



Soft-Shell Clam Recruitment Monitoring Network

Technical Report:

2020 Spring Baseline Clam Survey Results

by Dr. Brian Beal and Sara Randall

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July 14, 2020

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Acknowledgments:



We thank the Maine Sea Grant College Program for providing funding for this work.



Recommended Citation:

Beal, B.F. and S.F. Randall. 2020. Soft-Shell Clam Recruitment Monitoring Network Technical Report #1: 2020 Spring Baseline Clam Survey Results. Downeast Institute, Beals, ME. 39 pgs.

Cover photo:

Clam Recruitment Monitoring Network deployment at Upper Landing, Wells, May 2, 2020.

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July 2020 Technical Report

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Clam Recruitment Monitoring Network deployment at Maine Yankee cove, Wiscasset, May 6, 2020.

Summary

With financial support from the Maine Sea Grant College Program, the Downeast Institute (DEI) and the University of Maine at Machias (UMM) have partnered with nine municipal shellfish programs spanning the coast of Maine to measure densities of soft-shell clams recruiting to mudflats. During 2020 and 2021, clam recruitment on two intertidal flats in each community is being quantified to better understand local, regional, and coastwide trends in clam production. The information collected from this **Soft-Shell Clam Recruitment Monitoring Network** will provide state and local shellfish managers with information to better equip them for the challenges of sustaining and/or enhancing clam populations in a dramatically changing marine environment.

This report provides information about the Clam Recruitment Monitoring Network's study sites, design, and sampling process. It also details results of an initial baseline survey measuring clam densities and sizes that was conducted at all 18 study sites in May 2020, the same time when predator protected units (recruitment boxes) were deployed and installed at each flat.

Background

For more than three decades, commercial landings of soft-shell clams in Maine have been declining (Fig. 1), and this has occurred at the same time that sea surface temperatures (SSTs) in the Gulf of Maine have been increasing (Fig. 2). While many factors contribute to the productivity of intertidal flats along the Maine coast, seawater temperature is a critical driver that influences everything from spawning and reproduction to predation (by both native and invasive species), as well as sediment chemistry which affects the ability of clams of all sizes to produce their protective shells. Clam landings are used as a proxy for clam production, but do not tell the entire story because of annual, regional, and seasonal differences in fishing effort. Fisheries-independent data sources, however, do exist. During the past two decades, with help from students, clambers, and municipal officials, the Downeast Institute and the University of Maine at Machias (UMM) have taken thousands of sediment cores from clam flats from Kittery to Lubec to measure clam densities as well as their sizes. Results of those sampling efforts align with the 30-year downward trend in commercial clam landings. Additionally, DEI and UMM scientists have conducted hundreds of field experiments at various locations along the coast. Results of these trials generally indicate that fewer clams are reaching commercial sizes now than in the past (i.e., research published in Beal et al., 2018; Beal et al., 2016).

The **Soft-Shell Clam Recruitment Monitoring Network** was created to standardize fisheries-independent data collection, and to begin building a long-term database. By deploying identical monitoring units at intertidal sites spanning the coast, we can begin to quantify differences in clam recruitment and survival at local, regional, and statewide scales. This effort may inform new measures to better manage soft-shell clam resources during a period of warming seawater, and help reverse the 40-year trend of declining landings.

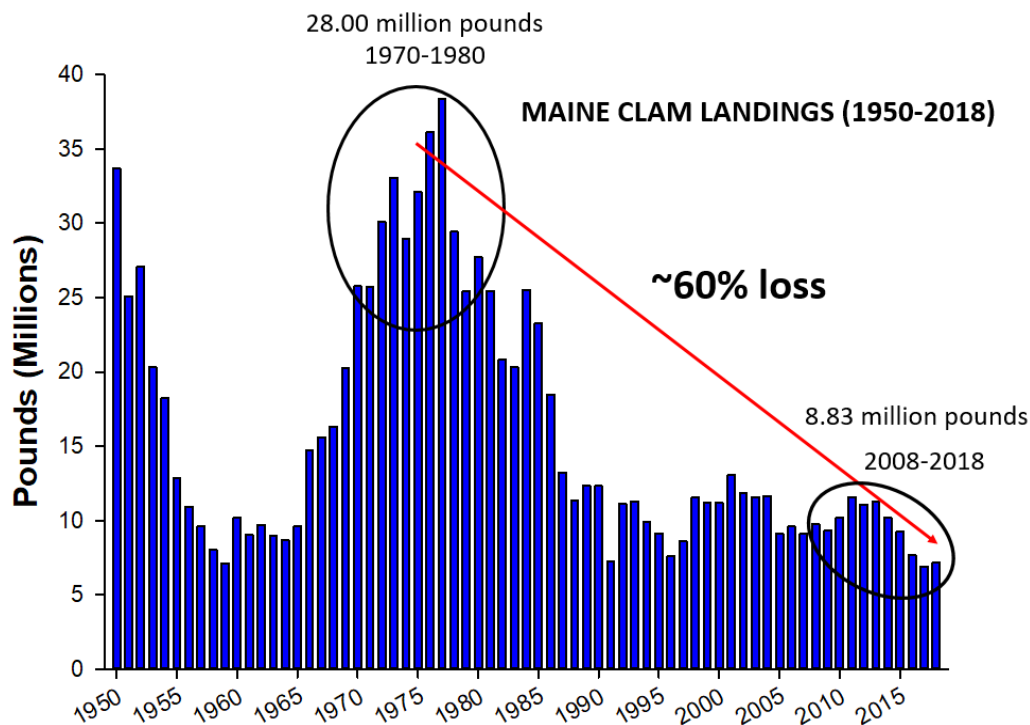


Figure 1.
Maine soft-shell clam landings (1950-2018).
[View Historical Maine Fisheries Landing Data](#)

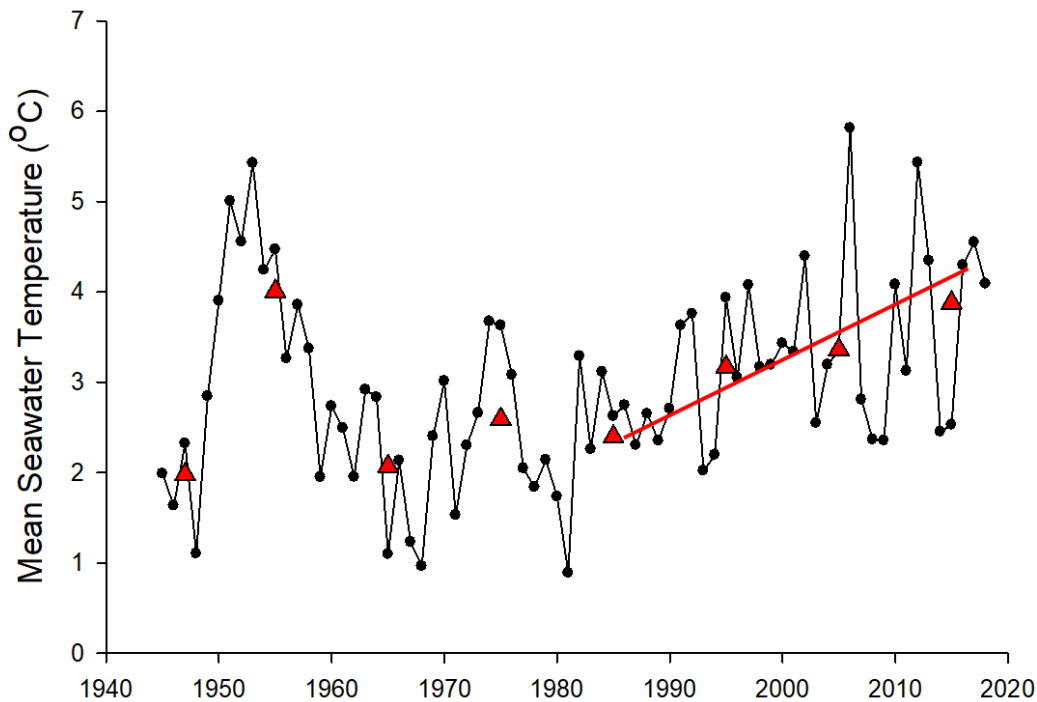


Figure 2. Average wintertime (1 January to 31 March) sea surface temperature (SSTs; black dots) at West Boothbay Harbor, Maine (1945-2018). Decadal averages (red triangles). [View Boothbay Harbor Environmental Data](#)

Clam Biology

To understand how the Soft-Shell Clam Recruitment Monitoring Network works, it is helpful to know the basics of clam biology. Like many marine bivalves, soft-shell clams have two discrete life-history phases. They begin life as a microscopic egg, not much larger than 70-microns (0.003 inches), that is expelled into the water by a female. The egg becomes fertilized by a sperm that, similarly, is ejected into the water by a male. Within 24 hours, this fertilized egg becomes a complex organism with cilia (hairs) that propels it through the water, a mouth, heart, gut, and anus that, collectively, enables the swimming clam larvae to obtain and digest its food (phytoplankton, or microalgae) as it continues developing and growing. After 48-72 hours, the clam larvae develops two valves (shells) and an even more elaborate means to propel itself up and down in the water using its swimming organ called the velum (Fig. 3).

Depending upon water temperatures, clam larvae may swim for 3-4 weeks before they settle to intertidal mudflats at a size that is between 250 to 300-microns (0.010 to 0.012 inches). When scientists encounter these animals, they refer to them as “recruits.” That is, clam recruitment is a two-step process: 1) settlement from the water column to the flats, followed by 2) some period of time when the clams survive and can be detected. Therefore, the size of a clam recruit could be anything from a microscopic speck to a half-inch or larger animal. Another phrase that is used to describe “recruits” is “0-year class individuals,” which means a clam that is not yet 1 year-old.

