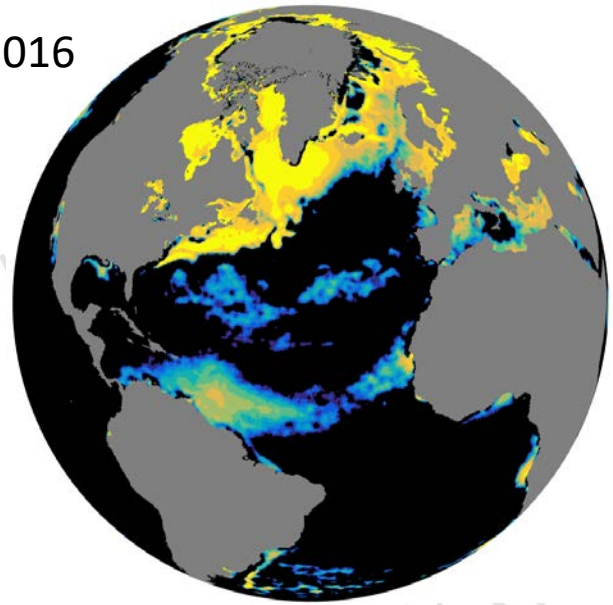


(IPCC 2014)

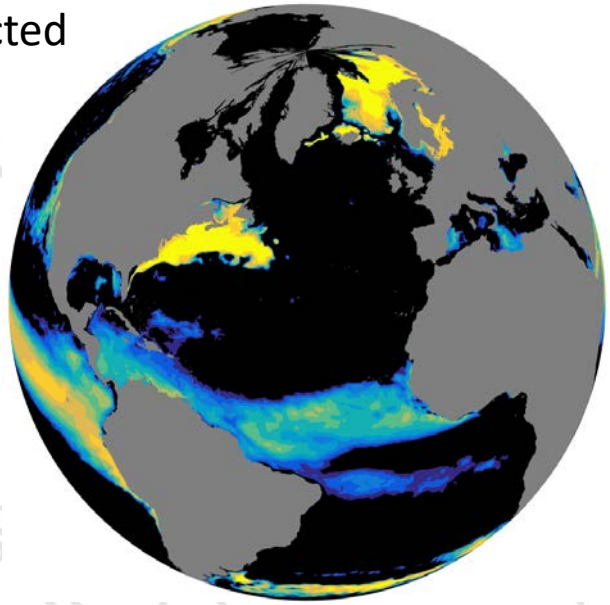
Climate resilience and adaptation

Gulf of Maine Research Institute

2002-2016

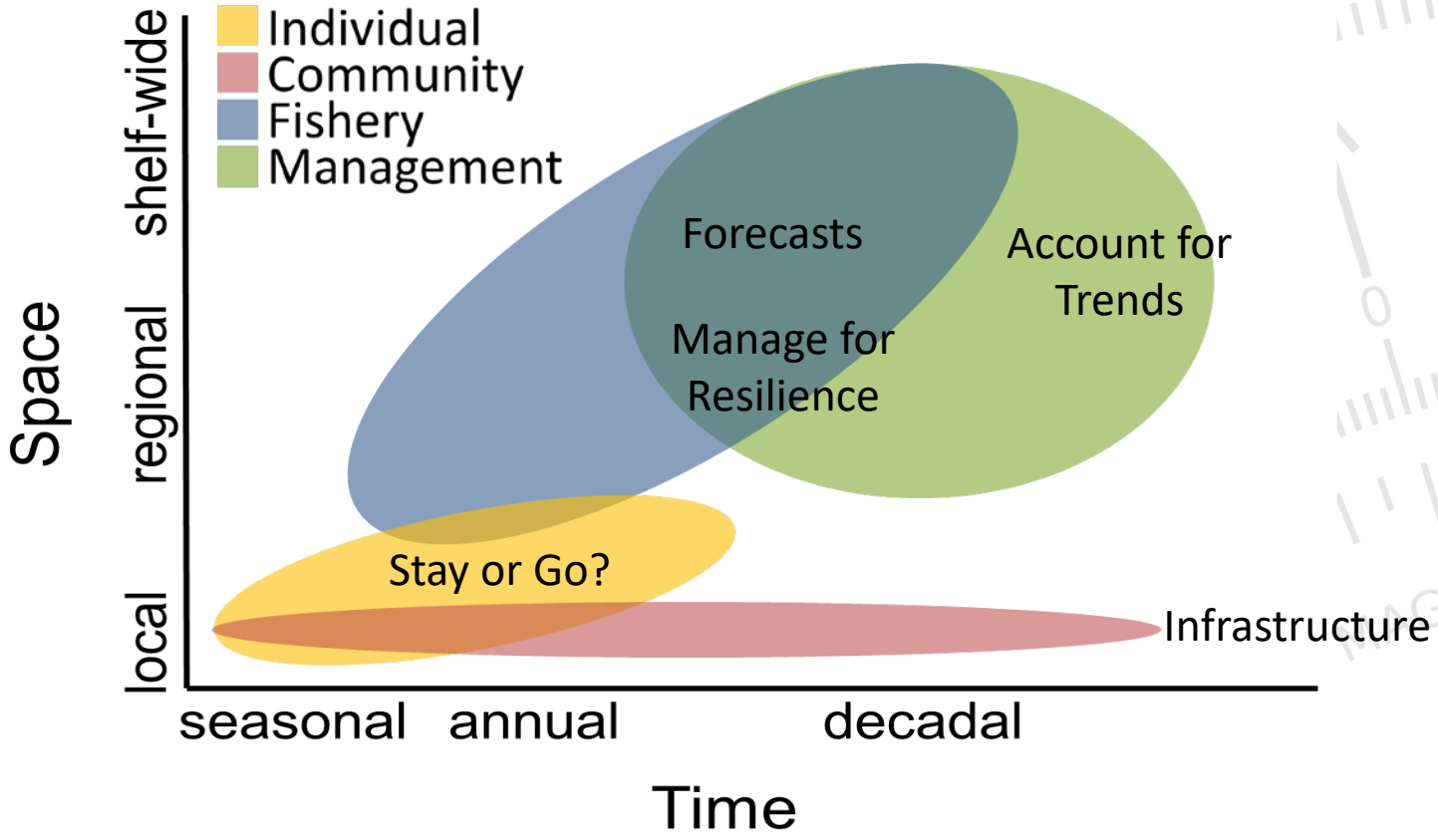


Predicted



(Saba et al. 2016)

Climate resilience and adaptation



(Mills et al., in prep.)

Climate resilience and adaptation

Gulf of Maine Research Institute

Challenges:

- Moving beyond historical analogues
- Differential response rates (biological and human)
- Changing social, economic, institutional contexts

Responses:

- Assess vulnerabilities and opportunities
- Build industry and community capacity for adaptation
- New climate-relevant information streams

