



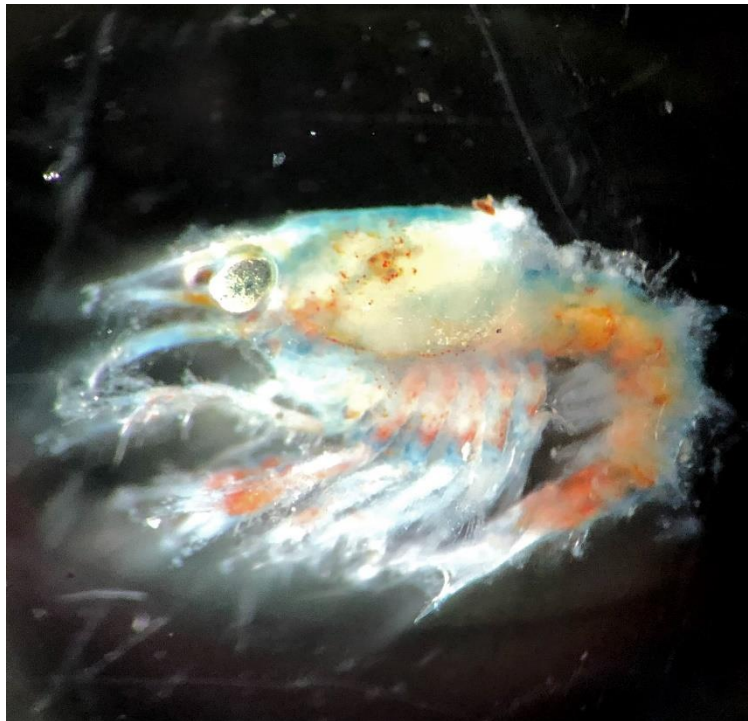
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2021 Survey Season Annual Report

May and June 2021

**Larval Lobster Abundance Survey
of the VW1 Study Area**



Submitted to:
Vineyard Wind LLC
700 Pleasant Street, Suite 510
New Bedford, MA 02740

2021 Survey Season Annual Report

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Project Title: Larval Lobster Abundance Survey of the VW1 Study Area

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PROJECT SUMMARY

The University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST) and Massachusetts Lobstermen’s Association (MLA) conducted a larval lobster abundance survey in Vineyard Wind’s Lease Area OCS-A 0501, referred to as VW1 Study Area, and an easterly adjacent Control Area (see Figure 1).¹

The primary goal of this project was to identify baseline conditions in the VW1 Study Area and Control Area, and to then compare potential impacts on several marine species of proposed wind development activities in the areas between years. To establish a baseline, a Before-After-Control-Impact (BACI) design was employed to detect eventual patterns of sustained difference.

For the planktonic sampling locations, we employed a random sampling design by stratifying the area of interest using existing lease blocks. Lease blocks within the two study areas – VW1 Study Area and Control Area – were identified and divided into smaller sub-areas called aliquots. An aliquot (within each lease block) was randomly selected and served as a sampling location that held constant throughout the survey season. There were 15 sampling sites selected in the VW1 Study Area and 15 in the Control Area, for a total of 30 stations. At each location plankton, tows were sampled twice per month in May and June 2021 using a towed neuston net.

Larval lobster samples were collected at each location with a neuston net; for the season, we collected seven total lobster larvae ranging from stages one to four. The average larval lobster density was 0.035 larvae per 1,000 cubic meters (m³) in the development area and 0.031 larvae per 1,000m³ in the Control Area. The four sampling periods of the larval lobster abundance survey were completed in May and June 2021. The American lobster, black sea bass, and lobster tagging portion of the study was not completed in 2021 due to delays in receiving the Record of Decision for the Vineyard Wind 1 project from the Bureau of Ocean Energy Management. Therefore, Year 3 of the study provided a baseline comparison to Year 1 and Year 2 on temporal abundance and distribution of lobster larvae in the upper layer of the water column.

