

The Tale of Two Bays: A comparison of the American horseshoe crab population in Wellfleet Bay, MA and Great Bay Estuary, NH and lessons to be learned

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The incredible horseshoe crab

“Living fossils”



Mesolimulus spp.

Lomax and Racay, 2012



An Annual Spectacle

- Spawning season
 - Late Spring to early Summer
 - New England/ Mid-Atlantic States
 - May and June



Horseshoe crab spawning activity

- Female-male pairs
 - Satellite males
- High tide
- Sandy/ coarse sediment beaches
- Nests and eggs
 - At the high tide water line



<http://thelife-animal.blogspot.com/2012/10/horseshoe-crab.html>



Credit to Watson Lab

An important resource for the season

- To the estuarine ecosystem
 - Migratory birds
 - Red knot (IUCN Threatened)
 - Benthic organisms
 - Bioturbation
- To mankind
 - American eel and whelk fishery
 - Bait
 - Biomedical industry
 - Blue blood, *Limulus* amebocyte lysate



Red Knot
(*Calidris canutus*)



http://www.abcbirds.org/picts/abcprograms/policy/bait_bag.jpg



Credit: Mark Thiessen,
National Geographic Magazine Staff

What's been happening

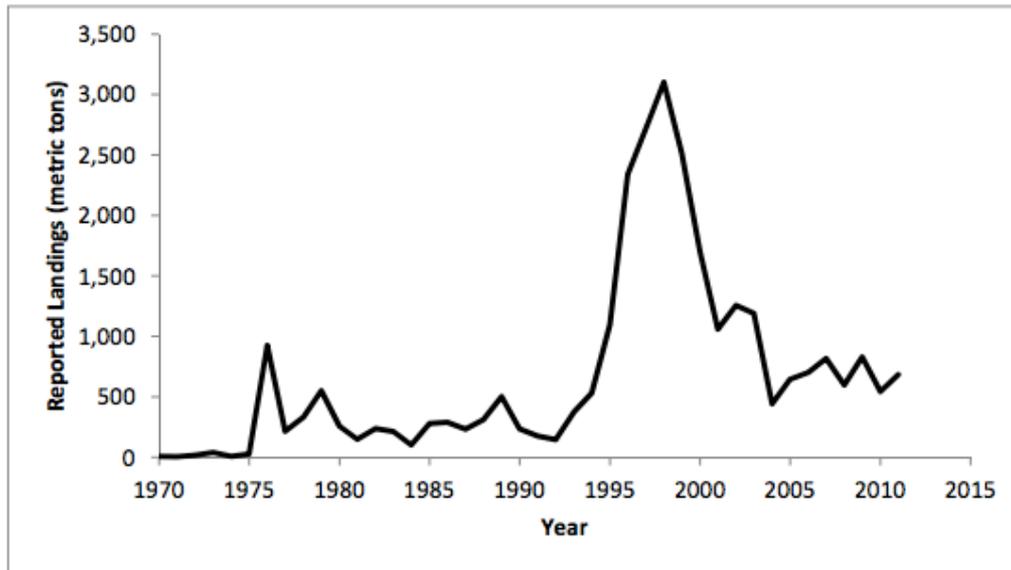


Figure 1. Reported Atlantic coast horseshoe crab landings (metric tons), 1970 – 2011 (NMFS Commercial Landings Database, August 2013).

- Atlantic States Marine Fisheries Commission (ASMFC)
 - 1998
 - Regulations state-by-state
- Monitoring Programs
 - Reports of landings
 - Bait
 - Biomedical
 - Egg counts
 - Spawning Surveys

Yet, ...

- “Declining abundance ... evident in the New York and New England regions... These declines were evident in the previous 2004 and 2009 stock assessments, and trends have not reversed.”
- “The status of horseshoe crabs in the New England region appears worse than what it was during the 2009 stock assessment...”
 - [2013 Horseshoe Crab Stock Assessment Update Aug 2013 \(ASMFC\)](#)
- “Estimates of relative abundance on the spawning beaches remain low.”
 - [Massachusetts Compliance Report to the ASMFC – Horseshoe crab 2012 \(MA Division of Marine Fisheries\)](#)

Surveying for Horseshoe Crabs

- Horseshoe crab spawning season
- First survey in Delaware in 1990
 - **New and full moon high tides**
 - Finn et al. 1990
- Many states have developed surveys based on Delaware
 - **Survey during new and full moon of horseshoe crab spawning season**



