What's next for blue crabs? Forecasting blue crab range expansion into the Gulf of Maine

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Bodega Bay, CA

Bodega Marine Lab

San Juan Islands, WA

State of Washington

Friday Harbor Labs



Great Barrier Reef, Australia

Lizard Island Research Station

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Panama

Smithsonian Tropical Research Institute

Florida

-A Mat

Florida State University Coastal & Marine Lab



Northeastern University Marine Science Center

Species Ranges



Climate Change and Range Expansion



Climate Change and Range Expansion



Blue Crabs (Callinectes sapidus)



"Beautiful savory swimmer"
Live in coastal estuaries
Omnivorous diet

(predators and scavengers)

Lifespan: 3-4 years
Adult size: 4-9 inches

Blue Crab Range Expansion?



Estuaries Provide Important Sevices

- protect shorelines from storms, floods, erosion
- filter water (remove pollutants and sediment)
- remove and recycle nutrients
- sequester carbon
- provide habitat for valuable species

Threatened by:

- Coastal development
- Pollutants and nutrients in run-off
- Invasive species
- Sea level rise & Climate change

Blue Crabs are Important Predators



Blue Crabs are a Major Fishery



8th largest commercial fishery in U.S. 5th largest in value (over \$200 million dollar industry)

Over 60,000 metric tons caught annually 75% from North Carolina, Virginia, Maryland, Louisiana

Important recreational fishery in New England

Source: NMFS 2010

Blue Crabs aren't alone...



Research Questions

- □ What limits the northern range of the blue crab?
- Will blue crabs expand their range northward as climate warms?
- How will salt marshes be affected by blue crabs and directly by temperature increases?
-] How do blue crabs interact with invasive green crabs?



Blue Crab Life Cycle



What limits the northern range?



Physiology (too cold)

What limits the northern range?



(too cold) Recruitment limitation (crabs can't get there) **Species** Π interactions (predator or competitor)

Physiology

Lack of habitat or food

What limits the northern range?



 Physiology (too cold)
 Recruitment limitation

(crabs can't get there)

Species
 interactions
 (predator or competitor)

Lack of habitat

Blue Crab Life Cycle



Adults and Late Larval Stages





Within-estuary water temperature



Early Larval Stages







Sea surface temperature

Early larval stages likely limited by cold temperatures in the summer

Nantucket Sound

Cape Cod Bay



Blue Crabs and Temperature



Crab Density Data from Mass DMF Flounder Surveys (1976-2014)

Blue crab densities generally increase with increasing temperature



How will marshes be affected?

1) Where are the crabs and what do the marshes look like?

Surveys to describe patterns in crabs, invertebrates, and plants north and south of Cape Cod (2014-2015)

 How will crab introduction and temperature increase (alone and together) affect marshes?

Lab and/or field experiment based on surveys, using existing environmental gradient (2016-2017)



2014 Summer Survey Sites

Wells Bay NERR

Plum Island Sound

Narragansett Bay

Waquoit Bay NERR

Great Meadows Marshes

143 km

© 2014 Google Image Landsat Data SIO, NOAA, U.S. Navy, NGA, GEBCO



Crab Trapping

5 meters back from creek bank

creek channel

creek bank

- Crab species
- Crab abundance
- Crab size
- Crab sex

Vegetation & Invertebrate Surveying



 Invertebrate abundances crab burrows mussels snails other crustaceans







2015 Summer **Survey Sites** Provincetown Duxbury Wellfleet Namskaket Marsh Nauset Inlet Sparrowhawk Landing Sandwich **Quivett Creek** Herring River Stage Harbor (Oyster Pond River) Centerville Waquoit Bay NERR Image U.S. Geological Survey Data SIO, NOAA, U.S. Navy, NGA, GEBCO 33 km Image Landsat © 2015 Google

















Who gets the food?









Who gets the food? Did a predation event occur?





Who gets the food? Did a predation event occur?



Why Crab Zonation?

Negative interactions between species, or different environmental preferences?



Does this partitioning of habitat allow for their coexistence?

Will have undergrad working on this summer

Implications

- Environmental and biotic (predatory) controls of disruptive, invasive green crabs
 - Possible biotic control by native predator?
- Whether blue crabs are coming to an estuary near (or just north of) you
- How crabs and climate change impact marsh ecosystem services



How you can help me:

Let me know if you see (or have ever seen) any blue crabs north of Cape Cod

> Alive, dead, or shells (molts)? When and where? How big?



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Northeastern University

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