**Supporting Information**

**Title**

Evaluating biodegradable alternatives to plastic mesh for small-scale oyster reef restoration

**Authors**

Devin Comba, Terence A. Palmer, Natasha J. Breaux, Jennifer Beseres Pollack\*

**Author Affiliation**

Harte Research Institute for Gulf of Mexico Studies

Texas A&M University-Corpus Christi

Corpus Christi

TX 78412

USA

**\* Corresponding author**

E-mail: [jennifer.pollack@tamucc.edu](mailto:jennifer.pollack@tamucc.edu)

**Journal**

*Restoration Ecology*

**Date**

December 17, 2021

*Tables*

Table S1. p values of main effects ANOVAs. Bold values indicate significant differences (α= 0.05). Station was included as a random effect. \*Oyster height includes the control treatment as a factor level, while the other metrics account for tray effects. Transformations used prior to ANOVA are in parentheses.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Comparison** | **Effect** | **Oyster Density**  **(4th root)** | **Oyster Height\***  **(Log base e)** | **Fauna Density**  **(4th root)** | **Fauna Biomass**  **(4th root)** | **Fauna Diversity**  **(no transformation)** |
| **Treatment Types\*:**  Bagged versus Loose Shell | Treatment | 0.254 | **0.001** | **3.44E-05** | **1.01E-05** | 0.757 |
| Depth | 0.624 | 0.838 | **0.011** | **0.026** | **0.032** |
| Date | **8.66E-46** | **1.61E-45** | 0.437 | **6.08E-10** | **0.048** |
| Treatment x Depth | 0.447 | 0.129 | 0.599 | **0.037** | 0.997 |
| Treatment x Date | **0.005** | **7.04E-05** | 0.103 | **0.009** | 0.996 |
| Depth x Date | 0.358 | 0.069 | **3.36E-04** | 0.285 | 0.727 |
| Treatment x Depth x Date | 0.084 | 0.187 | 0.815 | 0.131 | 0.904 |