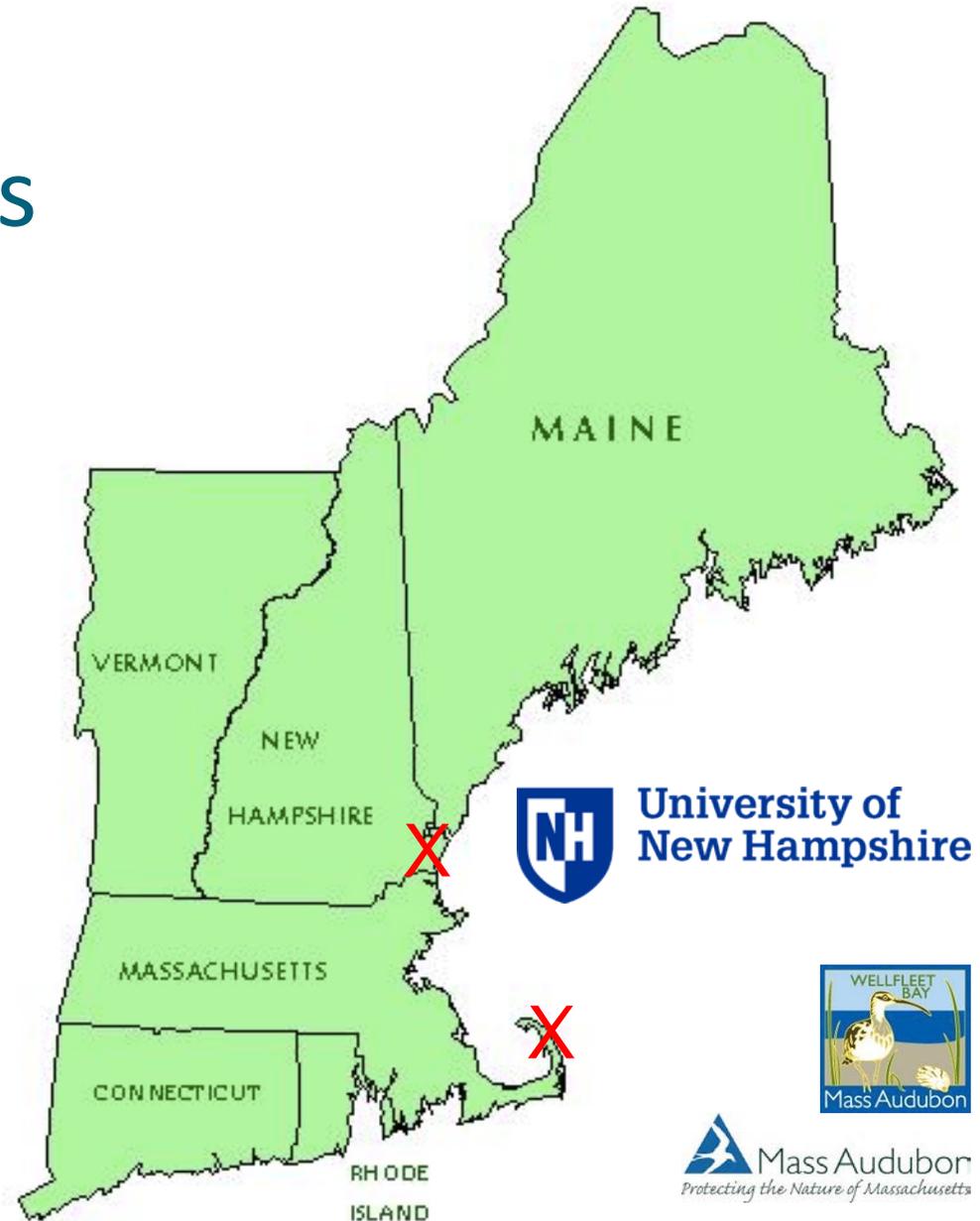
http://www.dnr.sc.gov/assets/flash_photos/horseshoe crab.jpg



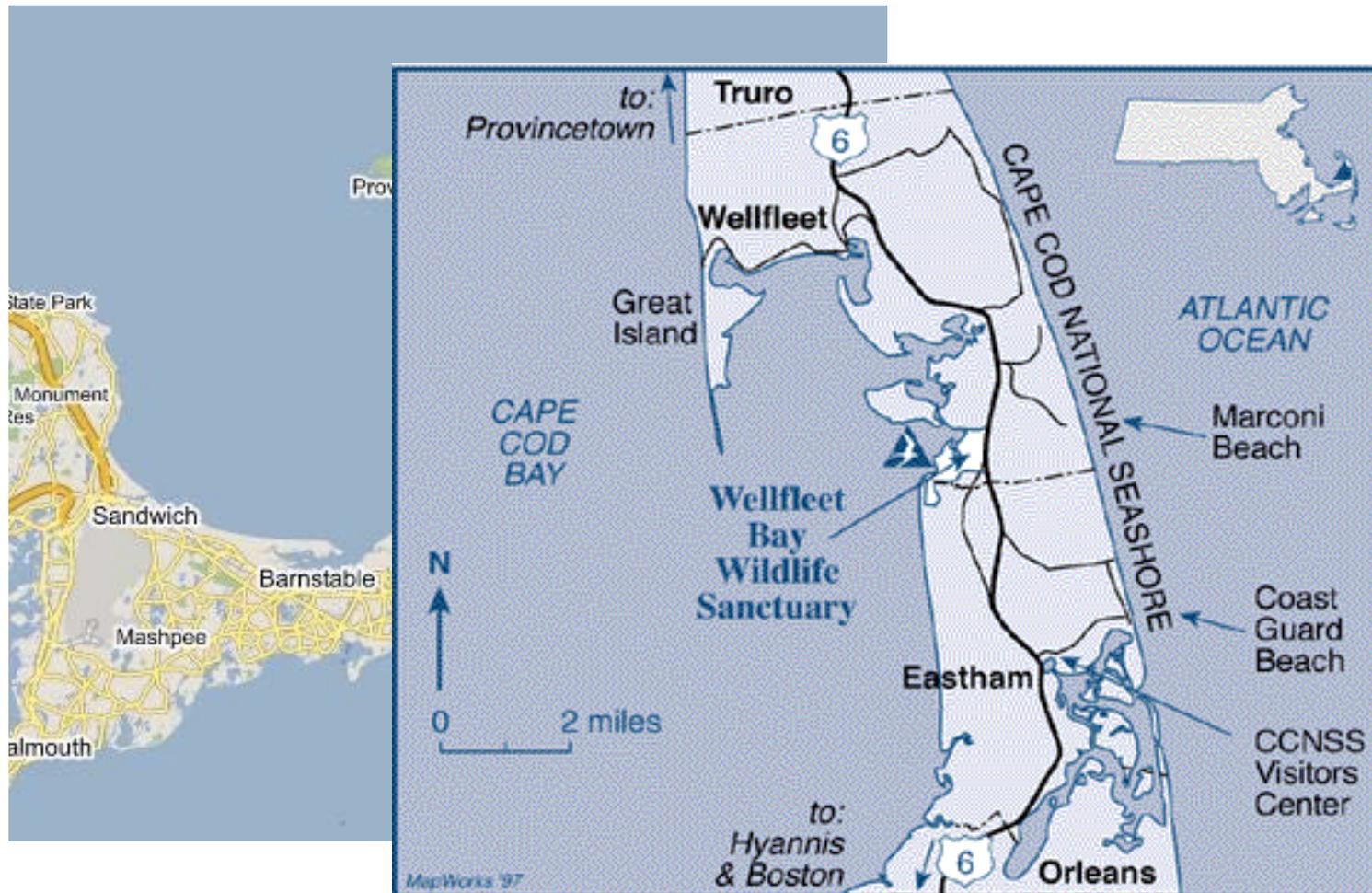
<http://oceancity.stateventuresllc.netdna-cdn.com/wp-content/uploads/2014/11/128-horseshoe-crabs1.jpg>

