

**I have an invasive
species joke. It hasn't
arrived yet, so watch
out for it.**



Marine Invasive Species: A Watch List for the Gulf of Maine

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Boston Harbor

Project stemmed from USGS NRPP collaboration with Boston Harbor Islands National Park

- Michelle Staudinger
- Marc Albert
- Lucy Lockwood

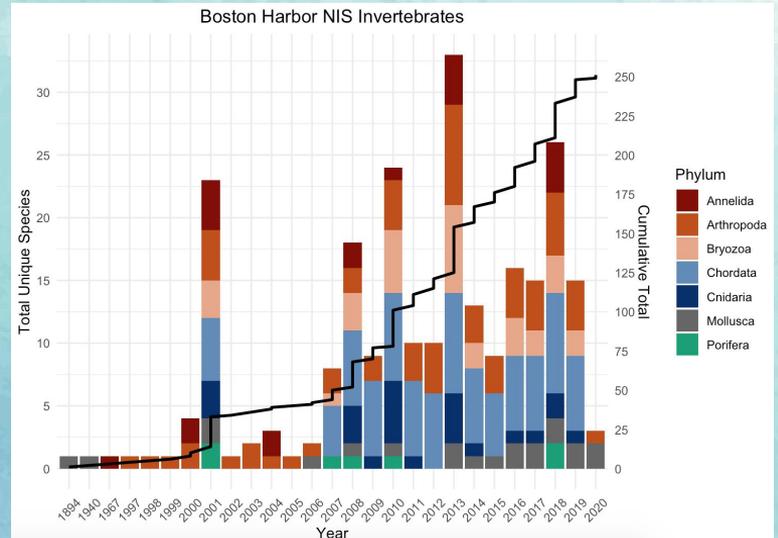
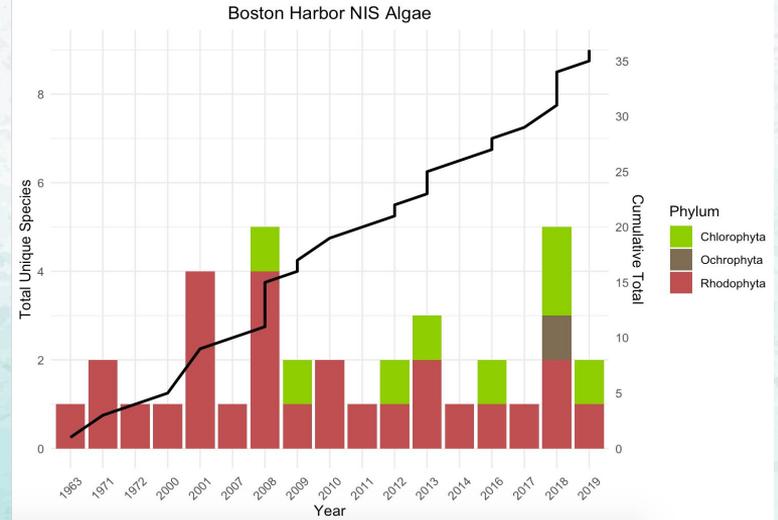
Document historic and current biodiversity

- Data synthesis - state and federal data, scientific publications of park surveys, and public biodiversity databases (GBIF/OBIS)
- Updated field surveys



Boston Harbor

- Project stemmed from USGS NRPP collaboration with Boston Harbor Islands National Park
- Document historic and current biodiversity
 - Data synthesis
 - Updated field surveys
- Data:
 - Fed/State records (NPS, MA CZM, MA DMF)
 - Scientific studies, surveys, and publications
 - Research grade database observations (GBIF)
- **Total NIS species: 54**
 - **46 invertebrates, 8 Algae**



Boston Harbor

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- Dominate groups: Red algae, crustaceans (crabs, shrimp), tunicates



