Green Crabs and Soft-Shell Clams: Results from Large-Scale Field Studies Examining Measures to Mitigate Predator Effects on Clam Survival and Growth



Sara Randall Associate Director, Downeast Institute



Dr. Brian Beal (University of Maine at Machias and Downeast Institute), Chad Coffin and Clinton Goodenow Jr. (Maine Clammers Association), Kyle Pepperman, Bennett Ellis, Cody Jouret, George Protopopescu, Justin Lewis (Downeast Institute)

Downeast Institute

- Marine Field Station of the University of Maine at Machias
- Easternmost marine research laboratory and education center in the US.
- Public shellfish hatchery



2012: Clammers Sounded the Alarm and Alerted Policymakers and Scientists

ENVIRONMENT MAY 30, 2013 / 4:05 PM / 5 YEARS AGO

Warmer seas fuel Maine crab invasion, clammers say

Clammers: Crab threat needs action

By Larry Grard Igrard@keepmecurrent.com - March 11, 2014

Attacking the green crab

By Larry Grard Igrard@keepmecurrent.com - December 3, 2013



FREEPORT – Local clammers say they are encouraged that Gov. Paul LePage has established a task force to study the devastating impact that the European green crab is having on the shellfish fishery.



Keep Our Waters Clean! MAINE CLAMMER'S ASSOCIATION

Maine Soft-Shell Clam Decline



Freeport's 2013 Investment

 Green crab trapping and manipulative field trials to determine effects of green crabs on the fate and growth of soft-shell clams.



FREEPORT – The Freeport-based Maine Clammers Association and others concerned with the damage that green crabs are inflicting on the state's clamming industry are taking another step in fighting the problem, with a Green Crab Summit, scheduled on Dec. 16 at the University of Maine.



DEI's 2014 — 2017 Large-Scale Freeport Field Experiments

- Cooperatively with clammers
- Find cause of the clam decline and test methods to enhance clam populations.
- 27 different experiments
- 78 field sites
 - + 2 years of subtidal and intertidal green crab trapping
 - + 3 million juvenile clams raised in two upwellers.

2014: Predator Exclusion Fencing







2013: 2,520 sq. ft. **2014:** 1,680 sq. ft. **Total**: 4,200 ft. (4/5th of a mile)

Findings:

 Fencing has no more ability to reduce/deter green crabs (and other predators) than netting alone.

Protecting and Growing Clams Under Predator Deterrent Netting



364 nets installed and maintained over the course of the experiments. 89,952 sq. ft. of netting.





Protecting and Growing Clams in Predator Deterrent Boxes:



- Measured growth and survival of clams
- Tests ability of different size mesh to deter predators.
- 466 deployed (not counting recruitment boxes)





Measuring Clam Recruitment





2015: 120 boxes at 20 locations.

2016: 840 boxes @ 20 locations @ all 3 tidal heights.

2017: 235 boxes @ 5 locations, staggered deployment to determine clam and crab spawning.

1,195 total in Freeport (have also been deployed other places along the coast)

Clams settling later in the year benefit from a temporal refuge as predation rates fall with temperature after September.

Greeen Crab Growth Rate: Growth rates are much faster than those observed by Berrill (1982).

- the largest crab (46.6-mm CW) from a box with mesh w/aperture of 6.4 mm grew at least 37.5 mm in CW over the 211 days from April to Nov. 2015.
- A crab in Pet Screen mesh box grew 29.8 mm.









Top Discoveries of the Field Experiments

1. Predation is the most important factor regulating softshell clam populations.

A) Clams can survive and grow when they are protected from predators.

B) Clam recruitment is still occurring in high amounts.

- Results showed juvenile soft-shell clams settling in high concentrations (1,400 and 2,300 individuals/ft² in some areas), while unprotected mud right next to the recruitment boxes are void of clams, indicating that they were consumed after settling.
- Clam recruits attained densities 899x greater in large-scale plots which excluded large (>6 mm) predators than in adjacent sediments where predators were undeterred.

Journal of Shellfish Research

- Combined with predator exclusion experiments from 2014 - 2015 in Fore and Webhannet Rivers.
- Collectively, results suggest that post-settlement mortality rates of soft-shell clam recruits exceed 99% and these early losses are primarily responsible for explaining lack of abundance of juvenile clams.



Need to Adapt Soft-Shell Clam Management

Maine's waters are among the fastest warming in the world and are predicted to continue to warm.

Green crabs thrive in these warmer waters.

Warmer waters mean more and more predation.

Green crabs are a permanent part of the marine system in Maine.

It's All About Adaptive Shellfish Management!

1) Expect and work around high levels of green crabs and predators.

2) To ensure the future viability of the clam fishery it will be necessary to update commonly used shellfish management tools. For example, municipal Shellfish Programs will need to expand from a passive enforcement-only approach to a more directed, ecology-based active management approach.

Large-scale clam protection projects should be swiftly implemented.





www.downeastinstitute.org/freeport.htm

