Massachusetts Department of Fish and Game

In-Lieu Fee Program

Marine Habitat Enhancement, Yarmouth MA Artificial Reef (IL05) 2024 Annual Report

Implemented by the Division of Marine Fisheries

DFG ILF Project Number: ILF4-CSTL-IL05
Army Corp Permit #: NAE - 2012 - 00311
issued May 8, 2014

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Submitted to:

The Massachusetts In-Lieu Fee Program

Administered by the Department of Fish and Game

Dan McKiernan, Director

Submitted February 4, 2025

Project Overview

In 2019, the Massachusetts Department of Fish and Game (DFG) In-Lieu Fee Program (ILFP) funded the Division of Marine Fisheries (DMF) to implement a marine subtidal habitat enhancement project in Nantucket Sound. The project is located within a 125-acre permitted artificial reef site 2.2 miles off the coast of Yarmouth (Figure 1). The site was permitted in 2014 under the Corps General Permit number NAE-2012-00311. Project construction consisted of deploying two-thousand cubic yards of granite and secondary use concrete to create dispersed patches of structured habitats extending two to six feet off the bottom. Construction was completed on January 14, 2020, and a side scan survey of the site was completed on January 23, 2020. Deployment and side scan survey results were reported to the ILFP in Marine Habitat Enhancement, *Yarmouth MA Artificial Reef Annual Report - Revised August 6, 2020.* The report also included a request by DMF for an adjustment of available credits to reflect the actual (vs. the proposed) amount of habitat enhanced by the project.

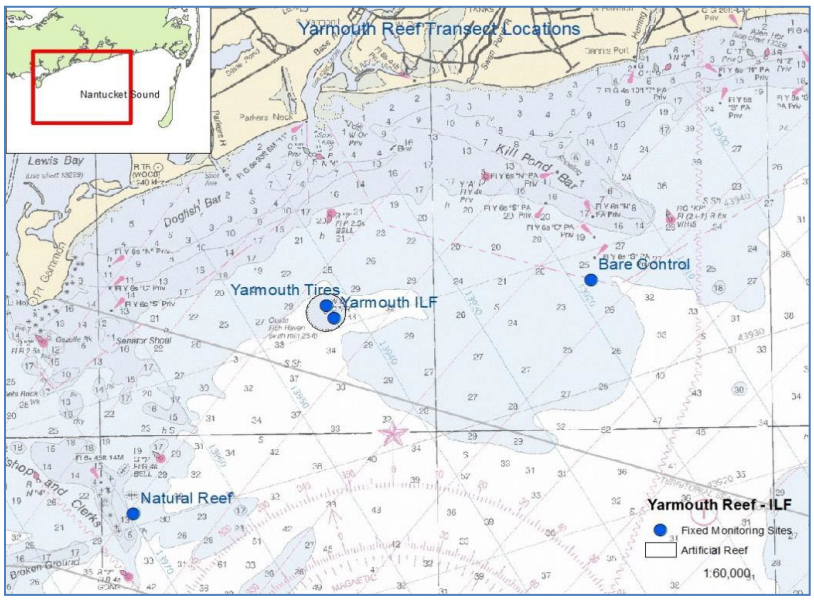

Figure 1. Location of Artificial Reef and Monitoring Stations.

Initial credit generation estimate for this project was 0.366 tidal wetlands credits based on proposed structured habitat enhancement within a 1.1-acre footprint at a ratio of 1:3 (reef structure 0.35 acres, undisturbed sandy bottom 0.66 acres). However, DMF deployed additional materials within a larger area than initially proposed and necessitating a request for a larger credit release to reflect the increased habitat enhancement achieved. On November 24, 2020, a new credit release schedule was approved by the Corps to account for the actual project enhancement area based on the findings of the side scan survey. Total project credits were increased to 0.7 tidal wetland credits to reflect 0.699 acres of structured habitat enhancement within a 2.1-acre footprint. The Corps also confirmed the release of 0.2796 credits for successfully meeting the project's design and construction performance standards (40% of total credits). The release of the remaining 0.0699 construction and design credits (10% of total credits) is contingent upon the completion of a follow-up side scan survey in 2025.

Ecological performance monitoring accounts for fifty percent (0.3495 credits) of available project credits. This report includes a summary of data collected over four years of monitoring, with a full evaluation of ecological performance monitoring to be completed in 2025 and summarized in a final report.

Monitoring

Monitoring data is collected by DMF staff in accordance with a monitoring schedule (Table 1) and covers the five-year period from 2020-2025. Transect surveys and video surveys using Baited Remote Underwater Video (BRUV) are conducted annually between May and October when migratory species are present in

Nantucket Sound. Additional transect surveys were also collected between November and April for three years to assess ecological performance outside of the growing season. Monitoring data summarized in this report includes all data collected through 2024. The final year of monitoring for this project will be completed in 2025.

