



**NOAA
FISHERIES**

Fisheries in a changing world: examples from the Northeast U.S. Shelf

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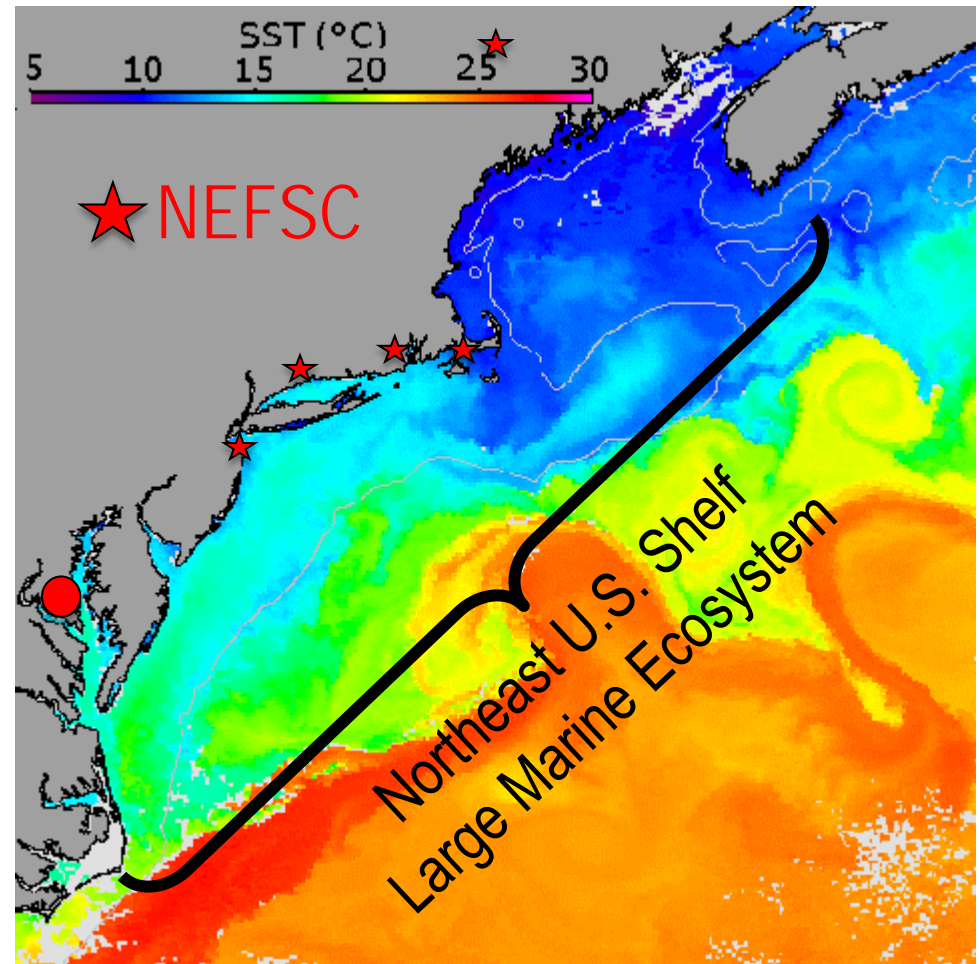
NOAA Fisheries

Fisheries in a changing world: examples from the Northeast U.S. Shelf

- NOAA Fisheries Priority
 - Maximize fishing opportunities while ensuring the sustainability of fisheries and fishing communities.
- Natural scientists and social scientists need to work together to achieve this priority

