Marine Invasions in a Rapidly Warming

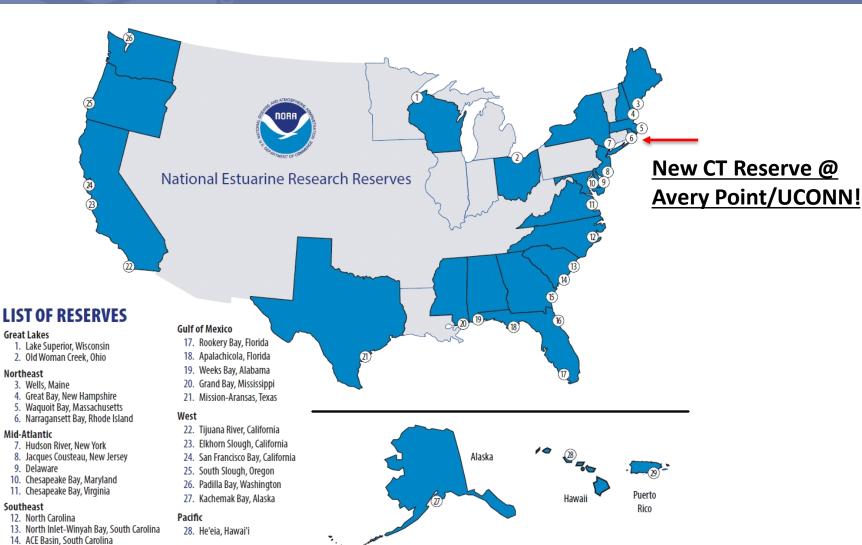
Gulf of Maine:

Using citizen scientists to track the spread of marine invasive species in Southern Maine.

Casco Bay Estuary Partnership Monitoring Committee Meeting May 11th, 2023



National Estuarine Research Reserve System (NERRS)



Caribbean

29. Jobos Bay, Puerto Rico

Sapelo Island, Georgia
 Guana Tolomato Matanzas, Florida



Mission: To understand, protect, and restore coastal ecosystems of the Gulf of Maine through integrated research, stewardship, environmental learning, and community partnerships.



System-Wide Monitoring Program (SWMP)





Abiotic Monitoring

- 15 min Water quality
- Monthly nutrients
- 15 min Meteorological
- Marsh elevation/SETs

Biological Monitoring

- Habitat change (veg transects/SAV)
- Biodiversity (fish/plants/crustacea)
 - Invasive species
 - · Crab
 - Larval fish
 - Veg transects

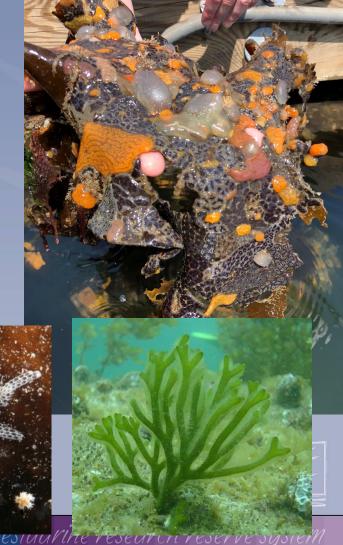
MISSION: Identify and track short-term variability and long-term changes in the integrity and biodiversity of estuarine ecosystems.

Marine Invasive Species "101"

- Species represent complex range of taxa and "life histories".
 - Less known about behavior outside of native range
 - Cryptogenic?
 - Identification can be difficult...







Marine Invasive Species "101"

- Estuaries and coasts are most heavily invaded.
 - Vectors shipping/aquaculture/etc.
 - Impacts from climate change "extreme effects" on estuaries.



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Review

An 'extreme' future for estuaries? Effects of extreme climatic events on estuarine water quality and ecology

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ARTICLE INFO

Keywords: Estuary Water quality Climate change ABSTRACT

Recent climate observations suggest that extreme climatic events (ECE; droughts, floods, tropical cyclones, heat waves) have increased in frequency and/or intensity in certain world regions, consistent with climate model projections that account for man's influence on the global climate system. A synthesis of existing literature is presented and shows that ECE affect estuarine water quality by altering: (1) the



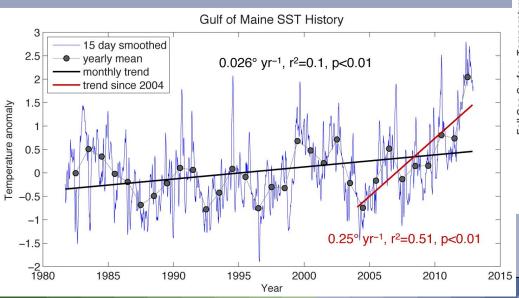
tuanionan <mark>estuarine research reserve system</mark>

