Massachusetts Division of Marine Fisheries

Lake Tashmoo, Tisbury, MA

Eelgrass Survey

2022

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Introduction

Lake Tashmoo is a 269-acre estuary located in the Town of Tisbury on Martha's Vineyard, MA, with a mean depth of 4.3 ft, a tidal range of 2 ft, and a single tidal inlet into Vineyard Sound to the north. Mapped habitats within Lake Tashmoo include bay scallop (*Argopecten irradians*), soft-shell clam (*Mya arenaria*), quahog (*Mercenaria mercenaria*), razor clam (*Ensis leei*), alewife (*Alosa pseudoharengus*), American eel (*Anguilla rostrata*), horseshoe crab (*Limulus polyphemus*) and winter flounder (*Pseudopleuronectes americanus*) spawning, tidal flats, salt marsh, and eelgrass (*Zostera marina*) (Appendix A).

The Town of Tisbury contacted the MA Division of Marine Fisheries (MA DMF) in spring 2021 with a request for assistance in mapping existing eelgrass in Lake Tashmoo. Biologists from the MA DMF Habitat Program and Shellfish Program conducted a survey in response to this request on June 11, 2021, with a MA DMF vessel equipped with side scan sonar and drop camera equipment. Staff from the Tisbury Shellfish Department provided an additional vessel and assisted with drop camera data collection. The predetermined areas were fully surveyed with side scan, and spot checked with drop cameras at geo-referenced groundtruthing locations.

Methods

The Town of Tisbury provided MA DMF with a map delineating the survey areas of interest (Figure 1). MA DMF conducted a side scan sonar survey with groundtruthing at the proposed sites on June 11, 2021. Site conditions on the day were partly cloudy, calm and in the mid 60's F. The survey was conducted between 9:00AM and 1:30PM to coincide with an incoming tide, predicted for 1:15PM on the survey date (Appendix B). MA DMF biologists Dr. John Logan and Steven Voss conducted all side scan sonar and photo groundtruthing of the western survey area from a 20' DMF Maritime Skiff. Tisbury staff Danielle Ewart and MA DMF biologist Dr. Christian Petitpas conducted photo groundtruthing of the northern survey area from the Tisbury Shellfish Department skiff.

Figure 1. Eelgrass survey locations. Grey polygons represent the survey area of interest.

Data Collection

Acoustic Mapping (side scan) – The side scan survey utilized a Humminbird 698SI system with a 455 kHz side scan sonar and an 83/200 kHz dual beam downward-looking bathymetric sonar. The transducer was mounted off the port-side of a 20' Maritime Skiff. The GPS antenna is integrated into the Humminbird processing unit which was mounted four feet forward from the transducer.

Survey lines were generated in ArcGIS 10.8.1 The resulting shapefiles were converted to .kml files and exported to the Humminbird side scan system using the proprietary software HummViewer. The transect lines (Figure 2) were organized and renamed in the Humminbird display unit for convenient access once in the field. Side scan data were recorded along the planned lines at a speed of 3 to 4 kts. The Humminbird system includes a display and data collection unit on which the transducer data can be recorded to an SD card. Side scan sonar data were processed on a PC and then exported as GeoTIFF images.

Figure 2. Transect lines developed to cover areas of interest.

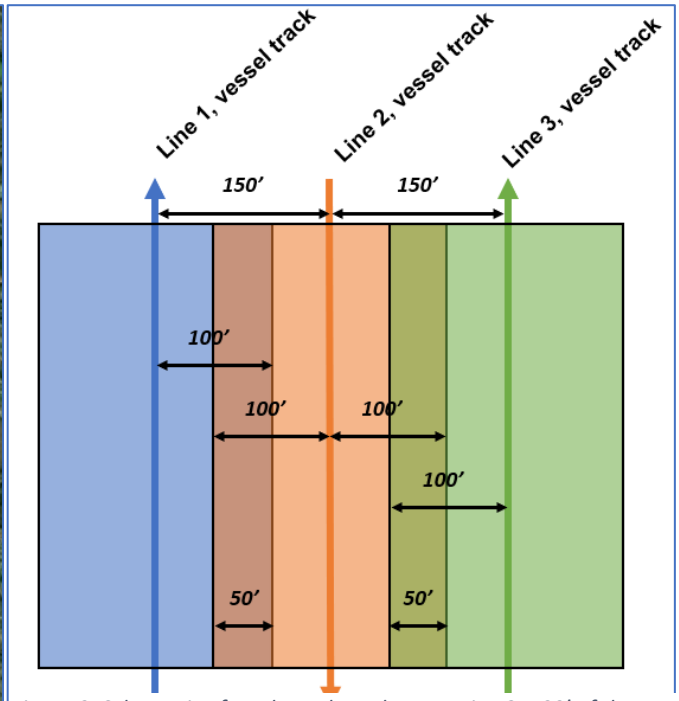

Figure 3. Schematic of tracks and overlap. For Line 2, 100' of the original 200' of seafloor imaged is also imaged on Line 1 and Line 3 passes. The overlap is the darker shaded sections of the diagram.

Parallel survey transect lines were positioned approximately 150 feet apart (Figure 3). This spacing was used to ensure 150% spatial coverage of the seafloor. This is the operating standard used to improve interpretation of side scan sonar data since imagery at the outer edge of the range is often compromised due to signal attenuation (Kaeser and Litts 2013). The planned survey lines were oriented to optimize the best direction for data collection based on the orientation of the survey areas.

Methods employed by DMF for side scan surveys are described in more detail in Standard Operating Procedures Manual for Side scan Sonar (MA DMF 2018).

Photo Acquisition – Photo verification, or groundtruthing, was conducted on the same day, immediately after fininshing the side scan survey. Photo data collection occurred from both the MA DMF Maritime Skiff and the Tisbury Shellfish Department Skiff. The Shellfish Department Skiff used a Deep Blue Pro SplashCam (Figure 4) live-feed underwater camera mounted to a drop camera frame to survey predetermined point locations in the shallower northeastern area of the pond. A Garmin GPS76 handheld unit was used for positioning. MA DMF collected the southern and western areas with a GoPro Hero 5 affixed to a PVC camera frame. The side scan data stream was viewed live on the Humminbird display unit during the survey. Indiscernible bottom signatures and locations inside and outside of the eelgrass meadows were flagged for groundtruthing. Positioning for groundtruthing using the Humminbird system has an accuracy of approximately 15 feet (Humminbird 2013).

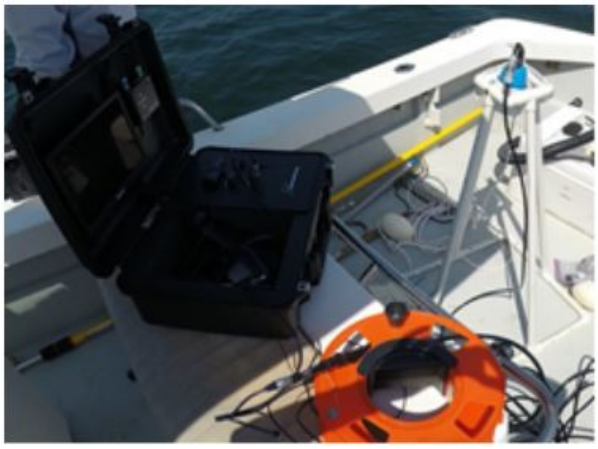

Figure 2. Deep Blue Pro SplashCam setup.

Methods employed by DMF for photo groundtruthing of eelgrass beds are further described in "Standard Operating Procedures Manual for Underwater Video" SOP underwater photo-video edition 2 (mass.gov).

Data Processing

Side scan sonar data were processed with SonarTRX Pro Ver 15.1.5859.19587. SonarTRX is a software system that can view and process both 2D and 3D hydroacoustic data from multiple low- and high-end side scan sonar units. The primary processing steps included beam angle, slant range, and removal of the water column corrections. The corrections place each sonar ping in the correct geographic space on the seafloor. Positional error is related to several variables such as survey speed, GPS signal quality, and variation in vessel and transducer heading relative to course. The extent of this error has not been tested at this time but based on in-field experience we estimate it to be approximately 10 feet.

Each georeferenced transect line was exported for viewing in ArcGIS 10.8 as GeoTIFFs. The assemblage of transect lines in the GIS software was used to create a mosaic of the whole study area and delineate the

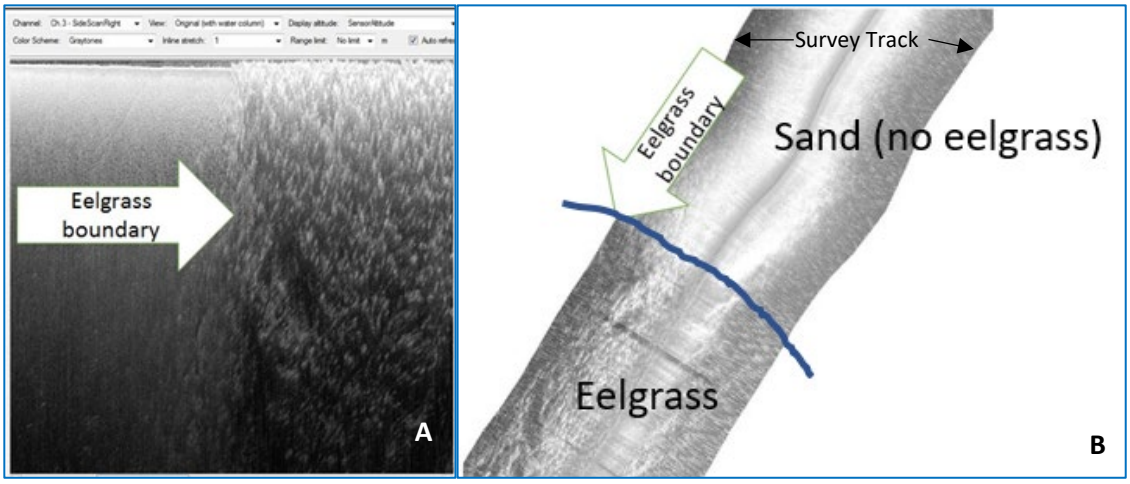

Figure 5. (A) Humminbird data in playback view in SonarTRX showing eelgrass boundary. (B) Humminbird data as a geo-referenced mosaic in ArcGIS showing eelgrass boundary.

boundary of the eelgrass meadows (Figure 5). Habitat delineation was done in ArcGIS 10.8 at a range of scales

from 1:500 to 1:2,000. The processing workflow followed DMF Standard Operating Procedures for SonarTRX processing.