Fisheries in a changing world: examples from the Northeast U.S. Shelf

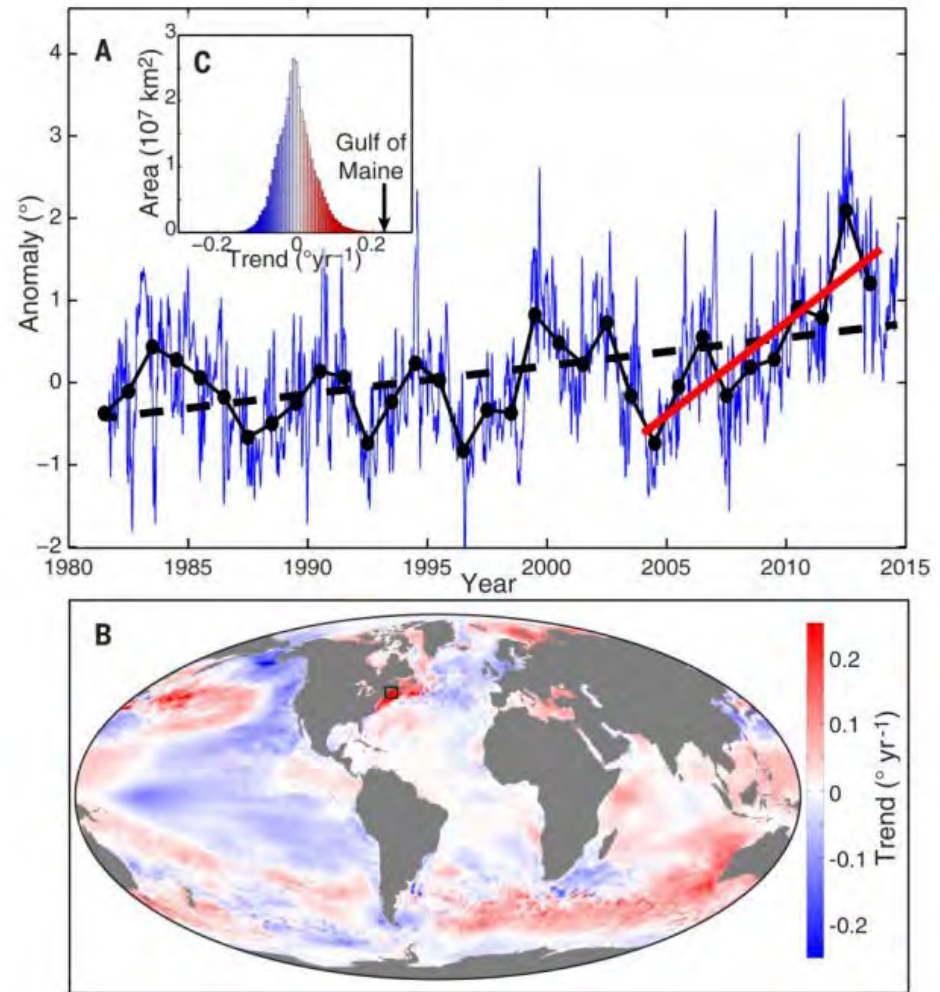
- \$1.7 billion in commercial landings
- >5.5 million recreational anglers
- Important part of cultural heritage



Fisheries in a changing world: examples from the Northeast U.S. Shelf

Northeast U.S. Shelf Ecosystem is one of the fastest warming marine systems in the world

