SOAR: Supporting Oyster Aquaculture and Restoration
Oyster Purchase Program

Site Monitoring Final Report
Fairhaven and Bourne, Massachusetts

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August 2022

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1.0 Introduction

The closure of restaurants and limited seating capacity during the COVID-19 crisis led to a dramatic decline in demand of farmed shellfish across the country. Lacking the ability to market their oysters, famers were running into space limitations, leading to the inability to plant future crops and economic peril. The Nature Conservancy in collaboration with Pew Charitable Trusts, U.S. National Oceanic and Atmospheric Administration and the U.S. Department of Agriculture developed the Supporting Oyster Aquaculture and Restoration (SOAR) initiative to alleviate COVID-19 economic impacts on oyster farms, at the same time increasing critical oyster habitat and spawning stock biomass. The SOAR initiative aimed to purchase 5 million mature oysters, from farmers impacted by COVID-19, to rebuild 27 acres of native shellfish across 20 restoration sites.

In conjunction with restoration efforts, SOAR intends to describe the effectiveness of the environmental benefit from deployment of oysters to the restoration sites. Monitoring survival, length distribution, density, and recruitment of oysters within a restored reef provides data required to estimate the ecosystem services provided by the reef and allows practitioners to adaptively manage projects. Determining arial extent, reef height, and environmental variables (i.e., temperature, salinity, dissolved oxygen) within the project footprint provides critical physical and environmental metrics to allow temporal in-site or cross-site analysis of habitat changes.

Restoration activities through the SOAR initiative resulted in oyster deployments in the fall of 2020 and spring of 2021 on two existing oyster restoration projects in southeastern Massachusetts: Little Buttermilk Bay, Bourne and Nasketucket Bay, Fairhaven (Figure 1). Both restoration sites were monitored one year post oyster planting to obtain the objectives.

- *Map reef extent and height over the project footprints.*
- *Determine survival, length frequency, density, and recruitment of oysters within the project footprints.*
- *Describe environmental variables of the restored habitats – sediment type, temperature, salinity, and dissolved oxygen.*

These data will allow for an estimate of oyster population structure and survival within the restoration sites and effectiveness of the enhancement program. This report details monitoring efforts and results of SOAR restoration within Little Buttermilk Bay and Nasketucket Bay, Massachusetts.

2.0 Oyster planting background

Little Buttermilk Bay and Nasketucket Bay were previously seeded with spat-on-shell oysters within six years of SOAR restoration, however, planting described below accounts for SOAR planted oysters only. Sub-plots within each location are named based on participating farms.

Little Buttermilk Bay, Bourne, Massachusetts

An estimated 35,647 single set oysters with a mean valve height of 98 mm were seeded in two distinct sub-plots within Little Buttermilk Bay, 'Butter Milk Bay' and 'Green Acres/Monk's Cove' (Figure 2, Table 1). An estimated 16,912 oysters were planted in Butter Milk Bay sub-plot with a mean valve height of 116 mm (Table 1). An estimated 18,735 oysters were planted in Green Acres/Monk's Cove sub-plot with a mean valve height of 90 mm (Table 1).

Nasketucket Bay, Fairhaven, Massachusetts

An estimated 141,000 single set oysters with a mean valve height of 97 mm were seeded in four sub-plots within Nasketucket Bay, 'Round Hill', 'Taylor', 'Ward/Copper Beach', and 'Spindrift' (Figure 3, Table 1). An estimated 36,277 oysters with a mean valve height of 95 mm were planted in Round Hill sub-plot; 23,795 oysters with a mean valve height of 92 mm were planted in Taylor sub-plot; 52,268 oysters with a mean valve height of 99 mm were planted in Ward/Copper Beach sub-plot; and 28,660 with a mean valve height of 99 mm were planted in Spindrift sub-plot (Table 1).

3.0 Methods

The objectives listed above were met using the following methods.

3.1 Reef delineation

SOAR specific oyster deployments were measured independent of preexisting spat-on-shell deployments when possible. In some cases, spat-on-shell and single set SOAR deployment were overlapping, therefore, the entire extent of oysters was measured together. Reefs were visually located using SCUBA. Divers swam a 2-meter grid pattern over the entire seeded area and marked the boundaries of individual oyster reefs within each sub-plot with survey stakes. A Global Positioning System was used to determine coordinates of each survey stake and centroid coordinates for each reef. A measuring tape was used to determine perimeters of reefs. Coordinates and pile perimeters were imputed into geospatial software to calculate total reef area per sub-plot. In cases where oysters were evenly distributed throughout the entire sub-plot or macroalgae mats prevented visual assessment of reef area, the entire sub-plot was used as a basis for reef boundary.

Reef height of SOAR oyster plantings was assessed via manual observation. Use of transects across reef boundaries and individual reef height measurements were not applicable, as oysters were seeded in a single layer on the benthic substate resulting in no vertical relief.

3.2 Environmental parameters

Sediment beneath oysters in each quadrat was characterized as mud (very soft, high organic content), sand/silt (fine grain sand with a mixture of silt and mud), hard sand (hard, coarse grain sand with or without presence of rocks <20 cm diameter), rock/cobble (coarse sand with rocks >20 cm diameter). Presence and percent coverage of dominant macro algae, identified to the lowest practical taxon, was documented as an additional data layer. Water temperature and salinity were measured during each

site using an Extech environmental probe. Buzzards Bay Coalition long term environmental data were used to garner annual 2021 mean dissolved oxygen, total organic nitrogen, algal pigments within the water column, and water clarity in relative proximity to each restoration site (Buzzards Bay Coalition 2021).

Two long term environmental monitoring sites, LB2X and LB2N, were located within 110 m and 314 m, respectively, from the Little Buttermilk Bay restoration sites. One long term environmental monitoring site, Earls Marina, was located two miles from the Nasketucket Bay restoration sites.

3.3 Oyster density, length distribution and survival

Sub-plots were surveyed independent of one another. In efforts to reduce standard error of estimated number of oysters within each sub-plot, delineated oyster reefs were surveyed independently within each plot where possible. Reef area and oyster metric data were combined for each reef within a single sub-plot to determine total reef area, estimated number of live, dead and recruit oysters and length frequency.