Groundtruthing imagery and survey tracks were spatially corrected, indexed, and plotted in GIS (Figure 6). Images were analyzed for eelgrass presence and classified as Sand (no eelgrass), Patchy (<50% eelgrass), or Dense (>50% eelgrass). Appendix C includes the image, location, and classification data for groundtruthing imagery.

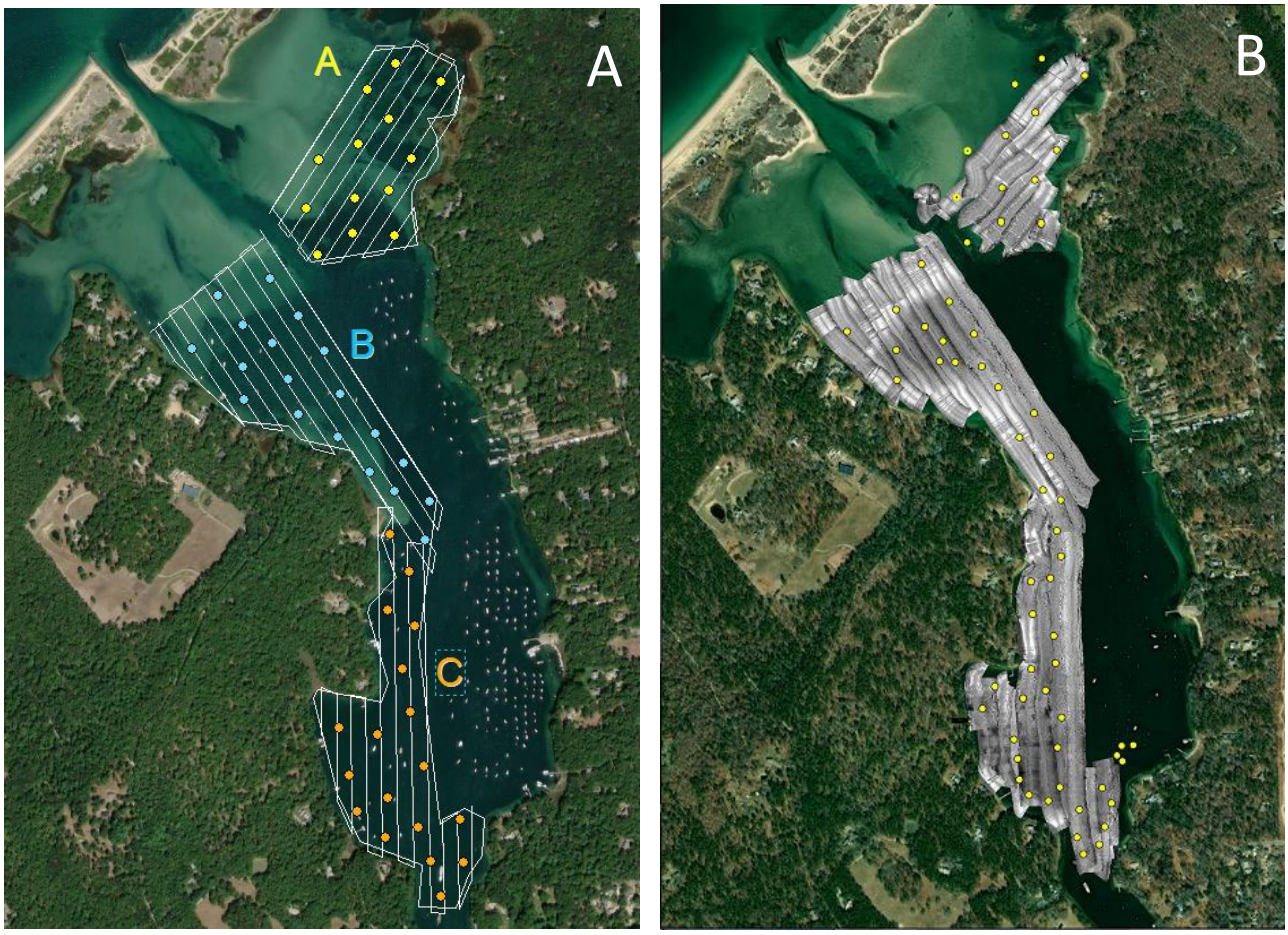

Figure 6. Proposed (A) and geo-referenced (B) survey track lines and groundtruth photo points.

Results

Table 1. Summary of eelgrass survey data collection and results

Number of side scan transects	31
Area surveyed	99 acres
Sand area (eelgrass absent)	52 acres
Patchy area (<50% cover)	16 acres
Dense area (>50% cover)	31 acres
Mapped eelgrass area (Patchy + Dense)	47 acres
Number of photos collected	62 (22 Tisbury /40 MA DMF)
Photos classified as Sand (eelgrass absent)	26
Photos classified as Patchy	22

Photos classified as Dense	14

Acoustic mapping – 31 transect lines were completed to cover the full extent of the 99-acre survey area. (Figure 6B; Table 1). In the side scan sonar mosaic, eelgrass has a characteristic pattern which can be used to delineate eelgrass spatial extent. Polygons were created around the eelgrass boundaries observed in the sonar data (Figure 7A).

Photos – 62 photos were collected within (54 photos) and outside (8 photos) the survey area (Figure 7B; Table 1). Image interpretation was qualitatively characterized according to estimated percent cover of eelgrass, with 26 images classified as Sandy (no eelgrass present), 22 images as Patchy (<50% eelgrass), and 14 images as Dense (>50% eelgrass).

Analysis of side scan survey data coupled with the collection of photo data to verify survey results identified 47 acres (16 acres of Patchy and 31 acres of Dense) of eelgrass habitat within the 99 acres surveyed (Figure 8; Table 1).

Discussion

Seagrass loss is occurring globally (Short et al. 2006) and in Massachusetts eelgrass losses have been documented statewide (Costello and Kenworthy 2011). Lake Tashmoo has also experienced eelgrass loss since DEP's 1995 survey identifying 91 acres of eelgrass within the embayment (Table 2). Eelgrass losses are correlated to eutrophication, habitat degradation, climate change, and anthropogenic impacts.

Table 2. Summary of surveys of mapped eelgrass acreage of Lake Tashmoo 1995 – 2021.

Survey	Areal extent
DEP Mapped Eelgrass in Tashmoo – 1995	91 acres
DEP Mapped Eelgrass in Tashmoo – 2001	38 acres
DEP Mapped Eelgrass in Tashmoo – 2006-2007	38 acres
DEP Mapped Eelgrass in Tashmoo – 2010-2013	45 acres
DEP Mapped Eelgrass in Tashmoo – 2015-2017	47 acres
DMF Lake Tashmoo Survey - 2021	47 acres

The acreage of eelgrass identified in our survey was consistent with the delineations of the previous two DEP surveys conducted in 2013 and 2017 (Table 2). Our delineations are broadly comparable to the 2013 and 2017 DEP delineations, suggesting limited change in the overall areal extent of this eelgrass meadow between 2013 and 2021. Several factors, including variability of seasonal eelgrass growth patterns and survey methodologies influence habitat boundary delineations.

Side scan surveys and associated photo groundtruthing techniques are suitable for characterizing eelgrass distributions on an embayment scale. On finer scales, sparsely distributed eelgrass shoots can be missed. Accordingly, for the purposes of siting private aquaculture grants, a dive survey will inform DMF's final site certification decision and the results of this survey will not supersede a DMF diver survey.

