Supplementary Figures and Tables

Supplementary Material to: Artificial oyster reefs can facilitate the recovery of lost ecosystem function in fragmented seagrass habitat.

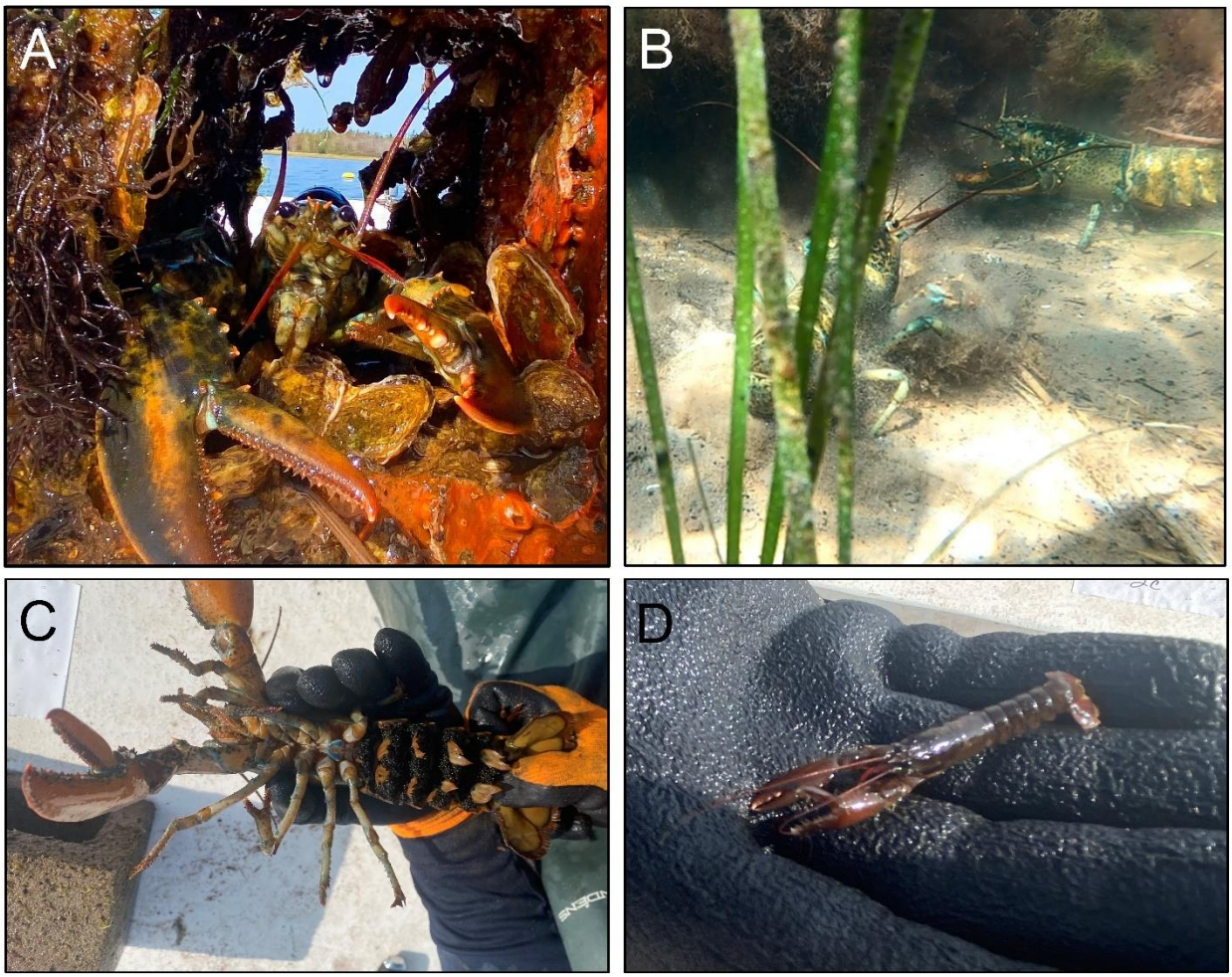

Figure S1. Notable observations of American lobsters (Homarus americanus) engaging with the artificial reefs, including (A) a sheltering lobster amongst some juvenile oysters and other organisms after bringing a concrete block onto the boat, (B) two lobsters fighting over access to a reef, (C) a berried female from one of the reefs, and (D) a juvenile recruit from one of the reefs.

Table S1. Model information for data loggers used to monitor abiotic parameters.

