Update on "Synthesis of Shoreline, Sea Level Rise, and Marsh Migration Data for Wetland Restoration Targeting"

Dec 14, 2021

Molly Mitchell

Project Activities

Finished 9/22

- Spreadsheet of data sources and metadata fact sheets
  - compile existing information about SLR inundation under forecasted climate change, topography of bay shorelines, shoreline condition (e.g., erosion rates, hardening, existing natural resources, etc)
- Literature review
- Stakeholder engagement
- Development of methodology to use consideration of marsh migration to assist with conservation/preservation/management decisions

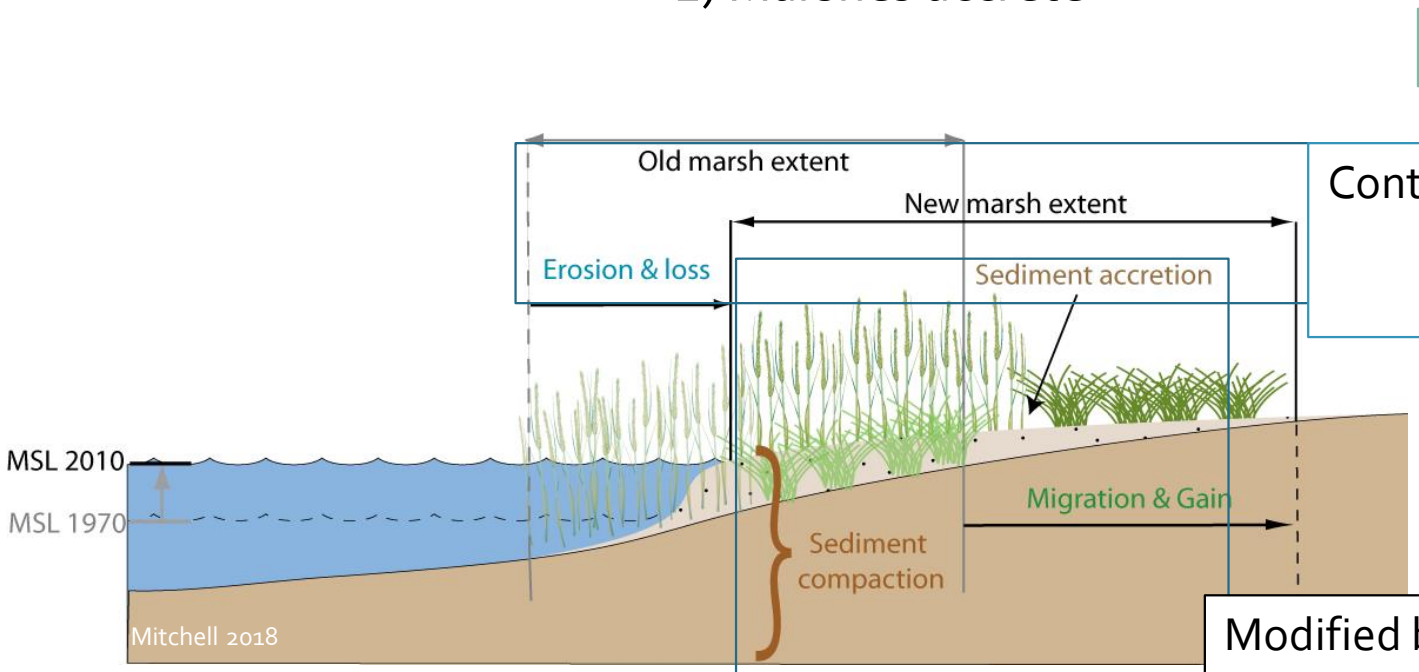
Project Scope

- This project will develop a methodology for using results from marsh migration models combined with social, landuse, and environmental data to inform marsh management, conservation, and restoration under sea level rise
- This project will provide a dataset of available information (scale, scope, etc) that could help inform management decisions

- This project will not run any marsh migration models
- This project will not result in the methodology being applied across the Chesapeake Bay

Marsh change in response to climate change

To keep pace with sea level: 1) Marshes migrate
2) Marshes accrete



Δ Water Levels

Controlled by:
SLR
Land elevation

Modified by:
Shoreline alterations
Erosion rates
Human Activity

Δ CO_2

Δ Water Levels

Δ Temperature

Controlled by:
Plant production
Sediment availability
Sediment respiration

This project was defined to look at ***marsh migration***

Updates on progress to date

Data sources spreadsheet

Sept 1, 2021

Data types investigated for the inventory include:

