

A Climate of Change & Challenges for Sustaining Healthy Coastal Ecosystems

An overview of research & monitoring initiatives

Dr. Jason Goldstein, Research Director

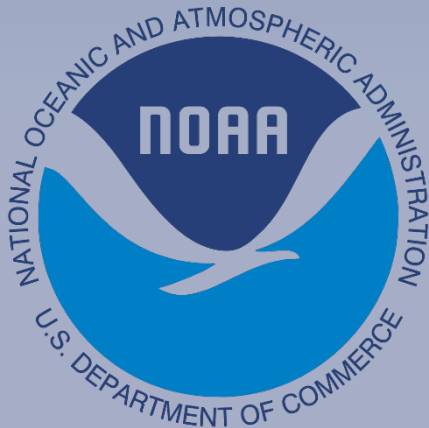
Wells National Estuarine Research Reserve (Wells NERR)

Maine Coastal Ecology Center

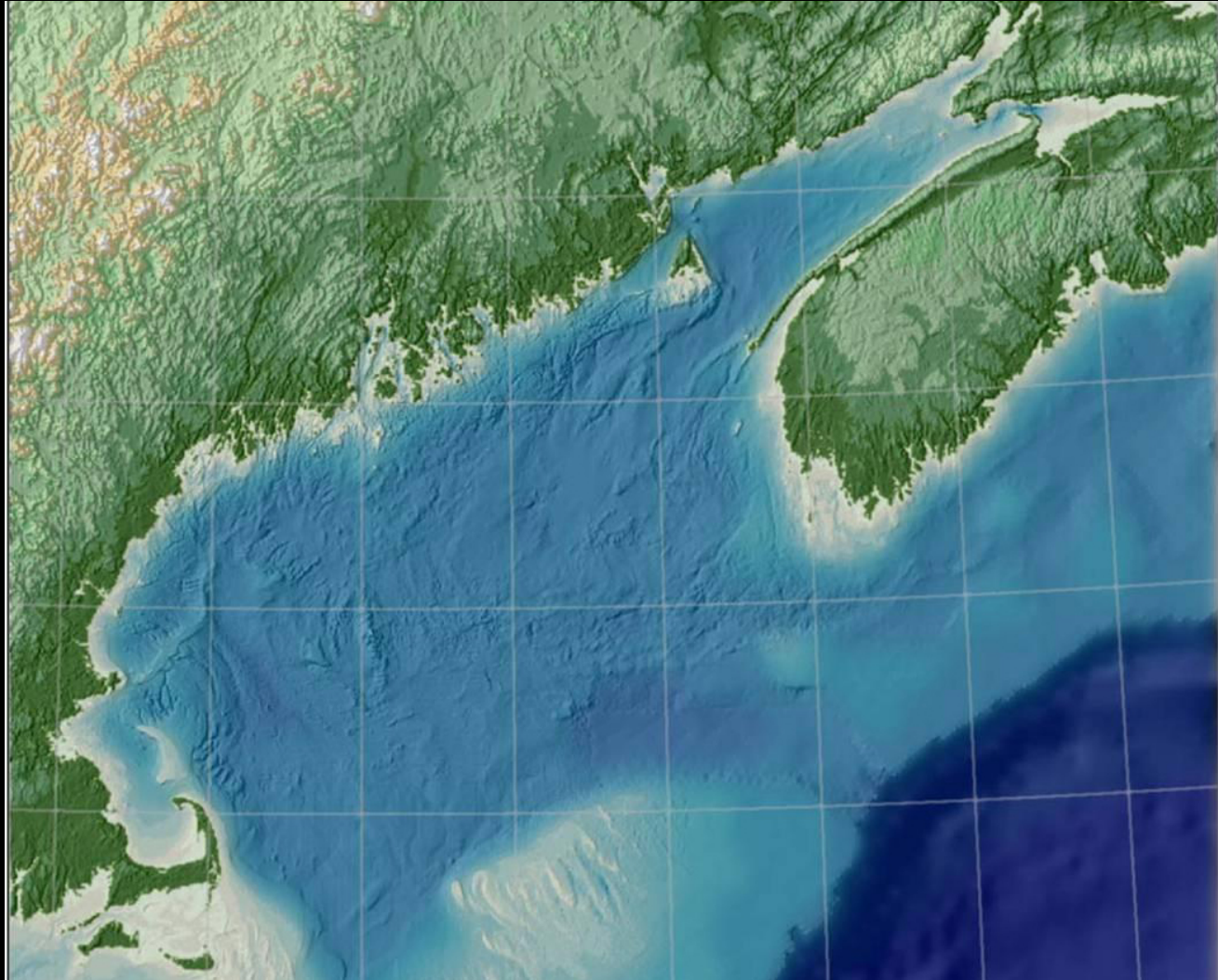
Wells, Maine

email: jgoldstein@wellsnerr.org

web: www.wellsreserve.org



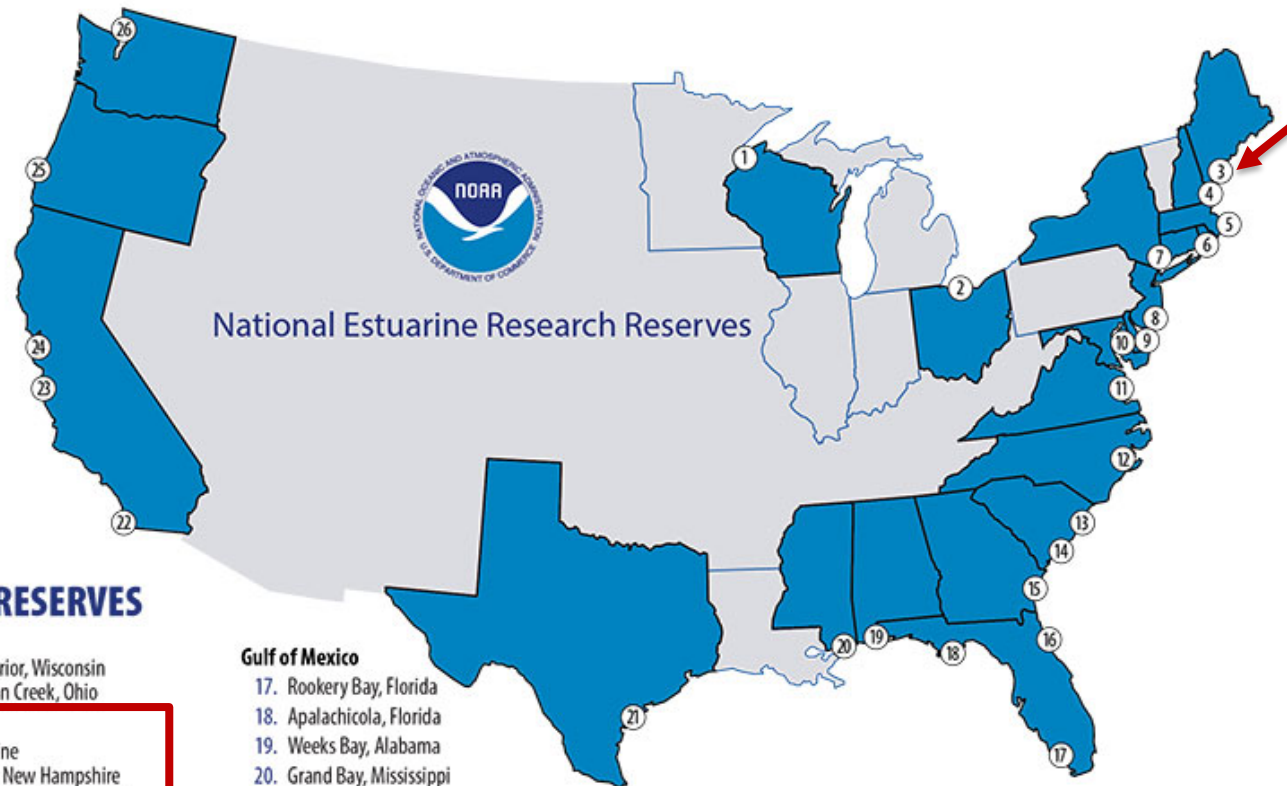
The Gulf of Maine (GoM)



- GoM Watershed: ~ 69,000 miles² (180,000 km²)
- Maine has some of the longest river systems in the country with its top ten rivers >75 miles long (longest is > 450 miles)



A National Network of Estuarine Research Reserves



LIST OF RESERVES

Great Lakes

1. Lake Superior, Wisconsin
2. Old Woman Creek, Ohio

Northeast

3. Wells, Maine
4. Great Bay, New Hampshire
5. Waquoit Bay, Massachusetts
6. Narragansett Bay, Rhode Island

Mid-Atlantic

7. Hudson River, New York
8. Jacques Cousteau, New Jersey
9. Delaware
10. Chesapeake Bay, Maryland
11. Chesapeake Bay, Virginia

Southeast

12. North Carolina
13. North Inlet-Winyah Bay, South Carolina
14. ACE Basin, South Carolina
15. Sapelo Island, Georgia
16. Guana Tolomato Matanzas, Florida