Parameter	Logger model	Link
Dissolved oxygen	Onset HOBO U26-001 dissolved oxygen logger	https://www.onsetcomp.com/products/data-loggers/u26-001?srsltid=AfmBOop_OLGXQ0DIiByQCPk7jHXzF-g6xCtvFpKXLYVDPydL6BX14Ogw
pH	Onset HOBO MX2501 pH and temperature logger	https://www.onsetcomp.com/products/data-loggers/mx2501?srsltid=AfmBOorCBO1OxM2rDKGJZKXs40iV198FoWYw3p6vUACcwyRk5MrStVbr
Temperature	Onset HOBO MX2501 pH and temperature logger	https://www.onsetcomp.com/products/data-loggers/mx2501?srsltid=AfmBOorCBO1OxM2rDKGJZKXs40iV198FoWYw3p6vUACcwyRk5MrStVbr
Turbidity	Observator Analite NEP-595 turbidity logger	https://observator.com/products/nep-595-turbidity-logging-probe/

Table S2. Results of pairwise comparisons between individual reef year classes for taxonomic richness and whole-community biomass. Estimate = model-predicted difference (direction and magnitude) of the first factor level in the contrast relative to the second level in the contrast, reported on the log-scale; SE = standard error; df = degrees of freedom.

Contrast	Estimate	SE	df	z-ratio	p-value
Richness					
0 year - 1 year	-0.95	0.15	Inf	-6.57	<0.0001
0 year - 2 year	-0.93	0.15	Inf	-6.39	<0.0001
1 year - 2 year	0.02	0.11	Inf	0.22	0.9742
Biomass					
0 year - 1 year	0.02	0.00	24	6.65	<0.0001
0 year - 2 year	0.03	0.00	24	7.49	<0.0001
1 year - 2 year	0.00	0.00	24	6.05	<0.0001

Table S3. Results of redundancy analysis RDA models for differences in abundance and biomass of whole communities, and sessile benthic animals only, across year classes.

Source of variation	df	Variance	F-value	p-value	Adjusted R^2
Whole-community biomass					
Model	2	0.43	42.16	<0.0001	0.76
Residuals	24	0.12	-	-	-
Sessile biomass					
Model	2	0.46	66.77	<0.0001	0.83
Residuals	24	0.08	-	-	-
Whole-community abundance					
Model	2	0.07	10.81	<0.0001	0.43
Residuals	24	0.08	-	-	-
Sessile abundance					
Model	2	0.17	13.14	<0.0001	0.48
Residuals	24	0.16	-	-	-

Table S4. Results of RDA pairwise comparisons between individual reef year classes for abundance and biomass of whole communities, and sessile benthic animals only, across year classes. df = degrees of freedom, SS = sum of squares.

Contrast	df	SS	z-ratio	p-value
Whole-community biomass				
0 year - 1 year	1	0.31	37.30	<0.0001
0 year - 2 year	1	0.41	51.98	<0.0001
1 year - 2 year	1	0.25	36.72	<0.0001
Sessile biomass				
0 year – 1 year	1	0.39	64.40	<0.0001
0 year – 2 year	1	0.45	94.08	<0.0001
1 year – 2 year	1	0.22	43.43	<0.0001
Whole-community abundance				
0 year - 1 year	1	0.06	18.13	<0.0001
0 year - 2 year	1	0.06	10.32	<0.0001
1 year - 2 year	1	0.04	6.77	<0.0001
Sessile abundance				
0 year - 1 year	1	0.17	16.65	<0.0001
0 year - 2 year	1	0.17	23.13	<0.0001
1 year - 2 year	1	0.05	4.22	<0.0001

Table S5. Results of generalized linear models for the effect of reef year class on the abundance and biomass of oyster spat and adults. LR χ2 = likelihood-ratio chi square test statistic; df = degrees of freedom.

Life stage	Source of variation	LR χ^2	df	p-value
Abundance				
Spat	Year class	27.8	2	<0.0001
Adult	Year class	331.2	2	<0.0001
Biomass				
Spat	Year class	28.3	2	<0.0001
Adult	Year class	5261.7	2	<0.0001

Table S6. Results of pairwise comparisons between individual reef year classes for abundance and biomass of oyster spat and adults. Estimate = model-predicted difference (direction and magnitude) of the first factor level in the contrast relative to the second level in the contrast, reported on the log-scale; SE = standard error; df = degrees of freedom.

Life stage	Contrast	Estimate	SE	df	z-ratio	p-value
Abundance						
Spat	0 year - 1 year	1.89	0.34	24	5.51	<0.0001
Spat	0 year - 2 year	0.87	0.34	24	2.54	0.0459
Spat	1 year - 2 year	-1.02	0.34	24	-2.97	0.0175
Adults	0 year - 1 year	-4.63	0.29	24	-16.14	<0.0001
Adults	0 year - 2 year	-7.26	0.29	24	-25.32	<0.0001
Adults	1 year - 2 year	-2.63	0.29	24	-9.18	<0.0001
Biomass						
Spat	0 year - 1 year	1.35	0.28	24	4.81	0.0002
Spat	0 year - 2 year	1.12	0.28	24	3.99	0.0015
Spat	1 year - 2 year	-0.23	0.28	24	-0.82	0.6937
Adults	0 year - 1 year	-4.19	0.24	24	-17.38	<0.0001
Adults	0 year - 2 year	-9.17	0.24	24	-38.06	<0.0001
Adults	1 year - 2 year	-4.98	0.24	24	-20.68	<0.0001

Table S7. Results of linear models testing for effects of stand, time of day, and Julian date (covariate) on dissolved oxygen, pH, and temperature. df = degrees of freedom, SS = sum of squares, MS = mean squares.