¹ The Bureau of Ocean Energy Management (BOEM) segregated Lease Area OCS-A 0501 into two lease areas – OCS-A 0501 and OCS-A 0534 – in June 2021. The VW1 Study Area, which is located in the area now designated as Lease Area OCS-A 0501, is referred to as the “501N Study Area” in SMAST fisheries survey reports compiled prior to the lease area segregation.

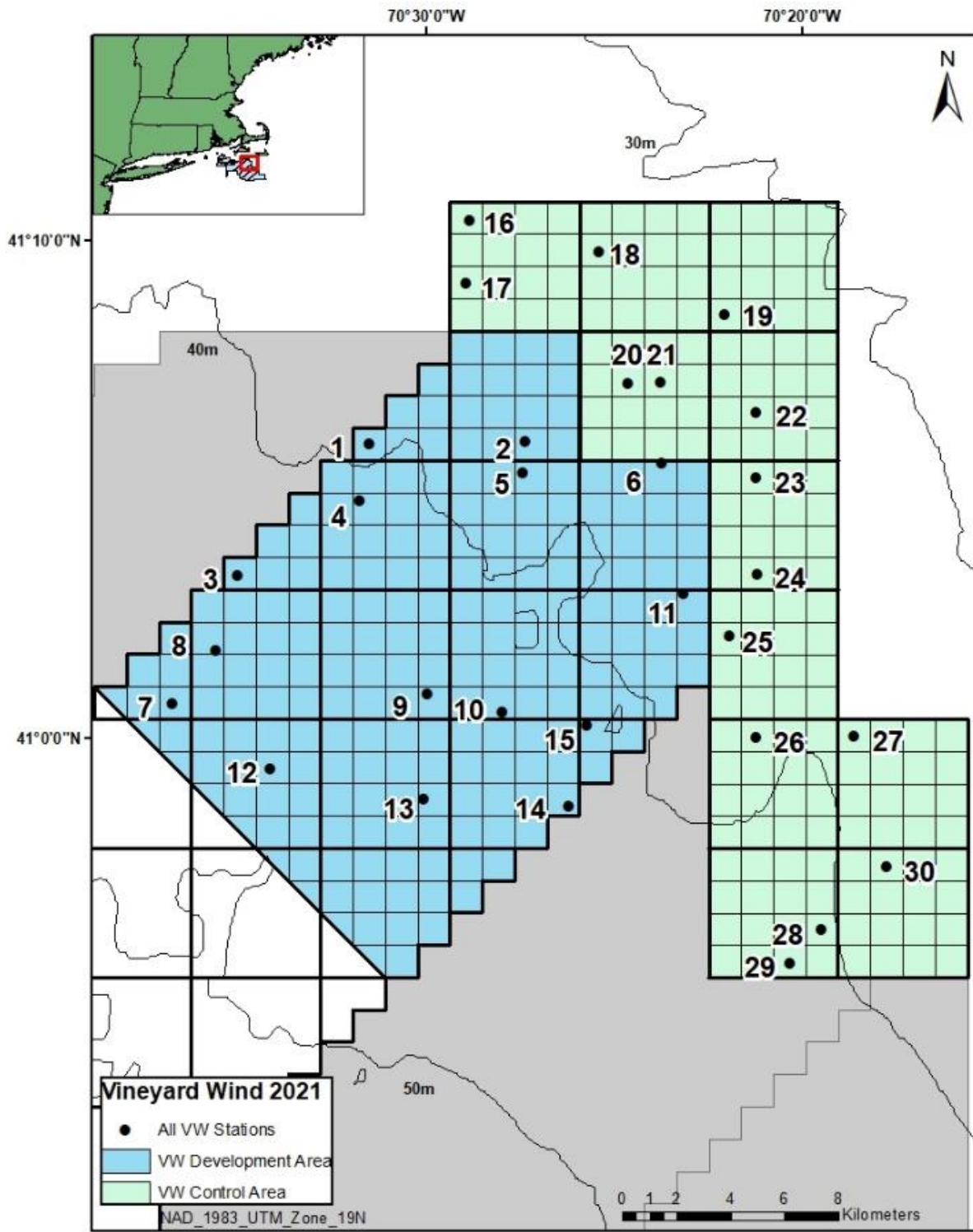


Figure 1. VW1 Study Area (blue) and Control Area (green) with randomly selected sampling sites (research locations).