Gulf of Mexico

17. Rookery Bay, Florida
18. Apalachicola, Florida
19. Weeks Bay, Alabama
20. Grand Bay, Mississippi
21. Mission-Aransas, Texas

West

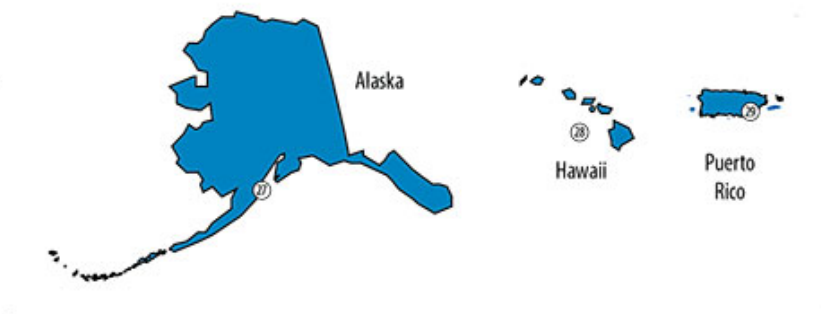
22. Tijuana River, California
23. Elkhorn Slough, California
24. San Francisco Bay, California
25. South Slough, Oregon
26. Padilla Bay, Washington
27. Kachemak Bay, Alaska

Pacific

28. He'eia, Hawai'i

Caribbean

29. Jobos Bay, Puerto Rico







wellsreserve
at laudholm

Wells National Estuarine
Research Reserve

"The Wells NERR Research Program studies and monitors change Gulf of Maine estuaries, coastal habitats, and adjacent coastal watersheds, and produces science-based information needed to protect, sustain, or restore them." Wells NERR Management Plan 2013-2018



Research and Monitoring Objectives:

1. Investigate coastal ecosystems, their habitats, their underlying physical and biological processes, and their response to natural changes and human activities
2. Encourage opportunities to conduct independent or collaborative research at the Reserve and in the Gulf of Maine region
3. Promote the development and implementation of regionally coordinated ecological monitoring of coastal habitats, and continue to maintain and expand the System Wide Monitoring Program (SWMP)

Wells NERR research and monitoring theme: Climate Change in the GoM

BUSINESS Posted June 27, 2016 | Updated June 28, 2016 INCREASE FONT SIZE

Climate change threatens to sink Gulf of Maine fishing industry

As waters warm, valuable species migrate and the fishing fleet shrinks.

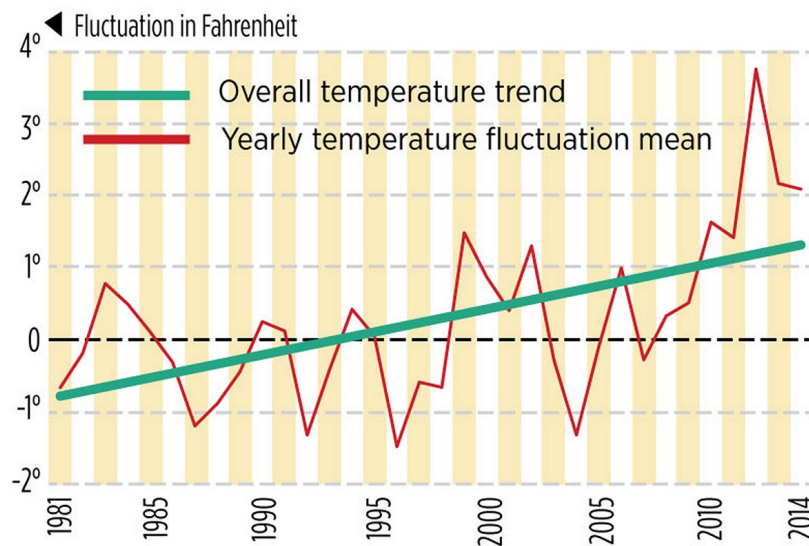
BY PATRICK WHITTLE THE ASSOCIATED PRESS

Share     46 Comments



Getting warmer

Sea surface temperatures in the Gulf of Maine have been rising over the past 35 years, and at nearly the fastest rate on the planet over the last 10. 2012 had the warmest readings in the 150 years humans have been collecting them.



SOURCE: Andrew J. Pershing/Gulf of Maine Research Institute

STAFF GRAPHIC | MICHAEL FISHER

The GoM is warming faster than 90% of the world's waters!



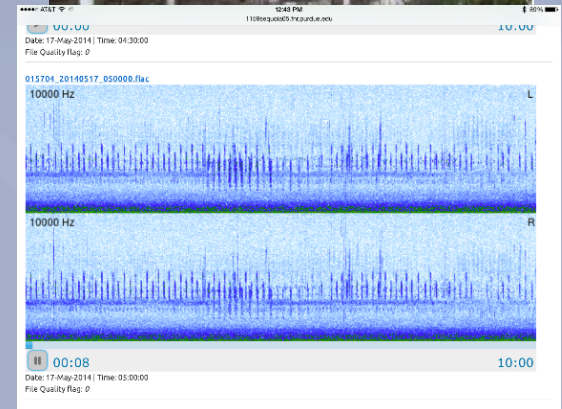
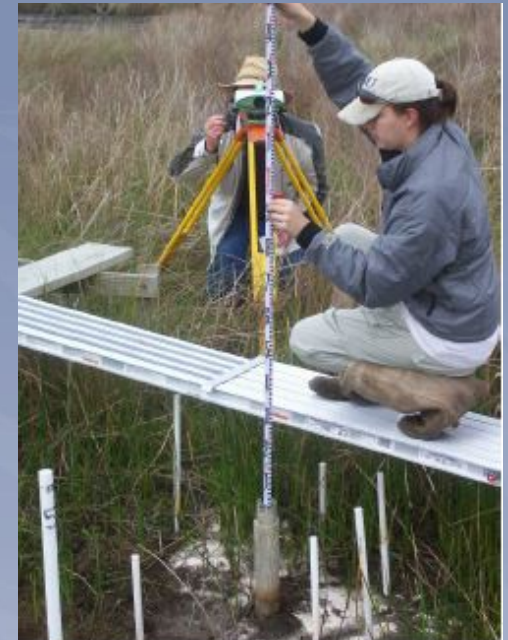
Workshop & Talk Goals

Or... this is what I'm supposed to talk about

1. Overview of resource/conservation management/research activities at the Wells NERR
2. Identify the importance of Marine Animal Telemetry and Marine Biodiversity Observations and identify/prioritize some of these needs
3. Offer a perspective on the value of a commitment to a long-term sustained Biological Observation Network in the Northeast Region