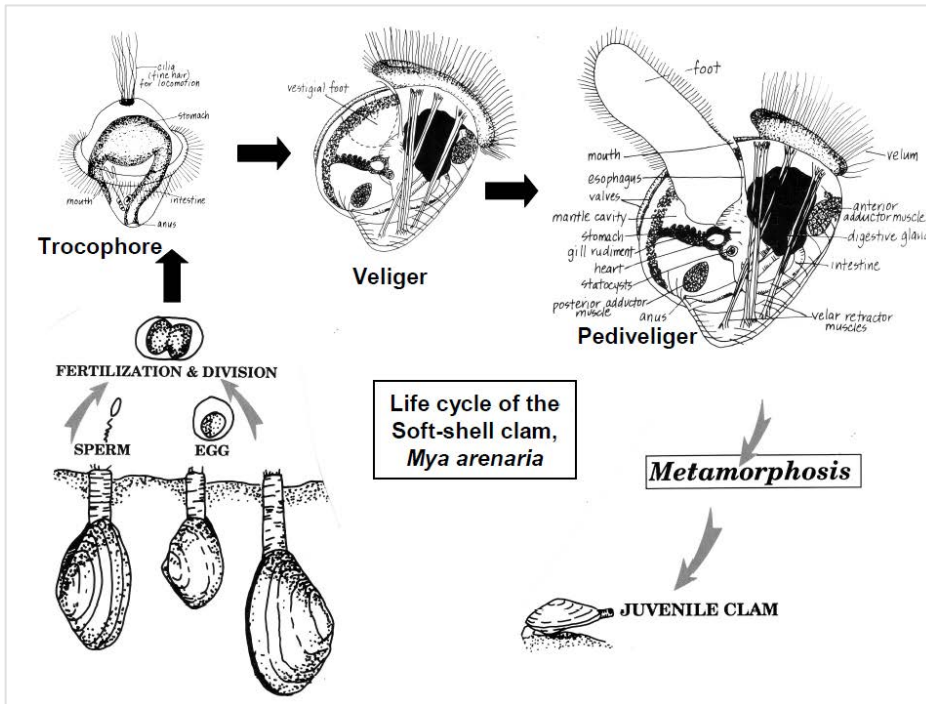


Figure 3.

The life cycle of the soft-shell clam begins with adults releasing their gametes into the water column where fertilization occurs followed by the first swimming stage, the trocophore. Next comes the veliger stage that lasts for up to two weeks followed by the pediveliger stage that occurs prior to metamorphosis (change of shape) and settlement. The juvenile clam, or recruit, is not much larger than 1/100th of an inch when it first settles from the water and becomes a bottom dweller. This is smaller than a grain of sand.

Clams are very mobile when they settle to the flats, and very susceptible to being consumed by any number of predators, including worms, crabs, and some species of carnivorous snails. These predators are very small themselves, and may be no larger than 1-2 mm (0.04 to 0.08 inches). Clams at these small sizes are vulnerable to other environmental factors, such as acidic sediments that may compromise their shells thereby increasing their vulnerability to predators.

The post-settled juvenile clams (recruits) that do survive continue to grow and face a new set of challenges from larger predators, including birds, fish, crabs, worms, snails, and humans. Therefore, a robust clam population depends on successful settlement from the water column followed by a relatively high survival rate of recruits.

Measuring Clam Recruitment and Survival

In 2015, DEI scientists began using a new tool, the soft-shell clam recruitment box (Fig. 4), to examine what recruitment looks like in a predator-protected environment compared to the unprotected environment of a mudflat. In April, prior to the clam spawning season, the scientists, along with clammers from the Maine Clammers Association, deployed 120 boxes in the Harraseeket River in Freeport, Maine (six boxes in each of 10 sites along both the east and west side of the river from near the mouth to the head) and sampled the boxes in November. Results of that study were published in the *Journal of Shellfish Research* (Beal et al., 2018), and can be found here: <https://downeastinstitute.org/wp-content/uploads/2018/08/035.037.0101.pdf>.



Figure 4.

A soft-shell clam recruitment box made of spruce strapping, 1-ft x 2-ft x 3-inches deep. The top and bottom are lined with a heavy-duty window screening called PetScreen® made from vinyl-coated polyester that is 7x stronger than fiberglass and aluminum screening (see: http://www.wholescreensandglass.com/Phifer_Pet_Screen.html). Boxes are anchored to the mudflat surface by pounding a 20-inch wooden lath at each short end into the sediment to a depth of 17-inches. Galvanized trap nails are used to attach the lath to the box.

Subsequently, DEI staff has worked with others who have used the boxes to determine soft-shell clam recruitment rates in a variety of coastal communities, including Cutler, Machiasport, Gouldsboro, Sullivan, Bar Harbor, Blue Hill, Penobscot, Deer Isle, Stonington, Islesboro, Searsport, Thomaston, South Thomaston, Bremen, Damariscotta, and Harpswell.

DEI established a coastwide **Soft-Shell Clam Recruitment Monitoring Network** in early May 2020 to standardize the survey methods and expand the geographic footprint of this work. This network is funded for two years (February 2020-2022) through the Maine Sea Grant College Program. We are seeking other sources of funding to continue and expand the Network to build a comprehensive, long-term data set that can be used to predict future trends in recruitment, similar in concept to the American Lobster Settlement Index (ALSI).

Soft-Shell Clam Recruitment Monitoring Network

The overarching goals of the Soft-Shell Clam Recruitment Monitoring Network are to:

- Increase visibility and public awareness of a fishery that is threatened by a dramatically changing marine environment;
- Create an extensive data set for shellfish managers to better understand factors that affect the fishery; and,
- Encourage participation and learning by coastal residents including clambers, shellfish committee members, and other municipal officials as well as K-12 grade students, their teachers and parents.

The main goal of the coastwide network is to observe soft-shell clam recruitment in predator-protected boxes from May to November, and compare those results to core samples taken in November from the ambient mudflat surrounding the boxes. Differences in density or clam size between the cores and boxes likely is due to predation.

Nine communities with vital commercial or recreational shellfish programs across the coast of Maine have partnered with DEI to create the Network. In an effort to obtain recruitment information from a representative sample of the coast, locations were equally divided between three regions of the Maine coast (southwest, midcoast, downeast) (Table 1; Fig. 5).

Southwest	Midcoast	Downeast
1. Wells (York)	4. Wiscasset (Lincoln)	7. Frenchman’s Bay [Franklin & Lamoine] (Hancock)
2. Scarborough (Cumberland)	5. Bremen (Lincoln)	8. Beals (Washington)
3. Brunswick (Cumberland)	6. Islesboro (Waldo)	9. Sipayik (Washington)

Table 1. Municipal shellfish programs participating in the Soft-Shell Clam Recruitment Monitoring Network characterized by coastal region. (Counties in parenthesis).

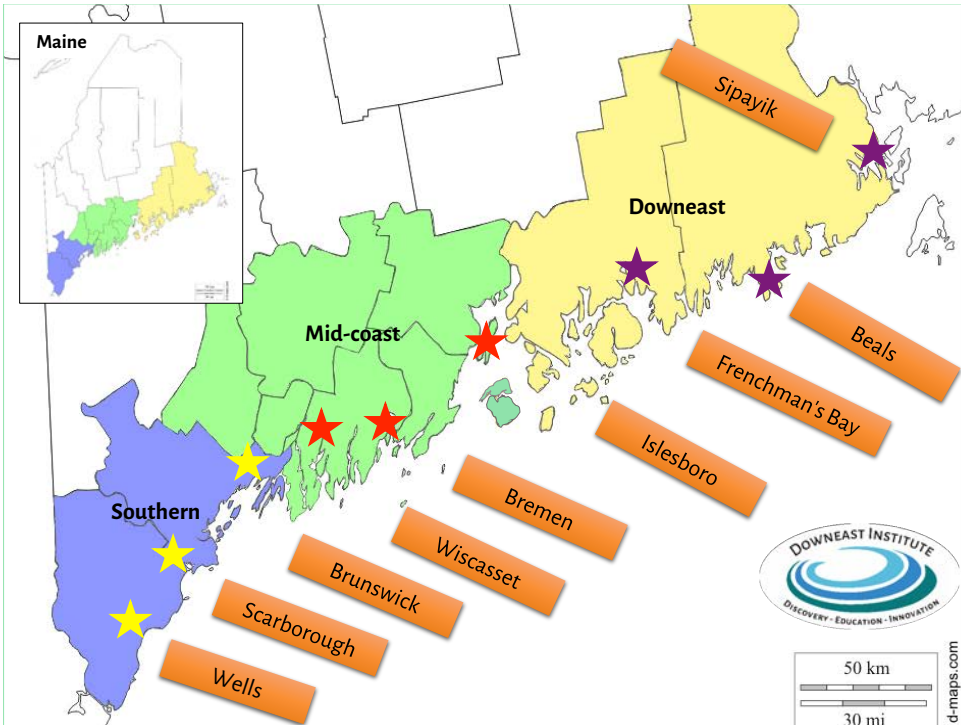


Figure 5. Map of towns participating in the Soft-shell Clam Recruitment Monitoring Network.

During the first two weeks of May 2020, within each community, recruitment boxes were placed in the lower mid-intertidal gradient at two flats. Standardizing placement at this tidal height on the flats allows for less ambiguous results. Deployment of the boxes and initial baseline clam density/clam size surveys occurred prior to clam spawning. Boxes were deployed during week one in each of the three southwest and one midcoast communities, while the remaining five communities began the project during week two. Because water temperatures trigger clam spawning, it is most likely for clams to spawn in midcoast and southern Maine prior to eastern Maine.

In addition, we introduced a small-scale experiment at each flat to compare the effectiveness of two different types of recruitment boxes. In more dynamic intertidal environments (typically characterized by sandy or gravelly sediments) we have observed erosion occurring under boxes, which can create gaps between the bottom of the box and the mudflat surface. Because the settling clams are many times smaller than the aperture of the PetScreen® (1.7 mm), they may enter the box from the top and exit immediately through the bottom into the gap. From previous field studies, it appears that woven ground cover bottoms may retain settling clams better than the PetScreen® bottoms in these conditions. To test this, one-half of the boxes at each flat have both a PetScreen® top and bottom, while the remaining half have a PetScreen® top and a ground cover bottom. The ground cover is constructed of UV-stabilized woven polypropylene.¹

Field Design

At each of the 18 intertidal flats (3 regions x 3 shellfish programs per region x 2 flats per community), sixteen boxes were deployed in a line parallel to the water's edge just above the mean low tide (0.0 ft) level. The experimental design we used is referred to as a “randomized complete block design” (Fig. 6). Blocks consist of two boxes approximately 3-ft apart: one with a screened bottom and the other with a ground cover bottom. Eight blocks (16 boxes) were installed at each flat with approximately 15-ft between each block.