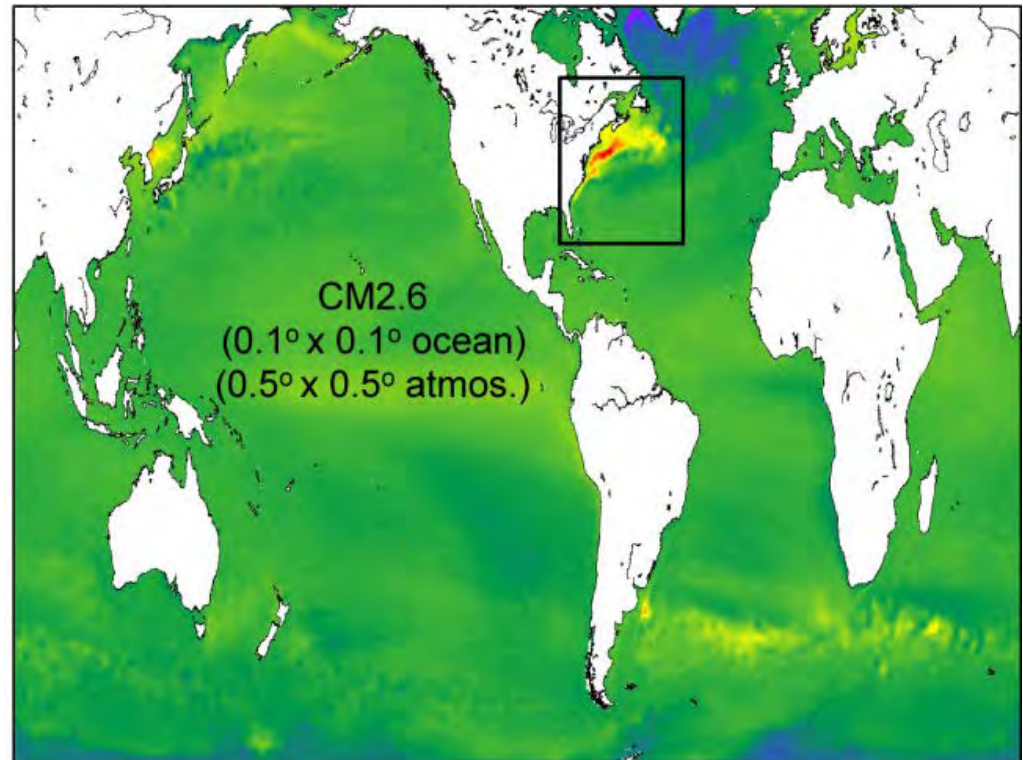
Pershing et al. 2015
Science



Fisheries in a changing world: examples from the Northeast U.S. Shelf

Enhanced warming is projected to continue through the century

Relative rate of warming is fast; relative magnitude of warming is high



Saba et al. 2015 JGR Oceans
GFDL CM2.6 High-resolution model

Biological Responses to Environmental Change

Endure

Move

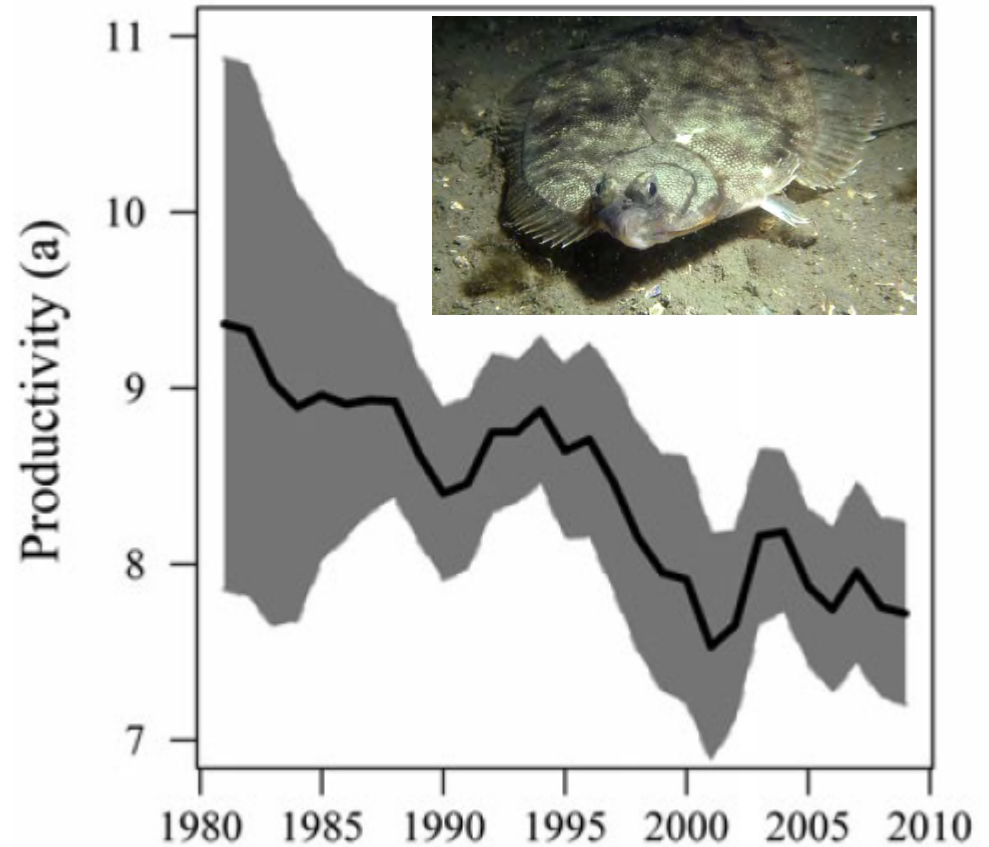
Adapt

Examples from the Northeast U.S.

Biological Responses - Endure

- Endure can result in changes to:
 - growth rate
 - productivity
 - recruitment
 - maturity
 - mortality
- Winter flounder productivity decreasing as temperature increasing