A story of two bays

- New England
 - Wellfleet Bay, MA
 - Great Bay Estuary, NH



Wellfleet Bay, MA



Wellfleet Bay, MA

Horseshoe crabs



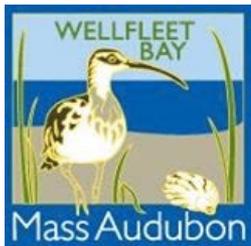
- Historically thought to be a nuisance for killing shellfish
 - Bounties to break off tail and be placed upside down at high tide line (Prescott, 2008)
- Currently, harvested for eel and conch
- Close harvest during new and full moons
 - Open harvest during non-moon periods (quarter moons)
 - Massachusetts Dept of Marine Fisheries, 2014
- Surveys conducted during new and full moons
 - Day and night high tides
 - Massachusetts Dept of Marine Fisheries, 2014

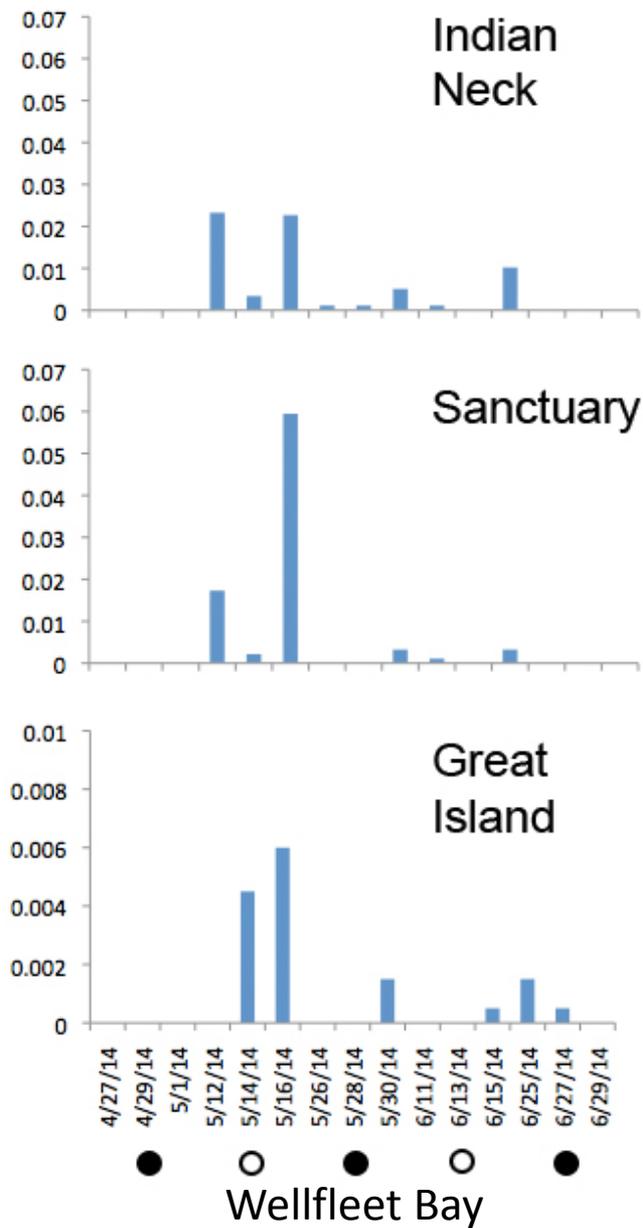
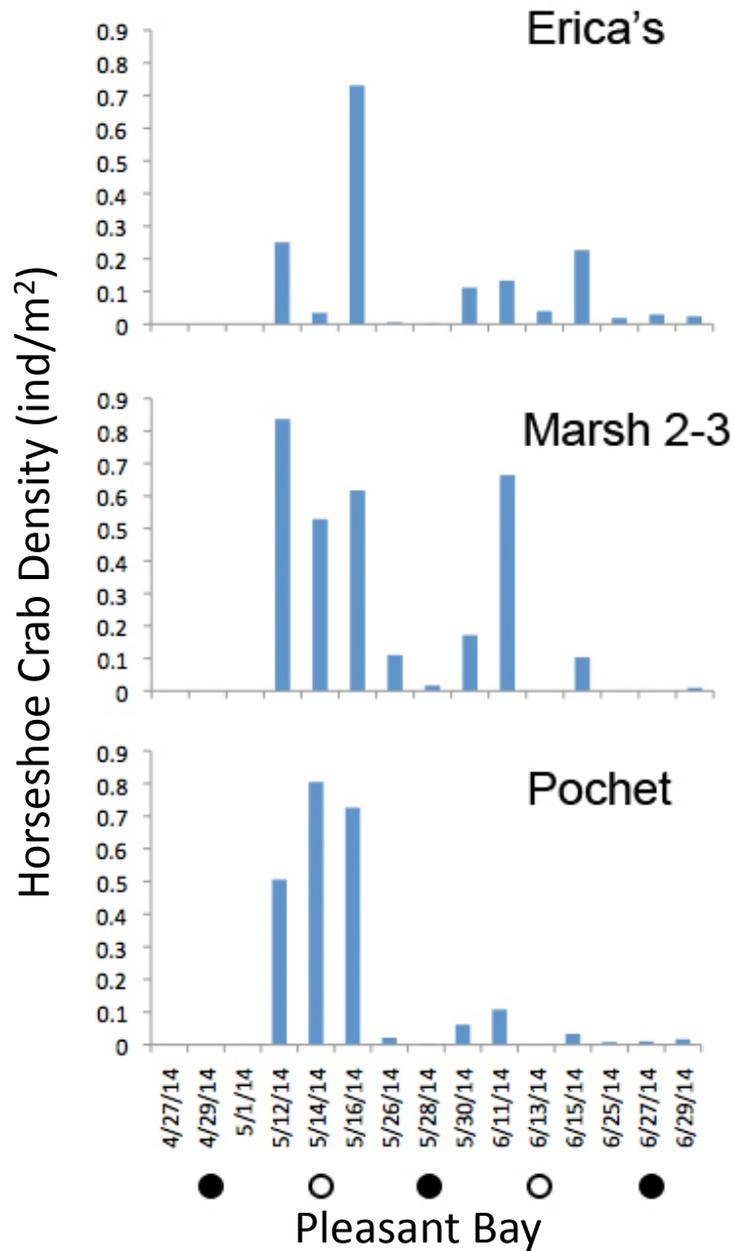


