Direct Seeding of Hatchery-Produced Oyster Larvae on to Constructed Oyster Reefs in the St. Lucie Estuary, Florida

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Introduction

Recent, extensive losses of oysters in the St. Lucie Estuary due to freshwater discharges have led to examination of larval seeding as a method to augment existing oyster reef restoration efforts. In an effort to restore oyster reef habitat in areas and/or times when recruitment may be equivocal, we tested whether direct, *in situ* remote setting can be a viable method of restoration.

Two seeding experiments were conducted to determine the influence of larval seeding, reef height, and cultch type in oyster settlement. In these studies we sought to determine:

1. Whether *in situ* remote setting could be a successful method to augment oyster restoration
2. Whether reef height had an effect on oyster settlement, and
3. Whether cultch type had an effect on oyster settlement.

Larval Seeding Experiments

I. Initial *in situ* remote setting experiment

In May 2009, four 9.3 m² (10' x 10') oyster reefs were constructed with bagged oyster shell near the base of the Evans Crary Bridge in the St. Lucie Estuary (see Fig. 1 and 2). Two of the 4 reefs were encircled with turbidity booms and ~ two weeks later seeded with 2 million eyed oyster larvae per enclosure (Fig. 3) . One month after seeding, spat per shell were counted. Three months after seeding shell bags sampled directly to estimate oyster density (# of oysters per 1L of cultch). Spat #'s and oyster densities from Seeded and Unseeded reefs were compared by ANOVA.

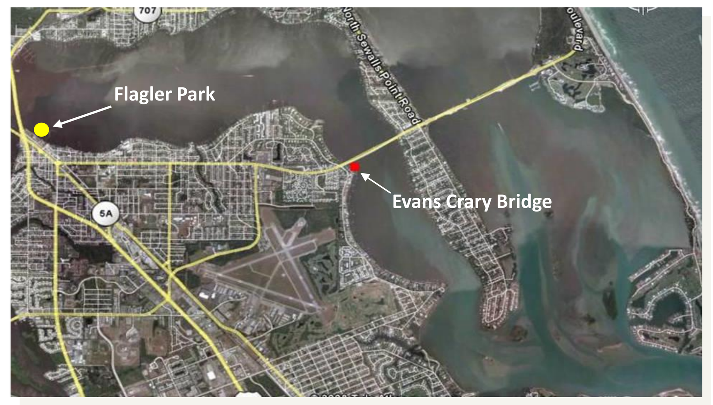
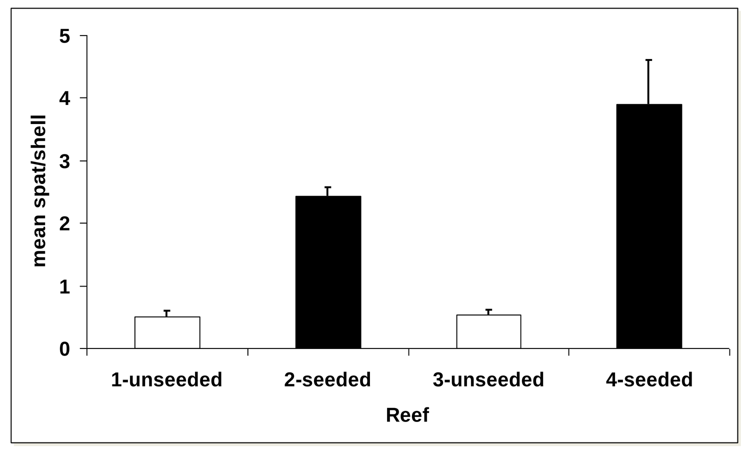


Figure 1. Oyster restoration sites in the St. Lucie River – Stuart, Florida. *In situ* remote setting was performed at the Evans Crary and Flagler Park sites in 2009 and 2014, respectively.

