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ASSESSING SHORELINE CHANGE AND VEGETATION COVER ADJACENT TO BACK-BARRIER SHORELINE STABILIZATION STRUCTURES IN GEORGIA ESTUARIES

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Abstract

Estuaries and their surrounding salt marshes are critical for the health of marine fisheries species as well as the health and protection of populated areas further inland (Cowart 2010). Salt marshes found along the shorelines of tidal creeks are important for protecting upland areas from erosion (Leonard and Reed, 2002; Moller and Spencer, 2002). Wave and tidal action along with sea level rise are the main forces that shape the variable shorelines of estuarine systems (Mattheus et al., 2010), but potential effects from anthropogenic efforts to stabilize in an attempt to mitigate erosion are largely unknown. Understanding how these shorelines and adjacent ecosystems respond to anthropogenic impacts is necessary when assessing the vulnerability of areas to sea level rise and erosion so that proper management techniques may be utilized to protect them.

Purpose

This project seeks to understand the geomorphological behavior of shorelines adjacent to shoreline stabilization structures including bulkheads, riprap structures, and living shorelines. Approximately 3,000 shoreline structures are documented along the Georgia coast (Georgia Department of Natural Resources), but there has been minimal research conducted regarding the impact of these structures on the change rates and vegetation of adjacent shorelines (Jackson et al., 2007). This project aims to evaluate the impacts of shoreline stabilization structures through analyzing shoreline change rates and vegetation cover.

