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Salt Marsh Values in a Changing World: Examining Sea Level Rise on Tidal Marshes with a Surface Elevation Table

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Examining Sea Level Rise on Tidal Marshes with a Surface Elevation Table

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Purpose

The study was conducted to look at how the salt marshes in the seacoast region of New Hampshire are responding to sea level rise and to determine if salt marshes are building or losing elevation relative to sea level. Marsh elevation can change due to deposition on the surface (accretion) as well as the building (or loss) of peat under the surface. To determine salt marsh elevation, a Surface Elevation Table (SET) was used across a series of bench-marks located in three salt marshes: two in Great Bay and one behind the barrier beach at Rye Harbor. An SET is a portable mechanical leveling device for measuring relative elevation change in wetlands. SET data were collected to monitor changes in marsh elevation and to compare these rates to those collected in the recent past.

Problem

Our world is changing as increased levels of carbon dioxide are released, accumulating in the atmosphere and warming the earth, melting the ice caps, and causing sea levels to rise. Sea levels were once measured at 1.7 mm per year (Wake et al. 2011), but now faster rates (Nicholls and Cazenave 2010, Church and White 2011) are threatening to drown our marshes if they cannot begin to grow faster (Cahoon and Guntenspergen 2010). Can our marshes keep up with the faster rates of sea level rise being measured today?

Salt Marsh Values

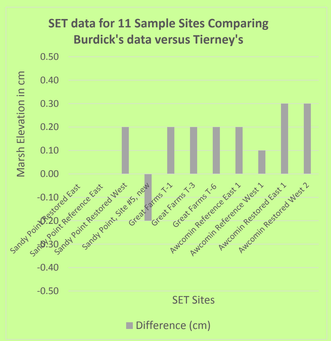
- Salt marshes are unique systems to monitor because they may help slow the rate of climate change in the future, as rising and warming oceans will enable them to more quickly capture carbon dioxide from the atmosphere and store it in peat.
- Salt marshes are one of the best examples of an ecosystem that can accommodate many organisms. They are home to 600 species of plants, animals, and insects.
- Besides supporting biodiversity, salt marshes act as a buffer for storms and protect shorelines from erosion by buffering wave action and trapping sediments. Salt marshes slow the velocity of waves and mitigate storm surges by storing water (Shepard et al. 2011).
- Salt marshes also help to protect water quality by filtering runoff, trapping sediments to build peat, and metabolizing excess nutrients.

Education and Outreach

Engaging the local community to have a better understanding of marsh values and their responses to rising sea levels is important if communities are to dedicate valuable resources to support marsh protection. One of my roles is to educate the public about the threats to their local communities and the values of marshes through a number of different venues such as presenting at the Ocean Discovery Day and classroom presentations at Hampton Academy.

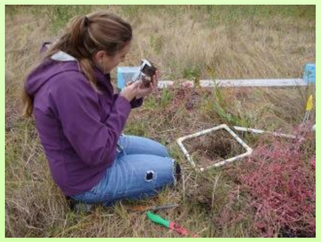
Field Procedures

At all sites, elevation was measured using a SET. At most sites, plant species were recorded along with percentage of cover for each measurement area. Anything unusual about the site such as deer prints or uneven topography was recorded. The date, time, and specific site location were also recorded.



Comparison Between Two Measurers

- When my measurements were compared to those of Burdick, he measured higher SET relative elevations on average (0.136 cm).
- A paired t-Test showed this difference is significant, indicating that switching from his measurements (2011) to my measurements (2013) could influence short term results like those available for Great Bay Farms, which I measured as growing 0.167 cm per year.



Abstract

Rising seas are threatening coastal communities and putting added pressures on the natural environment. Sea level rise rates are increasing on a global scale (from 1.7 to 3.2 mm/yr). Salt marshes are not only intertidal habitats acutely influenced by sea levels, but they also provide key ecosystem services such as: buffers against storm surges, habitat for wildlife, carbon dioxide storage, and pollutant filtration. In New England, salt marshes have built at a rate of 1 to 2 mm annually over the past 4,000 years, which has kept pace with sea level rise. However, we do not know if salt marshes can keep building if sea levels rise at a more rapid rate of 4 mm/yr or greater. To monitor how salt marshes are responding to faster sea level rise, we measured salt marsh accretion and elevation change along the coast of New Hampshire at three different marshes (a total of 11 stations) using marker horizons and a Surface Elevation Table (SET). The SET sites were established in two marshes over a decade ago and more recently at a third marsh in 2011. Data were collected in 2013 and the new rates are compared to previous elevation changes. The major findings included an unprecedented marsh elevation growth rate of 4.3 mm/yr, which shows that our marshes are building at rates fast enough to keep up with the current sea level rise. Furthermore, the rate of salt marsh building appears to be greater than the global sea level rate of 3.2 mm/yr, suggesting our local rate of sea level rise may be greater than 3.2mm/year. Salt marshes could provide a valuable indirect measure of local sea level rise.

