Delaware Estuary Living Shoreline Initiative (DELSI): Four New Installations in 2014

Angela Padeletti*[1], Danielle Kreeger[1], Joshua Moody[1], Laura Whalen[1], Alison Rogerson[2], Andrew Howard[2];
1.Partnership for the Delaware Estuary, Wilmington DE 19801; 2. Delaware Department of Natural Resources and Environmental Control, Dover, DE 19904

Introduction

Since 2007, the Delaware Estuary Living Shoreline Initiative (DELSI) has consisted of a regional, science-based effort to design, implement, and monitor new living shoreline projects. These projects are designed to boost coastal resilience, sustain critical ecosystem services, and showcase more environmentally-friendly approaches compared with traditional shoreline hardening practices. Building on successful bio-based tactics that were previously developed with the Rutgers Haskin Shellfish Research Laboratory, in 2014 we worked with partners to coordinate the design, installation and monitoring of living shoreline projects at four new salt marsh locations (Fig. 1). By the end of 2014 the construction, Phase 1, of these projects was completed. Plans are underway to plant each project, Phase 2, beginning in early spring 2015. Each location had unique site conditions and permit constraints, and each project had slightly different goals and monitoring needs. None of the projects would have been possible without full collaboration with diverse partners, such as Delaware Department of Natural Resources and Environmental Control, Rutgers Haskin Laboratory, The Nature Conservancy of New Jersey, and the Center for the Inland Bays in Delaware, among others.

Monitoring of Living Shorlines follow monitoring/action model in which quantitative measurements of key features drive design and installation phases (Fig. 2)

Data on physical, chemical and biological conditions are being compared among sites and between controls and treatments using a Before-After-Control-Indicator statistical design, with additional context being furnished by long-term monitoring at fixed reference stations as part of the Mid-Atlantic Coastal Wetland Assessment.

Lessons being learned on these new treatments will strengthen outcomes from our earlier living shoreline projects such as at Matt's Landing in the Maurice River NJ. These various lessons are being translated into long-term maintenance costs for bio-based living shoreline designs, for which little data exist. Although the general ecological benefits of living shorelines are diverse, we also continue to find that subtle differences in local site conditions and design criteria can lead to large variation in specific ecological outcomes (e.g. water quality, fish and wildlife habitat, sedimentation rates, erosion control). Therefore the effectiveness of Living Shorlines is contingent on target goals and considerable plasticity exists in project design to meet those goals (Table 1).

For more information see *www.delawareestuary.org/living-shorelines.*

Figures 1. Map of Living Shoreline sites.

Figures 2. Process used to design, install and monitor the living shoreline projects.

Table 1. Main objective and goals of four Living Shoreline's installed in 2014.

	Main Goals					
Site	Ecosystem Uplift	Improve Infrastructure	Enhance Shellfish Communities	Water Quality Improvement	Protect Habitat	Research & Development
Mispillion, DE	x		x	x		
Lewes, DE	x				x	x
Money Island, NJ	x	x				
Inland Bays, DE	x				x	x

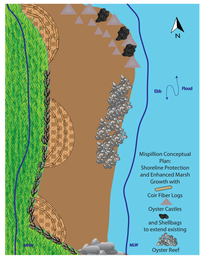
Mispillion

Site: Milford DE

Design: Hybrid design using coir materials with oyster castles and shell bags in an experimental array

Materials Used: 31 16" x 12' Coir logs, 3 Coir Mats, 1,100 oyster castles and approximately 600 shell bags

Partners: DuPont Nature Center, Delaware Department of Natural Resources, and the Slaughter Beach Fire Station



Figures 3. Conceptual Plan for Mispillion site.

Figures 4. Before installation of Mispillion, DE site.

Figures 5. After Phase 1 of installation of Mispillion, DE site.

Figures 6. The tops of Oyster Castles pyramids, January 2015. This site is a high energy site, to reduce wave energy and promote filter feeding benefits, oyster castles were installed in multiple configurations.

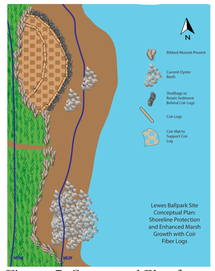
Lewes

Site: Lewes, DE

Design: A coir fiber cusp, with two tiers forming terraces

Materials Used: 19 16" x 12' Coir logs, 2 Coir Mats, and approximately 120 shell bags

Partners: Delaware Department of Natural Resources and the Delaware Historical Society



Figures 7. Conceptual Plan for Lewes, DE site.