Boston Harbor



Project Overview

Watch List

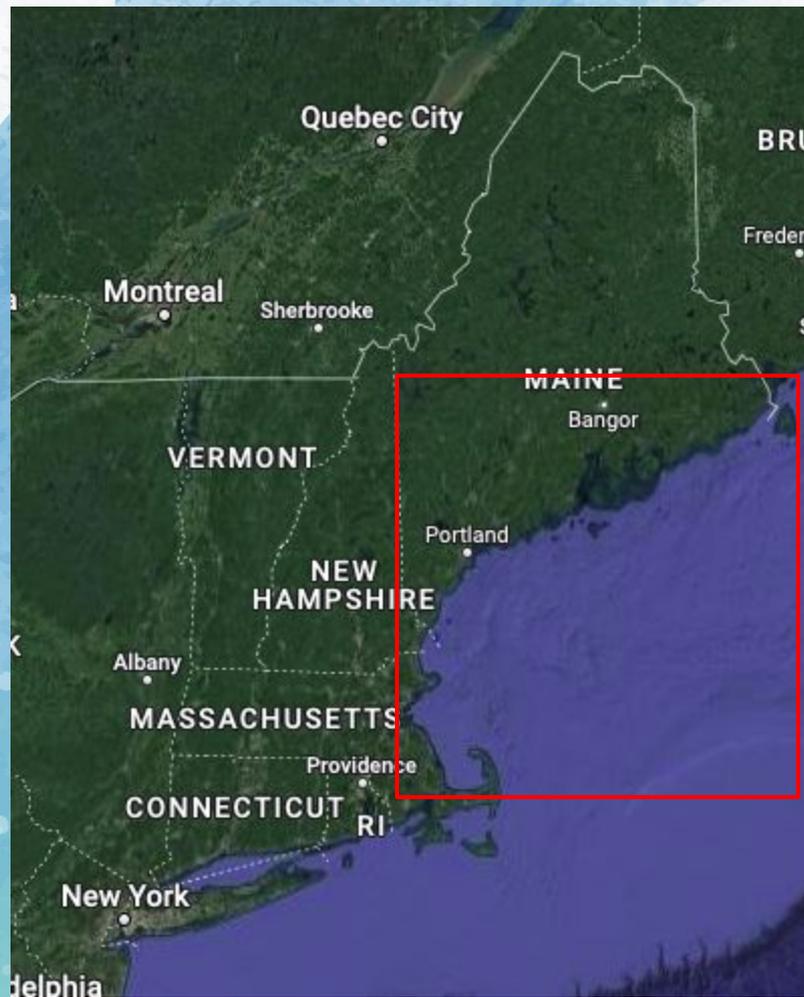


Impact
Assessment



Climate
Change
Projections





Watch List

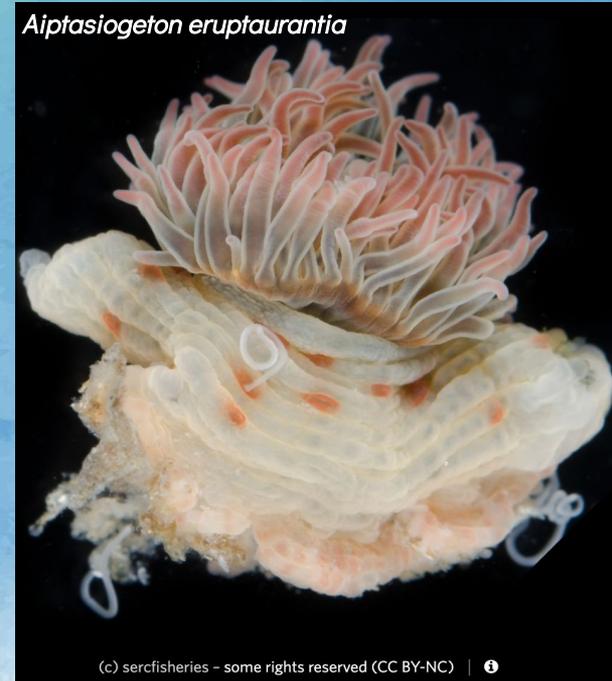


Gulf of Maine Watch List

- Range expanding species
- Species introduced from other regions
- Biological/ecological information
 - Region of origin
 - Habitat preferences
 - If listed elsewhere (IUCN ISSG/GRIIS)
 - Thermal tolerances
 - Reproduction (ex. Broadcast spawner? Direct deposit?)
- Location last observed

Total: 64 species

53 inverts, 11 algae



Red spotted anemone

Gulf of Maine Watch List: *Methods* 1

- Obtain global list of NIS (ISSG GISD) excluding target region (BOHA, GOM)
- Determine target region suitability for species
- Consider modes of reproductive pressures
- Adapted from Raser et al. (2017)



Lightbulb tunicate

Hemigrapsus takanoi



- Brush clawed shore crab
- Western pacific - Russia, Korean Peninsula, Japan
- Broad salinity tolerance (7 - 35ppt); temperature tolerance: 27°C
- Planktonic larval phase
 - 22 days - at 20°C water temperature, Landeira et al. (2019)
- Wadden Sea - affects mixed reef of oysters/mussels due to predation on young recruits
- Seen: Europe (Germany, Netherlands, Ireland - 2022)

