

Bates College

SCARAB

All Faculty Scholarship

Departments and Programs

Fall 2022

Recommendations for Establishing a Market for Invasive Green Crabs in New England

Eve Fischer

Jesse Minor

Marissa McMahan

Follow this and additional works at: https://scarab.bates.edu/faculty_publications

The Northeastern Geographer Policy Brief

Recommendations for Establishing a Market for Invasive Green Crabs in New England

Eve Fischer¹, University of Maine at Farmington, Department of Geography & Environmental Planning, eve.fischer@maine.edu

Jesse Minor, Bates College, Department of Biology, jminor@bates.edu

Marissa McMahan, Manomet, Resilient Habitats Program, mmcman@manomet.org

¹ Corresponding Author details

Eve Fischer

eve.fischer@maine.edu

Department of Geography & Environmental Planning

270 Main Street, Roberts Learning Center

University of Maine at Farmington

Farmington, ME 04938

Recommendations for Establishing a Market for Invasive Green Crabs in New England

Abstract

Green crabs are one of the most invasive marine species in the world. Their populations in New England have grown significantly due to climate change, increasing their environmental and socioeconomic impacts. Green crabs are voracious predators of soft shell clams, and have had a detrimental impact on the region's valuable clam fisheries. They also prey on juvenile lobsters and other shellfish and compete with native crab species for resources. Green crabs burrow into and damage eelgrass beds, which are a vital habitat for many marine species and an important "blue carbon" sink. Due to their rapid rate of reproduction as well as other biological characteristics, green crabs are essentially impossible to eradicate. Attempts to remove them have therefore been largely unsuccessful. A more promising solution to the green crab invasion is to establish markets and incentives for their exploitation. Culinary and bait markets would support continuous harvest of the crabs, keeping their population in check without devoting resources to futile eradication attempts. A green crab fishery would diversify New England's fisheries and make use of a highly abundant resource that is presently underutilized. Although there are challenges to developing a viable green crab fishery, it is likely the best strategy to combat their environmental impacts while simultaneously benefiting human communities.

Keywords

climate adaptation, fisheries management, invasive species, market-based solutions, sustainable food systems

Recommendations for Establishing a Market for Invasive Green Crabs in New England

Messages for Policy

- Market-based solutions can be the most cost-effective ways to reduce the environmental and economic harm from fully-established invasive species
- New England states should encourage green crab trapping via a regulated fishery
- Interstate communication and coordination is required to permit transport of live green crabs across state lines, a practice that is currently not aligned within New England
- Expanded culinary markets for invasive crabs requires fishery education on harvest techniques, including identifying valuable pre-molt crabs for the soft shell market
- States should support innovations that incorporate green crabs into novel products and markets (e.g., green crab meat processing machinery, biodegradable plastics, bait, and compost)
- New England states should improve communication about green crabs to better facilitate market development.

The Policy Problem

European green crabs (*Carcinus maenas*) are one of the most insidious invasive species in New England. The crabs pose a stark threat to the soft shell clam and lobster industries and their populations have grown rapidly as a result of climate change. The species first arrived in Long Island Sound in the early 1800s via ballast water in ships from Europe and extended their range into Maine by the early 1900s (Carleton and Cohen 2003). Green crabs feed on soft shell clams and are the principal cause of the dramatic decline in clam landings in the Gulf of Maine (Downeast Institute 2020). Green crabs cause habitat destruction by burrowing into eelgrass beds (Neckles 2015), which many marine species rely on for shelter and as critical nursery habitat. Green crabs are incredibly fecund, with female crabs laying as many as 185,000 eggs per year (Perry 2011).

Between habitat destruction, high rates of predation, and rapid reproduction, green crabs outcompete native crab species and pose a growing threat to lobster and clam populations (Rossong et al. 2006; Matheson and Gagnon 2012). Clamming and lobstering are two of New England's most valuable marine industries, and the serious threat from green crabs must be addressed through policy interventions. As regional waters warm, marine resource management

will require adaptive responses to both preserve existing values and to manage environmental change (Pershing et al. 2021). Policy-based adaptation to environmental change should incorporate the creation of markets for underutilized and invasive species such as green crabs. Further, market-based invasive species control mechanisms have the advantage of causing the least impact on state budgets and limited public resources while simultaneously growing taxable economic activity that can be directed towards environmentally positive outcomes.