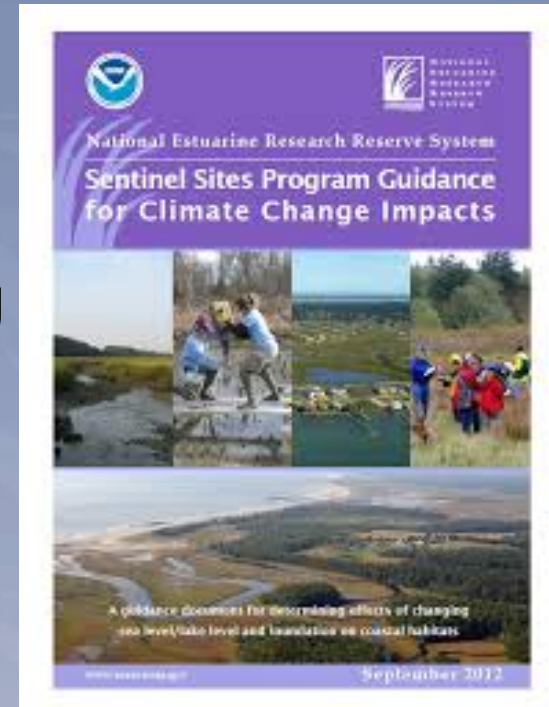


A summary of research-driven monitoring initiatives

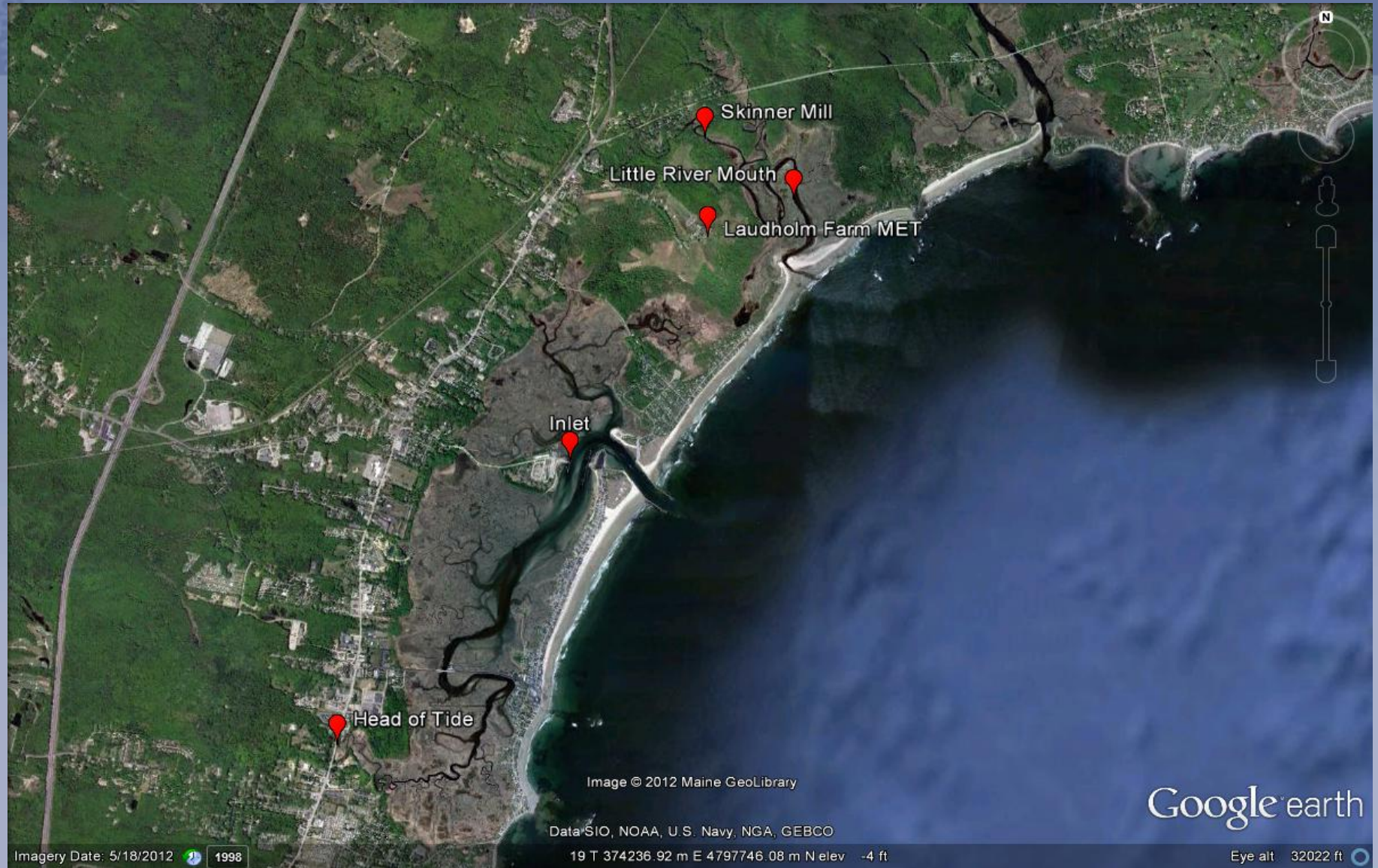


Monitoring tools across 'Sentinel Sites'

- Vegetation monitoring transects
- Surface Elevation Tables (SET)
- Ground water level and sediment monitoring
- Tide gauging
- Continual water quality monitoring (SWMP)



SWMP sites (long-term since mid 90s)



System-wide Monitoring Program (SWMP)

Abiotic Monitoring

- Water quality
- Nutrients
- Meteorological

Biological Monitoring

- Habitat Change
- Biodiversity (fish/plants)

Watershed and Land Use

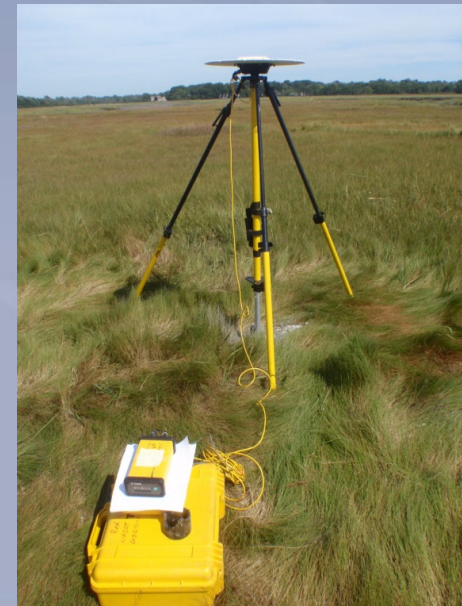
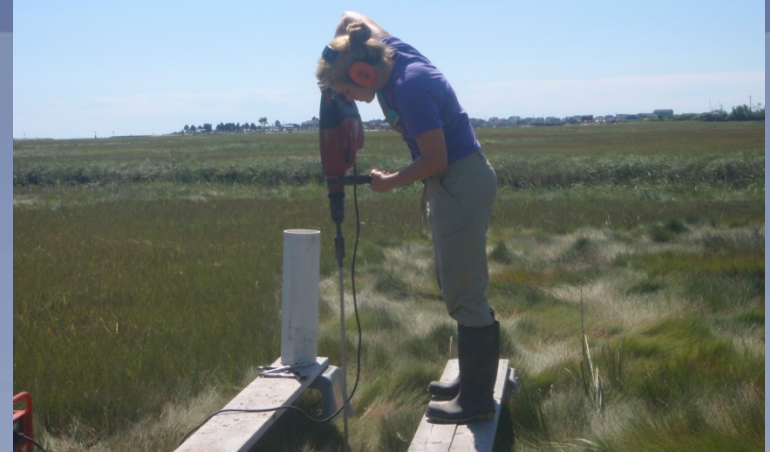
Habitat Classifications (GIS)

<i>Parameters Monitored</i>	
Water parameters:	Weather parameters:
pH	Temperature
Conductivity	Wind speed and direction
Salinity	Relative humidity
Temperature	Barometric pressure
Dissolved Oxygen	Rainfall
Turbidity	Photosynthetic Active Radiation
Nitrate	
Ammonia	
Ortho-Phosphate	
Chlorophyll a	

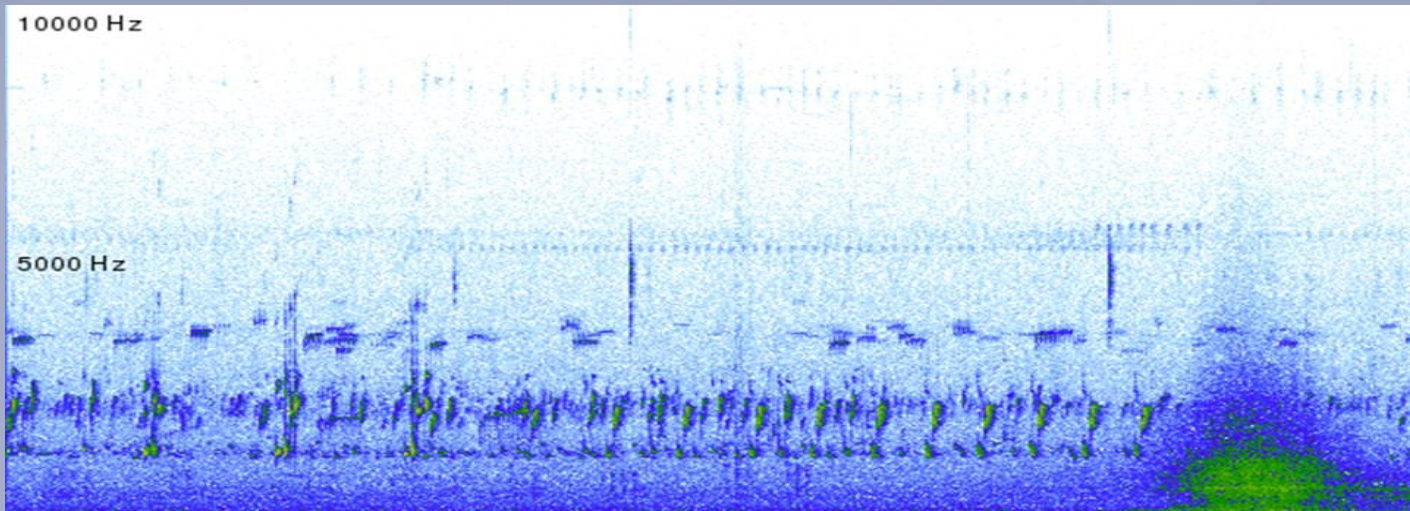


SET: Surface Elevation Table: records rate of marsh accretion

Does the marsh keep pace with sea level rise?



Sounds Worth Saving: Estuarine ecoacoustics



Ocean-Coastal acidification (OCA) in Maine: monitoring at Wells NERR

Breakdown of Maine's Fishing Economy (2013)



Shellfish species, which comprise more than 70% of the commercial fisheries in the Gulf of Maine, may be at exceptional risk.