- Sea level rise forecasts for multiple stations throughout the Chesapeake Bay
- Subsidence rates throughout the Chesapeake Bay
- Topographic and topo-bathy surfaces and bank heights
- Shoreline erosion rates and soil types
- Type and extent of shoreline alterations (e.g., bulkheads, revetments)
- Locations of living shorelines
- Distribution of natural resources (e.g., marshes, beaches, dunes)
- Assessments of marsh resilience (e.g., accretion rates, migration rates)
- Marsh plant community types and Phragmites invasion
- Projected marsh migration patterns
- Landuse/landcover (current and projected)
- Conserved lands
- Groundwater flow information
- Suspended sediment concentrations
- Locations of irrigation ditches that cross wetlands
- Economic and social community characteristics

Updates on progress to date

Data sources spreadsheet

Sept 1, 2021

Data_ID	Topics	Category	Data Name	Data Link	Data Source	Data Type	Date Range of Data	Resolution	Covered Geograph	Available online?	Citation
55	Type and Extent of Shoreline Alterations	Living Shorelines	A Tour of Living Shorelines in Delaware	https://dnrec.maps.arcgis.com/apps/MapJournal/index.html?appid=371a244682084370a78d0a54c5edb27a	Delaware Living Shorelines Committee	Story Map	Projects constructed around 2014-2016	Not Applicable	Coastal Delaware	Yes	A Tour of Living Shorelines in Delaware (2016). Story Map. Delaware Living Shorelines Committee. https://dnrec.maps.arcgis.com/apps/MapJournal/index.html?appid=371a244682084370a78d0a54c5ed
5	Assessments of Marsh Resilience	Coastal Wetlands	An Unvegetated to Vegetated Ratio (UVVR) for coastal wetlands of the Conterminous United States (2014-2018)	https://www.sciencebase.gov/catalog/item/5fa18656d34e198cb793cba5	USGS	GIS Data	2014-2018	Unknown	Atlantic Coast	Yes	Couvillion, B.R., Ganju, N.K., and Defne, Z., 2021, An Unvegetated to Vegetated Ratio (UVVR) for coastal wetlands of the Conterminous United States (2014-2018): U.S. Geological Survey data release, https://doi.org/10.5066/P97DQXZP.
34	Distribution of Natural Resources	Beaches Above High Water	Beaches Above High Water	https://gaia.vcu.edu/GemsMap/?extent=-8622879.4296%2C4433048.7104%2C-8405492.5212%2C4530582.3585%2C102100&showLayers=CoastalWildlife_MIL1_1625_0%3BCoastalWildlife_MIL1_1625_4%3BCoastalWildlife_MIL1_1625_7%3BCoastalLand_MIL1_8075%3BCoastalLand_MIL1_8075_1%3BCoastalLand_MIL1_8075_2%3BCoastalLan	Shoreline Studies Program (SSP), Virginia Institute of Marine Science (VIMS)	Map viewer; Tabular Data	2005-2006	NA	Coastal Virginia	Yes	Virginia's Non-jurisdictional Beach Assessment (2006). Virginia Institute of Marine Science Shoreline Studies