Mass Audubon Surveys

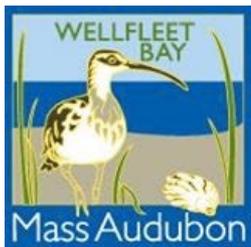
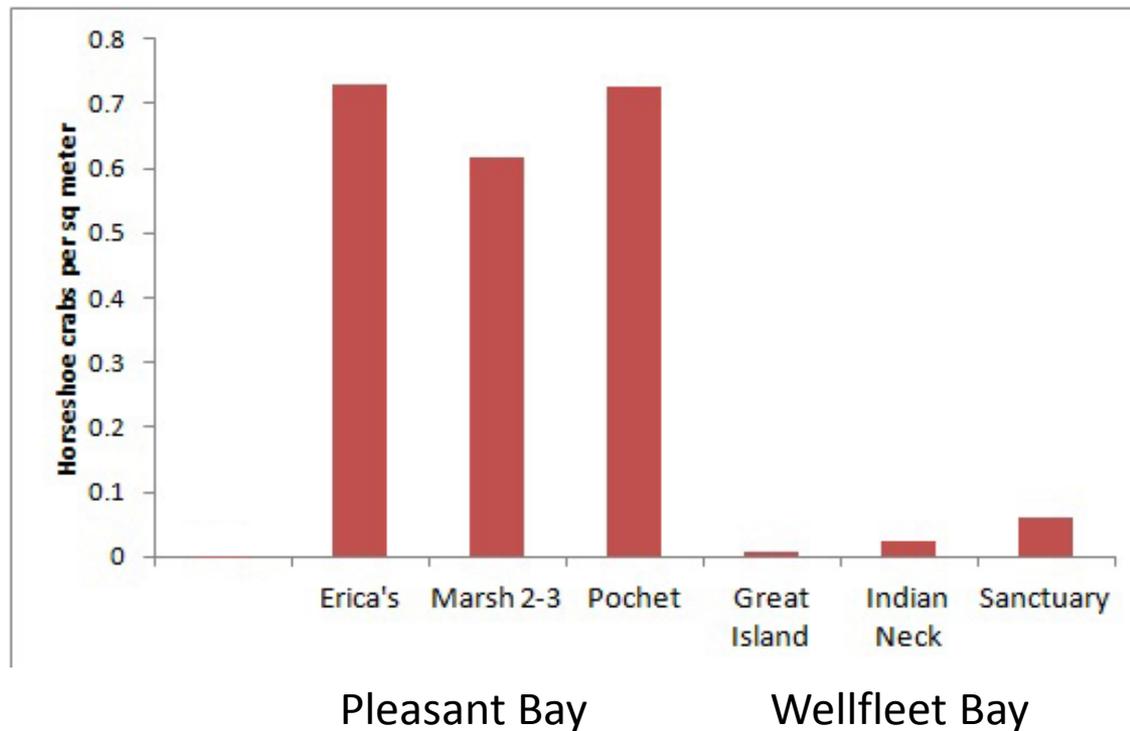
- Since 2000
 - Volunteers from the community
- Wellfleet Bay
 - Indian Neck, Wellfleet Sanctuary, Great Island
- Pleasant Bay
 - Erica's, Marsh 2-3, Pochet
 - Protected by Cape Cod National Sea Shore

