PROGRESS REPORT

Cooperative Agreement No: F15AC00027

Project Title: **Identifying Resilient Sites for Coastal Conservation,** part of Department of the Interior Project # 24, Decision Support for Hurricane Sandy Restoration and Future Conservation to Increase Resiliency of Tidal Wetland Habitats and Species in the Face of Storms and Sea Level

Reporting Period: January 1, 2016 through June 30, 2016

Receipt Organization: The Nature Conservancy

Project Leader: Dr. Mark Anderson

Were planned goals/objectives achieved last quarter? Yes, this was an extremely productive period for us. We launched the steering committee and finalized the methods for mapping salt marsh migration space. On bi-monthly steering committee calls, we had an excellent discussion on what constitutes a resilient coastal site and what characteristics impart resilience. We followed this up by developing methods for mapping buffer area, coastal response, tidal height variation, water quality, and sedimentation. The team reviewed the results of each analysis, and we are now working to finalize each one as well as develop additional characteristics related to coastal geomorphology, sediment input, flushing, topography, and soils.

NALCC Conservation Need Addressed: Decision Support for Hurricane Sandy Restoration and Future Conservation to Increase Resiliency of Tidal Wetland Habitats and Species in the Face of Storms and Sea Level

Progress Achieved: (For each Goal/Objective, list Planned and Actual Accomplishments)
This quarter begin with a transition of the lead analyst from Charles Ferree to Analie Barnett. This was followed by a launch of the steering committee and the analysis and preparation of materials for two calls. On each call the committee reviewed results for the study region and provided feedback on their accuracy or acceptability, and discussed key concepts on how to measure ecological resilience. Specifically, we had hoped to 1) run the salt marsh model at 10 meters for the whole region. 2) Compare the results of our pilot to the NOAA SLR model to identify its potential utility. 3) Create marsh units: assemble aggregate salt marsh, or whole estuary units from existing polygons, and estimate migration space for other habitats and 4) Begin to incorporate geophysical and biodiversity data into the site characterizations. We accomplished 1-3 within the first three months and spent most of our time on the fourth task

January - February 2016
Obtained and process NOAA SLR Viewer marsh migration data for comparison with the pilot area for which Charles Ferree (CF) had developed a logistic regression model to predict salt marsh migration space under different sea level rise scenarios for the state of Massachusetts. Performed spatial analysis to compare NOAA SLR Viewer marsh migration model with CF salt marsh migration model. Explored development of appropriate units for marsh migration space and discuss other marsh migration approaches with TNC staff and Brad Compton. Developed work plan for the project

March – April 2016
Steering committee
We researched and invited a group of 40 coastal ecologists representing all the states in the region as well as a few national and/or southeast focused ecologists. As the team primarily represented NGOs and academics we expanded it after the first call to include 12 agency staff from the Northeast. Both calls have been well attended with excellent participation and discussion.

Salt Marsh Migration
Prepared for and launched the first steering committee call for which our goal was to describe the project, identify potential metrics to assess coastal resilience, and to compare the NOAA SLR viewer marsh migration space with three existing approaches: MA logistic regression model, VA SLAMM model, ME NHP Tidal Wetland Migration model. To create the comparisons, we met with the VA and ME folks, talked through their methods, and then obtained their spatial data and overlaid it with the NOAA SLR model. The comparisons were very detailed and showed few differences between the various approaches. Based on this comparison, we developed an approach to create three analysis units: 1) tidal complexes, 2) marsh migration space, and 3) natural buffer space. We spatially linked all the analysis units and calculated approximately 20 metrics for each of the three units. We then conducted several queries to illustrate to the steering committee during our first call, how the metrics might be used by practitioners. The call was very well attended and we ended up with the following points of agreement.

- Use the simplified NOAA SLR data for estimates of migration space
- Incorporate "transitional marsh" into the space model
- Create a buffer area as defined by local connectedness and watersheds
- Run <u>multiple</u> scenarios of inundation, not just 3 ft/1 meter – maybe continuous
- Stratify results using Coastal Shoreline Units - perhaps even more finely cut.

We also received a lot of comments on various aspects of the project, several of which we addressed on the next call. These included a request to agree on the basic concept of a resilient coastal site, to be explicit about non-marsh components, tidal flats, shell fish, swamp, beach and the degree to which marsh migration/ buffer area is a proxy for all coastal habitats (beaches, tidal flats, rocky shore, seagrass, shell fish). We also got a list of characteristics for the migration and buffer space which we are now working of. These are discussed below.

