Effects of Sea Level Rise and Climate Variability on Ecosystem Services of Tidal Marshes, South Atlantic Coast

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The investigators employed field and laboratory measurements, geographic information systems (GIS), and simulation modeling to investigate how tidal marsh area and delivery of ecosystem services will be affected by accelerated sea level rise (SLR) along the South Atlantic (GA-SC) coast. Different habitats of tidal marshes provide different quantities of ecosystem services. For example, aboveground biomass was 40 to 70 percent greater in tidal freshwater and brackish marshes than in salt marshes. Tidal freshwater and brackish marshes also provided greater waste treatment per unit area than did salt marshes. These marshes sequestered three times more N in soil and supported two to three times greater potential denitrification than salt marshes.

Model simulations using the IPCC mean (52 cm) and maximum (82 cm) estimates of SLR by 2100 for the Georgia coast suggest that salt marshes will decline in area by 20 percent and 45 percent, respectively. Tidal freshwater marshes will increase by 2 percent under the IPCC mean scenario but will decline by 39 percent under the maximum scenario. Delivery of ecosystem services associated with productivity (macrophyte biomass) and waste treatment (N accumulation in soil, potential denitrification) also will decline. These findings suggest that tidal marshes at the lower and upper salinity ranges and their attendant delivery of ecosystem services will be the most affected by accelerated SLR unless geomorphic conditions (i.e., gradual increase in elevation) enable tidal freshwater marshes to migrate inland, or vertical accretion of salt marshes increases to compensate for accelerated SLR.

The effects of climate variability were evaluated by analysis of climate (rainfall, temperature, salinity, freshwater discharge) and selected ecosystem services data collected from 2000 to 2006 from permanent plots of 10 marshes of the Georgia Coastal Ecosystems Long Term Ecological Research (LTER) study domain. The data revealed that river discharge was the most strongly correlated with the measured ecological variables. Discharge was positively correlated with *Spartina alterniflora* aboveground biomass and sediment deposition. *S. alterniflora* on the marsh plain also was positively correlated with precipitation. Salinity was inversely correlated with freshwater discharge. Increasing salinity was associated with reduced *S. alterniflora* aboveground biomass and greater numbers of fiddler crabs. There was no association between temperature and the measured ecological variables.

This work provides a basis to: (1) understand how ecosystem services vary among salt-, brackish-, and tidal freshwater marshes; (2) determine how sea level rise will alter marsh area and delivery of ecosystem services; and (3) elucidate how climate variability affects temporal patterns of macrophytes, epifauna, and sediment deposition.

Reference:

Craft C, Clough J, Ehman J, Joye S, Park D, Pennings S, Guo H and Machmuller M. Forecasting the effects of accelerated sea level rise on tidal marsh ecosystem services. *Frontiers in Ecology and the Environment* 2009;7:73-78.

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