Elevation Changes Associated with Various Salt Marsh Plant Communities

Rachael Dye, Coastal Geologist, Geoscientist in the Park, GeoCorps America

Mark Adams, GIS Specialist, Cape Cod National Seashore, National Park Service

Jane Barnes, Geoscientist in the Park, GeoCorps America

Stephen Smith, Plant Ecologist, Cape Cod National Seashore, National Park Service

Megan Tyrell, Research and Monitoring Coordinator, Cape Cod National Seashore, National Park Service

Photo Credit: Anne Ribereau-Gayon

Making note of crab burrows, soil sample locations and vegetation type.

Nikon DTM 550 Total Station used for surveying the marsh

Using the total station to record the survey points and the vegetation type at each point.

Salt marshes are important habitat for plants and animals.

Photo Credit: Anne Ribereau-Gayon

Placing flags as guides for survey lines.

Abstract

Denudation of salt marsh vegetation (salt marsh dieback) on Cape Cod, MA is driven by herbivory of a native, nocturnal crab species, *Sesarma reticulatum*. Large areas of bare sediments as well as rapid shifts in the distribution and abundance of salt marsh plants are occurring at the mouth of the Herring River in Wellfleet, where high densities of these crabs occur. We conducted ground-based elevation surveys in 2011 and 2012 to assess annual change at this site. In addition, we compared results with a 2011 LiDAR survey. Very large differences between the LiDAR and ground based elevation surveys were observed, which was likely due to the inability of the airborne LiDAR to penetrate the vegetation canopy. Where the vegetation canopy has been lost to herbivory driven dieback, airborne LiDAR may be able to produce relatively accurate elevation data. Comparison of the two ground based elevation surveys indicates that elevation loss is detectable using highly accurate survey methods and that these losses occur in sparsely vegetated or bare sections of the marsh. Shifts in plant distributions and variable sediment accumulation rates associated with these communities will synergistically lead to continued rapid change in the physical and biological characteristics of this site.

Photo Credit: Tyler Coverdale

Sesarma reticulatum, the purple marsh crab, at the mouth of a burrow.

A large area of salt marsh dieback in the study area at the mouth of the Herring River, Cape Cod, Massachusetts.

Comparison of LIDAR to Total Station Surveys

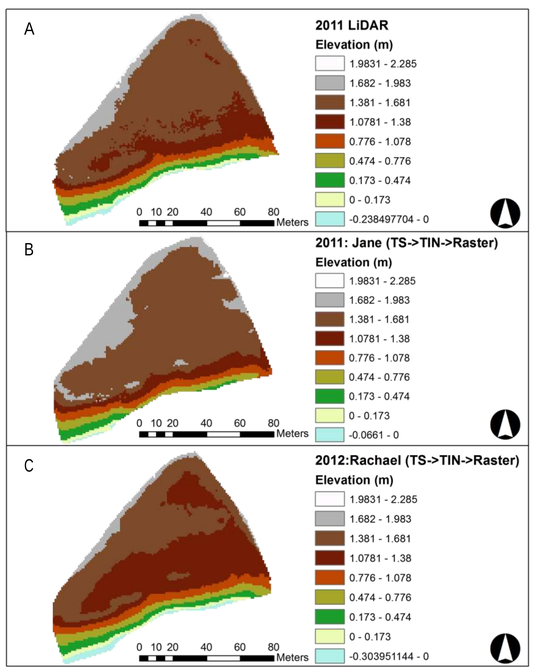


Figure A, B, and C show three different surveys, a LIDAR survey conducted in early spring 2011, a total station survey conducted in late summer 2011, and a total station survey conducted in mid summer 2012, respectively. The most notable differences between the three surveys are the presence or absence of the low area at the northern extent of the marsh, and the presence or absence of the higher berm along the southwestern seaward edge of the marsh.

Vegetation Map

To map the vegetation in the salt marsh, a total station was used to measure and record the coordinates of each survey point. At each point was coded with the species that were present. Using ArcView, I went through the steps shown in the flow chart below to create the map below, which shows the extent of each plant species and the dieback areas.