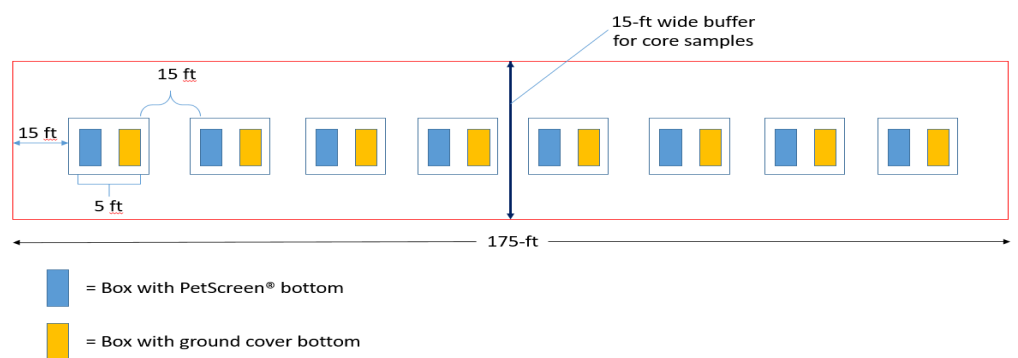


Figure 6.
Field layout at each flat.

¹ <https://www.americannettings.com/product/woven-ground-cover/>

In addition to soft-shell clams, recruitment boxes collect other organisms that can settle through the 1.7 mm mesh or that can crawl in through the mesh. Organisms that we have observed in the typical boxes (those with PetScreen® tops and bottoms) include other bivalves with planktonic larvae, such as: American oysters, European oysters, Baltic macomas, Blue mussels, False angel wings, Razor clams, Surf clams, Hard clams (quahogs), and False quahogs. We have also found several species of snails, such as: periwinkles, mud snails, and oyster drills. Other species we have encountered include bloodworms, sand worms, and sand shrimp. Finally, boxes do not completely deter predators, as we have found green crabs in some boxes. Green crabs can enter the boxes via settlement from the plankton (at sizes less than 1.5 mm in carapace width), or can crawl in through the aperture of the mesh shortly after they settle to the flats. Crabs that molt or shed can become entrapped in the recruitment box and prey on the clams and other organisms.

What About Controls?

The Clam Recruitment Monitoring Network experiments don't require controls because findings from two previous field studies, conducted in 2016 and 2018, allowed us to reach some important conclusions. In these studies DEI scientists placed control boxes (i.e. wooden frames without any screening on top or bottom) on the mud and determined that the number of clams found in the controls did not differ significantly from the number of clams found in core samples taken from the adjacent mudflat.

The 2018 field study also tested several additional types of controls. These included boxes with: 1) complete bottoms and tops with one-quarter of the PetScreen® removed; 2) complete bottoms and tops with three-quarters of the PetScreen® removed; 3) complete bottoms and no tops; and, 4) no bottoms and complete tops with PetScreen®. The average number of clams per square foot and average clam size were measured, and neither differed significantly between core samples taken from the control and those taken in the adjacent mudflat. These results verify that recruitment boxes do not attract clams, but are simply static collectors that reflect recruitment conditions at the particular site.

Hypotheses

The field design will allow us to test seven null hypotheses related to the average number and size of soft-shell clams found in the recruitment boxes in November:

1. There is no difference between regions;
2. There is no difference between communities within a region;
3. There is no difference between flats within a community and region;
4. There is no difference between the two treatments (PetScreen® vs. ground cover bottoms);

5. The relationship between clam number or clam size and the treatments does not differ between regions;
6. The relationship between clam number or clam size and the treatments does not differ between communities within a given region; and,
7. The relationship between clam number or clam size and treatments does not differ between flats within a community in a given region.

2020 Deployment

During the first two weeks in May 2020, we worked with a small crew of people in the nine communities to establish the Soft-Shell Clam Recruitment Monitoring Network sites (Table 2; Fig.5).

Region	Community	Flat	Latitude	Longitude	Date
Southwest	Wells	Dolphin Lane	43.312598	-70.566041	05/02/2020
		Upper Landing	43.328310	-70.564968	05/02/2020
	Scarborough	Jones Creek	43.545055	-70.337574	05/05/2020
		Winnock Neck	43.563433	-70.332752	05/05/2020
	Brunswick	Harpwell Cove	43.851390	-70.337574	05/03/2020
		Thomas Point	43.889054	-69.891326	05/03/2020
Midcoast	Wiscasset	Cushman Cove	43.980916	-69.675589	05/06/2020
		Maine Yankee	43.949494	-69.698933	05/06/2020
	Bremen	Sam's Cove	43.987371	-69.424402	05/14/2020
		Broad Cove	44.029679	-69.410194	05/14/2020
	Islesboro	Little Broad Cove	44.307537	-68.899876	05/12/2020
		Ryder Cove	44.342229	-68.888036	05/12/2020
Downeast	Lamoine	Raccoon Cove	44.467405	-68.284742	05/13/2020
	Franklin	Hog Bay	44.574758	-68.223165	05/13/2020
	Beals	Squid Pond	44.504950	-67.602240	05/11/2020
		Perio Point	44.521038	-67.609106	05/11/2020
	Sipayik	Half Moon Cove	44.951776	-67.043796	05/15/2020
		Gleason Cove	44.967142	-67.054778	05/15/2020

Table 2. Regions, Communities, Local name of Flat, Latitude/Longitude and deployment date of soft-shell clam recruitment boxes.

After recruitment boxes were installed at each flat, we took bottom core samples (N = 16) using a coring device that was 6-inches in diameter x 6-inches deep (approximately 0.02 ft²). Two samples were taken from each of the eight blocks (Fig. 5) at a distance several feet away from each box. The samples enabled us to establish initial density, average size, and size distribution of clams at each location (Table 3).

Region	Community	Flat	# clams/ft ²	Size (mm)	Size (in.)
Southwest	Wells	Dolphin Lane	3.2	4.5	0.177
		Upper Landing	3.5	4.6	0.181
	Scarborough	Jones Creek	1.9	8.6	0.339
		Winnock Neck	29.6	40.8	1.606
	Brunswick	Harpwell Cove	0.0	.	.
		Thomas Point	1.3	5.8	0.228
Midcoast	Wiscasset	Cushman Cove	23.9	23.4	0.921
		Maine Yankee	17.2	18.1	0.713
	Bremen	Sam's Cove	0.0	.	.
		Broad Cove	0.6	11.3	0.445
	Islesboro	Little Broad Cove	0.9	4.5	0.1777
		Ryder Cove	3.2	7.2	0.283
Downeast	Lamoine	Raccoon Cove	28.0	39.3	1.547
	Franklin	Hog Bay	2.2	10.4	0.409
	Beals	Squid Pond	2.2	3.5	0.138
		Perio Point	8.3	7.0	0.276
	Sipayik	Half Moon Cove	4.8	5.1	0.201
		Gleason Cove	1.9	4.7	0.185

Table 3. Region, Community, flat, soft-shell clam density (# individuals/ft²), and average shell length of clams found (mm and inches).

We have included additional information about the May 2020 survey results from each flat in the Appendix.

Next Steps

Recruitment boxes will remain in the field until November 2020 when they will be removed and the contents of each washed through a 1 mm sieve. All clams from each box will be counted, and a representative sample of individuals measured to give an estimate of the distribution of sizes. In addition, the adjacent (unprotected) mudflat will be sampled using the same 6-inch diameter x 6-inch deep coring device used in May. The number and size of clam recruits in the core samples will be compared to what is found in the recruitment boxes. The difference in number per square foot and/or size distribution of clams between boxes and the core samples reflects the difference that this type of predator protection affords (aka the recruit “survival rate”). Knowing the survival rate gives Shellfish Committees information about why a flat is commercially productive or not.

Volunteers

We thank each person who assisted us in the field and with coordination, and appreciate their time and effort in helping initiate this project.

Community

Wells

Assistants

Everett Leach, Shellfish Warden
Mike Yorke, Harbormaster
Ken Lowell, Shellfish Committee member
Aaron Gott

Scarborough

Randy Richardson, Shellfish Warden
Nate Orff, Shellfish Committee Chair
Chad Coffin (Maine Clammers Association)

Brunswick

Dan Deveraux, Shellfish Coordinator
Susan Olcott, Shellfish Committee Chair
Dan Sylvain, Shellfish Warden

Wiscasset

Donnie James, Shellfish Committee Chair, clammer
Timmy James, Shellfish Committee member, clammer

Bremen

Boe Marsh, Shellfish Committee Chair
Jamie Farrar, clammer
Scott Hutchison, clammer
Bobby Kaler, clammer
Dale Witham, clammer

Islesboro

Janis Petzel, Shellfish Committee Chair
Dave Petzel
Ken Smith, Shellfish Committee member
Travis Sterns

Lamoine/Franklin

Joe Porada, Shellfish Committee Chair, clammer
Mark Whiting (Hancock Soil & Water Conservation District)

Beals

Evan Busch
Hannah Carver
Aquila Chase
Rachel Smith
Robert Alley, Shellfish Committee Chair, clammer

Sipayik

Chris Johnson (Sipayik Tribal Government)
Chris Bartlett (Maine Sea Grant)

We look forward to working with you (and, hopefully, clammers, teachers, and K-12 grade students) in the fall. Thank you!



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- Beal, B. F., Nault, D.- M., Annis, H., Thayer, P., Leighton, H., & B. Ellis. 2016. Comparative, large-scale field trials along the Maine coast to assess management options to enhance populations of the commercially important soft-shell clam, *Mya arenaria* L. *Journal of Shellfish Research* 35(4), 711–727.



Appendix

Spring 2020

Baseline Clam Survey Results

May 2020

Southern Maine

Wells

Scarborough

Brunswick

Wells, Maine

Upper Landing & Dolphin Lane (2 May 2020)

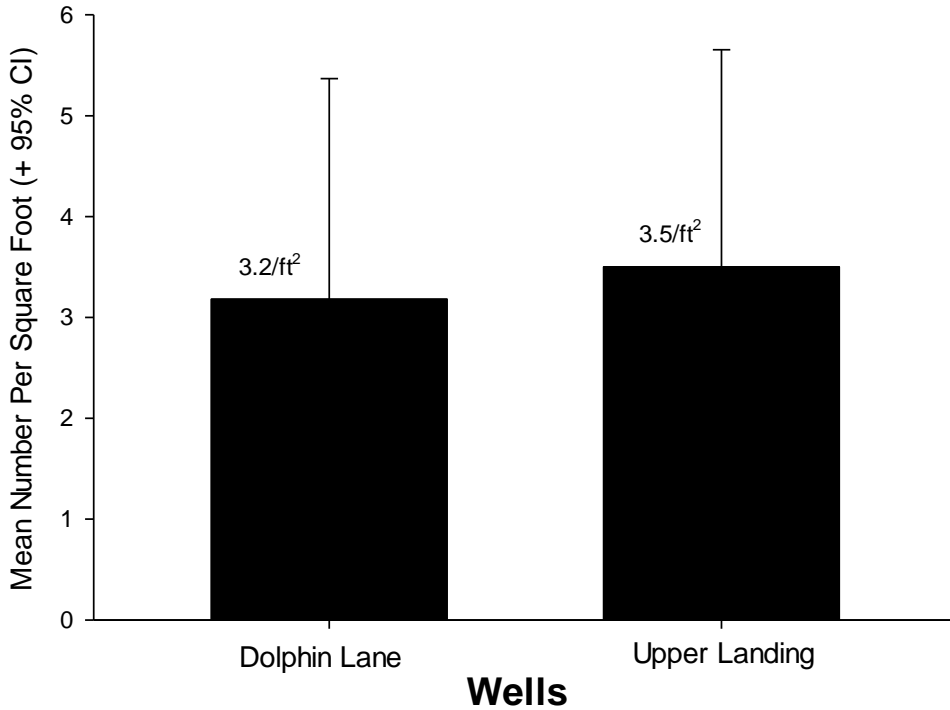


Figure A-1.