Figures 8. Before installation of Lewes, DE site.

Figures 9. Prior to second deck installation at Lewes, DE site.

Figures 10. Restoration Coordinator, J. Moody, standing next to cured oyster shell pile. One of the lessons learned with implementing multiple living shorelines at once was the limitation of shell can be a hindrance. Not only do they provide habitat for mussels and oysters to recruit to, shell bags placed along coir logs provide protection for the logs, promoting project success.

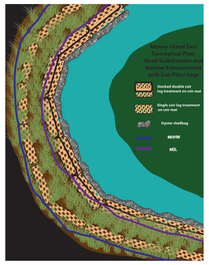
Money Island

Site: Newport, NJ

Design: Dual installation on both sides of road, with coir materials

Materials Used: 36 16" x 12' Coir logs, 3 Coir Mats, and approximately 300 shell bags

Partners: The Nature Conservancy



Figures 11. Conceptual Plan for one of the Money Island, NJ sites.

Figures 12. Before installation of East site at Money Island, NJ site.

Figures 13. After Phase 1 installation of East site at Money Island, NJ site with Phase 2 planned for 2015.

Figures 14. Oyster shell bags are placed perpendicular to two logs to create "baffels". The Money Island site creek moves swiftly into and out of the marsh as it passes the installation. Baffels slow down water as it moves over top the installation to increase sedimentation from the water column.

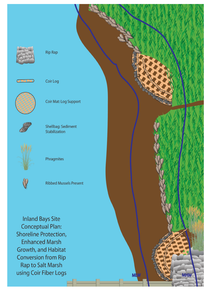
Indian River

Site: Rehoboth Beach DE

Design: Coir fiber cusps, in front of 1)natural marsh and 2)rip-rap

Materials Used: 20 16" x 12' Coir logs, 2 Coir Mats, and approximately 200 shell bags

Partners: Delaware Department of Natural Resources, Delaware Center for Inland Bays, Indian River Marina



Figures 15. Conceptual Plan for Inland Bays, DE site.

Figures 16. Before installation of Inland Bays, DE site next to rip-rap.

Figures 17. After Phase 1 installation, prior to planting of Inland Bays, DE site.

Figures 18. Wheel-barrowing sand into the site by hand. This site did not naturally trap sediments and so sand fill was acquired. Sites with low TSS like this, may require sand fill.

Next Steps

Next steps include planting all four Living Shorelines in the spring of 2015. Plantings of suitable vegetative species will target the optimal elevations to maximize growth and production, helping to stabilize the coir materials and accumulated sediments. Plant sources include purchased plugs of *Spartina alternaflora* as well as locally salvaged clumps of plants and mussels that have become fully dislodged along nearby erosion sites (Fig. 19). Salvaged material quickly maximizes sediment capture due to its ability to slow TSS-rich waters entering the treatment and has increased resilience as it is acclimated to local conditions (Fig. 20).

Figures 20. A salvaged plug from the nearby area on a coir log. Note the large established root mass around the plants embedded with mussels.

Figures 19. Planting includes plugs from nurseries (in the foreground) and plugs salvaged from the surrounding area, in the background (taller *S. alternaflora*).

Monitoring will continue after planting in spring 2015. Pre-construction data will then be compared to one year post construction. Oyster demographics and densities will continue to be monitored to assess water quality benefits (Fig. 21). For a detailed explanation of monitoring protocols see Kreeger Poster; *Scientific Monitoring Protocols to Gauge Living Shoreline Protocols.*

Figures 21. Spat on Oyster Castles (October, 2014). Monitoring includes physical, biological, chemical and other attributes. Recruitment of bivalve communities is among the biolocial attributes monitored.

PDE and it's partners are in the planning phase of a living shoreline along the Cooper River in Camden, NJ. This first freshwater installation will also include habitat for freshwater mussels. For a more detailed explanation of the Camden Living Shoreline Project see Kreeger Poster ; *Mussels, Marshes and Submerged Grasses; Hybrid Living Shoreline Concepts to Remediate Urban Tidal Freshwater Waterfronts.*

ACKNOWLEDGEMENTS: We would like to thank our funders, as well as our many partners, listed by individual project. These projects take many long hard, rainy, hot, buggy hours to instal and to monitor. Special thanks to Priscilla Cole, Kurt Cheng, LeeAnn Haaf, Jessie Bird, Pat Milillio, Jocelyn Robinson, Matt Jennette, Maggie Pletta, Moses Katkowski and all those who made these projects possible.