

Characterization of bottom fauna and submerged aquatic vegetation

Proposed lease site of Bailey Coffin for a standard lease (non-discharge)
located in Freeport, Maine.



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General comments

I visited the proposed lease site of Ms. Bailey Coffin on (Figs. 1 & 2) Friday, July 15, 2022 during low tide, which according to a NOAA tidal chart occurred at 6:52 am in Portland, Maine with a height of -1.5 ft. That is, it was an unusually low tide, even for a spring tide. I arrived at the site one hour prior to low tide, and left the site approximately one hour after low tide.

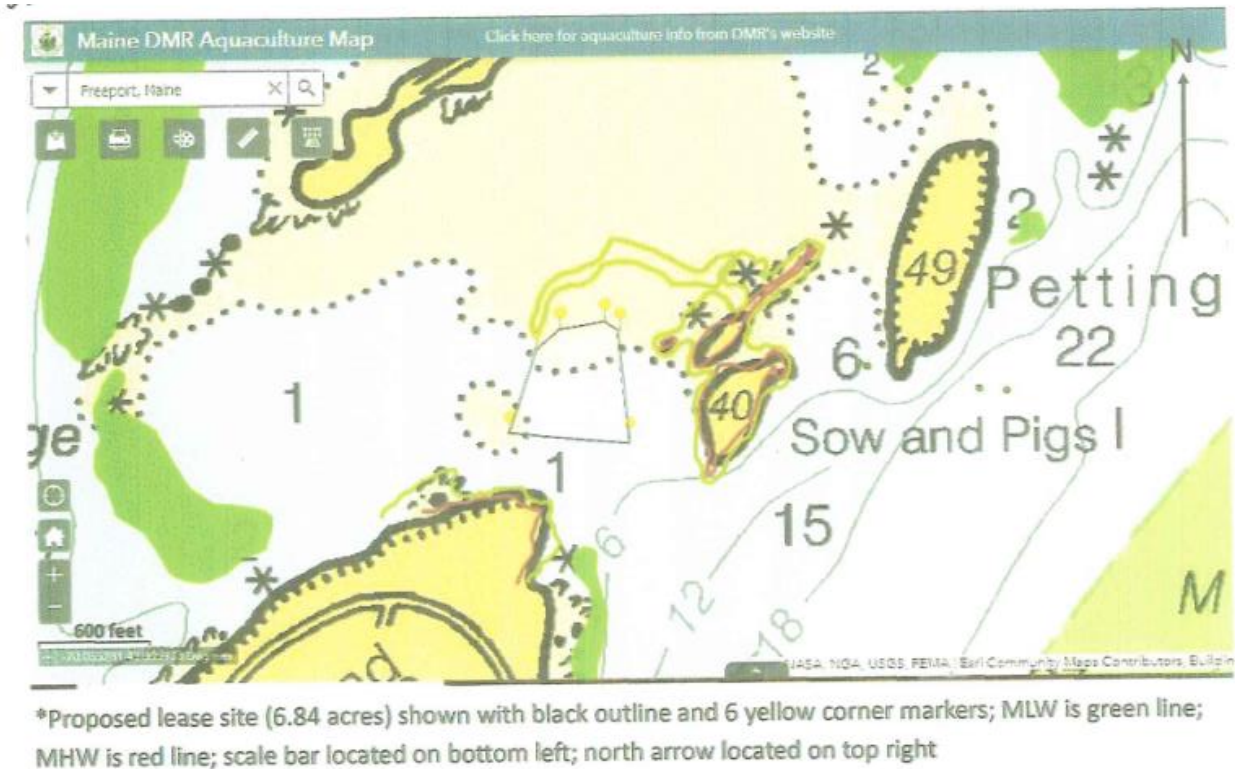


Figure 1. The proposed lease site (polygon in the center of the nautical chart) of Ms. Bailey Coffin in Freeport, Maine. Figure from: https://www.maine.gov/dmr/aquaculture/leases/pending/documents/COMPLETE_05.17.21_Coffin_Bailey.pdf. The nearest land (southwest of the proposed lease site) is the northeast corner of Bustins Island.

During the visit, approximately one-half of the site was exposed revealing a muddy bottom littered with mostly dead valves of four bivalve species: soft-shell clam, *Mya arenaria*; northern quahog, *Mercenaria mercenaria*; blue mussel, *Mytilus edulis*; and, European oyster, *Ostrea edulis*. I walked across the exposed mud and took several photographs of the bottom (Figs. 3-4).