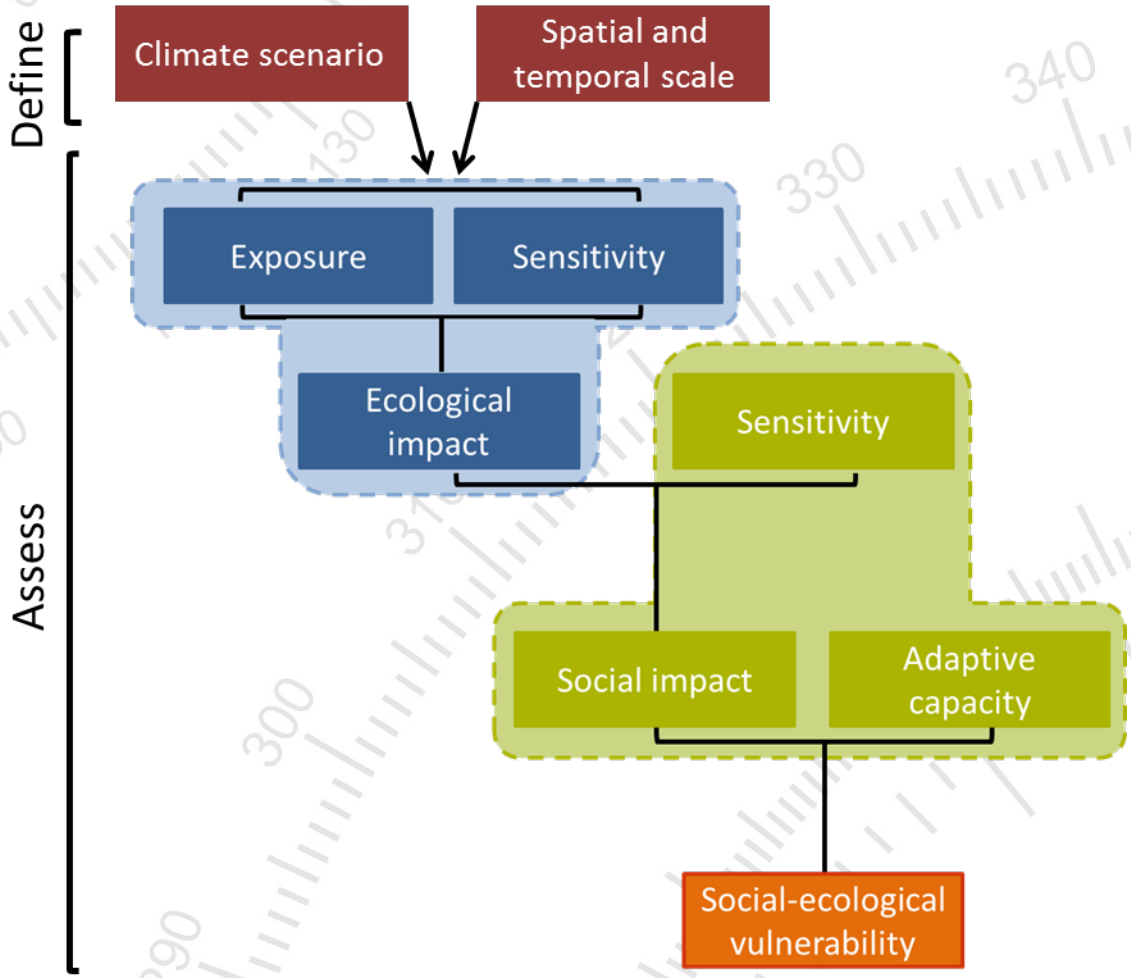
Climate resilience and adaptation

Gulf of Maine Research Institute

Evaluating Social-Ecological Vulnerability and Climate Adaptation Strategies for Northeast U. S. Fishing Communities

- Assess vulnerability of fishing communities to climate impacts
- Evaluate social and economic outcomes of climate-driven changes in species availability
- Quantify benefits of potential adaptation strategies
- Identify factors that facilitate or hinder adaptation

Social-ecological vulnerability assessment



Adapted from Cinner et al. 2013; Johnson and Welch 2010

In-depth analyses in four communities

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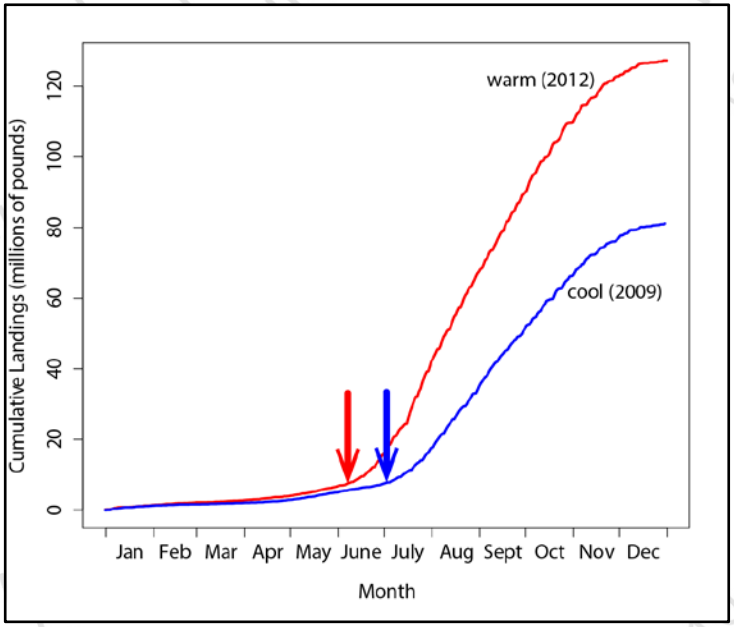
	North	South
Low diversity	Stonington, ME	New Bedford, MA
High diversity	Portland, ME	Point Judith, RI