Gulf of Maine Watch List: *Methods 2*

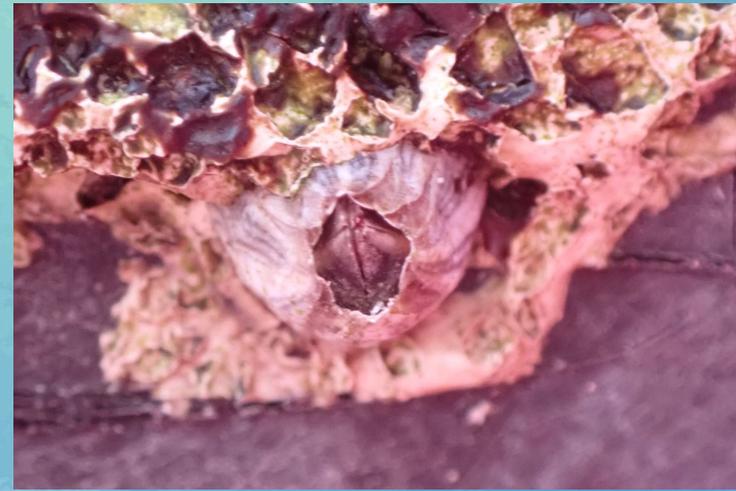
- Range expanding native southern species
- Range expanding invasive species in southern regions



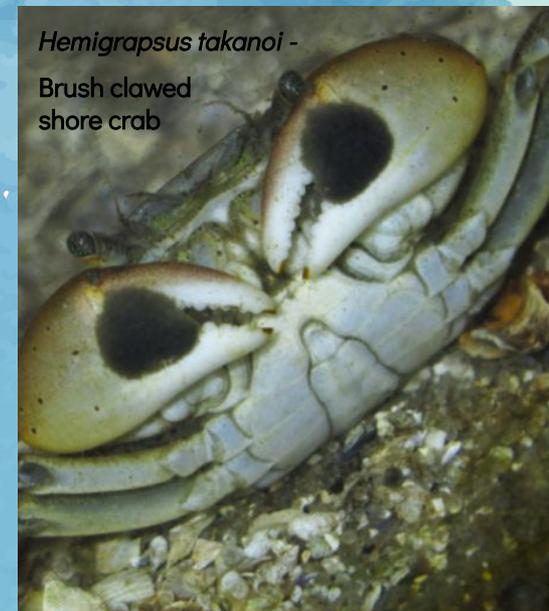
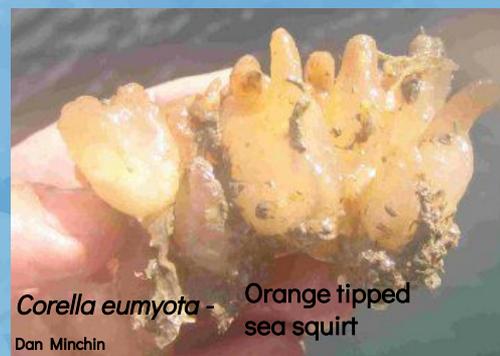
Red spotted anemone

Amphibalanus amphitrite

- **Striped barnacle**
- Indo west pacific
- Broad salinity tolerance (10-52ppt), broad temperature tolerance (-5°C air temperature** to 40°C)
- Competition for settlement sites (with native barnacles and oysters), negatively impact oysters due to settlement on shells
- Seen: Southern New England - Rhode Island



Range Expanding and Potential Invaders



Impact Assessment



Impact Assessment

- Environmental impact classification for alien taxa - **EICAT**
(Hawkins et al. 2014)