Table1. Monitoring Schedule

		Pre-Deploy	Year 0 (2020)		Year 1 (2021)		Year 2 (2022)		Year 3 (2023)		Year 4 (2024)	Year 5 (2025)
			May-Oct	Nov-Apr	May-Oct	Nov-Apr	May-Oct	Nov-Apr	May-Oct	Nov-Apr	Annual	Annual
Permanent transect survey Quadrats (sessile species) and Swath (mobile species) along 50m fixed transects	natural reef	**10/6/2009**	**9/24/2020**	**3/22/2021**	**8/26/2021**	**x**	**8/3/2022 10/11/2022**	**3/22/2023**	**8/14/2023**	**4/9/2024**	**8/14/2024**	**x**
	natural bare		**9/24/2020**		**8/26/2021**		**8/3/2022**		**8/14/2023**		**8/13/2024**	x
	artificial reef	**10/6/2009**	**7/1/2020**	**1/14/2021 3/22/2021**	**5/18/2021 8/26/2021 (to complete May Sampling)**	**x**	**5/20/2022 10/112022**	**3/21/2023**	**9/6/2023**	**4/1/2024**	**8/13/224**	**x**
Camera/ Video survey (BRUV)		**y**	**9/1/2020 10/2/2020**		**4/14/2021 5/27/2021 8/10/2021**		**6/2/2022 7/29/2022**		**6/1/2023 7/12/2023 8/1/2023 9/28/2023 10/5/2023**		**5/24/2024 8/2/2024 8/21/2024 10/3/2024**	**x**
Side scan survey		**11/5/2019**	**1/23/2020**									**x**
Temp / acoustics			**6/3/2020**		**5/18/2021**		**5/20/2022**		**3/21/2023**		**4/1/2024**	**x**
x - Proposed												
Completed												
Additional												
y- see Harrison, Simonetta & Rousseau, Mark. (2020). Comparison of Artificial and Natural Reef Productivity in Nantucket Sound, MA, USA. Estuaries and Coasts. 43. 10.1007/s12237-020-0749-6.												

In 2024, there were four SCUBA UVC monitoring field days: April 1 and April 9 to complete the final year of Nov-April (off-season) sampling, and August 13 and August 14, covering the Year 4 (2024) May-Oct sampling period. HOBO remote temperature loggers and VEMCO acoustic receivers were swapped out in April, with new equipment deployed to the site expected to remain on station into 2025. SCUBA transect data collection occurred at the artificial reef (4/1, 8/13) the natural rocky reef (4/9, 8/14) and bare sandy (8/13) sites.

Additionally, four BRUV deployments occurred in 2024 between May and October (5/24, 8/2, 8/21, and 10/3). Processing BRUV survey data collected from 2020-2024 for quantitative length analysis and relative abundance estimates (MaxN) began in 2024 and will continue through 2025. Video imagery has been reviewed to identify new or unique species. Status of all data collection and processing is summarized in Table 2.

Table 2. Status of Data Collection

	Ecological Performance: Diversity (species presence / richness)			Ecological Performance: Production (Size / age class / % cover similarity)		Design and Construction	Status of Collected Data 12/2024
	Mobile	Sessile		Mobile	Sessile		
Diver Survey	X[1]	X[1]		X	X[1]		processed
BRUV	X			X[1]			in processing
Remote Acoustic	X						Ongoing – 2020 – 2024 data is in processing
Side scan Sonar Survey						X	To be completed Spring 2025
[1] primary data source for analysis							

Methods

Ecological performance monitoring parameters were established to assess species diversity and species size class distributions (production) at the newly deployed reef structures when compared with a nearby natural rock reef site.

Species diversity is assessed using diver-based underwater visual census (UVC) surveys along 50m transects. Finfish, sessile and mobile macroinvertebrates are counted within two-meters of both sides of a transect. Sessile invertebrate and macroalgae percent cover estimates are collected from 20 $1m^2$ quadrats along each transect. Quadrat locations are determined by randomly selecting two quadrats every ten meters from each side of the transect (20 ($1m^2$) quadrats/50m).

Mobile species detectability using UVC surveys can be significantly underestimated due to poor visibility and diver effect (reaction of fish to divers). To help address this, remote acoustic sensors are deployed year- round to a fixed location within the new reef habitat to record presence of any fish that has been implanted with an acoustic tag. Fish presence is recorded when a fish travels within +/- four hundred feet of a receiver. The receiver records date/time, and tag ID, which can then be traced back to species, tagged location, etc., from a database. Divers recover the acoustic receiver data from the field once per year for processing. Unique mobile species (species not recorded in UVC's) counts from acoustic receivers and BRUV analysis also inform mobile species diversity metrics.

Size class distribution (production) is assessed using BRUV data collected from fixed stations at the rock reef, tire reef, ILF reef, and bare sand sites. Visibility is estimated directly from BRUV videos using a bait box (0.8 m from camera) as a guide. Still frames for analysis are captured from each 30-minute recording in 30-second increments for a total of 60 analyzed frames per recording (sampling event). The identity of each species of fish, an index of its relative abundance (MaxN), and quantitative length estimates of two species of economic significance, *Centropristis striata (*black sea bass (BSB)), and *Stenotomus chrysops* (scup) are documented within each frame. Unique mobile species (species not recorded in UVC's) counts from BRUV's also inform mobile species diversity metrics.

Specific field sampling methods are further described in *Appendix A - Yarmouth Artificial Reef Monitoring SOPs for the ILF-funded deployment in 2020.*

Preliminary Results

2024 monitoring was completed in accordance with the monitoring schedule (Table 1), with BRUV sampling data collected during four events during the migratory season (May-October). BRUV sampling will continue through 2025. Preliminary observations from the first four years of BRUV and UVC survey data relative to species diversity and size distribution of species are summarized in Table 3.