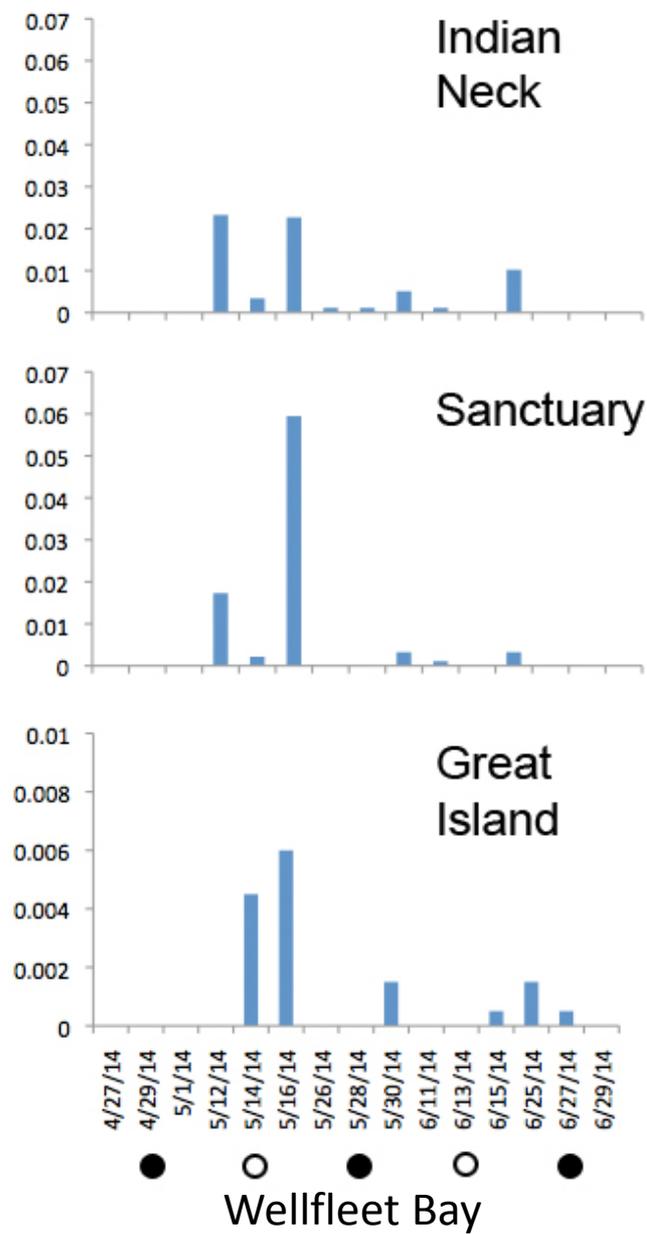
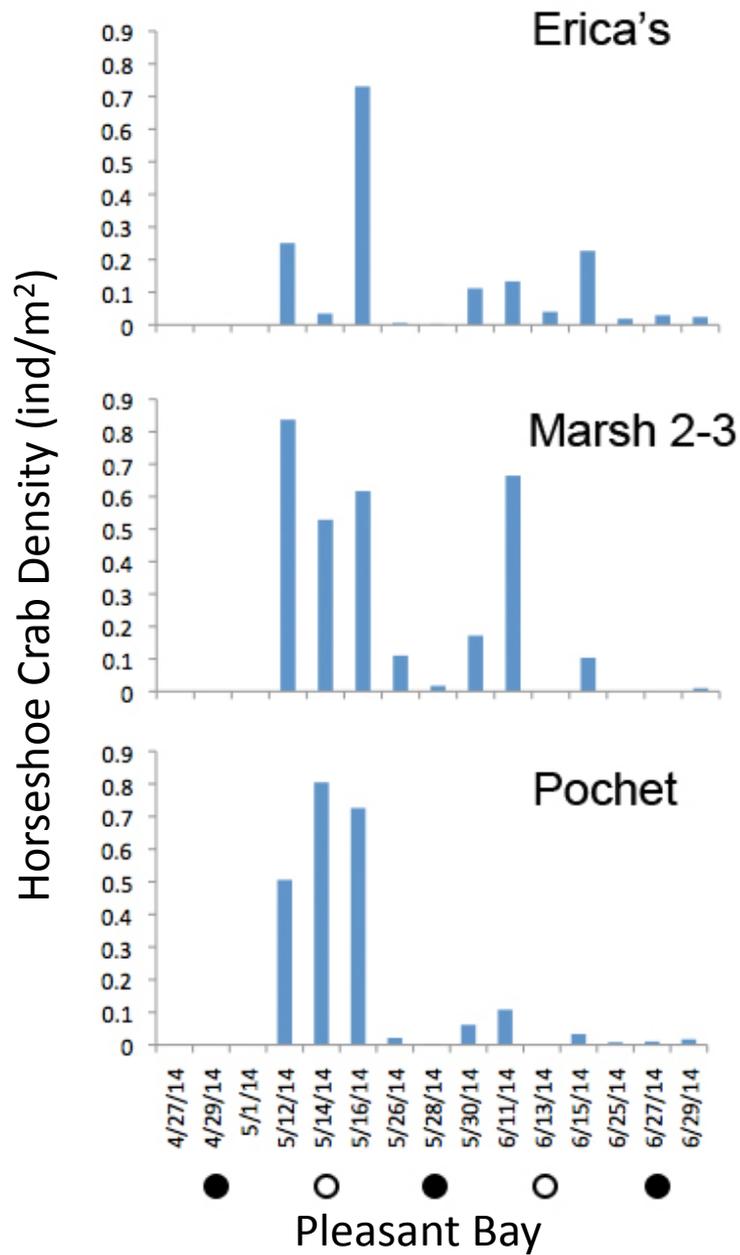
(But biomedical harvest is allowed)