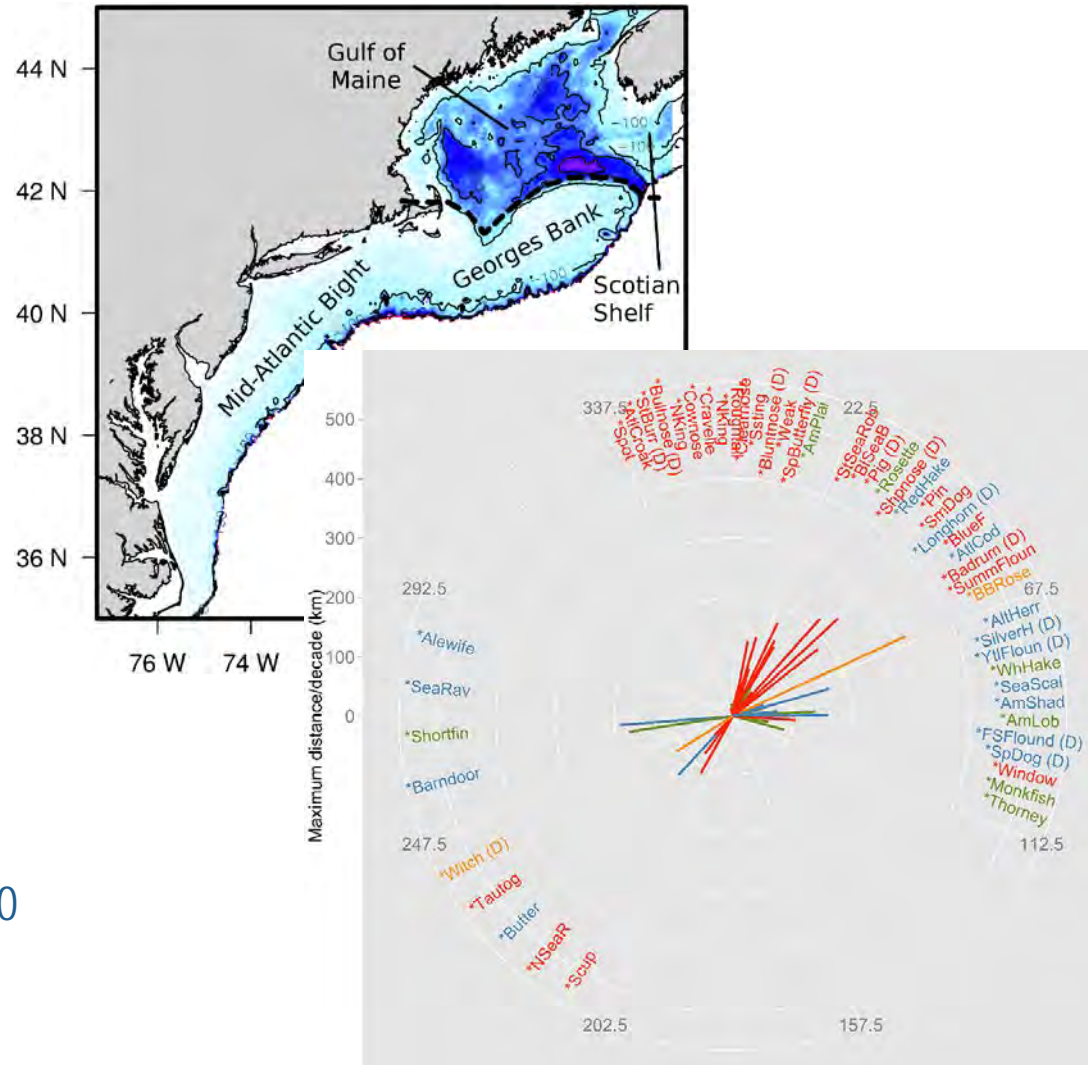
SNE/MAB Winter Flounder



Bell et al. (2014). ICES JMS 71:2416-2428

Biological Responses - Move

- Moving can occur at:
 - Individual level
 - Population level
 - Inter-generationally
 - Phenology
- Many species on NEUS shelf exhibit evidence of moving in response to climate



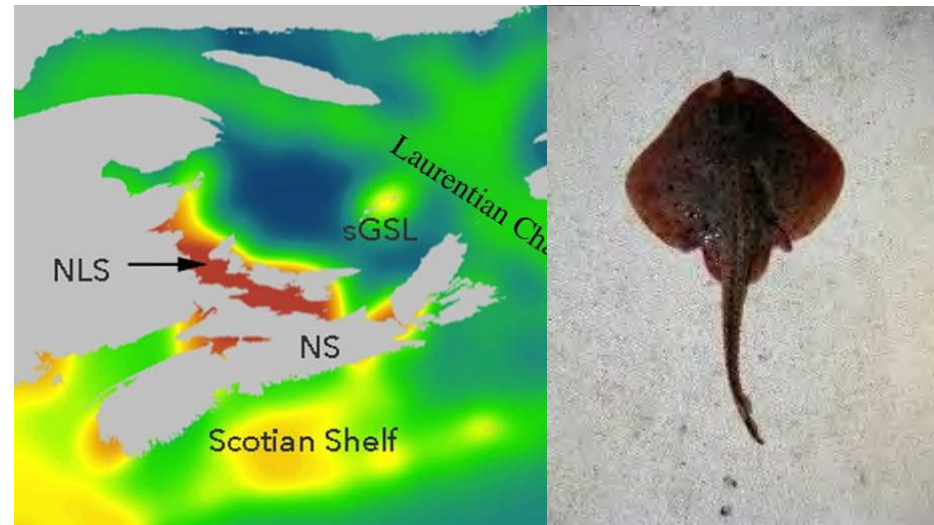
Kleisner et al. (2016). PLOS e0149220

Nye et al. (2009) 393:111-129

Walsh et al. (2017)

Biological Responses - Adapt

- Adaptation least studied
 - Genetic
 - Epi-genetic



Stiasny et al. (2018) Scientific Reports 8:8348

Lighten et al. (2016) RSOS 160299

Benstan et al (2016) Mol Ecol 25:5073-5092

life-history trait	SS	sGSL
max age	21	11
size 50% maturity (cm)	76–77	40–42
age maturity (years)	8–9	5–6
mean egg case length (mm)/wet mass (g)	80.9/41.8	64.1/12.9

