National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
Office of Education and Outreach

PARKScience
Integrating Research and Resource Management in the National Parks
ISSN 1090-9966

Volume 26, Number 2, Fall 2009

Published: 28 October 2009 (online) • 8 December 2009 (in print) • http://www.nature.nps.gov/ParkScience/index.cfm?ArticleID=319&Page=1

In Focus

Sea-level rise, climate change, and salt-marsh development processes at Fire Island

By Betsie Blumberg

By Betsie Blumberg

NORTH ATLANTIC COAST Cooperative Ecosystem Studies Unit (CESU) research partners have been addressing complex issues at coastal national park units for more than a decade. One of these projects, undertaken in partnership with scientists and graduate students from the University of Rhode Island and the U.S. Geological Survey focused on the salt marshes at Fire Island National Seashore. The project's objectives were to quantify marsh elevation change in relation to recent rates of sea-level rise. Under a regime of accelerated sea-level rise there is concern that marshes could become submerged, perhaps changing from vegetated meadows to mudflats and open water. It is important to understand the processes that maintain marshes.

Fire Island is a barrier island along the south shore of Long Island, New York. Its bay shoreline is salt marsh. When bay tides flood the marsh, sediment can accumulate, raising the surface elevation of the marsh, while buildup of marsh peat also contributes to elevation increase. At the same time, however, sediment is compacting, organic matter is decomposing, and erosion can carry away surface material, causing subsidence or elevation loss. Subsidence occurs naturally, but it can threaten the survival of the marsh if it progresses more quickly than accretion or sea-level rise.

"Under a regime of accelerated sea-level rise there is concern that marshes could become submerged, perhaps changing from vegetated meadows to mudflats and open water."

Monitoring of three marsh areas began in 2002 and continues for the long term. To determine the status of the marsh elevation, both surface elevation and vertical accretion were measured (fig. 1). Surface elevation was measured by installing a vertical benchmark pipe through the peat and into the underlying sediment, to provide a constant reference elevation. A surface elevation table (SET) was then attached to the benchmark pipe and pins were lowered to the marsh surface (fig. 2).

Repeated pin measurements, twice a year, recorded changes in marsh surface elevation relative to the benchmark elevation. Vertical accretion or accumulation of material on the marsh surface was measured using small feldspar marker horizon plots, circles of feldspar spread on the surface. When cores were taken periodically from the plots, the feldspar marker clearly showed the level marked at the start of the study, and accretion was indicated by the depth of material above the marker (fig. 3).

At each site, the data indicated that vertical accretion was greater than marsh surface elevation. Although sediment accumulated on the marsh surface, measurement of the marsh surface elevation indicated that the marsh was subsiding. Furthermore, compared with local measurements of sea-level rise, the marsh surface levels were not keeping pace with sea-level rise. The hypothesis that may explain this subsi¬dence is that as the marsh becomes wetter or less well drained, the marsh vegetation produces fewer of the roots and rhizomes that comprise the peat. Decomposition and subsidence of belowground peat appear to be outpacing the deposition of sediment on the marsh surface. More sediment delivered to the surface would balance the process.

The elevation deficit at Fire Island was small, but if it continues, Fire Island marshes are likely to become wetter; the high marsh grass species, *Spartina patens*, will be replaced by the dominant *Spartina alterniflora* and open water habitat may increase. Salt marshes associated with barrier islands often receive pulses of sediment during storms, often associated with overwash and inlet processes, but it was noted that no major storms occurred during the six-year monitoring period. A sediment pulse could relieve the elevation deficit.

Monitoring continues. The longer the duration of monitoring, the easier it is to identify trends. Findings to date suggest that long-term maintenance of barrier island salt marshes is tightly coupled with inlet and overwash processes. Further, as sea level rises, marshes often grow vertically, but also can encroach on upland areas, assuming that the landscape adjacent to the marsh is free of impediments to this landward migration (e.g., bulkheads). Dr. Charles Roman, research coordinator for the North Atlantic Coast CESU, reports that this technology is now being applied at Cape Cod and Assateague Island national seashores and Gateway National Recreation Area to determine the relationship between sea-level rise and salt-marsh elevation. Chief of Resource Management at Fire Island Michael Bilecki says that this project has made the north side of the island, the bay side, a priority. “Before, the concern was beach erosion on the ocean side. Now we see that there are some big issues on the bay side and we are understanding relationships between barrier island processes and bayside marshes.”