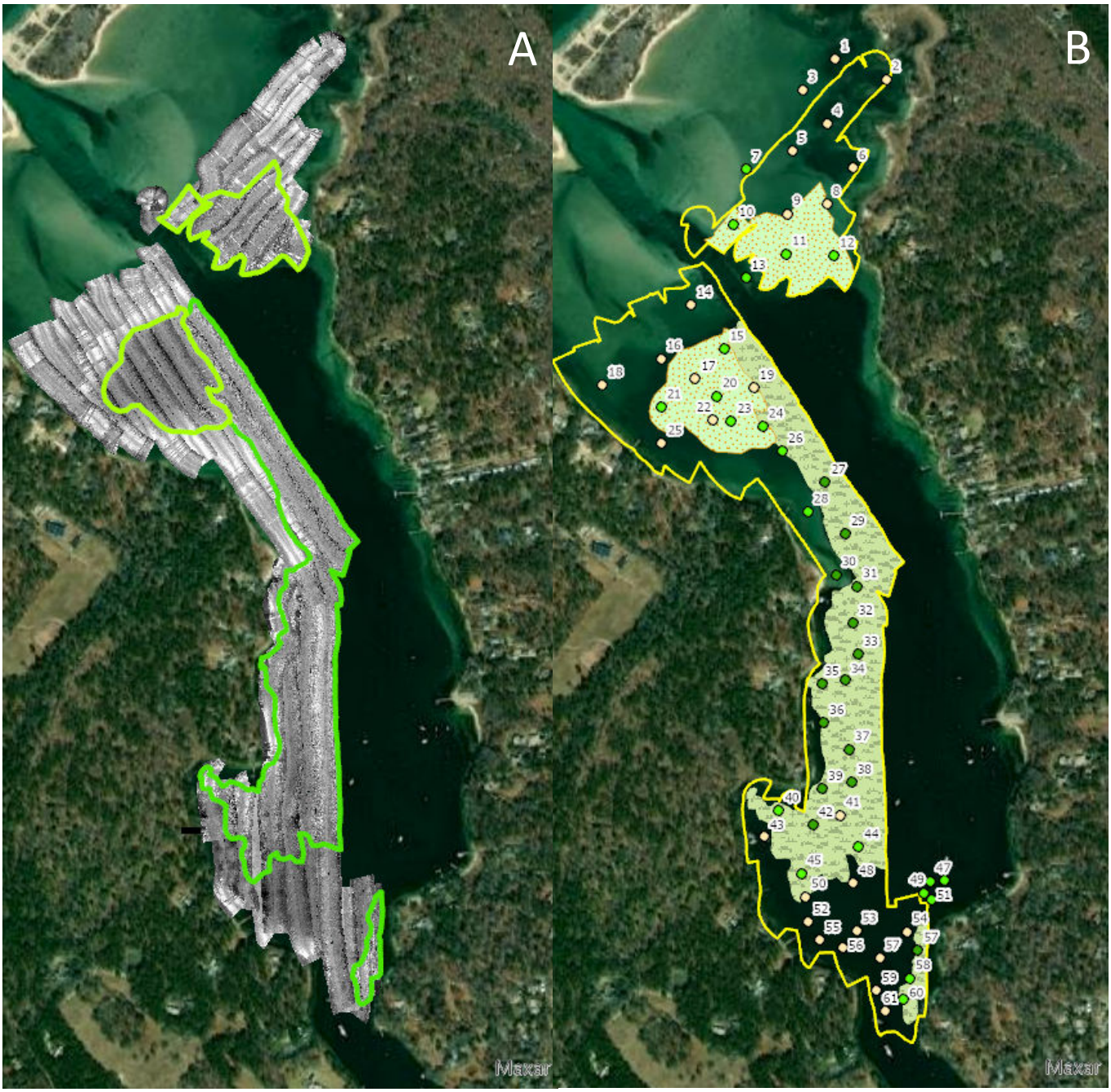

Figure 7. Delineated eelgrass spatial extent within the side scan survey area (A) and spatially corrected and indexed photo groundtruth stations (B). Additional information on eelgrass classification of groundtruthing data is available in Appendix C.

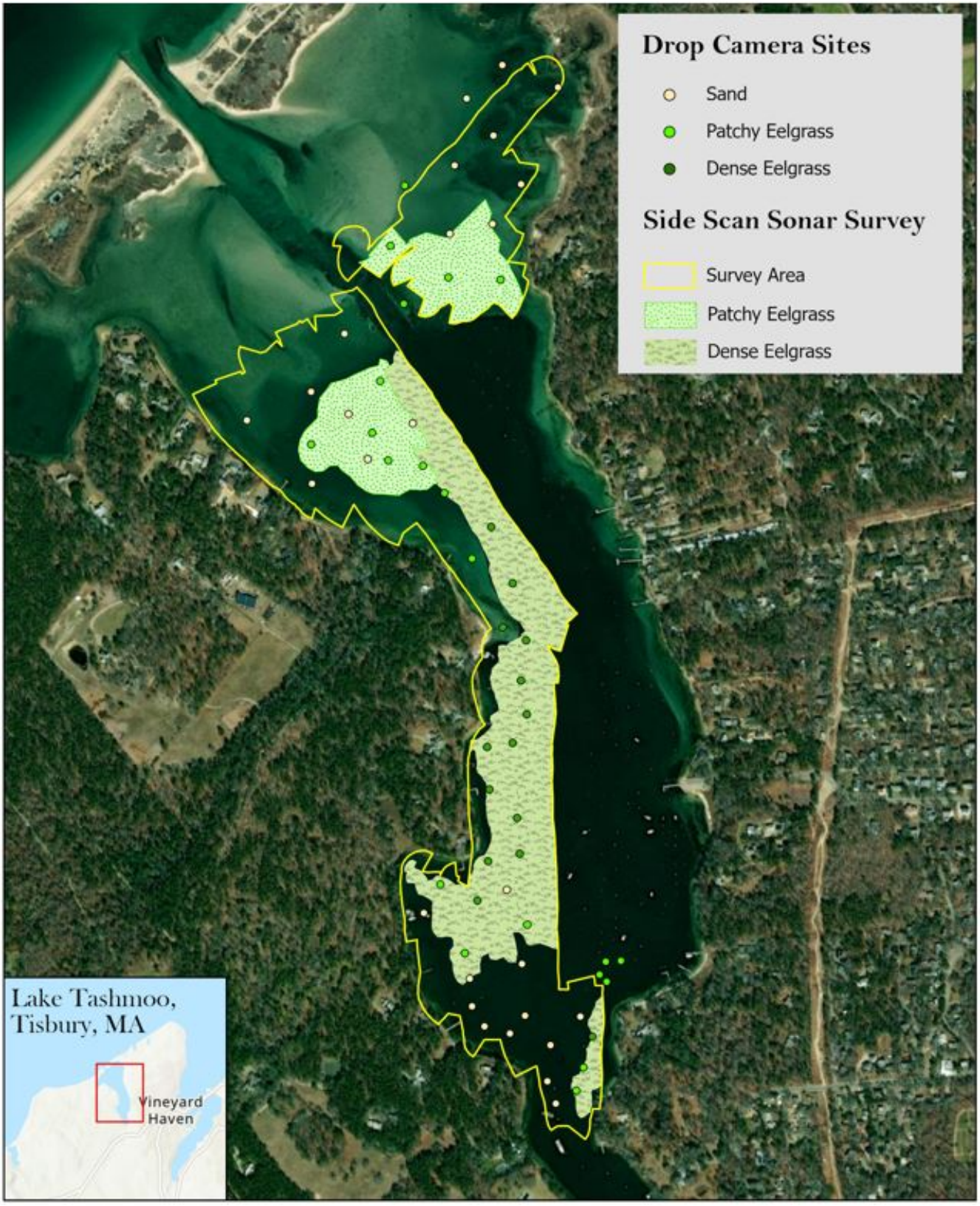

Figure 8. Delineated eelgrass boundaries with coded drop camera locations.

References

Costello, C.T., and W.J. Kenworthy. 2011. Twelve-year mapping and change analysis of eelgrass (Zostera marina) areal abundance in Massachusetts (USA) identifies statewide declines. Estuaries and Coasts. 34 (2): 232– 242. https://doi.org/10.1007/s12237-010-9371-5.

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Kaeser, A.J. and T.L. Litts. 2013. An Illustrated Guide to Low-cost Side Scan Sonar Habitat Mapping. 314 pp. https://www.fws.gov/panamacity/resources/An%20Illustrated%20Guide%20to%20LowCost%20Sonar%20Habitat%20Mapping%20v1.1.pdf. Accessed 13 April 2020.

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Appendices

Appendix A: Mapped Habitats.

Appendix B. Survey Conditions on 06/11/2021.

Appendix C: Image, spatial reference, and eelgrass classification of groundtruthing data.

Appendix D: Copy of field notes.

Appendix A: Mapped Habitats

Shellfish Suitability Habitat (Source: https://www.mass.gov/info-details/massgis-data-shellfish-suitability-areas).

