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Investigation of the Effects of Sea Level Rise on Sea Turtle, Shorebird, Seabird, and Beach Mouse Nesting Distributions Within the South Atlantic Landscape Conservation Cooperative Region

INVESTIGATION OF THE EFFECTS OF SEA LEVEL RISE ON SEA TURTLE, SHOREBIRD, SEABIRD, AND BEACH MOUSE NESTING DISTRIBUTIONS WITHIN THE SOUTH ATLANTIC LANDSCAPE CONSERVATION COOPERATIVE REGION

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Sea level rise (SLR) and disturbances from increased storm activity are expected to diminish coastal habitats available for sea turtle, seabird, shorebird, and beach mouse nesting by removing habitat as well as inundating nests during critical incubation periods. The goal of our research is to evaluate past nesting patterns of coastal nesting species and predict effects of sea level rise along the South Atlantic Bight. Maps of coastal vulnerability to SLR combined with historical data sets of long-term and spatially extensive nesting habitat will lead to models that enhance our understanding of the environmental changes occurring from climate change and their effects on species. The results will equip policy makers and natural area managers with the ability to prioritize those areas which will need the greatest conservation intervention. In this poster, we will outline our objectives and present our work, which is in progress.

The coastal study areas include nesting beaches for fourteen species from North Carolina south to Melbourne, Florida. Our study links long-term survey data for four species of sea turtle, three species of shorebird, five species of seabird, and two beach mouse species to maps of coastal vulnerability to sea level rise (SLR) to understand the effects of sea level rise on population viability and socioeconomic effects. Habitat suitability maps are created for coastal nesting species along the South Atlantic Bight. A model of SLR will be integrated along with biological observations in order to predict vulnerability to nesting habitat loss for species within our study region. Habitat loss vulnerability maps under different predictions of SLR, considering local SLR and eustatic SLR induced by climate change, will allow natural area managers to construct strategies for mitigating the impacts of a changing climate on these coastal nesting species, many of which are threatened and endangered. We plan to estimate the socioeconomic costs of changes in coastal nesting habitats and the benefits of implementing different mitigation strategies. Last, we will estimate future populations of these species with SLR, given survivorship under different development scenarios.

Our first objective is to create habitat suitability maps for fourteen coastal nesting species. Coastal nesting habitats are subject to disturbance, i.e., erosion, accretion, and overwash, as a

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result of regular tidal and extreme storm events. Nests of turtles, shorebird, and seabird species are regularly washed out with storm surges. The spatial (location, elevation and distance from the high water line, nest depth) and temporal nesting behaviors influence the susceptibility of different species to flooding. In addition to simply reducing the available nesting habitat, the frequency and extent of these disturbance events are thought to be exacerbated as a result of SLR; thus, storm surge events expected every 100 years may become 40-year events.

SLR estimates vary geographically depending largely on mesoscale hydrodynamics and geology. Thermal expansion is estimated to produce an 18-60 cm rise by 2100 with an average of 4.2 mm per year until 2080. Recent evidence suggests that sea level may rise more rapidly than previously predicted, due to an accelerated rate of ice loss from the Greenland Ice Sheet. Low lying narrow coastal and island beaches are particularly sensitive to SLR and are especially vulnerable when coastal development prevents landward migration of beaches.

We are in the process of integrating all GIS and location-specific data of nests and burrows collected across our study region into a data layer for this study. We are using 2005-2010 annual surveys for sea turtle nests, 2-3 survey years (depending on subregion) for seabird and shorebird locations, and 2005-2010 annual surveys for beach mouse distributions to map the extent of nesting locations for each species along the coastline of our study area. Coastal habitat will be ranked based on relative density of nests, nesting pairs, or burrows, which will determine its relative importance, or habitat suitability, for each species.

Our second objective is to integrate the USGS SLR Coastal Vulnerability Index with known distributions of coastal nesting species to visually present coastal nesting species habitat vulnerability across the South Atlantic Bight. Sea turtles seabirds, shorebirds, and beach mice generally have a high level of nesting site fidelity. We will produce spatially explicit nest density maps with GPS data for the different species across the coastline abutting the South Atlantic Bight using historic beach mice, sea turtle, seabird, and shorebird nesting data. These will provide primary locations along the shoreline and from high tide lines along with elevation information derived from existing, recent airborne LiDAR.

Our third objective to explore the socioeconomic costs of the effects of sea level rise and storm surges on coastal nesting species and the socioeconomic benefits of adaptation strategies. We hypothesize that the regions with the greatest levels of coastal nesting species and highest chance of inundation due to SLR will experience the greatest economic losses. To complete our understanding of the effects of SLR on coastal species nesting distribution we will: 1) estimate the socioeconomic costs of changes on turtle, shorebird, seabird and beach mouse nesting distribution; and 2) estimate the socioeconomic benefits of some adaptation/response strategies.

In sum, we will present preliminary data analyses and maps for objective one as well as our proposed research for objectives two and three. With the results from our study, planners and decision makers will be able to choose from a portfolio of mitigation techniques for policies relevant to coastal nesting species. There is an urgent need to determine long-term plans so that the most cost-effective strategies of reducing the effects of sea level rise on coastal species can be determined.