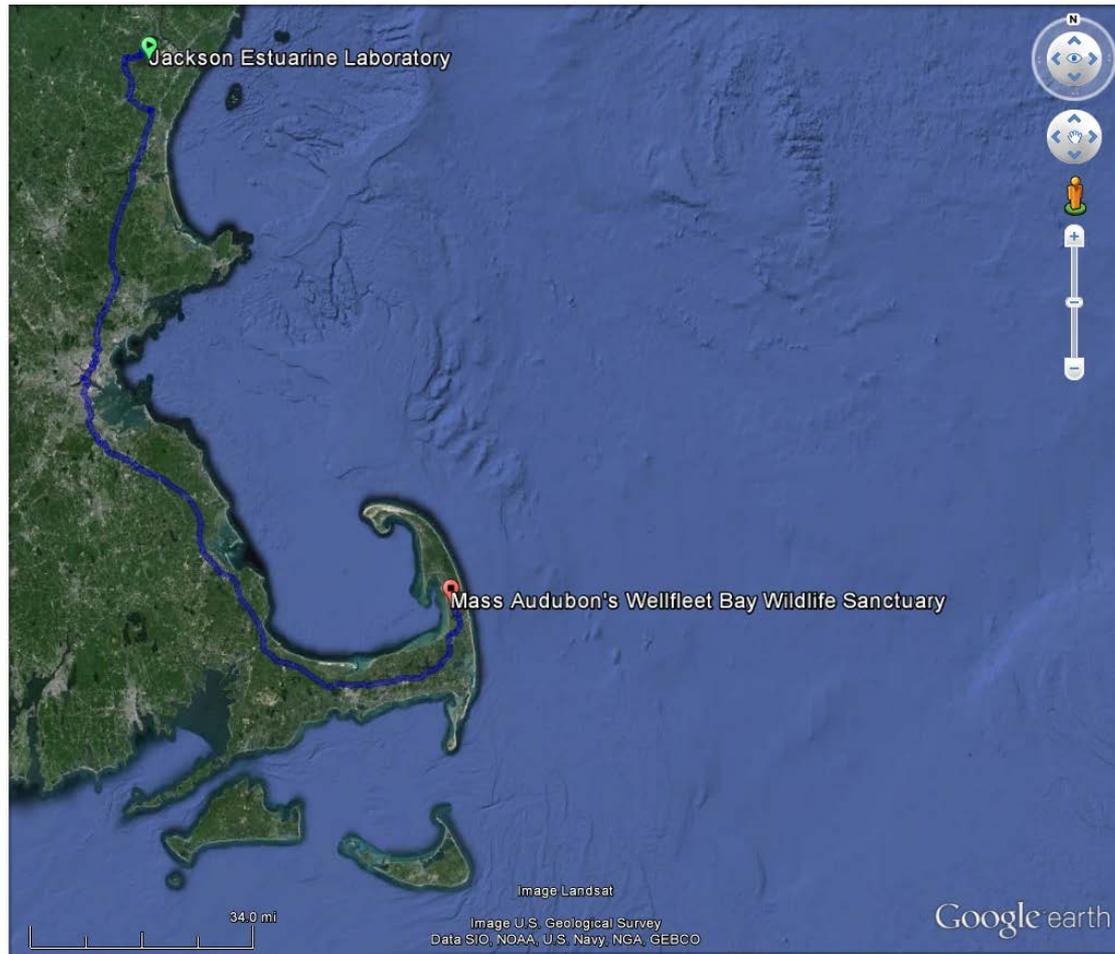


Mass Audubon Surveys on May 16, 2014





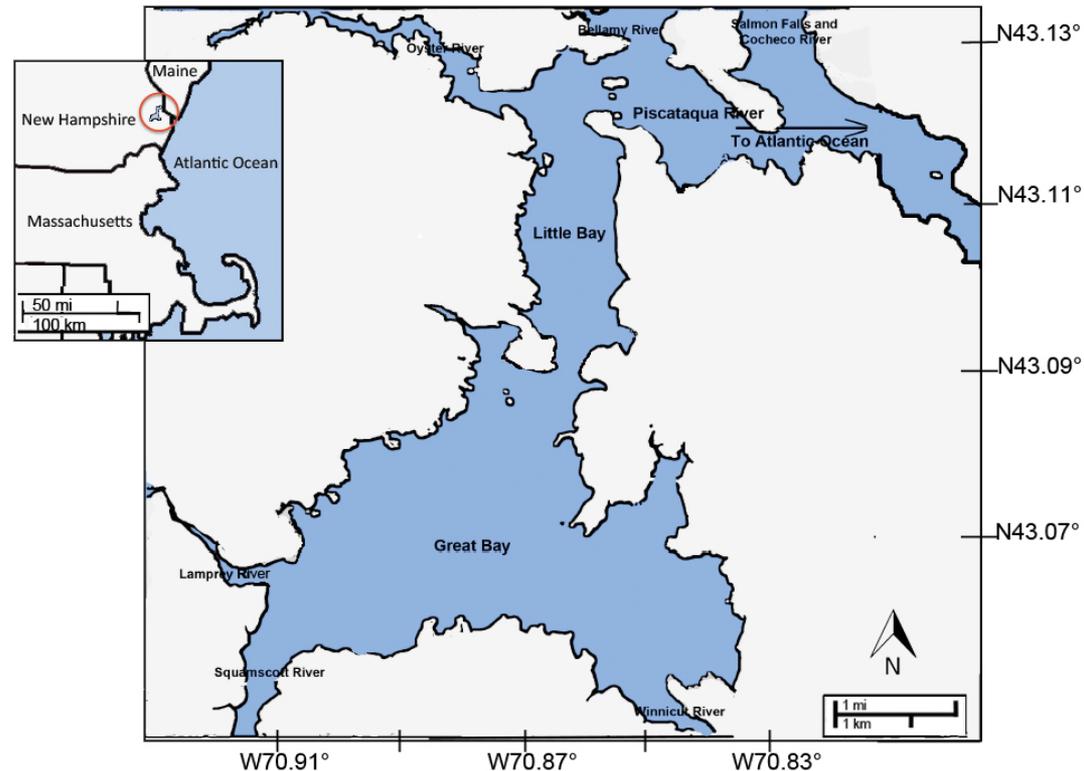
Drive ~150 miles north...