Survival, growth, density, and recruitment of oysters within each project footprint and sub-plot was assessed via the use of quadrat monitoring. One sixteenth meter quadrats were used in Nasketucket Bay due to high oyster density. One quarter meter quadrats were used in Little Buttermilk Bay, as oyster density was relatively low, and entire sub-plots were used as a basis of reef delineation. To mitigate bias of sampling, quadrats were sampled in a haphazard fashion until adequate spatial coverage of the reef was achieved. All oysters were excavated from quadrats and live and recently dead (hinge still intact "boxes") were enumerated by quadrat. Valve height of up to 25 oysters per quadrat were measured to the nearest millimeter. Measurements of naturally recruited and spat-on-shell oysters were recorded independently from SOAR planted oysters. Oyster population estimates for each sub-plot were calculated by extrapolating mean oyster density to total reef area. Survival within each sub-plot was calculated based on estimated live and dead (box) oysters.

4.0 Results

4.1 Reef delineation

Little Buttermilk Bay

Both Buttermilk Bay and Green Acres/Monk's Cove sub-plots were comprised of relatively even distribution of single oysters under a thick algal mat, precluding the delineation of individual oyster reefs within each sub-plot. The two sub-plots were separated by 63 m allowing for clear delineation and monitoring of each seeded area. Buttermilk Bay sub-plot encompassed 646 m^2 and Green Acres/Monk's Cove encompassed 252 m^2 for a total seeded area of 898 m^2 (0.22 acres) (Table 2, Figure 2). Vertical relief of reefs was negligible as oysters were seeded directly on the existing benthic substrate in a single layer.

Nasketucket Bay

Four sub-plots were seeded within Nasketucket Bay with a total reef area of 1,172 m^2 (0.29 acres) (Table 2, Figure 3). Round Hill sub-plot was comprised of four distinct reefs totaling 225 m^2 with negligible oyster density between reefs. Taylor sub-plot was comprised of three distinct reefs totaling 108 m^2 with negligible oyster density between reefs. Ward/Copper Beach sub-plot had even distribution of oysters spread through the entire sub-plot of 601 m^2. Spindrift sub-plot was comprised of three distinct oyster reefs totaling 238 m^2 with negligible oyster density between reefs. Delineation between oysters planted within Ward/Copper Beach and Spindrift sub-plots was not possible to discern, as oysters were contiguous along their shared border. Provided coordinate boundaries between the two sub-plots were used as a basis for plot delineation along the shared border. Vertical relief of reefs within all sub-plots was negligible as oysters were seeded directly on the existing benthic substrate in a single layer.

4.2 Environmental parameters

Little Buttermilk Bay

Sediment within Little Buttermilk Bay restoration site was comprised of sand/silt and soft mud with high organic loading. Large rafts of macro algae, predominantly *Gracilaria tikvahiae* and *Codium fragile*, were present on 70 – 80 % of the planted area. The macro algal mats in most cases were 30 – 60 cm thick. Long term water quality monitoring from Buzzards Bay Coalition indicated 2021 annual mean low dissolved oxygen (DO) concentrations within 100 m from the restoration site was 79 % saturation with a range between 72 % - 104 %. These measurements are an index of water column DO which does not provide an accurate representation of oxygen saturation under the algal mat which can be considerably lower during periods of warm water and high biological oxygen demand. Mean 2021 organic nitrogen was 0.34 ppm; mean 2021 water clarity was 1.6 meters; and mean algal pigments was 7.9 µg/l in Little Buttermilk Bay (Buzzards Bay Coalition 2021).

Nasketucket Bay

Sediment in the Nasketucket Bay restoration site was comprised of sand/silt. Marco algal mats of *Gracilaria tikvahiae* and *Codium fragile* were present within 30 % of the site, however, the mats were thin compared to Little Buttermilk Bay. Mean 2021 low DO in Nasketucket Bay was 64 % with a range between 48 % - 104 %. Mean 2021 organic nitrogen was 0.3 ppm; mean 2021 water clarity was 1.7 meters; and mean algal pigments was 4.9 µg/l at the Nasketucket Bay Earls Marina water quality station (Buzzards Bay Coalition 2021).

4.3 Oyster density, length distribution and survival

Spat on shell oysters not included in data presented below.

Little Buttermilk Bay

A total of 54, ¼ m^2 quadrats were surveyed within the Little Buttermilk Bay restoration site, yielding a mean density of 44 ± 13 live oysters m^{-2}, 22 ± 11 box oysters m^{-2}, and 0.2 ± 0.1 recruit oysters m^{-2} across the site (Table 2). The oyster population across the Little Buttermilk Bay site was estimated at 28,658 ±

8,774 live oysters, 16,036 ± 6,661 dead oysters and 279 ± 167 recruit oysters. Density within the Buttermilk Bay sub-plot was calculated at 16 ± 5 live oysters m^{-2}, 12 ± 3 box oysters m^{-2} and 0.4 ± 0.3 recruit oysters m^{-2}. Population within the Buttermilk Bay sub-plot was estimated at 10,336 ± 3,366 live oysters, 8,031 ± 2,083 box oysters and 279 ± 167 recruit oysters. Density within Green Acres/Monk's Cove sub-plot was calculated at 73 ± 22 live oysters m^{-2} and 32 ± 18 box oysters m^{-2}. Population estimates within Green Acres/Monk's Cove sub-plot was estimated at 18,322 ± 5,408 live oysters and 8,005 ± 4,578 box oysters. No recruit oysters were observed with Green Acres/Monk's Cove sub-plot (Table 2).

Mean valve height of live oysters within Buttermilk Bay sub-plot was 120 ± 3 mm with a range of 61 to 219 mm. Mean valve height of box oysters within Buttermilk Bay sub-plot was 111 ± 3 mm with a range of 28 to 172 mm. Mean valve height of recruit oysters within Buttermilk Bay sub-plot was 78 ± 19 with a range of 37 to 124 mm (Table 3, Figure 4a). Mean valve height of live oysters in Green Acres/Monk's Cove sub-plot was 112 ± 2 mm. Mean valve height of box oysters in Green Acres/Monk's Cove sub-plot was 83 ± 2 mm (Table 3, Figure 4b).