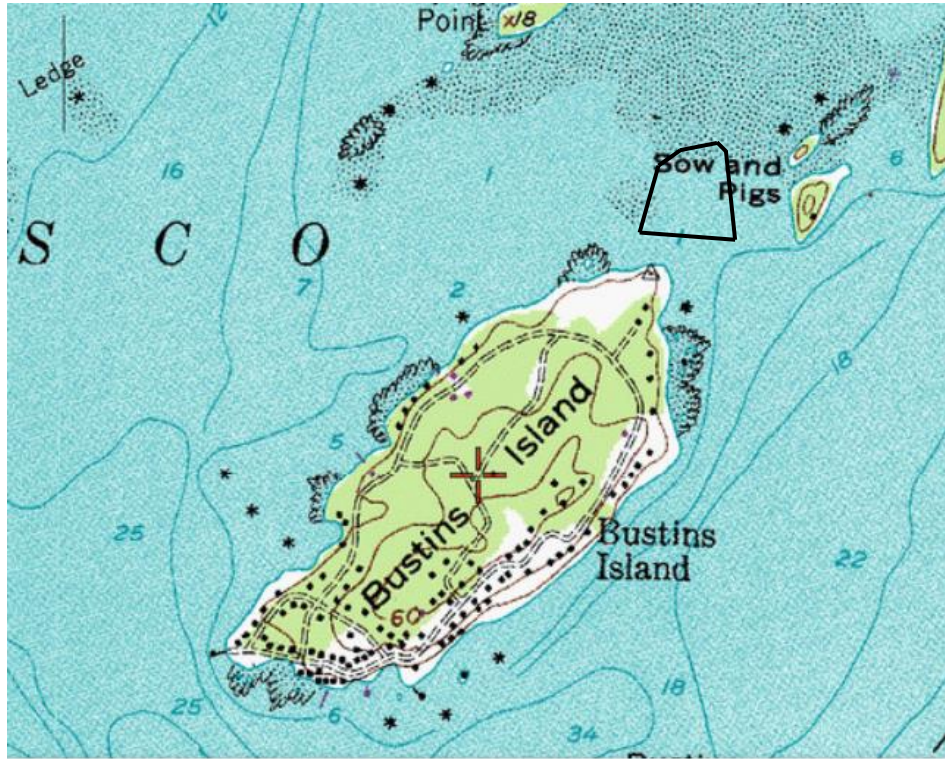


Figure 2. Topographic map of Bustins Island, and Sow and Pigs along with a drawn polygon representing the proposed lease site of Ms. Bailey Coffin. The northeastern tip of Bustins Island is located at: $43^{\circ}47'56.29''\text{N}$; $70^{\circ}04'11.18''\text{W}$. The southwest corner of the proposed lease site (red star) is located at: $43^{\circ}48'19.03''\text{N}$; $70^{\circ}04'0.69''\text{W}$.



Figure 3. A) Taken near the northeast corner of the proposed lease site looking toward the northeast tip of Bustins Island. B) Close-up of shells scattered about the entire bottom.



Figure 4. The exposed soft bottom of the proposed lease site with mostly dead, disarticulated quahog and soft-shell clam shells along with a few European oyster shells. Photo is looking southwest towards Bustins Island.

Methods

The purpose of the visit to the proposed lease site was to characterize the benthic fauna and flora. Once the tide had receded to its lowest level (-1.5 ft at 6:52 am), a series of four 35-meter line transects were established (Fig. 5) and five benthic core samples (area = 0.1963 ft², or 0.01824 m²) were taken randomly along each line (N = 20; Fig. 6). Samples were placed in labeled plastic bags, and the contents of each were washed through a 1 mm sieve within two hours after sampling. The

residue on the sieve was examined closely for live polychaete and nemertean worms, bivalves, gastropods, crustaceans, and fish. The shell length (greatest linear distance) of all bivalves, except European oysters, was recorded to the nearest 0.1 mm using digital calipers. Shell height (greatest linear distance from the umbo to the ventral margin) was recorded for European oysters. In addition, shell length (greatest linear distance from the spire to the bottom of the aperture) was recorded for common periwinkles.

