Evidence of Enhanced Ecosystem Functionality After Restoration of Habitats on a Highly Degraded Coastline

A statement of interest submitted to editors of Shore and Beach

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The naturally productive Mobile Bay estuary has experienced high rates of habitat loss over the last half century due to exponential growth of industrial pursuits and population expansion (1). Additionally, the conversion of saltmarsh to hardened erosion prevention structures has modified natural wave attenuation so that high energy waves, exacerbated by heavy boating and shipping traffic, have led to enhanced erosion of the coastline (2). These alterations have driven losses in shoreline ecosystem functionality, including: wave action buffering, sediment retention, organic matter deposition, and nekton habitat. An indirect effect of shoreline degradation includes the erosion driven sedimentation implicated in the loss of nearly 50% of the bay's submerged aquatic vegetation (SAV) due to declines in benthic light availability (3,4). These losses have led to a growing interest in experimentation with coastal restoration methodologies to regain some of the services once rendered by now defunct habitats.

Here, we examine two living shoreline restorations differing in design, implementation, and restoration focus to determine the ability of restored shoreline habitat to enhance ecosystem functionality. First, a marsh restoration constructed to repair a degraded marsh habitat that had become dominated by *Phragmites karka*, resulting in a monospecific shoreline with high erosion rates. Second, the use of emergent vegetation as a shoreline stabilization technique to replace concrete rubble bulkhead near a heavily trafficked boat launch. Monitoring for both restorations focused on reducing shoreline erosion rates and habitat for nekton, while the marsh restoration additionally focused on several marsh vegetation health and diversity metrics, organic matter deposition, and water quality parameters. To determine enhanced functionality, we compared measurements taken for the restored areas to those taken concomitantly in adjacent unrestored shoreline areas to serve as controls. These monitoring efforts were conducted for 1.5 years with a seasonal sampling structure.

Our monitoring of the marsh restoration found evidence for enhancement of several ecosystem services, including shoreline stability and seaward expansion of coastal marsh land, habitat for structure-dependent nekton species (of which, several are commercially and recreationally valued), higher organic detrital deposition to sediments that likely drove findings of enhanced invertebrate biomass and diversity within restored marsh sediments, high marsh vegetation diversity and emergence of natural Gulf Coast marsh zonation patterns over time, and appearance of SAV directly adjacent to the restored marsh. The living shoreline technique using emergent vegetation appeared successful as a shoreline stabilizer despite consistently heavy boating traffic in the area. Additionally, what is considered a relatively new occurrence of SAV immediately adjacent to the living shoreline restoration was discovered. However, this project experienced unexpected large-scale anthropogenic perturbation that prevented the determination of success for other functional services, yet presents a learning opportunity to encourage better communication between cooperative agencies. In conclusion, this monitoring study of the two living shoreline style restorations found indications of enhancement for multiple ecosystem services including shoreline stabilization and healthy habitat diversity. This study also provides evidence that living shorelines may present a better alternative to hardened shorelines as erosion prevention mechanisms with more ecosystem services compared to much of Mobile Bay's currently degraded shorelines.

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