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Johns Point Landing Living Shoreline – Ecological Monitoring : Final Report to Gloucester County

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Final Report to Gloucester County

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Johns Point Landing Living Shoreline Ecological Monitoring

VIMS monitoring activities consisted of three components:

- Monitoring of marsh vegetation establishment after planting
- Documenting ribbed mussel and oyster recruitment and growth in experimental bags of oyster shell at the living shoreline
- Monitoring infaunal communities prior to and after living shoreline implementation

Marsh Vegetation

We surveyed marsh vegetation within 2 locations (*i*) a natural/reference marsh in close proximity in Bryant Bay and (*ii*) the newly planted marsh of the living shoreline at Johns Point Landing, Virginia. We placed five transects perpendicular to the shoreline and along each transect we sampled quadrats ($0.25m^2$) within low and high marsh habitats. Sampling occurred after planting of the living shoreline and near the end of the growing season (August 22, 2014). We recorded marsh plant composition, species abundance, and height.

Benthic invertebrates

We sampled benthic invertebrates (infauna) before and after construction of the living shoreline at Johns Point Landing. Unfortunately, construction timing did not allow infauna sampling to occur during the peak biological period (summer-fall). We sampled in April 2014 (prior to plantings, but after sill placement) and again in late August 2014. The reference marsh was sampled concurrently for comparison. At each site, we collected three replicate benthic samples in the nearshore shallow subtidal and the intertidal using an Ekman Grab that sampled a surface area of 0.025 m^2. Samples were rinsed into a 0.5 mm sieve, preserved, and identified to the lowest possible taxonomic level, usually species. Sediment samples were also analyzed for organic matter and grain size. Before and after time-frames will be compared to document changes in benthic habitat quality and communities.

Bivalves (oysters, mussels, clams) can provide a variety of ecosystem services including stabilizing shorelines, decreasing suspended particulates and nutrients, and increasing water clarity. During placement of oyster bags for living shoreline construction, we placed experimental 'sacrificial' bags of oyster shell for periodic removal to document settlement. Six experimental bags were placed at five points along the oyster sill. We retrieved a set of replicate bags monthly to assess bivalve (mussel, oyster) bivalve settlement and growth for 4 months and plan to retrieve the last 2 remaining sets of bags in October and after 1 year. For each retrieved bag, we counted the number of bivalves and other fauna on each shell, recorded the size of each bivalve, counted the number of shell, and estimated organic material (algae) associated with the shell. We compared the species composition, abundance and average sizes over time to document bivalve settlement and growth during the first year of oyster sill placement.

Marsh Planting and Oyster Sill Placement – 26 April 2014

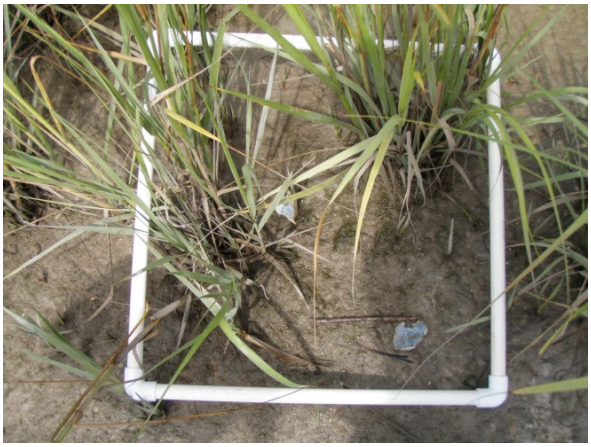
Marsh planting – *Spartina alterniflora* and *Spartina patens*

Bags of oyster shell used in sill construction

'Sacrificial' bags of oyster shell

Johns Point Landing Marsh Growth – 22 August 2014

We estimated that ~ 535 m^2 of marsh has been created (~290 m^2 *Spartina alterniflora* and 245 m^2 *Spartina patens*) at Johns Point Landing. Following plantings of ~ 8 plants per m^2 in April 2014, the marsh quickly grew and filled in with an estimated 131 *S. alterniflora* stems per m^2 and 1,080 *S. patens* stems per m^2 evident in August 2014. Many of the plants of both species were producing seeds in August which is encouraging for marsh establishment.