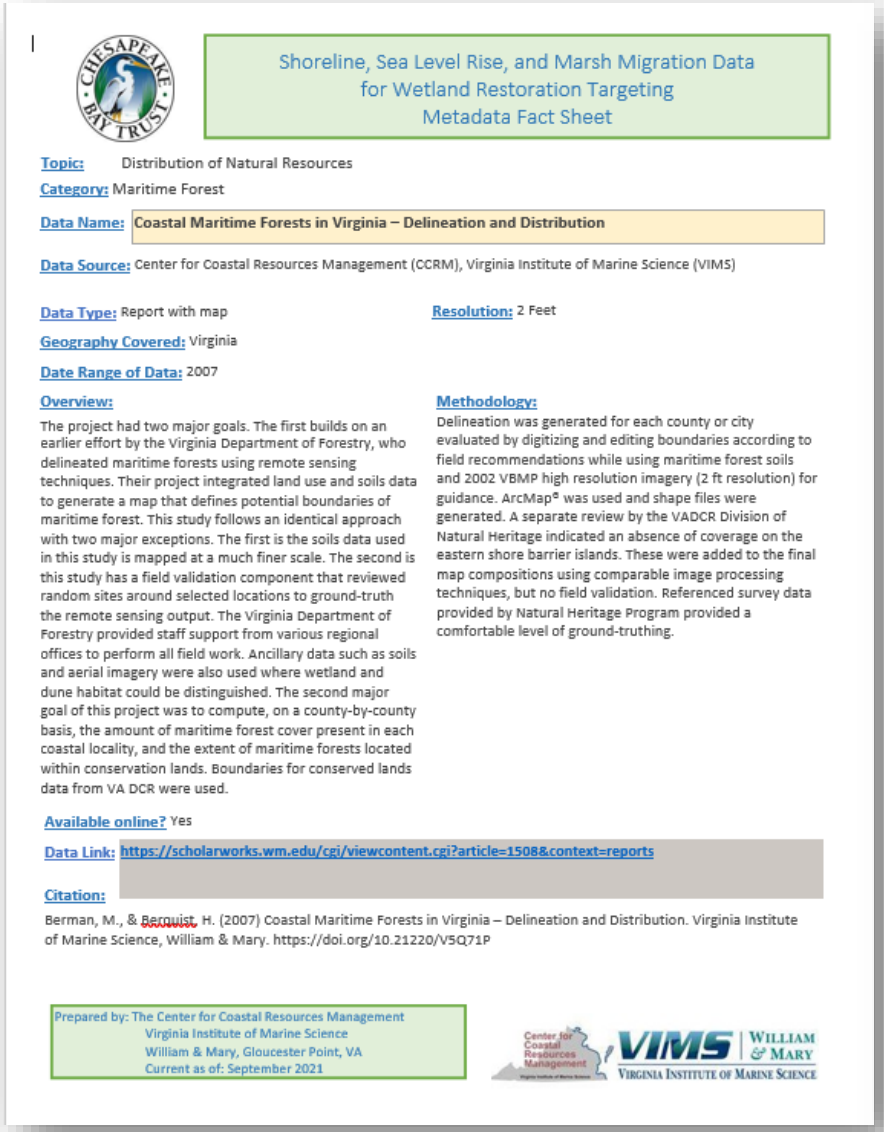
- 111 data sources identified
- 14 topics, including sea level rise, natural resources, landuse, and social/economic data
- Topics subdivided into >50 categories of data

Updates on progress to date

Metadata factsheets

Literature review

Sept 1, 2021



Shoreline, Sea Level Rise, and Marsh Migration Data for Wetland Restoration Targeting
Metadata Fact Sheet

Topic: Distribution of Natural Resources

Category: Maritime Forest

Data Name: Coastal Maritime Forests in Virginia – Delineation and Distribution

Data Source: Center for Coastal Resources Management (CCRM), Virginia Institute of Marine Science (VIMS)

Data Type: Report with map

Resolution: 2 Feet

Geography Covered: Virginia

Date Range of Data: 2007

Overview:

The project had two major goals. The first builds on an earlier effort by the Virginia Department of Forestry, who delineated maritime forests using remote sensing techniques. Their project integrated land use and soils data to generate a map that defines potential boundaries of maritime forest. This study follows an identical approach with two major exceptions. The first is the soils data used in this study is mapped at a much finer scale. The second is this study has a field validation component that reviewed random sites around selected locations to ground-truth the remote sensing output. The Virginia Department of Forestry provided staff support from various regional offices to perform all field work. Ancillary data such as soils and aerial imagery were also used where wetland and dune habitat could be distinguished. The second major goal of this project was to compute, on a county-by-county basis, the amount of maritime forest cover present in each coastal locality, and the extent of maritime forests located within conservation lands. Boundaries for conserved lands data from VA DCR were used.

Methodology:

Delineation was generated for each county or city evaluated by digitizing and editing boundaries according to field recommendations while using maritime forest soils and 2002 VBMP high resolution imagery (2 ft resolution) for guidance. ArcMap® was used and shape files were generated. A separate review by the VADCR Division of Natural Heritage indicated an absence of coverage on the eastern shore barrier islands. These were added to the final map compositions using comparable image processing techniques, but no field validation. Referenced survey data provided by Natural Heritage Program provided a comfortable level of ground-truthing.