Mean mortality across the Little Buttermilk Bay restoration sites was estimated at 37 % with 44 % mortality in the Buttermilk Bay sub-plot and 30 % mortality in the Green Acres/Monk's Cove sub-plot (Table 2).

Nasketucket Bay

A total of 75, 1/16 m^2 quadrats were surveyed within the Nasketucket Bay restoration site, yielding a mean density of 154 ± 30 live oysters m^{-2}, 89 ± 18 box oysters m^{-2}, and 15 ± 7 recruit oysters m^{-2} across the site (Table 2). The oyster population across the Nasketucket Bay site was estimated at 153,131 ± 34,602 live oysters, 96,268 ± 19,602 dead oysters and 16,333 ± 7,319 recruit oysters. Density in Round Hill sub-plot was calculated at 314 ± 33 live oysters m^{-2}, 100 ± 19 box oysters m^{-2} and 19 ± 6 recruit oysters m^{-2}. Population within the Round Hill sub-plot was estimated at 70,560 ± 7,309 live oysters, 22,560 ± 4,310 box oysters and 4,320 ± 1,324 recruit oysters. Density within Taylor sub-plot was calculated at 148 ± 33 live oysters m^{-2}, 85 ± 24 box oysters m^{-2} and 16 ± 7 recruit oysters m^{-2}. Population estimates within Taylor sub-plot was estimated at 16,013 ± 3,603 live oysters, 9,216 ± 2,600 box oysters and 1,728 ± 735 recruit oysters. Density within Ward/Copper Beach sub-plot was calculated at 82 ± 31 live oysters m^{-2}, 65 ± 15 box oysters m^{-2} and 11 ± 6 recruit oysters m^{-2}. Population estimates within Ward/Cooper Beach sub-plot was estimated at 49,042 ± 18,307 live oysters, 39,105 ± 9,173 box oysters and 6,731 ± 3,459 recruit oysters. Density within Spindrift sub-plot was calculated at 74 ± 23 live oysters m^{-2}, 107 ± 15 box oysters m^{-2} and 15 ± 8 recruit oysters m^{-2}. Population estimates within Spindrift sub-plot was estimated at 17,517 ± 5,383 live oysters, 25,387 ± 3,519 box oysters and 3,554 ± 1,800 recruit oysters (Table 2).

Mean valve height of live oysters within Round Hill sub-plot was 102 ± 2 mm with a range of 9 to 156 mm. Mean valve height of box oysters within Round Hill sub-plot was 84 ± 2 mm with a range of 9 to 141 mm. Mean valve height of recruit oysters within Round Hill sub-plot was 43 ± 4 mm with a range of 9 to 68 mm (Table 3, Figure 5a). Mean valve height of live oysters within Taylor sub-plot was 108 ± 2 mm with a range of 16 to 165 mm. Mean valve height of box oysters within Taylor sub-plot was 93 ± 3 mm with a range of 16 to 126 mm. Mean valve height of recruit oysters within Taylor sub-plot was 53 ± 7

mm with a range of 9 to 100 mm (Table 3, Figure 5b). Mean valve height of live oysters within Ward/Copper Beach sub-plot was 108 ± 3 mm with a range of 14 to 155 mm. Mean valve height of box oysters within Ward/Copper Beach sub-plot was 97 ± 2 mm with a range of 14 to 147 mm. Mean valve height of recruit oysters within Ward/Copper Beach sub-plot was 48 ± 5 mm with a range of 14 to 76 mm (Table 3, Figure 5c). Mean valve height of live oysters within Spindrift sub-plot was 110 ± 3 mm with a range of 20 to 159 mm. Mean valve height of box oysters within Spindrift sub-plot was 96 ± 2 mm with a range of 9 to 142 mm. Mean valve height of recruit oysters within Spindrift sub-plot was 50 ± 7 mm with a range of 20 to 93 mm (Table 3, Figure 5c).

Mean mortality across the Nasketucket Bay restoration sites was estimated at 41 %. Mortality within each sub-plot was: 24 % in Round Hill, 37 % in Taylor, 44 % in Ward/Copper Beach and 59 % in Spindrift (Table 2).

5.0 Discussion

The Nature Conservancy's Supporting Oyster Aquaculture and Restoration initiative aimed to alleviate COVID-19 economic impacts on oyster farms, at the same time increasing critical oyster habitat and spawning stock biomass. Restoration activities in Southern Massachusetts through the SOAR initiative resulted in successful planting of nearly two-hundred thousand single set mature oysters within Nasketucket Bay, Fairhaven and Little Buttermilk Bay, Bourne. The SOAR initiative differs from traditional oyster restoration programs, as it plants mature single oysters instead of year one spat-on-shell. This difference in technique is significant and possesses both pros and cons compared to traditional spat-on-shell restoration, including but not limited to; 1) reduced year-1 mortality post planting, 2) higher spawning stock biomass and filtration capacity on a per oyster basis during year-1 and year-2 post planting, 3) lower habitat value due to less complex biogenic structure and, 4) shorter life expectancy of planted oysters. Investigating population structure of planted single set oysters post restoration efforts is a key component of determining SOAR initiative efficacy.

Year-1 post planting oyster mortality within Little Buttermilk Bay and Nasketucket Bay restoration sites was lower compared to regional spat-on-shell projects. Fifteen years of monitoring data within 20 spat-on-shell restoration sites in Rhode Island revealed mean year-1 mortality of 78 ± 3.2 % (Griffin 2016). In contrast, mean year-1 mortality within the SOAR projects herein was 40 ± 0.05 %. Reduced year-1 mortality of large single set oysters compared to spat-on-shell is driven by greater individual oyster mass, thus, increasing predator refuge and decreasing initial smothering from planting. Spat-on-shell oysters set on all sides of setting media; subsequently, high mortality occurs in the act of planting, as oysters on the bottom of the media can become smothered by sediment. Initial smothering of mature single set oysters post planting is unlikely if planted in appropriate sediment.