Average number of soft-shell clams per square feet at Upper Landing and Dolphin Lane study sites (n = 16).

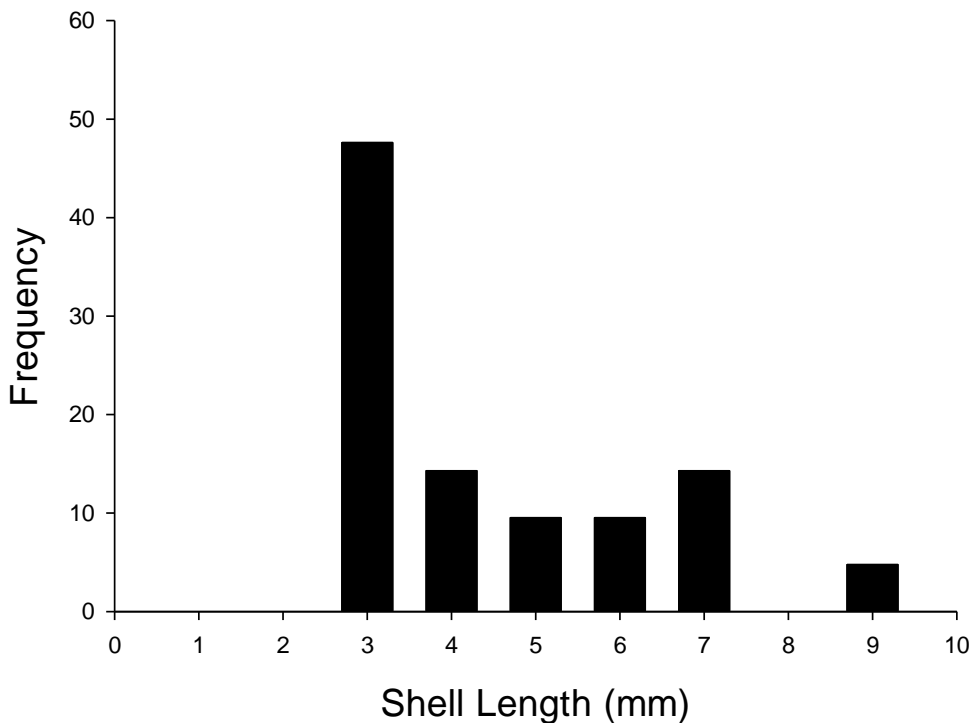


Figure A-2.

Shell length of soft-shell clams at both study sites combined (n = 21).

Scarborough, Maine

Jones Creek and Winnock Neck (5 May 2020)

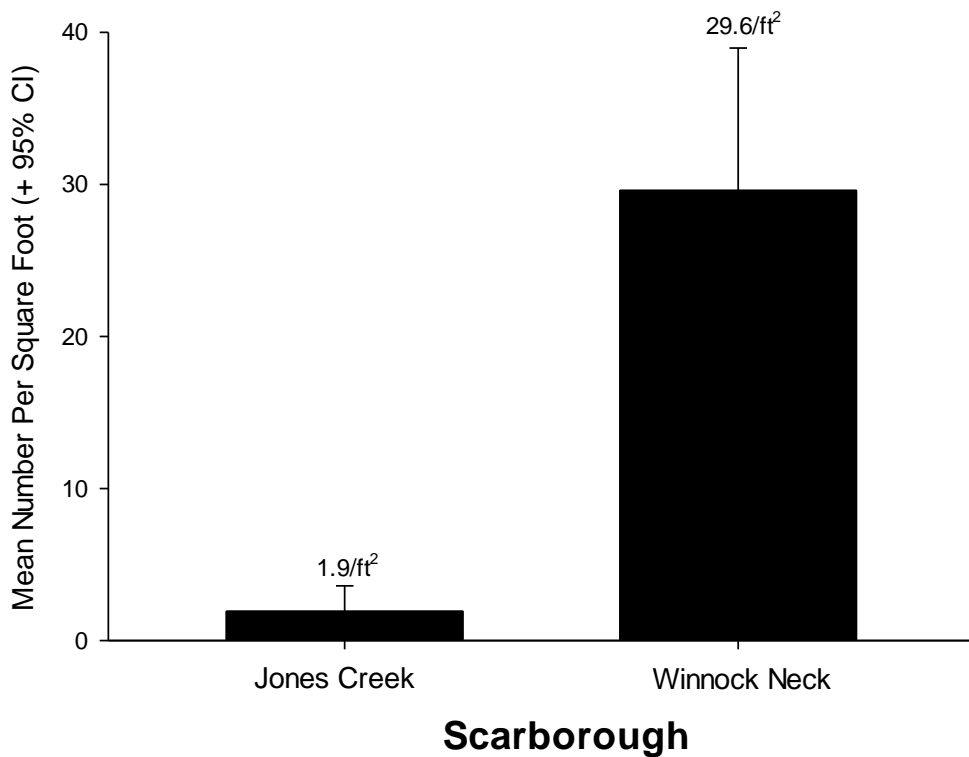


Figure A-4.

Average number of soft-shell clams per square feet at Jones Creek and Winnock Neck study sites (n = 16).

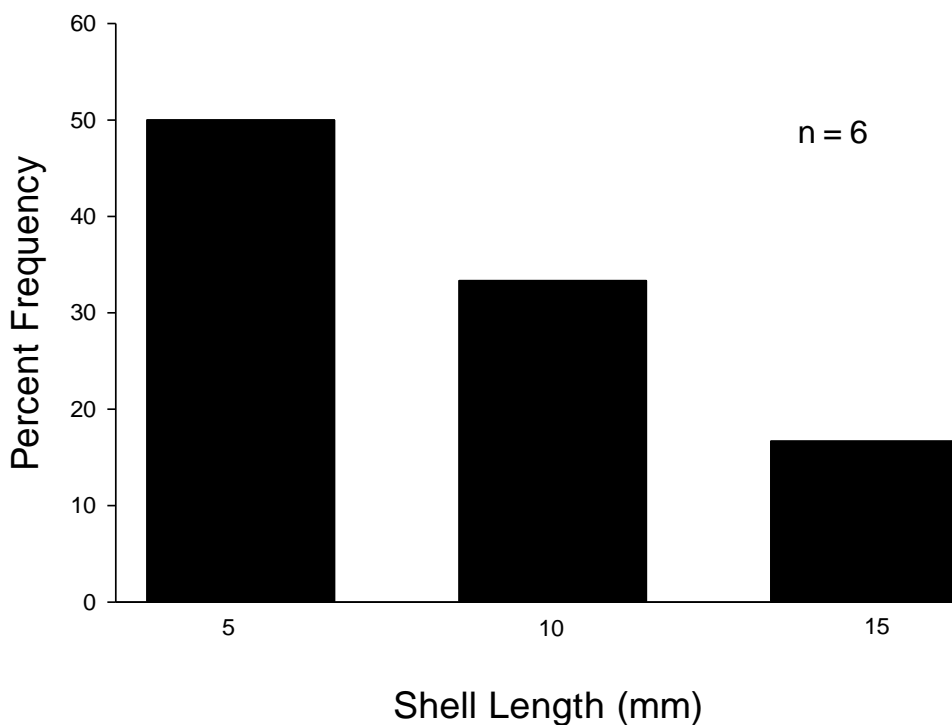


Figure A-5.

The distribution of clam sizes at Jones Creek, Scarborough, Maine. Mean shell length = 9.02 ± 4.3 mm (n = 5).

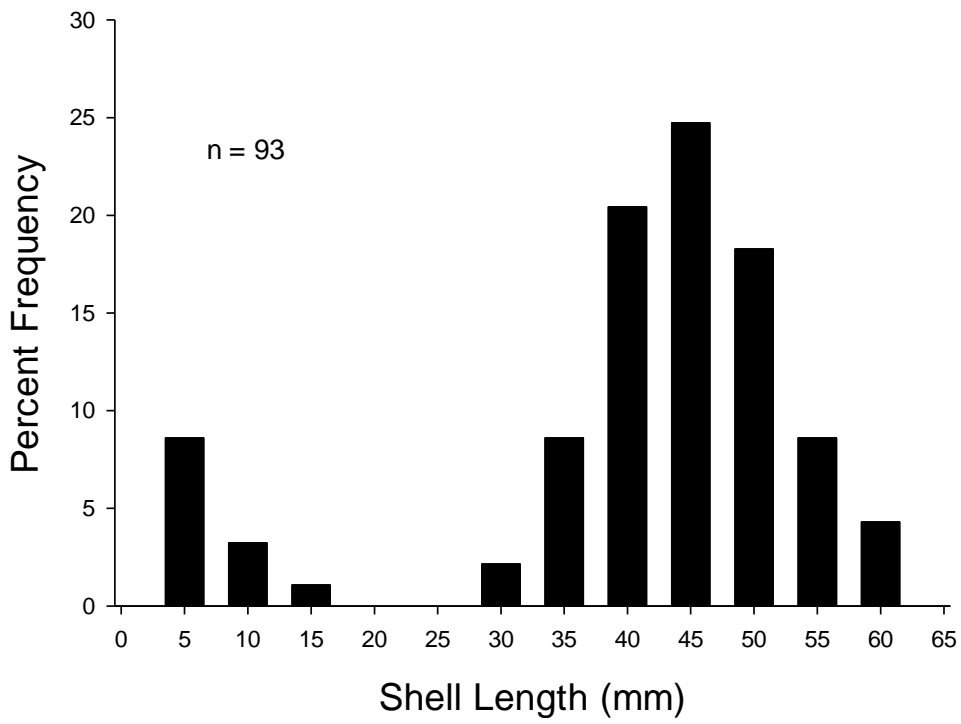


Figure A-6. Size frequency distribution of soft-shell clams at Winnock Neck, Scarborough Maine.