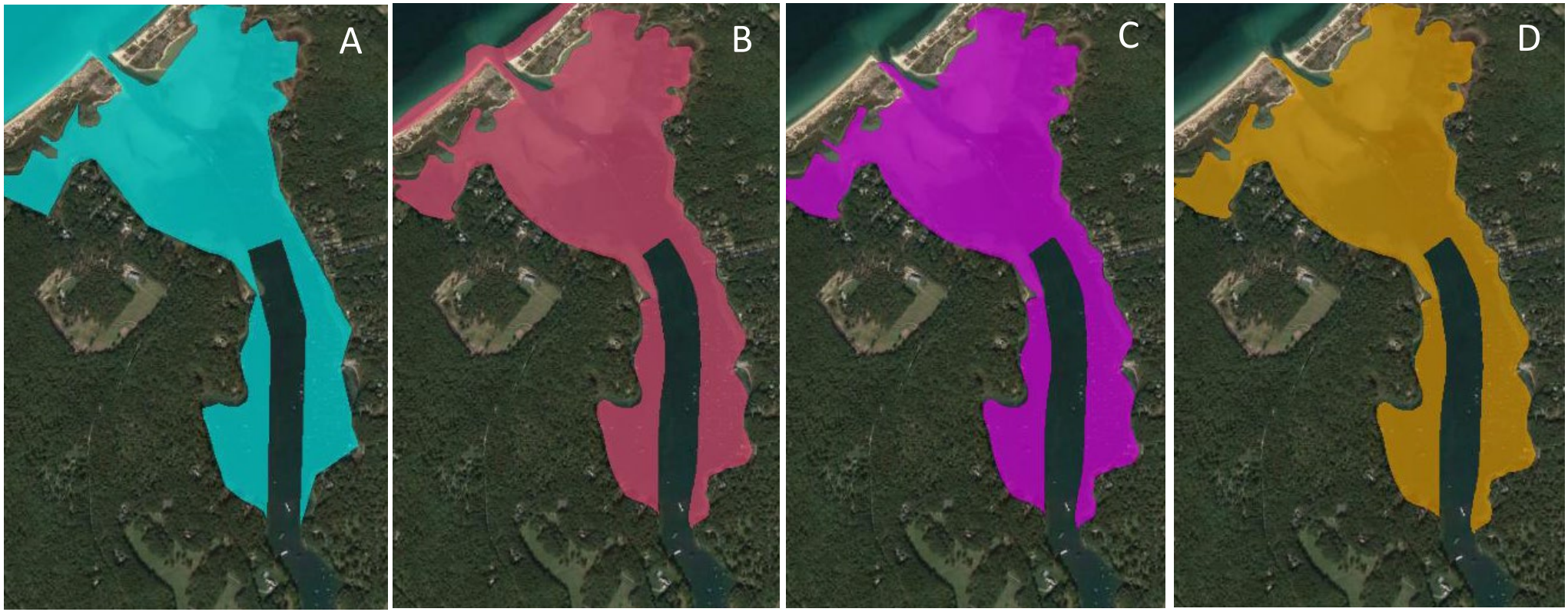

Figure A1. Mapped Shellfish Suitability Habitat. A. Bay scallop (*Argopecten irradians*). B. Soft-shell clam (*Mya arenaria*). C. Quahog (*Mercenaria mercenaria*). D. Razor clam (*Ensis leei*).

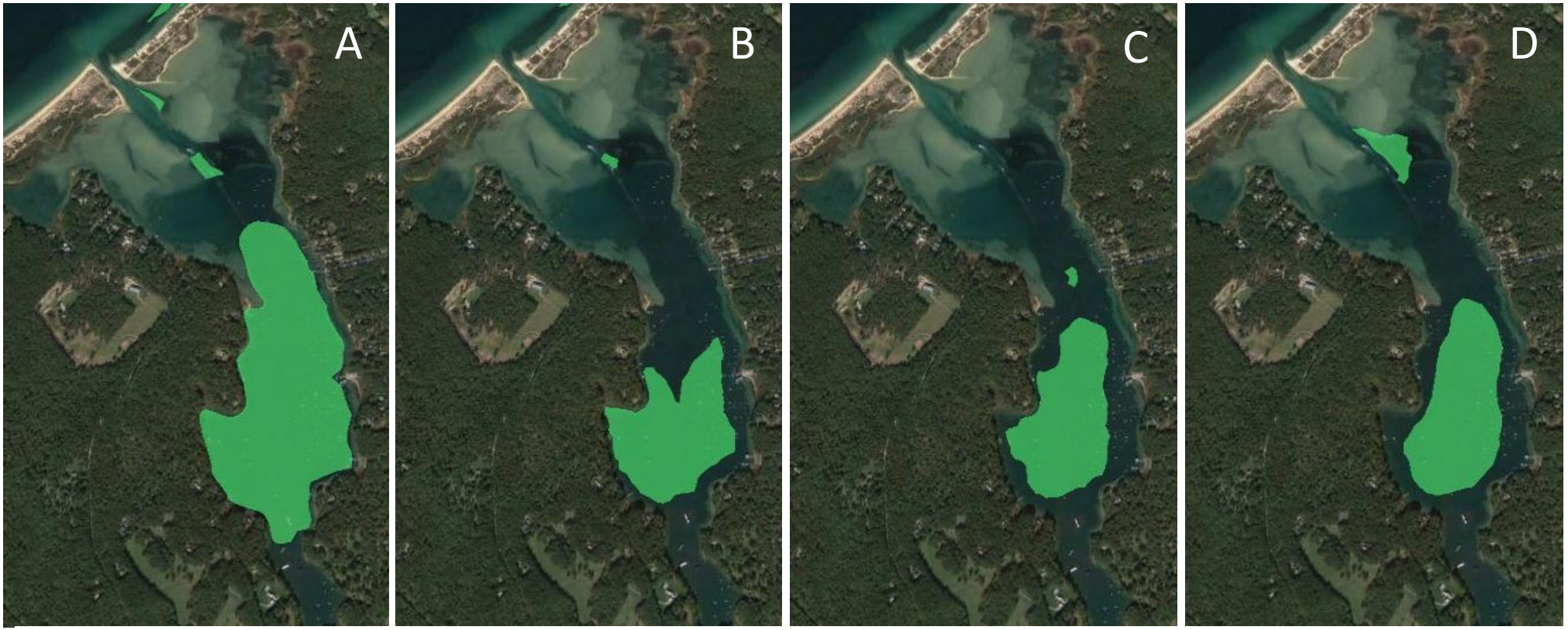

Figure A2. Eelgrass (*Zostera marina*) mapped by MA DEP by year. A) 1995. B) 2001. C) 2006-2007. D) 2010-2013.

Figure A3. Eelgrass (*Zostera marina*) mapped by MA DEP. E) 2015-2017 (most recent). F) 1995, 2001, 2006-2007, 2010-2013, and 2015-2017 layers combined.

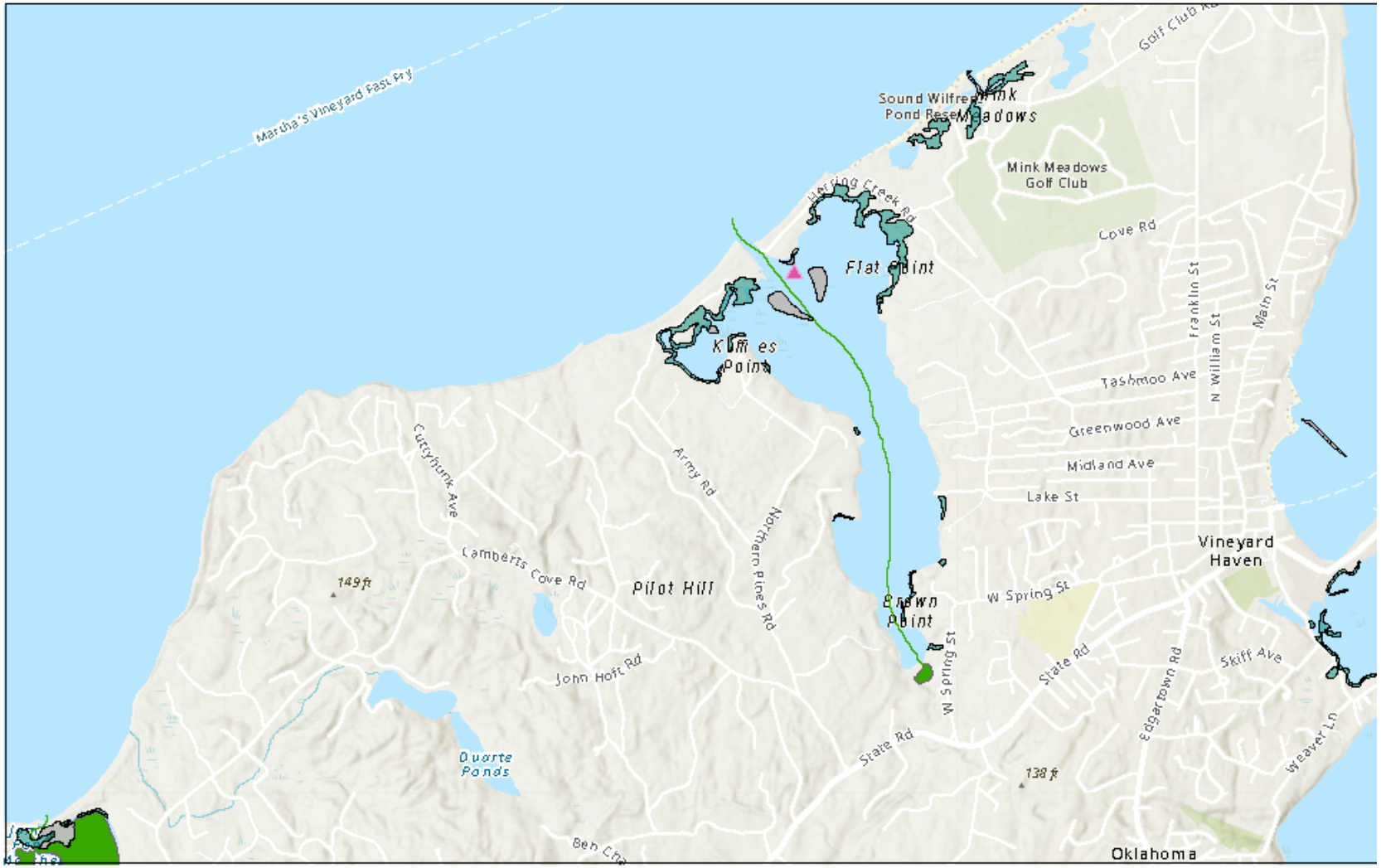

Figure A4. Mapped tidal flat, salt marsh, diadromous fish, and Horseshoe crab habitats.

Appendix B: Survey Conditions on 06/11/2021.

