Coastal Resilience Tools: A Review

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About me

LSU Rising Senior

Track Athlete

Undergraduate Researcher

Why this internship?

I wanted to experience what it was like working on the planning side of restoration.

Climate Resiliency Workgroup's Marsh Adaptation Project

Purpose of Resilience Tool Review

Many tools exist for targeting restoration project sites…. How do they compare?

- *How do these tools determine resilience?*

- *How do these tools vary in their usefulness for targeting large-scale tidal marsh restoration?*

These are important questions to answer before we decide which tools to use to target specific locations for tidal marsh restoration.

This aids us in obtaining an improved understanding of which metrics other organizations use to define resilience.

Resilience Tools… What are they??

Resilience tools are GIS-based programs that combine different sources of data into metrics to determine which areas of land are likely to be the most resilient in the face of climate change.

Tools will provide different conclusions based on:

- Spatial resolution
- Incorporated metrics
- Methodology
- Data sources

Resilience Tools… Which Ones Did I Analyze?

Jurisdictional:

- Maryland Greenprint
- ConserveVA
- Adapt VA

Regional/National:

- The Nature Conservancy Resilient Lands Tool
- USGS Coastal Change Hazards Portal
- NOAA Sea Level Rise Viewer
- Chesapeake Bay Program Restoration Targeting

Combined Tools (under development)

Methods

1. Review the tools

2. Record metrics and layers in resilience tool compilation document

3. Identify sources when available

4. Develop matrix table summarizing metrics included in tools

5. Write a simplified final report comparing metrics across tools

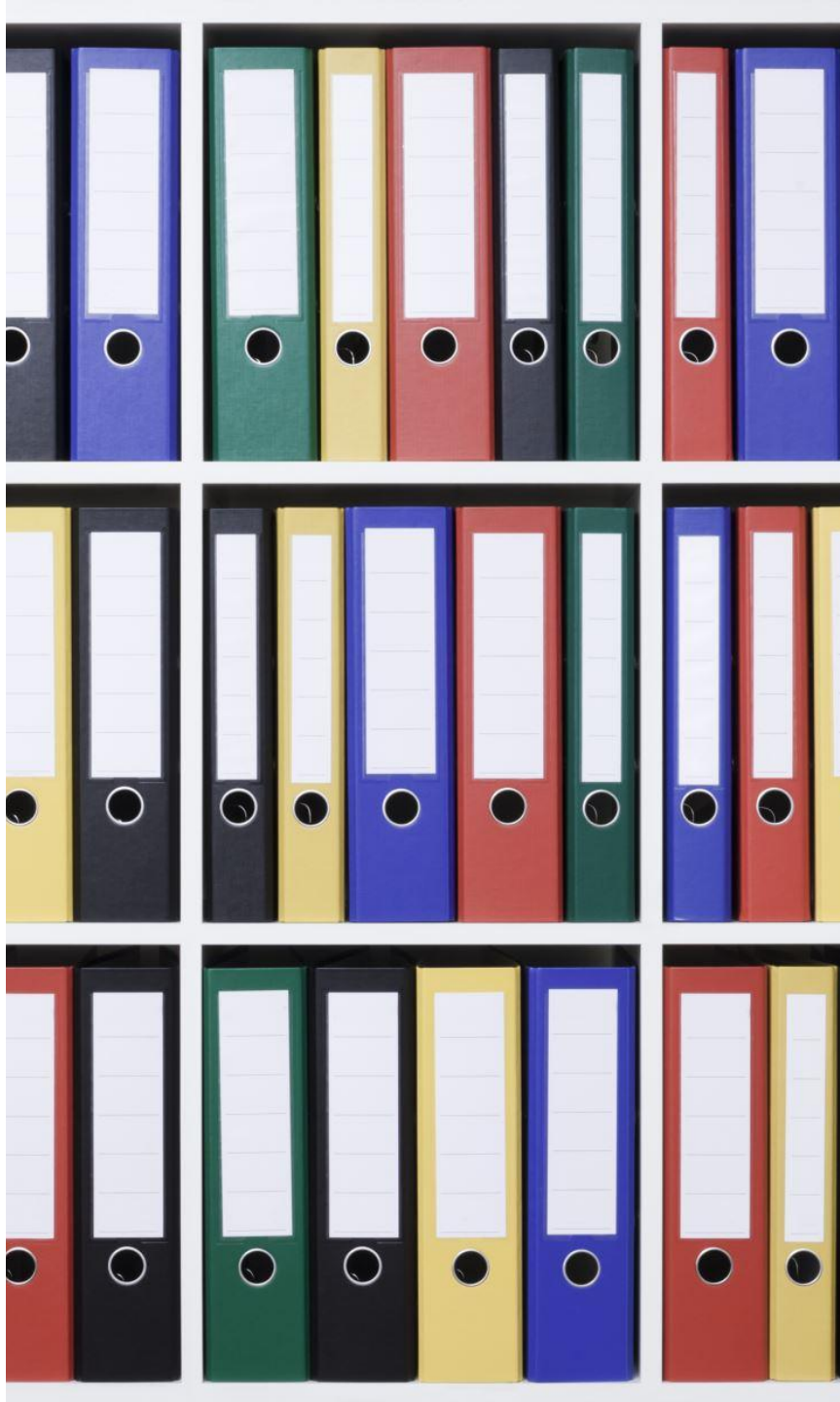
Main Products:

- Resilience Tool Compilation Document
- Matrix Table
- Final Report

Resilience Tool Compilation Document

Deep dive with extensive explanation of each tool, including:

- Agency that developed it
- Point of contact
- Incorporated metrics
- Data sources
- Methodology
- Limitations of the tool
- Notes regarding its development and relevance to tidal marsh restoration



Matrix Table

- Organized visual representation of the resilience tools with a color-coded key signifying the incorporation of a category as a metric versus a data layer
- Integrated Resilience Layer: Includes multiple metrics
- Individual Data Layer: Single metric

Legend	X: Metric Present	S: Included as part of a separate layer	P: Partially Included (explained on a case-by-case basis)	Green vs Yellow: Green signifies inclusion as a metric within a resilience-related layer while yellow signifies inclusion as a separ resilience layer with other metrics. The use of the yellow categories is in inference-making while the green categories directly ir the tool.

Explanation: A filled-in cell expresses the inclusion of the resilience metric above in that tool. Green cells signify inclusion of the metric as a main metric of decisionmaking while yellow cells signify inclusion as a layer but not necessarily interaction with other layers.

Tool Name	Geomorphology	Elevation	Sea Level Rise	Wave Power	Storm Surge Height	Erosion Rate	Existing Habitat Hazard Mitigation	Sediment Input	Land Use	Tide Range	Marsh Migration Space	Water Quality	Habitat Connectivity	Habitat Important for Aquatic Species	Social Vulnerability Inclusion	Coastal Slope
Maryland Greenprint_	x	x	x	x	x	x	x				x	s	s	s		
ConserveVirginia											x	s	x			
Adapt VA		x	s	x			p		x	x					s	
TNC Resilient Lands	x	x	x				x	x	x		x	x	x			
**TNC Coastal Sites (Integrated into TNC Resilient Lands)			x				x	x	x		x	x	x			
USGS Coastal Change Hazards	x		x	x		x				x						x
CBP Restoration Targeting Communities											x					
NOAA Sea Level Rise Viewer		x	x			x	p			x	s				x	

Tool	Link	Data Link
Maryland Greenprint	https://geodata.md.gov/greenprin	Data built into map, can be see
ConserveVirginia	https://www.dcr.virginia.gov/cons	
Adapt VA	http://cmap2.vims.edu/AdaptVA/	
TNC Resilient Lands	https://maps.tnc.org/resilientland	http://www.conservationgateway.o
TNC Coastal Sites	https://tnc.maps.arcgis.com/apps	
USGS Coastal Change Hazards	https://marine.usgs.gov/coastalc	
CBP Restoration Targeting Commur	https://gis.chesapeakebay.net/ta	
NOAA Sea Level Rise Viewer	https://coast.noaa.gov/digitalcoa	https://coast.noaa.gov/slrdata/

Category	Explanation (these may be at different scales for different tools)
Geomorphology	Investigates the propensity of the coastline to erode based on the landform and substrate
Elevation	The elevation above sea level influences the probability of inundation by coastal flooding and storm surge.
Sea Level Rise	The vulnerability of the coast to coastal flooding influenced by the long-term predicted change in sea level.
Wave Power	The potential for shoreline erosion is influenced by the wave power which is in turn influenced by wind speed and direction and size of open water, among other conditions.
Storm Surge Height	The height of storm surge in an area as compared to other areas based on the SLOSH model.
Erosion Rate	The speed at which the land is eroding or accreting, calculated by comparing satellite imagery.
Existing Habitat Hazard Mitigation	Scored based on the presence or absence of different habitats that protect land to different extents, such as SAV being less effective at mitigating natural disaster damage than a maritime forest.
Sediment Input	The supply of marsh-sustaining sediment to an area influences its ability to withstand erosion and accrete to keep up with sea level rise.
Land Use	Land cover categories that influence the water quality of potential marsh migration areas and the ability of the marsh to migrate. The tools do not indicate whether or not residential land uses are considered as potential marsh migration locations or not.
Tide Range	Difference between mean high tide and mean low tide with greater tidal range increasing resilience.
Marsh Migration Space	Suitable low-lying areas to accommodate future tidal habitat.
Water Quality	Taking into account the benefits of existing habitats for water quality and, in the case of the TNC Coastal Sites tool, the water quality of potential marsh migration areas as important to the ability of the marsh to
Habitat Connectivity	The remaining blocks of habitat and the pathways connecting them.
Habitat Important for Aquatic Species	Habitats important to the preservation of water quality.
Social Vulnerability	Taking into account the characteristics of a group or individual that impacts their ability to anticipate, cope with, resist, and recover from a physical hazard, such as a natural disaster.
Coastal Slope	The slope of the coast as a percentage, with a higher slope increasing resilience.