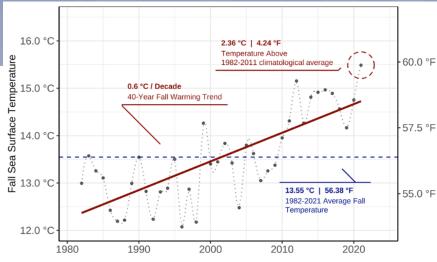
A Rapidly Warming Gulf



- Gulf of Maine one of fastest warming bodies of water on the Planet
 - 2012 GOM temp "anomaly"
 - Fall 2021- 2nd warmest on record in Gulf of Maine.

46 F (7.8C) in Mid Jan 2022...





(Kemberling, Pershing - GMRI)





What is MIMIC?



"The Marine Invader Monitoring and Information Collaborative"

- Network of trained volunteers, scientists and state/university staff
- Monitor for marine invasive species along the
 New England coastline (2008-present)
- Docks, Tidepools, and Cobble Shore







Goals of the MIMIC Program

- Early Detection: Find non-native species before they spread and/or become established in the ecosystem
- Education: Educate about marine invasive species and how to reduce their spread
- **Data:** provide data to scientist and mangers dealing with invasive species issues.







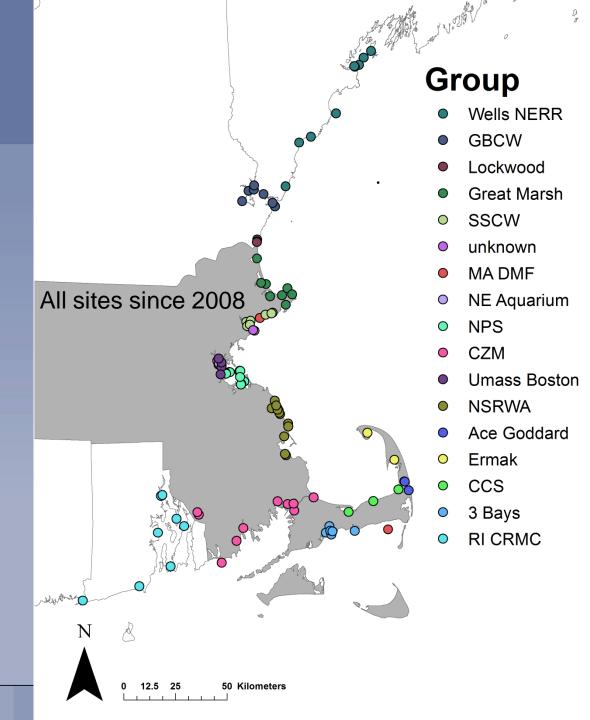


MIMIC Sites:

Since 2008

- 130 sites have been monitored
- 17 non-profits/state/university partners
- Over 2,500 monitoring events





Chebeague Stone Pier Casco Bay MIMIC Sites 2022 12 sites ~ 30+ volunteers Chebeague Island Chandler's Wharf June-Oct 2022: 30+ community members/volunteers 2 island primary schools (Chebeague and Long) 75 monitoring events Portland • Peaks Island Dock Spring Point Marina Peak's tidepool Segal's Reef SMCC Dock Google Earth South Portland



Collaborations and Citizen Scientist at Work! (MIMIC)