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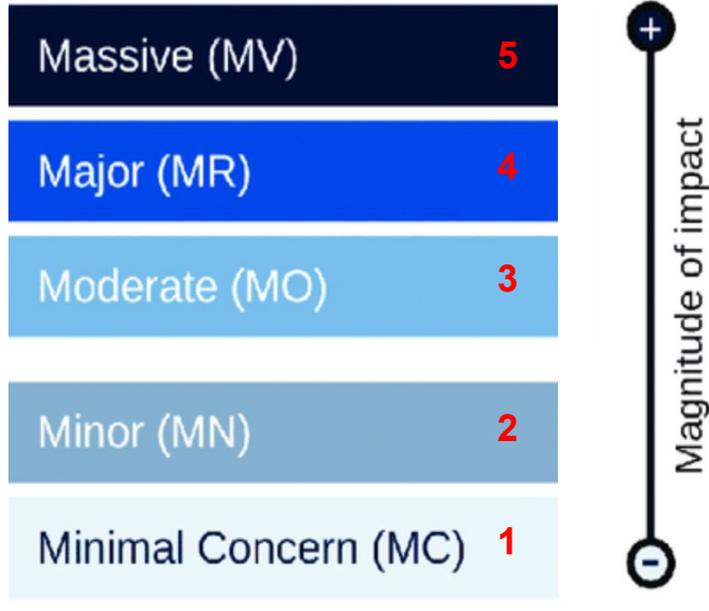
Impact Assessment

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- Environmental impact classification for alien taxa - **EICAT** (Hawkins et al. 2014)
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- Type and magnitude: classify 1-5 scale - negative impacts
- Henry and Sorte (2021) - positive impacts
- Mark species with high potential impacts and risks

Impact Assessment Scale



- **5 - Massive:** replacement and local native population extinction and irreversible changes to structure of communities/ecosystem
- **4 - Major:** local native population extinction and potential reversible change to structure of communities/ecosystem
- **3 - Moderate:** declines in native population size, but no change to structure of communities/ecosystem
- **2 - Minor:** reduction of fitness of native individuals but no decline in population size
- **1 - Minimal:** unlikely to have caused deleterious impacts



Impact Assessment Example: *Hemigrapsus takanoi*

WoS search results: 54 papers total

Citation	Affected System	Impact value	Mechanism (EICAT)	Description	Relevant text	Affected Species	Country	Study Location
Nour, O., M. Stumpp, Sonia C. Morón Lugo, F. R. Barboza, and C. Pansch. 2020. Population structure of the recent invader <i>Hemigrapsus takanoi</i> and prey size selection on Baltic Sea mussels. <i>Aquatic Invasions</i> 15:297–317.	Environmental	-2	Predation	This study aimed to determine the potential impact of <i>H. takanoi</i> on the mussel-dominated ecosystem of Kiel Fjord (Germany) through a series of laboratory predation experiments. Resulting data suggests this crab species is an important predator that may impact populations of <i>Mytilus edulis</i> .	<i>H. takanoi</i> exerts a significant pressure on smaller mussels (< 15 mm shell length) in the Kiel Fjord area. In turn, this might affect <i>M. edulis</i> recruitment patterns in the future.	<i>Mytilus edulis</i>	Germany	Kiel Fjord
van den Brink, A. M., S. Wijnhoven, and C. L. McLay. 2012. Competition and niche segregation following the arrival of <i>Hemigrapsus takanoi</i> in the formerly <i>Carcinus maenas</i> dominated Dutch delta. <i>Journal of Sea Research</i> 73:126–136.	Environmental	-4	Competition/Pre	This study describes the arrival of <i>H. takanoi</i> in the Dutch delta and a significant increase in abundance and dominance of habitat opportunistically after an unrelated decline in local <i>Carcinus maenas</i> population; <i>H. takanoi</i> has been described as a fierce interference competitor to <i>C. maenas</i> and predator on small/juvenile <i>C. maenas</i> which has caused increased mortality for <i>C. maenas</i> . Populations of <i>C. maenas</i> are only able to be maintain to survival and reproduction in areas where <i>H. takanoi</i> densities are low.	Whereas <i>C. maenas</i> used to be by far the most abundant crab species in the Oosterschelde, from spring 2004 on <i>H. takanoi</i> showed up in the sample. From that time on <i>H. takanoi</i> was often more abundant than <i>C. maenas</i> . Once settled and numerous the two <i>Hemigrapsus</i> species appeared to be predators on and/or superior competitors for the space occupied by juvenile <i>C. maenas</i> shore crabs	<i>Carcinus maena</i>	Netherlands	Dutch delta Oosterschelde tidal bay