Within a single growing season, Johns Point Landing marsh has become established with plant densities (131 stems m^2) similar to other marsh-sill living shorelines (avg 145 stems m^2)(**Figure 1**). Densities may increase over time to become similar to natural fringing marsh densities within Bryant Bay and elsewhere.

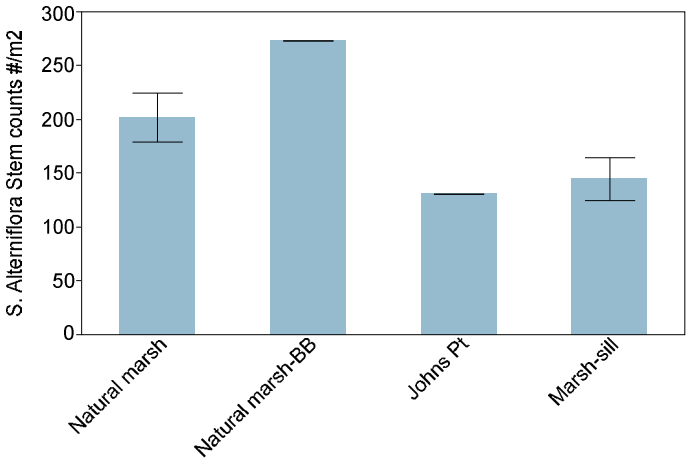


Figure 1. Marsh plant density. Natural marsh represents data (n=33) from fringing marshes throughout Chesapeake Bay. Natural marsh-BB is the nearby reference marsh in Bryant Bay, and Marsh-sill represents data (n=9) on created marshes with sills in the Bay that are between 2 and 12 years old.

Benthic macroinvertebrate community

Benthic macroinvertebrate species diversity was similar at the onset of living shoreline implementation (April 2014) and immediately following construction (late August 2014); however, there were differences in the species assemblages. Only a few species were present during both sampling periods these included the bivalve *Macoma balthica* and the polychaete worms *Leitoscoloplos fragilis, Glycera spp, Neanthes succinea,* and *Heteromastus filiformis.* The bivalves *Tellina agilis, Tagelus plebeius* and polychaetes *Arenicola cristata, Amphitrite ornate* were only observed prior to construction. Following construction, the site was primarily populated by common estuarine worms such as *Capitellidae spp, Glycera spp,* and young bivalves *Gemma gemma* and *Mya arenaria.* A decline in abundance and a shift in invertebrate communities are expected immediately after construction that is disruptive of bottom habitat. At Johns Point Landing the species assemblages shifted but overall abundance and diversity remained comparable (**Figures 2 and 3**) with higher abundances observed in August. Seasonal variability in benthic assemblages is typically high which likely explains, at least in part, the change in species observed. A nearby natural marsh sampling during the same time periods had similar shifts in benthic assemblages. This suggests that John Point Landing benthic communities are recovering following the living shoreline construction. As with other marsh creation project, full ecosystem function including benthic characteristics and fauna may take at least several years. Continued systematic monitoring will be necessary to ensure wetland function is fully realized.