Species diversity –In 2024, UVC surveys observed 27 unique species on the ILF reef site compared to 26 species at the rocky reef site and 3 species at the bare sand site. Transect sampling was completed in a two-week period for Nov-Apr sampling and within a two-day period for May-Oct.

An encrusting bryozoan (*Schizoporella* sp.) was the only new sessile species observed at the artificial reef during UVC surveys in 2024. New sessile species observed during UVC surveys of the artificial reef in 2023 included maiden's hair, palmate sponge, crumb bread sponge, and club tunicate. New mobile species observed in 2024 include sand dollar and butterfly fish. Since 2020, the total number of unique species has increased annually at the artificial reef site. While the number of finfish and macroinvertebrate species observed during swath monitoring has varied, the number of macroalgae and macroinvertebrates observed during quadrat sampling continues to increase. This was an expected outcome as the reef continues to undergo successional colonization BRUV footage analyses have identified at least six unique finfish species (sand tiger shark, blue runner, bluefish, Atlantic menhaden, grey trigger fish, and bluntnose stingray) not identified in UVC surveys. Mobile species data is summarized in Table 6a and 6b. Sessile species data is summarized in Table 7a and 7B.

Size class distribution – BRUV survey data collected since 2020 has not been processed for analysis; however, video imagery has been reviewed to identify new or unique species (see Table 3 and Figure 2). Video processing includes still frame extraction and analysis for abundance and fish lengths. Preliminary BRUV species presence results are summarized in Table 8.

Table 3. Annual UVC & BRUV Species Summary Tables

UVC Species Summary		2020 Transects			2021 Transects			2022 Transects			2023 Transects			2024 Transects		
		Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site
Total # of Species		16	14	4	21	22	5	25	27	6	28	30	7	26	27	3
Swath Monitoring	Finfish	7	6	2	4	4	2	6	5	3	5	5	4	3	6	2
	Macro Mobile Invertebrates	0	4	2	2	4	3	1	5	3	6	4	3	5	4	1
	Total	7	10	4	6	8	5	7	10	6	11	9	7	8	10	3
Quadrat Monitoring	Macroalgae	7	2		9	8		11	10		10	12		11	10	
	Macro Sessile Invertebrates	2	2		6	6		7	7		7	9		7	7	
	Total	9	4		15	14		18	17		17	21		18	17	

BRUV Species Summary		2020 BRUV (Preliminary)			2021 BRUV (Preliminary)			2022 BRUV (Preliminary)			2023 BRUV (Preliminary)			2024 BRUV (Preliminary)		
		Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site	Rocky Reef Site	ILF Reef Site	Bare Sand Site
Total # of Species		6	5	4	4	4	8	4	5	8	9	7	10	9	11	7
	Finfish	6	5	4	4	4	7	4	5	6	9	7	8	9	10	6
	Macro Invertebrates	0	0	0	0	0	1	0	0	2	0	0	2	0	1	1

