Marine Mischief:

Salt marshes, climate change, and invasive species, oh my!

Summary: New England salt marshes are highly productive, providing ecosystem services for people and native biodiversity. Human activities are causing climate change and affecting species composition in salt marshes, threatening these valuable ecosystems. The fate of these ecosystems depends on their natural resistance and the management actions taken in the immediate future.

Invasive Species (IS) and Climate Change (CC) in New England Salt Marshes

Salt marsh ecosystem services:

- Coastal protection from flooding
- Carbon sequestration and improved water quality
- Habitat for fish, shellfish, and wildlife

Marsh dieback and degredation caused by:

- Increased burrowing and herbivory by both native and invasive crabs
- Northern range expansion by the native fiddler crab *Minuca pugnax* (see Nuisance Neonatives Management Challenge)
- Abundance increases of nonnative species like the green crab (*Carcinus maenas*)
- Extreme climate events (e.g. droughts)

Consequences:

- Destabilization of marsh banks
- Reduction in biodiversity due to increased predation
- Reduction in flood mitigation and carbon sequestration

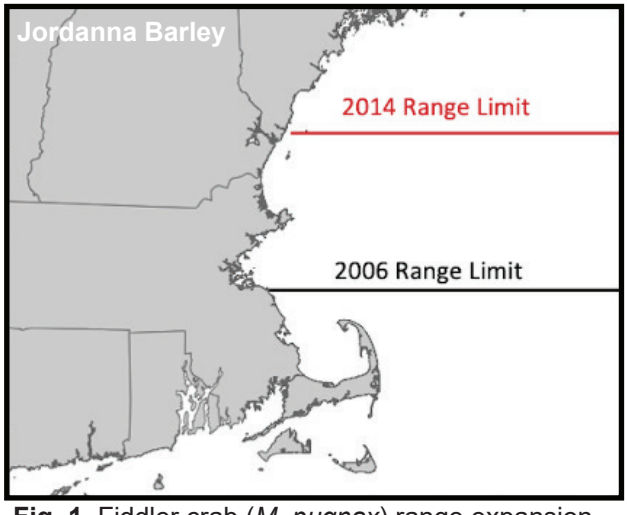

Fig. 1. Fiddler crab (*M. pugnax*) range expansion.

Fig. 2. Green Crab (*C. maenas*).

Fig. 3. (A) Aerial view of salt marsh dieback on the East Coast. (B) Close up view of crab herbivory.

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Which management strategies are best for salt marshes?

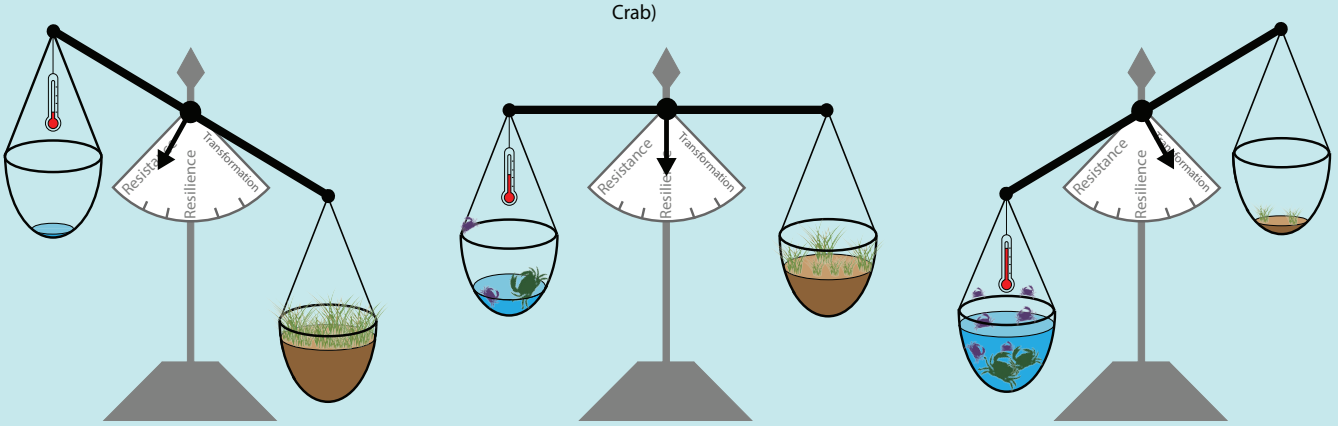
Native keystone species (e.g. cordgrass)

Increasing temperatures

Native species whose effects have changed (e.g. Purple Marsh Crab)

Nonnative species (e.g. Green Crab)

Rising sea levels



There are still a few remaining salt marshes where the effects of native species strongly outweigh any effects of CC and IS. These nearly pristine habitats, which maintain their original biodiversity and functions, make excellent candidates for RESISTANT management actions in the future.

For most salt marshes, increased water temperatures, sea level rise, and invasive/ range-expanding species have had significant negative impacts. Nevertheless, these salt marshes remain balanced, and some ecosystem services are still provided. In these marshes, RESILIENT management actions (like cordgrass restoration and crab trapping) make the most sense.

Some salt marshes cannot be restored to their original ecosystem structure and function because the compound effects of IS and CC outweigh any remaining stabilizing effects of keystone species. In these situations, managers should prioritize TRANSFORMATION, fundamentally shifting the biodiversity and ecosystem services provided by the salt marshes.

Managing for resilience makes sense for most of the current salt marshes in the Northeast US.

Current management efforts:

- Revegetation with native species (e.g. planting cordgrass, removal of invasive giant reed)
- Removal of burrowing crab species (e.g. trapping native purple marsh crabs and nonnative green crabs in degraded areas)
- Monitoring of native populations and keystone habitats to improve proactive identification of areas of concern
- Habitat restoration to restore ecosystem services (e.g. bank stabilization and marsh elevation to increase resistance to rising tides, ditching to promote tidal exchange)

Additional recommendations:

- Limit human removal of natural predators
- Reduce release of invasives through regulation
- Collaboration between stakeholders across multiple agencies
- Large-scale climate change mitigation (reduce emissions and warming)

Fig. 4. Cordgrass revegetation

Learn more at: risccnetwork.org **DOI:** https://doi.org/10.7275/b5c2-np62

References: Alber et al. 2008. Estuar. Coast. Shelf Sci.; Barbier et al. 2011 Ecol. Monogr.; Crotty et al. 2017 PLoS One; Gedan et al. 2011 Mar. Ecol. Prog. Ser.; Lopez et al. 2021 (Embracing the future: https://scholarworks.umass.edu/eco_ed_materials/11/); Perry et al. 2020 J. Environ. Manage; Peterson St-Laurent et al. 2021 Commun. Biol.; Raposa et al. 2019 J. Crust. Biol.