Observed mortality within the SOAR restoration sites was likely driven by oyster energetics, disease, food flux and microenvironment water quality. Farmed oysters can experience a wide range of condition due to high density husbandry practices leading to excessive competition and food limitation to individuals not exposed to adequate food flux (i.e., individuals in the middle of overstocked bags or cages). Oysters with low condition are vulnerable to mortality during planting events and overwintering due to added stress and low energy reserves. Oysters were planted with a wide range of valve heights, precluding the ability to decern specific overwinter or summer mortality events from length frequency

data. While disease diagnostics were not conducted on SOAR oysters during year-1 monitoring events, it can be presumed part of the observed morality is due to dermo *(Perkinsus marinus)* and seaside organism unknown *(Halplosporidium nelsoni)*. Dermo is common within wild, restored, and cultured oysters along the northeastern seaboard. Levels of *P. marinus* infection build with age, as does associated percent mortality (Encomio *et al.* 2005), often causing mortality in infected oysters between 80 - 120 mm. *H. nelsoni* prevalence has been increasing in regional waters (Smolowitz, Pers. Comm) and often causes mortality events in the spring when spores synchronously sporulate. Water quality data obtained from Buzzards Bay Coalition indicated adequate food availability and dissolved oxygen. Observed mortality is partially attributed to smothering of dense macro algal mats, particularly in Little Buttermilk Bay. Dense algal mats can create microenvironments reducing food flux to benthic dwelling bivalves, causing reduced energy reserves, and increasing risks of mortality from disease, predation and/or starvation. Decomposing algal mats can also reduce dissolved oxygen levels directly under mats due to increased biological oxygen demand coupled with degraded water exchange. Box oysters filled with anoxic mud were observed under dense algal mats in Little Buttermilk Bay, indicating mortality resulting from smothering.

A distinct advantage of planting mature single set oysters instead of year one spat-on-shell is the immediate increase in spawning stock biomass within the given body of water. Recruitment within the Nasketucket Bay restoration site after the first year of planting SOAR oysters was fifteen times higher than observed during previous restoration efforts at the same site using spat-on-shell oysters and encompassed 11 % of the estimated oyster population. High oyster recruitment on suitable settlement substate (e.g., breakwater rip rap and boulders) around Nasketucket Bay was also noted during monitoring events. While high local recruitment events cannot be directly correlated to SOAR planting, the association is likely and highly encouraging. Recruitment was not observed within Buttermilk Bay. Mechanisms controlling recruitment are not fully understood, however, thick algal mats covering suitable settlement substate will preclude successful recruitment.

Results from this survey indicate normal mortality and growth rates of SOAR planted oysters along with high recruitment in Nasketucket Bay. Planting mature single set oysters in conjunction with traditional spat-on-shell restoration appears to be an excellent mechanism to directly increase spawning stock biomass when needed. A cost-benefit analysis, based on environmental services, of planting mature single oysters vs. year one spat-on-shell would aid in understanding the efficacy of this method of oyster enhancement. The SOAR restoration initiative in southeastern Massachusetts has succeeded in assisting local farms weather COVID-19 market downturns at the same time increasing critical oyster habitat and exploring alternative oyster enhancement methodology.

The deliverables of this survey have been met. At the present time, no further actions are planed under this contract.

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7.0 Tables

Table 1. Estimated number of oysters seeded and shell height by site. Oysters seeded in the fall of 2020 and spring of 2021 through the SOAR initiative in Little Buttermilk Bay and Nasketucket Bay, Massachusetts.

Water Body	Farm Plot	Estimated No. Oysters Planted	Mean Shell Height (mm)
Nasketucket Bay Fairhaven	Round Hill	36,277	95
	Taylor	23,795	92
	Ward/Copper Beach	52,268	99
	Spindrift	28,660	99
	Combined	141,000	97
Little Buttermilk Bay, Bourne	Buttermilk Bay	16,912	116
	Green Acres/ Monk's Cove	18,735	90
	Combined	35,647	98

Table 2. Oyster metrics from SOAR restoration monitoring in Nasketucket Bay and Little Buttermilk Bay, Massachusetts. Oysters planted in the fall and spring of 2020 and 2021, respectively. Reefs monitored in winter/spring of 2022.

Water Body	Farm Plot	Reef Area (m2)	Estimated No. Live	se	Estimated No. Dead	se	Estimated No. Recruit	se	Mean Live Density (m2)	se	Mean Dead Density (m2)	se	Mean Recruit Density (m2)	se	% Mortality
Nasketucket Bay, Fairhaven	Round Hill	225	70,560	7,309	22,560	4,310	4,320	1,324	313.6	32.5	100.3	19.2	19.2	5.9	24%
	Taylor	108	16,013	3,603	9,216	2,600	1,728	735	148.3	33.4	85.3	24.1	16.0	6.8	37%
	Ward/Copper Beach	601	49,042	18,307	39,105	9,173	6,731	3,459	81.6	30.5	65.1	15.3	11.2	5.8	44%
	Spindrift	238	17,517	5,383	25,387	3,519	3,554	1,800	73.6	22.6	106.7	14.8	14.9	7.6	59%
	Combined	1,172	153,131	34,602	96,268	19,602	16,333	7,319	154.3	29.7	89.3	18.3	15.3	6.5	41%
Little Buttermilk Bay, Bourne	Buttermilk Bay	646	10,336	3,366	8,031	2,083	279	167	16.0	5.2	12.4	3.2	0.4	0.3	44%
	Green Acres/ Monk's Cove	252	18,322	5,408	8,005	4,578	-	-	72.7	21.5	31.8	18.2	-	-	30%
	Combined	898	28,658	8,774	16,036	6,661	279.4	167.1	44.4	13.3	22.1	10.7	0.2	0.1	37%

Table 3. Length data of sub-sampled oysters in Nasketucket Bay and Little Buttermilk Bay, Massachusetts.