Great Bay Estuary, NH



- NH has ~18 mi of coastline
- 10,000 acres tidal flats, open water, wetlands
- National Estuarine Research Reserve
- Fishing allowed with appropriate permit



Great Bay Estuary, NH Horseshoe crabs



Jackson Estuarine Lab Durham, NH

- Minimal to no horseshoe crab harvest
- No organized monitoring program

pers. comm. Carloni from NH Fish and Game, 2013

Identify spawning activity in Great Bay Estuary

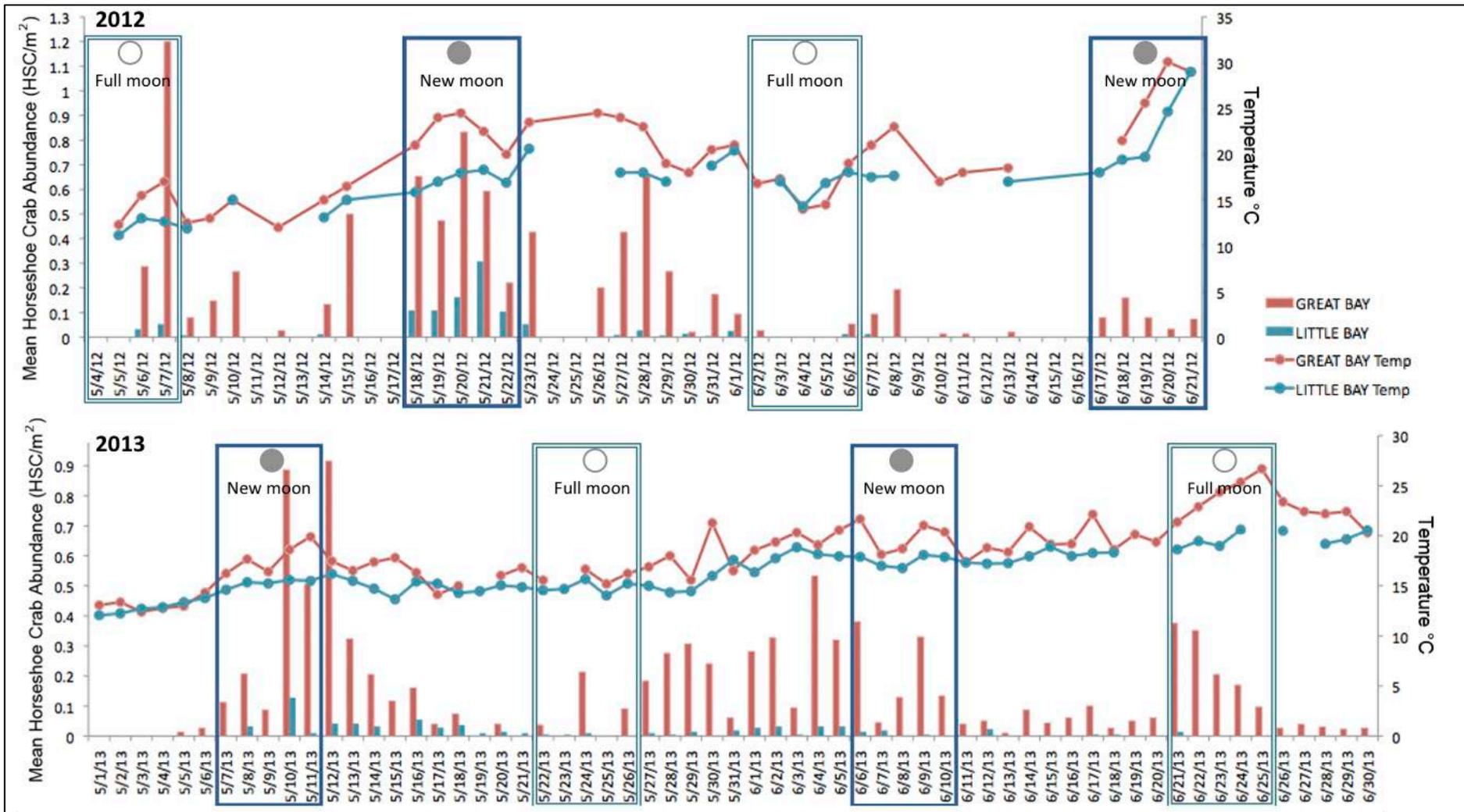
- When do horseshoe crabs spawn?
Where do horseshoe crabs spawn?
- Understand factors influencing spawning activity
 - Full and/or new moon?
 - Tide height?
 - Day or night?
 - Temperature?
 - Rain (salinity)?
 - Wave activity?