Sample Sites

Sandy Point Marsh

Sandy Point Discovery Center is located in Stratham, NH, at the north end of Depot Road. Four SET sites were measured: Sandy Point Restored East, Sandy Point Restored West, Sandy Point Reference East, and Sandy Point new #5. The old SET was used for all sites except the Sandy Point new #5. The sites were visited on October 15th and October 16th, 2013 on cloudy and breezy days.

Old SET

Great Bay Farms

At Great Bay Farms, three SET sites were visited which were labeled according to a nearby vegetation transect: T-1, T-3, T-6. All three sites were visited on October 11th, 2013 on a cool and overcast day. The new SET was used to measure the marsh surface elevation.

Awcomin Marsh

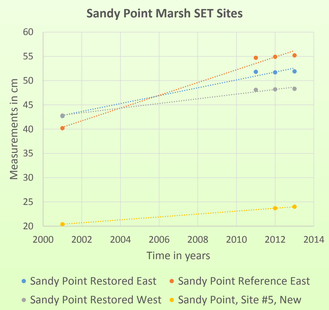
Awcomin marsh is located in Rye, NH off Route 1A which is directly across from the Rye Harbor Marina. Four SET sites visited on October 25th, 2013 on a cool, windy, and sunny day. The old SET was used. The sites included: Reference East #1, Reference West #1, Restored East #1, and Restored West #2. Compass readings were recorded, but feldspar and dominant species data were not.

New SET

Methodology

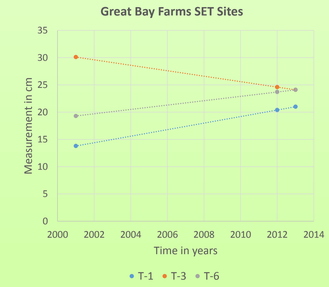
The sites included Awcomin Marsh, Sandy Point Marsh, and Great Bay Farms totaling 11 SET sample sites. At Awcomin Marsh, the old SET was used. At Sandy Point, the old SET was used, except for the new #5 site that was established in 2012, and at Great Bay Farms the new SET was used for all three sites. At all of the sites, compass readings were taken as well as SET readings for the four cardinal directions. At Great Bay Farms and Sandy Point sites, feldspar readings were taken at each of the two marker horizons. In addition, plant species were identified and percent cover recorded.

Results



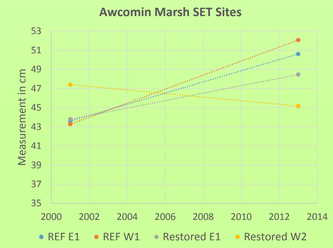
Sandy Point Marsh

- The mean elevation growth from 2001 to 2011 for all four sites is 0.963 cm/yr.
- The mean elevation growth from 2011 to 2013 for the restored and reference sites is 0.133 cm/yr.
- The average elevation growth from 2001 to 2013 for the Sandy Point Marsh is 0.825 cm per year
- Paired t-test for 2001 to 2011 and 2011 to 2013 was reported as 0.0325 probability that the two rates (early and later rates) are not different. Therefore, it appears that the marsh is still building, but the building rate has slowed in the past several years.



Great Bay Farms

- Relative elevation began to be measured at this site in 2011. Since then, elevation increased an average of 0.17 cm/yr over the past two years.
- The t-test for Great Bay Farm for 2012 and 2013 resulted in 0.335 probability, indicating that between the two years, elevations were not significantly different.
- The average difference for all the Great Bay Farms site from 2001 to 2013 was 0.167cm/yr. However, we cannot accurately tell how fast the marsh is building because we do not have enough data.



Awcomin Marsh

- The average elevation growth for the Awcomin Marsh from 2001 to 2013 was 0.379 cm/yr.
- The timeline ranges from 2001 until 2013. The data shows that overtime all sites are building in elevation with the exception of the restored W2 site.

Conclusion

The study conducted resulted in evidence showing that regionally salt marshes are keeping pace with sea level rise, even at faster rates than projected.

- Marsh elevation growth rate of 4.3 mm/yr, which shows that our marshes are building at rates fast enough to keep up with the current sea level rise.
- Salt marsh building in the New Hampshire seacoast area is greater than the global sea level rise rate of 3.2 mm/yr.
- The local rate of sea level rise may already be greater than 3.2mm/year as indicated by the rate of marsh building.

Looking Ahead

- We need to protect our salt marshes to better prepare for climate change.
- Understanding the rate at which salt marsh elevations are changing is important in regards to storm protection and choices for future adaptation of coastal towns.
- It is important to be consistent in proper data collection techniques and to have practice prior to taking measurements.
- It is important to take samples around the same time of year so that possible impacts from winter ice (compression) does not alter the results.
- Currently, we don't know whether the newer model of the SET is more accurate than the older SET; future studies may be beneficial to see if there are differences.
- Overall, monitoring salt marshes and sea level rise rates is beneficial in determining if salt marshes will continue to be able to survive the growing pressures of sea level rise and continue to provide ecosystem services to coastal communities.

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