May-June 2016

Concepts
We developed a conceptual model and working definition model of a resilient coastal site. We kicked off the second call by discussing and agreeing on the concept of a resilient site:
"The capacity of a site to support diversity, productivity, and ecological function as the climate changes. The resilience of a coastal site is measured by its available options such as space for migration and movement, a diversity of available habitats and microclimates, high quality soil and water with unimpeded inputs, connectedness among natural systems. We assume the composition and relative abundance of communities and species will change to track the changing climate and water levels. Resilience is not a direct measure of loss "

There was high agreement on this definition. Two participants noted that it was tricky to stay focused on the resilience of a site, easy to slip into resilience of a system.

Resilience Characteristics
We developed and presented maps and analysis for five characteristics suggested on the first call:

<u>Sites and Space</u>:
We created and reviewed the three interlinked units:

- Current tidal complexes > 5 acres (Data Source: 2010 CCAP estuarine classes: estuarine emergent/scrub shrub/forest, unconsolidated shore, beach),
- Migration space for current tidal complexes (Data Source: NOAA SLR Viewer 10 m data),
- Buffer area: Natural land surrounding migration space and current tidal complexes. (Data Source: 2011 NLCD with local connectedness)

These were shown in various parts of the study area, and we discussed and agreed that they would work. It was agreed that **Space** itself, measured as the size of the unit, was an important resilience characteristic that allowed for options.

<u>Response Type</u>

We met with Erika Lenz to understand her spatially explicit coastal response model (Lenz et al (2016) and then obtained the data and integrated the model into our spatial units (tidal complexes and migration space) to identify areas that might responded dynamically as opposed to statically to sea level rise. We showed the results to the steering committee and the response was generally positive although there was concern that the results are overly sensitive to error in the land cover accuracy. Also the fact that so much of the shoreline scores "about as likely as not" it was noted that it might not provide very much information.

<u>Range of Tidal Thresholds</u>

We calculated the types and variety of tidal threshold present in the migration space units using the NOAA sea level rise data in a novel way. Our rationale was that migration space with more tide levels have increased resilience because they offer more options for ecological processes and species. Response from the steering committee was that this metric made sense although there were questions about how it correlated with tidal amplitude and whether the thresholds were correct.

<u>Water Quality – Nitrogen Yield</u>

Nutrients is single largest pollution problem impacting US coastal waters and higher eutrophication translates to a restricted ability to adapt and lower resilience. After examining several approaches for quantifying nutrient inputs (e.g. National Fish Habitat Action Plan Coastal Index, Northwest Atlantic Marine Assessment Coastal Water Quality Index) we settled on the USGS SPARROW 2002 regional surface water quality models. We updated this model by developing a strong and significant statistical relationship between the 2002 model results and the 2002 land cover types, and then using this relationship to estimate N inputs based on 2011 land cover data. Next we calculated the drainage area-weighted avg. N class for each buffer unit in the region. The response of the team was that the methods sounded good and the results looked credible.

<u>Sediment Inputs.</u>

We used Natural Capital's InVEST sediment delivery model USLE to create a draft map overland sediment generation and delivery to the stream. This model is complex and requires seven inputs:

1) DEM (NHDPlus v2 hydrologically modified DEM)
2) Land Use (NLCD 2011)
3) Erodibility (SSURGO kfactor grid)
4) Rainfall erosivity (Renard et al. 1997)
5) Watershed summary unit (WBD HUC12 polygons)
6) USLE cover factor for each LULC
7) USLE practice factor for each LULC

The outputs are useful estimates of sediment export (tons/pixel), and sediment export (tons/watershed). We did not have time to review this with the steering committee so that will be a priority on our next call.

Goals for the upcoming Quarter include:

Complete the mapping and characterization of physical options by finalizing the coastal response and range of tidal thresholds models and adding in range of sediment/geology types, range of microclimates, and perhaps geomorphic alignment.

Complete the mapping and characterizing of condition characteristics that ensure that expected processes are functioning within the space. This includes finalizing the water quality (N loading) and sediment inputs, and by developing a measure of connectedness, and freshwater flushing.

Integrate the characteristics into a single model that estimates the relative resilience of each coastal site within coastal shoreline unit types and within the region. Continue to engage the steering committee and begin preparing the final report

Expected End Date: February 28, 2017 (Note: we received a no cost extension to this date)

Employment Information:
As required by the terms of this Agreement, we are reporting that no Veteran or Youth have been hired during the period of this report.

Signature:

Mark Anderson
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Date: July 28, 2016