Sediment Dynamics and the Stability of Maine's Largest Salt Marsh

Satya Kent, 2019

The purpose of my research this summer was to determine the stability of Scarborough Marsh in the face of future sea level rise. Salt marshes, which are covered by sea water at high tide and exposed at low tide, provide numerous ecosystem services. For example, they provide nursery habitat for fish and crustaceans, increase water quality by filtering out pollutants, protect property against storm surges, and store carbon away from the atmosphere. Nonetheless, marshes face numerous threats such as nutrient pollution and human disruption of food webs. The largest threat, however, may be accelerated sea level rise due to global warming.

As climate change causes sea levels to rise, marshes must constantly increase their elevation in order to stay above water. Many salt marshes are unable to keep pace, so it is of great importance to be able to quantify their stability. To determine if a marsh is stable or not, scientists study the movement of sediment during tidal cycles and construct a sediment budget. Marshes keep pace with sea level rise primarily by way of a process called vertical accretion, sediment accumulation on top of the marsh. Therefore, a marsh is considered stable if there is a net import of sediment and unstable if there is a net export.

For my project this summer, I took an instrument heavy approach to determine sediment flux. I chose a study site on the Nonesuch River (a main tributary of Scarborough Marsh) and installed a datalogger box on the high marsh connected to salinity, turbidity, water level, and water temperature probes reaching down into the bottom of the tidal channel. To measure water velocity, I installed two tilting current meters on the bottom of the channel. In addition, I installed two programmable pump samplers that collected water samples on either bank. Twice a week, my mentor Peter Lea and I boated out to our site to maintain the instrumentation and download the data. In the lab, I filtered, dried, and weighed the water samples to calculate suspended sediment concentration, which is used to calibrate the turbidity readings from the in-place sensor. The next step is to determine continuous discharge from the velocity profiles and calibrate that data with the periodic discharge data. Once I have these two estimates, I will be able to calculate continuous records of sediment and create a sediment budget.

I have helped plan and set up an exciting, brand new project that will likely be further developed and fine-tuned for years to come. However, a large portion of my time was (unexpectedly) spent troubleshooting instrumentation, so I don't currently have much in the way of results, and the overarching question of marsh stability is still unanswered. Nevertheless, I have identified some interesting patterns regarding tidal asymmetry, the tendency of either the ebb (outgoing) or flood (incoming) tide to dominate in the system, which provides us with first order insights into the direction of sediment transport. The Nonesuch River tends to be predominantly flood tide dominant, which means the incoming tide is shorter and stronger, potentially favoring a net import of sediment into the marsh. In the future, we plan to use higher quality instrumentation called an Acoustic Doppler Current Profiler to more accurately measure velocity and discharge. I hope to continue to be involved in this project in some capacity, whether it's assisting with field work throughout the academic year, spending another summer of research at Bowdoin, or turning it into an honors project.

Faculty Mentor: Peter Lea

Funded by the Rusack Coastal Studies Fellowship

For more information on my project, including a video:
http://community.bowdoin.edu/news/2017/08/a-bowdoin-investigation-can-a-maine-marsh-survive-rising-seas/