Water Body	Farm Plot	Mean Live Shell Height (mm)	se	Mean Box Shell Height (mm)	se	Mean Recruit Shell Height (mm)	se
Nasketucket Bay, Fairhaven	Round Hill	102	2	84	2	43	4
	Taylor	108	2	93	3	53	7
	Ward/Copper Beach	108	3	97	2	48	5
	Spindrift	110	3	96	2	50	7
	Combined						
Buttermilk Bay, Bourne	Buttermilk Bay	120	3	111	3	78	19
	Green Acres/ Monk's Cove	112	2	83	2	-	-
	Combined	116	3	97	3	78	19

8.0 Figures

Figure 1. Location of SOAR restoration sites in southeastern Massachusetts.

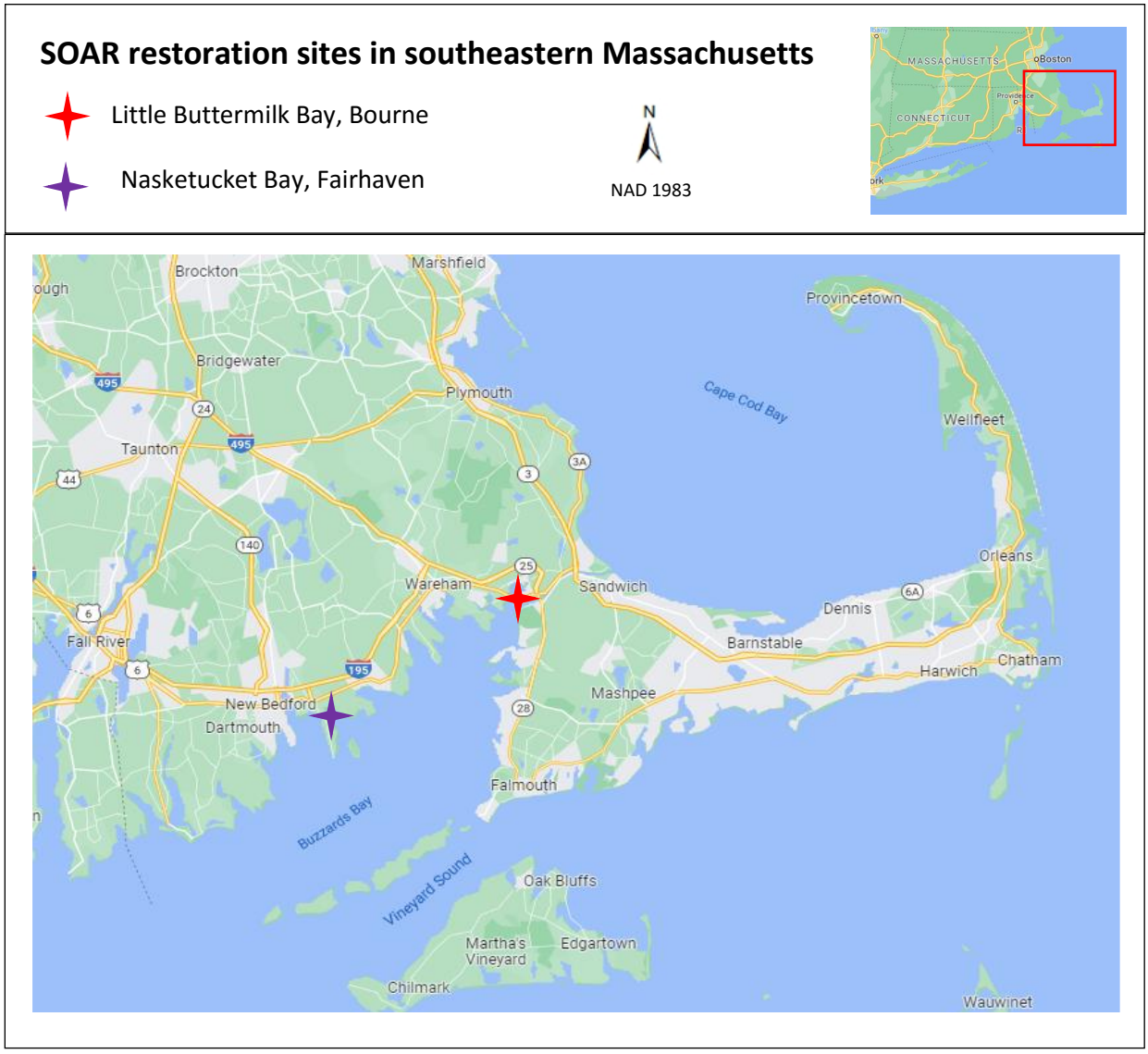


Figure 2. SOAR restoration sub-plots in Little Buttermilk Bay, Bourne, Massachusetts. Entire sub-plots used as basis for reef area.

