Seven Years In Texas: Habitat Transitions and Breakwaters - Ryan Fikes

Marsh erosion caused by shell berms and threatening a home, triggered construction of a rock breakwater in 2017, followed five years later by an extension of the breakwater. The breakwater was built at Schicke Point in Matagorda Bay, Texas. It stopped marsh erosion and was rapidly colonized by eastern oysters. Sediment accumulated behind the breakwater, supporting colonization of polychaetes while allowing marsh to expand and seagrass to establish. The breakwater survived Hurricane Harvey with its 6-foot storm surge. The breakwater and resulting habitat changes support the multiple lines of defense approach to protecting coastal ecosystems.

We have visited the reef annually to track changes in habitat and the breakwater. One trip was typically conducted during a cold front "blow out" when most of the breakwater was exposed. A second trip was usually made in the summer to map changes in the marsh edge. Collection of drone imagery enhanced our ability to see large scale changes in different habitats during the very limited time allotted to field visits.

We are learning lessons about the ability of breakwaters to protect and restore habitats and the value of "monitoring" behavior of the project over the long-term. A key question, still unresolved, is whether oysters will "grow" the breakwater as sea level rises.

Project funding was provided by the adjacent homeowner, Hasty Johnson, the U. S. Fish and Wildlife Service, and the Matagorda Bay Mitigation Trust.

Long-term sediment transport modeling supporting Deschutes Estuary Restoration – Chi Lu

The Deschutes Estuary located in Olympia, Washington, USA was drastically modified in 1951 following the construction of a dam on the river to form the Capitol Lake. The waterbody upstream of the dam includes the 260-acre lake basin. since the construction of the dam, the lake has been a valued community amenity. Today, the waterbody is closed to active public use due to a number of environmental and water quality issues, including the presence of invasive species and inadequate sediment management. Long-term management strategies and actions were needed to address the issues in the Deschutes Estuary.

One of the proposed solutions includes restoration of the estuary by removal of the dam. And one of the biggest concerns was the potential impact of increased sedimentation and maintenance dredge needs on the navigable areas downstream of the dam.

STUDY OBJECTIVE

This abstract provides an overview of a numerical modeling study conducted by Moffatt & Nichol (M&N) as part of the Deschutes Estuary Long-term Management Environmental Impact Statement (EIS) project. The study aimed to assess four project alternatives, including a Managed Lake, Estuary, Hybrid, and a No Action Alternative for the Deschutes Estuary. The study's objective was to quantitatively compare these alternatives in terms of the maximum water levels, flow velocities, upland flooding, and sediment erosion and deposition patterns within the area. This study's challenges included modeling of two distinct hydrological configurations, one with the 5th Avenue Dam in place (No Action and Managed Lake) and another without it (Estuary and Hybrid). Additionally, the study simulated time-dependent and non-linear gate operations, incorporated a long-term morphological model featuring various sediment classes, and employed different speed-up approaches for multi-year morphological simulations.

METHODOLOGY

The study utilized a three-dimensional (3D) hydrodynamic-morphologic modeling system, Delft3D, developed by Deltares. To capture density-driven estuarine circulation and enhanced flocculation associated with salinity gradients under Estuary and Hybrid alternatives, the 3D configuration of the model was used, and freshwater/saltwater mixing was incorporated.

FINDINGS

This modeling study provided quantitative comparison of the alternatives , informing the decision-making process for the long-term management of the Deschutes Estuary .

Restoring Submerged Aquatic Vegetation Habitat in the Barataria Basin Estuary: Analysis, Design, and Construction of a Nature-Based Breakwater System - Ryan Waldron

Prior to the Deepwater Horizon oil spill, healthy beds of Submerged Aquatic Vegetation (SAV) thrived along the shores of Lakes Salvador and Cataouatche in Louisiana's Barataria Basin Estuary. Activities to address spill impacts led to significant SAV loss in areas also experiencing erosion. DWH-funded restoration efforts aim to create suitable conditions for SAV re-establishment (targeted species include Vallisneria americana, Potamogeton pusillus, etc.). Reduced bed shear stress was identified as the key factor for SAV recovery. Wave attenuation was deemed the primary strategy, and phase-resolving wave modeling identified rubble mound breakwaters as the most cost-effective solution to maximize protected area while achieving target stress reductions.

A 1:2 ratio of protected area to re-vegetation area (100 acres protected for 50 acres restored) was established due to SAV's natural migration patterns within suitable habitat. Coupled hydrodynamic/wave modeling confirmed the breakwaters' effectiveness in reducing bed shear stresses below critical thresholds during non-storm conditions. The 20-year storm event exceeded the threshold in limited locations, and only temporarily.

Hurricane Ida presented unforeseen challenges. Pre-construction surveys revealed a lowered lakebed and a previously unlocated pipeline crossing the breakwater alignment. Collaborative efforts led to adjustments in breakwater design, quantities, and construction methods. This included adjusting the breakwater cross-section and evaluating geotechnical stability of additional material placement. The pipeline revising the access methodology.

This project demonstrates the successful implementation of a nature-based approach to create suitable habitat for SAV species. It also underscores the importance of post-construction monitoring and flexible adaptation strategies in the face of unexpected environmental changes.

Ecological uplift potential of green bulkheads - Taylor Beck

Bulkheads are a grey infrastructure built for erosion control in waterfront environments. The bulkhead's harsh vertical relief does not provide comparable habitat value to a natural marsh for estuarine organisms. One method to bring ecological uplift to the grey space is to install a green bulkhead in front of the bare bulkhead. The green bulkhead's design is an interpretation of a marsh organ in which PVC are installed at different heights to accommodate tidal range. The PVC are filled with sand and planted with native Spartina alterniflora. To test the method, Delaware Department of Natural Resources and Environmental Control – Delaware Coastal Programs installed a green bulkhead in Little Assawoman Bay in 2022 that has experienced varied success. Monitoring efforts include a photographic timeline, nekton seines, eDNA metabarcoding, and water quality over the growing season for three years. This presentation will discuss the ecological uplift success, adaptive management, pitfalls, and potential for green bulkheads as a bulkhead addition.

Coastal armoring and declining sediment availability along the Northeast US coast - Brian Yellen

We used satellite observations and GIS analyses to evaluate changes in the supply of suspended sediment to the littoral zone along the Northeast US coast. We used historical shoreline change observations to estimate the mass of sediment introduced to the littoral zone since the late 1800s and since 1990. We show that shoreline change has slowed in step with increased shoreline armoring, reducing littoral zone sediment inputs.

We estimated long time series of suspended sediment concentration across the Northeast US using the entire Landsat 5-9 catalog in Google Earth Engine. This included 40,000 images, with an average of 800 images for any given location across the Northeast US littoral zone to characterize trends and seasonal patterns of suspended sediment availability. Across our five sentinel sites, we observed a 20-50% decline in coastal suspended sediment concentrations. We also found persistently higher sediment concentrations during winter versus summer, consistent with winter storms providing a major source of coastal sediment during erosive events.

With increasing rates of sea level rise and declining sediment sources, there is an urgent need to identify creative solutions to likely deficits of coastal sediment. Results of our suspended sediment mapping can be used to help design adaptive coastal management practices, including providing constraints for tidal sediment flux when building living shorelines and restoring tidal flow to restricted marshes.