Source of error	df	SS	MS	F-value	p-value
Dissolved oxygen					
Stand	1	58.86	58.86	33.60	<0.0001
Time of day	1	26.53	26.53	15.14	<0.0001
Julian date	29	351.49	12.12	6.92	<0.0001
Stand × Time of day	1	47.93	47.93	27.36	<0.0001
Stand × Julian date	29	50.08	1.73	0.99	0.4873
Residuals	1358	2378.68	1.75	-	-
pH					
Stand	2	2.80	1.40	123.58	<0.0001
Time of day	1	0.40	0.40	34.99	<0.0001
Julian date	29	9.40	0.32	28.62	<0.0001
Stand × Time of day	2	0.49	0.25	21.84	<0.0001
Stand × Julian date	58	0.47	0.01	0.71	0.9521
Residuals	2037	23.07	0.01	-	-
Temperature					
Stand	2	12.80	6.40	10.58	<0.0001
Time of day	1	6.50	6.54	10.80	<0.0001
Julian date	29	5269.30	181.70	300.34	<0.0001
Stand × Time of day	2	6.50	3.24	5.36	0.0048
Stand × Julian date	58	31.40	0.54	0.89	0.6985
Residuals	2037	1232.30	0.61	-	-

Table S8. Results of the generalized linear mixed model (Gamma distribution) for effects of stand, time of day, and Julian date (covariate) on turbidity. . LR χ2 = likelihood-ratio chi square test statistic, df = degrees of freedom.

Source of error	LR X^2	df	p-value
Stand	863.18	2	<0.0001
Time of day	13.82	1	0.0002
Julian date	466.17	17	<0.0001
Stand × Time of day	29.07	2	<0.0001
Stand × Julian date	191.14	34	<0.0001

Table S9. Results of pairwise comparisons between the three stands for each of the four abiotic parameters monitored. Estimate = model-predicted difference (direction and magnitude) of the first factor level in the contrast relative to the second level in the contrast, reported on the log-scale; SE = standard error; df = degrees of freedom. For "z-ratio/t-ratio " column, z-ratios apply to dissolved oxygen, pH, and temperature (linear models), while t-ratios apply to turbidity (generalized linear mixed model with Gamma distribution).

Contrast	Estimate	SE	df	z-ratio/t-ratio	p-value
Dissolved oxygen					
Reef - Inside	-	-	-	-	-
Reef - Outside	-	-	-	-	-
Inside - Outside	0.31	0.07	1358	4.20	<0.0001
pH					
Reef - Inside	-0.05	0.01	2037	-8.95	<0.0001
Reef - Outside	-0.10	0.01	2037	-16.76	<0.0001
Inside - Outside	-0.05	0.01	2037	-7.81	<0.0001
Temperature					
Reef - Inside	-0.05	0.04	2037	-1.16	0.4749
Reef - Outside	-0.22	0.04	2037	-5.02	<0.0001
Inside - Outside	-0.17	0.04	2037	-3.86	<0.0001
Turbidity					
Reef - Inside	-1.92	0.11	1239	-17.87	<0.0001
Reef - Outside	-1.85	0.11	1239	-17.16	<0.0001
Inside - Outside	0.08	0.06	Inf	1.29	0.0093

Table S10. Results of pairwise comparisons between day and night at each of the three stands for each of the four abiotic parameters monitored. Estimate = model-predicted difference (direction and magnitude) of the first factor level in the contrast relative to the second level in the contrast, reported on the log-scale; SE = standard error; df = degrees of freedom. For "z-ratio/t-ratio " column, z-ratios apply to dissolved oxygen, pH, and temperature (linear models), while t-ratios apply to turbidity (generalized linear mixed model with Gamma distribution).

Stand	Contrast	Estimate	SE	df	z-ratio/t-ratio	p-value
Dissolved oxygen						
Outside	Day - Night	-0.09	0.10	1358	-0.92	<0.0001
Inside	Day - Night	0.66	0.10	1358	6.47	<0.0001
Reef	Day - Night	-	-	-	-	-
pH						
Outside	Day - Night	-0.02	0.01	2037	-1.82	0.0692
Inside	Day - Night	0.04	0.01	2037	5.10	<0.0001
Reef	Day - Night	0.06	0.01	2037	7.10	<0.0001
Temperature						
Outside	Day - Night	-0.04	0.06	2037	-0.67	0.5006
Inside	Day - Night	0.22	0.06	2037	3.57	0.0004
Reef	Day - Night	0.18	0.06	2037	3.03	0.0025
Turbidity						
Outside	Day - Night	-0.12	0.02	1239	-4.99	0.0001
Inside	Day - Night	0.03	0.02	1239	1.71	0.0883
Reef	Day - Night	0.09	0.12	1239	0.75	0.4537