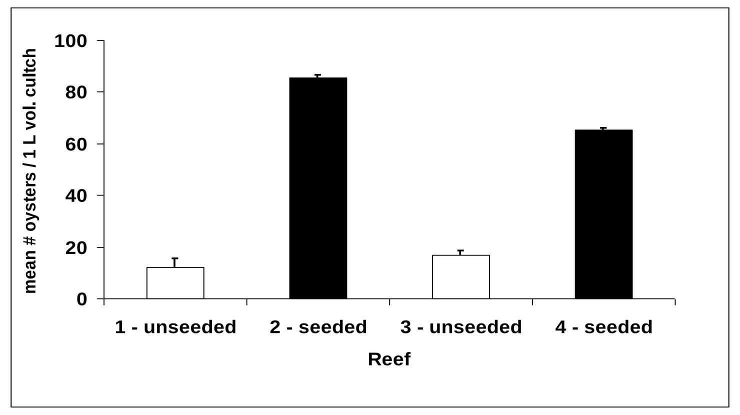
Figure 2. Community-based construction of oyster reefs at Evans Crary site.

Figure 3. Larval seeding of constructed oyster reefs.

Mean number of spat per shell was greater on seeded reefs vs. unseeded reefs ($p<0.05$).



Oyster densities were greater on seeded reefs vs. unseeded reefs ($p<0.05$)



II. Influence of cultch type and reef height on larval seeding

On May 3, 2014 at Flagler Park (Fig. 1 and 4) eight 1.0 m² high and low profile reefs (0.3 m and 0.15 m height; Fig. 5) were constructed. All reefs contained bags of MSA (mixed shell aggregate) and oyster shell arranged in an alternating fashion (Fig. 6). 3.5 million oyster larvae were added to reefs enclosed within a turbidity boom (Fig. 7). One month later, oyster shells and MSA were sampled from all reef types (Seeded and Unseeded, High and Low profile, Oyster and MSA) and spat were counted. Data were analyzed by Fisher's Exact test for percentage of shell containing spat and Bootstrap 2-sample t-test for comparing mean number of spat per shell across reef types. Significance was determined at 0.01 due to the number of pair-wise comparisons (Kirchoff, et al).

Figure 4. Flagler Park site showing Seeded and Unseeded areas

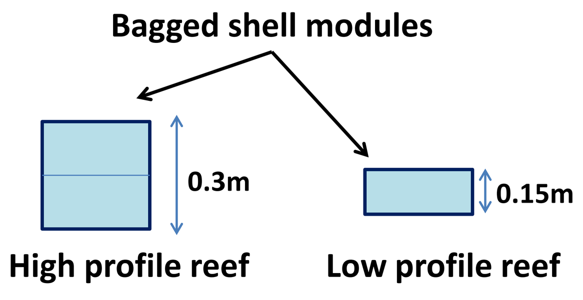


Figure 5. Diagram of High and Low profile reefs.