Brunswick, Maine

Harpswell Cove & Thomas Point Beach (3 May 2020)

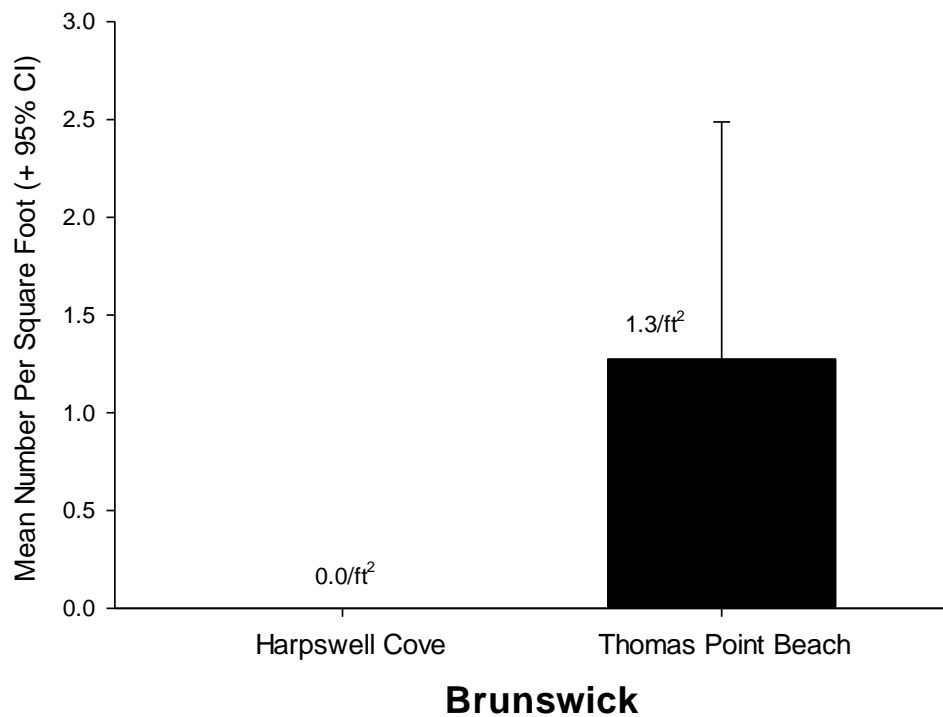


Figure A-3.

Average number of soft-shell clams per square feet at Harpswell Cove and Thomas Point Beach study sites (n = 16).

Harpswell Cove:

No clams (*Mercenaria* or *Mya*) were found in the 16 core samples.

Thomas Point Beach:

Four *Mya* were recovered in the 16 cores from Thomas Point Beach. The sizes of these individuals were as follows: 4.55 mm, 6.46 mm, 7.40 mm, and 4.75 mm.

In addition, two cores from Thomas Point Beach contained hard clams, *Mercenaria mercenaria*. Two occurred in one core (these measured 42.13 mm and 46.49 mm in length), and one occurred in another core (it measured 42.88 mm). All three clams were 3 years old. The density of hard clams was 0.64 ± 0.93 individuals per ft².

Midcoast Maine

Wiscasset

Bremen

Islesboro

Wiscasset, Maine

Cushman Cove & Maine Yankee (6 May 2020)

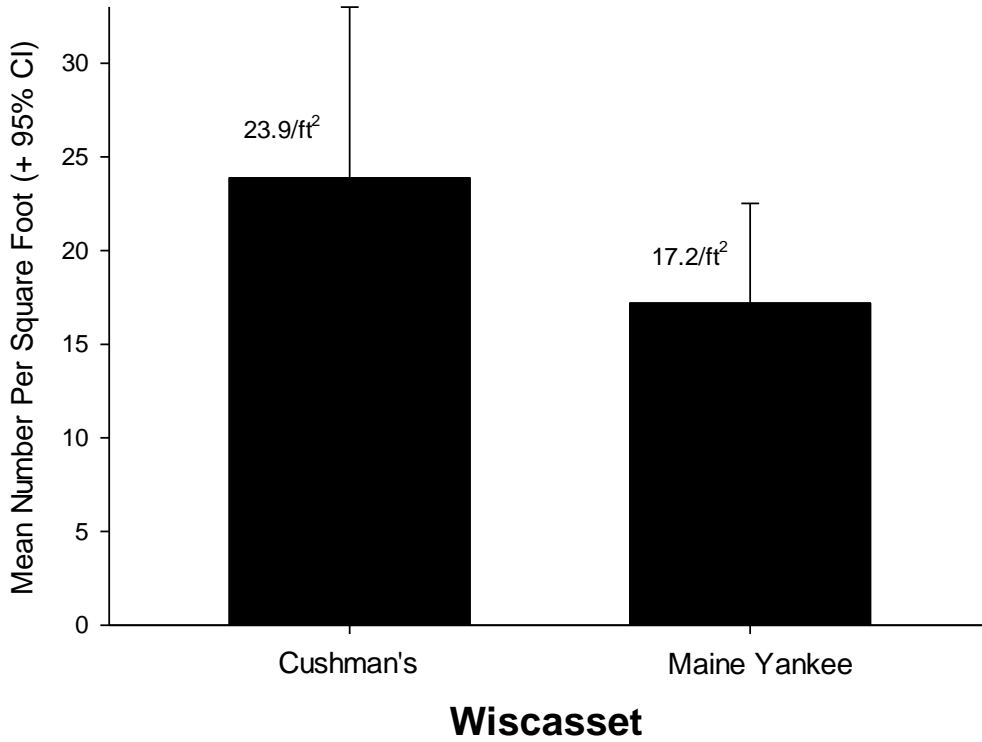


Figure A-7. Average number of soft-shell clams per square feet at Cushman Cove and the Maine Yankee study sites (n = 16).

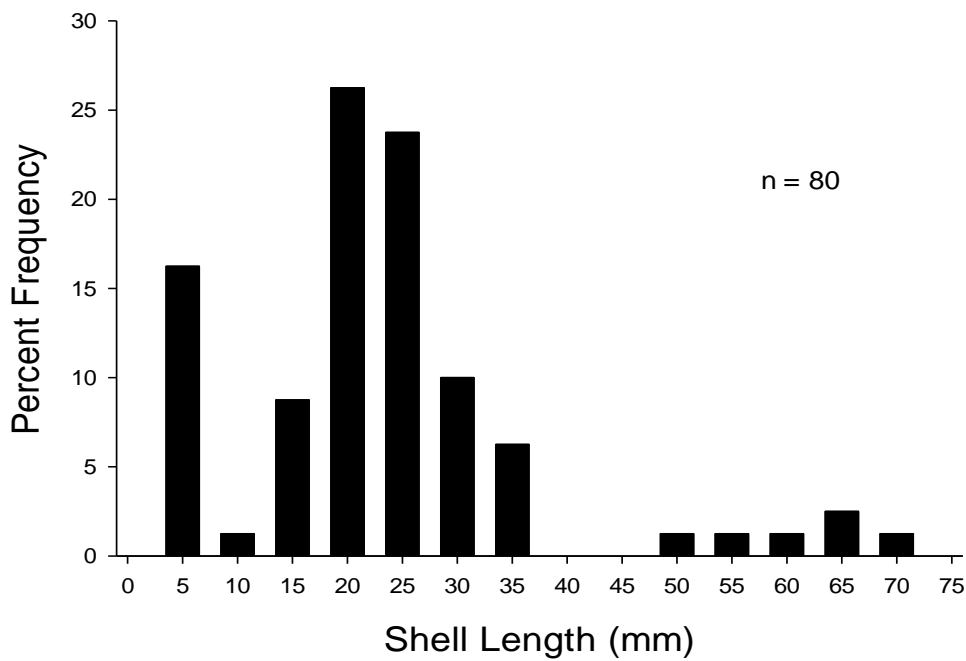


Figure A-8. Size frequency distribution of soft-shell clams at Cushman Cove, Wiscasset Maine.

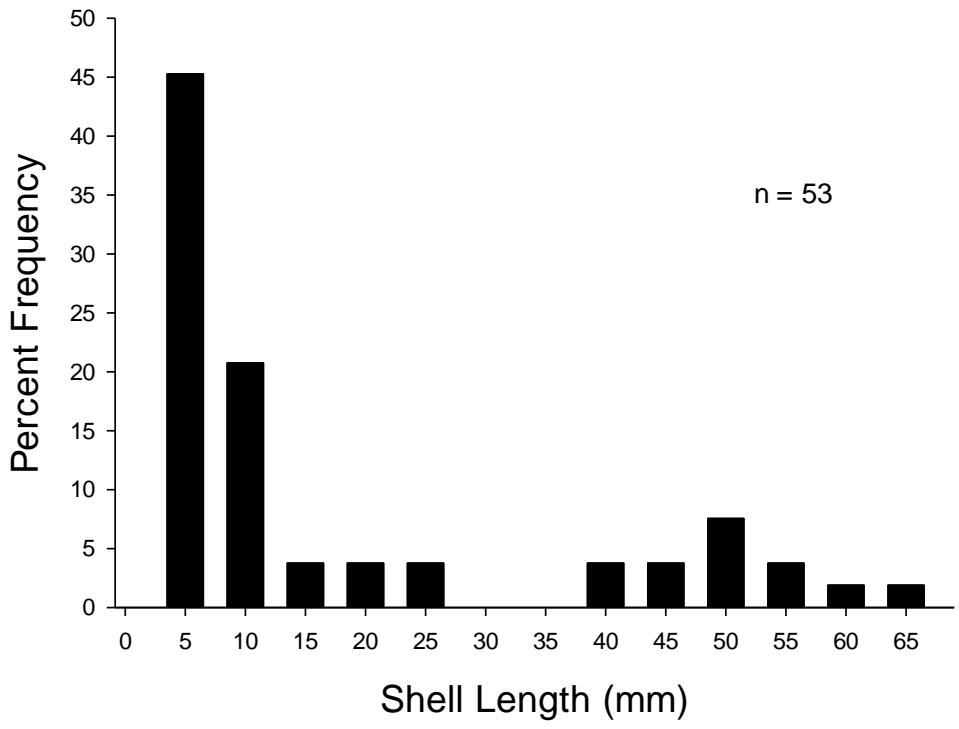


Figure A-9.
 Size frequency distribution of soft-shell clams at Maine Yankee, Wiscasset, Maine.