Biological monitoring efforts:

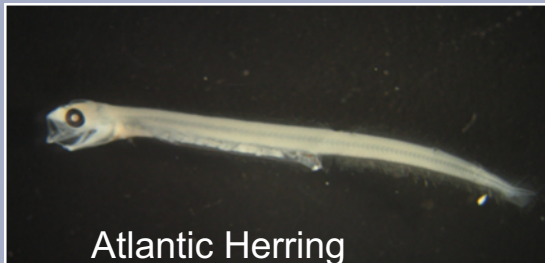
- Ichthyoplankton (2008-present)
- Wading birds (1991-present)
- Beach Profile Monitoring (2001-present)
- Marine Invasive Species (2008-present)
- Maine Healthy Beaches (2010 – present)
- Seonet (2010 – present)
- Soundscape Ecology (2014-present)



Wells NERR larval fish monitoring

Goals:

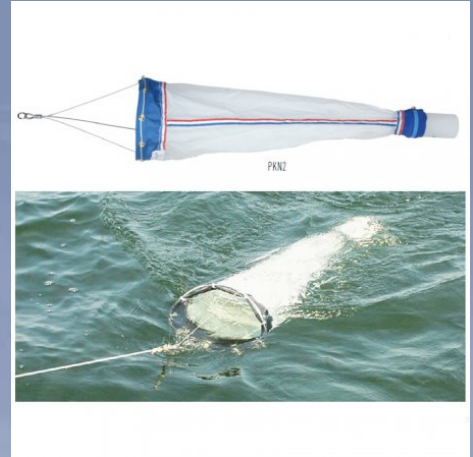
- Understand the abundance and diversity of larval fish in the Webhannet River Estuary and how that is changing over time
- Correlate environmental factors of interest on fish larvae assemblages and diversity
- Track changes in species, timing of spawning events, diversity, and general abundance in relation to changes in our natural systems



Atlantic Herring



Black Sea Bass

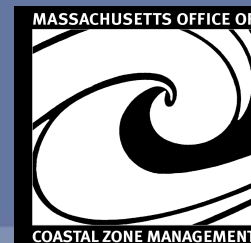


Spotfin Butterfly



Sea Raven

Marine Invader Monitoring & Information Collaborative (MIMIC)



- A network of scientists, state agency workers, and trained volunteers
- Monitor for marine invasive species along the New England coastline
- Developed to help “fill the gaps” between the Rapid Assessment Surveys (RAS)
- **Since 2008:**
 - 114 sites have been monitored
 - 15 non-profits and individuals have been involved from RI to ME
 - Over 1000 (1181) monitoring events at over 100 sites (114)





University of
New Hampshire



Environmental DNA (eDNA)



www.estuarydna.org/



Dr. Alison Watts, UNH

LETTER

“Sight-unseen” detection of rare aquatic species using environmental DNA

Christopher L. Jerde¹, Andrew R. Mahon¹, W. Lindsay Chadderton², & David M. Lodge¹

- Detection rates 80-96%
- Faster & cheaper sampling (< 30 min, <\$30/sample)
- A new monitoring tool



national estuarine research reserve system

Animal telemetry as a tool to investigate 'sentinel' crustaceans



Lobster Telemetry



Dr. Jason Goldstein, Wells NERR



Prof. Win Watson, UNH



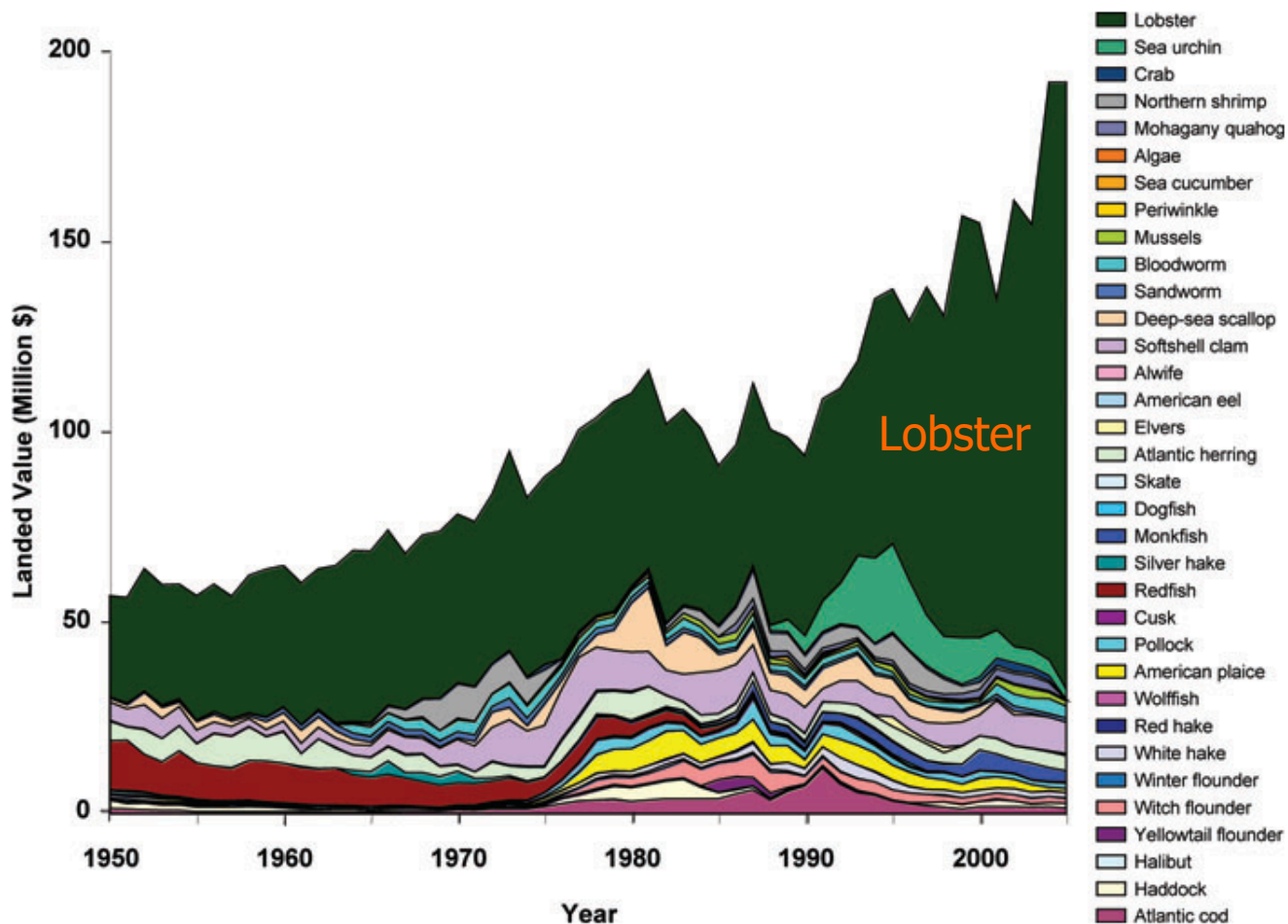
Josh Carloni, NH F&G



Ben Gutzler, UNH



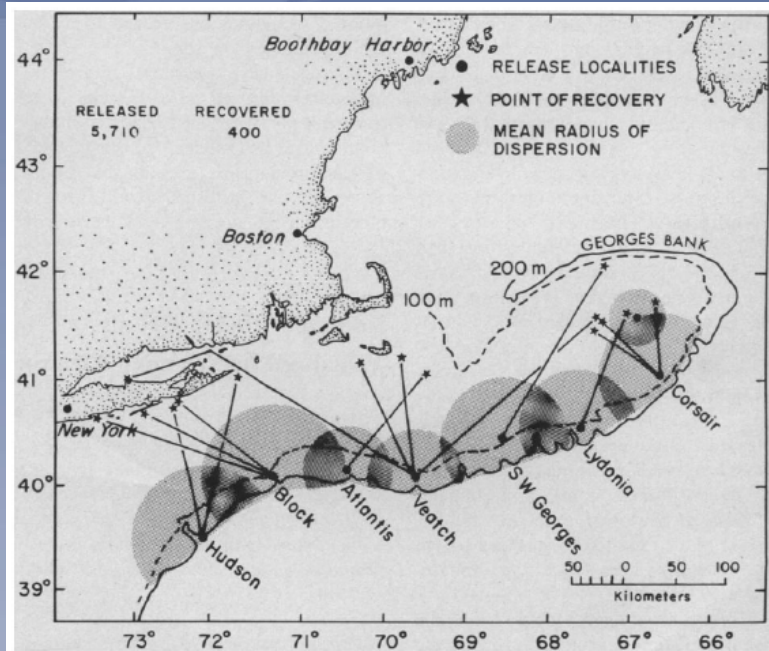
Lobster value in the Gulf of Maine



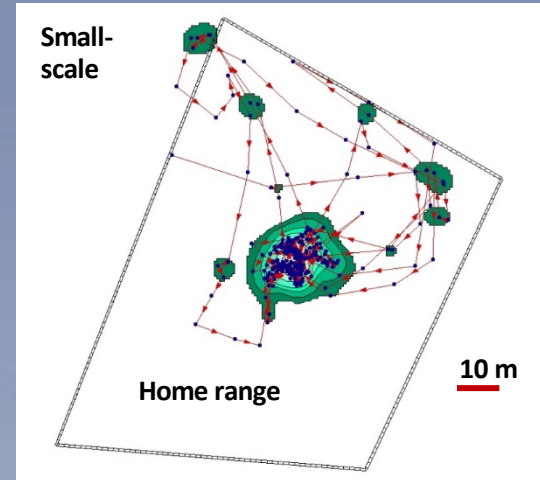
(U.S. Bureau Labor Statistics 2010)