Human Responses to Environmental Change

Endure

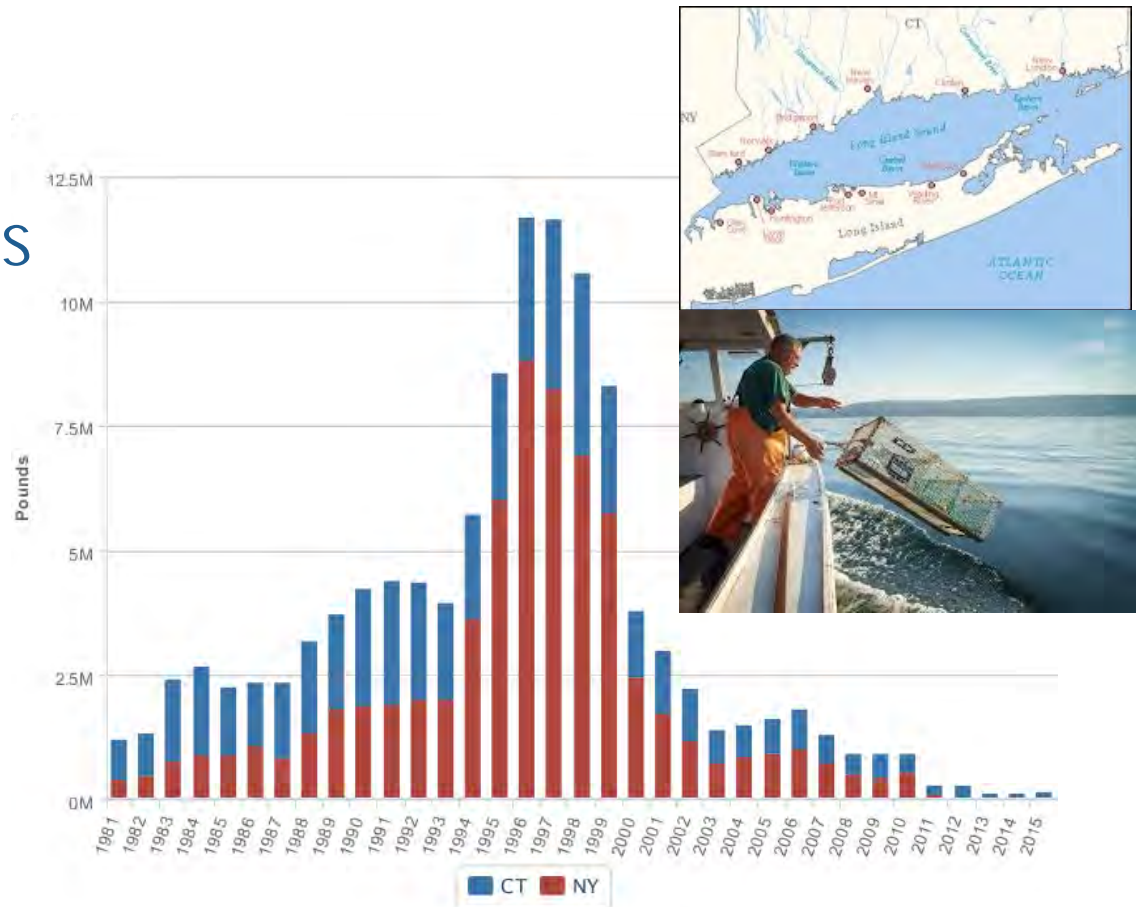
Move

Adapt

Examples from the Northeast U.S.

