

Climate Change and Coastal Refuge Dynamics: The Case of Cape Romain National Wildlife Refuge

Chris Ellis, National Oceanic and Atmospheric Administration, Coastal Services Center,
2234 South Hobson Avenue, Charleston, SC 29405; chris.ellis@noaa.gov

Raye Nilius, US Fish & Wildlife Service, South Carolina Lowcountry Refuges Complex,
5801 Highway 17 North, Awendaw, SC 29429; raye_nilius@fws.gov

CLIMATE CHANGE IS THE MOST COMPELLING CONSERVATION CHALLENGE OF OUR TIME. Accelerating climate change will affect our nation's fish, wildlife, and plant resources in profound ways. While many species will continue to thrive, some populations may decline and in some instances, go extinct. Others will survive in the wild only through direct and continuous intervention by managers. This defining challenge for the conservation community requires the U.S. Fish and Wildlife Service (USFWS) and its employees and partners to apply the skill, determination, creativity, and commitment to conserving the nation's natural resources that have defined the American conservation movement since its inception more than 130 years ago.

The USFWS draft Climate Change Strategic Plan establishes a basic framework within which the USFWS and its employees will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, and habitats in the face of accelerating climate change. The plan employs three key strategies to address climate change: adaptation, mitigation, and engagement. Adaptation refers to planned management actions the USFWS will take to help reduce the impacts of climate change on fish, wildlife, and their habitats. Mitigation involves reducing our carbon footprint by using less energy, consuming fewer materials, and appropriately altering our land management practices. Engagement involves reaching out to Service employees; local, national, and international partners in the public and private sectors; key constituencies and stakeholders; and the broader citizenry of this country, to join forces and seek solutions to the challenges to fish and wildlife conservation posed by climate change.

Cape Romain National Wildlife Refuge (refuge) is 66,287 acres of land that extends 22 miles along the South Carolina coast. The refuge is comprised of barrier islands, salt marshes, tidal flats, and open water, all of which lie to the east of the Intracoastal Waterway. The elevation of most of these lands is less than 5 feet above mean sea level. Nearly 29,000 acres of the refuge is federally designated wilderness. The refuge was originally established for the protection of migratory birds, because of its importance on the Atlant -

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ic migratory flyway. The refuge is also home to the largest nesting population of loggerhead sea turtles north of Florida.

The effects of a changing climate on the refuge will mostly be from a rising sea level, causing accelerated beach erosion, submergence of extensive salt marsh habitats that account for 45% of the refuge, and conversion of salt marsh to tidal flats and open water. The coastal zone is dynamic, and the response of coastal areas to sea-level rise is more complex than simple inundation. Erosion is a natural process from waves and currents, and sea-level rise exacerbates coastal change by accelerating erosion rates. These effects of climate change are currently altering habitats, and adding pressure to vital habitats for threatened species, such as the loggerhead sea turtle and piping plover.

Accelerated rates of sea-level rise will inhibit some of the major functions of salt marshes and coastal beaches. Coastal development, hardened barriers, and dredged boat channels now prevent landward migration of these coastal habitats. However, there are many tidal creeks and wetlands on adjacent lands that may provide future habitat for wildlife to adapt to these changing conditions. There are many vulnerable species that rely on these habitats, including several species of migratory birds, such as the American oystercatcher, and commercially important fish and shellfish.

Accelerated beach erosion

Accelerated beach erosion will destabilize and fragment the islands within the refuge. This will decrease suitable nesting beaches for sea turtles and seabirds, and more nests



will be subject to inundation. Tropical storms and even strong prevailing winds can push water over islands, or create escarpments that cut into the fragile dunes, thus reducing the overall available habitat for trust species (federal trust species includes migratory birds, threatened species, endangered species, inter-jurisdictional fish, marine mammals, and other species of concern). Maritime forest on Bulls Island has been affected as the beach retreats inland, and a levee around the refuge's most significant freshwater impoundment is at risk from rising sea levels. Loss of the impoundment will reduce wintering habitat for several waterfowl species.

Salt marsh submergence

Under normal conditions, salt marshes can keep pace with a moderate level of sea-level rise from sediment inputs and the detritus that builds up within a marsh. As the rate of sea-level rise increases, salt marshes will not be able to keep pace, and gradually degrade and become submerged. Three key determinants of future tidal marsh acreage are the capacity of the marsh to raise its surface to match the rate of rising sea level, the rate of erosion of the seaward boundary of the marsh, and the availability of space for the marsh to migrate inland.

A recent study determined that headward erosion within tidal creeks in the salt marsh is occurring at a rate of 1.9 meters per year (Hughes et al. 2009). Where tidal marshes become submerged or eroded, the loss of habitat would negatively affect numerous wetland-dependent species. Bird species that rely on island habitat for protection from predators would be forced to abandon key nesting areas.

Reference

Hughes, Z.J., D.M. FitzGerald, C.A. Wilson, S.C. Pennings, K. Wieski, and A. Mahadevan. 2009. Rapid headward erosion of marsh creeks in response to relative sea level rise. *Geophysical Research Letters* 36:1–5.