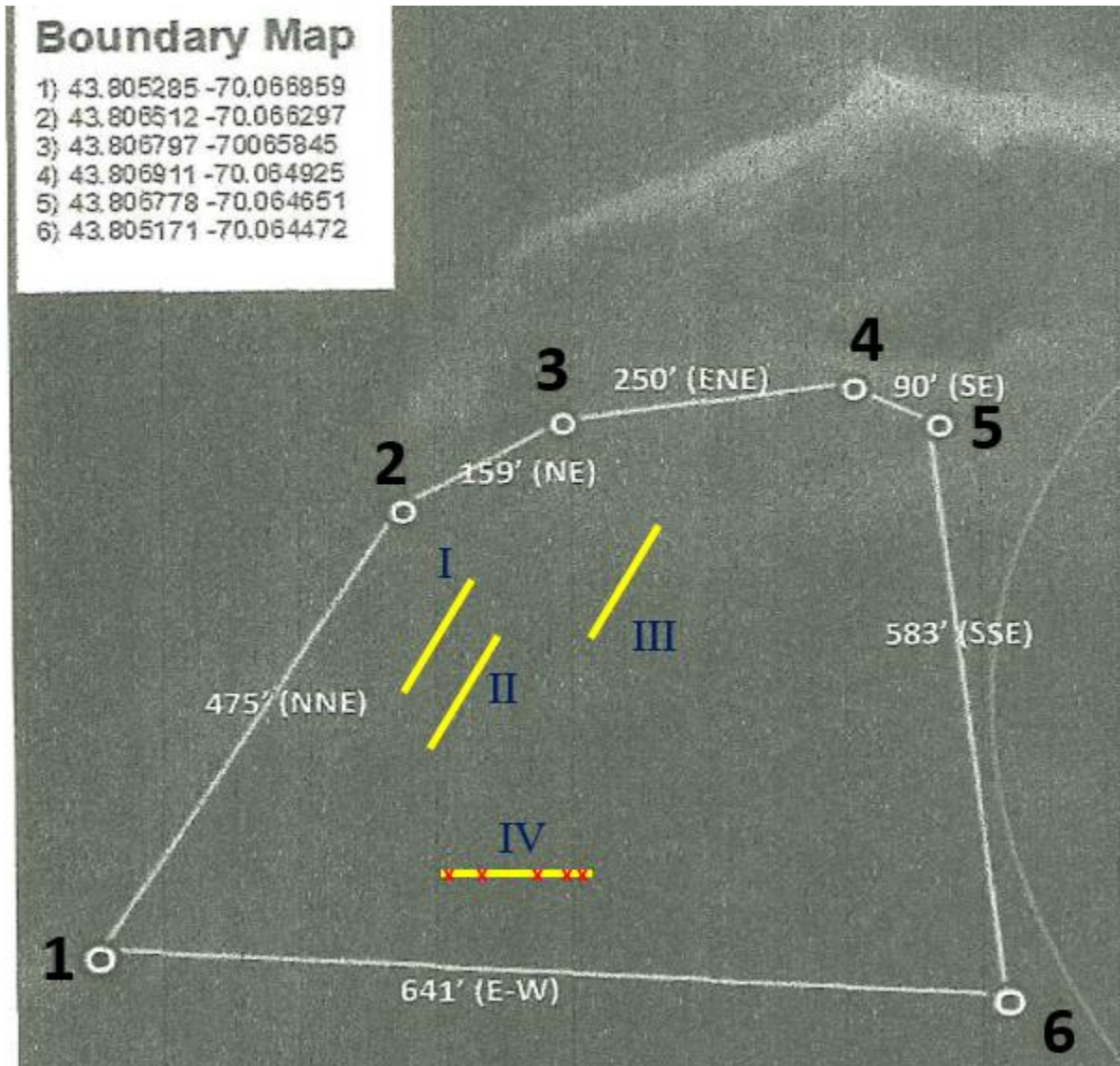


Figure 5. The proposed lease site located in the town of Freeport between Bustins Island and the Sow and Pigs, Freeport, Maine. A series of four 35-meter transects were established during low tide, and five benthic cores were taken randomly along each line. (The area to the right (= south) of the transects was under water (6-18 inches) at low tide. Samples were used to characterize and quantify the benthic epifauna and infauna. The map was taken from: https://www.maine.gov/dmr/aquaculture/leases/pending/documents/COMPLETE_05.17.21_Coffin_Bailey.pdf.