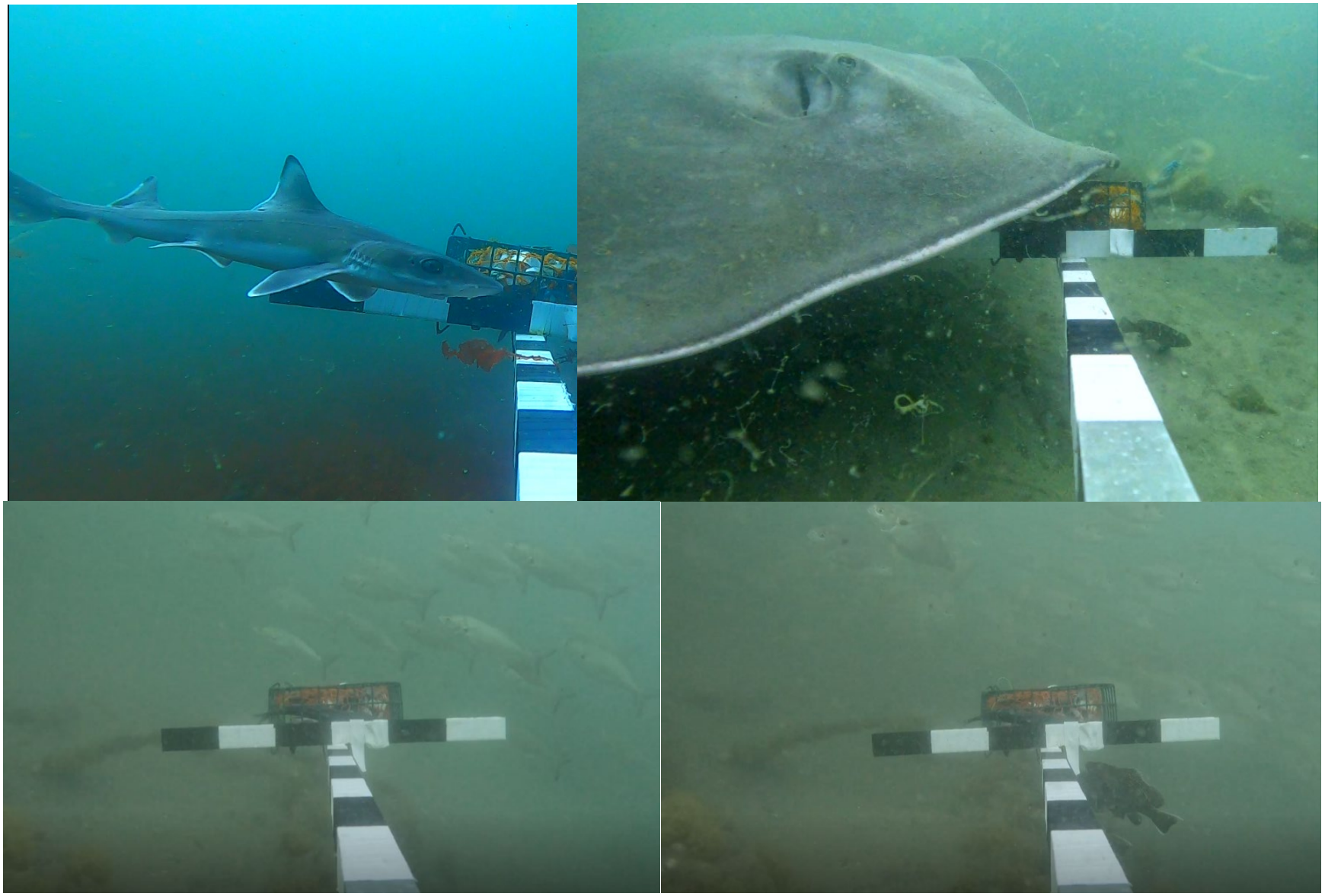

Figure 2. Still images taken from 2024 BRUV footage. Top Left: dogfish at Bare Control Site. Top Right: bluntnose stingray at ILF site. Bottom Left: school of Bluefish at ILF site. Bottom Right: black sea bass and school of blue runner at Bare Control Site.

CY2024 Budget Update

In calendar year 2024, the ILF Yarmouth reef project (IL05) expended $4,636 in dive pay (including indirect and payroll), monitoring supplies, boat operations, and travel. A breakdown of the expenses to date is summarized in Table 4. No expenses were charged for air tank fills in 2024. The remaining project balance is $11,462.

Table 4. Budget summary table.

Line Item	Approved 5-Year Budget	CY2019 Expenses	CY 2020 Expenses	CY 2021 Expenses	CY 2022 Expenses	CY 2023 Expenses	CY 2024 Expenses	CY 2025 Expenses	Total Expenditures	Remaining Balance
SCUBA air tank fills	$2,160	$800	$0	$0	$0	$0	$0		$800	$1,360
Boat fuel and maintenance	$15,500	$1,174	$82	$0	$0	$0	$775		$2,031	$13,469
Monitoring supplies	$14,500	$4,611	$0	$0	$0	$1618	$894		$7,123	$7,377
Vehicle travel and lodging	$2,750	$0	$0	$0	$0	$139.31	$457		$596	$2,124
Material Deployment Contract	$230,000	$0	$246,277	$0	$0	$0	$0		$246,277	($16,277)
Dive pay	$10,187	$0	$653	$1,188	$598	$1,858	$2,510		$6,807	$3,380
Total	**$275,097**	**$6,586**	**$247,012**	**$1,188**	**$598**	**$3,615**	**$4,636**		**$263,635**	**$11,462**

Credit Release/Performance Standards

Newly deployed structures were expected to undergo early successional changes, and fifty percent of project credits are linked to ecological performance standards assessing similarity to nearby natural structured habitat. Accordingly, no additional credits will be requested for release until the completion of all 2025 monitoring.

Project credit tables reflect a 2020 Corps approved credit adjustment to 0.7 tidal wetland credits, based on 0.699 acres of structured habitat enhancement within a 2.1-acre footprint, replacing the initially proposed credits of 0.366 for 0.35 acres of structured habitat enhancement within a 1.1- acre footprint (Table 5). Fifty percent of project credits are linked to construction and design, of which 40% have been released (0.2796). The release of the final 0.07 construction and design credits is contingent upon the completion of a follow-up side scan survey in 2025.

Summary

The final year of scheduled monitoring will be completed in 2025. Three distinct methods, acoustics, BRUV, and UVC transect surveys are utilized to collect data for assessing performance for credit release. Acoustic data using remotely deployed receivers continues to be collected, although data has not been processed. BRUV image and video data collection will continue to be employed to document species presence. To date, sixteen field days have been utilized to collect BRUV data post deployment. UVC survey is the primary data collection method for assessing species diversity and % similarity (production) of sessile species. To date, seventeen field days have been utilized for post deployment UVC surveys. Eight transects (2 at natural bare, 2 at natural reef, 4 at artificial reef) are sampled during May-Oct, and six transects (2 natural and 4 artificial reefs) are sampled during Nov-Apr. A preliminary assessment of 2021 and 2022 UVC data identified potentially significant temporal gaps between initiation and completion of data collection within the May-Oct season (100 days in 2021 and 146 days in 2022). which were addressed in subsequent sampling years by completing May-Oct UVC sampling within shorter data collection windows (23 days in 2023 and 2 days in 2024).

A few interesting observations are noteworthy, notwithstanding data limitations. Scup and black sea bass were observed at all sampling sites, indicating a wide/uniform species distribution throughout Nantucket Sound. Tautog were only observed on sites with structure. Macroalgal species presence continues to increase over time. This is expected for macroalgae and for several sessile invertebrate species, as new structures undergo several stages of colonization and early successional stages. Divers observed adult-sized finfish species while monitoring the reef site, and angling was observed at the reef during all monitoring visits, indicating larger sized fish were consistently present on the reef throughout the season.

