

COASTAL SQUEEZE

Sea Level Rise and Massachusetts Saltmarshes



Background

Saltmarshes, by their geographic definition, are more critically threatened by sea level rise than most ecosystems. Estimates for sea level rise in the next 80 years range from just under a foot to over 8 feet, and even 1 foot of sea level rise could have serious consequences for the survival of our saltmarshes (NOAA 2017, NCA 2014). Coastal saltmarshes exist partially in the intertidal zone and are adapted to being regularly inundated. Distinct marsh zones form dependent on how long and how frequently each area is inundated, from the wet mudflats and pools all the way up to the high marsh and salt pannes. These tidal marsh zones shift inland as sea level rises and they become more regularly inundated for longer periods. This is what's known as saltmarsh migration. Barriers to this migration such as a steep slope, development, or a fragmented ecosystem prevent this landward movement, and as the sea level rises the marsh ecosystem instead diminishes in size.

This study examines the saltmarshes of Essex county, Massachusetts and models them to see what they might look like under different sea level rise scenarios. How much of our saltmarsh will remain? Where might they migrate inland? And are these migration areas protected from future development?

Methods

Suitability Analysis

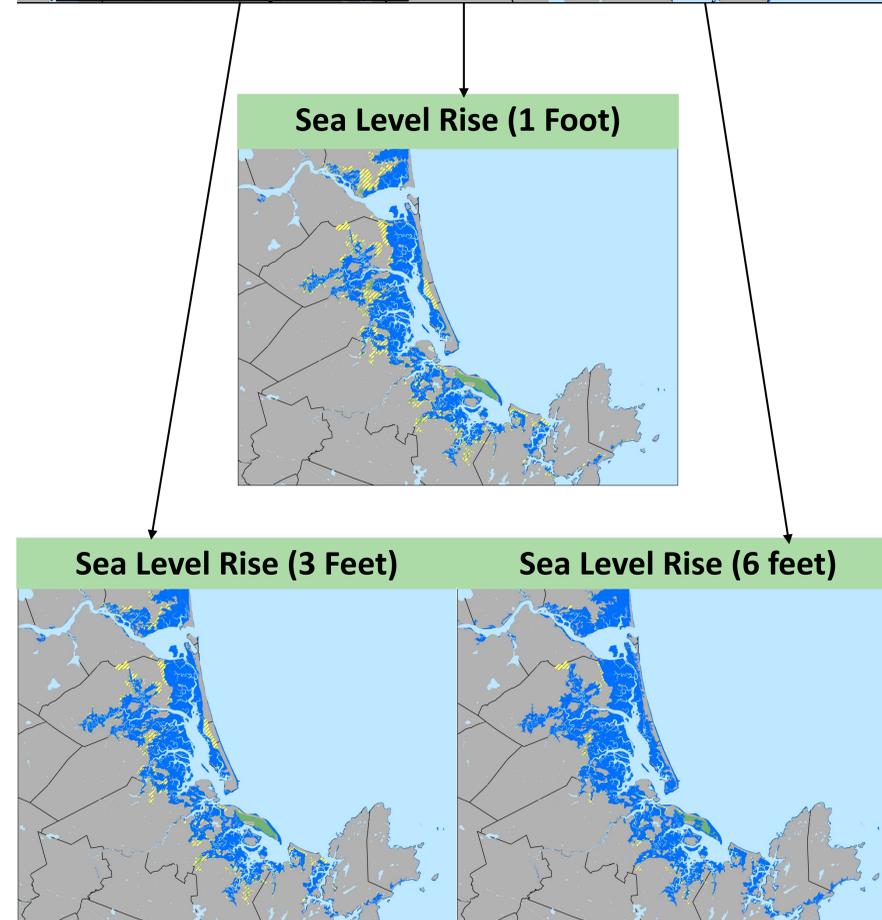
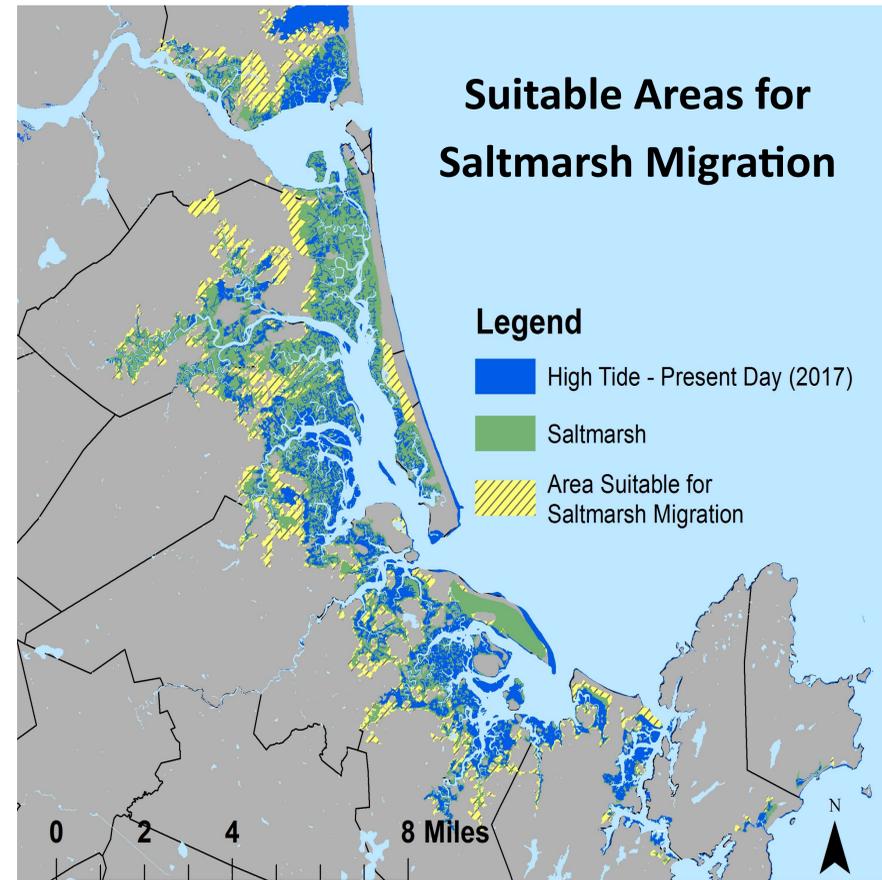
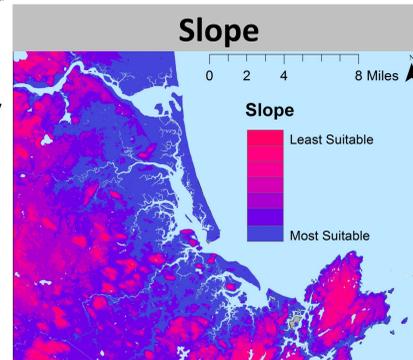
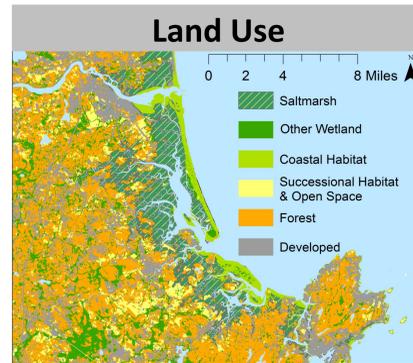
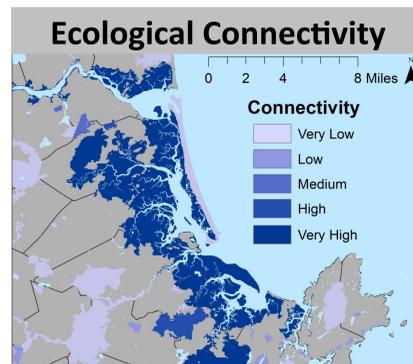
A suitability analysis was used to determine areas where saltmarshes might feasibly migrate as the sea level rises, and was weighted with the following factors:

Connectivity (60%): Saltmarshes are naturally large and relatively unbroken. Fragmented habitats are less able to migrate inland. Data on ecological connectivity were adapted from the Critical Linkages Project by UMass Amherst, The Nature Conservancy's Resilient and Connected Landscapes project, and MassGIS's BioMap2 data.