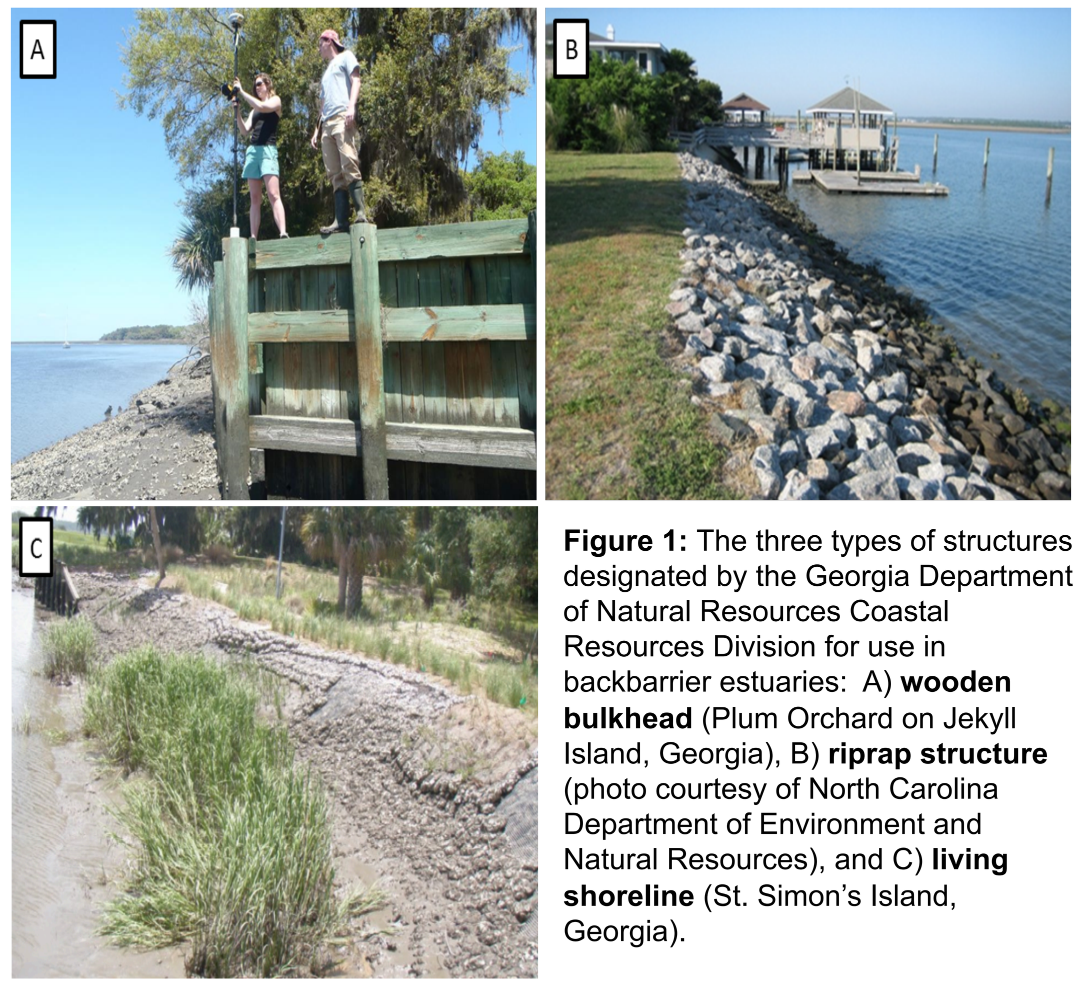

Figure 1: The three types of structures designated by the Georgia Department of Natural Resources Coastal Resources Division for use in backbarrier estuaries: A) **wooden bulkhead** (Plum Orchard on Jekyll Island, Georgia), B) **riprap structure** (photo courtesy of North Carolina Department of Environment and Natural Resources), and C) **living shoreline** (St. Simon's Island, Georgia).

Methodologies

-Shoreline Change Rate Analyses

The shoreline change rate analysis portion of this project is GIS and imagery based. Historical aerial imagery and previously digitized historical shorelines were used to determine shoreline change rates of shorelines adjacent to 12 structures permitted between 1980 and 1990. The shoreline change rates from the 1800s to 2013 were determined using the program AMBUR.

Figure 3: Progression of shoreline preparation and digitization for analysis: A) delineated shoreline stabilization structure (blue line), B) straight line between the endpoints of the structure (pink line), C) relative placement of polygons (orange rectangles) perpendicular to the structure endpoint line, D) heads-up digitization of shorelines that fall within the polygons (green line- year 1 shoreline, red line- year 2 shoreline).

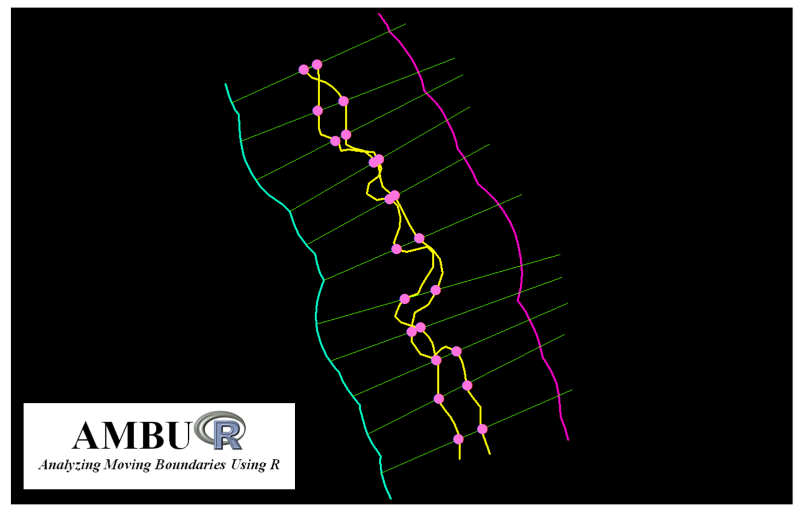

Figure 4: AMBUR uses baselines (pink and teal lines) to cast transects (green lines) that pass through the digitized shorelines (yellow lines) to create intersection points (pink points) that are used to calculate the rates of shoreline change.