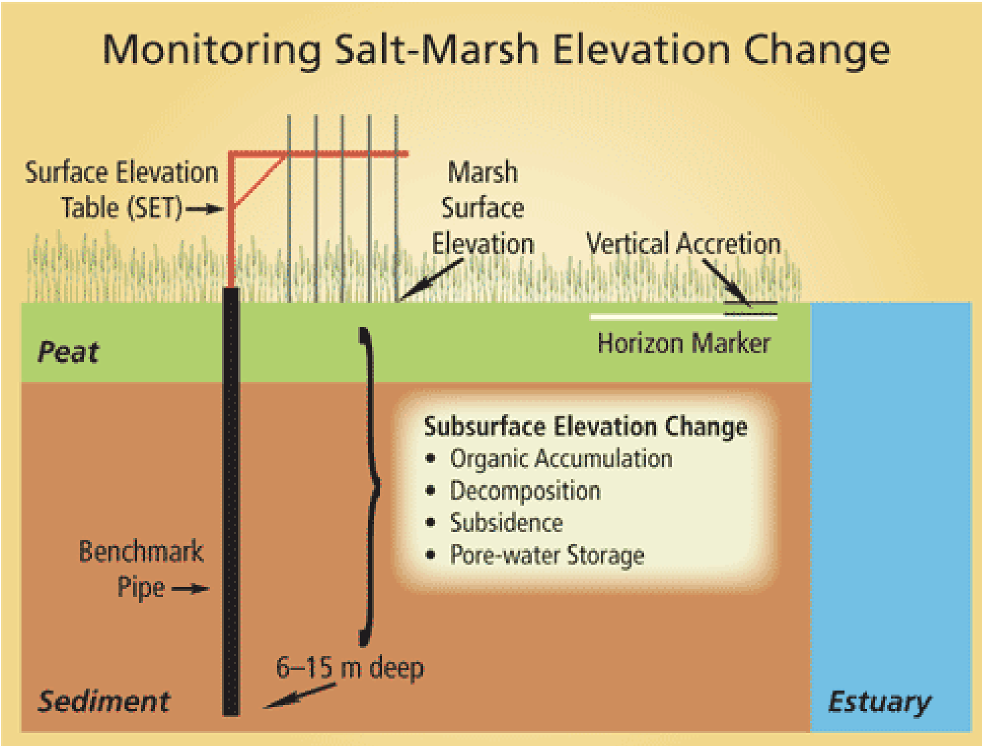
Final report

Roman, C., J. W. King, D. R. Cahoon, J. C. Lynch, and P. G. Appley. 2007. Evaluation of marsh development processes at Fire Island National Seashore (New York): Recent and historic perspectives. Technical Report NPS/NER/NRTR–2007/089. National Park Service, Northeast Region, Boston, Massachusetts. Accessed 2 June 2009 from http://www.nps.gov/nero/science/FINAL/F
http://www.nps.gov/nero/science/FINAL/FIIS_marsh/
FIIS_marsh_sealevel_final_July07_v2.pdf.

—Contact the author.

NPS photo

Figure 1. Investigators examine measuring pins in the rod-type surface elevation table to discern changes in overall marsh elevation. A third scientist prepares to freeze a marsh core sample using liquid nitrogen.



SPARTINA ALTERNIFLORA SYMBOLS COURTESY OF THE INTEGRATION AND APPLICATION NETWORK (IAN.UMCES.EDU/SYMBOLS/), UNIVERSITY OF MARYLAND CENTER FOR ENVIRONMENTAL SCIENCE

Figure 2. This schematic shows the surface elevation table and feldspar horizon marker used in the study to monitor changes in the elevation of the salt marsh at Fire Island relative to changes in sea level.

NPS Photo

Figure 3. This cryo-core sample of the marsh surface horizon shows the white feldspar marker and sediment that has accumulated above it, indicating accretion of soil.

Park Science, Volume 26, Number 2, Fall 2009, ISSN 1090-9966
National Park Service, U.S. Department of the Interior
Natural Resource Program Center, Office of Education and Outreach
Lakewood, Colorado