Attempts to control green crab populations have historically focused on total eradication via physical removal, with the aim of protecting threatened native species and habitats. Eradication efforts have devoted little attention to economic development that utilizes invasive species, likely because of the moral and policy complexity surrounding responsible and “sustainable” use of damaging invasive species (Larsen et al. 2011). If elimination of invasive species is the goal, then economic development based on those species poses a set of challenges that policymakers are likely not eager to consider. Additionally, it can be argued that eradication policies stifle business investment into new products and markets, because the overarching eradication policy would undercut any sustainable business case that makes use of invasive species (Fischer et al., in preparation).

Beyond eradication, other mechanisms of invasive species control do exist. One proactive example is protecting clams with nets or fenced barriers that exclude green crabs (Beal et al. 2016; Hagan and Wilkerson 2018). While exclosures are an effective method of reducing localized predation, it is labor-intensive, limited in geographic scope, and does not reduce the further encroachment of green crabs into soft shell clam habitats. To date, New England states have largely adopted a state-by-state approach to the green crab invasion, including Maine’s governor-appointed Green Crab Task Force (Maine Department of Marine Resources 2015) and Sea Grant funding to explore eradication strategies (New Hampshire Sea Grant 2022). States have been slow to implement the recommendations and solutions, with state policies continuing to mostly focus on physical removal strategies that are costly, labor intensive, and generally ineffective.

Key Findings

The green crab invasion is a complex issue with implications for fisheries, markets, communities, and ecologies. Because of the biological and ecological life-history traits of green crabs, the environmental and economic problems they pose do not have any straightforward solutions. If no additional actions are taken, green crab populations will continue to expand,

putting further pressure on soft shell clam, lobster, and native crabs, as well as critically important coastal habitats. Green crabs have been established in New England for over 200 years. Therefore, responsible policy solutions must incorporate the species into marine resource management, markets, and food systems..

Because green crabs cannot be eradicated, efforts that rely on removing them from the water without establishing a system to perpetuate their removal will be unsuccessful. Therefore, New England states should pursue strategies that contain mechanisms to incentivize continuous and ongoing green crab harvest and removal. The clear option for implementing such a mechanism is to establish markets for green crabs.

There are several potential markets for green crabs. They can be used as bait in existing and emerging fisheries (St. Hilaire et al. 2016), composted for use as a soil amendment (Park 2018), and processed into value-added products such as pet food or novel materials such as bioplastics (Barrett 2020). Finally, green crabs can be used for human consumption in culinary markets, either as soft-shelled crabs or value added products like broth or mince (Galetti et al. 2017). Of these market possibilities, the culinary market has the greatest potential value, with fishers receiving upwards of \$30 USD/lb for soft shell crabs (Manomet, unpublished data). In addition, culinary processing creates waste streams that can be directed into compost and pet food, adding additional value to the harvested crabs and building new ancillary business opportunities. Establishing a culinary market is the best solution to the invasive green crab problem, because markets for pet food, compost, and other products that make use of processed crabs can be supported by culinary market waste streams or in addition to culinary use.

Within New England, Massachusetts has implemented several policy solutions to combat the green crab invasion that other states can adopt. Massachusetts state policy focuses on easy access to green crab fishing to incentivize population reduction. State law allows anyone to trap green crabs commercially or recreationally if they give notice to the Department of Marine Fisheries, which grants Letters of Authorization (Massachusetts Division of Marine Fisheries 2021). The process is free and easily available. Massachusetts also removed green crabs from its classification list of “edible crabs.” Paradoxically, this switch keeps green crabs from being subject to the more intensive permitting associated with lobstering and crabbing, while expanding the market possibilities for an invasive but edible crab. Massachusetts fisheries are closely tied to the bait market in southern New England and New York, which encourages trapping and removal of green crabs. Further expanding the use of green crabs as bait could

increase the number of people fishing for green crabs, which would simultaneously help solve supply shortages that are currently hindering their culinary use.

New England coastal states have varying policies on green crab trapping. Connecticut lists green crabs as a bait species and allows trapping them with a regular recreational marine fishing license (CT.gov 2021). Connecticut Sea Grant also runs a citizen science green crab monitoring program on Nantucket, and hosts an annual green crab derby. Rhode Island encourages trapping and disposing of green crabs and does not require a license to catch them. New Hampshire law allows the taking of green crabs in any amount by any legal method with possession of a regular lobster and crab license. New Hampshire Sea Grant's Green Crab Project, partnered with Manomet, runs a citizen-led green crab monitoring survey, as well as conducting research into culinary market development. Maine requires a green crab permit, which costs \$10 for residents and \$20 for nonresidents. The encouragement of green crab trapping by these states bodes well for the establishment of culinary and bait markets.

Implications for Policy

A culinary market for green crabs will make the best use of a harmful invasive species as an underutilized resource, while simultaneously being the most effective long term way to reduce its large population and environmental impacts. Multiple policy actions are required to support the growth of a green crab fishery.