Lobsters display a variety of movement patterns



(Cooper & Uzmann 1971)



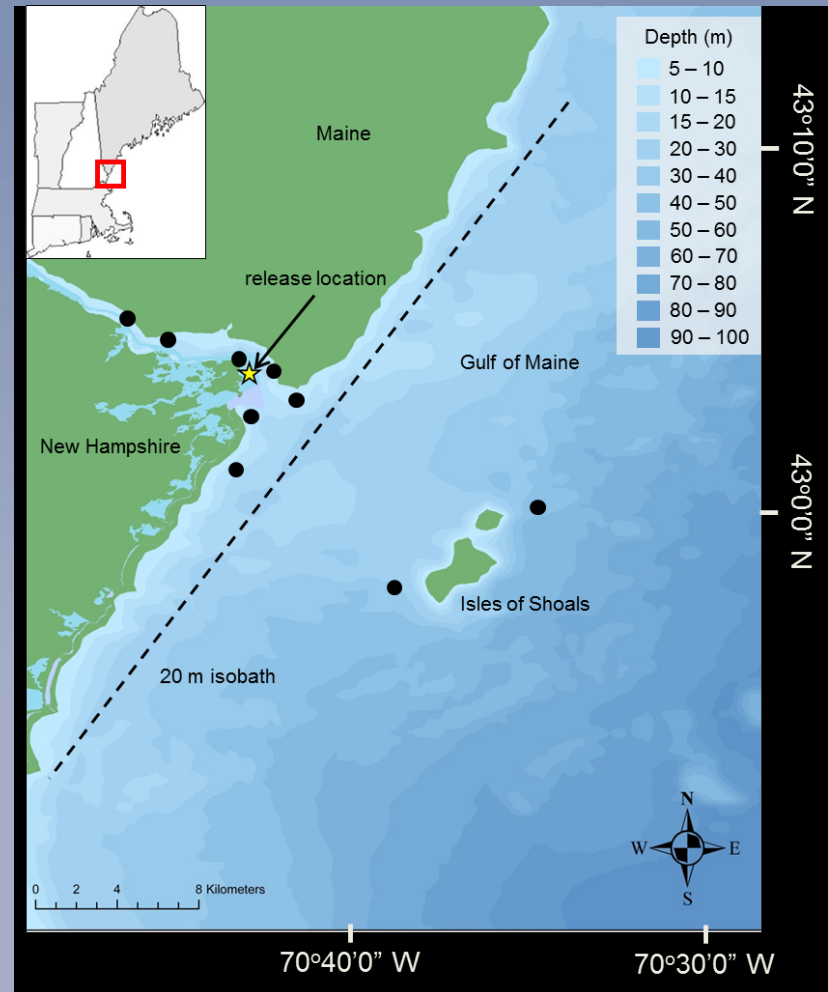
(Scopel et al. 2009)

- Most movements are local in nature (< 10 km) (Lawton and Lavalli 1995)
- Some move very large distances (> 20 km)
- Generally accepted pattern is inshore in summer (warmer water), offshore fall/winter
- Majority of studies are mark-recapture (low-resolution)

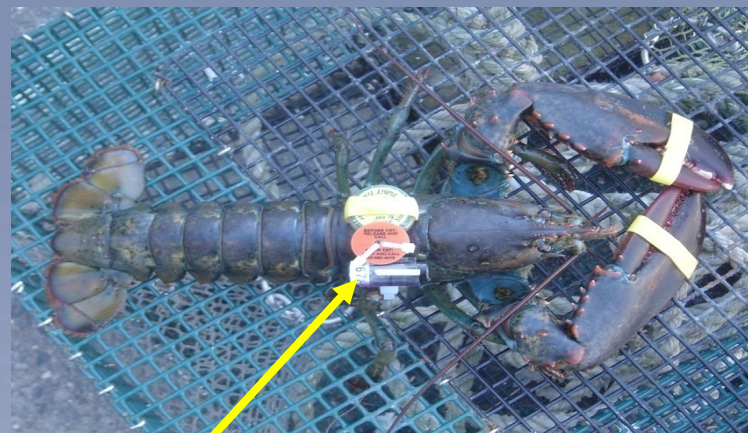
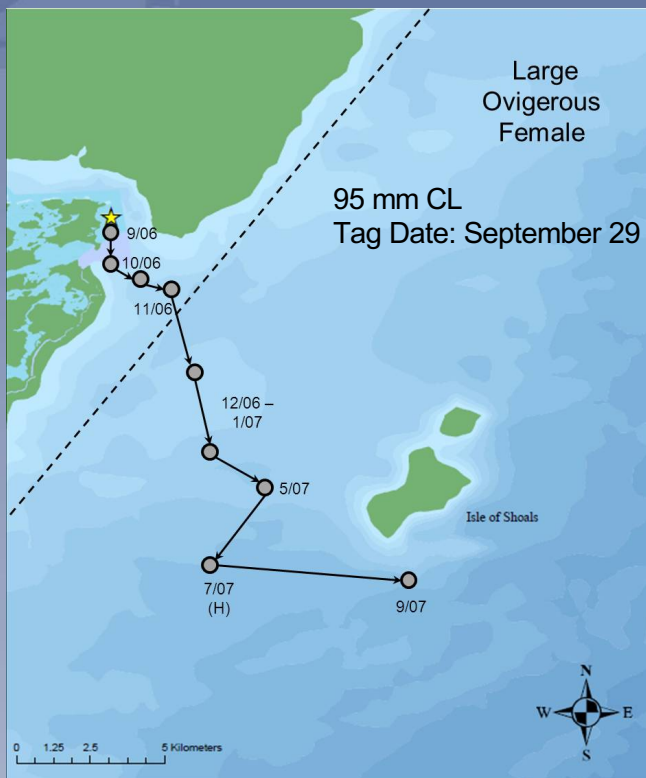


Telemetry design

- Fine-scale movements (VRAP)
- Receiver arrays, NH seacoast (VR2)
- Manual Tracking (VR100)
- Lobstermen (NH, ME, MA)



Example 1: Ovigerous lobsters



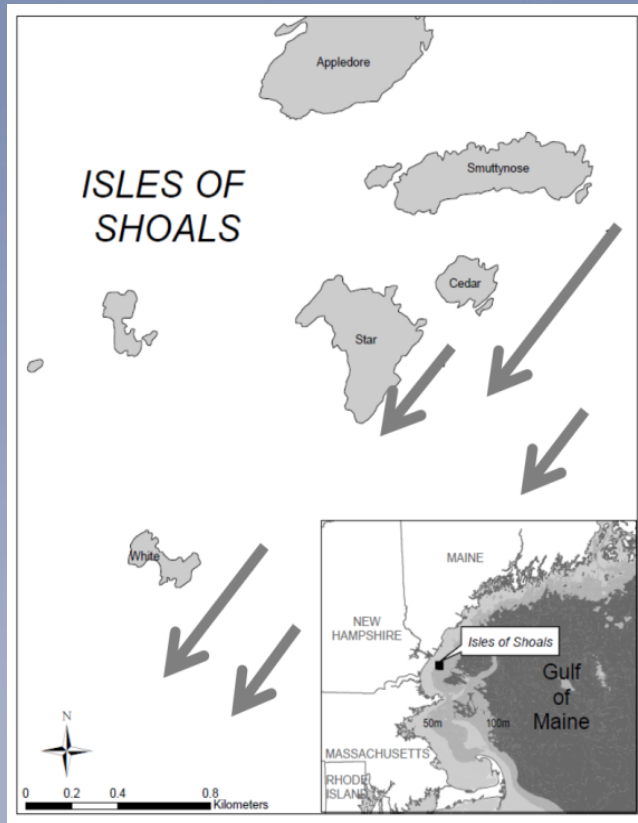
Lobster Backpack

(Goldstein & Watson 2015a,b)