- Model social and economic outcomes
- Identify and evaluate adaptation strategies of interest
- Assess factors that facilitate or hinder adaptation

New information streams: forecasts



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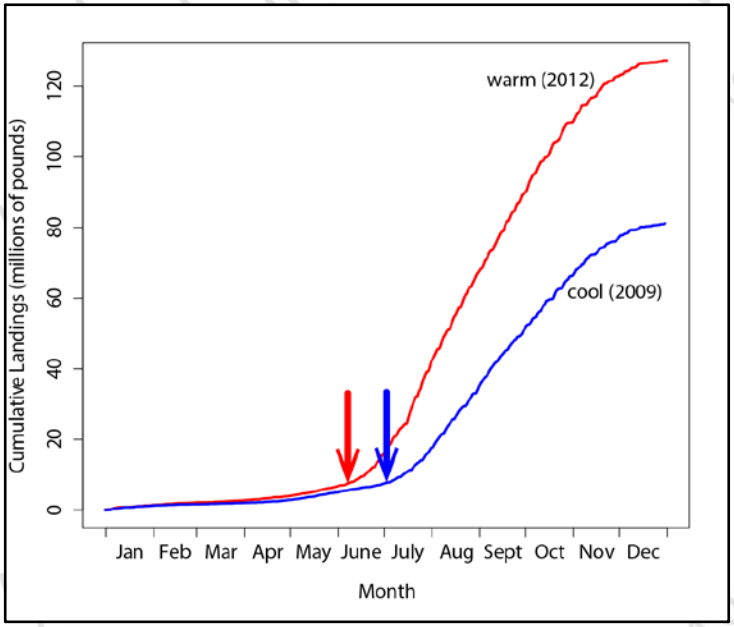

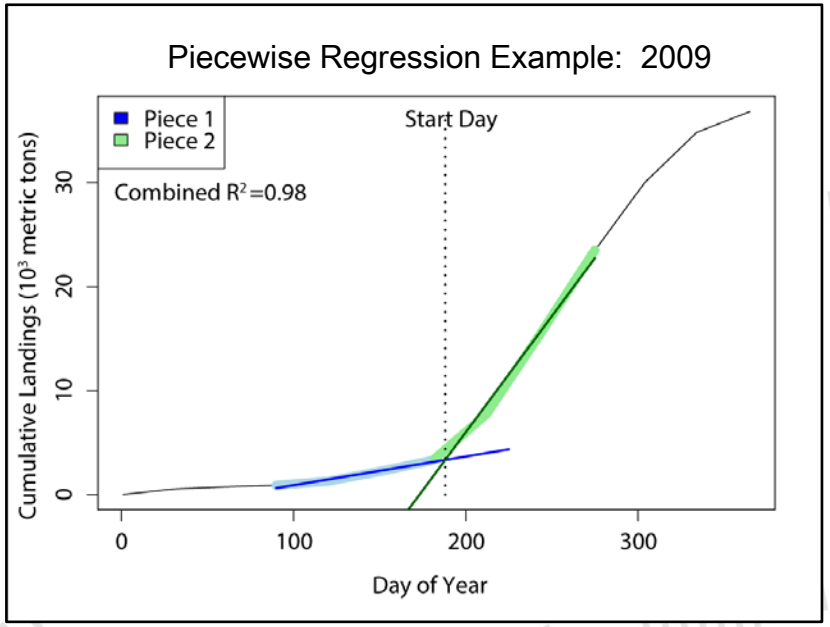

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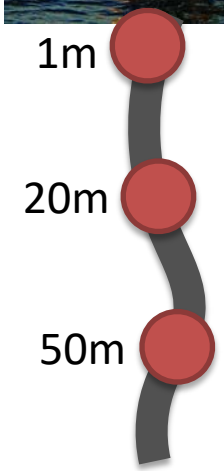

