First-Year Performance of the *Pervious Oyster Shell Habitat* (POSH) Along Two Energetic Shorelines in Northeast Florida

UNF UNIVERSITY of NORTH FLORIDA

Hunter Mathews and Kelly J. Smith

Department of Biology, University of North Florida, Jacksonville, Florida

UNF Institute of Environmental Research and Education

INTRODUCTION

- Oyster reefs provide valuable habitat, filter water, contribute to nutrient cycling, and stabilize our marsh shorelines.
- 85% of global oyster reef habitat has been lost to overharvesting, degradation of water quality, and disease.[1]
- Novel restoration methods attempt to successfully restore and protect intertidal shorelines, while minimizing negative environmental impact.
- The *Pervious Oyster Shell Habitat* (POSH) is an artificial reef structure composed of oyster shell bound by a thin layer of Portland cement *(Figure 1).*[2]
  - The POSH uses no plastic, has a reduced carbon footprint, utilizes oyster shell, and is structurally complex.
- Reef Innovations' "Oyster Ball" was selected as a comparison structure due to its popularity and similar design.

Figure 1: POSH (a) and Oyster Ball (b) Module

METHODS

- Structures were deployed in June and July of 2021 at Kingsley Plantation (KP) in the Timucuan Ecological and Historic Preserve, and Wright's Landing (WL) at the Guana Tolomato Matanzas National Estuarine Research Reserve *(Figure 2).*

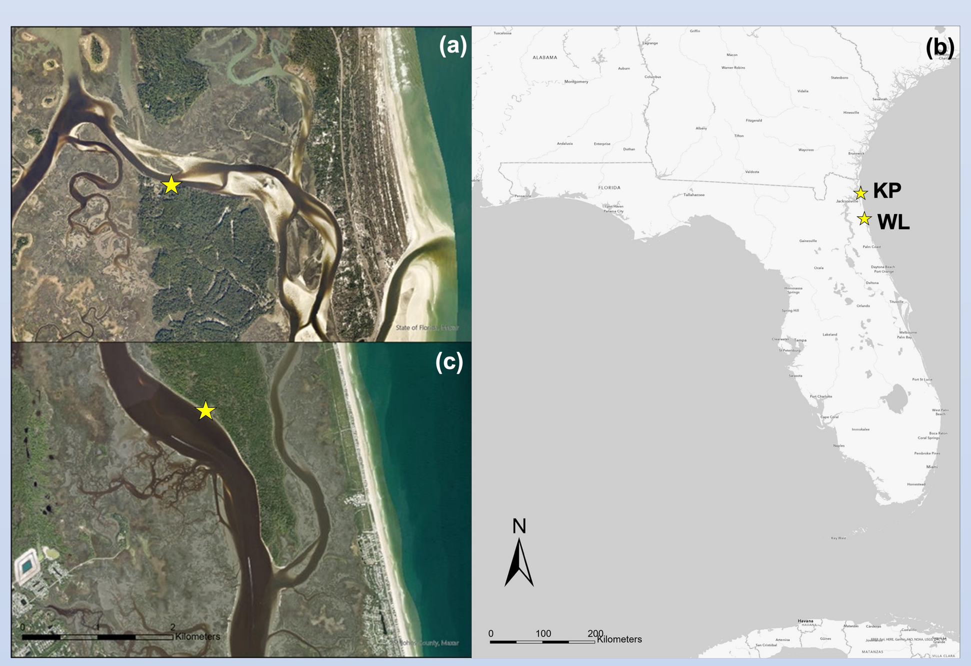

Figure 2: Study Sites. KP Along the Fort George River (a), Both Sites in NE Florida (b), and WL Along the Tolomato River (c)

- Experimental shorelines were deployed as six 3-module reefs along the mean low water line.
- Restoration success criteria were adopted from *Baggett et al.*[3], including oyster density, oyster size distribution, and reef height at 1 year.
- Monthly oyster spat and barnacle settlement was compared between oyster shells coated Portland cement and untreated oyster shells using oyster T bars.
- Recruitment of oysters and barnacles was assessed on POSH and Oyster Ball modules as individuals/100 cm^2 by using elastic trellis netting to define equivalent areas on each side of every structure. Oyster shell heights were measured at 4 months and 1 year following deployment on the POSH and Oyster Ball modules.