Great Bay Estuary Surveys

(aka Master's thesis research)

- Survey beaches
 - Little Bay (Great Bay Marina, Adam's Pt)
 - Great Bay (Moody Pt, Sandy Pt)
 - Volunteers from the community
- *Survey every day-time high tide from May to June
 - 2012 and 2013
- Note environmental conditions
 - Water temperature
 - Tide height
 - Wave height
 - Rainfall





(Cheng, 2014)

Findings

- No relationship to lunar cycle
 - No relationship to highest tides
- HOWEVER, strong environmental influences
 - Temperature
 - Wave activity
 - Rainfall



Credit to Mark Messina

Horseshoe crab use

Wellfleet Bay

- Harvested for bait and biomedical
- Demand
 - Bait (For whelk fisheries)
 - Biomedical (in Pleasant Bay; Associates of Cape Cod)
- Management and regulations
 - Organized state surveys
 - No harvest during the new and full moon
 - Harvest allowed outside of lunar periods
- Regulation of Catches (322 CMF 6.34); Mass DMF

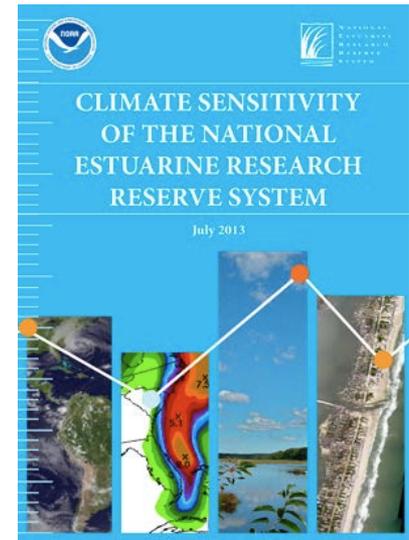
Great Bay Estuary

- Minimal to no harvest
- Not a high demand
- Management and regulations
 - No organized state surveys
 - Recreational harvest allowed/ no closed season
- New Hampshire Saltwater Fishing Digest 2015, NH Fish and Game

Why study horseshoe crabs at all?

Lessons learned

- Ecosystem services
 - Food
 - Bioturbation
- “Living fossil”
 - Have existed for millions of years
- Sentinel species to assess the health of estuaries
 - Currently,
 - Estuaries at first risk/ indicator to climate change
 - “The climate exposure of each [estuarine] reserve provides first alarm indicators about the effects of climate change on the coastal ecosystems.” NOAA Aug 2013

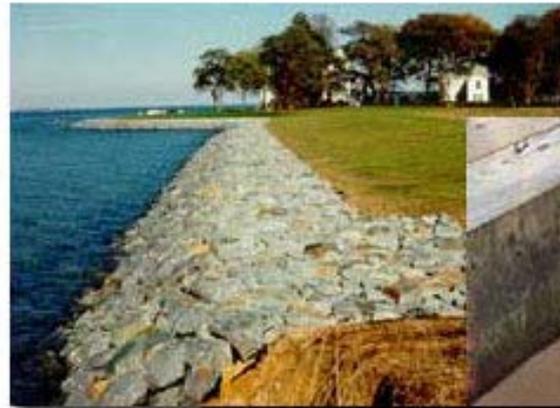


The past...



Delaware Public Archives 1928

Fate of horseshoe crabs



Shoreline rip rap



Unknown,

Concrete discharge pipe



Bulkheading reduces shoreline habitat



PBS



Climate Change

biodiversity.wordpress.com/2011/11/15/
polar-bears-and-climate-change/

Future implications and studies

- Horseshoe crab spawning activity
 - Risk: Are other states missing the mark?
 - Surveys conducted during lunar cycle
 - Ex: MA harvest closure during the lunar cycle (MA DMF, 2014)

Future implications and studies

- Horseshoe crab spawning activity
 - Risk: Are other states missing the mark?
 - Surveys conducted during lunar cycle
 - Ex: MA harvest closure during the lunar cycle (MA DMF, 2014)
 - Consider the way we monitor horseshoe crabs
 - Methods based on locations
 - Avoid generalization
- Learn and understand horseshoe crabs in local populations

Future implications and studies

- Overall,
 - Risk: Climate change
 - Effects on horseshoe crab life history
 - Eggs, development, spawning
 - Effects on other species who rely on horseshoe crabs
 - Red knot spring migration
 - At what point will climate change impact horseshoe crab populations?

Credit to Nancy Rabke



Credit to John Norton



Helen Cheng



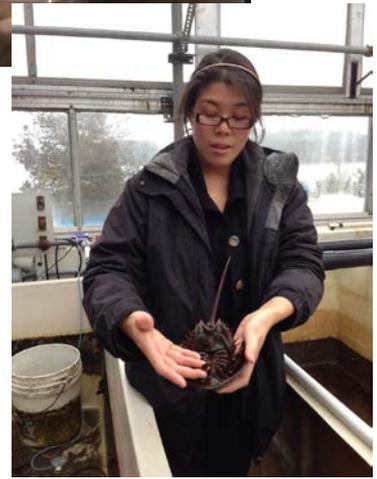
Credit to Joanna Burger



Credit to Amanda Sherman



Helen Cheng



Credits to Rebecca Zeiber, Gini Russell, Ronald Kielb, SeaCoast Science Center

Thank you!

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 - [Mark Faherty](#)
 - [Bob Prescott](#)
 - [Diane Silverstein](#)
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- And many more!



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Questions?