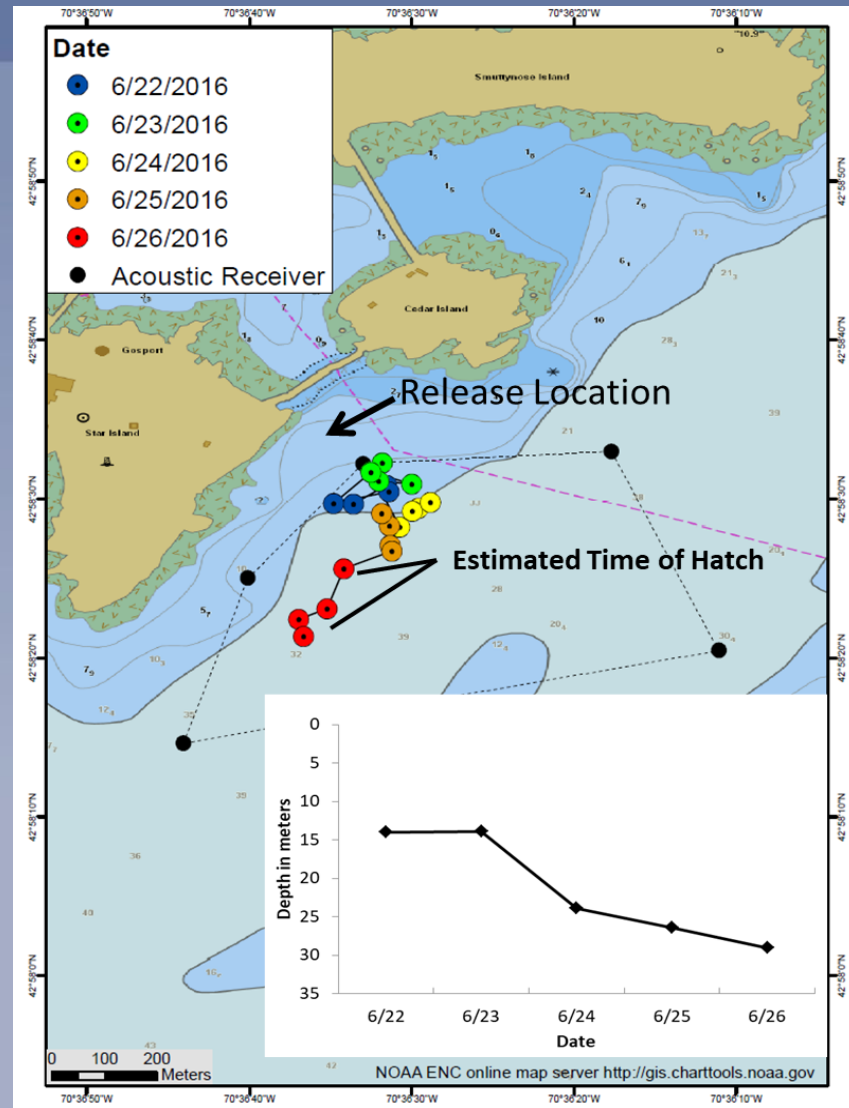
- Total distance moved: 21 km (13 miles)
- Hatch confirmed by recapture and lab-based studies



Example 2: Fine-scale movements of ovigerous lobsters

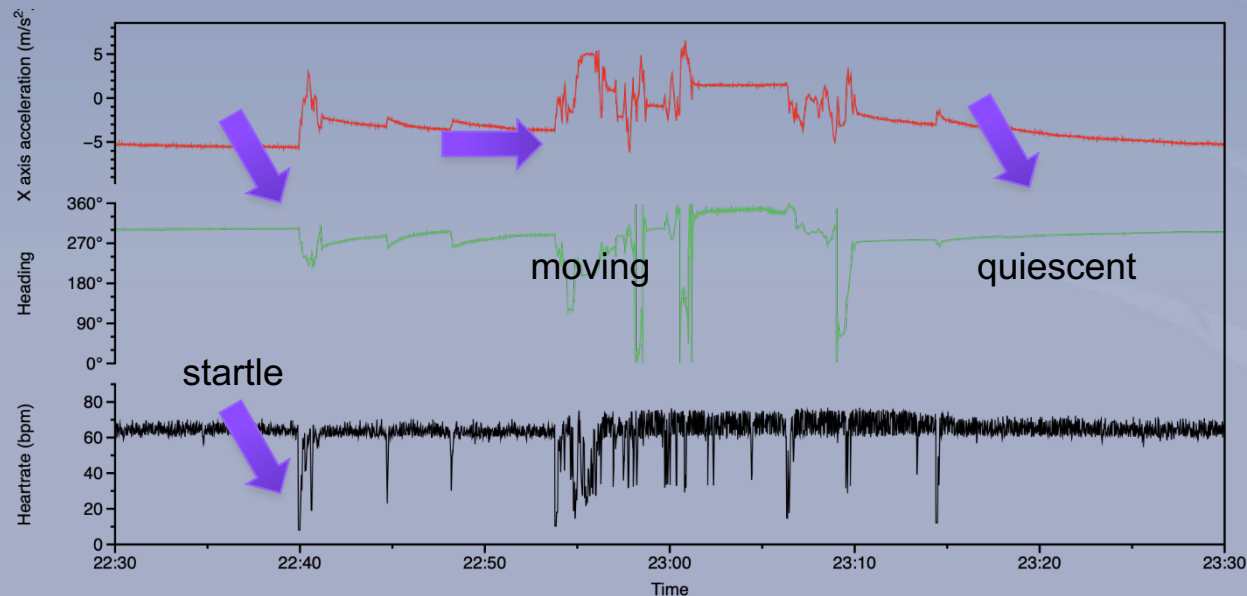


(Carloni et al. in-prep)



Example 3: Using data loggers to examine lobster behavior in the field

- What does the daily life of a lobster look like?
- Logging acceleration and heart rate to determine periods of activity and responses to stimuli in freely moving lobsters





Jonah Crab Telemetry



Lars Hammer, UNH



Prof. Win Watson, UNH



Prof. Nathan Furey, UNH



Ben Gutzler, UNH



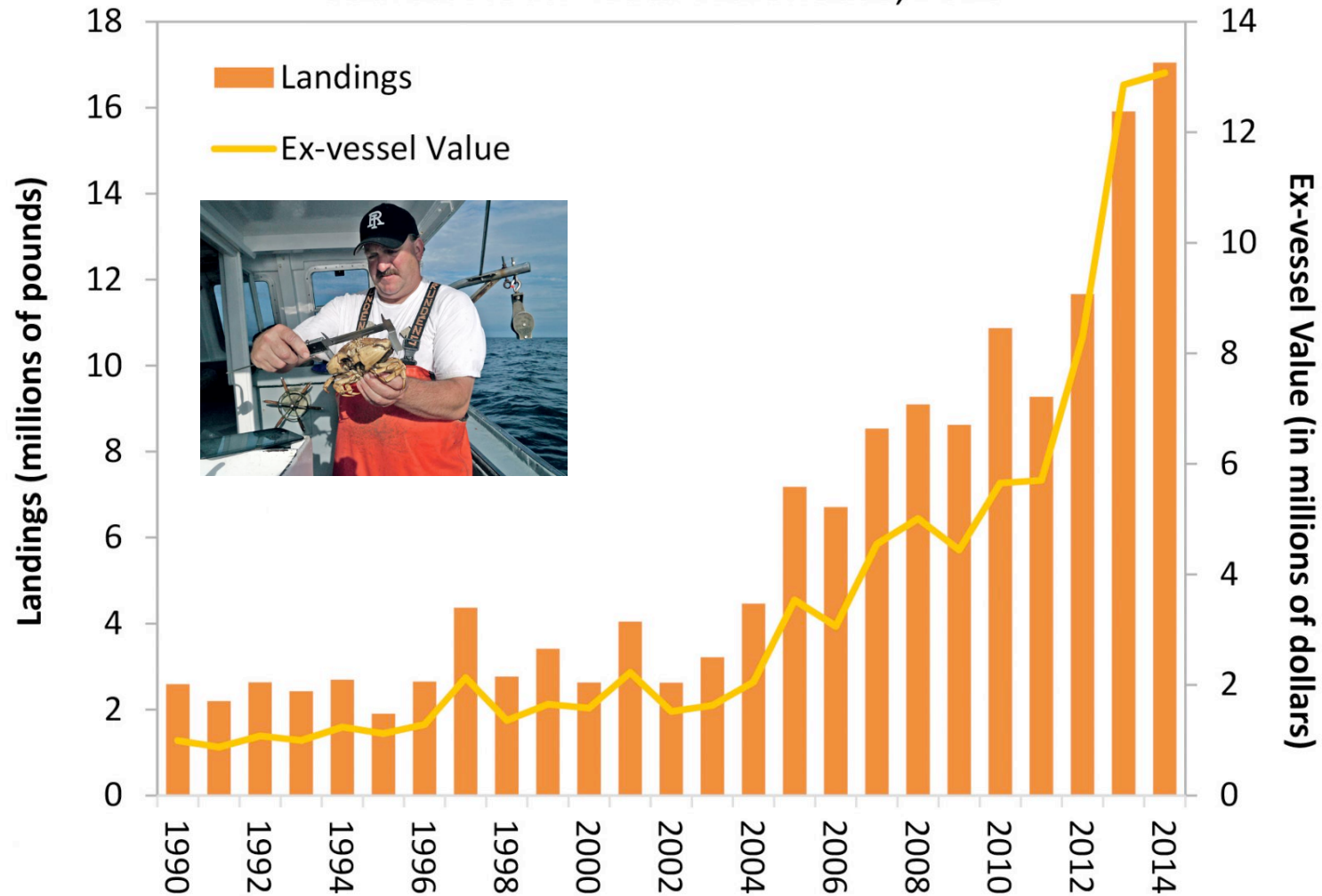
Josh Carloni, NH F&G



A rapidly expanding fishery!