A total of $4,077 was expended in 2024, below the proposed project budget of $4,122 for the year.

The release of the remaining 0.42 potential project credits will require meeting specific monitoring performance benchmarks outlined in Table 5 and is expected to be completed in 2025.

Short videos created using a GoPro footage collected during monitoring are routinely posted to the Artificial Reef Playlist on the MA Marine Fisheries YouTube Channel.

Acknowledgements

DMF appreciates all those who assisted in the field and reviewed this draft, especially Steven Voss, Vin Malkoski, Forest Schenck, Dave Chosid, Kevin Creighton, Iris Seto, Ross Kessler, Alex Boeri, and Laura Tomlinson from DMF. Thanks to Aisling O'Shea and Elisabeth Cianciola for draft edits and budget assistance. Thanks also to the Town of Yarmouth Department of Natural Resources and the Cape Cod Salties for their continued project support.

Table 5. Goals, Performance Standards, Metrics and Mitigation Credit Release Schedule (updated 01/2022)

Type of mitigation	**Project Area**		**Proposed Habitat Area**		**Proposed Credits**
Artificial Reef Habitat	2.1 acres		Reef structure – 0.699 acres Undisturbed sandy bottom – 1.4 acres Total enhanced area = 2.1 acres		.70 wetland credits (*multiplier 1:3 for 2.1 acres of enhanced marine subtidal habitat*)
Performance Standards & metrics	**% Total Credit**	**Credit amount**		**Timeline -credit release**	**Comments**
Design & Construction Parameters:	**50%**	**0.35** (0.1830)			Designed to maximize its potential to function effectively as sub-tidal structured habitat
Materials deployed to site as specified in design	40%	0.2796 (0.1464)	2019 / 2020	Post-construction	Completed. 40% credit based on adjusted credit release (reference ACOE 11/24/20 letter)
Material remains within proposed site and remains stable in accordance with permit conditions	10%	0.0699 (0.0366)	2025	Post 5-year monitoring report	Upon completion of 5-year (2025) side scan sonar survey
Monitoring: Conducted as per monitoring plan					**Submitted annually** Year 1 through Year 4 monitoring data are included with this report. Ecological performance is assessed across two or more years of monitoring data.
Ecological Performance: Diversity	**25%**	0.175 (0.0915)			Monitoring results show evidence of similarity of species diversity
Species diversity – mobile species	12.5%	0.08735 (0.04575)	2020-2025	Percent similarity exceeds 60% in two monitoring periods	The resident mobile species assemblage on the reef shall have species richness similar to natural reefs within the region.
Species diversity – sessile species	12.5%	0.08735 (0.04575)	2020-2025	Percent similarity exceeds 60% in two monitoring periods	The resident sessile species assemblage on the reef shall have species richness similar to natural reefs within the region
Ecological Performance: Production	**25%**	0.175 (0.0915)			Monitoring results show evidence of multiple size classes of predator and prey species
Size/age class similarity of mobile species – upper-level consumers	12.5%	0.0875 (0.04575)	2020-2025	Percent similarity exceeds 60% in two monitoring periods	Mobile species size class distribution on the artificial reef shall be similar to natural reefs within the region
Size/age class similarity of sessile species – benthic community/ lower-level producers	12.5%	0.0875 (0.04575)	2020-2025	Percent similarity exceeds 60% in two monitoring periods	The relative abundance of the top 10 sessile species on the artificial reef shall be similar to the top 10 sessile species on natural reefs within the region
Total Credit Potential	**100%**	**0.70** **(0.366)**		**2020-2025**	**Wetlands Mitigation Credits**

Table 6. Mobile and Nonmobile Species Identified through UVC Swath Monitoring (Summer / Fall)

	Date	8/13/2024		8/14/2024		8/13/2024				Average All		
	Location	Bare Control (BC)		Natural Rock Reef (RR)		Artificial Reef (AR)				BC	RR	AR
	Transect (Bearing)	1 (0)	2 (180)	1 (0)	2 (260)	1 (80)	2 (135)	3 (230)	4 (300)	Average Ct / Transect		
Arthropods	Spider/dec. crab Family Majidae (*Libina/Hyas*)	2	0	0	0	0	0	0	0	1	0	0
Sponges	Yellow Sponge (*Cliona celata*) - nonmobile	0	0	3	5	0	0	6	1	0	4	1.75
Fish	Scup (*Stenotomus chrysops*)	0	0	1	2	7	5	13	0	0	1.5	6.25
	Juvenile Scup	0	0	0	5	5	6	0	0	0	2.5	2.75
	Cunner (*Tautogolabrus adspersus*) Estimate	38	0	40	63	0	0	0	0	19	51.5	0
	Summer flounder (*Paralichthys dentatus*)	0	0	0	0	1	0	0	0	0	0	0.25
	Black sea bass (*Centropristis striata*)	0	0	0	1	0	2	1	3	0	0.5	1.5
	Juvenile Black sea bass	44	20	66	51	105	230	194	202	32	58.5	182.75
	Tautog (*Tautoga onitis*)	0	0	0	0	5	3	5	10	0	0	5.75
	Juvenile Tautog	0	0	0	0	1	0	0	3	0	0	1
	Butterfly fish (*Chaetodon sp.*)	0	0	0	0	0	0	0	1	0	0	0.25