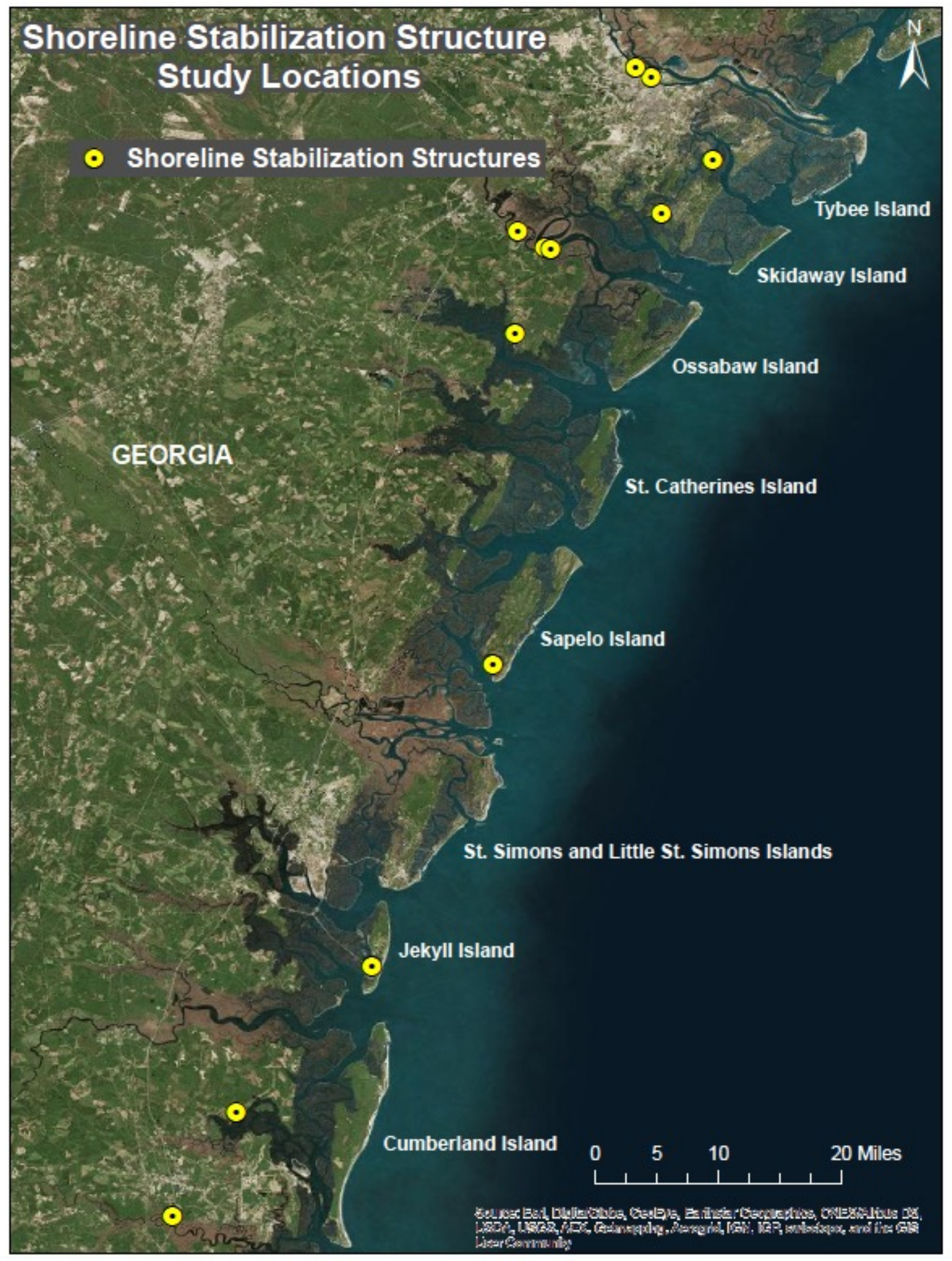

Figure 2: The spatial extent of shoreline stabilization structure study sites. The sites represented here are the sites used in the shoreline change analyses.