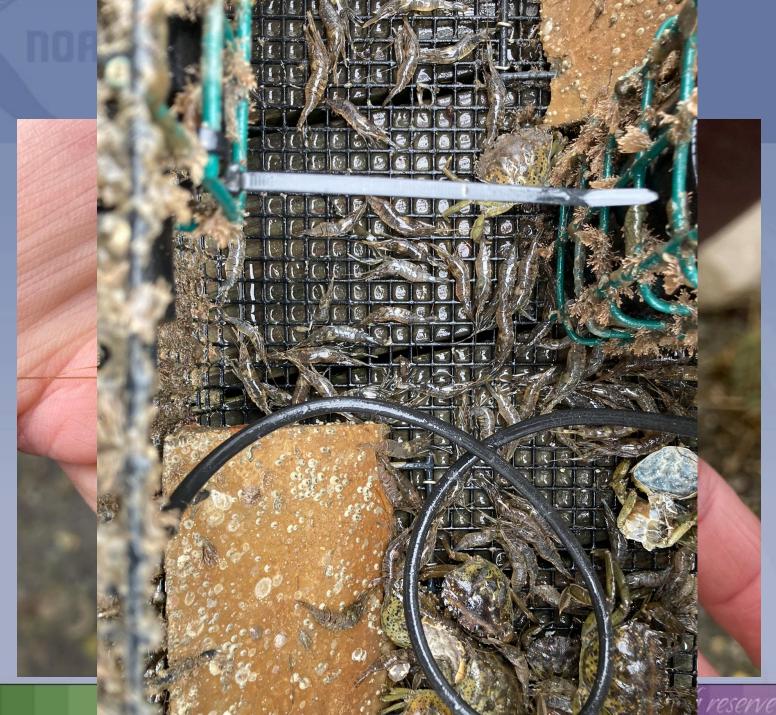


What are we seeing?.... Impacts to Kelp in Casco Bay











reserve system

Diplosoma (fouling tunicate)



New Species of Tunicate?!..

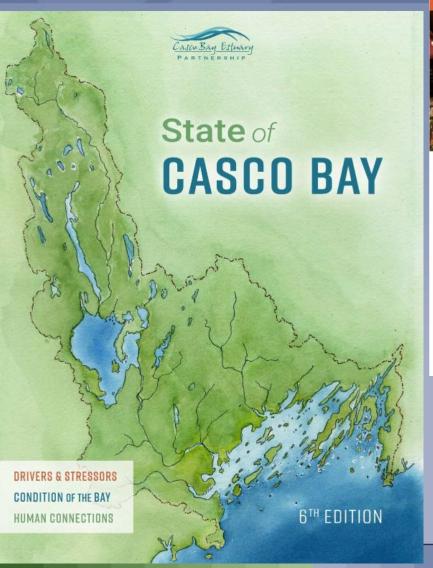


"Styella plicata"

Found at SMCC dock in Oct. 2021 and was still present in Dec!....Overwinter?



Data informing our partners!





WHY IT MATTERS

Invasive species are animals, algae, and other organisms that are not native to a region but arrive there through human activity and become self-sustaining. They may harm ecosystem processes, the economy, and public health.

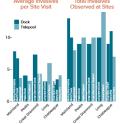
The highly invasive European green crab, Carcinus maenas, was first observed in Casco Bay in 1905. It has become

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and '

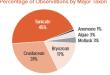
Green crahs were found mostly in tidepools, where they are the most frequently observed non-native species. Docks and piers were dominated by tunicates and bryozoans. Data based on observations

from 2016 to 2020 at all Casco Bay sites

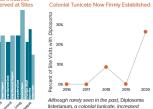


ost every site visit identifled at least one invasive species. From 2016 through 2020, typically two to eight invasive species were observed on

Percentage of Observations by Major Taxon



Of the 23 invasive species targeted by the MIMIC program, tunicates, which here includes six different species, are the most frequently observed invasives. This graph is based on 1,500 observations from 2016 to 2020.



listerianum, a colonial tunicate, increased dramatically in 2020. Before 2016, Diplosoma had only been observed once, in 2014. It was observed three times in 2018 and then eleven times in 2020. Observed in rocky intertidal communities since 2010 (MA CZM 2013), it now

STATUS & TRENDS

The Marine Invader Monitoring and Information Collaborative (MIMIC) in Casco Bay is a partnership between CBEP and the Wells National Estuarine Research Reserve (Wells NERR). Wells NERR trains community scientists to identify 23 species of invasives,

including tunicates,

RAPID ASSESSMENT SURVEY (RA The Gulf of Maine Rapid Assessment Survey (RAS) is a regional survey of invasive species conducted every three to five years and led by the

Massachusetts Office of Coastal Zone Management and MIT Sea Grant College Program. Since 2000, scientists have sampled dozens of sites from Maine to New York in July or August, Taxonomic experts identify native and non-native macroalgae and invertebrates on floating docks and related structures, such as pilings, ropes, and boat fenders.

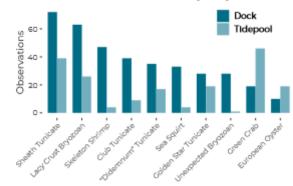
From Massachusetts to Maine, the teams found that the percentage of invasive species has remained relatively stable. observed in both 2013 and 2018 known to be invasive.