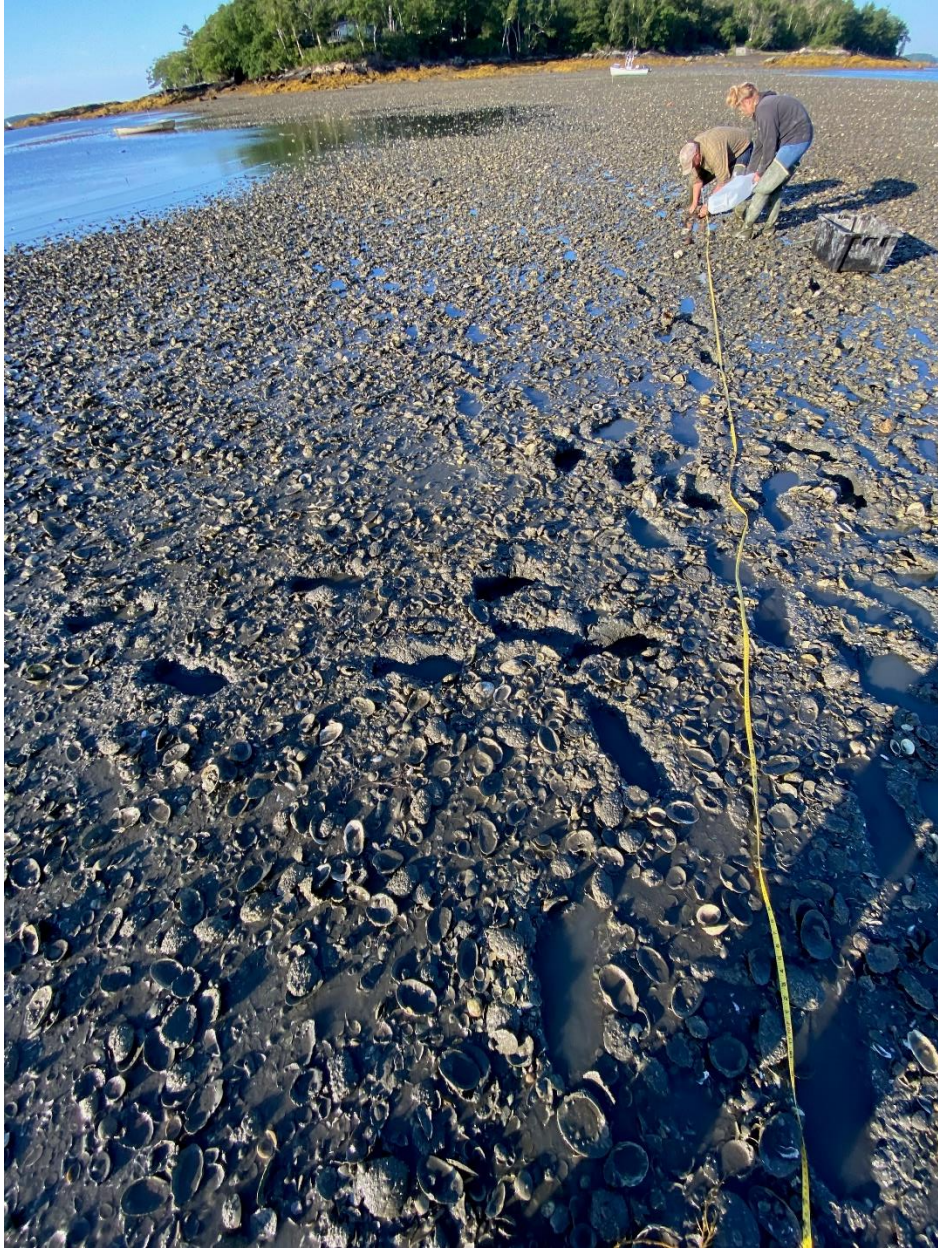


Figure 6. One of four line transects that benthic cores were taken from near low tide on 14 July 2022 at the proposed lease site between Bustins Island and Sow and Pigs, Freeport, Maine.

Results

Immediately after low tide, I walked the area that was submerged in an attempt to find and quantify submerged aquatic vegetation. I was unable to find any eelgrass, *Zostera marina*, or macrofauna such as furoid algae (e.g., *Fucus* spp., *Ascophyllum nodosum*), kelp (e.g., *Laminaria digitata*, *Saccharina latissima*, *Saccharina longicuris*), Irish sea moss (*Chondrus crispus*) or false Irish moss (*Mastocarpus stellatus*).

Seventeen species were observed in the core samples that occurred across five phyla and six classes (Table 1). The two most frequent species were the Atlantic slipper shell, *Crepidula fornicata*, and the convex slipper shell, *Crepidula convexa*. These were attached to many of the dead shells that littered the bottom (Figs. 3-4 & 6). Three other species (the common periwinkle, *Littorina littorea*, the northern quahog, *Mercenaria mercenaria*, and Gould's Pandora, *Pandora gouldiana*) ranked in the top five in terms of density (Table 2).

The size frequency distribution of *L. littorea*, *M. mercenaria*, and *P. gouldiana* are presented in Figs. 7-9).