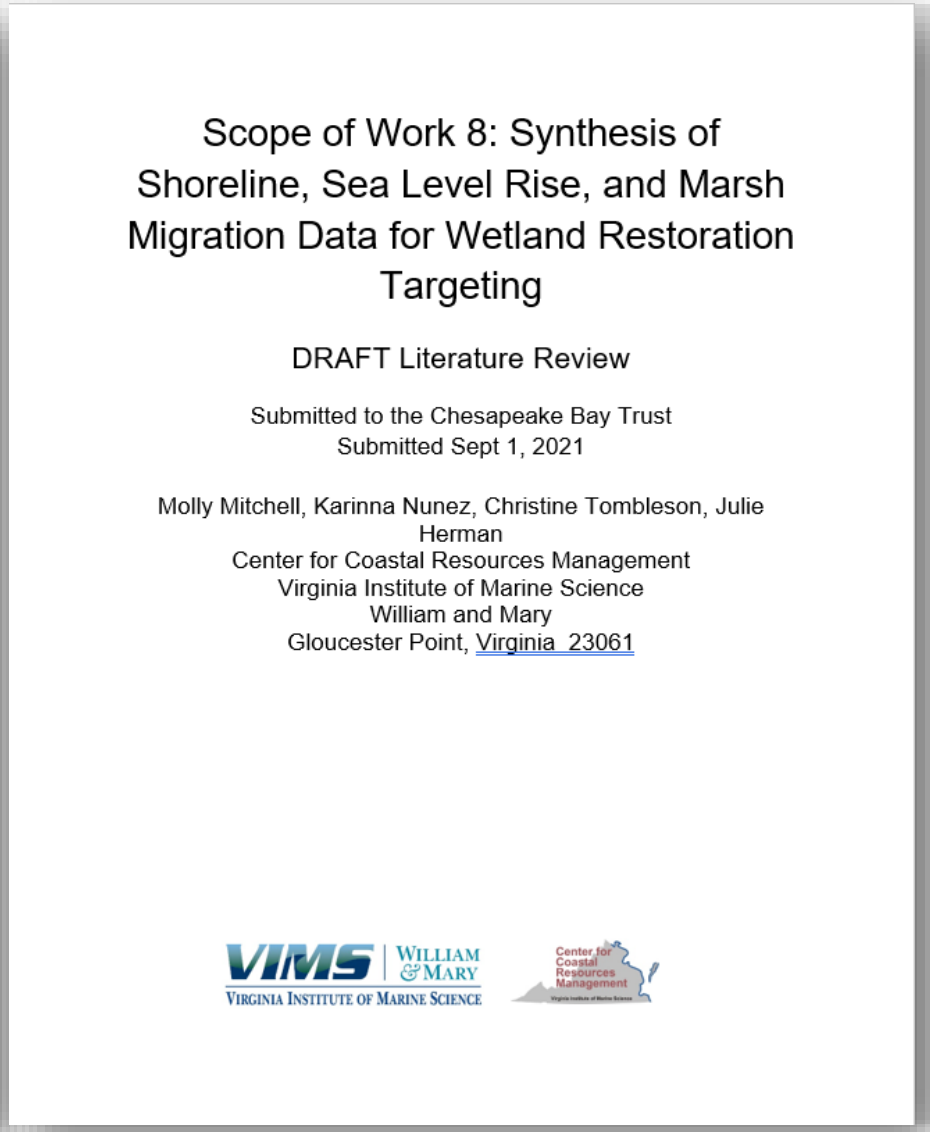
Available online? Yes

Data Link: https://scholarworks.wm.edu/cgi/viewcontent.cgi?article=1508&context=reports

Citation:

Berman, M., & Berquist, H. (2007) Coastal Maritime Forests in Virginia – Delineation and Distribution. Virginia Institute of Marine Science, William & Mary. https://doi.org/10.21220/V5Q71P

Prepared by: The Center for Coastal Resources Management
Virginia Institute of Marine Science
William & Mary, Gloucester Point, VA
Current as of: September 2021



Scope of Work 8: Synthesis of Shoreline, Sea Level Rise, and Marsh Migration Data for Wetland Restoration Targeting

DRAFT Literature Review

Submitted to the Chesapeake Bay Trust
Submitted Sept 1, 2021

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Updates on progress to date

Literature review

Models of marsh response, not just migration

Sept 1, 2021

Landscape-scale Models

- Landscape-scale models often use fixed rates (e.g., erosion rates) during the entire simulation. Landscape scale models fall into two broad categories: topography-driven models (SLOPE, **Evolution of Tidal Marsh**) and elevation/process driven models (**SLAMM, NOAA MM, Nicholas Institute**).