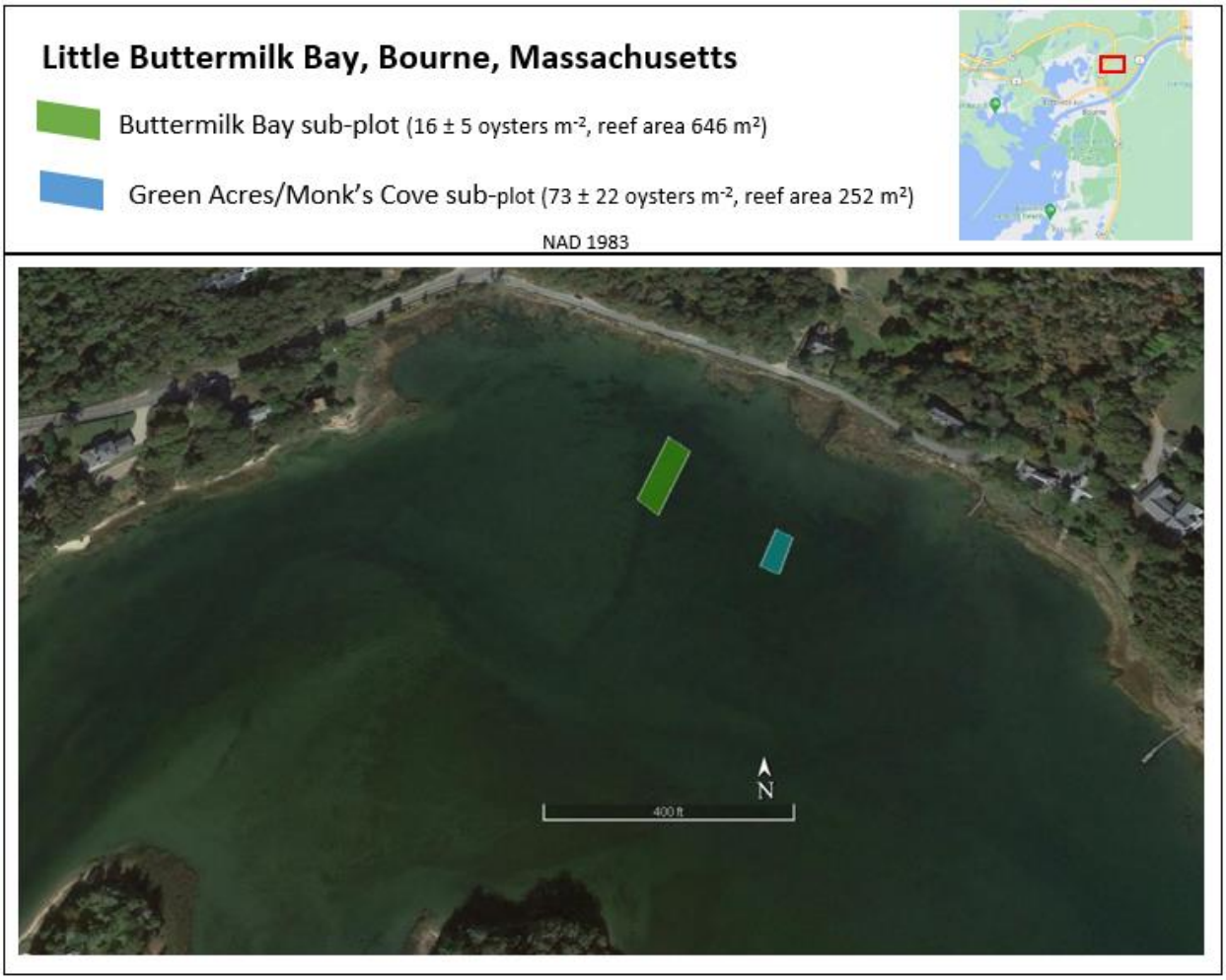


Figure 3. SOAR restoration sub-plots and individual reefs in Nasketucket Bay, Fairhaven, Massachusetts. Solid polygons represent reef footprint. Transparent polygons represent sub-plot boundaries with negligible oyster density.

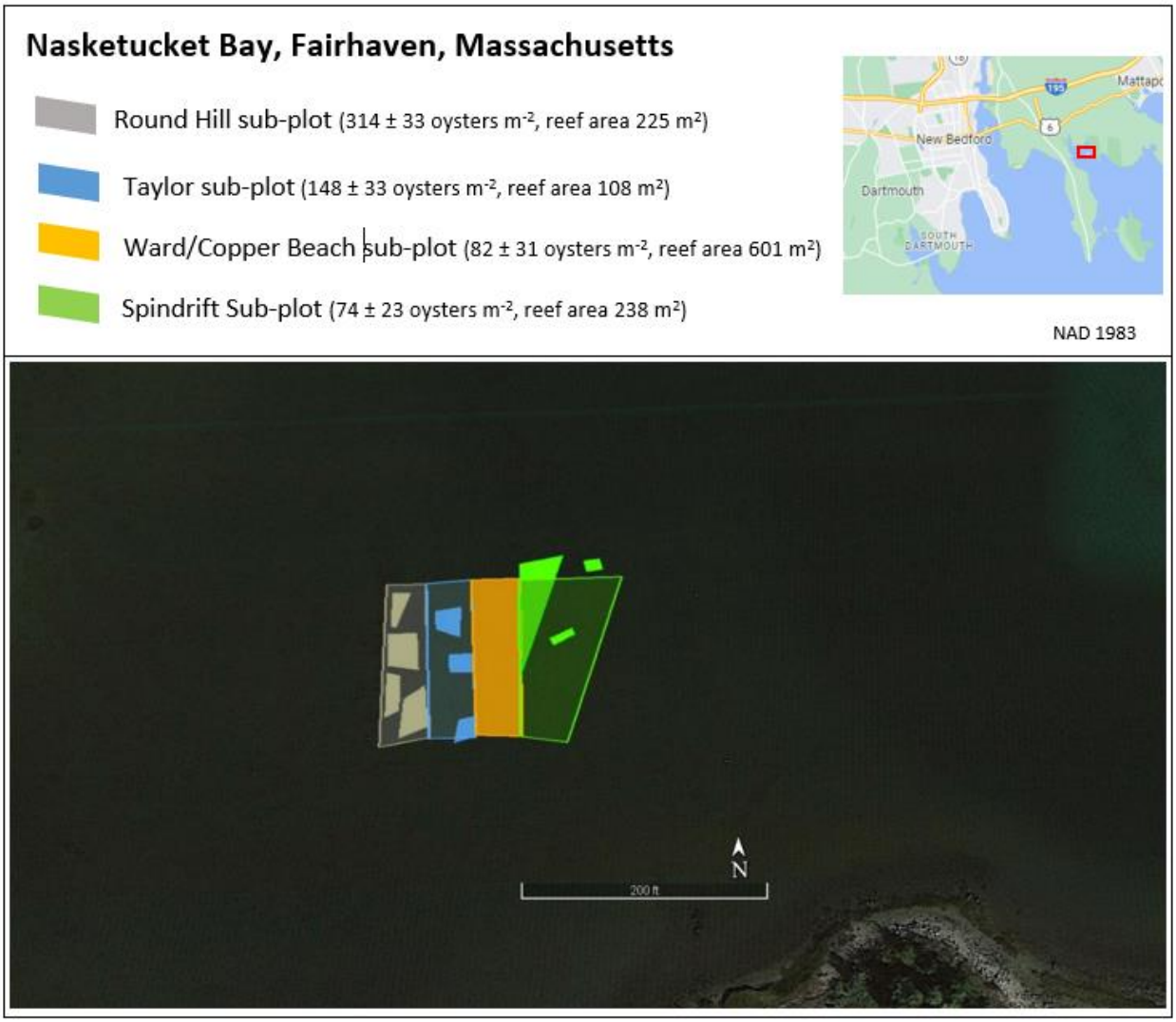
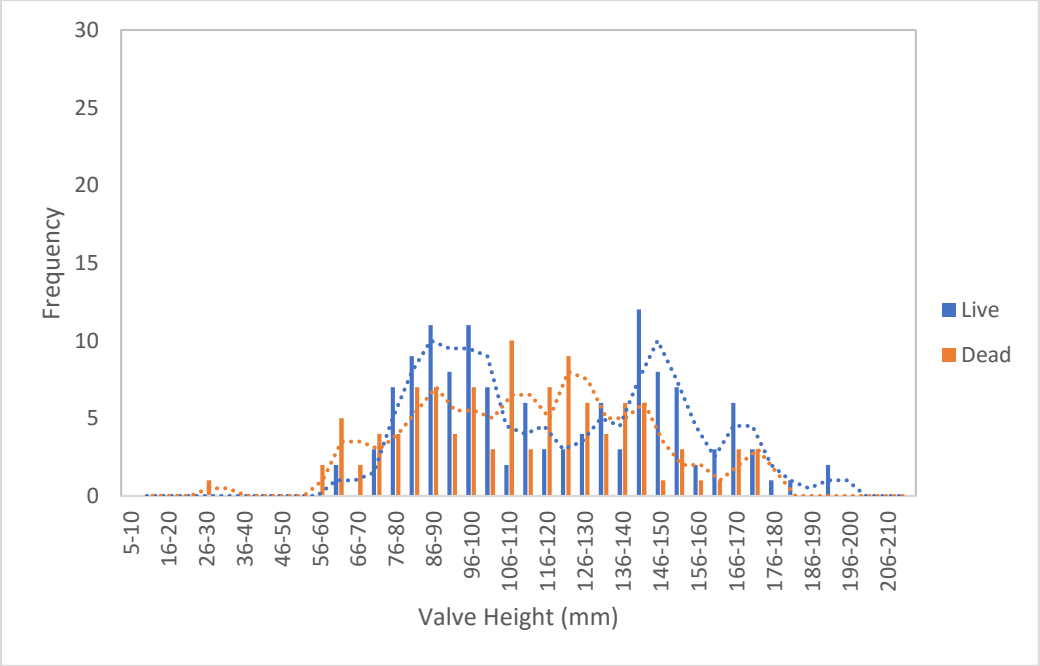