Bremen, Maine

Broad Cove & Sam's Cove (14 May 2020)

Broad Cove:

Of the sixteen core samples taken at Broad Cove, all but one had no soft-shell clams. One core had two clams (9.77 mm and 12.73 mm). This is an average of 0.64 ± 2.63 clams per square foot. This density is nearly identical to that estimated in November 2019 when a brushing study was completed at the same site and tidal height.

Sam's Cove:

No soft-shell clams were found in any of the sixteen core samples at this site. Four cores contained the false quahog (*Pitar morrhuanus*). This results in a density of 1.27 ± 1.21 individuals per square foot. These look a lot like the northern quahog (see Fig. 19). In addition, the northern hard clam, or quahog (*Mercenaria mercenaria*) was found in three cores, which represents a density of 0.95 ± 2.05 individuals per square foot.



Figure A-19.

The false quahog, *Pitar morrhuanus* (left; 50.9 mm), and northern quahog, *Mercenaria mercenaria* (right; 57.9 mm).

Islesboro, Maine

Ryder Cove & Little Broad Cove (12 May 2020)

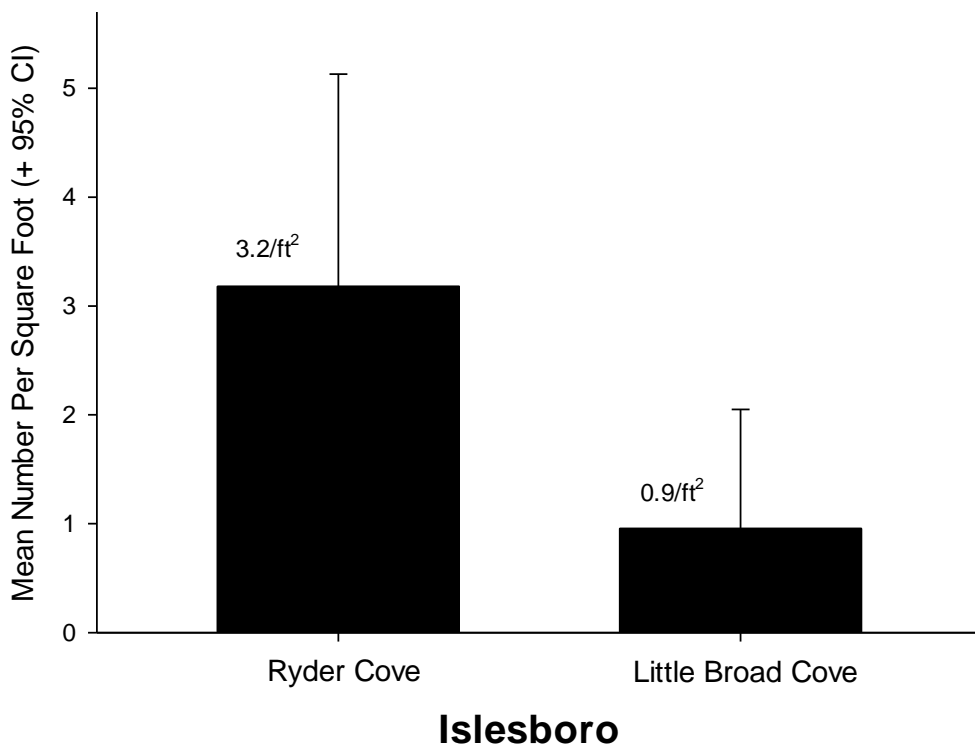


Figure A-13.

Average number of soft-shell clams per square feet at Ryder Cove and Little Broad Cove study sites (n = 16).

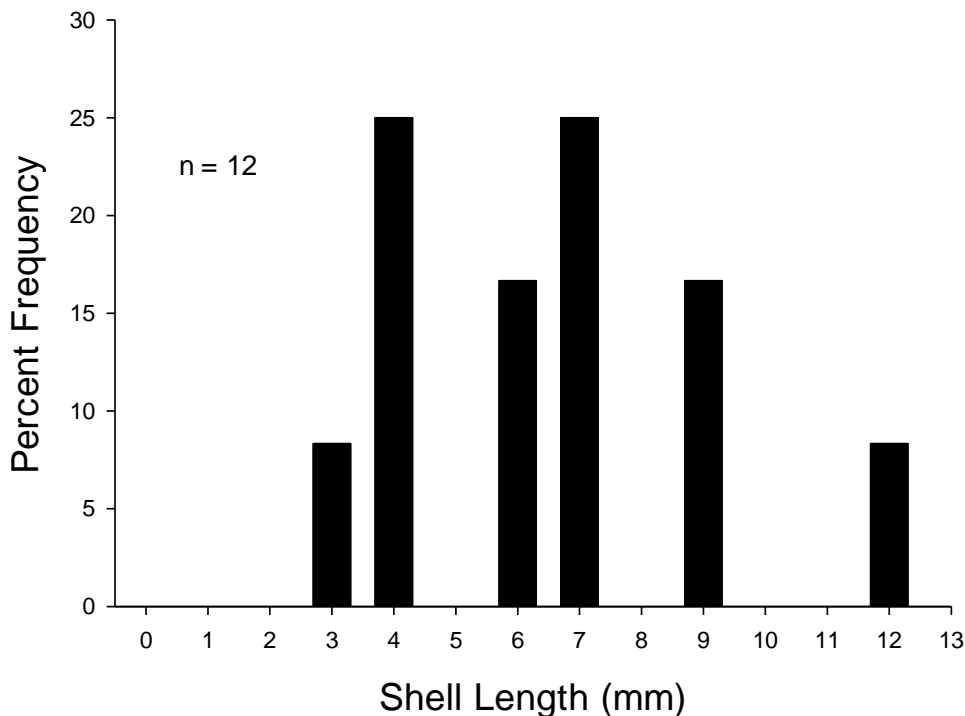


Figure A-14.

Size frequency distribution of soft-shell clams at Ryder Cove and Little Broad Cove, Islesboro, Maine. Average shell length (Ryder Cove) = 7.2 ± 2.06 mm (n = 9). Average shell length (Little Broad Cove) = 4.5 ± 4.8 mm (n = 3).

In addition to clams in the samples, two green crabs were found in separate cores at both sites. At Ryder Cove, green crabs were found in core #1 (5.12 mm carapace width, CW) and #7 (5.30 mm CW). At Little Broad Cove, green crabs were found in core #11 (4.42 mm CW) and #13 (16.08 mm CW).

Milky ribbon worms (*Cerebratulus lacteus*) and another species of ribbon worm – the red ribbon worm (*Lineus ruber*), both soft-shell clam predators, were found in cores at both locations. These are not Annelid polychaetes worms (commercial, and segmented), but unsegmented worms from another Phylum (Nemertea). One occurred in a single core at Little Broad Cove; however, seven were discovered in cores at Ryder Cove (or about 2.2/ft²).

Downeast Maine

Frenchman's Bay

Beals

Sipayik

Frenchman's Bay Regional Shellfish Committee

Raccoon Cove, Lamoine & Hog Bay, Franklin (May 13, 2020)

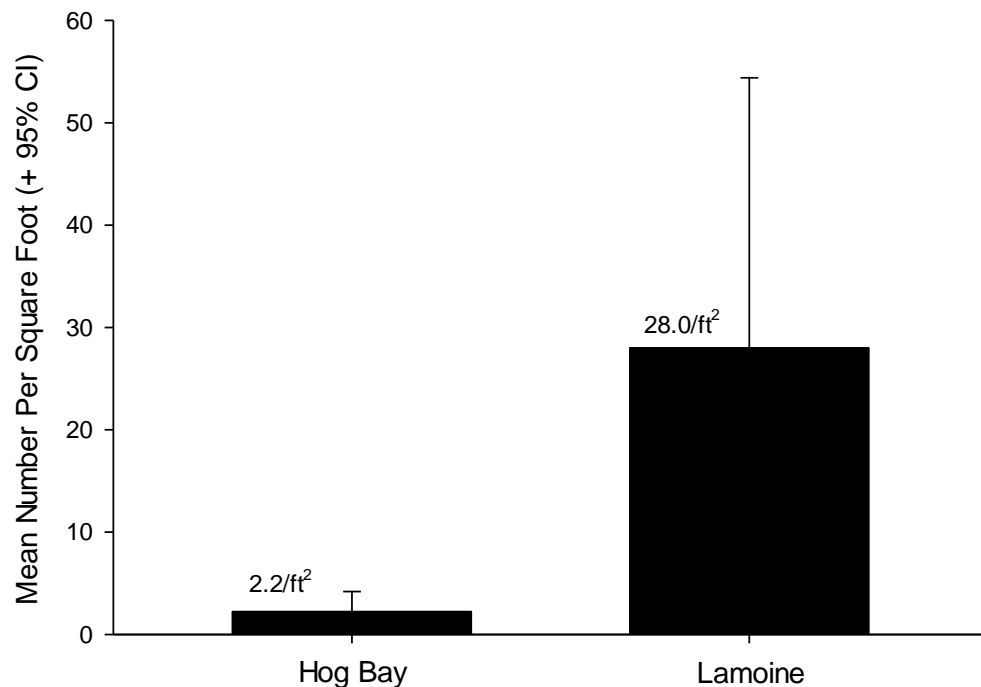


Figure A-15.

Average number of soft-shell clams per square feet at Hog Bay (Franklin) and Raccoon Cove (Lamoine) study sites. (n = 16) The data from Lamoine contains a sample that had 41 live soft-shell clams, and it was the only sample that contained more than four clams. This may not be representative of that site.