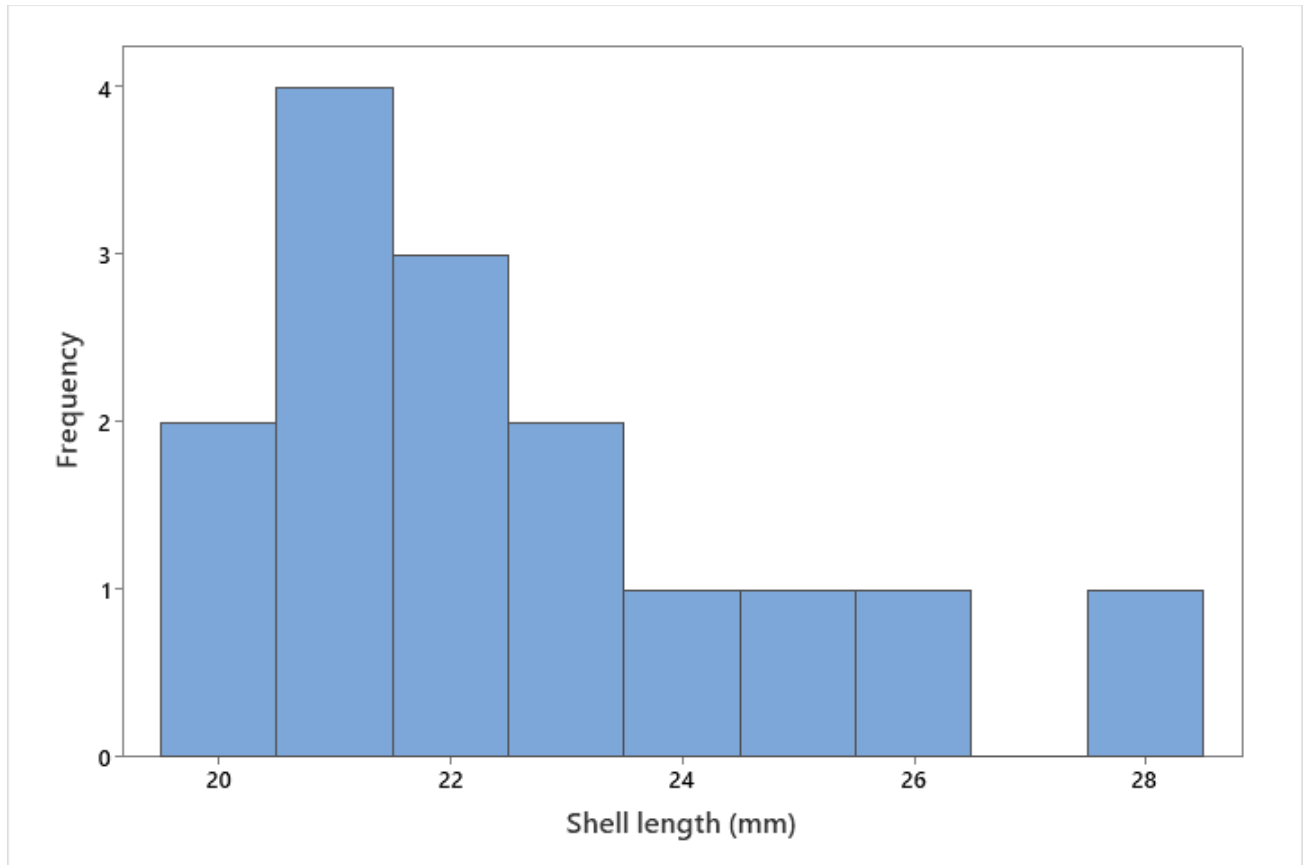


Figure 7. Size-frequency distribution of the common periwinkle, *Littorina littorea*, pooling data from each of the four transect lines from benthic core samples taken at the proposed lease site on 14 July 2022. Mean shell length (\pm 95% CI) was 22.6 ± 1.3 mm. (N = 15)

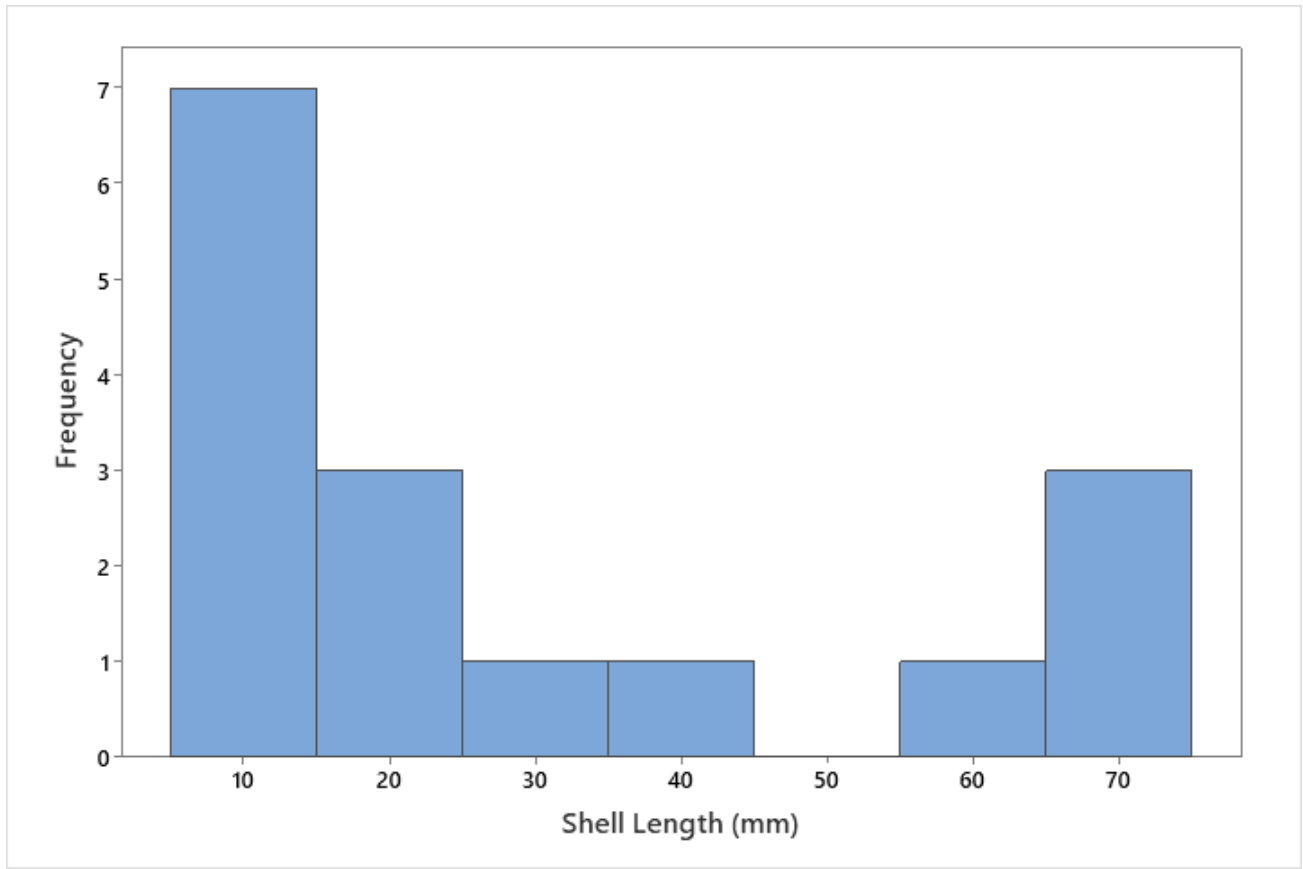


Figure 8. Size-frequency distribution of the northern quahog, *Mercenaria mercenaria*, pooling data from each of the four transect lines from benthic core samples taken at the proposed lease site on 14 July 2022. Mean shell length (\pm 95% CI) was 29.8 ± 24.1 mm. (N = 16)