Table 6a. Mobile and Nonmobile Species Identified through UVC Swath Monitoring (Winter/Spring)

	Date	4/1/2024				4/9/2024		Average All	
	Location	Artificial Reef (AR)				Natural Rock Reef (RR)		AR	RR
	Transect (Bearing)	1 (80)	2 (135)	3 (230)	4 (300)	1 (0)	2 (260)		
Arthropods	Spider/dec. crab Family Majidae (*Libina/Hyas*)	4	0	2	1	2	6	1.75	4
	Large hermit crabs (*Pagarus sp.*)	2	0	4	0	1	2	1.5	1.5
Cnidarians	Frilled anemone (*Metridium senile*)	0	0	0	0	25	100	0	62.5
Echinoderms	Sand dollar (*Echinarachnius parma*)	0	1	0	0	0	0	0.25	0
Gastropods	Northern moon snail (Euspira *heros*)	0	0	0	1	1	0	0.25	0.5
	Channeled whelk (*Busycotypus canaliculatus*)	0	0	0	0	0	1	0	0.5
Sponges	Yellow Sponge (*Cliona celata*)	25	12	7	13	5	12	14.25	8.5
Fish	Cunner (*Tautogolabrus adspersus*)	0	0	0	0	1	0	0	0.5
	Shorthorn, grubby & longhorn (*Myoxocephalus sp.*)	1	0	0	0	0	0	0.25	0

Table 7a. Sessile Species Identified during UVC Quadrat Monitoring (Summer / Fall)

Date	8/13/2024 & 8/14/2024						Average All	
Location	Natural Rock Reef (RR)		Artificial Reef (AR)				RR	AR
Transect (Bearing)	1 (0)	2 (260)	1 (80)	2 (135)	3 (230)	4 (300)		
Brown Algae								
Knotted wrack (*Ascophyllum nodosum*)	2	0	0	0	0	0	1	0
Brown seaweed/kelp (*Sargassum filipendula*)	0.5	1.2	0	0	0	0	0.85	0
Unid filamentous browns	0	0	0	0	0	0	0	0
Red Algae								
Red Filamentous/ Foliose	5.125	7.544	0.2	0	0.09	0	6.406	0.0725
Red Blade (*Palmaria or Membranoptera)*	0.8	0.1	0	0	0.09	0	0.45	0.0225
Irish moss (*Chondrus crispus)*	0.6	1.444	0	0	0	0	1	0
Red seaweed (*Porphyra sp.*)	0	2.5	1.09	0.5	0	0.1	1.154	0.431
Sea moss (*Gracilaria sp.*)	0.625	2.2	0	0	0	0	1.5	0
Unid filamentous reds	0	0.3	0	0	0	0	0.15	0
Green Algae								
Green blade (*Ulva lactuca*)	0	0	0	0	0	0	0	0
Branching green (*Codium sp.*) drift	0.111	0	0	0	0	0	0.07692	0
Unid filamentous greens	0	0	0	0	0	0	0	0
Invertebrates								
Tufted or bushy bryozoan (*Bugula or C. turrita*)	12.3	44.3	1.59	2.09	9.9	13.8	28.3	6.845
Sheath tunicate (*Botrylloides violaceus*)	0.1	0.09	0	0.2	0.38	0.9	0.095	0.37
Northern Rock Barnacle (*Balanus balanoides*)	0	0	0	0	0	0	0	0
Pink-hearted hydroid *(Tubularia crocea*)	0	0	0	0.3	0	0	0	0.075
Yellow sponge (*Cliona celata*)	0.7	0.2	0.19	0.09	0	0.1	0.45	0.095
Northern cup coral (*Astrangia poculata*)	1.1	0	0.39	0.39	1.48	0.49	0.55	0.6875
(Schizoporella sp.) (rust Bryozoan)	0.2	0	0.1	0	0	0	0.1	0.025

Table 7b. Sessile Species identified during UVC Quadrat Monitoring (Winter / Spring)

Date	4/1/2024 & 4/9/2024						Average All	
Location	Natural Rock Reef (RR)		Artificial Reef (AR)				RR	AR
Transect (Bearing)	1 (0)	2 (260)	1 (80)	2 (135)	3 (230)	4 (300)		
Brown Algae								
Knotted wrack (*Ascophyllum nodosum*)	0	0	0	0	0	0	0	0
Brown seaweed/kelp (*Sargassum filipendula*)	0.5	0.2	0	0.09	0	0.1	0.35	0.0475
Unid filamentous browns	0.09	0.27	0.38	0.5	0.56	0	0.18	0.36
Red Algae								
Red Filamentous/ Foliose	0.19	3.59	1.5	1.7	0	0.19	1.89	0.8475
Red Blade (*Palmaria or Membranoptera)*	1.08	0.19	0	0	0	0	0.635	0
Irish moss (*Chondrus crispus)*	0.2	4.19	0	0	0	0	2.195	0
Red seaweed (*Porphyra sp.*)	0	0	0	0.1	0	0	0	0.025
Sea moss (*Gracilaria sp.*)	0.18	0.09	0	0.18	0	0	0.135	0.045
Unid filamentous reds	6.77	26	0.09	1.1	2.18	2.69	16.385	1.515
Green Algae								
Green blade (*Ulva lactuca*)	0	0	0	0	0.1	0.1	0	0.05
Branching green (*Codium sp.*) drift	0.1	0	0.6	0.79	0.2	0.2	0.05	0.4475
Unid filamentous greens	6	8.27	0	0	0	0.18	7.135	0.045
Invertebrates								
Tufted or bushy bryozoan (*Bugula or C. turrita*)	1.3	1.19	0.38	9.1	9.59	0.88	1.245	4.9875
Sheath tunicate (*Botrylloides violaceus*)	0	0	0	0	0.09	0	0	0.0225
Northern Rock Barnacle (*Balanus balanoides*)	0.5	0	0	0	0.1	0.29	0.25	0.0975
Pink-hearted hydroid *(Tubularia crocea*)	0.09	0.1	0	2.5	2.19	0	0.095	1.1725
Yellow sponge (*Cliona celata*)	0	0.1	1.5	0.1	0	0.2	0.05	0.45
Northern cup coral (*Astrangia poculata*)	4.5	0	0	0.09	0.3	0.6	2.25	0.2475
(Schizoporella sp.) (rust Bryozoan)	0.5	0	0.1	0.6	0.2	0.9	0.25	0.45