RESULTS

Oyster and Barnacle Densities

All error bars represent ± 1 SE.

* *indicates a significant difference found by an independent samples t-test.*

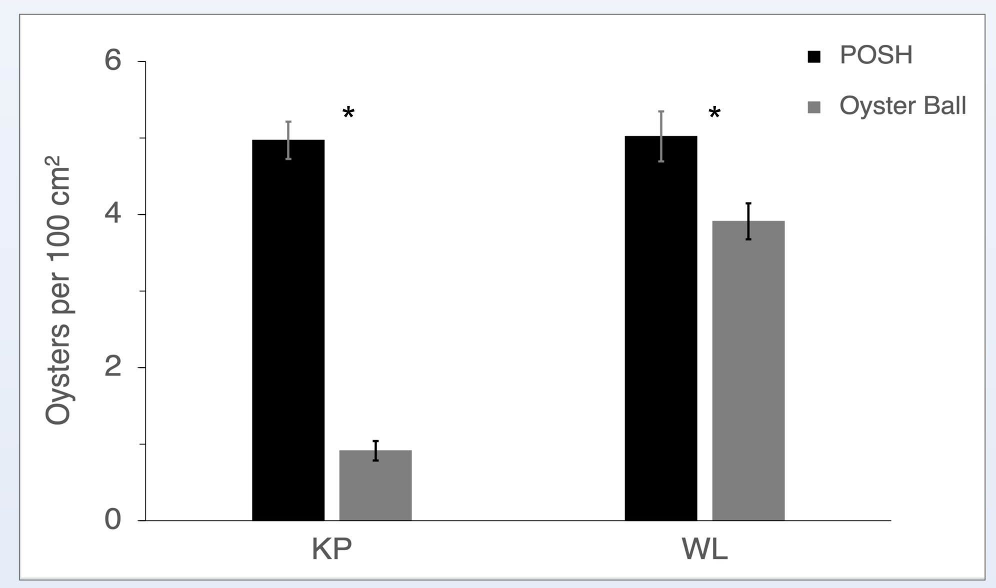

Figure 3: Oyster Density Comparison.
KP: POSH, x = 5.0 ± 0.2, n = 69; OB, x = 0.9 ± 0.1, n = 52
WL: POSH, x = 5.0 ± 0.3, n = 33; OB, x = 3.9 ± 0.2, n = 36

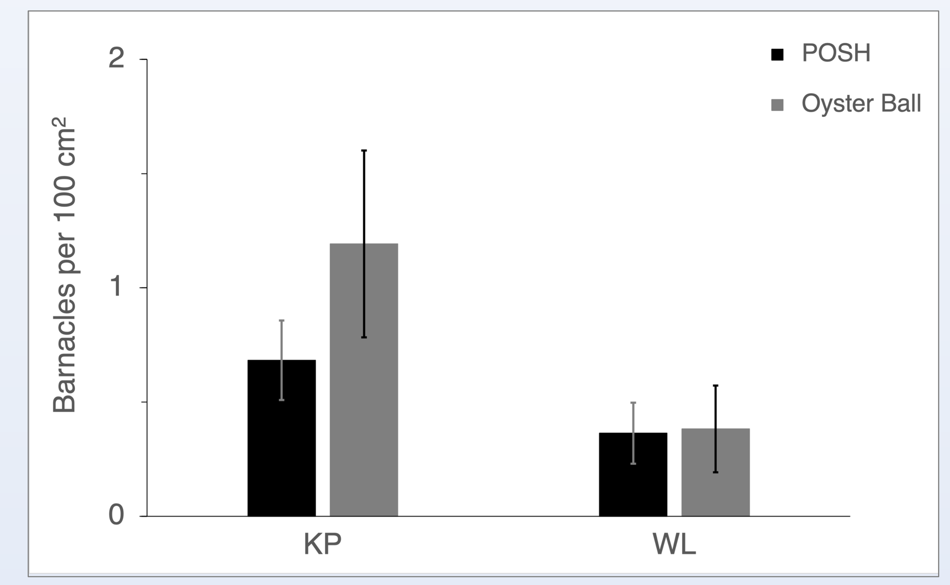

Figure 4: Barnacle Density Comparison.
KP: POSH, x = 0.7 ± 0.2, n = 69; OB, x = 1.2 ± 0.4, n = 52
WL: POSH, x = 0.4 ± 0.1, n = 33; OB, x = 0.4 ± 0.2, n = 36