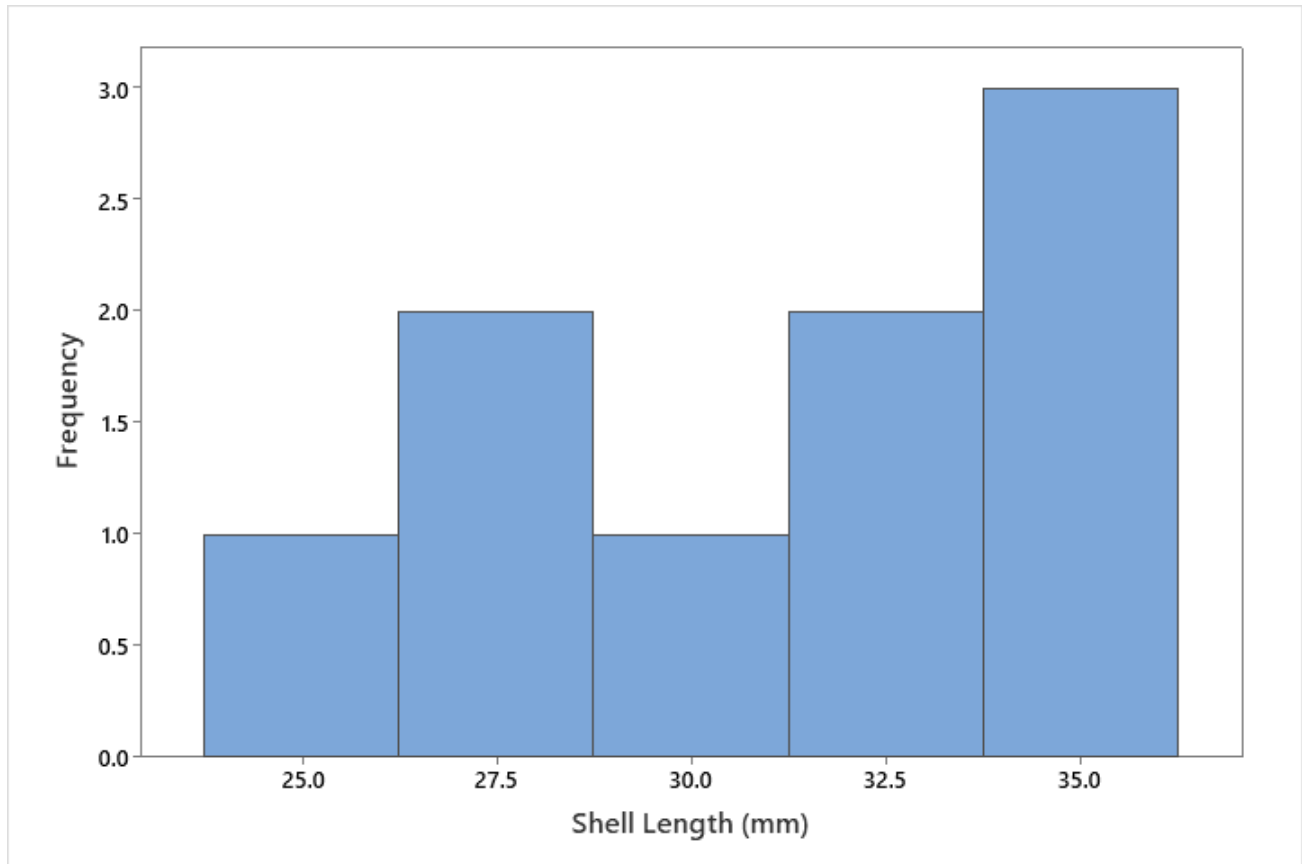


Figure 9. Size-frequency distribution of Gould's Pandora, *Pandora gouldiana*, pooling data from each of the four transect lines from benthic core samples taken at the proposed lease site on 14 July 2022. Mean shell length (\pm 95% CI) was 31.3 ± 2.9 mm. (N = 9)

Other observations

During the site visit, a number of species were observed that were not included in the benthic core samples because they did not occur frequently. I observed many large green crabs at/near the low water mark around the time of low tide. Two crabs were taken for measurements (both males). Those carapace widths measured 77.9 mm and 80.3 mm. In addition, several juvenile rock crabs, *Cancer irroratus*, were observed, but none measured. While it was not possible to assign a species to the various depressions scattered throughout the proposed lease site (Fig. 10), it is likely that large green crabs or rock crabs could be responsible. Besides crabs, two species of exotic colonial ascidians (tunicates) were observed, including the golden star tunicate, *Botryllus schlosseri*, and the carpet sea squirt, *Didemnum vexillum*.