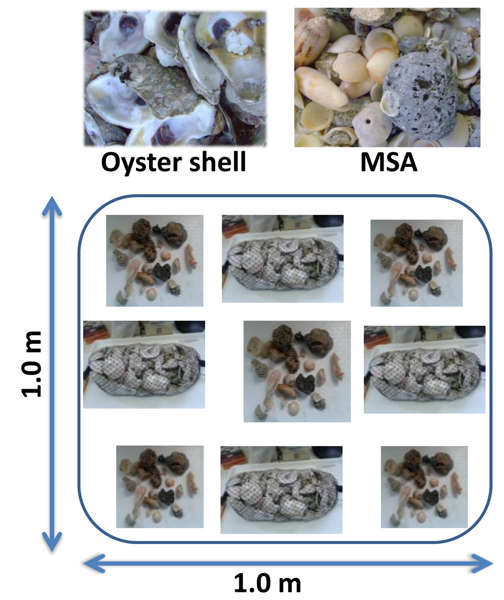
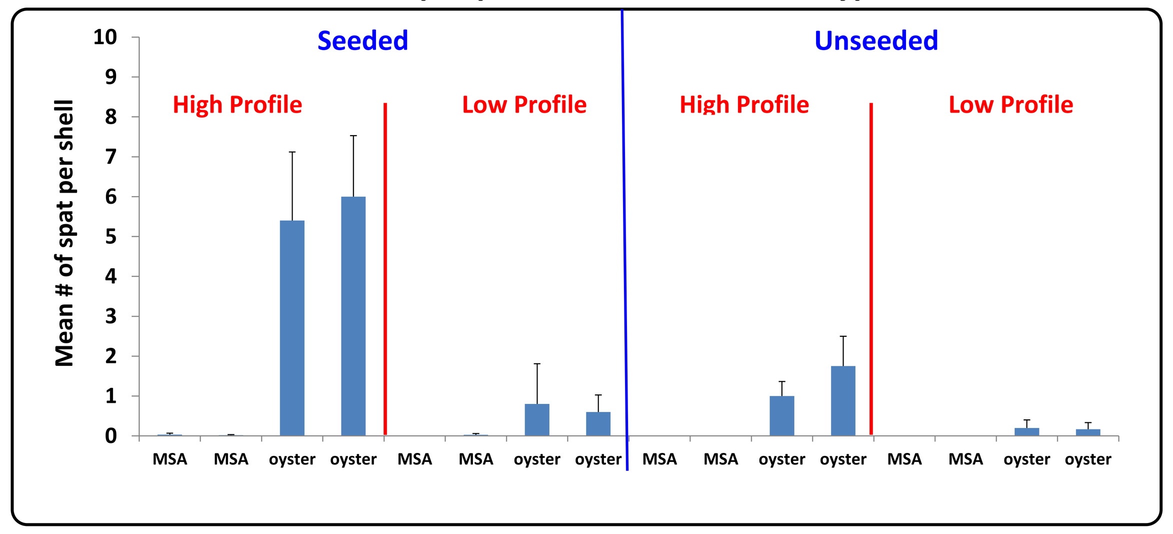


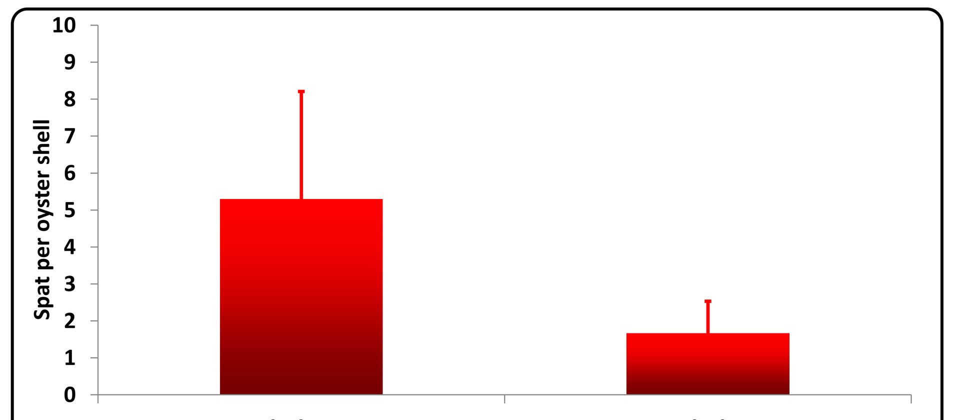
Figure 6. Oyster shell and Mixed Shell Aggregate (MSA) cultch and arrangement of shell bags in reefs.