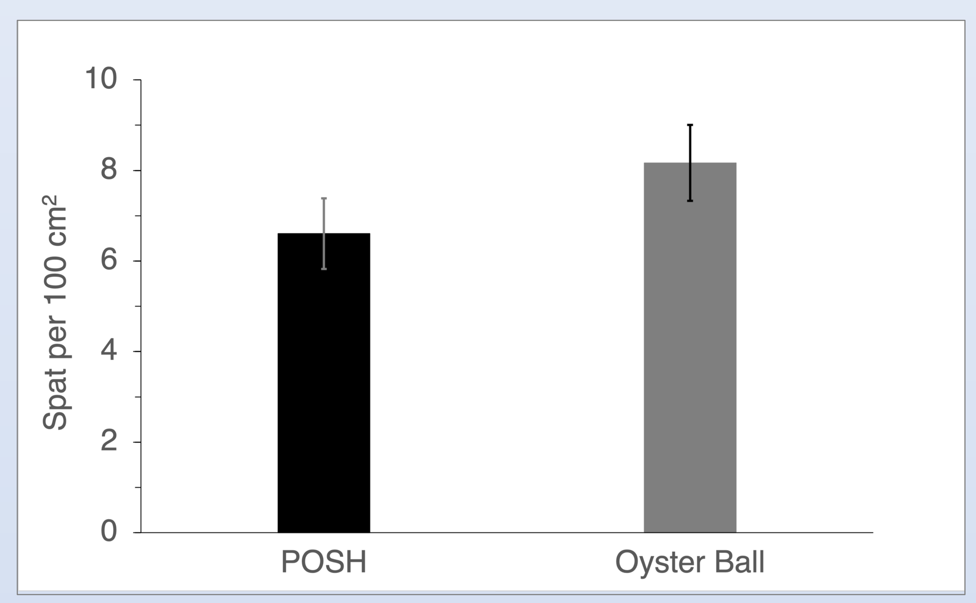

Figure 5: Spat Density Comparison at WL.
POSH, x = 6.6 ± 0.8, n = 33; OB, x = 8.2 ± 0.8, n = 36