Table S2. ANOVA outputs for transformed oyster and fauna metrics. Station was included in the model as a random effect (y ~ Treatment \* Depth \* Date + (1|Station)).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Oyster Density (4th root)** |  |  |  |  |  |  |
| Effect | **Sum Sq** | **Mean Sq** | **NumDF** | **DenDF** | **F value** | **Pr(>F)** |
| Treatment | 1.829 | 1.829 | 1 | 96.000 | 1.317 | 0.254 |
| Depth | 0.371 | 0.371 | 1 | 5.742 | 0.267 | 0.624 |
| Date | 1119.468 | 279.867 | 4 | 96.000 | 201.541 | **8.66E-46** |
| Treatment:Depth | 0.808 | 0.808 | 1 | 96.000 | 0.582 | 0.447 |
| Treatment:Date | 21.899 | 5.475 | 4 | 96.000 | 3.943 | **0.005** |
| Depth:Date | 6.146 | 1.536 | 4 | 96.000 | 1.106 | 0.358 |
| Treatment:Depth:Date | 11.770 | 2.943 | 4 | 96.000 | 2.119 | 0.084 |
| **Oyster Height (log base e)** |  |  |  |  |  |  |
| Effect | **Sum Sq** | **Mean Sq** | **NumDF** | **DenDF** | **F value** | **Pr(>F)** |
| Treatment | 7.220 | 3.610 | 2 | 120 | 7.080 | **0.001** |
| Depth | 0.021 | 0.021 | 1 | 120 | 0.042 | 0.838 |
| Date | 303.292 | 75.823 | 4 | 120 | 148.696 | **1.61E-45** |
| Treatment:Depth | 2.125 | 1.063 | 2 | 120 | 2.084 | 0.129 |
| Treatment:Date | 18.636 | 2.329 | 8 | 120 | 4.568 | **7.04E-05** |
| Depth:Date | 4.569 | 1.142 | 4 | 120 | 2.240 | 0.069 |
| Treatment:Depth:Date | 5.874 | 0.734 | 8 | 120 | 1.440 | 0.187 |
| **Fauna Density (4th root)** |  |  |  |  |  |  |
| Effect | **Sum Sq** | **Mean Sq** | **NumDF** | **DenDF** | **F value** | **Pr(>F)** |
| Treatment | 37.107 | 37.107 | 1 | 98.000 | 18.853 | **3.44E-05** |
| Depth | 13.209 | 13.209 | 1 | 98.000 | 6.711 | **0.011** |
| Date | 7.500 | 1.875 | 4 | 98.000 | 0.953 | 0.437 |
| Treatment:Depth | 0.549 | 0.549 | 1 | 98.000 | 0.279 | 0.599 |
| Treatment:Date | 15.590 | 3.897 | 4 | 98.000 | 1.980 | 0.103 |
| Depth:Date | 45.280 | 11.320 | 4 | 98.000 | 5.751 | **3.36E-04** |
| Treatment:Depth:Date | 3.072 | 0.768 | 4 | 98.000 | 0.390 | 0.815 |
| **Fauna Biomass (4th root)** |  |  |  |  |  |  |
| Effect | **Sum Sq** | **Mean Sq** | **NumDF** | **DenDF** | **F value** | **Pr(>F)** |
| Treatment | 15.619 | 15.619 | 1 | 94.177 | 21.784 | **1.01E-05** |
| Depth | 5.852 | 5.852 | 1 | 6.679 | 8.162 | **0.026** |
| Date | 45.370 | 11.342 | 4 | 94.380 | 15.820 | **6.08E-10** |
| Treatment:Depth | 3.208 | 3.208 | 1 | 94.177 | 4.474 | **0.037** |
| Treatment:Date | 10.287 | 2.572 | 4 | 94.156 | 3.587 | **0.009** |
| Depth:Date | 3.660 | 0.915 | 4 | 94.380 | 1.276 | 0.285 |
| Treatment:Depth:Date | 5.224 | 1.306 | 4 | 94.156 | 1.822 | 0.131 |
| **Fauna Diversity (no transformation)** | |  |  |  |  |  |
| Effect | **Sum Sq** | **Mean Sq** | **NumDF** | **DenDF** | **F value** | **Pr(>F)** |
| Treatment | 0.155 | 0.155 | 1 | 94.008 | 0.097 | 0.757 |
| Depth | 16.263 | 16.263 | 1 | 4.102 | 10.107 | **0.032** |
| Date | 16.064 | 4.016 | 4 | 94.019 | 2.496 | **0.048** |
| Treatment:Depth | 0.000 | 0.000 | 1 | 94.008 | 0.000 | 0.997 |
| Treatment:Date | 0.278 | 0.069 | 4 | 94.007 | 0.043 | 0.996 |
| Depth:Date | 3.299 | 0.825 | 4 | 94.019 | 0.512 | 0.727 |
| Treatment:Depth:Date | 1.666 | 0.417 | 4 | 94.007 | 0.259 | 0.904 |

Table S3. Similarity percentage (SIMPER) results comparing fauna communities of deep and shallow sites. Abundances were root-transformed before analysis. N = 118 samples.

