Habitat Conservation for Climate Adaptation: Initial Lessons from the Field

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LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

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Introduction

Coastal managers from state to local levels are seeking to develop and implement climate adaptation plans. Conservation of natural habitats can be part of a comprehensive strategy for adapting to climate change, and public and private organizations recognize the need to consider climate impacts in the prioritization of natural resource protection areas.[1]

The State of Maryland is a leader in conservation planning and addressing climate change. The state's 2008 Climate Action Plan identified the need for natural resource protection in the face of sea level rise and recommended that the state direct its protection and restoration activities to strategic, high-priority resource areas. The Maryland Department of Natural Resources (DNR) has several efforts underway to proactively identify statewide coastal land and water resources that provide important wildlife habitats, have regional significance for migratory birds, protect coastal communities from storm surge and erosion, sequester large amounts of carbon, provide sediment and nutrient water-quality benefits, and generate economic benefits through farming, forestry, fishing, and passive recreation. One of these efforts, GreenPrint Maryland, which uses state green and blue infrastructure assessments to identify the most ecologically important lands, will be further refined to include climate change priorities.

The very coastal habitats that have the potential to protect human communities from some climate change impacts are themselves at risk from the effects of climate change, particularly sea level rise, erosion, and storm surge. In 2009, Maryland received a National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center-sponsored Coastal Management Fellow to help determine conservation and management actions that would enhance the state's ability to increase the resilience of coastal habitats. The project involves spatial analysis in a geographic information system (GIS) to produce an assessment tool for evaluating and ranking parcels for state land acquisition by effectively incorporating climate change considerations into the state's existing conservation priorities and programs. Armed with this information, state and local conservation organizations can take a more climate-strategic approach to land acquisition and make choices with an understanding of the benefits for climate adaptation.

The NOAA Coastal Services Center provided spatial analysis advice to Maryland and, working with the state, identified initial project considerations for conservation- or ecosystem-based climate adaption planning that can benefit others undertaking similar efforts. These project considerations are highlighted in this document:

- **Narrowing Your Focus**
- **Using or Modifying Existing Conservation Plans**
- **Defining a Geographic Scale**
- **Assessing Available Data and Filling Information Gaps**
- **Selecting Models and Methods**
- **Resources for More Information**

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[1] A. Colls, N. Ash, and N. Ikkala. 2009. *Ecosystem-Based Adaptation: A Natural Response to Climate Change*. Gland, Switzerland: IUCN. 16 pages.

Narrowing Your Focus

- Choose one climate impact for immediate focus
- Identify key adaptation strategies for the chosen climate impact
- Identify criteria for selecting conservation areas that implement adaptation strategies

Many climate impacts could be considered when identifying conservation priorities (e.g., temperature shifts, precipitation changes, and sea level rise). The range of climate impacts can be intimidating, and an adaptation strategy for one impact may offset the strategy for another. Concentrating on one impact at a time can provide clarity and improve progress, and additional impacts can be added into the analysis at a later time. Use a steering committee or local experts to determine the most important impact for immediate consideration.

Once the focus is narrowed to a specific climate impact, use climate literature, local experts, and stakeholders to identify possible strategies that will facilitate adaptation by natural and human communities to the selected impact. Adaptation strategies should be developed to a level of detail that allows for criteria that can prioritize specific conservation areas to implement the adaptation strategy. These criteria will help define steps and specific data needed for GIS spatial analysis.

Maryland Application

The project team narrowed the immediate focus to the impacts of sea level rise. A workshop brought together local experts and stakeholders to identify key sea level rise adaptation strategies most suitable for the area.

At the workshop, four topical focus groups (aquatic and terrestrial ecosystems, transportation and land use, human habitat and health, natural resource-based industries and agriculture) narrowed consideration to 12 key adaptation strategies. Maryland's coastal fellow further narrowed the project scope by considering factors such as the commonalities between adaptation strategies, spatial data needs and availability for analysis, and clarity and consensus of spatial criteria that could be used to analyze areas for their specific adaptation potential.

Sea level rise adaptation strategies that were considered include preserving habitat migration corridors, protecting suitable habitat, preventing development in high risk areas, and increasing conservation of natural areas that can protect human communities from storm surge. Spatial criteria for these types of adaptation strategies include spatial overlap with existing priority habitats, presence of habitat migration barriers (e.g., impervious surface), upslope from coastal marshes with potential to migrate inland with rising seas, proximity to already protected areas, and proximity to community developments. The project team continues to develop criteria with sufficient spatial detail to incorporate into a GIS analysis of the state's coastal landscape.

Using or Modifying Existing Conservation Plans

- Identify existing conservation planning efforts
- Decide if the current project will benefit from existing efforts

Building from existing conservation planning efforts can build partnerships toward a common goal and reduce duplication by using available knowledge, data, and analyses. Consider connecting with a variety of planning efforts, including hazards, smart growth, and climate adaptation, to allow conservation priorities to be integrated holistically.

Maryland Application

Maryland's Program Open Space is a highly successful state-funded land conservation program. In an effort to strategically and effectively achieve the greatest conservation benefit from the state's land conversation funds, Maryland DNR completed statewide green and blue infrastructure plans to help target lands and sensitive aquatic areas for protection and restoration. Both plans used GIS analyses to identify a network of high-protection-priority coastal, aquatic, wetland, and forest habitats. GreenPrint Maryland, a program that uses these resource assessments to identify the most ecologically important lands in the state, provides accountability and performance measures to track where the state is spending its conservation dollars. Delivered through an interactive mapping system, GreenPrint Maryland allows conservation partners to work together in a complementary and strategic fashion.