Figure 7. Adding oyster larvae to boom enclosure

Mean number of spat per shell across all reef types

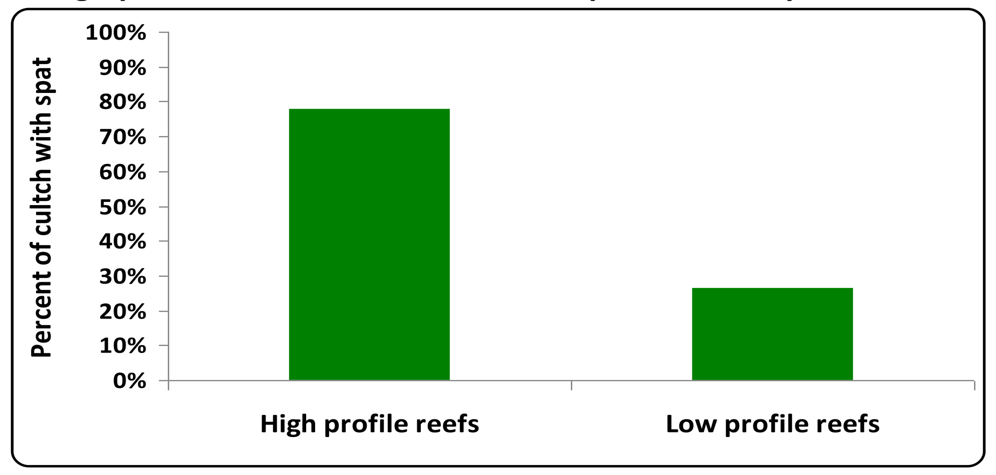


Seeded oyster shell had 3 times more spat per shell than unseeded oyster shell



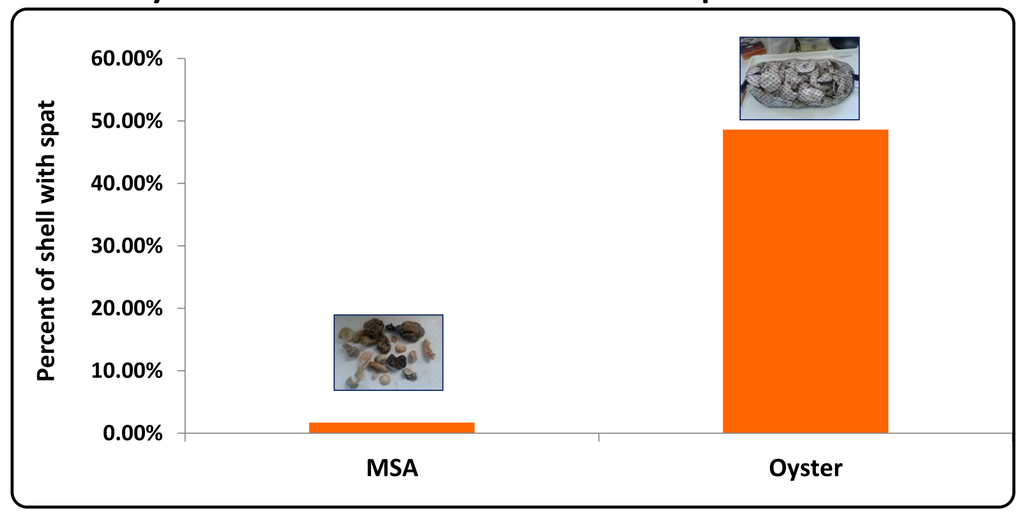
Bootstrap 2 sample t-test for comparing mean spat per shell (t-statistic = 3.770, p-value (two-sided) = 0.006, n = 10 (seeded oyster); n = 9 (unseeded oyster).

High profile reefs had 3 times more spat than low profile reefs



Fisher's exact test for comparing percent of shell with spat settlement (high profile reef = 0.778, low profile reef = 0.263; p-value (2-sided) = 0.003).

Oyster shell contained 29 times more spat than MSA



Fisher's exact test for comparing percent of shell with spat settlement. 48.6% of oyster shell contained spat and 1.7% of MSA contained spat; p-value (2-sided) < 0.001).

Discussion

Although larval seeding increased the number of spat per shell, vertical relief proved to be a significant factor in spat settlement in both seeded and unseeded treatments. Oysters have an increased survival rate on high profile reefs due to greater access to algae and increased flow (Lenihan 1999). Additionally, the base of low profile reefs become buried in sediment, which can smother oyster spat settled on them. The differences in spat settlement between cultch types was also striking and corroborate earlier observations from field samplings and tank experiments in which spat settlement was significantly higher on oyster shell vs. MSA. These past and current observations compared spat settlement in which both cultch types were immediately adjacent to each other. Future restoration efforts should have success using seeding larvae on high profile reefs composed of oyster shell.

Literature Cited

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Acknowledgments

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