Salt Marsh Elevation

Background

Tidal salt marshes are considered critical coastal resources at Cape Cod National Seashore (CACO) and throughout the northeast coastal parks. CACO is currently implementing several long-term monitoring programs within these ecosystems, including sediment elevation. Roman *et al.* (2001) recognized that the long-term sustainability of these ecosystems is threatened by predicted acceleration in the rate of sea-level rise. If the marshes cannot accrete sediment at a similar rate as sea level rise, the plants will gradually drown and die. Eventually the marsh will convert to subtidal shallow open water habitat through soil subsidence and erosion. This is why it is critical to obtain high-resolution measures of soil elevation change relative to sea level rise to determine marsh vulnerability to submergence (Cahoon, *et al.*, 2006). Thus, understanding the relationship between salt marsh accretion, elevation change, accelerating sea level rise, and human-induced alterations of the estuary and watershed is critical to determining long term sustainability of salt marshes at CACO and other coastal parks.

Figure 1. A typical permanent station on the marsh surface at Nauset Marsh with the SET.

Status and Trends

Salt marsh integrity and the ability of salt marshes to build vertically are impacted by human activities, such as dikes or other tidal restrictions, which alter natural sediment transport patterns and contribute to loss of salt marsh habitat. Currently CACO is monitoring sediment elevation changes at 22 sites in three different marsh systems: Hatches Harbor, Herring River and Nauset Marsh. Nauset Marsh has never been subject to tidal restrictions and is considered a reference system. The tidal restriction at Hatches Harbor was remediated in 1999 and the Herring River tidal restoration is in the planning stages. Surface elevation change is monitored with the surface elevation table (SET) and vertical accretion is measured using artificial soil marker horizons (Figures 1 and 2).

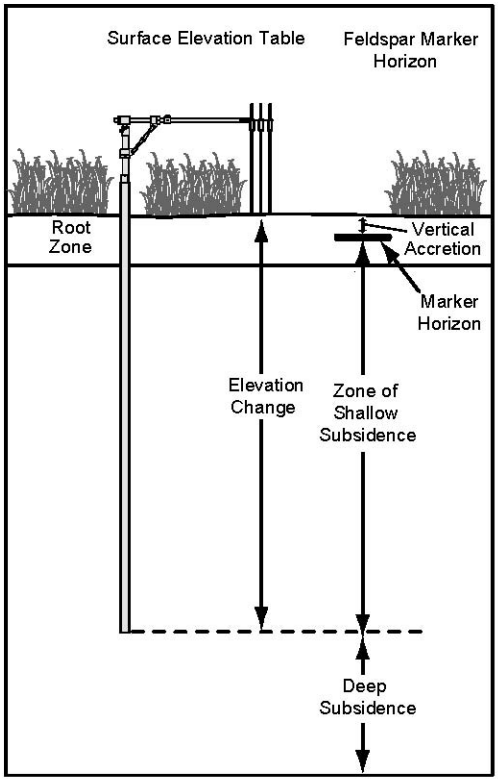

Figure 2. A diagram illustrating a typical SET and feldspar marker horizon at a permanent station. When used simultaneously, the SET and Marker Horizon techniques can provide information on below ground processes that influence elevation change.

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At Nauset Marsh, the surface processes are resulting in a 3.89 mm/year accretion rate which exceeds the regional sea level rise rate of 2.6 mm/yr (Figure 3). These data indicate that Nauset Marsh is capable of maintaining its sedimentary budget under the prevailing conditions of the last decade. At Hatches Harbor and the Herring River, sediment elevation and accumulation rates are highly variable and more difficult to interpret because these systems are respectively still recovering or currently under the influence of tidal restrictions.

Management Implications

Precise measures of marsh elevation are necessary to determine rates of change, particularly relative to sea level rise, and to gain an understanding of the processes responsible for elevation changes. The trajectory of salt marsh surface elevation change is a critical variable for understanding salt marsh stability in both the short and long-term especially as sea level rise and other anthropogenic stresses accelerate. Using data collected with the SET-marker horizon approach, CACO park managers can determine if surface elevation is keeping pace with sea-level rise and whether they should manage surface or subsurface processes of sediment and organic matter accumulation in order to maintain surface elevation in both natural and restored marshes. For example, at Gateway National Recreation Area, the Jamaica Bay salt marsh is disappearing rapidly. Efforts to halt the marsh decline thus far have included spraying thin layers of sediment onto the marsh surface as well as adding sediment backfill to halt further erosion. CACO has not experienced drastic surface loss, but our long term monitoring program will allow park scientists to quickly respond to changes in marsh elevation and accretion rates.

An additional benefit derived from monitoring salt marsh elevation trajectories is that they are useful to interpreting any observed long-term changes in salt marsh vegetation and associated fauna (Cahoon *et al.*, 2006).

For example, many salt marsh plants are sensitive to the duration of salt water inundation which is directly related to their elevation. Changes in elevation and sediment accumulation that are noted within CACO's three monitoring sites will help park scientists understand or predict changes in the distribution of key salt marsh plant species.

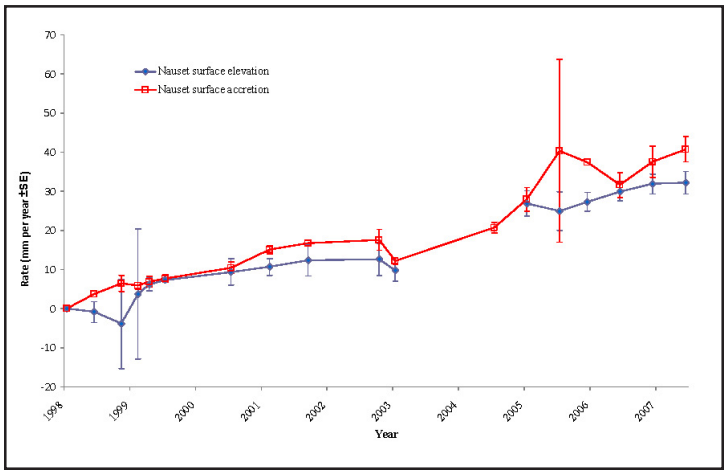

Figure 3. Surface elevation and accretion rates at Nauset Marsh from 1998 to 2007. Both elevation and accretion are 3.89 mm/yr, indicating that this site has been able to keep pace with the regional rate of sea level rise (~2.6 mm/yr). Data provided by Mary Jane James-Pirri, University of Rhode Island, Graduate School of Oceanography.

References Cited

Roman, C. T., James-Pirri, M-J., and Heltsche, J. F. 2001. Monitoring salt marsh vegetation: a protocol for the Long-term Coastal Ecosystem Monitoring Program at Cape Cod National Seashore. Final Report to the Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore, Wellfleet, MA 02667, 47 pp.

Cahoon, D. R., Lynch, J.C., and Hensel, P.F. 2006. Monitoring salt marsh elevation: a protocol for the Long-term Coastal Ecosystem Monitoring Program at Cape Cod National Seashore. Final Protocol to the Long-term Coastal Ecosystem Monitoring Program, Cape Cod National Seashore, Wellfleet, MA 02667, 104 pp.

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