USING GEOGRAPHIC INFORMATION, GLOBAL POSITIONING & LIGHT DETECTION AND RANGING SYSTEMS TO ASSESS SALT MARSH CHANGE ALONG THE CONNECICUT SHORE

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Martin Johnson Heade - Salt Marsh at Southport, Connecticut, about 1862-63

OBJECTIVES:

Salt marsh systems in Long Island Sound, and globally, have experienced a suite of physical and biological changes over the past century. Some have become much more prevalent over the last quarter-century, including replacement of natural vegetation by the reed *Phragmites australis*, erosion and vegetation changes that may be associated with sea level rise, and sudden wetland dieback (Figure 1). The research we are conducting seeks to a) quantify the extent of change in selected salt marshes along the Connecticut coast that may be associated with sea level rise and sudden wetland die back and assess factors that may be contributing to such changes, b) develop and test GIS models that predict the susceptibility of marsh systems to such changes, and c) assess ecological consequences due to habitat conversion.

RESEARCH BEING CONDUCTED :

We are working in several marsh systems along the Connecticut coast, including marshes in Guilford, Branford and New Haven, using a combination of geospatial technologies including geographic information systems (GIS) global positioning systems (GPS) and light detection and ranging (LIDAR) in order to assess marsh changes. These are being supplemented by ecological field surveys and analyses. Using these approaches we are quantifying a set of metrics related to habitat changes (e.g. location of low marsh / seaward edge, incidence of die back patches, degree of marsh slumping, topographic heterogeneity) and overall characteristics (e.g. marsh size, creek density, surrounding land use and geomorphology, plant patch structure).

Marshes are being initially analyzed using high resolution digital imagery that was collected in 2004 for the UCONN GeoSpatial Technology Program. This work is being done using GIS. Both natural color and infrared images are used to quantify habitat change metrics. Data are also be collected on surrounding land use and geomorphology, and the presence of structures and conditions that potentially constrain water movement and spreading over marsh systems, contributing to potential "coastal squeeze" (Figure2).

Fig. 1. Sudden wetland die back and erosion at the Banca marsh in the Stony Creek section of Branford, CT.

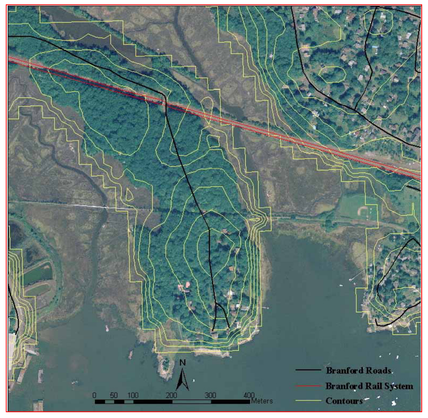


Fig. 2. Assessment of elevations and other features surrounding marshes in the Stony Creek section of Branford, CT to assess coastal squeeze.

Fig. 3. GPS mapping

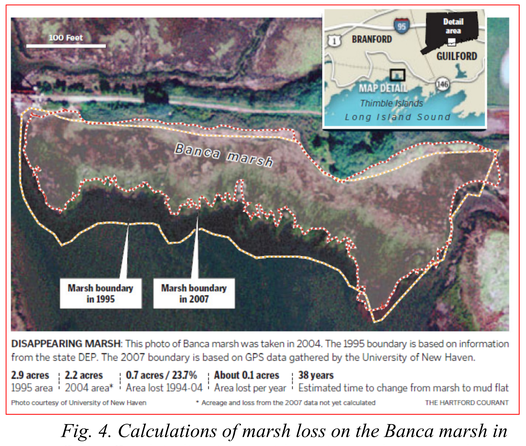


Fig. 4. Calculations of marsh loss on the Banca marsh in Stony Creek indicating rapid erosion at the seaward edge.

TRACKING MARSH LOSS:

Using historical aerial photographs and current mapping technologies we are measuring the rates and patterns of marsh loss. Using GPS we are mapping the seaward edge of marshes (Fig 3.), entering this information into a GIS and then calculating rates of marsh loss relative to historical and current data (Figure 4).

We are also using LIDAR to develop elevation models that provide a measure of variability in marsh topography (Figure 5). LIDAR uses optical sensors that generate energy using lasers. The time interval between when the laser pulse is generated and received back at the antenna in an airplane after reflecting from a target on the ground is recorded. With precise knowledge of the aircraft position computed using GPS, topography can then be inferred very accurately. The LIDAR data we are using was obtained in 2004 by the UCONN Geospatial Technology Program. Marshes undergoing rapid erosion show highly variable topography throughout the marsh and analysis of the LIDAR data allows us to quantify and track this variability to determine additional measures of marsh loss rates and, in addition to the other types of data being collected (Figure 6), to eventually be able to screen marshes and predict their susceptibility to the types of changes described.

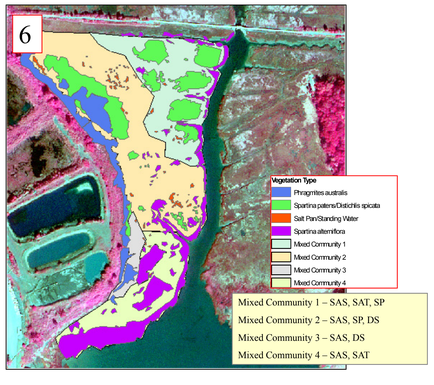
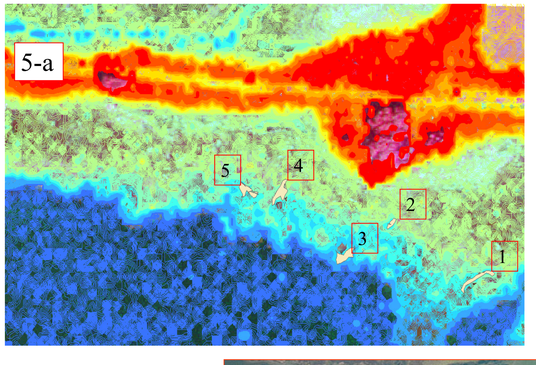
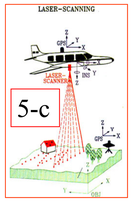


Fig. 6. Interpretation of vegetation distribution based on image data and field data collection





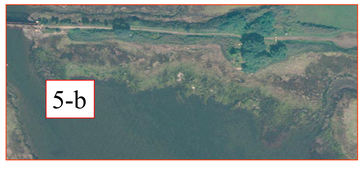


Fig. 5. a) Topography of the Banca marsh in Stony Creek based on LIDAR data. Dark blue areas indicate mudflat areas underwater or exposed at low tide, light blue, blue-green and yellow-green areas indicate lower elevations (depressions) on the marsh. Red and bright yellow indicate higher plants and trees. Numbered beige-colored areas are marsh features (pools) that are being tracked using GPS to assess short term erosion rates. Insets show b) a true color image of the marsh and c) how LIDAR data are collected.

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