Frenchman's Bay

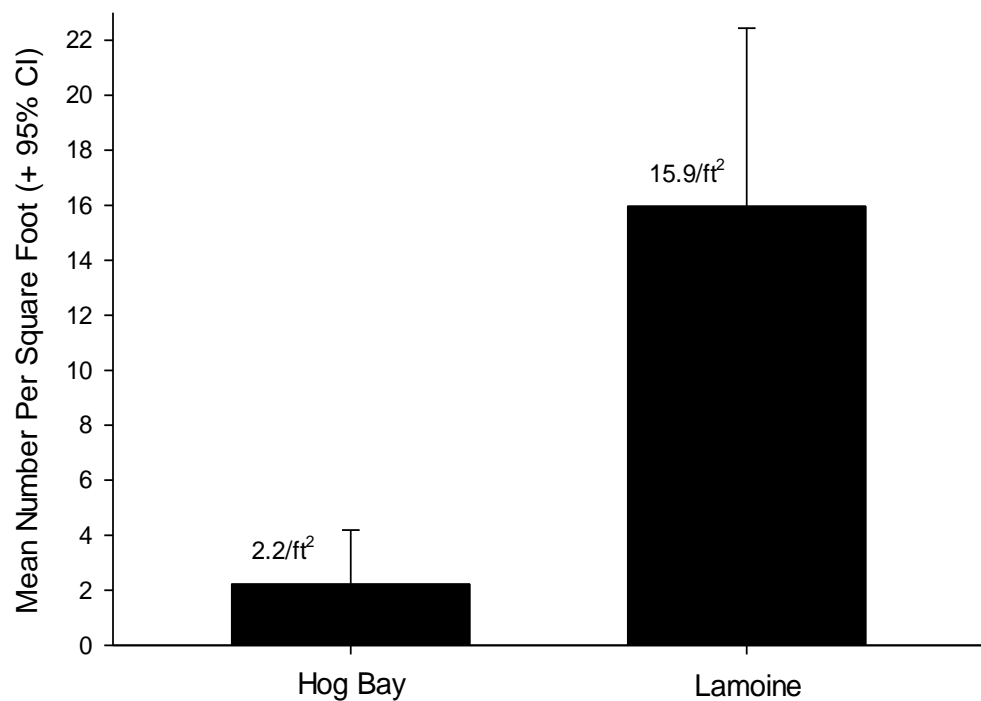


Figure A-16.

Average number of soft-shell clams per square feet at Hog Bay (Franklin) (n = 16) and Raccoon Cove (Lamoine) study sites (n = 15). The data from Lamoine excludes one core sample that contained 41 live soft-shell clams. This chart may be more representative of the population at Raccoon Cove.

Frenchman's Bay

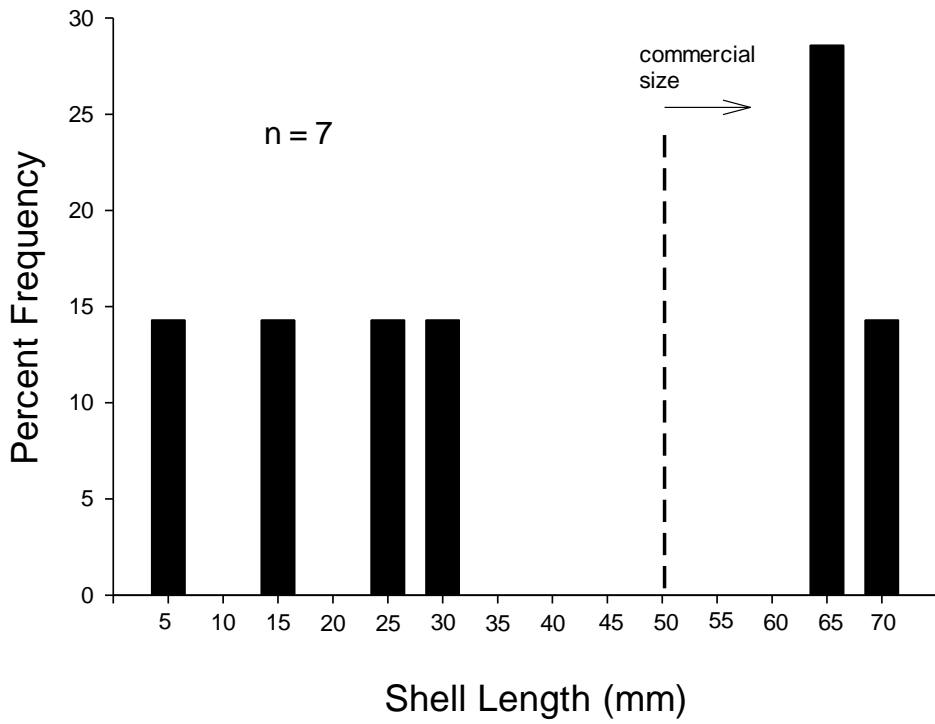


Figure A-17. Size frequency distribution of soft-shell clams at Hog Bay in Franklin, Maine. Average shell length = 39.3 ± 25.47 mm (n = 7).

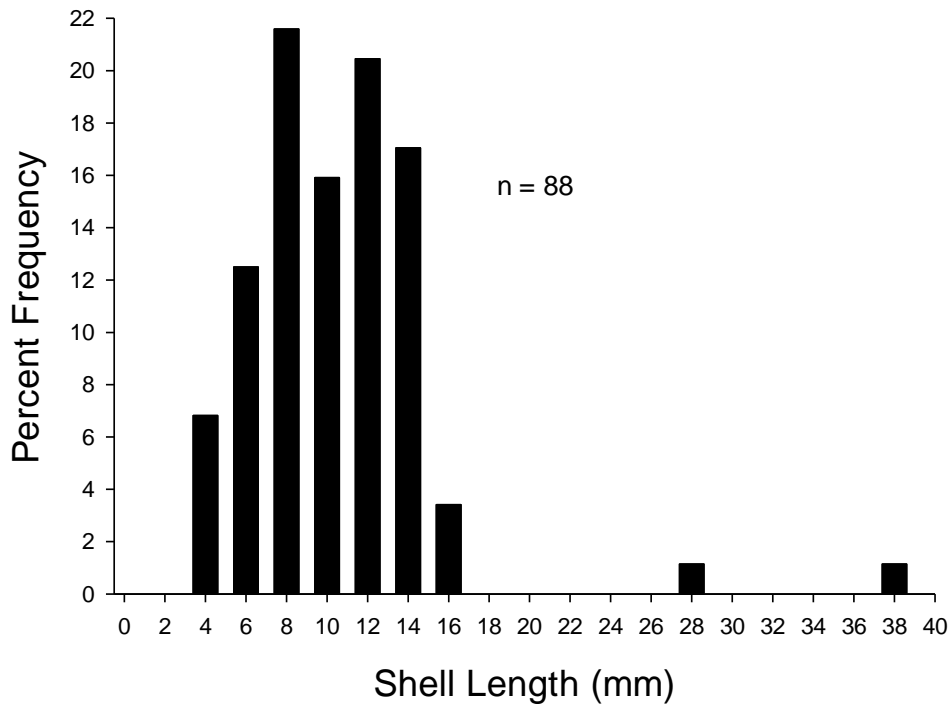


Figure A-18. Size frequency distribution of soft-shell clams at Raccoon Cove in Lamoine, Maine. Average shell length = 10.4 ± 0.99 mm (n = 88). This distribution includes all clams sampled in the sixteen cores.

Beals, Maine

Squid Pond & Perio Point (11 May 2020)

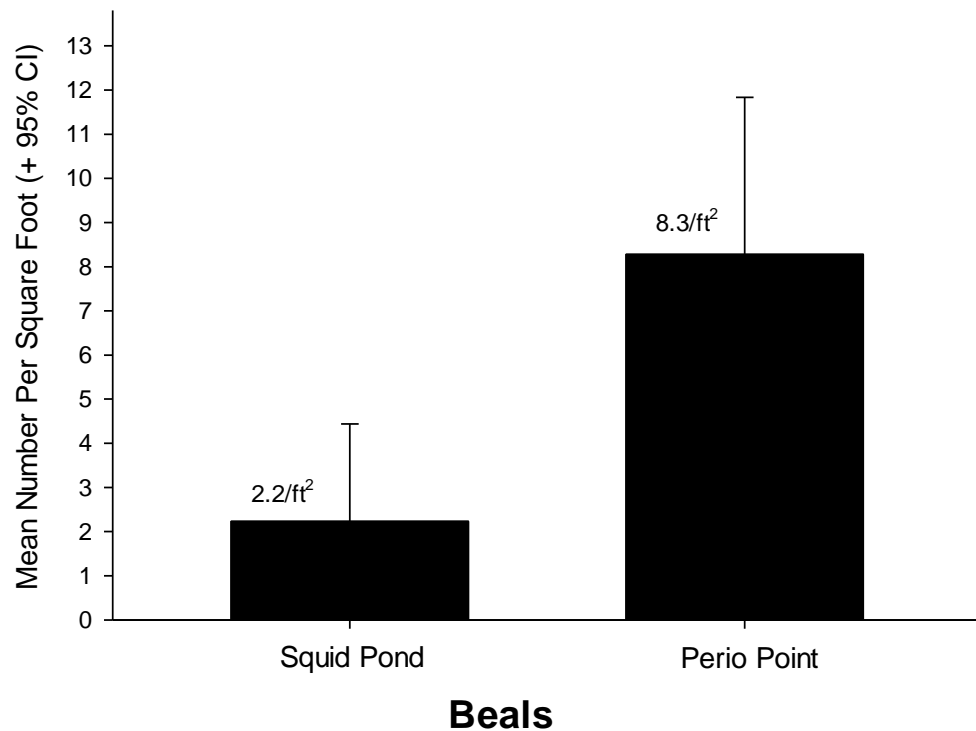


Figure A-10.

Average number of soft-shell clams per square feet at the Squid Pond and Perio Point study sites (n = 16).

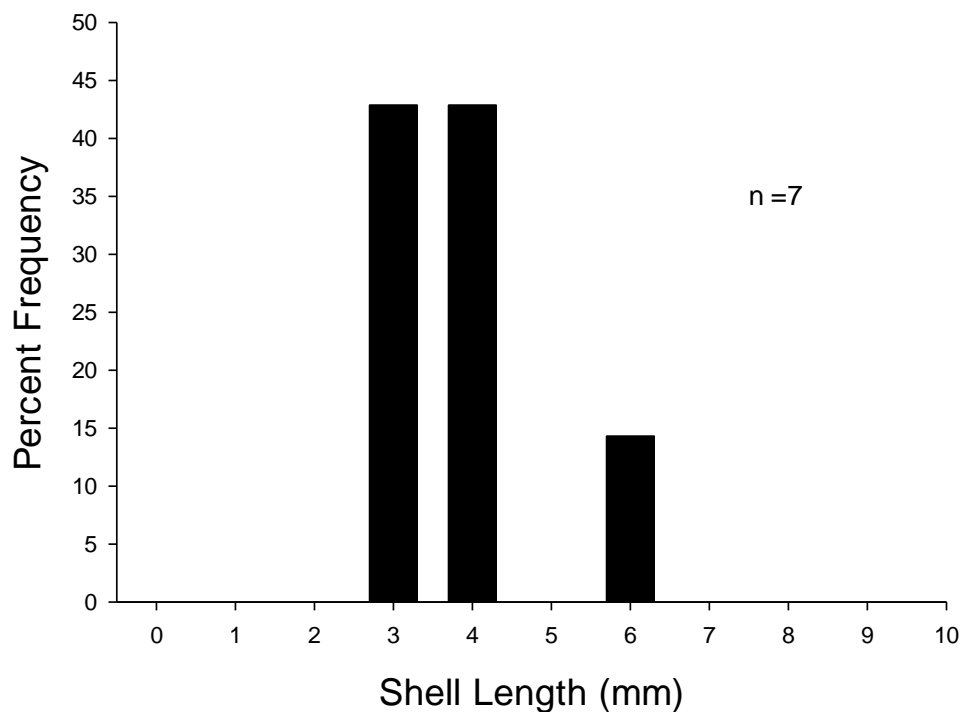


Figure A-11.