METHODS

Larval Lobster Study

A towed neuston net collected samples at each randomly selected station twice per month in May and June 2021. The sampling net was deployed off the stern of commercial fishing vessels; the net opens to 2.4 x 0.6 x 6 meters (m) in size and is made of a 1,320-micrometer mesh (Figure 2). The net, when towed, samples the top 0.5 m of the water column. One 10-minute tow at approximately 4 knots was conducted at each location. Each tow had Onset® temperature, pH, dissolved oxygen, and conductivity sensors to track changes in environmental conditions and correlate catch metrics with this data. The contents from each tow were washed into tubs, sorted, and stored in a mixture of 10% formalin: 90% seawater, as described by Milligan (2010). Once back in the lab, samples were transferred into 70% ethanol for preservation and lobster larvae were staged according to Herrick (1911).

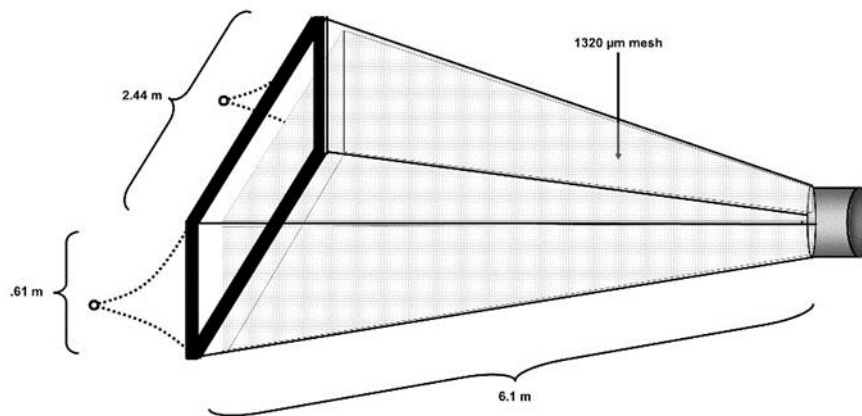


Figure 2. Diagram of the larval sampling net and frame.

SMAST worked in cooperation with Capt. Jarett Drake and Capt. Mohawk Bolin on the project, who allowed the scientists on board their commercial fishing vessels and deployed and maintained the gear used in the survey. Also, given the onset of the COVID-19 pandemic, industry partners and SMAST worked to develop Coronavirus research activity plans which allowed the surveys to progress with no significant delays.

RESULTS AND DISCUSSION

Each vessel utilized standardized tow durations of 10 minutes, a net sampling opening to 1.75 square meters (m²), and average tow speeds ranging from 2.0 to 4.0 knots depending on the sea state. This translated to an average of 1,853.2 ± 329.04 m³ of water sampled at each tow location. In total, n=7 lobster larvae were captured during the larval study, with n=3 (Table 1, Figure 2) in the VW1 Study Area and n=4 in the Control Area. Catches per sampling period ranged from n=0 to n=7 larval lobsters of life stages one, two, three, and four (Table 1). Larval lobster density per sampling period ranged from 0 to 0.09 ± 0.07 lobster larvae per 1,000 m³ of seawater sampled. Combined, there were an estimated 0.033 ± 0.013 larvae per 1,000 m³, with a higher density in the VW1 Study Area than in the Control Area, 0.035 ± 0.02 and 0.031 ± 0.02 larvae per 1,000 m³, respectively (Table 2). While other species, such as fish, crabs, shrimp, jellyfish, and various isopods, were observed and collected during the larval towing periods, we did not classify these samples further. However, all samples were stored and preserved for possible future analysis.