Maryland's coastal fellow is leveraging this work to analyze priority habitats with potential marsh migration and storm surge impact information and additional criteria, effectively adding climate change conservation priorities as an additional element. The result will be the identification of priority habitats and adjacent locations that are most likely to facilitate adaptation to sea level rise. These additional land conservation criteria will be integrated into the targeting and project-scoring methods in place through GreenPrint Maryland.

Defining a Geographic Scale

- Consider the scale needed to accomplish the project goals and whether the project can or should be completed in sections
- Match project scale to that of existing data and planning efforts being leveraged

Defining a geographic scale is important when doing any GIS analysis. Project goals and the geographic extent of the analysis should determine the most appropriate scale. For conservation projects, consider the types of habitats to be evaluated and the scale at which they function. Because systems and habitats are interconnected and may not function in isolation at a small parcel level, landscape-level conservation is often the appropriate initial analysis scale for assessing ecosystem-based climate change adaptation strategies. This type of analysis can later be considered in conjunction with additional data and analysis at a finer scale. The resolution of the spatial data used for analysis must match project goals. Analysis of small features and changes will require high-resolution data sources. Also consider the scale of data used from existing planning efforts. For large study areas, it is often useful to test the analysis process on a smaller subsection of the full area. Piloting the process can identify early on if revisions are needed to the original procedures.

Maryland Application

The goals of the project were to conduct analyses that incorporate sea level rise impacts into conservation priorities and develop a tool to evaluate parcels for protection. To accomplish this, the project team is conducting analyses at both the landscape scale and at the parcel level. The state's green and blue infrastructure assessments were created from a landscape-scale GIS analysis, and

therefore the project team was able to build from that effort to identify additional priority habitats. For every parcel considered by the Maryland DNR land acquisition and planning team, the quantitative landscape-scale data and the data that are relevant at the parcel scale are summarized in a conservation scorecard. These scorecards provide a numeric ranking for every parcel under consideration and allow resource managers to invest limited state funding into the most ecologically important projects. Additional climate change criteria will be added to this scoring system and incorporated as an element of the conservation scorecard.

Assessing Available Data and Identifying Information Gaps

- Identify available data to prioritize areas for protection
- Identify gaps in data and information

To conduct analyses to identify priority areas for climate change adaptation, an inventory of geospatial data and information must be conducted. The data can be used in a GIS to apply criteria and identify priority areas. Information gaps are common and, if possible, should be filled to achieve more accurate results and better address the climate change impact. For example, elevation data are needed to create sea level rise and storm surge scenarios and to run marsh migration models. High-resolution elevation data are needed to yield credible results for site-specific planning and assessment. Filling information gaps and ensuring the data cover the entire geographic scope of the project may become a significant and time-consuming part of the effort to incorporate climate change impacts into conservation priorities.

Maryland Application

Maryland created a data inventory and acquired data outputs from the Sea Level Affecting Marshes Model (SLAMM). Because the SLAMM outputs did not include the newest lidar elevation data available for the region, the model needed to be rerun to incorporate the latest data. Storm surge had been modeled using the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. However, existing outputs did not include potential storm surge extent given a higher sea level scenario, something Maryland wanted to consider in its analysis.

Selecting Models and Methods

- Identify existing models and methods options
- Understand the data and expertise needed to use the models and methods
- Select a model or method based on available data, the team's technical capabilities, and the end goal

Explore available climate models and methods to find the ones most appropriate for use or that can be acquired within the scope of the project. In some cases, all the data needed to run a model do not exist and will need to be created. For example, many states do not have the lidar-based digital elevation models (DEMs) necessary for running models. It is also important to select a model or method that matches the project team's technical capabilities. While evaluating models and methods, identify the technical skills necessary and ensure the project team either has those skills or can acquire them. Finally, the outputs and results of the chosen model or method should be well understood and accurately interpreted to ensure that the model results support the end goal of the project.

Maryland Application
The project team investigated the available marsh migration models and decided to use the predictive model SLAMM, version 6.0. This model was chosen because the state has high-resolution DEMs for all coastal counties, as well as localized data that the model can accommodate, such as sediment accretion rates.

The team decided to use the SLOSH model to consider storm surge that incorporates sea level rise. The team members needed to build technical skills to understand the dynamics of the SLOSH model and attended the Center's Coastal Inundation Mapping training to equip them with that knowledge.

The results from these models will be incorporated into the landscape-scale analysis, and additional criteria will be applied to determine priority conservation areas that facilitate both natural and human adaptation to sea level rise. These specific model outputs will be ranked using the existing targeting models; the ranked outcome will be incorporated into parcel scorecard assessments for state land acquisitions.

Resources for More Information

- Coastal Inundation Mapping Course
  www.csc.noaa.gov/digitalcoast/training/inundationmap.html
- Coastal Lidar Data
  www.csc.noaa.gov/digitalcoast/data/coastallidar/index.html
- GreenPrint Maryland Map
  www.greenprint.maryland.gov/
- International Union for Conservation of Nature Ecosystem-Based Management Adaptation
  http://cmsdata.iucn.org/downloads/iucn_eba_brochure.pdf
- Maryland Coastal Land Conservation and Sea Level Rise
  www.dnr.state.md.us/ccp/habitats_slr.asp
- Maryland Blue Infrastructure Assessment
  www.dnr.state.md.us/ccp/bi.asp
- Maryland Green Infrastructure Assessment
  www.dnr.state.md.us/greenways/gi/gi.html
- Sea, Lake, and Overland Surges from Hurricanes (SLOSH) Model
  http://slosh.nws.noaa.gov/sloshPub/index.php?L=7
- Sea Level Affecting Marshes Model (SLAMM)
  www.csc.noaa.gov/digitalcoast/tools/slamm/index.html