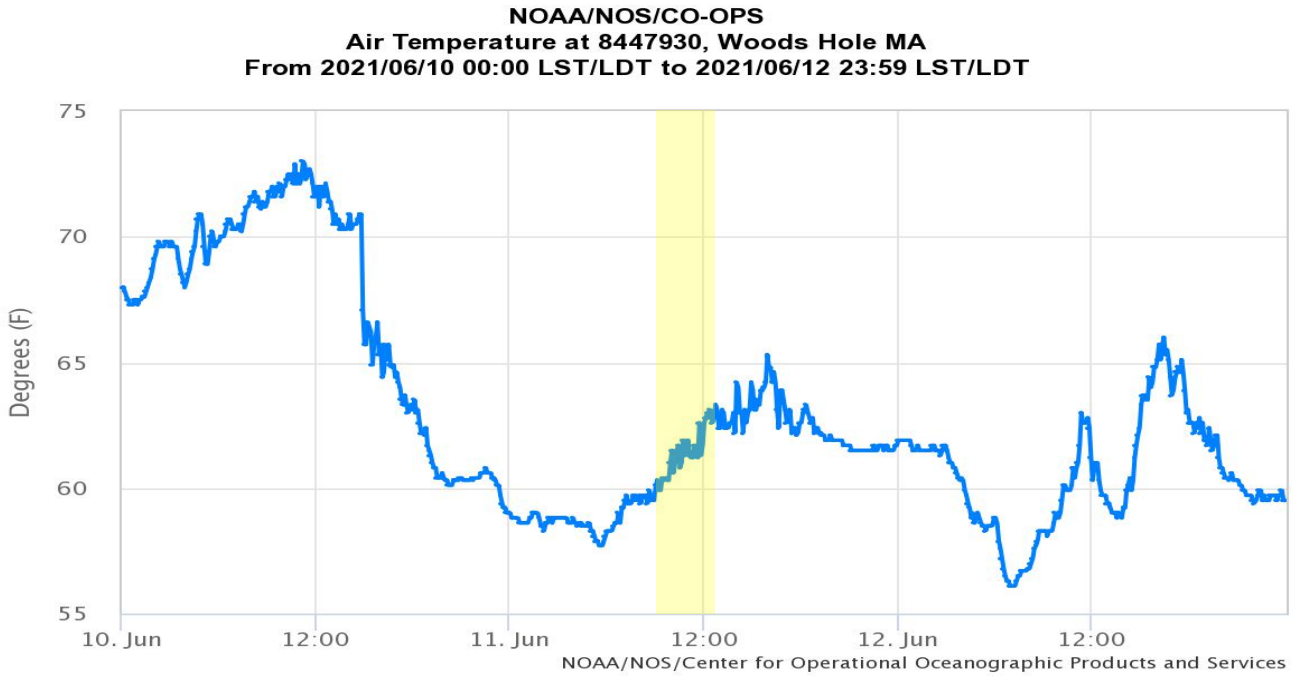

Figure B1. Air Temperature.

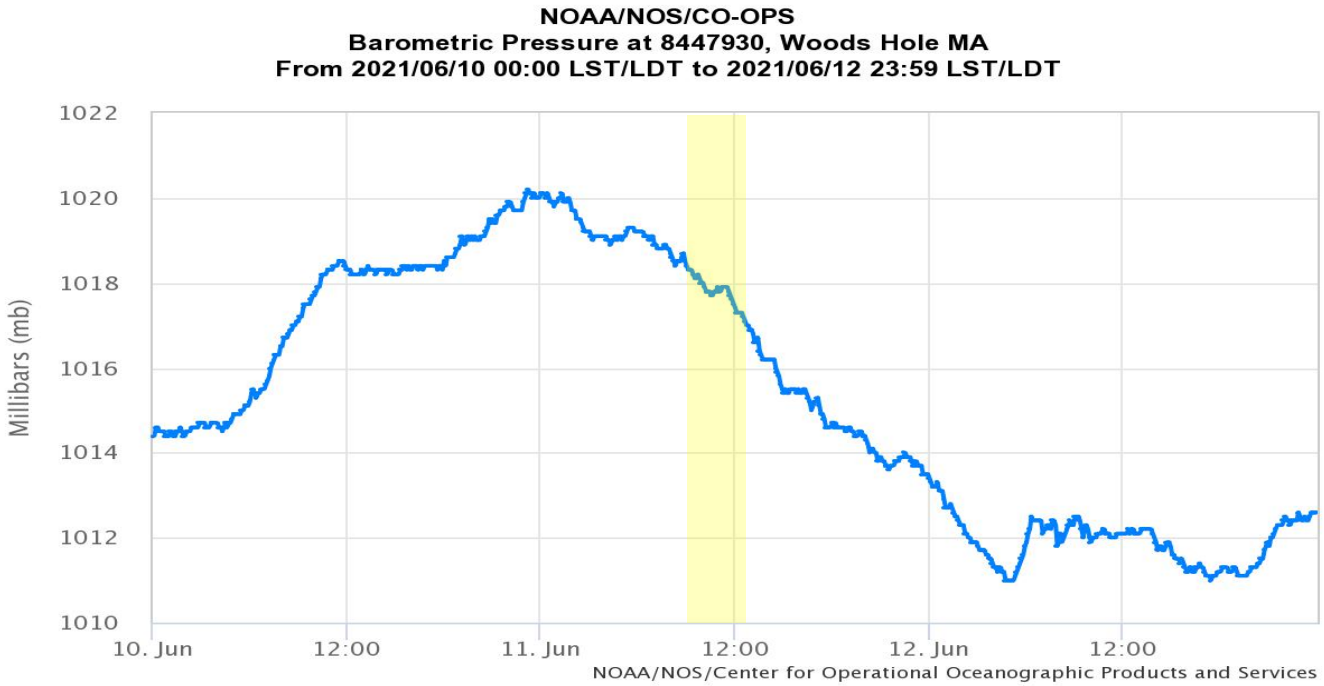

Figure B2. Barometric Pressure.

NOTE: Tides for Lake Tashmoo are typically 2.5 hours earlier than predicted for Vineyard Haven.

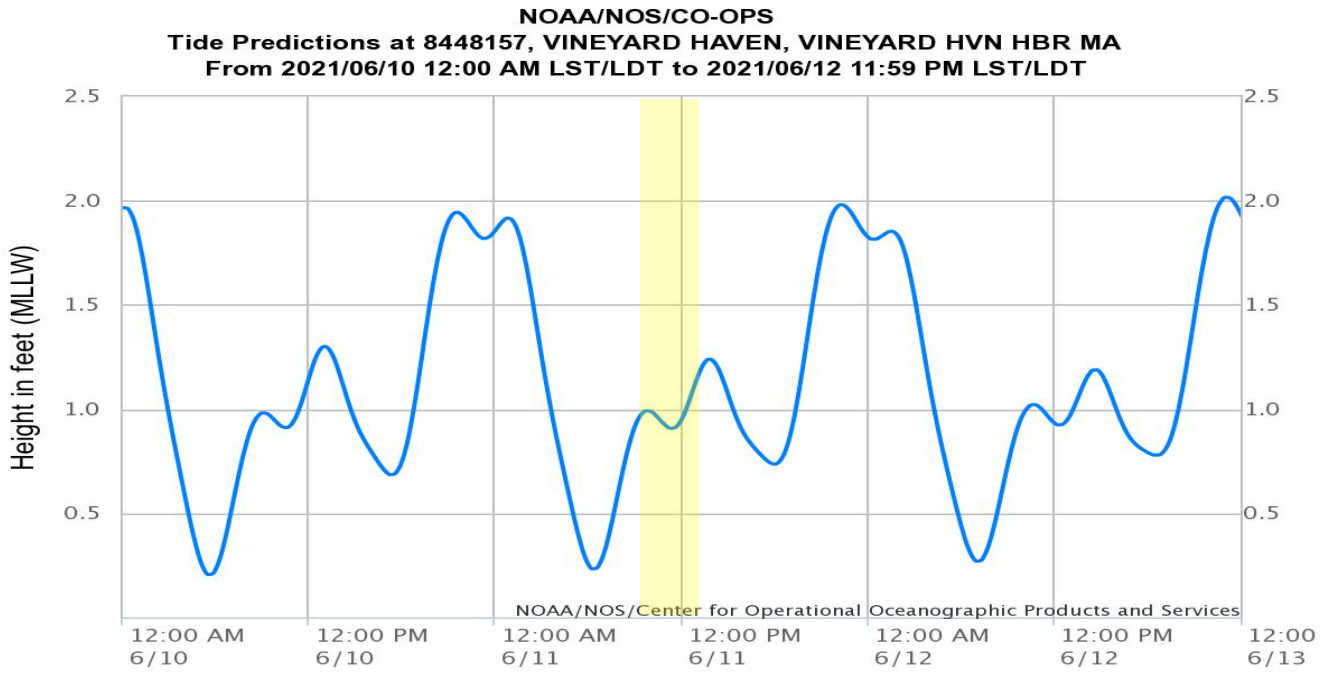

Figure B3. Tide Predictions (Vineyard Haven Harbor)