First, New England states must encourage green crab trapping via a regulated fishery. Maine has already made obtaining a commercial green crab license fairly easy, and there are no restrictions for recreational green crab fishing. From here, the most useful step is support for marketing, training, and education focused on increasing participation in the green crab fishery. The centuries-old culinary market for green crabs in Italy relies on harvesting premolt green crabs to produce a valuable soft-shell product (St. Hilaire et al. 2016). The soft shell crab market avoids the problem of processing meat from small crabs, as the entire body is eaten. In New England, the soft shell crab market could operate by either directly catching recently molted crabs, or trapping premolt crabs and holding them until they molt. Teaching identification of premolt crabs to people entering the fishery will be key to supporting culinary market establishment. Green crab fishing techniques and premolt crab identifiers can be taught through a series of workshops and expanded web-based information, and will be crucial to expanding the green crab fishery.

To cement a robust and reliable fishery and supply of green crabs for culinary use, further support should go towards research and development of innovations that incorporate green crabs into novel products. Research on processing machinery for extracting hard shell green crab meat will grow the lump-meat industry and is essential to expanding culinary use of an invasive and underutilized marine species. Investment in ongoing research into biodegradable plastics made with green crab shells will yield new environmentally-friendly business opportunities. The most important effort is garnering public awareness of green crabs as a food source, and making the knowledge of how to fish for, process, and cook with them widely available. Promoting green crabs as a culinary item is critical to taking advantage of this highly abundant resource while expanding marine and shore-based economies.

As climate change progresses in New England's waters, it is increasingly necessary to adapt and prepare for the future. As soft shell clams decline from predation and lobster landings shift eastward into Canadian waters, New England could benefit from incentivizing harvest of underutilized invasive species. This could in turn remove pressure from clam, lobster, and native crab populations while growing new markets and businesses and diversifying its fisheries. Coastal New England is well known for its seafood and restaurants, which provides an existing network for marketing green crabs and expanding their culinary use. Incorporation of green crabs into New England's vibrant culinary scene can provide a new market opportunity for shellfish harvesters who have been affected by the clam decline while introducing exciting new products that will draw tourism. If states can properly incentivize use of this overlooked resource, it would provide a creative adaptation strategy that may make our economies and marine environments more resilient to climate change impacts.

Eve Fischer is a Geography and Environmental Planning student at the University of Maine at Farmington. Email: eve.fischer@maine.edu. Her research focuses on invasive species management and carbon sequestration in campus forests.

Jesse Minor is a Lecturer of Biology & Environmental Studies at Bates College in Lewiston, Maine. Email: jminor@bates.edu. His research on human-environment interactions focuses on fengshui forests in China, fire ecology of Sky Island forests in the southwestern US, and climate resilience in coastal Maine communities.

Marissa McMahan is the Director of Fisheries at Manomet. Email: mmcMahon@manomet.org. Her research focuses on restoring ecosystem productivity and strengthening and diversifying fisheries resources in the Gulf of Maine.

Reference List

- Barrett, Axel. "Green Crab Bioplastics Made in Canada." Bioplastics News, February 12, 2020. <https://bioplasticsnews.com/2020/02/12/green-crab-bioplastics-canada/>. (Accessed November 14, 2022).
- Beal, B.F., Nault, D.-M., Annis, H., Thayer, P., Leighton, H., and Kanwit, K. 2016. Effects of predator-deterrent netting on growth and survival of wild and cultured individuals of the soft-shell clam, *Mya arenaria* L., in three coastal Maine communities (May to October 2015). <https://downeastinstitute.org/wp-content/uploads/2018/08/final-report-2015-study-dmr-dei-2nd-draft.pdf>. (Accessed December 20, 2021).
- Carlton, J.T., and Cohen, A.N. 2003. Episodic global dispersal in shallow water marine organisms: the case history of the European shore crabs *Carcinus maenas* and *C. aestuarii*. *Journal of Biogeography* 30: 1809-1820. <https://doi.org/10.1111/j.1365-2699.2003.00962.x>. (Accessed December 9, 2021).
- CT.gov. January 2021. "Bait Species, Blue Crab and Lobster Regulations." <https://portal.ct.gov/DEEP/Fishing/Saltwater-Fishing-Guide/Bait-Species-Blue-Crab-and-Lobster-Regulations>. (Accessed November 14, 2022).
- Downeast Institute. 2020. *Invasive green crab linked to soft-shell clam decline*. Downeast Institute. <https://downeastinstitute.org/the-cause-of-the-clam-decline/freeport-investigating-the-cause-of-the-clam-decline-2013-2018/> (Accessed October 31, 2021).