Temperature, salinity, dissolved oxygen, and pH were measured during all four sampling periods on larval tows in 2021. Breaks in the data were a result of a malfunctioning device (salinity sensor sampling period 3 in the VW1 Study Area). Minimum and maximum temperatures of 9.12°C and 18.24°C were recorded during the first and fourth sampling periods (May and June), respectively. The overall average temperature (°C) and its respective standard deviation (SD) throughout the survey was 13.31 (SD = 2.75) in both areas, 13.41 (SD = 2.95) in VW1 Study Area, and 13.21 (SD = 2.55) in the Control Area. The overall average salinity (PPT) throughout the survey was 27.95 (SD = 1.66) in both areas, 28.81 (SD

= 1.47) in the 501 N area, and 27.1 (SD = 1.38) in the control area. The overall average dissolved oxygen (DO; milligrams per liter [mg/L]) throughout the survey was 11.02 (SD = 0.78) in both areas, 10.94 (SD = 0.89) in the VW1 Study Area, and 11.08 (SD = 0.69) in the Control Area. The overall average pH throughout the survey was 8.34 (SD = 0.04) in both areas, 8.34 (SD = 0.03) in the VW1 Study Area, and 8.34 (SD = 0.05) in the Control Area (Figure 3, Table 3).

In 2019, all surveys were completed with eight sampling periods from June through October. In 2020, all surveys were completed with 10 sampling periods from May through October. In 2021, only the lobster larvae survey was completed with four sampling periods from May through June. A complete analysis of data collected from all surveys and years will be compared in the baseline assessment report.

Table 1. Summary of the counts of lobster larvae by stage during the survey.

Total Lobster Larvae Sampled							
Area	Sampling Period	Month	Larval Stage				Total
			I	II	III	IV	
Control	1	May	0	0	0	0	0
Control	2	May	0	0	0	0	0
Control	3	June	0	0	0	0	0
Control	4	June	0	0	3	1	4
VW1	1	May	0	0	0	0	0
VW1	2	May	0	0	0	0	0
VW1	3	June	0	0	0	0	0
VW1	4	June	1	1	1	0	3
Control	All	All	0	0	3	1	4
VW1	All	All	1	1	1	0	3
Both	All	All	1	1	4	1	7