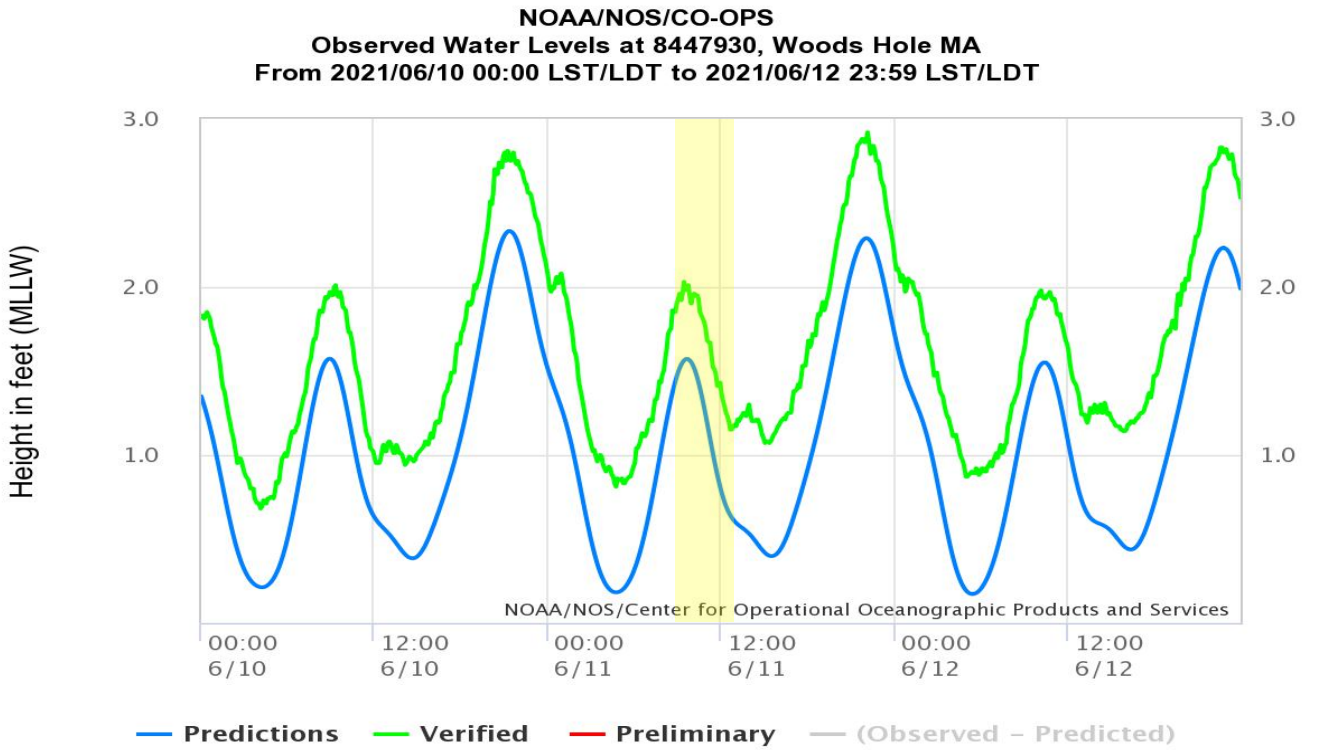

Figure B4. Observed Water Levels (Woods Hole, MA)

Appendix C: Image, spatial reference, and eelgrass classification of groundtruthing data.

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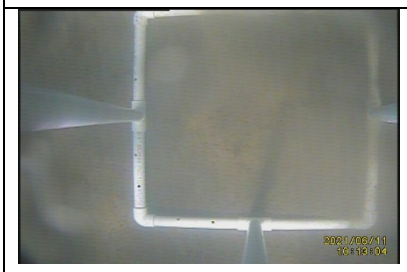	01	SplashCam-Town	Absent
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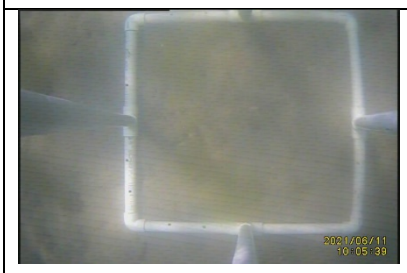
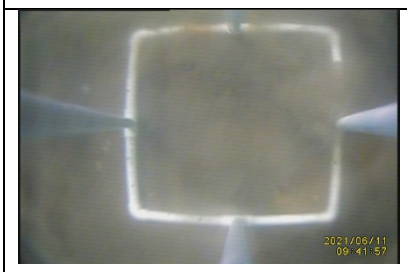
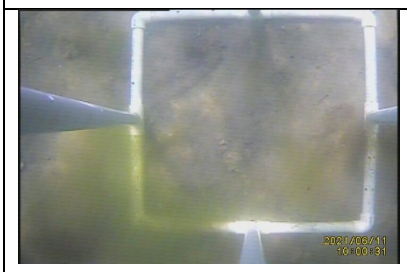
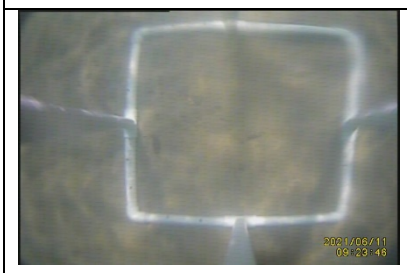
	03	SplashCam-Town	Absent
	04	SplashCam-Town	Absent
	05	SplashCam-Town	Absent

	06	SplashCam-Town	Absent
	07	GoPro-Town	Patchy Small single eelgrass shoot
	08	SplashCam-Town	Absent
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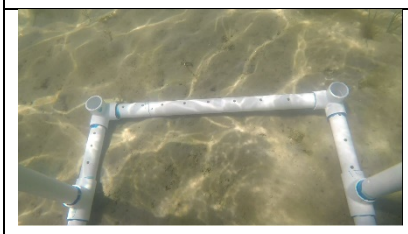
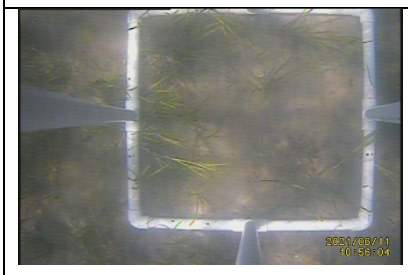
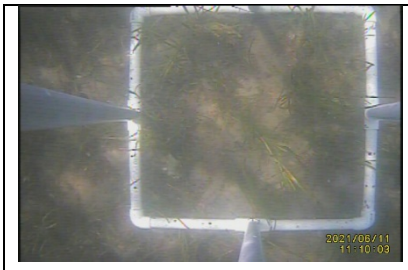
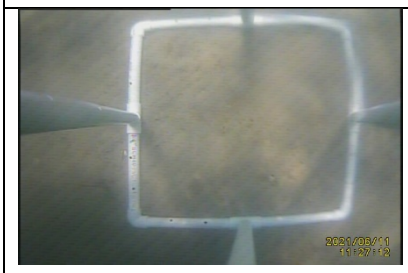
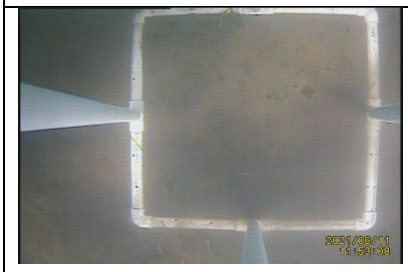
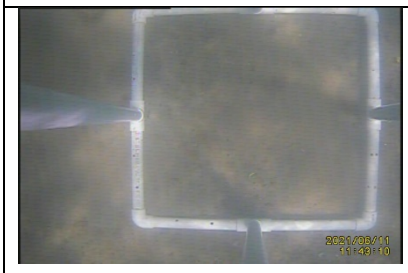
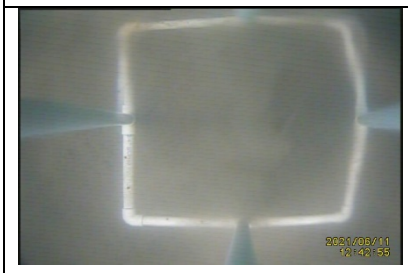
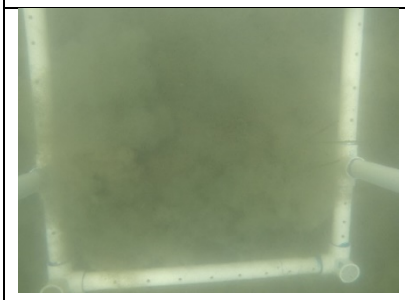
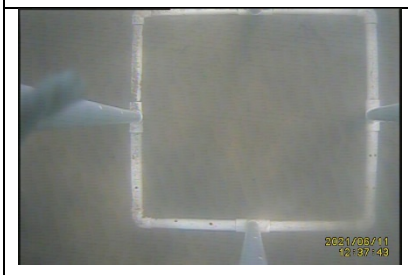
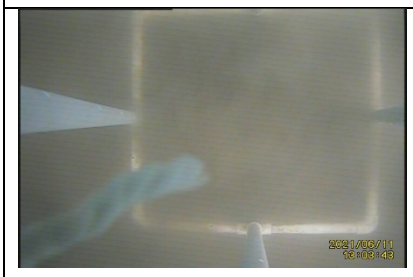
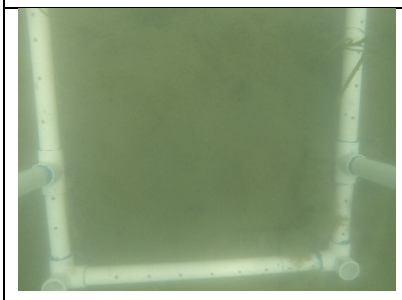
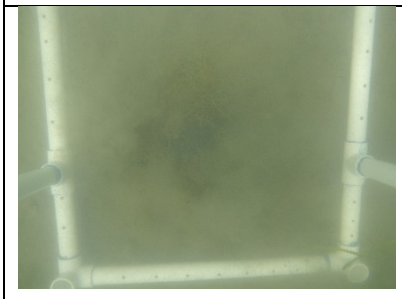
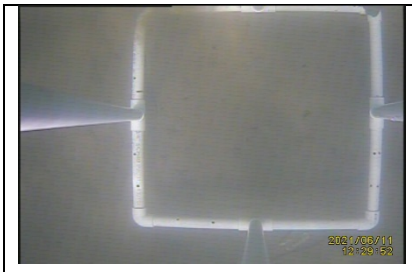
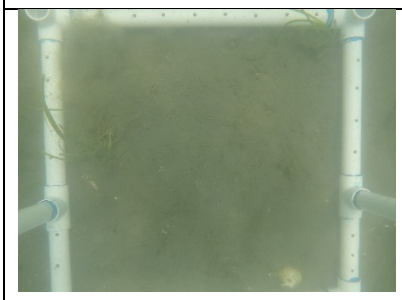
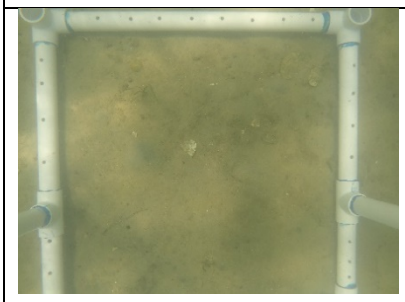
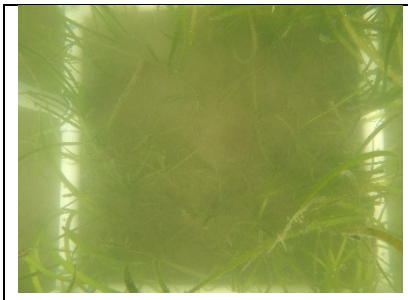
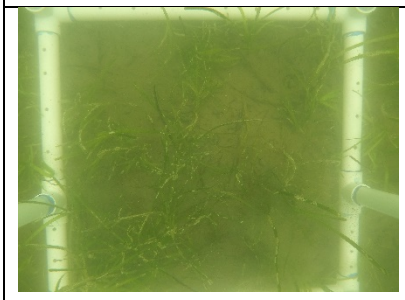
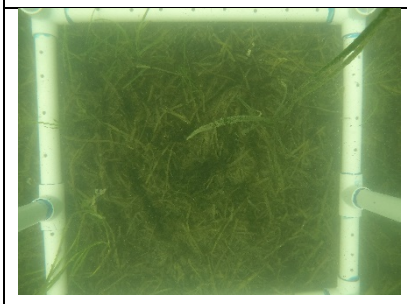
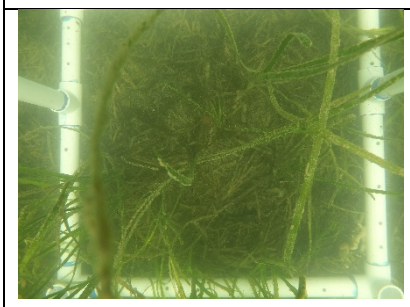
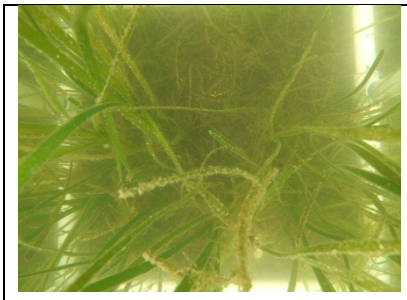
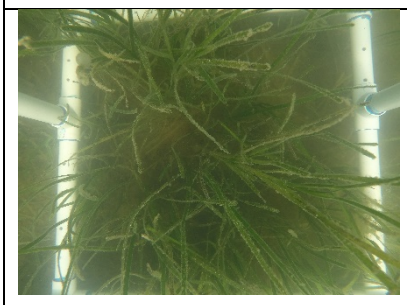
	10	GoPro-Town	Patchy Small eelgrass shoots
	11	SplashCam-Town	Patchy