Figure 4a-b. Length distribution of sub-sampled oysters in Little Buttermilk Bay by sub-plot. Dotted line represents moving average.

a. Buttermilk Bay sub-plot



b. Green Acres/Monk's Cove sub-plot

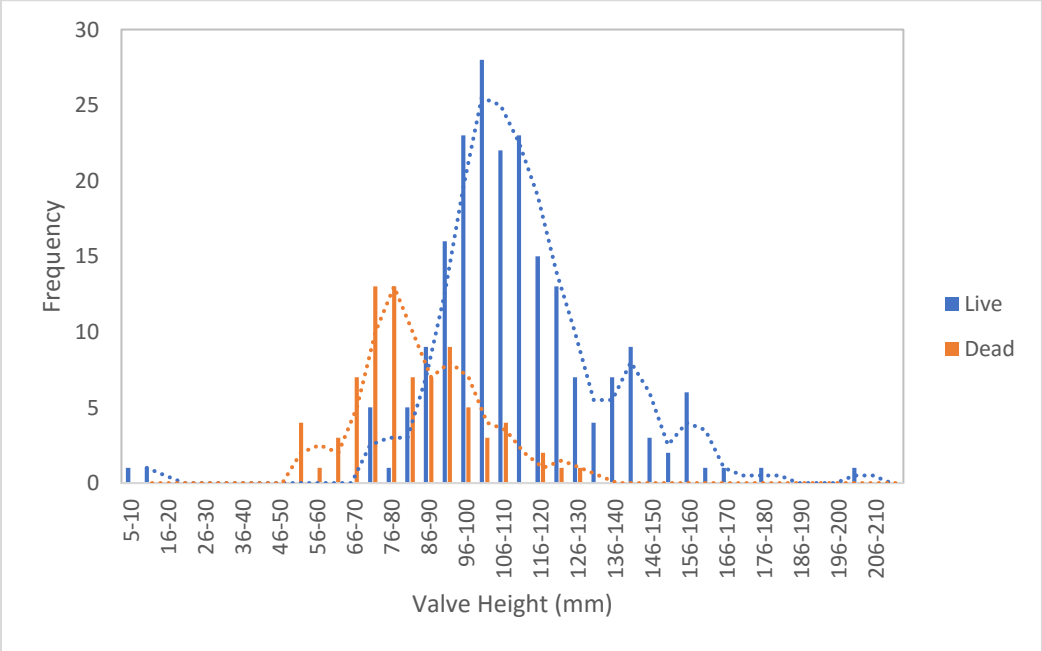
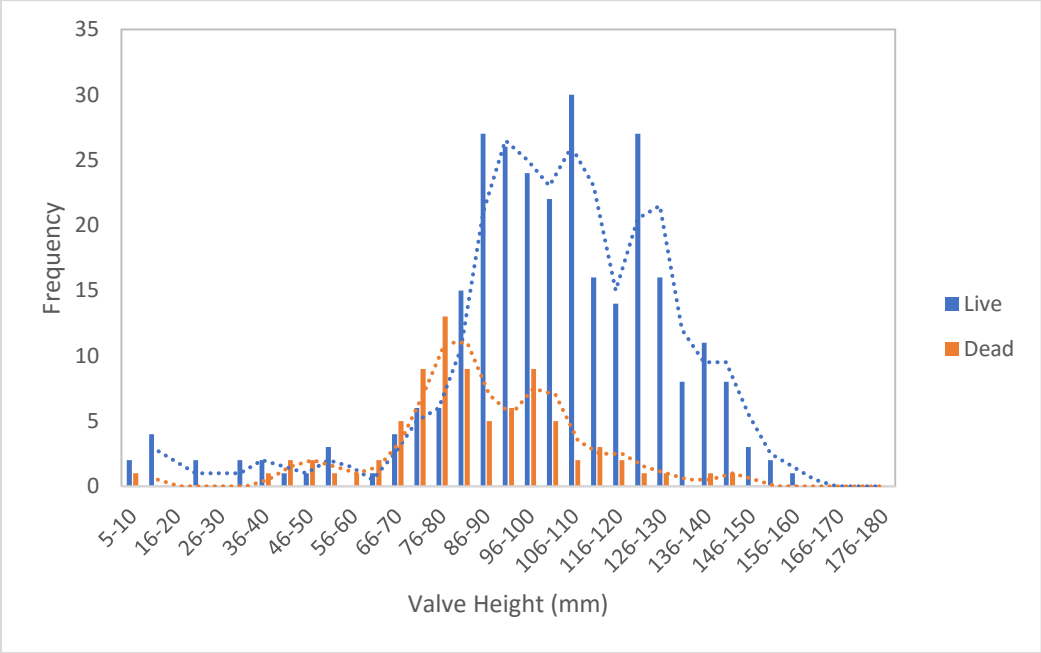