Figure 10. A depression in the soft-bottom sediments due to predator activity likely caused by a large crustacean such as a green crab or rock crab. This depression measured approximately 27 cm x 35 cm, and was 10 cm deep near its middle. No effort was made to quantify these depressions; however, the existence of these features indicates persistent foraging/predation activity.

Table 1. List of species discovered in benthic core samples taken on 14 July 2022 at the proposed lease site between Bustins Island and Sow and Pigs, Freeport, Maine. (Scientific names and authors were verified using the World Register of Marine Species (<https://www.marinespecies.org>)).

Common name	Scientific name	Phylum	Class
1) Sandworm	<i>Alitta virens</i> (M. Sars, 1835)	Annelida	Polychaeta
2) Bamboo worm	<i>Clymenella torquata</i> (Leidy, 1855)	Annelida	Polychaeta
3) Thread worm	<i>Lumbrineris</i> spp.	Annelida	Polychaeta
4) Flabelligerid worm	<i>Pherusa affinis</i> (Leidy, 1855)	Annelida	Polychaeta
5) Bloodworm	<i>Glycera dibranchiata</i> Ehlers, 1868	Annelida	Polychaeta
6) Milky ribbon worm	<i>Cerebratulus lacteus</i> (Leidy, 1851)	Nemertea	Pilidiophora
7) Common periwinkle	<i>Littorina littorea</i> (Linnaeus, 1758)	Mollusca	Gastropoda
8) Atlantic slipper shell	<i>Crepidula fornicata</i> (Linnaeus, 1758)	Mollusca	Gastropoda
9) Convex slipper shell	<i>Crepidula convexa</i> (Say, 1822)	Mollusca	Gastropoda
10) Northern quahog	<i>Mercenaria mercenaria</i> (Linnaeus, 1758)	Mollusca	Bivalvia
11) False quahog	<i>Agriopoma morrhuenum</i> (Dall, 1902)	Mollusca	Bivalvia
12) Gould's Pandora	<i>Pandora gouldiana</i> Dall, 1886	Mollusca	Bivalvia
13) European oyster	<i>Ostrea edulis</i> Linnaeus, 1758	Mollusca	Bivalvia
14) Seven-spined shrimp	<i>Crangon septemspinosa</i> Say, 1818	Arthropoda	Crustacea
15) Long-clawed hermit	<i>Pagurus longicarpus</i> Say, 1817	Arthropoda	Crustacea
16) European green crab	<i>Carcinus maenas</i> (Linnaeus, 1758)	Arthropoda	Crustacea
17) Shorthorn sculpin	<i>Myoxocephalus scorpius</i> (Linnaeus, 1758)	Chordata	Actinopteri

Table 2. Species list, number per core, square meter, and square foot as well as size (shell length for all bivalves except European oysters [in which case, shell height] and periwinkles, and total length of fish). All lengths and heights were measured with digital Vernier calipers to the nearest 0.1 millimeters.

<u>Transect</u>	<u>Sample</u>	<u>Species</u>	<u>Number per</u>			<u>Size (mm)</u>
			<u>Core</u>	<u>Square meter</u>	<u>Square foot</u>	
I	a	<i>A. virens</i>	2	109.6	10.2	
		<i>L. littorea</i>	1	54.8	5.1	21.1
		<i>C. fornicata</i>	8	438.6	40.7	
		<i>M. mercenaria</i>	1	54.8	5.1	7.7
		<i>P. longicarpus</i>	1	54.8	5.1	
	b	<i>C. lacteus</i>	1	54.8	5.1	
		<i>L. littorea</i>	3	164.5	15.3	20.5, 22.3, 21.2
		<i>C. fornicata</i>	8	438.6	40.7	
		<i>C. convexa</i>	4	219.3	20.4	
		<i>M. mercenaria</i>	3	164.5	15.3	67.2, 14.8, 16.0
		<i>C. maenas</i>	1	54.8	5.1	9.8
	c	<i>P. affinis</i>	1	54.8	5.1	
		<i>L. littorea</i>	1	54.8	5.1	20.4
		<i>C. fornicata</i>	9	493.4	45.8	
		<i>C. convexa</i>	4	219.3	20.4	
		<i>M. mercenaria</i>	2	109.6	10.2	20.8, 10.8
		<i>P. gouldiana</i>	1	54.8	5.1	32.3
	d	<i>C. fornicata</i>	2	109.6	10.2	
		<i>C. convexa</i>	1	54.8	5.1	
		<i>M. mercenaria</i>	1	54.8	5.1	69.6
		<i>P. longicarpus</i>	1	54.8	5.1	
	e	<i>C. fornicata</i>	13	712.7	66.2	
		<i>C. convexa</i>	5	274.1	25.5	
		<i>M. mercenaria</i>	1	54.8	5.1	14.4
		<i>A. morrhuanum</i>	1	54.8	5.1	30.2
<i>P. gouldiana</i>		1	54.8	5.1	28.7	
II	a	<i>C. torquata</i>	1	54.8	5.1	
		<i>P. gouldiana</i>	1	54.8	5.1	34.2
	b	<i>C. fornicata</i>	15	822.4	76.4	
		<i>C. convexa</i>	5	274.1	25.5	