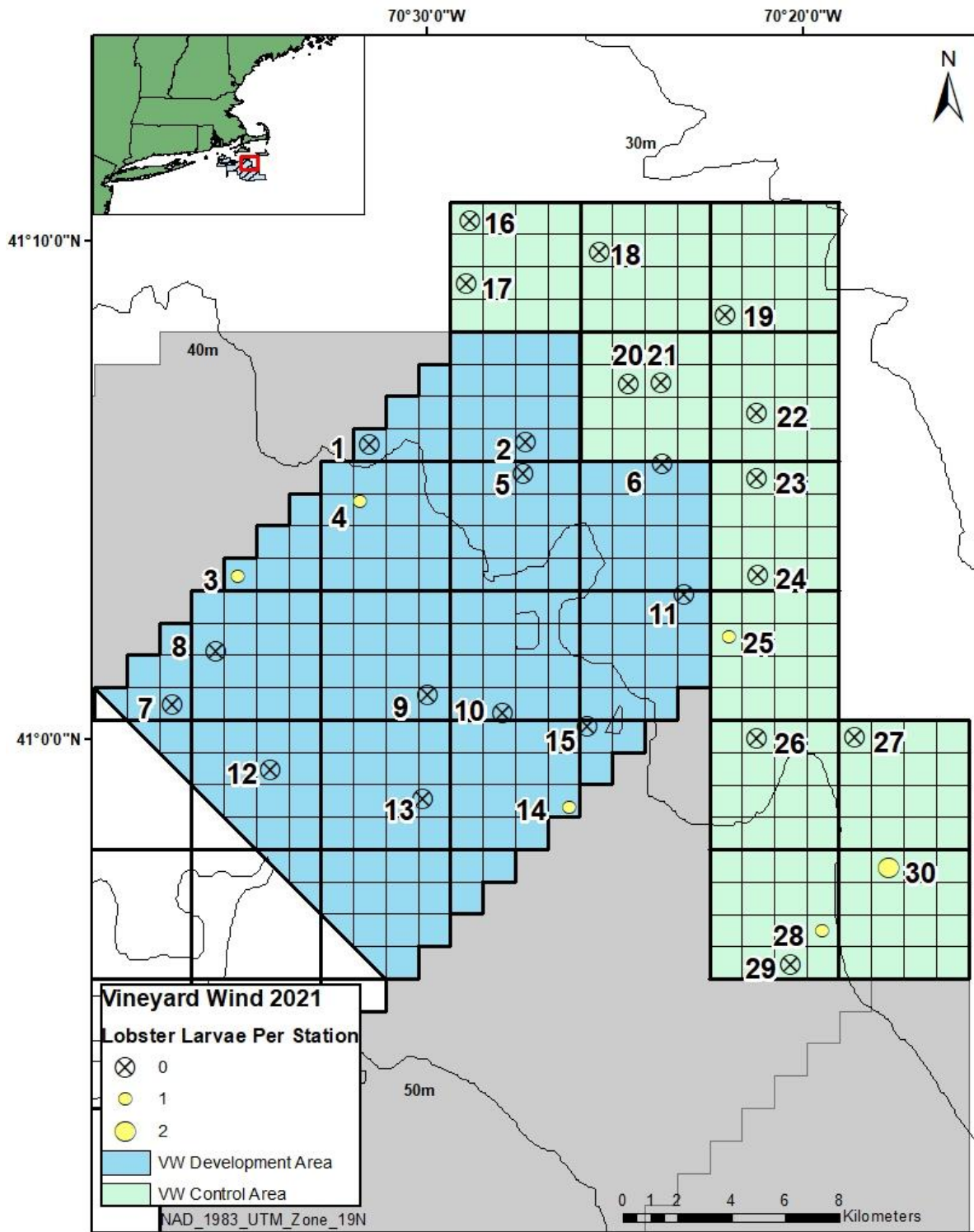


Figure 2. Map depicting the total number of lobster larvae sampled during neuston net tows at each location over the duration of the study in 2021.

Table 2. Summary of the mean density and standard error of lobster larvae estimated for each area over the duration of the study.

Mean Lobster Larvae / 1000 m							
Area	Sampling Period	Month	Larval Stage				
			I	II	III	IV	Total
Control	1	May	0	0	0	0	0
Control	2	May	0	0	0	0	0
Control	3	June	0	0	0	0	0
Control	4	June	0	0	0.09	0.03	0.12
VW1	1	May	0	0	0	0	0
VW1	2	May	0	0	0	0	0
VW1	3	June	0	0	0	0	0
VW1	4	June	0.05	0.05	0.04	0	0.14
Control	Average	All	0	0	0.02 ± 0.017	0.007 ± 0.007	0.03 ± 0.02
VW1	Average	All	0.01 ± 0.01	0.01 ± 0.01	0.009 ± 0.009	0	0.03 ± 0.02
Both	Average	All	.006 ± .006	.006 ± .006	.016 ± .1	.003 ± .003	0.03 ± .01

