QUANTIFYING THE INFLUENCE OF INLET MIGRATION ON TIDAL MARSH SYSTEM HEALTH

John Ramsey, Applied Coastal Research and Engineering, Inc., jramsey@appliedcoastal.com
Sean Kelley, Applied Coastal Research and Engineering, Inc., skelley@appliedcoastal.com
Brian Howes, University of Massachusetts at Dartmouth, bhowes@umassd.edu

BACKGROUND

It is well understood that inlets to tidal estuaries and salt marsh systems exist as a result of the balance between the littoral drift and tidal flushing. For natural inlet systems, a period of barrier spit elongation is followed by episodic breaching of the barrier beach, resulting in a more hydraulically efficient inlet channel. This cyclical process of barrier elongation and breaching often occurs over a period of years or decades, with significant alterations to the tide range and the associated tidal exchange (tidal flushing). These hydraulic changes often impact estuarine water quality and salt marsh plant community health over the same time periods. Quantification of changes to physical hydrodynamic processes as well as changes to the salt marsh plant community can be utilized effectively to determine the influence of inlet migration on marsh system health.

Along the northeast coast of the United States, healthy salt marsh communities are typically dominated by *Spartina alterniflora*, regardless of tide range. In southeastern Massachusetts, offshore semi-diurnal ocean tides vary significantly among the regional salt marsh systems, with mean tide ranges between 0.4 meters and 3.5 meters. Due to the wide range of tidal conditions within a relatively small geographic region with similar offshore salinity, the marsh system evaluation tool can be developed for a full range of physical conditions. In addition, well documented cases of impacts associated with spit elongation and episodic barrier breaching exist for the area: Allens Pond Inlet (FitzGerald, 1993), Chatham Harbor (Geise, 1988), and Popponessett Bay (Aubrey and Gaines, 1982).

METHODOLOGY

To quantify the influence of inlet position on physical parameters governing marsh health, a two-dimensional hydrodynamic model of the Ellisville Harbor system for both pre- and post-breach conditions was developed. Implementation of the modeling approach allowed optimization of inlet position to ensure that future barrier beach breaching occurs prior to the barrier beach elongation negatively impacting marsh health. The calibrated hydrodynamic model allowed for accurate determination of physical parameters governing marsh plain health including tidal elevation and hydroperiod. When combined with marsh plain recovery data, the hydrodynamic modeling information was utilized to develop a predictive tool to relate inlet position to overall *Spartina alterniflora* marsh system health.

RESULTS

Mechanical breaching of a barrier beach at Ellisville Harbor, Massachusetts provided the basis for assessing the impacts of barrier beach migration on salt marsh health. Barrier elongation had made the inlet channel hydraulically inefficient. By mechanically excavating a new channel approximately 400 meters north of the pre-breach channel, the tide range within the marsh system more than doubled (Figure 1). Following the inlet relocation project, marsh recovery has been documented within the historic marsh area due to the larger tide range (primarily a reduction in low tide elevations and a reduction in the hydroperiod across the marsh plain). Although an increased tide range has been shown to improve the overall potential habitat for *Spartina alterniflora*, the extent of recovery is strongly dependent on the local topographic and bathymetric conditions relative to the tide range.

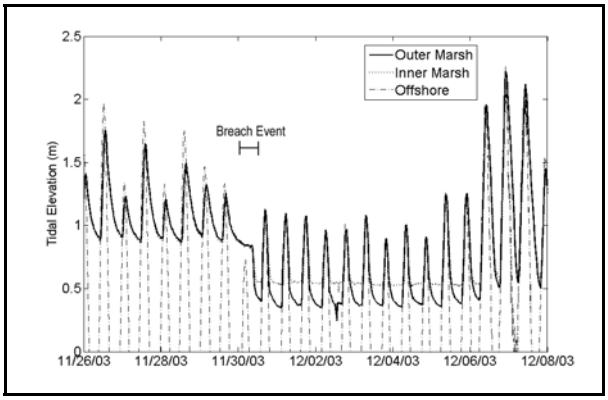

Figure 1. Marsh tidal excursion before and after breaching the new inlet at Ellisville Harbor.

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