Land Use (30%): Development is a significant barrier to saltmarsh migration. The more similar to a saltmarsh an ecosystem is in terms of soil and ecology, the less a barrier it presents.

Slope (10%): Saltmarshes are low-lying in nature and require relatively flat areas. Steep slopes present a barrier to saltmarsh migration.

The areas suitable for saltmarsh migration were then clipped based on adjacency to a saltmarsh and one another, and all but the top 2 suitability ranks were excluded.

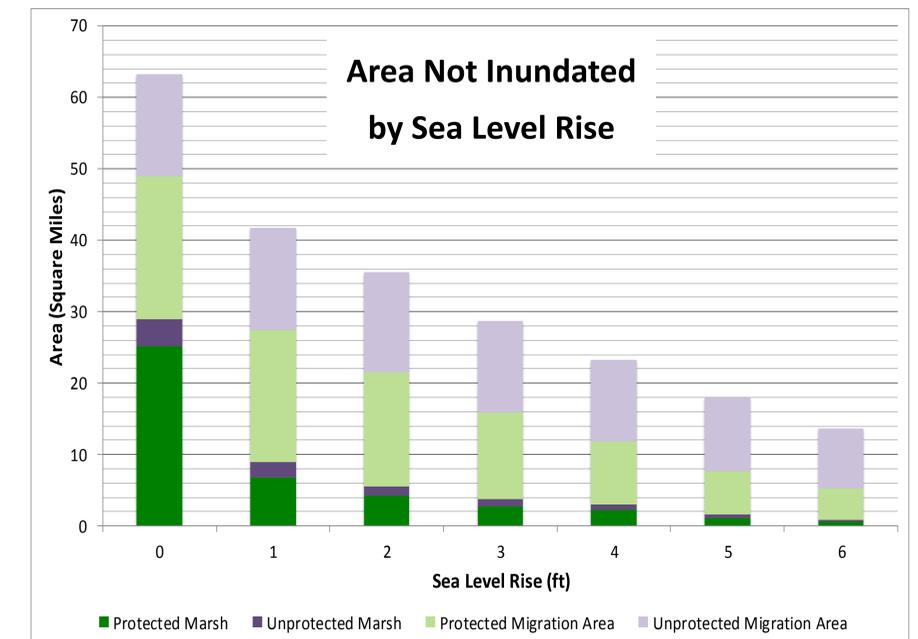


Iteration & Scripting

With the areas suitable for saltmarsh migration identified, data from the Massachusetts EEA were used to model different estimates of sea level rise. A python script and iterator designed for this project were used to project the sea level rise from 1 foot to 6 feet in 1 foot increments, erase any newly inundated areas, calculate the geometric area of the remaining saltmarsh and suitable migration area in square miles, and return a statistical summary. Additionally, these were cross-referenced with data on protected areas to determine what percentage of the remaining land was vulnerable to development.

Results & Conclusions

With just 1 foot of sea level rise, 69.2% of available saltmarsh in the study area would be lost. Another 11.5% would be lost at 2 feet, and an additional 16.4% over the next 4 feet of sea level rise. At 6 feet, less than a square mile of original saltmarsh would remain. Areas suitable for saltmarsh migration, by definition of their inland location, were less susceptible. Still, over a quarter of the area would be lost at 3 feet, and over half at 5 feet. Only about half of this area is protected from development, compared to over 80% of our current saltmarsh, and this percentage of protected migration area declines to a third at 6 feet of sea level rise. This is likely due to the bias for protected migration area to be located closer to the edge of the saltmarsh, and thus lost sooner than further unprotected but viable areas. This demonstrates that while a significant portion of protected land exists for saltmarsh to migrate to, the suitable areas least vulnerable to sea level rise remain unprotected.



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Coordinate System: NAD 1983 Massachusetts State Plane, Mainland FIPS 2001

Data Sources: MassGIS; Massachusetts EEA: StormSmart Coasts; Nature Conservancy: Resilient and Connected Landscapes; UMass Amherst: Critical Linkages Project

Works Cited: NOAA. (2017, January). GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES. Retrieved May, 2017, from https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

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