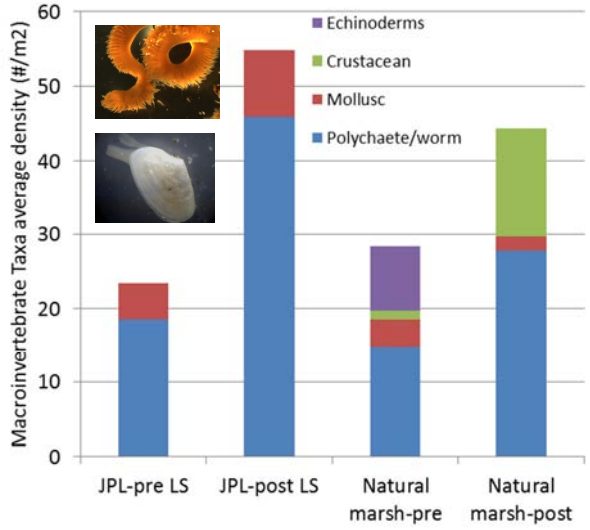


Figure 2. Macroinvertebrate community composition grouped by major taxa. JPL = Johns Point Landing. Pre-construction sampling occurred in April 2014 and post-sampling in August 2014.

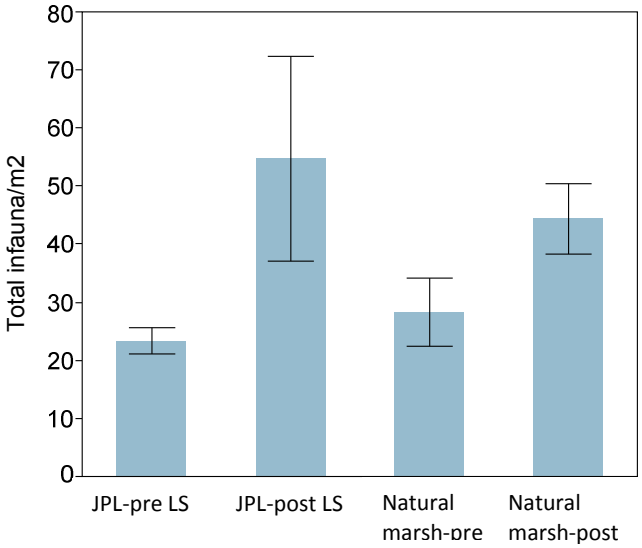


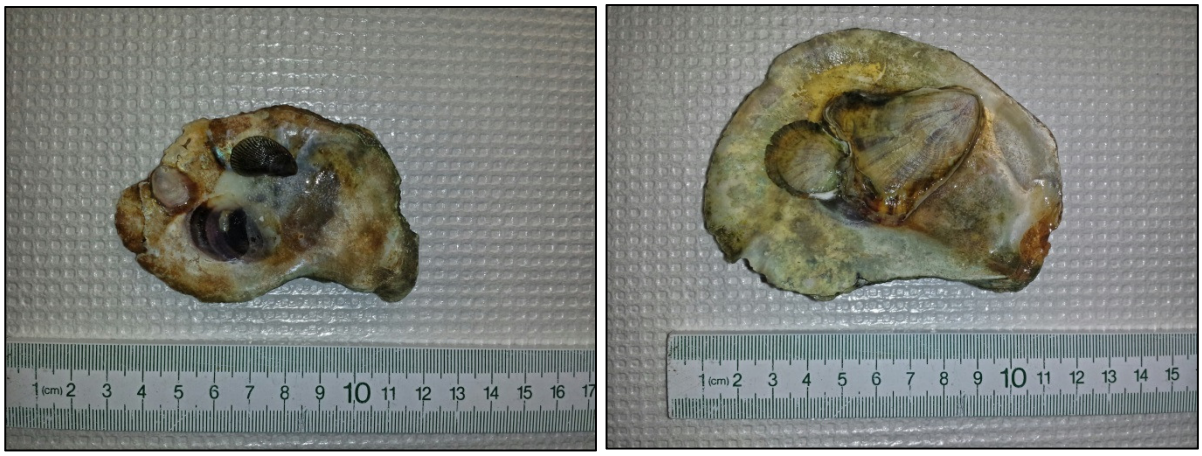
Figure 3. Average density of infauna (#/m˙) during pre and post-construction periods. Relatively high density during post-construction periods may be partly due to seasonal variability.

