**Coastal Virginia Ecological Conservation**

*Mapping Wetland Change Across the Coastal Regions of Virginia to Identify Areas Most Susceptible to Wetland Loss and Most in Need of Wetland Protection Advocacy*

**Project Team**

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**Project Overview**

***Project Synopsis:***

The Coastal Virginia Ecological Conservation team aimed to determine the vulnerability of tidal wetlands in coastal Virginia in the face of rising sea levels. Our team conducted suitability analyses to predict migration patterns and identify minimally urbanized and agricultural lands suitable for being re-naturalized to facilitate wetland migration. This project provides the partner, Wetlands Watch, with products to communicate information regarding wetlands decline through the end of the century, and advocate to lawmakers for the re-naturalization of urbanized land cover to mitigate ecosystem loss.

***Abstract:***

Wetlands provide many ecosystem services to coastal regions, such as water quality improvement, carbon sequestration, and flood control. However, sea-level rise poses a threat to wetlands and coastal communities. Wetland areas are declining as they are forced to migrate inland, and communities are exposed to heightened risks of inundation and storm surge. We partnered with Wetlands Watch, an environmental non-profit that aims to protect wetlands through education, advocacy, and community engagement. This project used Landsat satellites, lidar-derived products, and tidal data to determine the vulnerability of tidal wetlands and predict migration patterns. We conducted a binary suitability analysis, using maximum wetland migration capacity, slope, future locations of the intertidal zone, and anthropogenic barriers to estimate the future extent of wetlands on a decadal scale from 2030 to 2100. By the end of the century, we estimated a 78% decline in tidal wetland area. We also identified developed land suitable for being re-naturalized to facilitate wetland migration. Minimally urbanized and agricultural lands that overlap with potential locations for tidal wetlands are the most optimal for being converted. However, re-naturalization does not mitigate the overall wetland loss observed through the end of the century. This data can be used by Wetlands Watch to communicate the rising threat that wetlands face in response to sea-level rise and underscores the feasibility of using remote sensing to study and predict this process. These preliminary findings highlight the need for further research to better understand wetland migration, loss, and prioritization for conservation efforts.

***Key Terms:***

Sea level rise, remote sensing, wetland migration, suitability modeling, predictions, Landsat, lidar

***Application Area:*** Ecological Conservation

***Study Location:*** Coastal Virginia counties and cities: Accomack, Chesapeake, Gloucester, Hampton, Isle of Wight, James City, Matthews, Newport News, Norfolk, Northampton, Poquoson, Portsmouth, Suffolk, Surry, Virginia Beach, Williamsburg, and York.

***Study Period:*** 2008 to 2024, Forecasting to 2100

***Community Concerns:***

* The Hampton Roads area is among the most vulnerable regions in the United States when it comes to the effects of sea-level rise, second only to New Orleans in terms of risk. Hampton Roads’ low-lying coastal plain and proximity to the Atlantic Ocean and Chesapeake Bay expose it to heightened risks of inundation and storm surge events. Additionally, local land subsidence amplifies the impacts of rising sea levels.
* Coastal wetlands are vulnerable to the effects of sea-level rise, leading to increased inundation, erosion, and loss of habitat. Their degradation exposes vulnerable populations to increased risk of flooding and threatens the integrity of infrastructure and regional ecosystems. Prioritization of conservation efforts for wetlands are essential for preserving the services to Virginia communities.

***Project Objectives:***

* Determine feasibility of using remote sensing techniques to aid in understanding how wetlands have and will migrate because of sea level rise
* Map the extent of current wetlands and how they have evolved over recent history
* Develop a model that accurately calculates future intertidal zones accounting for subsidence and sea level rise
* Produce communication products that can be used to advocate change to lawmakers and educate the general public

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** | **Sector** |
| **Wetlands Watch** | Mary-Carson Stiff, Executive Director; Gabi Kinney, Community Engagement Project Manager | End User | Public Sector |

***Decision-Making Practices & Policies:***

Wetlands Watch is a nonprofit advocacy group based in Norfolk, Virginia that works to protect Virginia’s wetlands through education, legislation, and community engagement. At a policy level, Wetlands Watch uses activism to influence local government land use and regulatory decisions, and advocate for state and federal policy. Enhanced legal protection of wetlands at the state level is increasingly important for them in the wake of the *Sackett v. The Environmental Protection A*gency ruling, which removed federal protections of up to 63% of wetlands.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 7 ETM+** | Surface Reflectance | Used to qualitatively visualize the change in vegetation between 2008 and 2023 before using the USGS National Land Cover Database. |
| **Landsat 8 OLI** | Surface Reflectance | Used to qualitatively visualize the change in vegetation between 2008 and 2023 before using the USGS National Land Cover Database. |

***Ancillary Datasets:***

* National Oceanic and Atmospheric Administration Tidal Monitoring Stations – Measure the intertidal zone for different locations in the study area
* Chesapeake Bay Program Land Use/Land Cover Data Project – Identify current wetland extent.
* USGS National Land Cover Database – Identify anthropogenic barriers to wetland migration
* USGS 3-Dimensional Elevation Program – Digital Elevation Model, Slope Map Derivative

***Software & Coding Languages:***

* ArcGIS Pro 3.2.0 – Raster manipulation and map production
* Google Earth Engine Application Programming Interface (API) – Processing of Digital Elevation Model (DEM) and visualization of Color Infrared Imagery of Poquoson, Virginia

***End Products:***

|  |  |  |
| --- | --- | --- |
| **End Products** | **Datasets Used** | **Partner Benefit & Use** |
| **Future Wetlands Extent Maps** | Chesapeake By Program Land Use/Land Cover, United States Geological Survey National Land Cover Database, United States Geological Survey 3-Dimensional Elevation Program, National Oceanic and Atmospheric Administration Tidal Monitoring Stations | These maps show the projected wetlands extent for every decade from 2030 to 2100. The partner can use these maps to explain to the community the risks that wetlands are facing. |
| **Urban Conversion Maps** | Chesapeake By Program Land Use/Land Cover, United States Geological Survey National Land Cover Database, United States Geological Survey 3- Dimensional Elevation Program, National Oceanic and Atmospheric Administration Tidal Monitoring Stations | These maps show anthropogenic barriers within the future wetlands extents that can be converted from developed land to wetlands. Wetlands Watch can use these maps to recommend areas for re-naturalization to private, federal, and state organizations. |

***Product Benefit to End User:***

Wetlands Watch has a small staff and does not have the current capacity to conduct geospatial analysis or create their own maps with which to advocate for the protection of wetlands. Representatives of Wetlands Watch will be present at the 2024 General Assembly, allowing the opportunity to advocate for the protection of wetlands to state lawmakers. They can use statistics, graphs, and maps produced from this project to foster a more engaging and beneficial discussion with legislators about the importance and the fate of wetlands in Virginia, ideally leading to more robust protections for wetlands in the state.

**References**

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