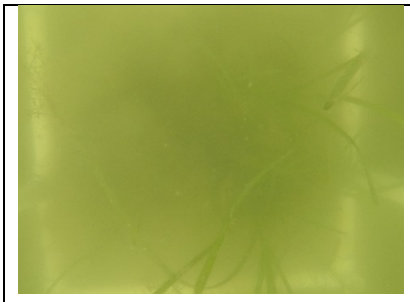
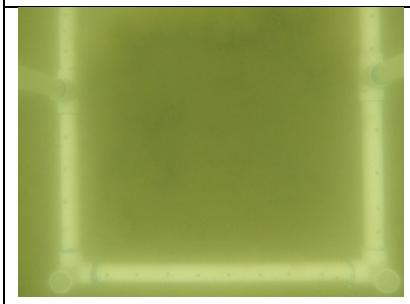
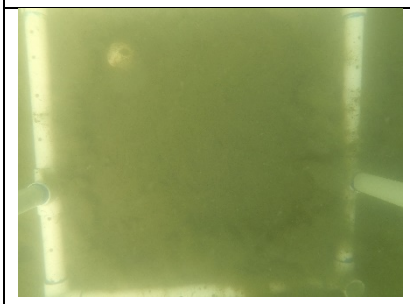
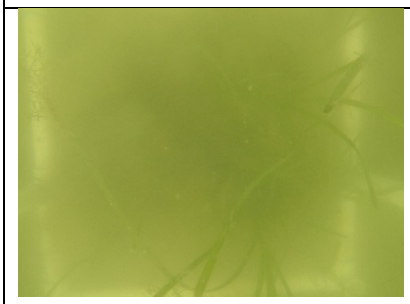
	12	SplashCam-Town	Patchy
	13	SplashCam-Town	Patchy
	14	SplashCam-Town	Absent
	15	SplashCam-Town	Patchy Few small eelgrass shoots
	16	SplashCam-Town	Absent
	17	SplashCam-Town	Absent Silty/murky-low vis
No Image	18	Visual from boat	Absent

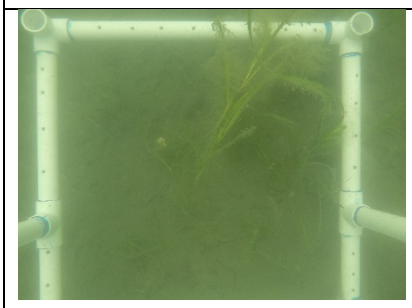
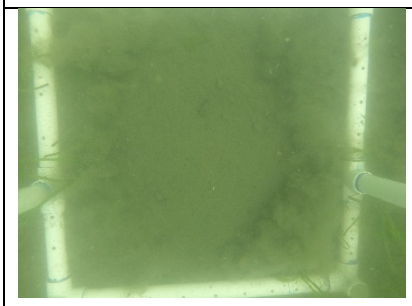
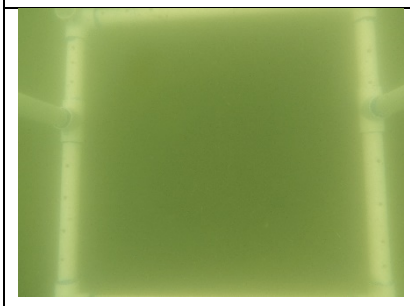
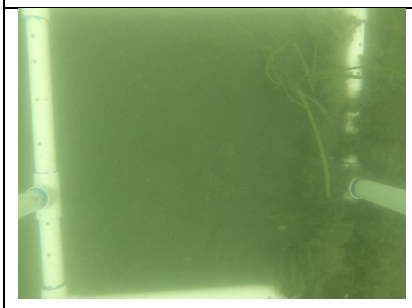
	19	SplashCam-Town	Absent Silty/murky-low vis
	20	GoPro- DMF	Patchy
	21	SplashCam-Town	Patchy Few small eelgrass shoots
	22	SplashCam-Town	Absent Silty/murky - low vis
	23	GoPro- DMF	Patchy
	24	GoPro- DMF	Patchy

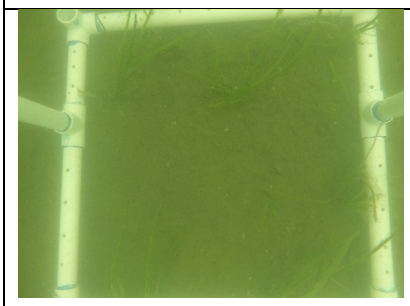
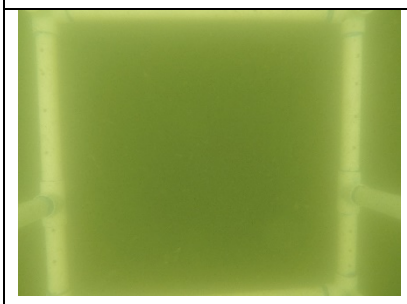
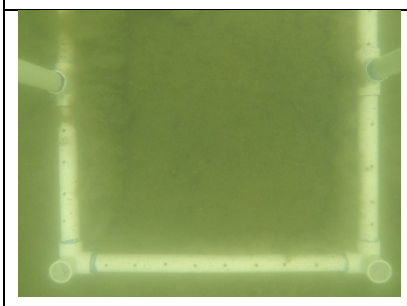
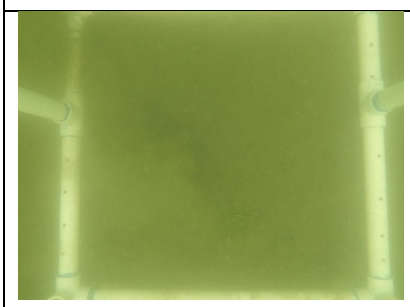
	25	SplashCam-Town	Absent
	26	GoPro- DMF	Patchy
	27	GoPro- DMF	Dense
	28	GoPro- DMF	Very patchy
	29	GoPro- DMF	Dense