Oyster Sill – Settlement and Growth of Bivalves

After only 1 month, we detected increases in colonizing species diversity and average size of individual animals collected from the oyster sill bags. Oyster spat, initially found attached to oyster shells within a single bag in the first month, were observed in all 6 bags by Month 3. Within 4 months, average individual oyster surface area (shell length x width) increased from 14.5 mm^2 to 387.8 mm^2 and the number of spat was more than 100 times greater (**Figure 4**). There was also evidence of a second spat set during the late summer. Average individual ribbed mussel surface area more than tripled from 13.8 mm^2 to 54.1 mm^2, while the number of mussels increased tenfold from 8 to 95 animals. Total number of colonizing organisms rose from 129 to 1640 and the average number of species found in each bag increased from 3 to 5. There were a total of 11 species observed to be associated with the oyster sill throughout the sampling period including oysters, ribbed mussels, barnacles, naked goby *Gobiosoma bosci* eggs, limpets, shrimp, anemone, tunicates, and clams (*Tagelus plebeius*). The amount of organic matter (algae) on the shells was similar from month to month. We intend to continue monitoring settlement and growth of bivalves on the oyster sill with a final collection late summer/fall next year (2015).

'Sacrificial' oyster bag collection for species counts

Ribbed mussel recruit on oyster shell



Oyster spat and mussels on shell-September 2014

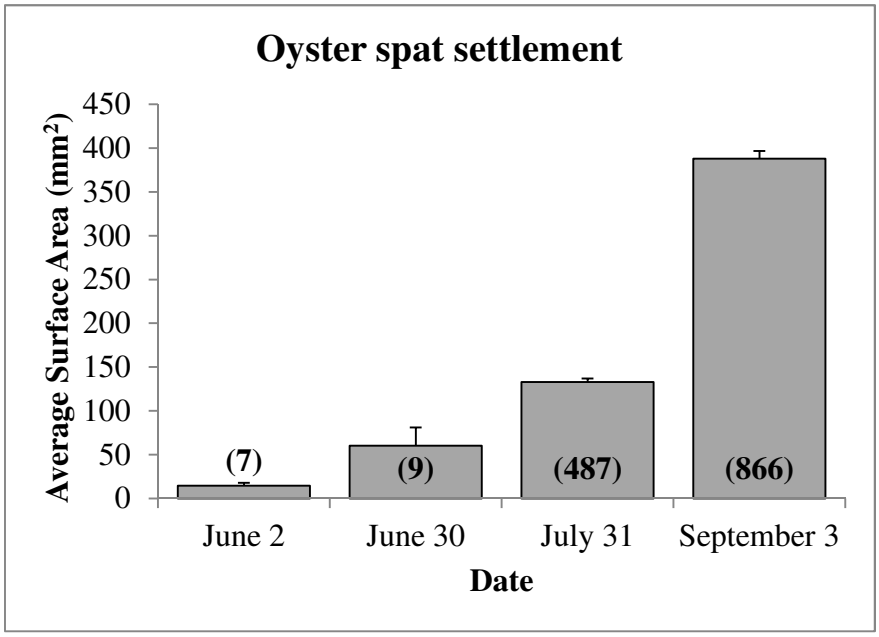


Figure 4. The number and size of oyster spat on the oyster sill increased dramatically over the course of four months. Sill placement occurred in late April 2014. Total number of spat is shown in bold.

Summary

On the basis of plant and bivalve settlement metrics, Johns Point Landing living shoreline project was a success. Within a single growing season, the created marsh has become established with plant densities similar to other previously established marsh-sill living shorelines. Densities may continue to increase over time to become similar to natural fringing marsh densities within Bryant Bay and elsewhere. After a single month, we detected use of the oyster sill by a variety of estuarine fauna including spawning fish. Oyster and mussel settlement and growth on the oyster sill continued to increase substantially over the monitoring period. Our study results suggest that the oyster sill is providing suitable habitat to a diverse assemblage that includes important Bay species.

Acknowledgements

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