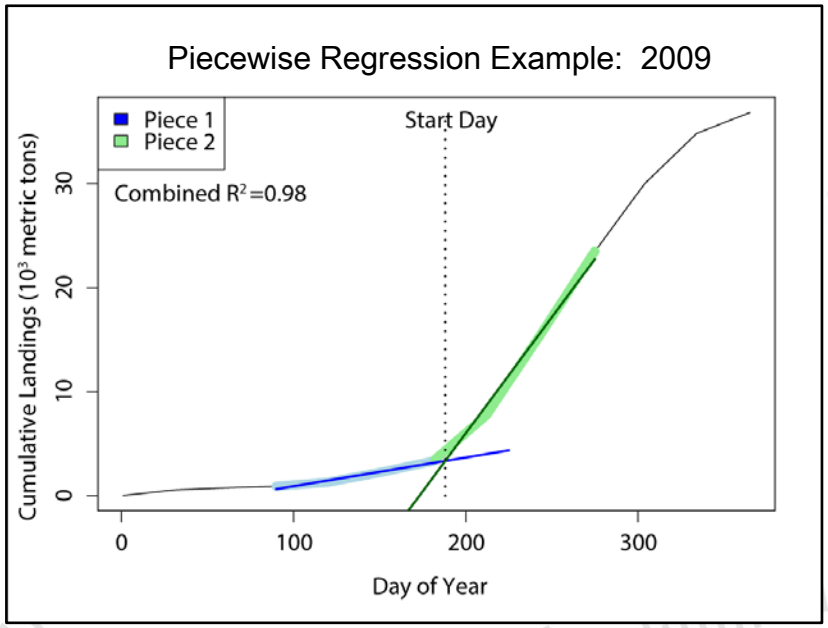

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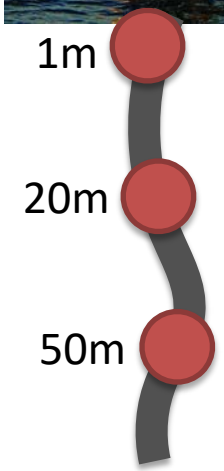