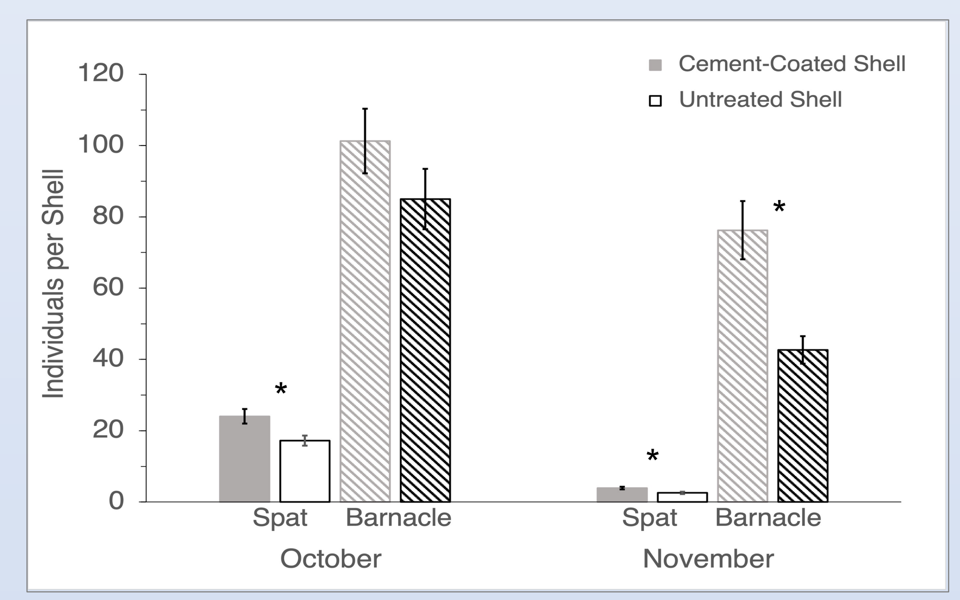

Figure 6: Settlement Substrate Comparison at KP.
OCT Spat: Cement, x = 24.0 ± 2.1; Untreated, x = 3.9 ± 0.4
Barnacle: Cement, x = 101.3 ± 9.1; Untreated, x = 85.0 ± 8.5
NOV Spat: Cement, x = 17.2 ± 1.4; Untreated, x = 2.6 ± 0.3
Barnacle: Cement, x = 76.3 ± 8.2; Untreated, x = 42.7 ± 3.9

Oyster Size Distributions

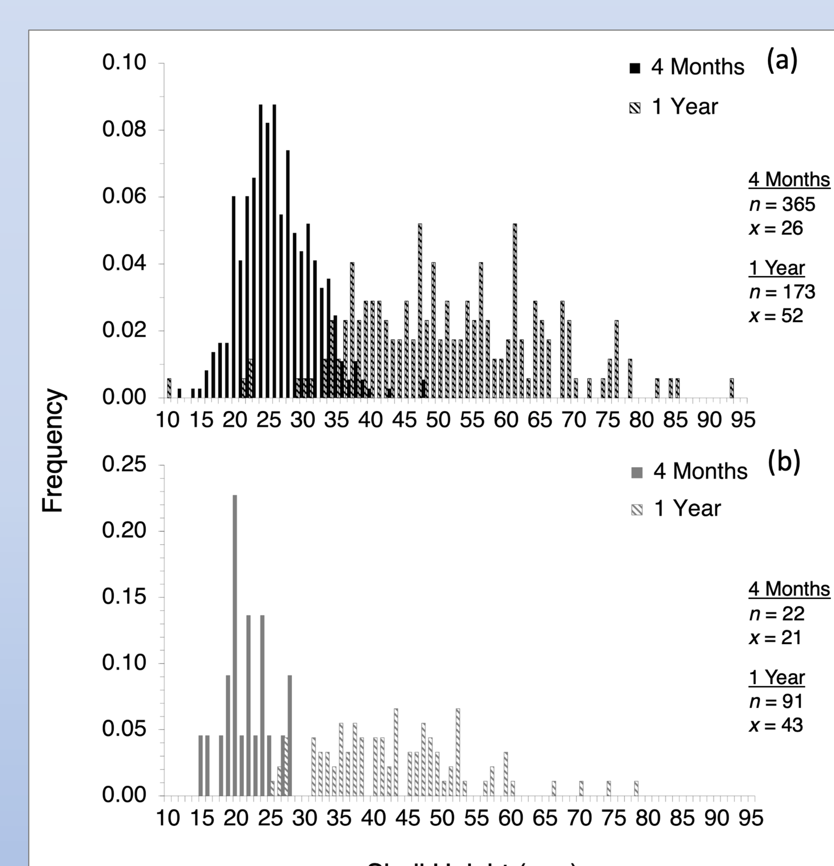

Figure 7: Oyster Size Distributions at KP. POSH (a) and Oyster Ball (b) at 4 months and 1 year. Note the different frequency range for the Oyster Ball due to a limit in sampled oysters.