Table 8. 2024 BRUV species presence table. One deployment per date. An "X" indicates one or more observations of the species. A question mark indicates an observation was made but species not confirmed?

Date	May 24 2024			August 1 2024			August 21 2024			October 3 2024			Total		
Site	RR	BC	AR	RR	BC	AR	RR	BC	AR	RR	BC	AR	RR	BC	AR
Scup (*Centropristis striata*)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black Sea Bass (*Centropristis striata*)	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Spider Crab (*Libinia emarginata)*		X						X						X	
Sand Tiger Shark *(Carcharias Taurus)*						X			X			X			X
Cunner (*Tautogolabrus adspersus)*							?						?		
Sea Robin (*Prionotus carolinus*)	X	X		X			X						X	X	
Tautog (*Tautoga onitis*)									X	X		X	X		X
Summer Flounder (*Paralichthys dentatus*)			X	X			X			X			X		X
Dogfish (spiny and/or smooth)					X			X			X			X	
Blue Runner (*Caranx crysos*)												X			X
Bluefish (*Pomatomus saltatrix*)										X		X	X		X
Striped Bass	X												X		
Grey Trigger Fish (*Balistes capriscus*)						X									X
Banded Rudderfish (*Seriola zonata*)					X									X	
Atlantic Menhaden (*Brevoortia tyrannus*)						?		?						?	?
Bluntnose Stingray (*Dasyatis sayi*)									X						X
Northern Kingfish (*Menticirrhus saxatilis*)										X			X		
American Lobster (*Homarus americanus*)												X			X
Total	4	4	3	4	3	5	5	5	5	6	3	7	9	7	11

Table 9. Mobile Species Annual Summary Table (by calendar year)

	Year	2020 Average All			2021 Average All			2022 Average All			2023 Average All			2024 Average All		
	Site	AR	RR	BC	AR	RR	BC	AR	RR	BC	AR	RR	BC	AR	RR	BC
Arthropods	American lobster (*Homarus americanus*)	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Spider/dec. crab Family Majidae (*Libina/Hyas*)	0	0	1	0	0	1	0	0	5.5	0.125	0	1.5	0.875	2	1
	Large hermit crabs (*Pagarus sp.*)	0.25	0	2.5	1.25	1.25	0	0.125	0	1.5	2.25	5.25	1	.75	.75	0
	Lady crab (*Ovalipes ocellatus*)	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Horseshoe crab (*Limulus polyphemus*)	0	0	0	0	0	0	1.75	0	0	0	0	0	0	0	0
	Mud crab Family *Panopeidae*	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0
	Blue crab (*Callinectes sapidus*)	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0
	Shrimp sp.	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0
Cnidarian/ Tunicates	Frilled anemone (*Metridium senile*)	0.25	0	0	0	0	0	0.125	0	0	0	12.5	0	0	31.25	0
	Northern cerianthid (*Cerianthus borealis*)	0	0	0	0	0	0	0.125	0	0	0	0	0	0	0	0
	Club tunicate (*Styela clava*)	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0
Gastropods	Common/waved whelk (*Buccinum undatum*)	0	0	0	0.25	0	0.5	0	0	0	0	0	0	0	0	0
	Channeled whelk (*Busycotypus canaliculatus*)	0	0	0	0	0	0.5	0	0	2.5	0.125	0.25	0.5	0	0.25	0
	Northern moon snail (*Euspira heros*)	0	0	0	0.5	0	0	0.125	0	0	0	0	0	0.125	0.25	0
	Blood ark/cockle (*Tegillarca granosa*)	0	0	0	0.125	0	0	0	0	0	0	0	0	0	0	0
	Nudibranch (*Nudibranchia* sp.)	0	0	0	0	3.5	0	0	0	0	0	6.5	0	0	0	0
Echinoderms	Sand dollar *(E. parma)*	0	0	0	0	0	0	0	0	0	0	0	0	0.125	0	0
Sponges	Yellow sponge (*Cliona celata*)	2.75	0	0	2.25	6.5	0	0.875	10	0	3	7	0	8	6.25	0
Fish	Scup (*Stenotomus chrysops*)	15.25	7	0	0.125	18.5	4.5	6.75	1.25	0	14.375	1	0.5	3.125	0.75	0
	Juvenile scup	0	24	100	15	91.25	0	0	61.25	100	0.375	0	0	1.375	1.25	0
	Cunner (*T. adspersus*) Estimate	12	149	0	5.375	6	0	37.875	17.75	0	1.75	8.25	2	0	26	19
	Shorthorn, grubby & longhorn sculpin (*Myoxocephalus sp.*)	0	1	0	0	0	0	0	0	0	0.5	0	0	0.125	0	0
	Summer flounder (*P. dentatus*)	0.75	0.5	0	0	0	0	0	0.75	0.5	0	0	0.5	0.125	0	0
	Black sea bass (*C. striata*)	14.5	88	1.5	4.625	2.25	0	30.875	5	0	0.75	2	2	0.75	0.25	0
	Juvenile black sea bass	0	106	100	32.875	67.75	782.5	82.75	205	477	60.75	15	71	91.375	29.25	32
	Tautog (*Tautoga onitis*)	9.75	4.5	0	4	0	0	11	1.75	0	4.625	1	0	2.875	0	0
	Juvenile tautog	0	2.5	0	0.25	0.25	0	15.375	1	0	7.5	3.25	0	0.5	0	0
	Northern sea robin(*P. carolinus*)	0.5	0.5	0	0	0	0	0.25	0.25	0	0	0.25	0	0	0	0
	Butterfly fish (*Chaetodon sp.*)	0	0	0	0	0	0	0	0	0	0	0	0	0.125	0	0
	*Yellow Highlighted cells note species that had a new or increased presence in 2024; Red Highlighted cells note species that were not observed for the first time; Yellow sponge is nonmobile															