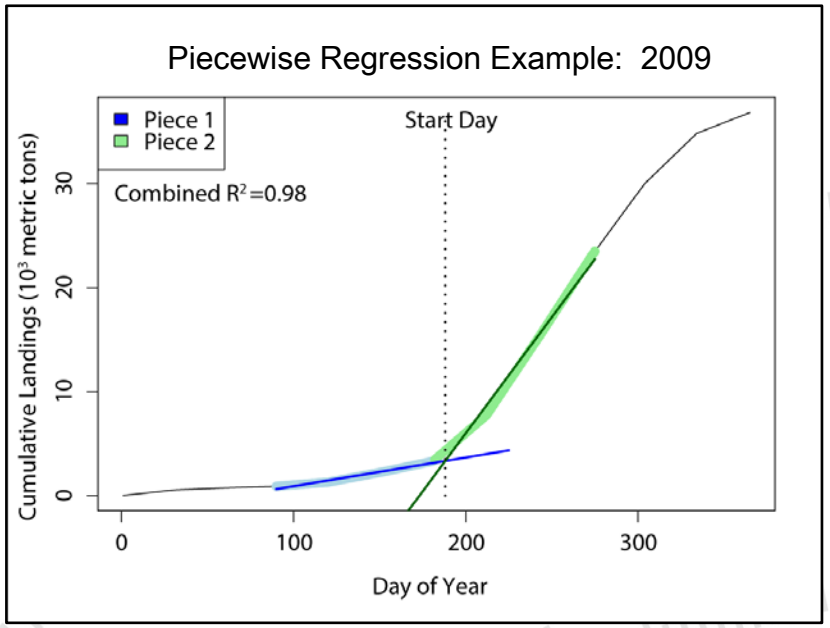

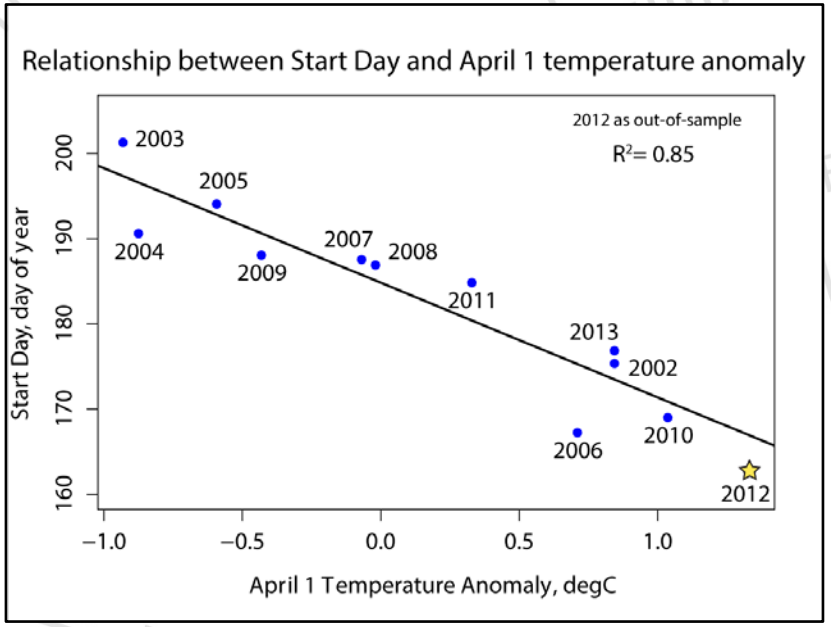

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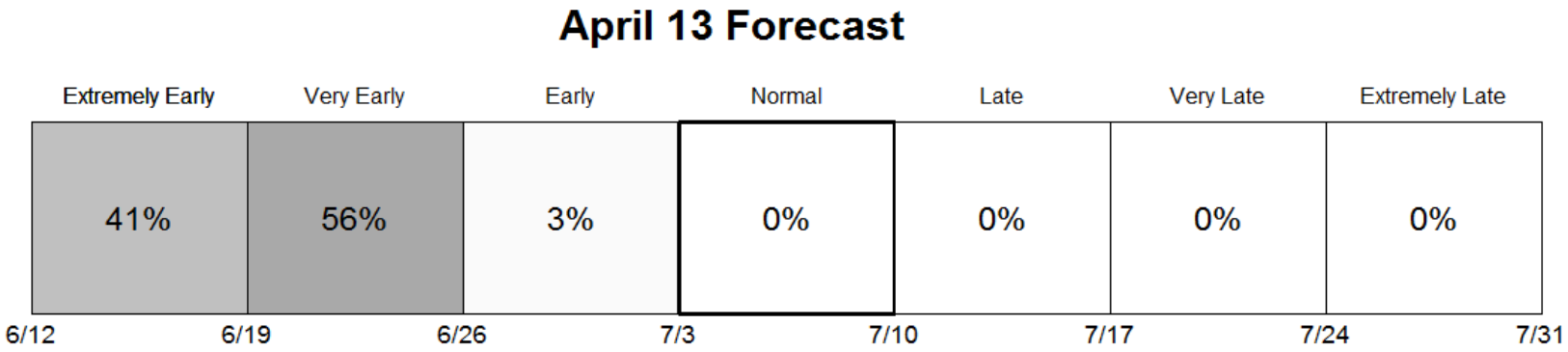

Photo: Curt Brown, Ready Seafood

Forecast development with industry

- What decisions do participants face that would be supported by forecasts?
- How do they currently use information?
- In what form is information most useful?
  - Access
  - Format
  - Communication
  - Training

Conclusions

- Warming on Northeast Shelf:
  - Rapid rate, extreme events, seasonal timing
- Effects on species in the region
- Impacts communities and management systems
- Northeast communities are at forefront of building readiness for climate adaptation
  - New efforts to support adaptation—assessments, information, strategies
  - Opportunities to learn globally-relevant lessons here
- Consider future conditions when making decisions

Questions?

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