Structure	End Point Rate (m)
RipRap	0.254698328
RipRap	0.348786681
RipRap	-0.433921826
RipRap	-0.68439725
RipRap	-0.380405699
RipRap	-0.916431891
Bulkhead	0.036328057
Bulkhead	-0.298360276
Bulkhead	-0.115267008
Bulkhead	-0.144078706
Bulkhead	-0.115209339
Bulkhead	0.043096013
Bulkhead	-0.053009744
Bulkhead	0.082336514

Table 1: This table shows preliminary data from the shoreline change rate analyses. The "Structure" column designates the structure type and the "End Point Rate" column gives the average distance between the newest and oldest shorelines analyzed for all of the transects cast for each of the sites. Analyzing these data using a t-test shows that there is no significant difference in end point rates between the two structure types (t-test, df= 12, p-value= 0.23),

Structure	*Mean*	*Standard Deviation*
RipRap	-0.3019	0.5061
Bulkhead	-0.0705	0.1250

Table 2: This table gives the means and standard deviations for the structure end point rates in meters.

-Vegetation Analyses

Vegetation data were collected from shoreline stabilization structures permitted between 1980 and 2010. A 50m by 30m grid was created adjacent to each shoreline stabilization structure parallel to the shoreline, and at each intersection point of the grid, percent cover, stem density, and stem height of the vegetation were recorded. These data were then grouped by shoreline stabilization structure and analyzed using Kruskal-Wallis and Wilcoxan rank sum tests.

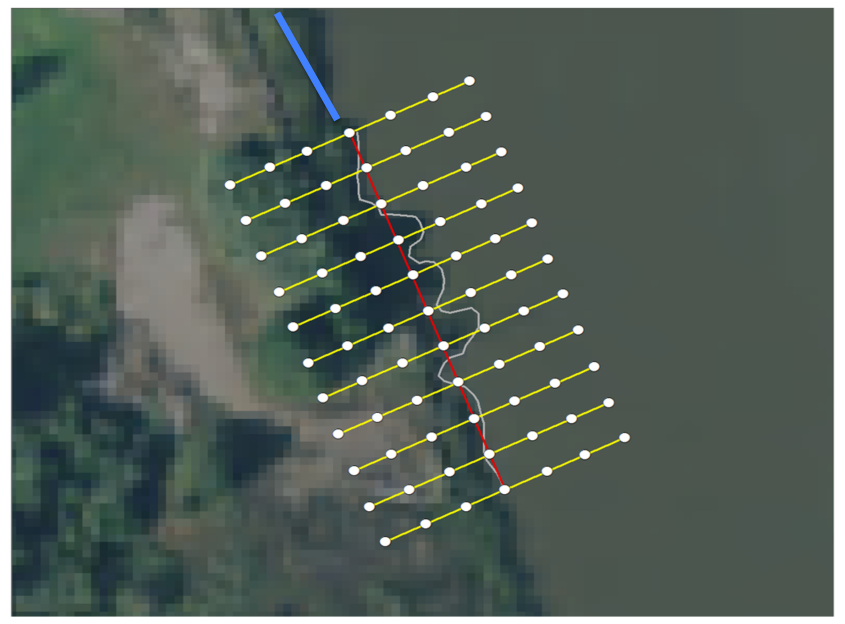

Figure 5: Vegetation sampling model: a 50 meter transect was cast parallel to the shoreline immediately adjacent to the structure (structure is blue line). This line (red) was the midpoint of the sampling grid. Transects (yellow) extended from the midline in both directions, 15 meters shoreward and 15 meters streamward. Vegetation percent cover, densities, and stem heights were recorded at 5 meter intervals along the newly constructed midline and at every 5 meters along the perpendicular transects (white points) using a 0.25^2 meter quadrat.