Table 10. Sessile Species Annual Summary Table (by calendar year)

Year	2020 Average		2021 Average		2022 Average		2023 Average		2024 Average	
Site	AR	RR	AR	RR	AR	RR	AR	RR	AR	RR
Brown Algae										
Knotted wrack (*Ascophyllum nodosum*)	0	0.15	0.063	0.075	0	0.821	0	0	0	0.5
Brown seaweed/kelp (*Sargassum filipendula*)	0	0	0	0	0.125	0.690	0.013	1.225	0.02375	0.6
Maiden's hair (*Ectocarpus*)	0	0	0	0	0	0	0.013	0	0	0
Unid filamentous browns	0.245	0.225	1.923	0.263	1.018	0.151	0.154	1.318	0.18	0.092
Red Algae										
Red filamentous/foliose	0.623	3.18	2.32	2.868	1.338	14.408	0.311	7.218	0.46	3.965
Red blade (*Palmaria or Membranoptera)*	0	0.975	0.26	0.215	0.123	1.513	0.131	0.023	0.01125	0.5425
Red coralline crust (*Lithothamnion sp.*)	0	0	0.125	0.175	0.563	0.256	0	0.823	0	0
Irish moss (*Chondrus crispus)*	0	0	0	3.323	0.063	2.051	0.15	2.145	0	1.613
Red seaweed (*Porphyra sp.*)	0	0	0	0	0	0.026	0.384	0.143	0.2253	0.455
Sea moss (*Gracilaria sp.*)	0	0	0	0	0	0.385	0.011	0.52	0.0225	0.782
Unid filamentous reds	0	1.24	5.526	16.345	0.165	0.046	0.285	8.123	0.7575	8.268
Green Algae										
Sea lettuce (*Ulva lactuca*)	0	0	0	0	0.233	0	0.165	0	0.025	0
Branching green (*Codium sp.*) drift	0	1.19	0.013	0.19	0.801	1.482	0.48	1.335	0.22375	0.061
Unid filamentous greens	0	0.045	0.063	0.023	0.316	0	0.011	0	0.0225	3.5675
Invertebrates										
Tufted or bushy bryozoan (*Bugula or C. turrita*)	0	28.095	1.283	6.693	3.77	16.333	1.665	4.323	5.916	14.77
Palmate sponge *(Isodictya sp.)*	0	0	0	0	0	0.128	0.025	0	0	0
Crumb bread sponge (*Halichondria sp.*)	0	0	0	0.025	0	0	0.011	0	0	0
Sheath tunicate (*Botrylloides violaceus*)	0	0	1.513	0.025	0.18	0.969	0.223	0.475	0.196	0.0475
Star tunicate *(Botryllus schlosseri*)	0	0	0	0	0.013	0	0	0.023	0	0
Northern rock barnacle (*Balanus balanoides*)	3.9	0	0	0.045	0.025	0	0.024	0.05	0.0488	0.125
Pink-hearted hydroid *(Tubularia crocea*)	0	0	0.025	0	0.188	0	0.49	0	0.624	0.0475
Snotty gray tunicate (*Didemnum sp.*)	0	0	0.013	1.05	0	0.046	0.075	0.075	0	0
Yellow sponge (*Cliona celata*)	0.825	0.4	0.223	1.725	0.15	0.538	0.163	1.145	0.2725	0.25
Yellow sea squirt (*Ciona Intestinalis)*	0	0	0.013	0	0	0	0	0	0	0
Blue mussel (*Mytilus edulis*)	0	0	0	0	0	0.026	0	0	0	0
Northern cup coral (*Astrangia poculata*)	0	0	0	0	0.025	1.359	0.208	0.495	0.4675	1.4
Rust Bryozoan (*Schizoporella* sp.)	0	0	0	0	0	0	0	0	0.2375	0.175
*Highlighted cells note species that had a new or increased presence in 2024.										