Several species, however have expanded their range. For example, the colonial tunicate Didemnum vexillum and the bryozoan Tricellaria inopinata were observed more frequently in Maine, and the ranges for the algae Colpomenia peregrina (moving southward) and Grateloupia turuturu (moving northward) expanded. Dasysiphonia japonica, a red alga, was observed for the first time in 2018 at both sites surveyed in Casco Bay-Port Harbor Marine (Portland) and Brewer South Freeport Marine (South





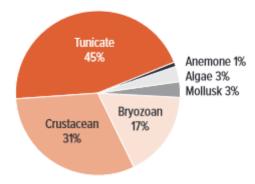
Number of Observations by Major Taxon



Green crabs were found mostly in tidepools, where they are the most frequently observed non-native species. Docks and piers were dominated by tunicates and bryozoans. Data based on observations from 2016 to 2020 at all Casco Bay sites.

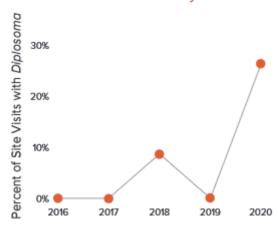
Almost every site visit identified at least one invasive species. From 2016 through 2020, typically two to eight invasive species were observed on

Percentage of Observations by Major Taxon



Of the 23 invasive species targeted by the MIMIC program, tunicates, which here includes six different species, are the most frequently observed invasives. This graph is based on 1,500 observations from 2016 to 2020.

Colonial Tunicate Now Firmly Established



Although rarely seen in the past, Diplosoma listerianum, a colonial tunicate, increased dramatically in 2020. Before 2016, Diplosoma had only been observed once, in 2014. It was observed three times in 2018 and then eleven times in 2020. Observed in rocky intertidal communities since 2010 (MA CZM 2013), it now

RAPID ASSESSMENT SURVEY (RAS)

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From Massachusetts to Maine, the teams found that the percentage of invasive species has remained relatively stable, with less than a quarter of all species observed in both 2013 and 2018 known to be invasive.

Several species, however, have expanded their range. For example, the colonial tunicate *Didemnum vexillum* and the bryozoan *Tricellaria inopinata* were observed more frequently in Maine, and the ranges for the algae *Colpomenia* peregrina (moving southward) and *Grateloupia turuturu* (moving northward) expanded. *Dasysiphonia japonica*, a red alga, was observed for the first time in 2018 at both sites surveyed in Casco Bay—Port Harbor Marine (Portland) and

2023 Rapid Assessment Survey!!



- Weeklong "Bio-Blitz" for marine invasive species
- Funded by NEANS/CBEP/In-kind Support
- Taxonomic experts from around the world
- Aug 6th-12th, 2023
- So. MA to Mid Coast ME
 - Wells, Portland, Freeport, Boothbay, 2 Downeast sites



One Crab, Two Crab, Green Crab.... BLUE CRAB?!?



Does Range Expansion = Invasive Species?

Climate change/warming waters, impacts to native species, etc.

Blue Crabs (*Callinectes sapidus*) caught in the Webhannet River Marsh, Wells, ME. Summer 2020.



Wells, ME











ng

Checked Weekly (thanks, interns & volunteers!)

- Count crabs
- Measure crabs
- Environmental data



DOAR



Lucrative fishery in Chesapeake
Bay & Gulf of Mexico



 $Caught\ commercially\ \&\ recreationally$

Blue crab

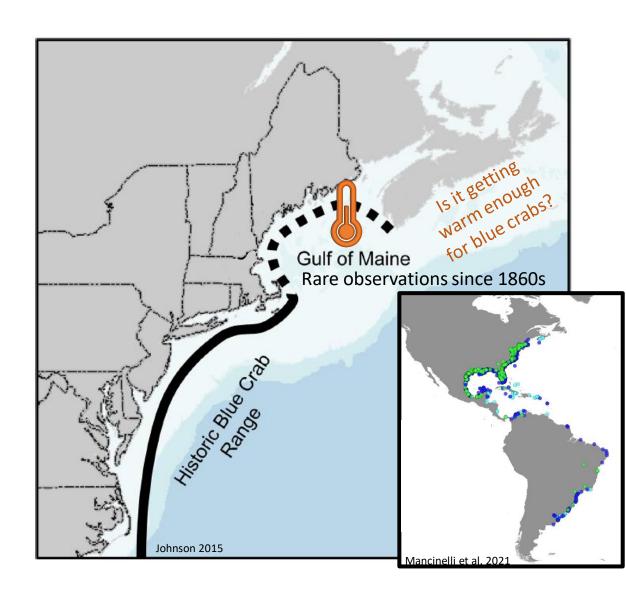
Callinectes sapidus

Beautiful Swimmer + Savory!