Social Responses - Endure

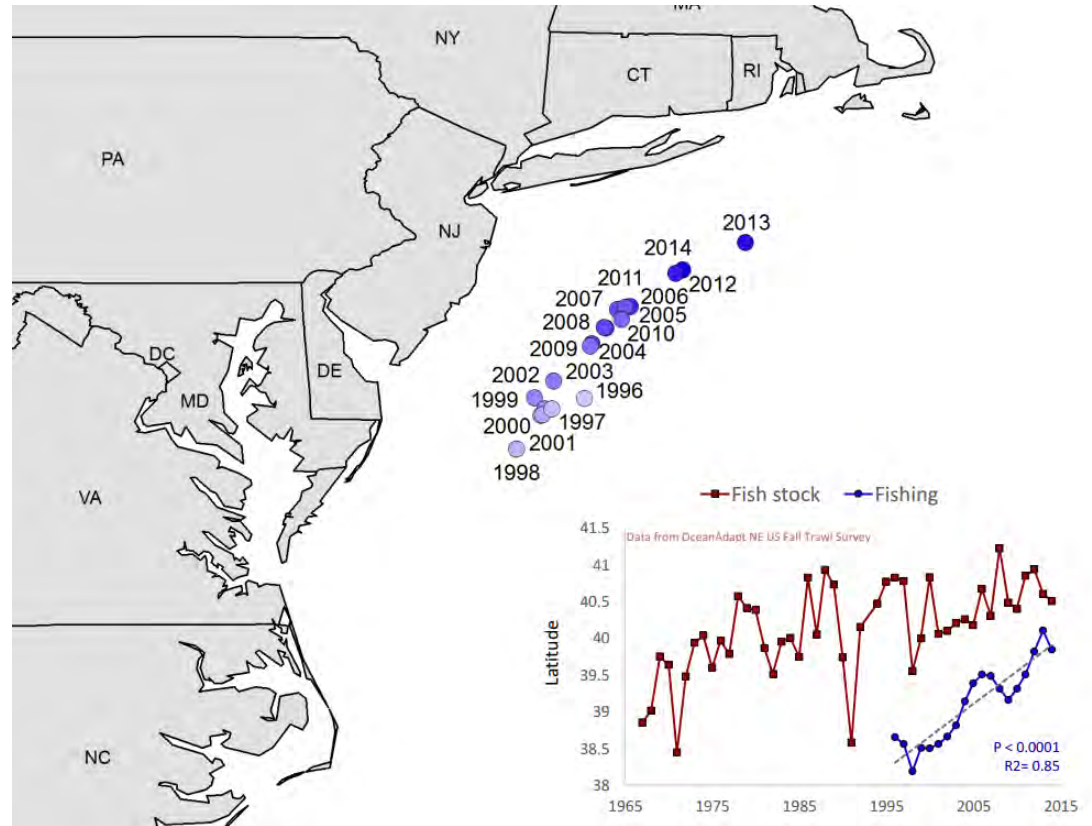
- Endure can results in:
 - Changing catch
 - Changing costs
 - Changing markets
- Lobster fishery in Southern New England has decreased



<http://longislandsoundstudy.net/indicator/lobster-landings/>

Social Responses - Move

- Fishing is changing location
 - Landings
 - Fishing
- Summer Flounder fishing effort shifting north



Brad Dubik et al. (2018) [presentation to MAFMC](#)

Pinsky and Fogarty. (2012) Climatic Change Letters

Social Responses - Adapt

Businesses always adapting:

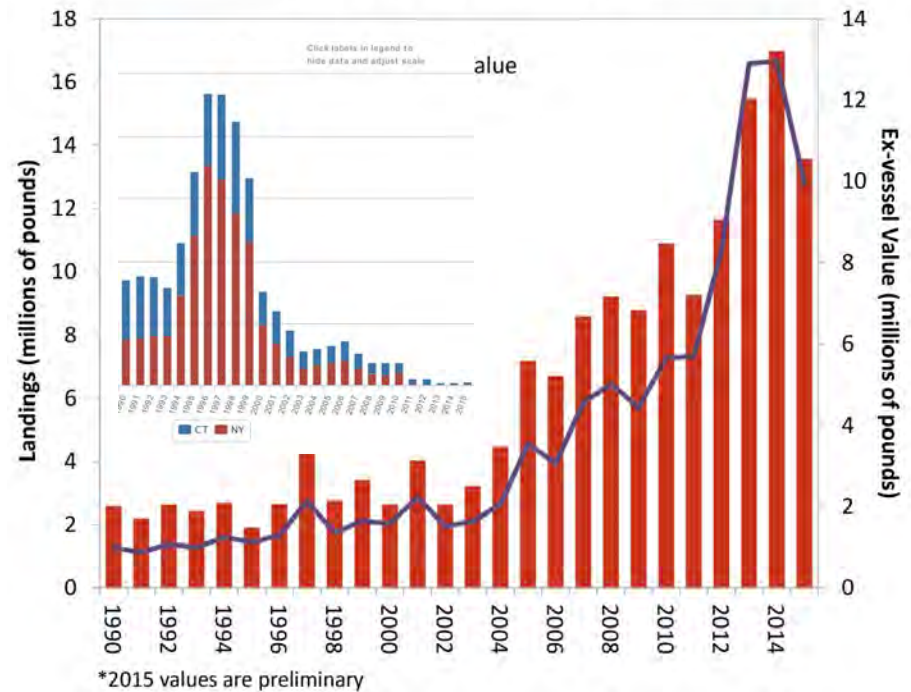
- Gear
- Target species
- Technology

Jonah crab

- w/ decline in lobsters, markets were developed for crabs
- landings have increased by 650%