Table 2. (cont.)

	c	<i>A. virens</i>	2	109.6	10.2	
		<i>L. littorea</i>	1	54.8	5.1	22.6
		<i>C. fornicata</i>	2	109.6	10.2	
		<i>C. convexa</i>	2	109.6	10.2	
		<i>M. mercenaria</i>	1	54.8	5.1	9.9
		<i>O. edulis</i>	1	54.8	5.1	51.4
		<i>C. septemspinosa</i>	1	54.8	5.1	
		<i>M. scorpius</i>	1	54.8	5.1	40.3
		d	<i>P. gouldiana</i>	1	54.8	5.1
	e	<i>C. lacteus</i>	1	54.8	5.1	
<i>L. littorea</i>		1	54.8	5.1	23.3	
<i>M. mercenaria</i>		1	54.8	5.1	69.5	
III	a	<i>C. lacteus</i>	1	54.8	5.1	
		<i>P. longicarpus</i>	1	54.8	5.1	
	b	<i>L. littorea</i>	1	54.8	5.1	25.9
		<i>P. gouldiana</i>	1	54.8	5.1	32.6
		<i>O. edulis</i>	1	54.8	5.1	81.5
	c	<i>C. torquata</i>	1	54.8	5.1	
		<i>P. affinis</i>	1	54.8	5.1	
		<i>C. convexa</i>	1	54.8	5.1	
		<i>A. morrhuanum</i>	1	54.8	5.1	24.5
	d	<i>A. virens</i>	1	54.8	5.1	
		<i>G. dibranchiata</i>	1	54.8	5.1	
		<i>C. lacteus</i>	1	54.8	5.1	
		<i>C. fornicata</i>	7	383.8	35.7	
		<i>C. convexa</i>	1	54.8	5.1	
		<i>P. gouldiana</i>	1	54.8	5.1	29.7
	e	<i>C. torquata</i>	1	54.8	5.1	
		<i>L. littorea</i>	1	54.8	5.1	23.6
		<i>M. mercenaria</i>	1	54.8	5.1	30.5
		<i>P. gouldiana</i>	2	109.6	10.2	35.7, 24.8
	IV	a	<i>C. fornicata</i>	3	164.5	15.3
<i>M. mercenaria</i>			2	109.6	10.2	20.8, 10.8
<i>P. longicarpus</i>			1	54.8	5.1	

Table 2. (cont.)

b	<i>C. torquata</i>	2	109.6	10.2	
	<i>C. fornicata</i>	5	274.1	25.5	
	<i>C. convexa</i>	4	219.3	20.4	
	<i>M. mercenaria</i>	1	54.8	5.1	55.7
c	<i>C. convexa</i>	1	54.8	5.1	
	<i>M. mercenaria</i>	1	54.8	5.1	39.0
	<i>P. longicarpus</i>	2	109.6	10.2	
d	<i>L. littorea</i>	1	54.8	5.1	27.8
	<i>C. fornicata</i>	18	986.8	91.7	
	<i>C. convexa</i>	3	164.5	15.3	
e	<i>Lumbrineris</i> sp.	1	54.8	5.1	
	<i>L. littorea</i>	5	274.1	25.5	19.6, 20.9, 21.6, 22.3, 25.4
	<i>C. convexa</i>	2	109.6	10.2	
	<i>M. mercenaria</i>	1	54.8	5.1	13.9
	<i>P. gouldiana</i>	1	54.8	5.1	28.2
	<i>P. longicarpus</i>	1	54.8	5.1	

Table 3. Mean (average) density of the five most abundant species occurring in benthic cores taken at the proposed lease site between Bustins Island and Sow and Pigs on 14 July 2022 during low tide. Mean densities are in square meters, and are presented with their 95% confidence intervals. Five benthic cores (area = 0.01824 m²) were taken randomly along four 35-meter transect lines within the proposed lease site. T1-TIV represent the four transect lines. The P-value represents a hypothesis test that asks the question: “Is there a significant difference in average density of species X between the four transect lines?” When the P-value is < 0.05, the answer to the question would be: “There is a statistically significant difference in mean density between the transect lines.” When the P-value is ≥ 0.05, the answer to the question would be: “There is no statistically significant difference in mean density between the transect lines. Statistically significant P-values appear in boldface.

<u>Species</u>	<u>T1</u>	<u>T2</u>	<u>T3</u>	<u>T4</u>	P-value
<i>Littorina littorea</i>	54.8 (83.3)	21.9 (37.3)	21.9 (37.3)	65.8 (147.6)	0.6876
<i>Crepidula fornicata</i>	438.6 (268.0)	186.4 (445.3)	76.8 (213.1)	285.1 (508.0)	0.3186
<i>Crepidula convexa</i>	153.5 (147.5)	76.8 (149.2)	21.9 (37.3)	98.7 (101.2)	0.2188
<i>Mercenaria mercenaria</i>	87.7 (60.9)	21.9 (37.3)	10.9 (30.4)	54.8 (48.1)	0.0188
<i>Pandora gouldiana</i>	21.9 (37.3)	21.9 (37.3)	43.9 (56.9)	10.9 (30.4)	0.4895