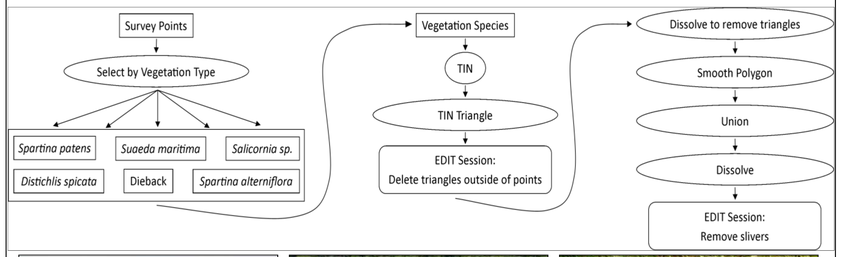
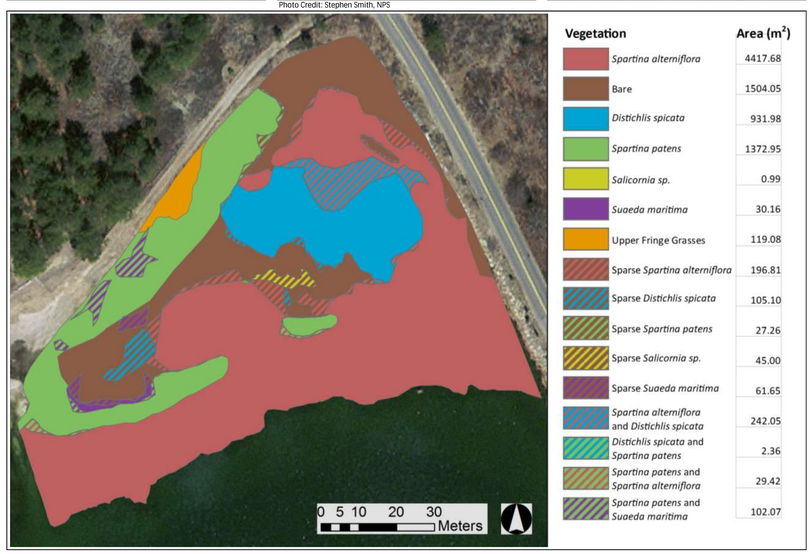


Photo Credit: Stephen Smith, NPS



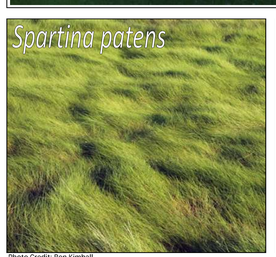
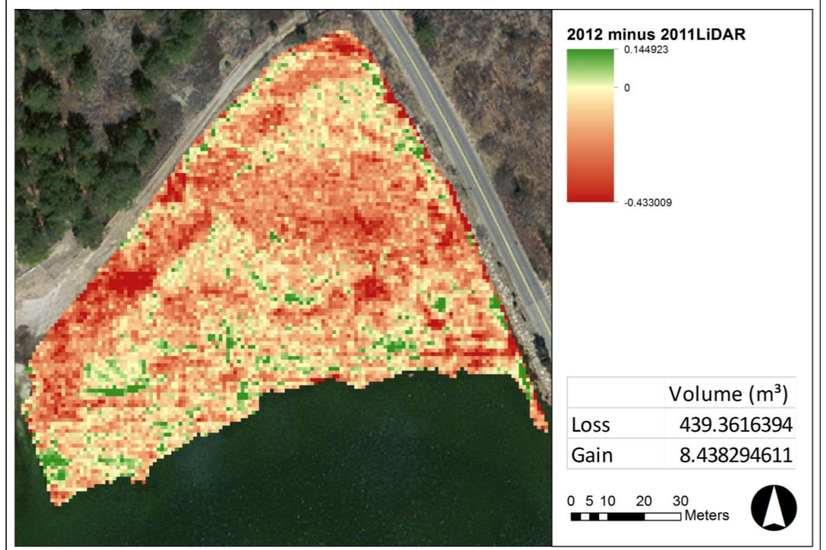


Photo Credit: Ben Kimball

Elevation Loss



By comparing the 2011 LIDAR and the 2012 elevation survey, I calculated there has been 439m^3 of elevation loss. This is not realistic and reflects the ability of ground based elevation surveys to detect the bare earth marsh surface while LiDAR returns are unable to penetrate the persistent vegetation canopy. Nevertheless, rapid erosion is likely occurring as reflected in the differences between the 2011 and 2012 ground based surveys.

Conclusions

Elevation Survey:

A consistent method of surveying with accurate measures of error is important when comparing surveys in salt marshes. Accretion and erosion amounts over the course of one year are small enough that a large error in the vertical measurement will drown out actual changes in elevation. As demonstrated in this project, airborne based LIDAR produces inflated elevation values in salt marshes with a thick canopy of vegetation. This overestimation of ground surface elevation can lead managers into a false sense of security regarding the vulnerability of salt marshes to sea level rise and other climate change associated threats to marsh integrity. We recommend extensive ground based elevation surveys to ground truth LIDAR elevation data, or consideration of other methods to assess salt marsh elevation changes.

Vegetation Survey:

Mapping the locations of different salt marsh vegetation species was very successful. The method of making the map outlined in the flowchart can be duplicated with future survey points. We expect to see the low marsh species, especially *Spartina alterniflora,* to expand into new areas as they erode and a continued decrease of high marsh species, such as *Spartina patens*.

Acknowledgements

National Park Service: North Atlantic Coastal Lab

Sophia Fox, Aquatic Ecologist

Kelly Medeiros, Hydrological Technician

Special thanks to the seasonal staff who helped with the surveying:

Agnes Mittermayr

Casey DeLay

Sam Porter

Scott Buchanan

Citations

Cape Cod National Seashore, National Park Service. *Characteristics of salt marsh dieback on Cape Cod.* Web. 10 May. 2013

Weldy, Troy, David Werier, and Andrew Nelson. 2013 New York Flora Atlas. New York Flora Association, Albany, New York.

THE GEOLOGICAL SOCIETY OF AMERICA®