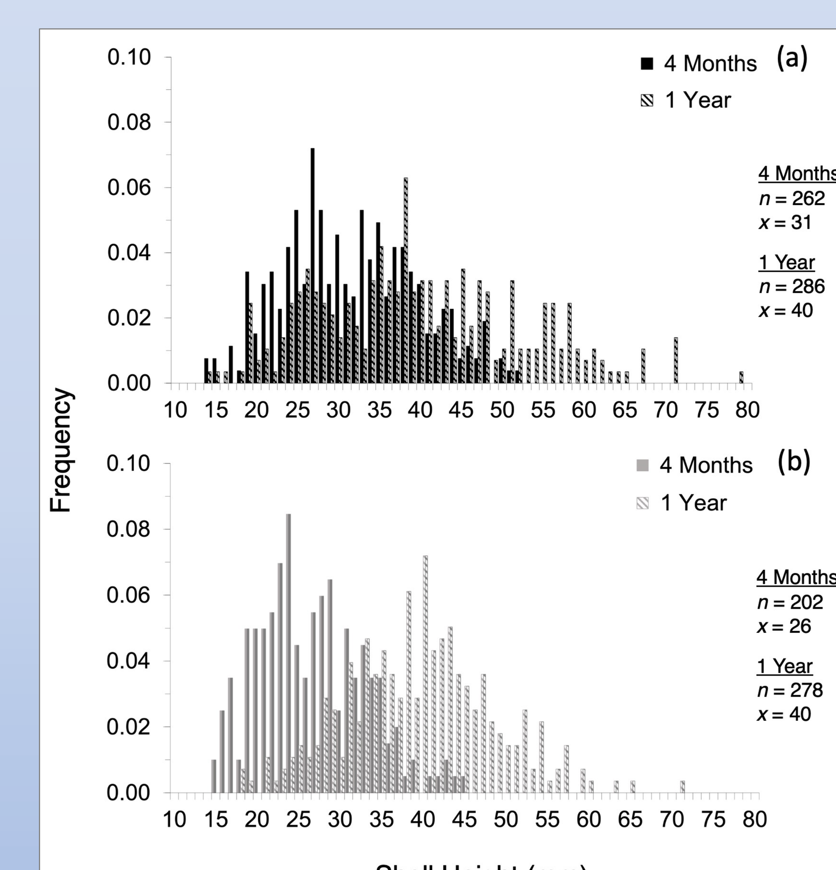

Figure 8: Oyster Size Distributions at WL. POSH (a) and Oyster Ball (b) at 4 months and 1 year.

DISCUSSION

- The POSH maintained high, consistent, and significantly greater oyster recruitment at both sites. Both structures recruited reproductive-sized oysters by the end of the year. Oyster development on the POSH resembled a healthy oyster reef with vertical growth.
- Barnacle densities were low, variable, and did not differ between structures at either site.
- Reef heights were similar between the structures after one year. Both structures shifted minimally over the year, and neither were damaged.
- Portland cement can be an optimal substrate for oyster settlement and recruitment. Early results show that the POSH can be a viable oyster reef restoration device in varying water quality and energetic conditions.
- Long-term monitoring is needed to more accurately assess the structure's sustainability as a living shoreline method.

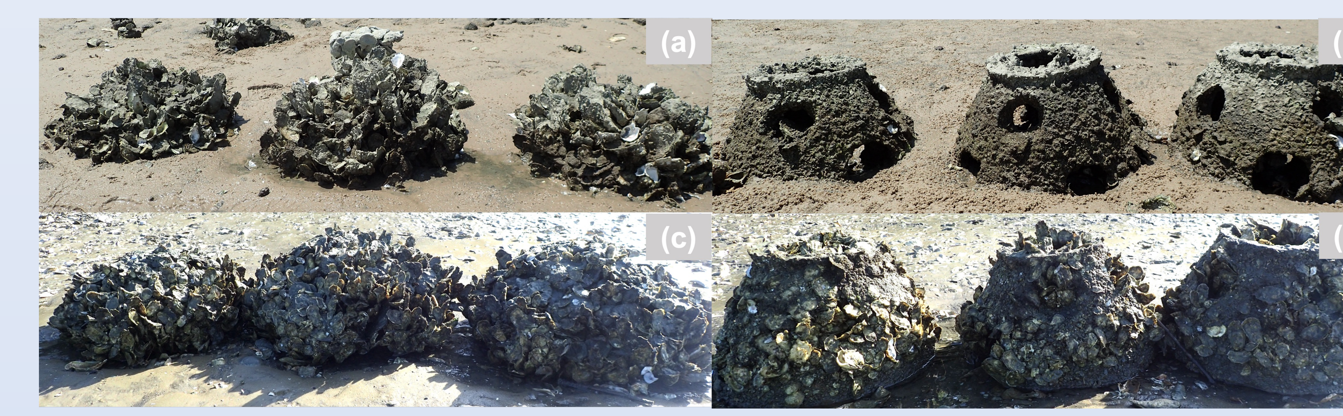

Figure 9: Reef Modules After One Year.
Oysters settled on POSH (a) and Oyster Ball (a) Modules at KP, and POSH (c) and Oyster Ball (d) Modules at WL.

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