*Parameters*

Resemblance: S17 Bray-Curtis similarity

Cut off for low contributions: 90.00%

*Group Deep*

Average similarity: 48.73

Species Av.Abund Av.Sim Sim/SD Contrib% Cum.%

Panopeidae 6.25 18.26 1.36 37.48 37.48

Eurypanopeus turgidus 2.89 6.10 0.99 12.52 50.00

Petrolisthes sp. 3.83 5.22 0.68 10.71 60.71

Alpheus heterochaelis 1.60 4.59 1.50 9.41 70.12

Gobiosoma bosc 1.57 3.75 1.08 7.70 77.82

Pyrgocythara plicosa 1.67 3.36 0.96 6.90 84.72

Bittiolum varium 1.47 3.14 0.71 6.44 91.16

*Group Shallow*

Average similarity: 65.13

Species Av.Abund Av.Sim Sim/SD Contrib% Cum.%

Petrolisthes sp. 7.34 14.03 3.42 21.54 21.54

Panopeidae 4.44 8.23 2.02 12.64 34.18

Eurypanopeus turgidus 3.70 7.09 2.06 10.89 45.07

Alpheus heterochaelis 2.64 4.92 1.67 7.56 52.63

Costoanachis avara 3.33 4.86 1.48 7.46 60.09

Gobiosoma bosc 2.26 4.24 2.30 6.51 66.60

Pyrgocythara plicosa 2.99 4.08 1.71 6.26 72.86

Parvanachis ostreicola 2.99 3.99 1.31 6.12 78.98

Boonea impressa 3.55 3.58 0.84 5.49 84.47

Opsanus beta 1.63 3.20 2.11 4.92 89.39

Marshallora nigrocincta 2.58 2.87 1.04 4.41 93.80

*Groups Deep & Shallow*

Average dissimilarity = 55.45

Deep Shallow

Species Av.Abund Av.Abund Av.Diss Diss/SD Contrib% Cum.%

Petrolisthes sp. 3.83 7.34 8.25 1.50 14.88 14.88

Panopeidae 6.25 4.44 5.69 1.20 10.26 25.14

Boonea impressa 0.08 3.55 4.83 1.19 8.70 33.84

Costoanachis avara 0.27 3.33 4.61 1.70 8.32 42.16

Parvanachis ostreicola 0.18 2.99 4.13 1.59 7.45 49.61

Eurypanopeus turgidus 2.89 3.70 3.61 1.17 6.51 56.12

Marshallora nigrocincta 0.14 2.58 3.47 1.30 6.25 62.38

Pyrgocythara plicosa 1.67 2.99 3.16 1.26 5.70 68.08

Eurypanopeus depressus 0.84 1.96 2.62 1.11 4.72 72.80

Alpheus heterochaelis 1.60 2.64 2.39 1.18 4.30 77.10

Bittiolum varium 1.47 0.64 2.20 0.99 3.96 81.07

Gobiosoma bosc 1.57 2.26 1.97 1.11 3.56 84.63

Astyris lunata 0.74 1.08 1.79 0.88 3.24 87.86

Opsanus beta 0.90 1.63 1.69 1.18 3.05 90.92

Table S4. Lab experiment statistical output from three-way repeated measures ANOVA (grazing experiment) and three-way main effects ANOVA (light and temperature experiment). Bold values indicate p < 0.05.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Experiment | Effect | DFn | DFd | F | p value | ges |
| Grazing Experiment | Treatment | 1 | 366 | 66.699 | **5.18E-15** | 0.154 |
| Material | 2 | 366 | 13.064 | **3.31E-06** | 0.067 |
| Days | 1 | 366 | 0.181 | 0.671 | 0.000 |
| Treatment:Material | 2 | 366 | 3.627 | **0.028** | 0.019 |
| Treatment:Days | 1 | 366 | 73.778 | **2.55E-16** | 0.168 |
| Material:Days | 2 | 366 | 0.707 | 0.494 | 0.004 |
| Treatment:Material:Days | 2 | 366 | 4.084 | **0.018** | 0.022 |
| Light and Temperature Experiment | Material | 2 | 351 | 33.369 | **5.41E-14** | 0.160 |
| Treatment | 8 | 351 | 0.805 | 0.598 | 0.018 |
| Days | 1 | 351 | 1.318 | 0.252 | 0.004 |
| Treatment:Material | 16 | 351 | 0.359 | 0.990 | 0.016 |
| Treatment:Days | 2 | 351 | 0.102 | 0.903 | 0.001 |
| Material:Days | 8 | 351 | 1.400 | 0.195 | 0.031 |
| Treatment:Material:Days | 16 | 351 | 0.559 | 0.913 | 0.025 |

*Figures*

Chart, line chart

Description automatically generated

a

b.

c

d.

Sampling Month and Year

Mar-20 Apr-20 May-20 Jun-20 Aug-20 Oct-20

Figure S1. Mean temperature (a), salinity (b), dissolved oxygen (c), and pH (d) at deep (~1 m) and shallow (<0.5 m) sites over time. Shading indicates standard deviation.

Chart

Description automatically generated

Figure S2. Cluster analysis (group average method) with similarity profile (SIMPROF) test of square root transformed fauna samples by depth and treatment. Black bars indicate meaningful clusters (p < 0.05).

Chart, line chart

Description automatically generated

Figure S3. Fauna diversity in combined treatments in deep (~1 m) and shallow (<0.5 m) sites over time. Shading indicates standard deviation.