- Fischer, E., McMahan, M., and Minor, J. In Preparation. Exploring the Culinary Potential of Invasive Green Crabs in Maine. *Maine Policy Review*.
- Galetti, J.A., Calder, B.L. and Skonberg, D.I. 2017. Mechanical separation of green crab (*Carcinus maenas*) meat and consumer acceptability of a value-added food product. *Journal of Aquatic Food Product Technology* 26 (2): 172-180. <https://doi.org/10.1080/10498850.2015.1126663>. (Accessed December 20, 2021).
- Green Crabs in Maine*. European Green Crab - Invasive Species: Maine Department of Marine Resources. (n.d.). <https://www.maine.gov/dmr/science-research/species/invasives/greencrabs/index.html> (Accessed October 31, 2021).
- Hagan, J.M, and E. Wilkerson. 2018. How to Install a Soft-shell Clam Farm. Manomet Sustainable Economies Program. Brunswick, Maine, USA. https://www.manomet.org/wp-content/uploads/2018/10/Manomet-Clam-Farm-Guidebook-2018_electronic-version.pdf. (Accessed December 20, 2021).
- Larson, D.L., Phillips-Mao, L., Quiram, G., Sharpe, L., Stark, R., Sugita, S. and Weiler, A. 2011. A framework for sustainable invasive species management: Environmental, social, and economic objectives. *Journal of Environmental Management* 92 (1): 14-22. <https://doi.org/10.1016/j.jenvman.2010.08.025>. (Accessed December 21, 2021).
- Manomet, Resilient Habitats Program. 2022. Green Crab Research. <https://www.manomet.org/project/green-crab-research/> (Unpublished raw data). (Accessed November 14, 2022).
- Massachusetts Division of Marine Fisheries. (n.d.). *Special permits & other forms for commercial fishing*. Mass.gov. <https://www.mass.gov/service-details/special-permits-other-forms-for-commercial-fishing> (Accessed October 31, 2021).
- Matheson, K. and Gagnon, P. 2012. Temperature mediates non-competitive foraging in indigenous rock (*Cancer irroratus* Say) and recently introduced green (*Carcinus maenas* L.) crabs from Newfoundland and Labrador. *Journal of Experimental Marine Biology and Ecology* 414: 6-18. <https://doi.org/10.1016/j.jembe.2012.01.006> (Accessed November 22, 2022).
- Neckles, H.A. 2015. Loss of eelgrass in Casco Bay, Maine, linked to green crab disturbance. *Northeastern Naturalist* 22 (3): 478-500. <https://doi.org/10.1656/045.022.0305>. (Accessed November 22, 2022).
- New Hampshire Sea Grant. 2022. <https://seagrant.unh.edu/our-work/invasive-species/nh-green-crab-project>. (Accessed November 14, 2022).
- Park, K. "Sea to Soil: Invasive Crabs Turn Fields Green." Island Institute, November 19, 2018. <https://www.islandinstitute.org/working-waterfront/sea-to-soil-invasive-crabs-turn-fields-green/>. (Accessed November 14, 2022).
- Perry, H. 2011. *Carcinus maenas* Linnaeus 1758: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL,

<https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=190>. (Accessed November 27, 2021).

- Pershing, A.J., Alexander, M.A., Brady, D.C., Brickman, D., Curchitser, E.N., Diamond, A.W., McClenachan, L., Mills, K.E., Nichols, O.C., Pendleton, D.E. and Record, N.R. 2021. Climate impacts on the Gulf of Maine ecosystem: A review of observed and expected changes in 2050 from rising temperatures. *Elementa: Science of the Anthropocene* 9 (1): 00076. doi: <https://doi.org/10.1525/elementa.2020.00076>. (Accessed December 17, 2021).
- Rosson, M.A., Williams, P.J., Comeau, M., Mitchell, S.C. and Apaloo, J. 2006. Agonistic interactions between the invasive green crab, *Carcinus maenas* (Linnaeus) and juvenile American lobster, *Homarus americanus* (Milne Edwards). *Journal of Experimental Marine Biology and Ecology* 329 (2): 281-288. <https://doi.org/10.1016/j.jembe.2005.09.007>. (Accessed November 22, 2022).
- St. Hilaire, S., Krause, J., Wight, K., Poirier, L. and Singh, K. 2016. Break-even analysis for a green crab fishery in PEI, Canada. *Management of Biological Invasions* 7 (3): 297–303. <http://dx.doi.org/10.3391/mbi.2016.7.3.09>. (Accessed December 20, 2021).