Jonah Crab Landings and Ex-vessel Value

Source: ACCSP Data Warehouse, 2015



- More than 70% of Jonah crab is harvested in southern New England

Movement post-claw removal (Summer-Fall 2018)

(simulated declawing trials in the field)

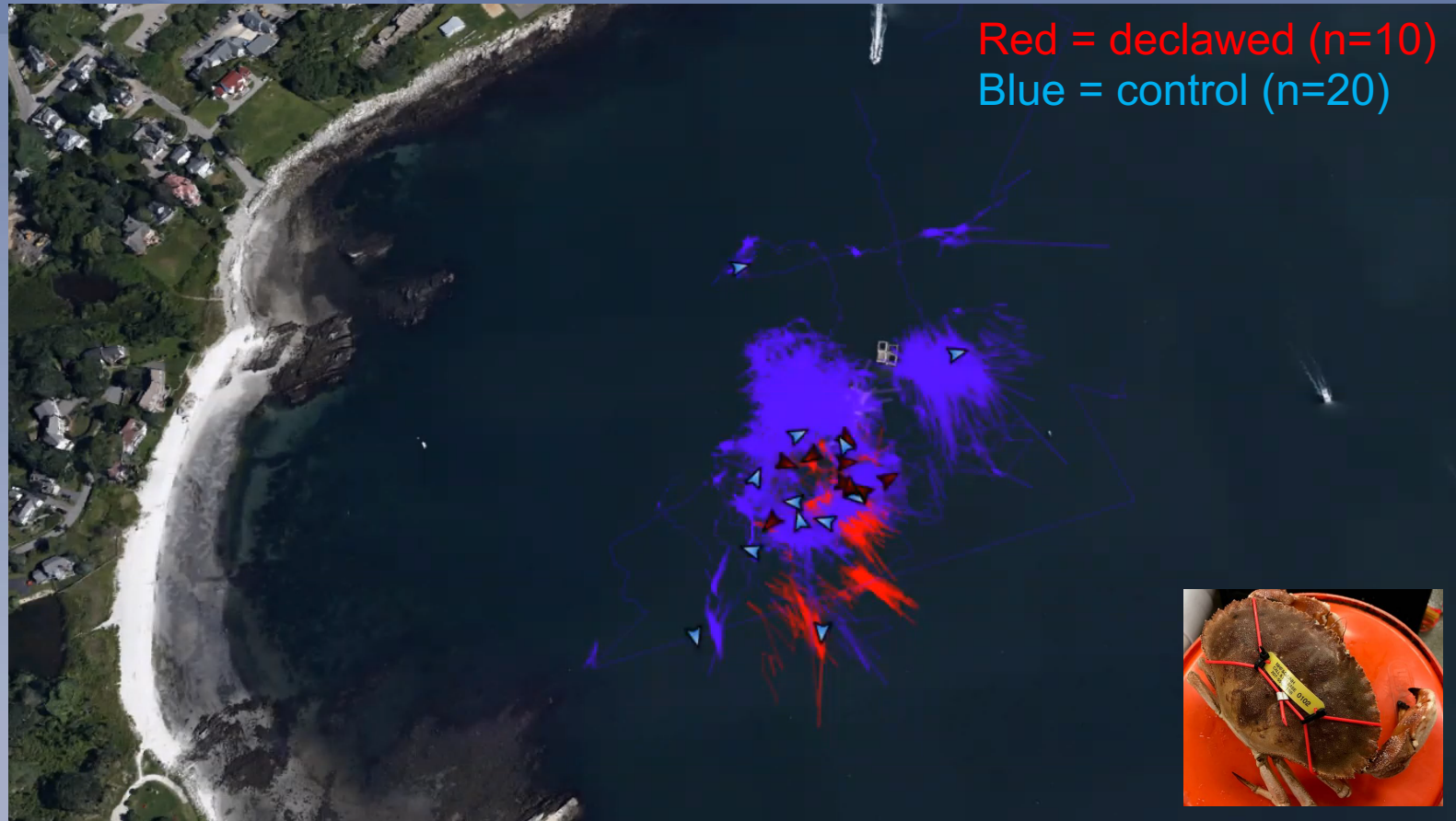


Mechanical claw removal

- 600 crabs tagged (~6 % recapture rate)
- Controls appeared to show longer movement events (still data crunching)
- Limitations with mark-recapture



Tracking movements using acoustic telemetry (simulated declawing – field trials)



- Total Time = October 20 - December 5
- Second study planned for Summer, 2019



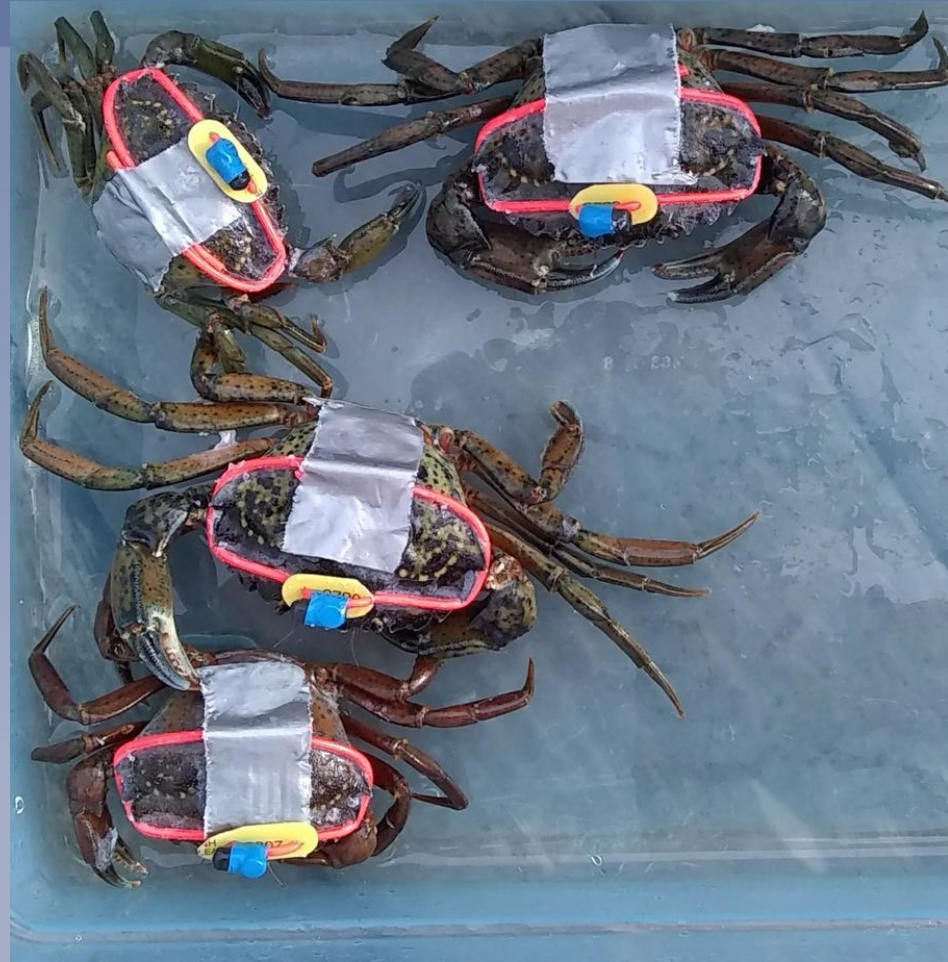
Green Crab Telemetry



Prof. Nathan Furey, Athena Ryan, UNH



Jessica Woodall, NOAA Hollings Scholar



Now THAT'S a crab graph!!