Site-specific Models

- Site-specific models are more mechanistic. They are employed to simulate responses for a specific site with a particular set of conditions and settings (MEM/CWEM). Do not model migration.

Combination and cross-scale models

- This integrated approach combines spatial dynamics of salt marshes and predicts the impacts of possible future sea-level conditions (Hydro-MEM,**TMM**). Require continuous data sets of hydrological, sedimentological, and biological data and often substitute fixed rates for missing data.

Updates on progress to date

Synthesis of available data

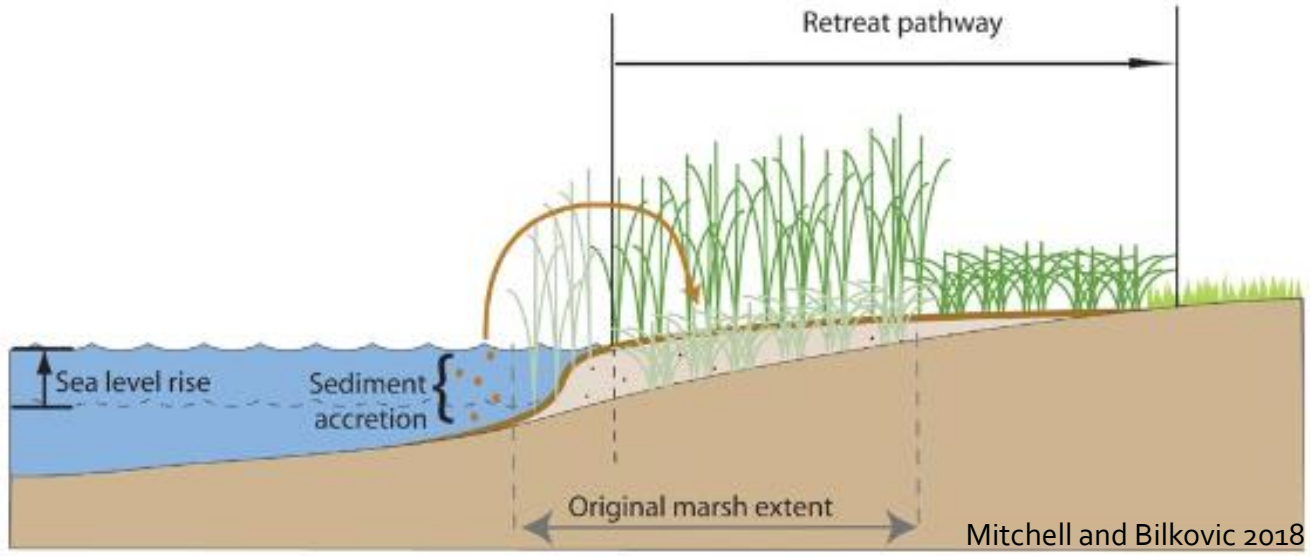
Sept 1, 2021

Strengths

- Land elevation
- Land use
- Shoreline stabilization*
- Fetch & wave models
- Social (census) data**

Weaknesses

- Erosion rates
- Sediment availability
- Marsh accretion rates
- Marsh plant composition
- Plant biomass/productivity



Mitchell and Bilkovic 2018

*data may be dated
**data may be dated and scales vary

Marsh model comparison

Oct 30, 2021

- Scope of the project is to develop a methodology that synthesizes marsh migration information in a format that can be used ***to assist with marsh conservation and restoration decisions*** under multiple sea level rise scenarios using a target areas within the Middle Peninsula (MP), Virginia.
- Methodology development steps:
  - 1) Determine existing models that have been run within the Middle Peninsula, Virginia;
  - 2) Using 1-3 targeted areas, compare results across the models to determine how different model parameters and formulations may affect projected marsh migration pathways;
  - 3) develop a methodology that combines model results with other landscape data to highlight considerations of marsh migration for restoration/conservation purposes.

Existing models run for the Middle Peninsula region (comprehensive!!!)