Blue Crab Range Expansion





The Backstory





2019 1 dead crab



2020 Live crabs in marsh!



Larvae found in historical samples!

2020

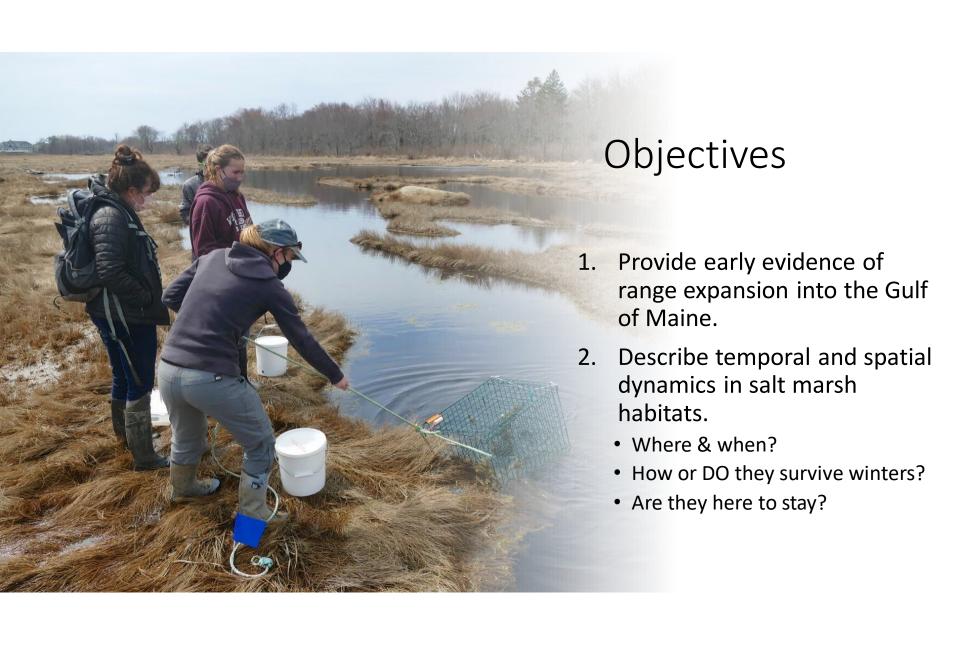


2020-present Start Trapping!



"Y-shaped" chromataphores on ventral surface near insertion of chelae

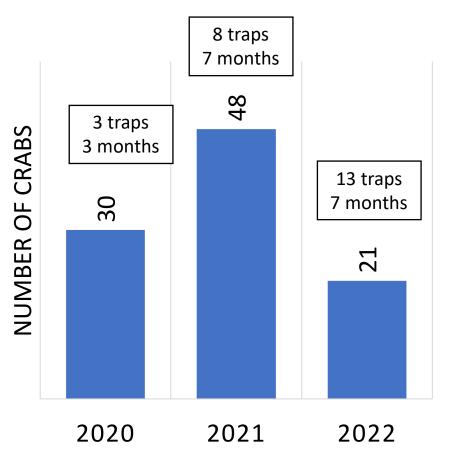
Posterior carapace spines-fairly exclusive to Callinectes





*Lot of variation from year to year

Wells, ME Trapping







2022 Casco Bay Community Grant

Funding: Casco Bay Estuary Partnership

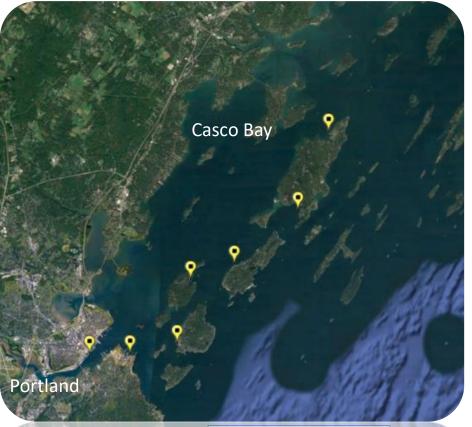
<u>Personnel:</u> Dr. Erin Grey & Brandon Harvey (Umaine), Dr. Jason Goldstein, Jeremy Miller, Laura Crane (Wells NERR)

- Leveraging existing MIMIC sites/
 Volunteers to monitor for blue crabs
- 2. Adult trapping, Larval Collectors, and eDNA samples
- 3. Working up eDNA and larval samples in the lab, report forthcoming...





Casco Bay Monitoring





Larval Collectors (larvae)





Trapping (adults)

Casco Bay Trapping results: O crabs.. BUT!



Thank you!!