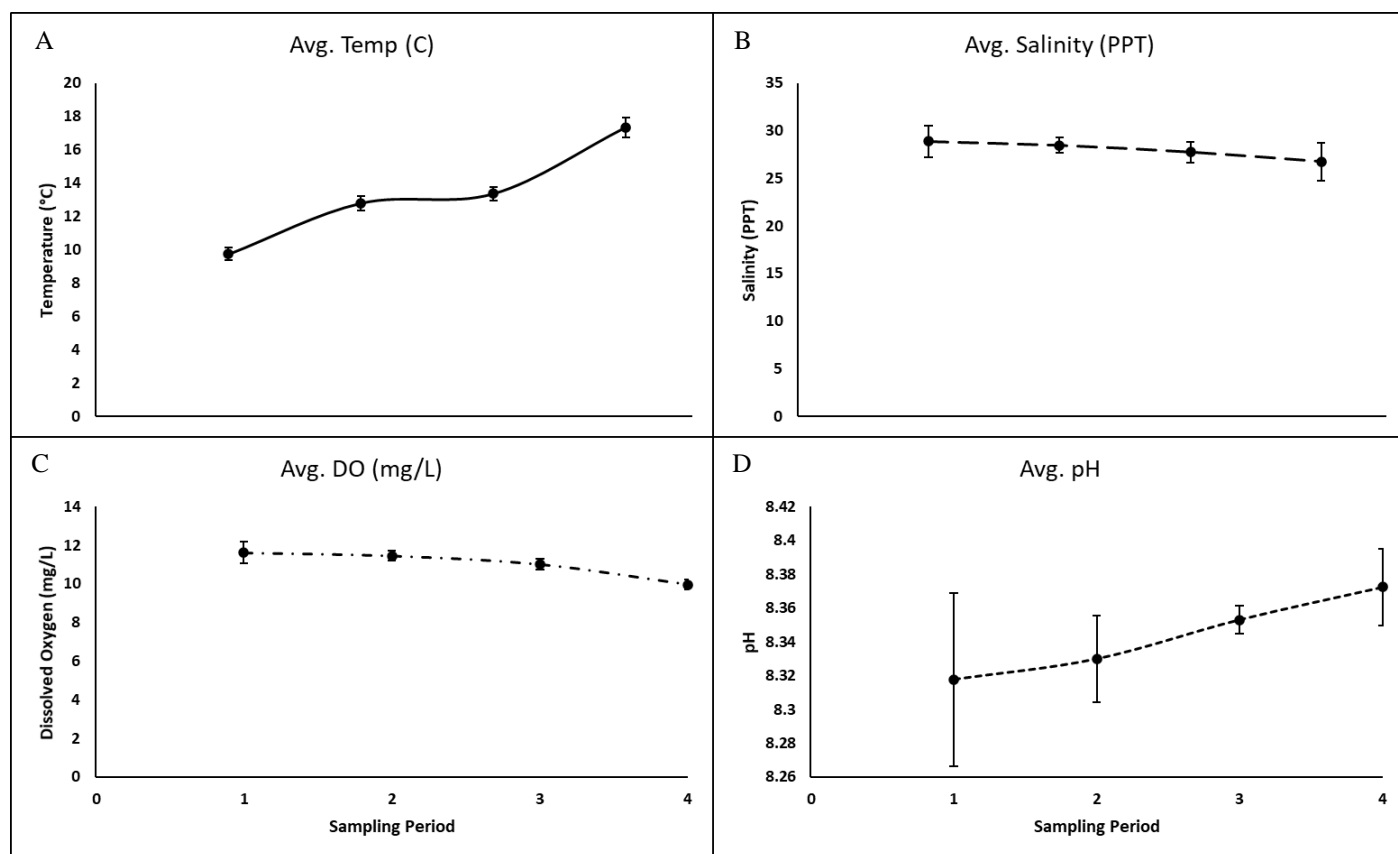


Figure 3. Environmental data by sampling period A) Average temperature in degrees Celsius, B) Average salinity in parts per thousand, C) Average DO in mg/L, D) Average pH. The timeframe of this dataset is May through June. All data points have their respective standard deviations included.

Table 3. The mean environmental data by sampling period and standard deviation for the duration of the 2021 survey.

Sampling Period	Environmental Factor			
	Temp (°C)	Salinity (PPT)	DO (mg/L)	pH
1	9.75 (0.40)	28.87 (1.63)	11.62 (0.56)	8.32 (0.05)
2	12.8 (0.42)	28.46 (0.81)	11.46 (0.27)	8.33 (0.03)
3	13.36 (0.41)	27.74 (1.09)	11.02 (0.30)	8.35 (0.01)
4	17.33 (0.59)	26.73 (2.01)	9.97 (0.24)	8.37 (0.02)
Total	13.31 (2.75)	27.95 (1.66)	11.02 (0.78)	8.34 (0.39)

LITERATURE CITED

Herrick, F. H. (1911). *Natural History of the American Lobster* (Document No. 747). Washington D.C.: United States Bureau of Fisheries

Milligan, P. J. (2010). *Abundance, distribution and size of American lobster (Homarus Americanus) larvae in Buzzards Bay, Massachusetts: a thesis in marine science and technology- living marine resources management*. University of Massachusetts Dartmouth School of Marine Sciences. Unpublished Master's Thesis