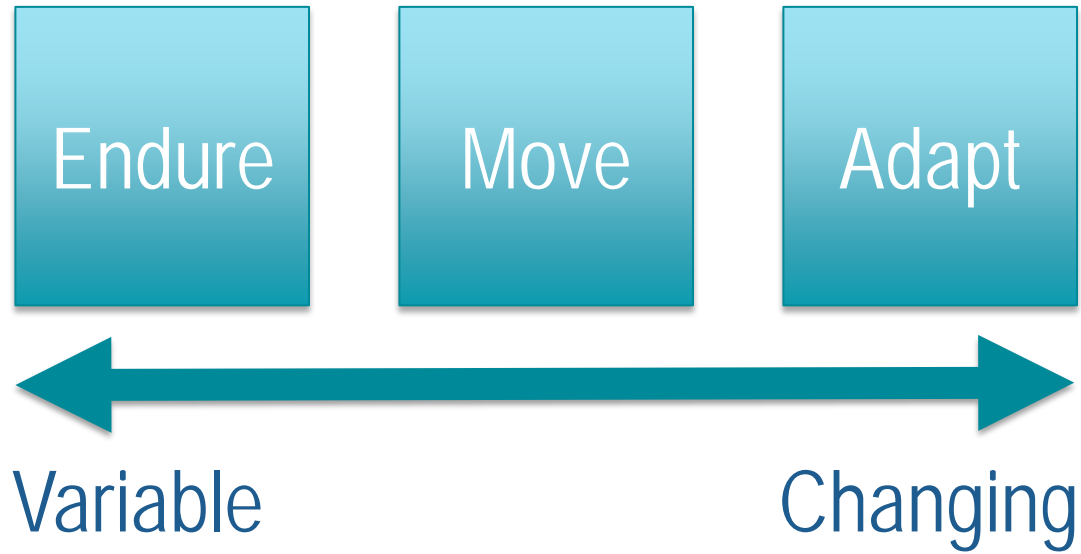
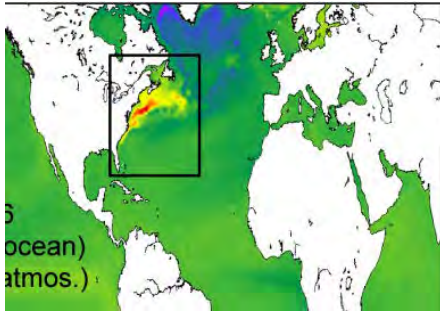
Jonah Crab Landings and Ex-vessel Value

Source: ACCSP Data Warehouse, 2016



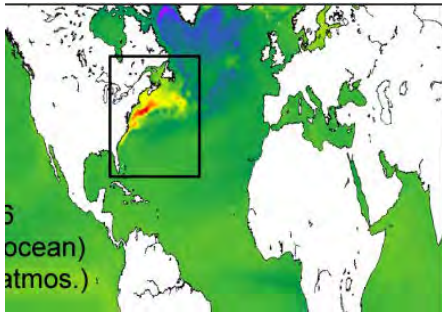
<http://www.asmfc.org/species/jonah-crab>

Response vs Pressure



Need to work with human dimensions in Northeast U.S. Shelf Ecosystem to communicate that the system is both variable and changing

Conclusions – In the Northeast U.S. Shelf Ecosystem



Endure

Move

Adapt

- Climate is changing fast (physics, chemistry)
- Biological and social components are changing fast
- Need to work across disciplines to meet NOAA Fisheries Priorities: fishing opportunities, sustainable fisheries, sustainable fishing communities.