Size frequency distribution of soft-shell clams at the Squid Pond, Great Wass Island, Beals, Maine. Average shell length = 3.5 ± 0.98 mm.

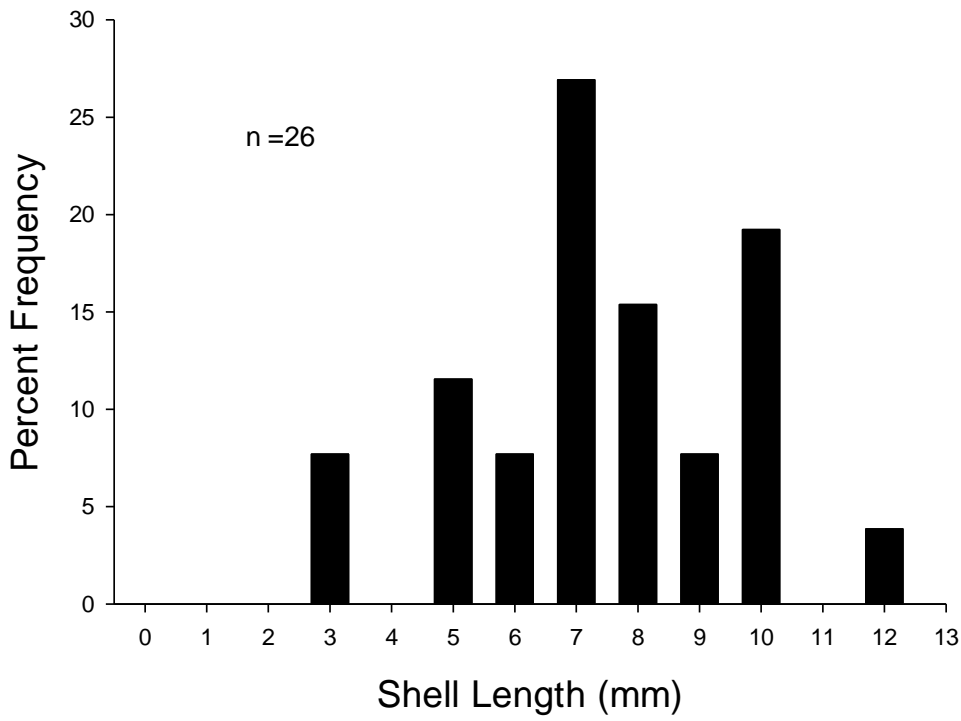


Figure A-12. Size frequency distribution of soft-shell clams at Perio Point, Beals Island, Beals, Maine. Average shell length = 7.0 ± 1.37 mm.

Sipayik, Maine

Gleason Cove & Half Moon Cove (15 May 2020)

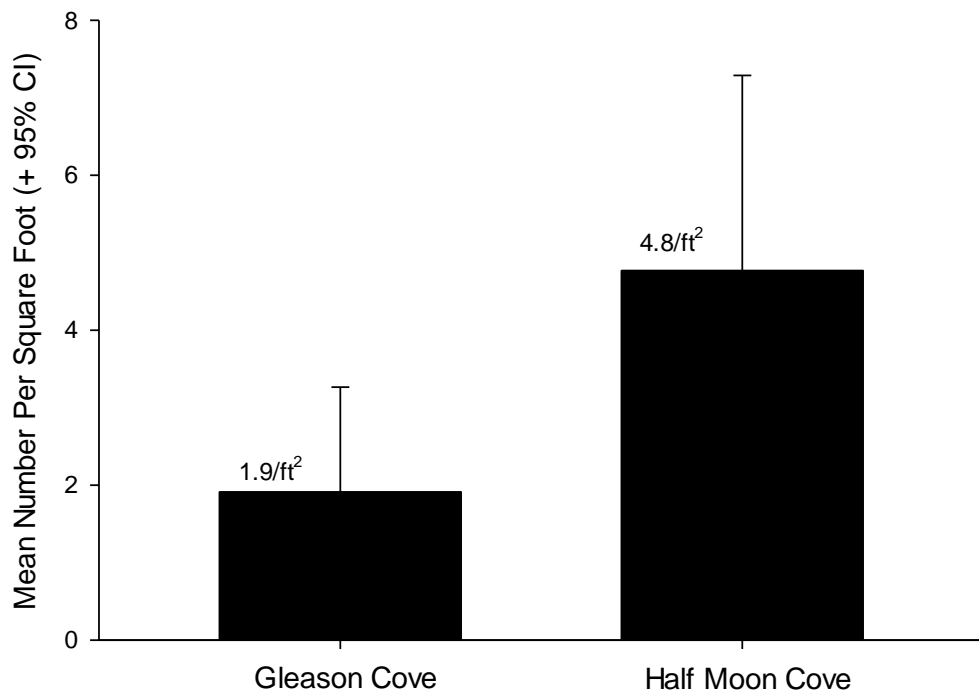


Figure A-20. Average number of soft-shell clams per square feet at Gleason Cove and Half Moon Cove study sites (n = 16).

Sipayik

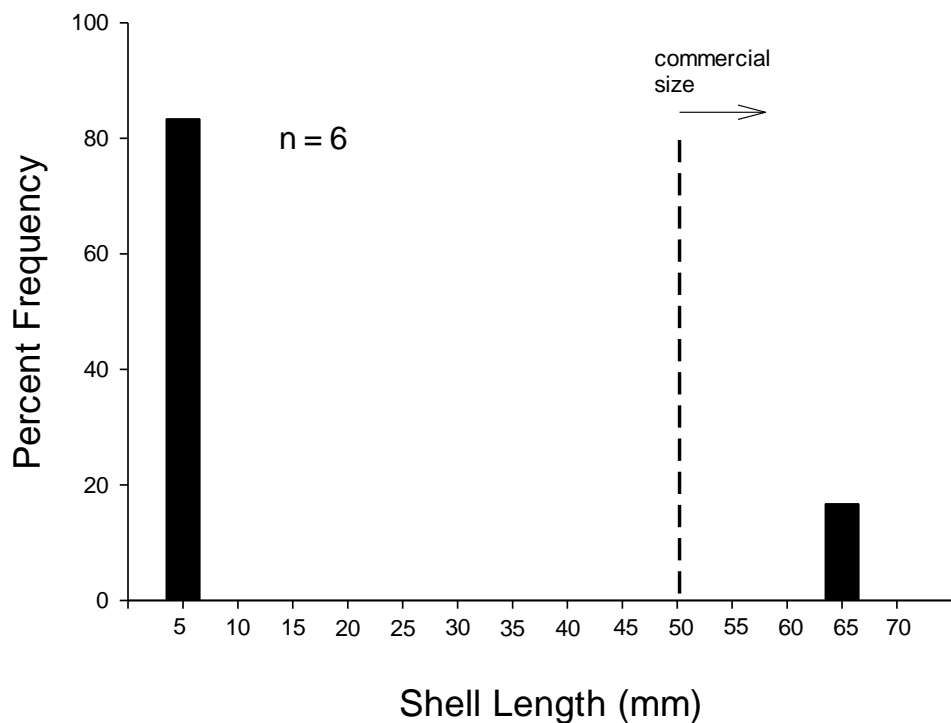


Figure A-21. Size frequency distribution of soft-shell clams at Gleason Cove in Sipayik, Maine. Median shell length = 4.67 mm (n = 6).

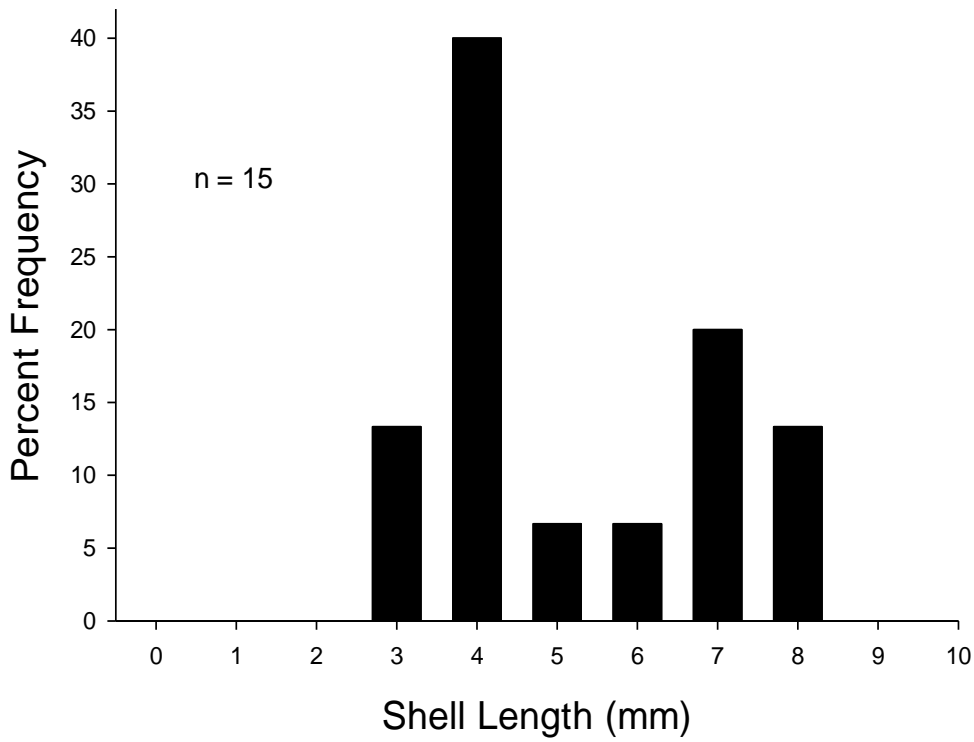


Figure A-22. Size frequency distribution of soft-shell clams at Half Moon Cove in Sipayik, Maine. Mean shell length = 5.07 ± 1.04 mm (n = 15).