

Longterm Surface Elevation Patterns in a Jug Bay Tidal Freshwater Marsh

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Jug Bay is one of three components of the Maryland Chesapeake Bay National Estuarine Research Reserve (MD-CBNERR). Located within the Patuxent River watershed, it comprises a diversity of habitats including one of the largest freshwater tidal wetlands on the U.S. East coast. In the face of hydrological changes resulting from anthropogenic impacts and rising sea levels, the long-term persistence of coastal wetlands is dependent on the interplay of sediment accretion (both organic and inorganic), erosion, and compaction that determines soil elevation relative to local water levels. From 1999 to 2001 sediment surface elevation change was measured along the intertidal gradient characterized by three different vegetation communities in two areas of differing sediment supply (north side vs. south side of abandoned railroad bed). Unpublished results of this study raised concerns on the longterm persistence of the marsh. The elevation of the sediment surface remained stable at the low and high marshes but significantly decreased at the mid/high marshes. High energy events such as hurricanes did not seem to be an important factor in altering sediment surface elevation, whereas frequent rain storms might play a role in the delivery of sediments to the interior of the marsh. After six years, measurements resumed at the same stations. Preliminary results now show a significant difference in surface elevation change between the marshes of the north and south side of the railroad, but no significant differences among intertidal marsh zones. Surface elevation change rates ranged from -2.06 to 11.12 mm/yr over a 9-year period.

Study Site Characterization

The study was conducted in the Glebe tidal freshwater marsh of Jug Bay, Patuxent River. This marsh was divided in 1895 by a railroad bed, that although abandoned in 1935 still persists as an structural/hydrological barrier (Figure 1).

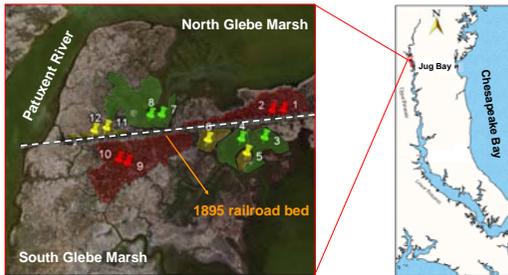


Figure 1. Aerial view of Glebe tidal freshwater marsh. Location of Surface Elevation Tables (SET) in the North and South side of the railroad bed are indicated.

	North Marsh	South Marsh
High intertidal	SET 1-2	SET 9-10
Mid-high intertidal	SET 11-12	SET 5-6
Low intertidal	SET 7-8	SET 3-4

Table 1. General characterization of the different marsh zones in the Glebe tidal freshwater marsh at Jug Bay.

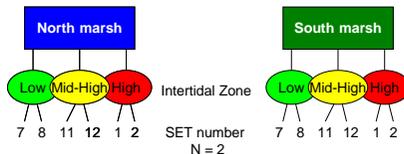
Marsh Intertidal Zone	Dominant Vegetation	Water Depth (cm)	Duration Flooding (hrs*)
Low	<i>Nuphar advena</i> (spatter dock) <i>Peltandra virginica</i> (arrow-arum) <i>Zizania aquatica</i> (wild rice)	30 - 65	8 - 9
Mid-High	Highly diverse zone <i>Thypha angustifolia</i> (cattail)-dominant <i>Sagittaria latifolia</i> (arrow head) <i>Bidens leavis</i> (bur marigold) <i>Impatiens capensis</i> (jewelweed)	5 - 20	2 - 4
High	Scrub shrub type wetland i.e. <i>Alnus serrulata</i> (alder)		1 - 2

* Duration of flooding per each tidal cycle

Study Objectives – Experimental Design

- Assess the longterm persistence of the Jug Bay Glebe tidal freshwater marsh under current rates of sea level rise.
- Determine the impact of the railroad bed dividing the Glebe tidal freshwater marsh on surface elevation patterns.

- Assess differences in surface elevation change among the different marsh intertidal zones.



Patterns in Surface Elevation Change

Temporal and spatial patterns in surface elevation were studied at all study sites for an initial period of three years (July 1999 to July 2001) using Surface Elevation Tables (SETs; Figure 2). SETs were re-measured in June 2007, February 2008, and July 2008. A record of approximately nine years was analyzed on this study.

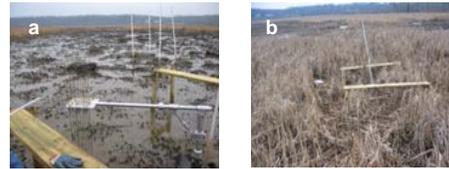
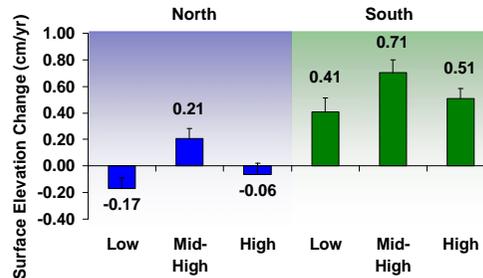


Figure 2. Surface elevation stations at a low intertidal zone (a) and a mid-high intertidal zone (b) in the south Glebe marsh, Jug Bay.

Table 2. ANOVA results of main effects. Variable = surface elevation change (cm/yr).

Main Effects	F Value	P value
Marsh zone	0.80	0.4918
Railroad side	5.98	0.0501
Zone* Railroad side	0.01	0.9874

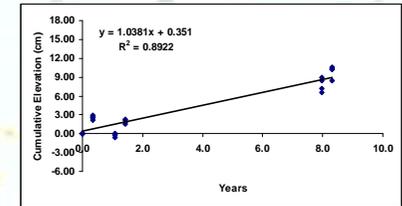


Result

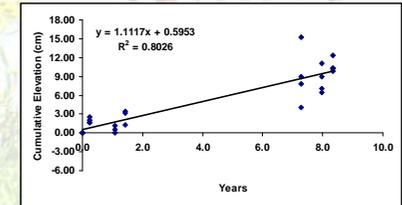
- Significant differences in surface elevation were found between the marshes of the north and south side of the railroad.
- Surface elevation did not change significantly among marsh intertidal zones.
- The interaction between marsh zone and railroad side was not significant.

Surface Elevation Change Trends

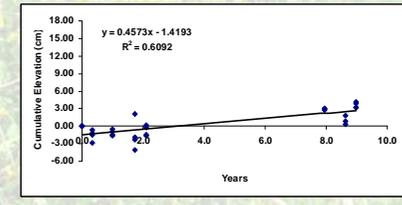
Linear regressions of cumulative surface elevation data for each SET plot were run to identify significant trends.



SET 9
High marsh



SET 6
Mid-high marsh



SET 4
Low marsh

Result

Marsh areas located in the south side of the railroad surrounding SET numbers 9, 6, and 4 showed a positive trend on surface elevation.

Conclusion

Given that rates of sea level rise in the Chesapeake Bay range from 2.7 to 4.5 mm/yr (Larsen 1998), this study suggests that the area of Glebe Marsh (Jug Bay) to the north of the railroad bed will not be able to keep pace with local sea level rise. The southern side of the marsh appears sustainable in the face of current rates.

Next Step

Further research will investigate the causes of observed sedimentation patterns including sediment fluxes among the different vegetation communities and between the north and south areas of Glebe Marsh.

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