Note: TNC Coastal Sites is a layer on the TNC Resilient Lands tool

Note: Maryland Coastal Resiliency Assessment is a layer on the greenprint map. Its metrics are the green rectangles while the yellow rectangles are other metrics.

Note: ConserveVirginia has a floodplains & flooding resilience category layer, but the data source is not listed or thoroughly explained

Note: ConserveVirginia maps areas outside of cities while ignoring areas inside cities. This is an inconsistent trend. Some areas are marked as developed and are colored gray despite clearly being marshland.

NOAA Sea Level Rise Viewer: The metrics in green all belong to the marsh migration layer. Sea level rise and high tide flooding, two metrics that help form the marh migration space layer, also have their own layers.

Note: ConserveVA and CBP Restoration Targeting Communities are red because they lack the necesary transparency of methodologies to accurately report their metrics

Final Report

Brief summary of the resilience tool compilation and the matrix spreadsheet combined into an easily understood report.

01

Overview of each tool

02

Comparison of the tools

03

Discussion on metric utility for targeting marsh adaptation projects

04

Possible improvements to the tools

Observations

- Marsh Migration Space: Maryland Greenprint, ConserveVirginia, TNC Resilient Lands, TNC Coastal Sites, CBP Restoration Targeting Communities (NOAA SLR Viewer as separate layer)
  - This is a predictably common layer among the tools that looks at the areas available for migration. The ways these areas are determined changes depending on the tool, and this may be worth further investigation.

- Land Use: AdaptVA, TNC tools
  - Related to marsh migration
  - Analyzes the category of land use to determine likelihood of marsh migration occurring

Observations

Two likely important metrics not used by many tools:

- Sediment Availability: TNC
  - Marshes depend on accretion to survive. Organic accretion is not likely to keep up with sea level rise, so locating restoration projects in areas that have high sediment loads could increase sustainability of the marsh and increase water clarity.

- Tidal Range: AdaptVA, USGS Coastal Change Hazards, NOAA SLR Viewer
  - Tidal range varies widely throughout the bay, with the mouth having three times the mean tidal range as Annapolis. Tidal range directly influences a marsh's resilience to sea level rise, so it could be an important factor in locating sites for maximizing the lifespan of marsh resilience projects.

Observations

- Existing Habitat Hazard Mitigation: Maryland Greenprint, TNC tools
  - This was a metric I found particularly interesting because it analyzed

Observations

- Erosion Rate/Wave Power: Maryland Greenprint and USGS Coastal Change Hazards (both), Adapt VA (wave power)
  - Interesting metric not directly included by many of the tools.
  - Two separate metrics on the spreadsheet, but directly related. Erosion rate is generally more comprehensive because it can be affected by things such as currents and sediment redistribution in addition to wave power.

Overarching Conclusions

- Data and methodology accessibility lacks in some tools, especially the ConserveVA tool and the CBP Restoration Targeting Combined tool (which is currently under development).
- The best tools to use change depending on location.
- A combination of tools will be useful depending on which metrics the Climate Resiliency Workgroup designates as the highest priority.
- TNC's Resilient Lands tool is likely to be the most consistently useful tool for tidal marshland restoration in the Chesapeake Bay region.
- Next step: have the tool creators verify the findings. Some tools may have models built into them that use metrics not indicated in the methodology description on the tool website

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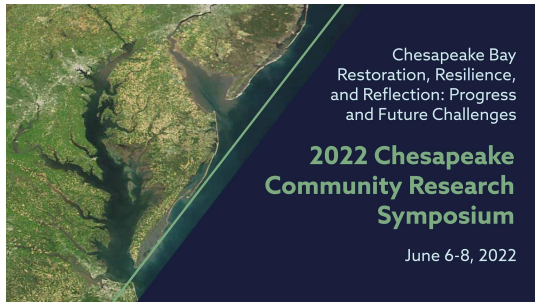

Other Experiences This Summer

Chesapeake Community Research Symposium

Maryland Department of Natural Resources field work – Franklin Point State Park and Ocean City

Scientific, Technical Assessment and Reporting team meetings networking

Climate Resiliency Workgroup meetings

Compiled partnerships spreadsheet of potential people to engage for tidal marsh restoration work

Chesapeake Bay Program
Science. Restoration. Partnership.

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- Randy Rowel, CRC

What is next for me?

I plan to:

- Graduate from LSU in May of 2023

- Attend law school (I do not yet know where)

- Start a career in environmental law

Questions?