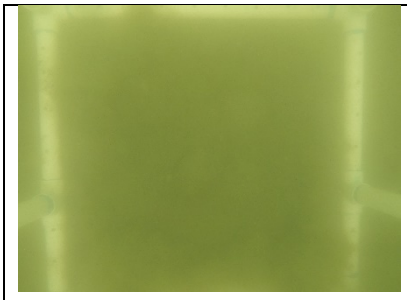
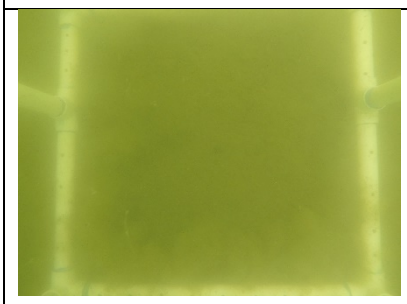
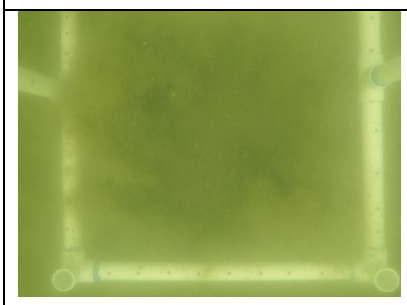
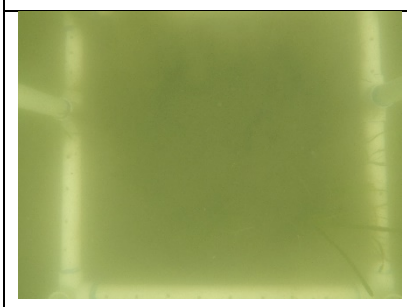
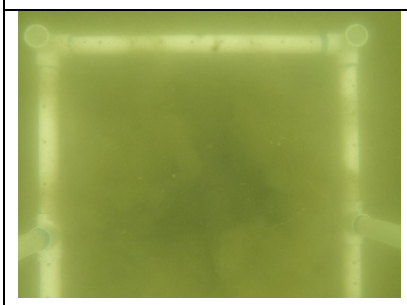
	30	GoPro- DMF	Dense
	31	GoPro- DMF	Dense
	32	GoPro- DMF	Dense
	33	GoPro- DMF	Dense
	34	GoPro- DMF	Dense

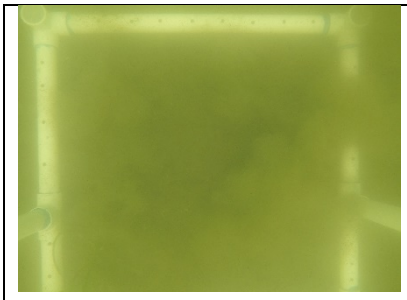
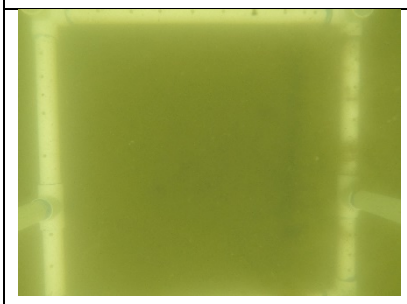
	35	GoPro- DMF	Dense
	36	GoPro- DMF	Dense
	37	GoPro- DMF	Dense
	38	GoPro- DMF	Dense
	39	GoPro- DMF	Dense

	40	GoPro- DMF	Patchy
	41	GoPro- DMF	Absent
	42	GoPro- DMF	Dense
	43	GoPro- DMF	Absent
	44	GoPro- DMF	Patchy

	45	GoPro- DMF	Patchy Murky but some eelgrass shoots visible
	46	GoPro- DMF	Patchy
	47	GoPro- DMF	Patchy
	48	GoPro- DMF	Absent
	49	GoPro- DMF	Patchy

	50	GoPro- DMF	Absent, Murky
	51	GoPro- DMF	Patchy
	52	GoPro- DMF	Absent
	53	GoPro- DMF	Absent
	54	GoPro- DMF	Absent

	55	GoPro- DMF	Absent
	56	GoPro- DMF	Absent
	57	GoPro- DMF	Absent
	58	GoPro- DMF	Patchy
	59	GoPro- DMF	Absent

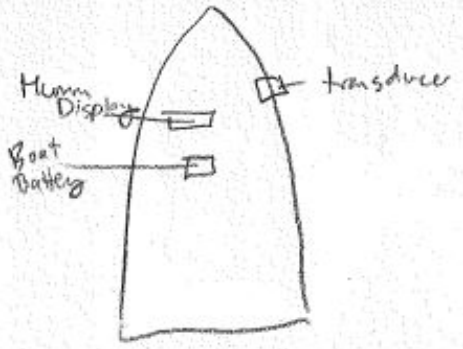
	60	GoPro- DMF	Patchy Shoot in lower left corner
	61	GoPro- DMF	Absent

Appendix D: Field Notes

SIDE SCAN SONAR SET UP

Date	6/11/21
Weather	calm, cloudy
Survey Area	Lake Tashmoo
Personnel	Voss + Logan
SSS & GPS System	Humm Display Hummingbird Helix 9

Vessel Name	Shark Maritime
Vessel Diagram	Side scan survey – Eelgrass mapping



Frequency	
Range	80 ft
Other	

SIDE SCAN SONAR LOGSHEET

Date: 6/11/21

Page no: 1

Line #	Time Start	Time End	Filename	Notes
1	9:09		wypt 316	Southern end ↑ 3 Kts
2	9:12		317	↓
3	9:15		318	↑
4	9:20		319	↑
5	9:29		320	↓ wypt 3001
6	9:36		321	↑ wypt 3002
~~7~~	—		322	toggle on
7	9:44		323	↓
8	9:52		324	↑
9	9:56		325	
10	9:59		326	
11	10:02		327	
12	10:15?	STOP	328	Too Shallow
13	10:18?		329	↗
14	10:24		330	
15	10:32		331	Visual eelgrass clumps
16	10:36		332	eelgrass clumps @ sw end
17	10:40		333	↗ visual - very patchy short shoots
18	10:43		334	↙
19	10:46		335	↓
20	10:48		336	
21	10:49		337	
22	10:57		338	
23	11:03		339	
24	11:10		340	
25	11:18		341	
26	11:25		342	
27	11:30		343	
28	11:34		344	
29	11:37		345	
30	11:41		346	
31	11:44		347	

C

A

B

Shark Nanitime / GoPro Groundtruthing DMF/GoPro

VIDEO LOGSHEET mark HumnUnit Recorder: Voss + Logan Date: 6/11/21 Page no: 1

Station No.	Time start	Time stop	Lat	Lon	Depth FT	Habitat Category	Zoom (Y/N)	Notes (weather, operation issues, objects/animals seen in video)
1	1203		3007	✓				
2	1205		3008	✓				
3	1207		3009	✓				
4	1208		3010	✓				
5	1210		3011	✓				
6	1212		3012	✓				
7	1214		3013	✓				
8	1217		3014	✓				
9	1218		3015	✓				
10	1219		3016	✓				
11	1220		3017	✓				
12	1222		3001	✓				
13	1224		3018	✓				
14	1226		3004	✓				
15	1228		3019	✓				
16	1229		3003	✓				
17	1230		3020	✓				
18	1232		3021	✓				
19	1233		3002	✓				
20	1235		3022	✓				
21	1237		3023	✓				
22	1238		3024					

VIDEO LOGSHEET

Recorder: Voss + Logan Date: 6/11/21 Page no: 2

Station No.	Time start	Time stop	Lat	Lon	Depth FT	Habitat Category	Zoom (Y/N)	Notes (weather, operation issues, objects/animals seen in video)
23	1240		3025	✓				
24	1241		3026	✓				
25	1243		3027	✓				
26	1244		3028 ↘	✓				
~~27~~	1245		~~3027~~ between	✓				
27	1247		3029 ↗	✓				
28	1248		3030	✓				
29	1249		3031	✓				
30	1250		3032	✓				
31	1252		3033	✓				
32	1254		3034	✓				
33	1255		3035	✓				
34	1:04		3036	✓				
35	1:06		3037	✓				
36	1:08		3038	✓				
South of mooring field			3039	✓				
			3040	✓				
			3041					
			3042					
			~~3043~~					

South 627

Groundtruthing Tisbury/Splash Cam

SPLASHCAM PHOTOS

VIDEO LOGSHEET

Recorder: Petitpas + Ewart Date: 6/11/21 Page no: 1

Station No.	Time start	Time stop	? Lat #	Lon	Depth FT	Habitat Category	Zoom (Y/N)	Notes (weather, operation issues, objects/animals seen in video)
A001	10:13:03	10:14:40	✓ 2		1.5			Sunny; SE 10-15
A002	10:05:12	10:05:39	✓ 2		~1m			
A003	10:21:58	10:22:43	✓ 2					
A004	09 41:39	09:41:57	✓ 2		~1.5			
A005	09 59 49	10:00:30	✓ 2					
A006	09 34:55	09:35:25	✓ 2		~1.5m			
A007	09:23:45	09:24:08	✓ 2		1m			
A008	09:28:35	09:29:00	✓ 2		1m			
GP A009	10:38 09	10:35:17	✓ video		2 ft			GoPro frame
GP A010		10 45:55	✓ video		2.5 ft			GoPro
A011	10 56:24	10:56:41	✓ 2		~1.5			Patchy eel grass all along path from 011 to 012
A012	11:09:04	11:10:03	✓ 2		~1.3m			eelgrass
A013	11:20:09	11:20 47	✓ 2					
B014	11:27:11	11:28:02	✓ 2					
GP B015	11:37 24	11:38:35	— No video					
016	11:51 52	11:53:08	✓ 2					
017	11 42 41	11:43 10	✓ 2					
018	No image							On Station 12:25 too shallow no image — no eelgrass —
019	12:36:54	12:37:43	✓ 2					silty
020	12 42 13	12:42:54	✓ 2					silty
021	12:48:41	12:49:45	✓ 2					silty
022	13:03 42	13:04:27	✓ 2					silty
023	12:29:52	12:31:22	✓ 2					