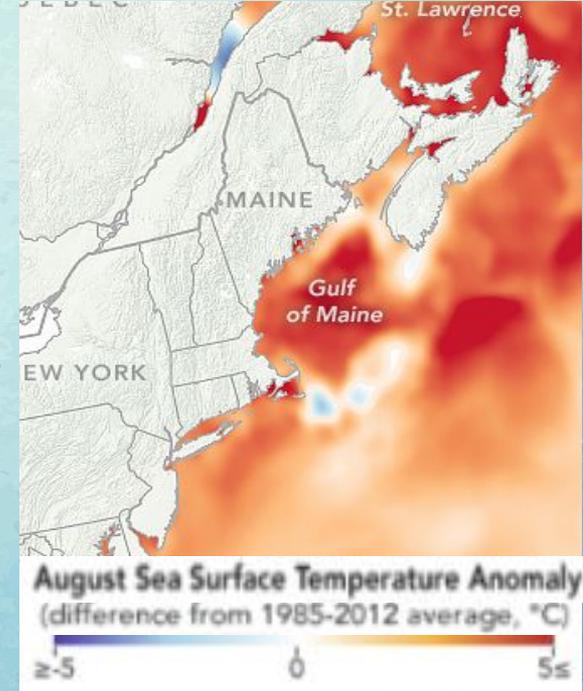
- Continued expert review of watch list species
- Guide prioritization of species for the impact assessment
- Email aputnam@umass.edu

Climate Change Projections



Climate Change Projections

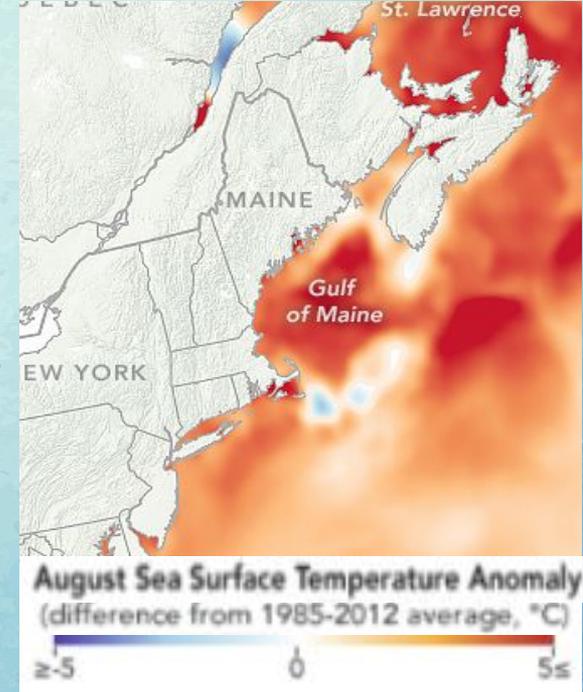
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Climate Change Projections

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Impact assessment top 5 species (negative or positive)



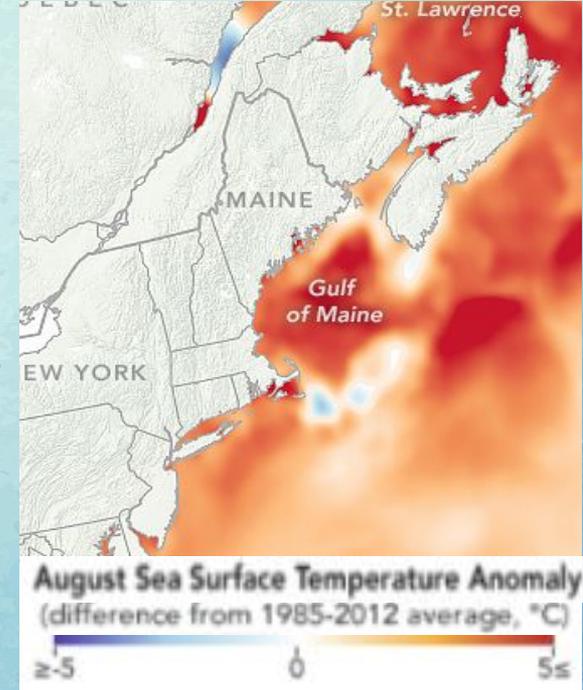
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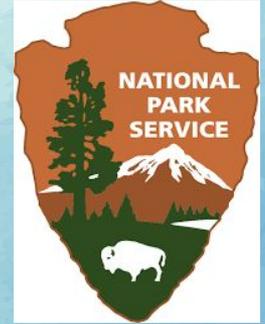
Impact assessment top 5 species (negative or positive)
(expert ID and literature review)

Environmental niche modeling

- *GARP - Genetic Algorithm for Rule set Prediction
- *Global occurrence data (ex. GBIF/OBIS)
- *environmental predictors (ex. SST, salinity)



Thank you!!



University of
Massachusetts
Amherst