Figure 5a-d. Length distribution of sub-sampled oysters in Nasketucket Bay by sub-plot. Dotted line represents moving average.

a. Round Hill sub-plot



b. Taylor sub-plot

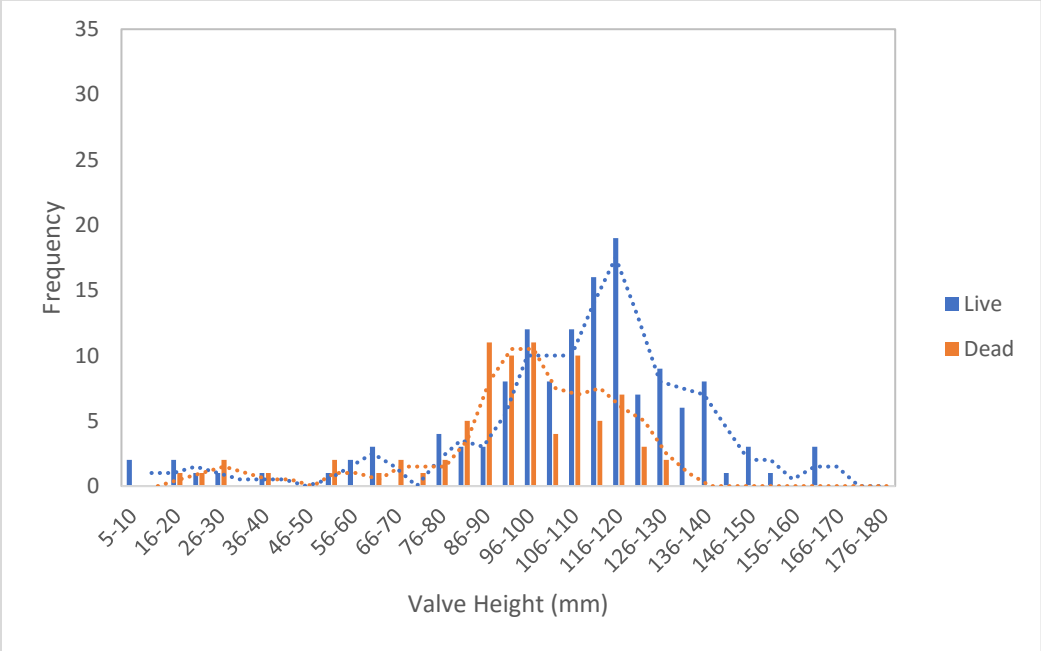
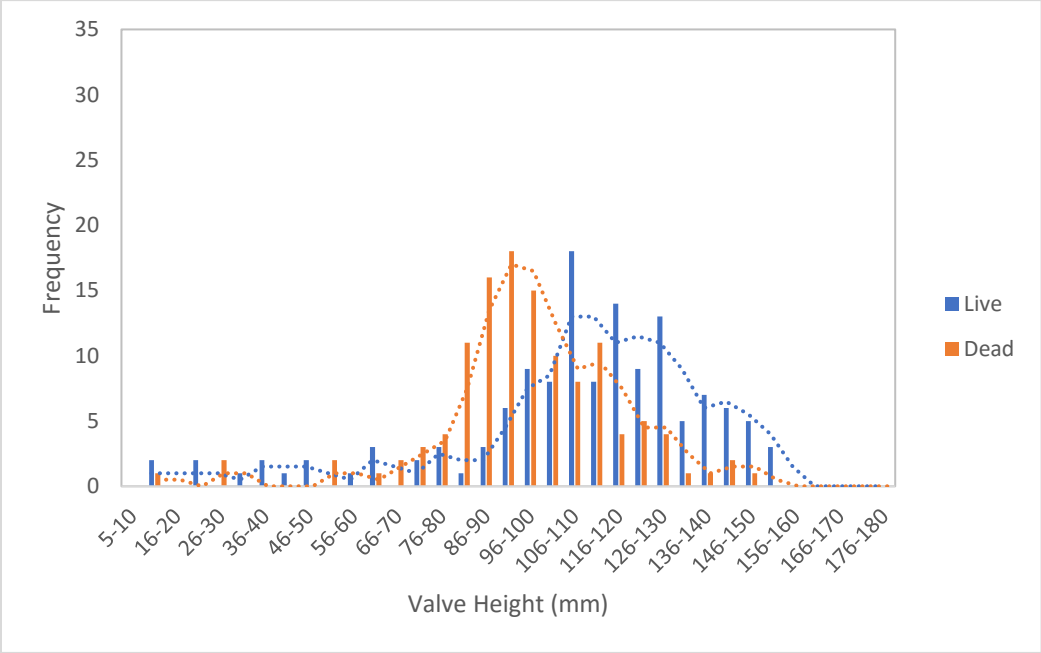


Figure 5a-d continued. Length distribution of sub-sampled oysters in Nasketucket Bay by sub-plot. Dotted line represents moving average.

c. Ward/Copper Beach sub-plot



d. Spindrift sub-plot