DAMARISCOTTA

YARMOUTH

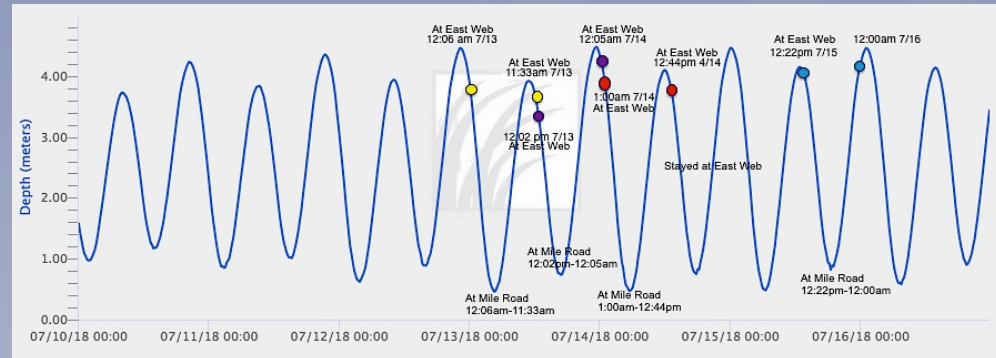
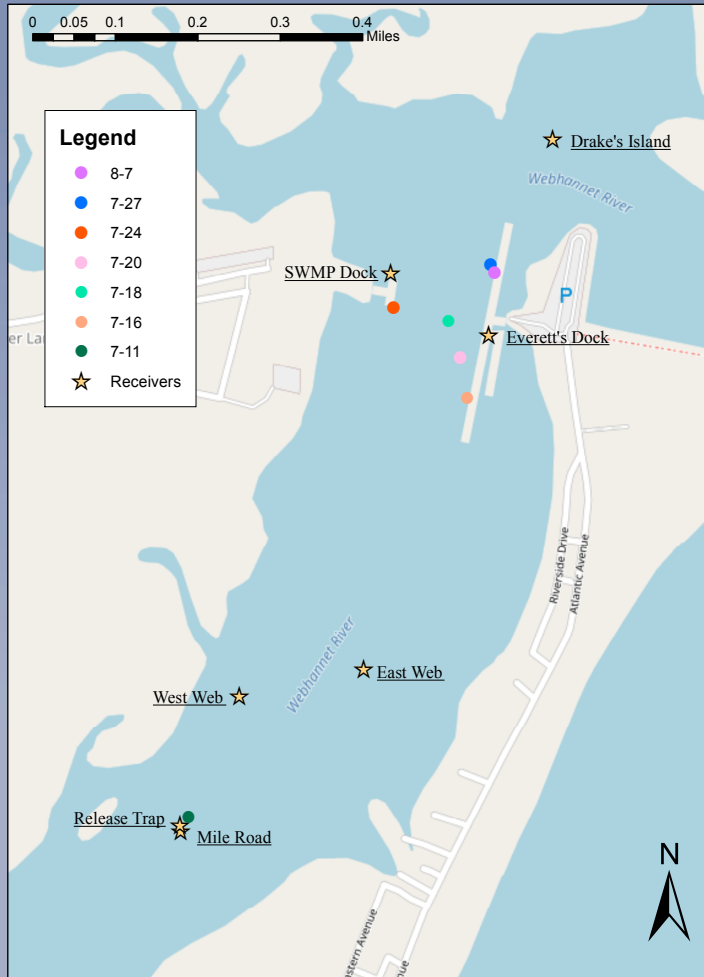
WELLS

Animal telemetry for invasive species (Green crabs)



Animal telemetry for invasive species (Green crabs)

Webhannet River, ME



The ability to use SWMP data to help inform animal telemetry



Some final thoughts

- The NERR System provides a good model for long-term sustained biological monitoring
- Sentinel sites and organisms are vital for measuring change
 - Marine animal telemetry is a fantastic and integrative tool
- Collaboration/integration/extension of observation methods especially to stakeholders are vital (and more efficient!)
- Thinking outside the box --- remote telemetry?



Questions?



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOAA

Extra Slides



national estuarine research reserve system

A collection of various marine organisms, including fish, squid, and invertebrates, displayed against a black background. The organisms are arranged in a grid-like fashion, showcasing a diverse range of marine life.





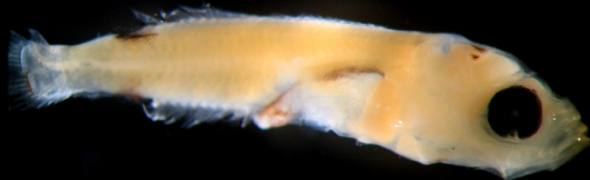
Atlantic Cod
Gadus morhua



Summer flounder
Paralichthys dentatus



Fourbeard Rockling
Enchelyopus cimbrius



Cunner
Tautoglabrus adspersus



Sand Lance and Rock Gunnel
Ammodytes americanus
Pholis gunnellus



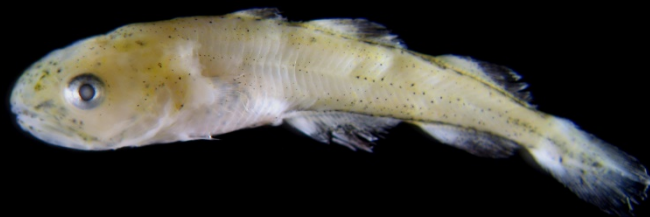
Winter flounder
Pseudopleuronectes americanus



Black Sea Bass
Centropristis striata

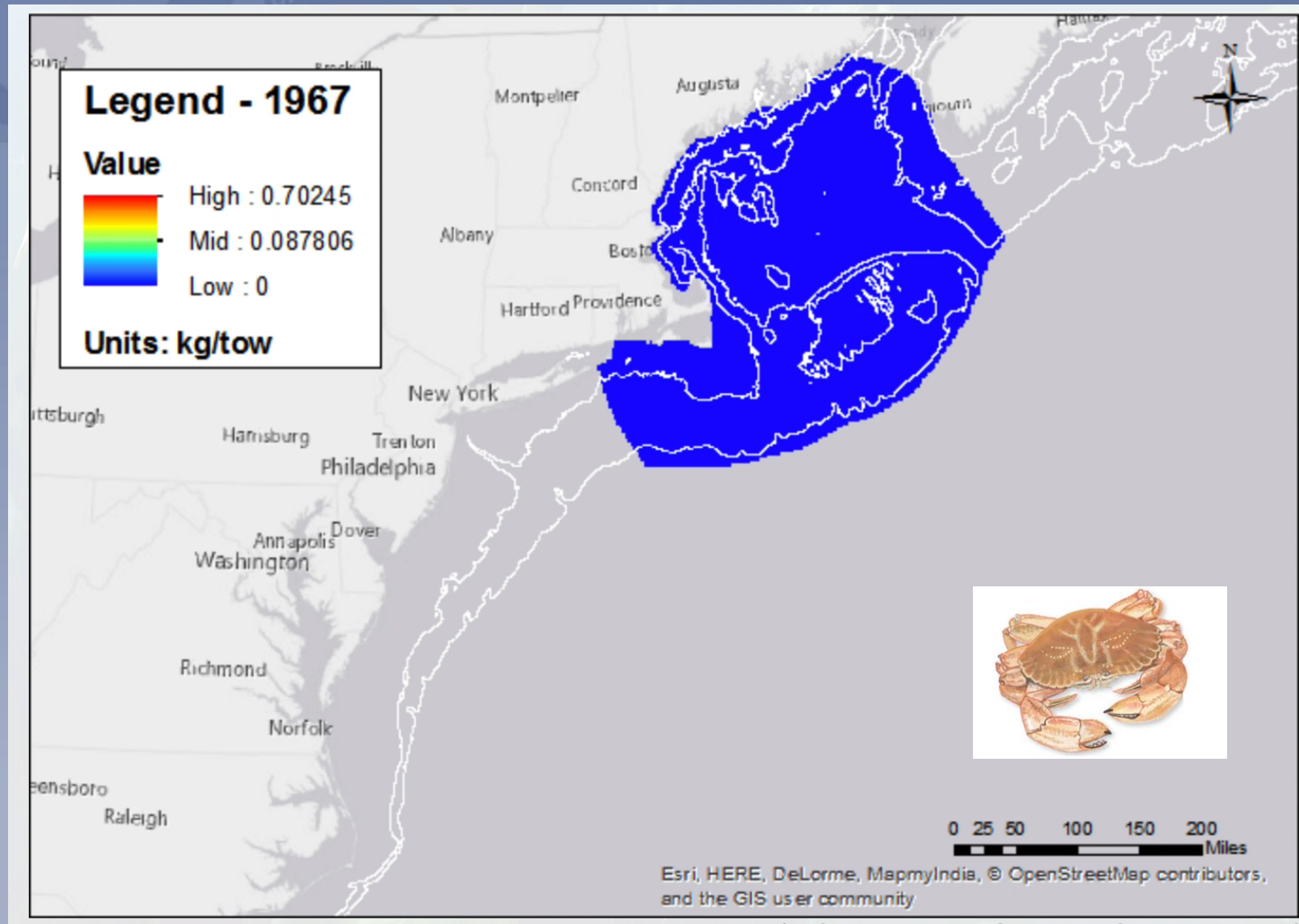


Red Hake
Urophycis chuss



Atlantic Tomcod
Microgadus tomcod

Jonah crab: An emerging fishery in the Gulf of Maine



(NOAA – NMFS Trawl Survey Data)

- ❖ The life cycle of Jonah crab is poorly described along with many aspects of their life-history (e.g., maturity, reproduction, seasonal movements)



MIMIC Summary

Since 2008

114 sites have been monitored

15 non-profits and individuals
have been involved from RI to
ME

Over 1000 (1181) monitoring
events at over 100 sites (114)

Currently

~50 sites monitored each year

9 groups participating

7 Groups participating since 2008/2009

North South River Watershed
Association

Great Marsh

Salem Sound Coastwatch

Wells National Estuarine
Research Reserve

Three Bays Preservation

National Park Service/New
England Aquarium