Model	Available for comparison	Time frames	Coverage
Evolution of Tidal Marsh Landscape	Yes–raster (1m resolution)	Any available (Data as elevations)	Entire MP
SLAMM 5.0 (NWF Chesapeake Bay) Landscape	Yes–raster (30m resolution)	IPCC B1 Mean = 31 cm rise by 2100; IPCC A1B Mean = 39 cm rise by 2100; IPCC A1f1 Mean = 49 cm rise by 2100; IPCC A1B Max = 69 cm rise by 2100; 1 meter rise by 2100; 1.5 meter rise by 2100; 2 meter rise by 2100	Entire MP
Tidal Marsh Model Combination	Yes - vector/raster (multi-scale)	Projections: 50 years (2020-2070). NOAA (2017) scenarios, adjusted by land subsidence rates documented in southeast Virginia by USGS (3.1 mm yr-1) (Eggleston and Pope 2013). - Intermediate Scenario: 622 mm rise by 2070. - Extreme Scenario: 1,243 mm rise by 2070.	Carter Creek and Taskinas Creek, VA
Sea Level Rise Viewer: Marsh Migration (NOAA) Landscape	Yes–raster	Any available (Data as elevations)	Entire MP
Coastal Protection and Blue Carbon for Eastern States (InVEST, Nicolas Institute) Landscape	Yes–raster	Any available (Data as elevations up to 4 ft)	Entire MP

Proposed comparison methodology

Overlay marsh migration paths from each model

Identify "strength of evidence" for upland areas being important for marsh migration based on model overlap

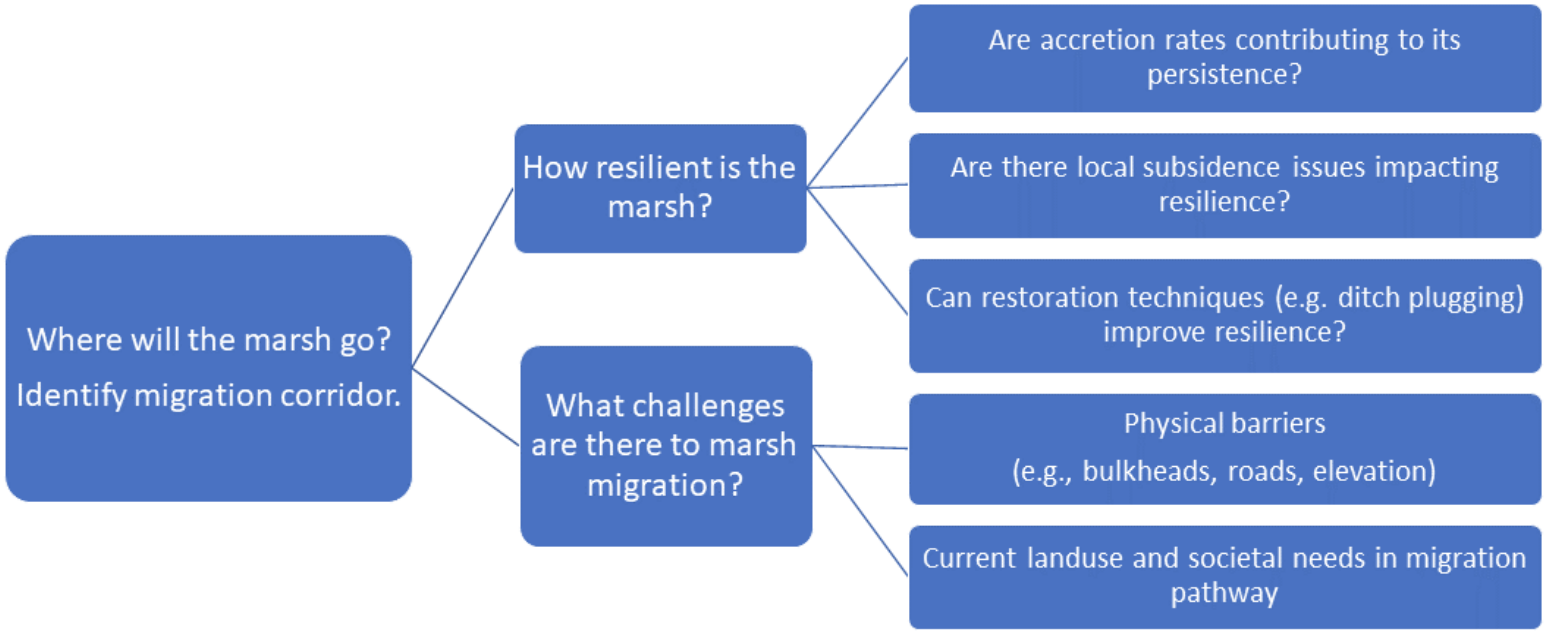
Challenges:

- Marsh edges are unlikely to line up (but we are only interested in migration pathway)
- Different scales will have outsized effects on migration pathways
- Aligning scenarios may be difficult

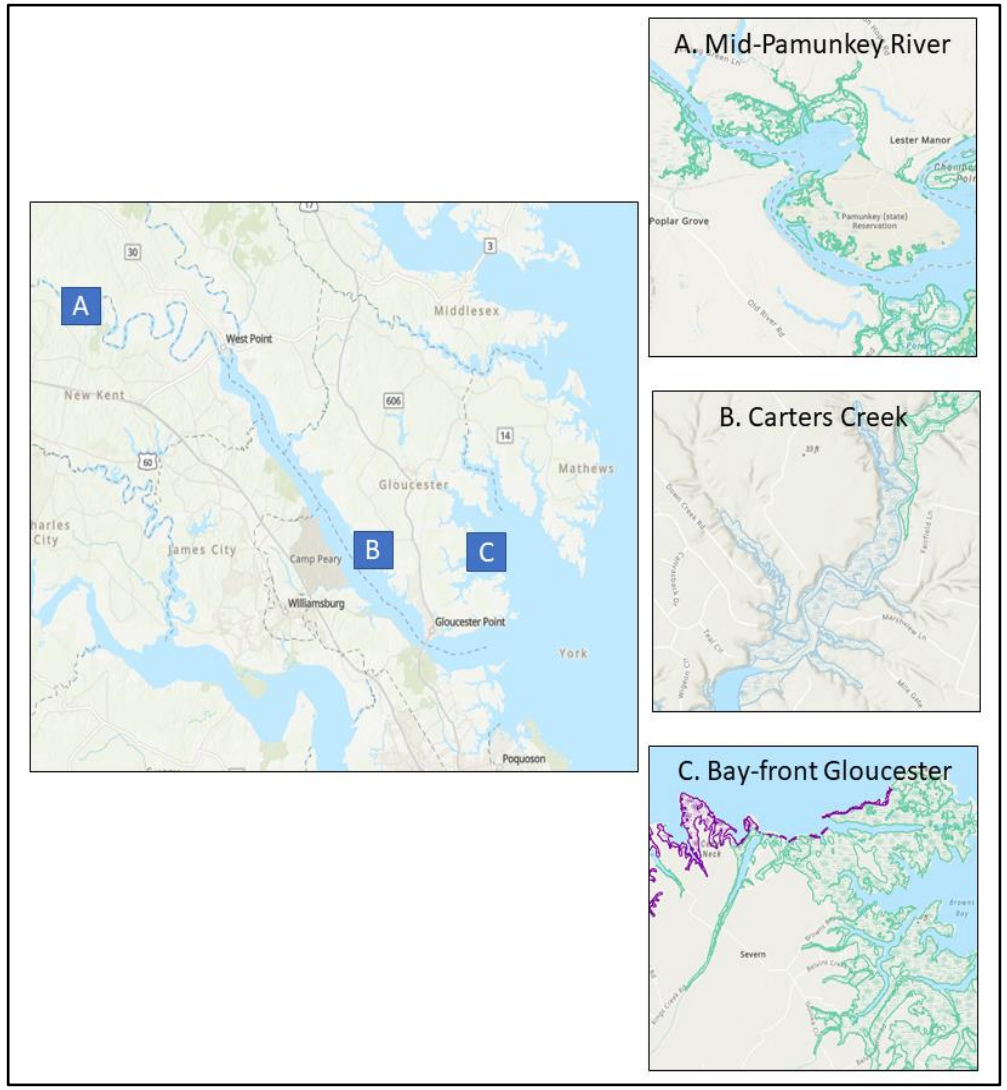
Always the goal is parsimony—the least difficult information to obtain that allows for effective management decisions

Proposed comparison methodology

Within the marsh migration corridor, we will develop criteria for consideration of 1) the difficulty of preserving lands in the migration corridor, 2) opportunities for improving marsh resilience (such as ditch plugging), and 3) physical characteristics (such as elevation and subsidence rates)
Areas of concern will be mapped to highlight the issues.



Where to target test area(s)?



- Three areas allows target testing to cover different elevations, marsh configurations, and social considerations
- Carters creek allows inclusion of a combination model into the comparison
- The Pamunkey river is centered in an areas of high social vulnerability and includes the Pamunkey Reservation. Results may be of interest to the reservation managers
- Challenge: no urban areas

Questions?

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