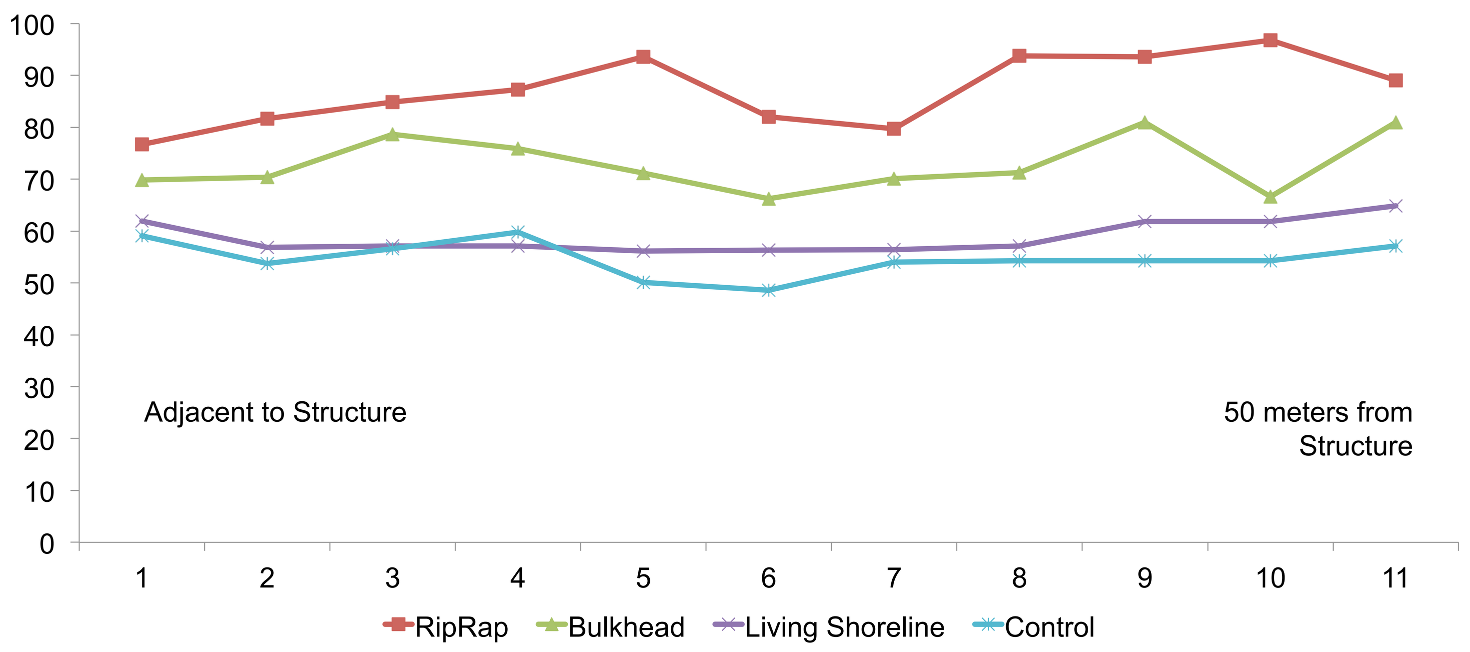

Figure 6: The preliminary results of the comparison of percent vegetation cover among the shoreline stabilization structures and control groups show that the structures (riprap, bulkhead, and living shoreline) and the control show the same general trends. However, the bulkhead and riprap groups have distributions that are significantly different from the control group (Wilcoxan rank sum p=6.092e-09 and p=2.023e-15, respectively).

Conclusion

The preliminary data from the shoreline change rate analyses show that shorelines adjacent to shoreline stabilization structures are erosional and there is no significant difference between the end point rates of bulkheads versus riprap structures (Tables 1 and 2). The preliminary vegetation percent cover analyses suggest all structure sites and control sites follow the same trends, but the vegetation percent covers of the bulkhead- and riprap-adjacent shorelines have significantly different distributions from the control shorelines (Figure 6).

This project is intended to collect baseline data on bulkhead, riprap, and living shoreline stabilization structures in order to set a framework for future study. These shoreline change rate data are of a higher resolution than has previously been calculated, and especially in the case of the living shoreline structures, these data are critical in order to monitor the health and stability of the shorelines adjacent to the structures.

Acknowledgements and Literature Cited

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