

Life in the Wild

News from Cape Romain, Ernest F. Hollings ACE Basin, Santee and Waccamaw National Wildlife Refuges

Cape Romain's Beach Babies

For the past thirty years Cape Romain's Turtle Recovery Team has spent six months a year patrolling refuge beaches. They are on a mission. Through storms, the summer's heat, and swarming insects, the Team works seven days a week searching for and safeguarding Loggerhead sea turtle nests. While the beaches on three refuge islands support 23% of the northern subpopulation of nesting Loggerheads north of Florida, nearly three fourths of all nests are laid on Cape Island.



Helena Jenkins, a volunteer on the Turtle Recovery Team, holds a rescued Loggerhead sea turtle.

Photo: Steve Hillebrand, USFWS

In many cases, the female turtles that nest on the refuge today may be those that were born on the refuge 25 to 30 years ago. When nesting season begins, they swim to the islands, crawl up out of the surf onto the land, and search for a nesting site. Whether they choose to lay their eggs on the beach, or return to the sea without laying their eggs, there is no mistaking whether or not they visited the beach. They use their flippers to drag themselves across the beach, creating distinctive tracks in the sand. Anyone

who comes across one of those tracks knows that a turtle has been by to visit. The female turtle uses her powerful rear flippers to dig a nest chamber in the soft sand. When the chamber is prepared, the female turtle lays 100-125 eggs. She then covers the eggs with sand, smooths the surface over the nest, and returns to the sea. Each year about 1,000-1,400 nests are laid on the refuge's three nesting beaches. At 100-125 eggs per nest, that amounts to an average of 132,000 eggs every year.

Some turtles return to the sea without laying any eggs. Others choose prime nesting areas, well away from the surf and high enough in elevation that the groundwater doesn't intrude into the bottom of the nest. When the Team finds a nest in a safe location, they mark the nest and place a wire enclosure over it on top of the sand. Approximately 31% of the nests that are found are handled in this fashion. The enclosure placed over the nest usually prevents raccoons from digging up the eggs. In the past few years mink have appeared on the islands. The enclosure does not prevent mink from digging up the eggs and mink predation on the eggs as well as the hatchlings has been observed in the last few years.

Today 69% of all the turtle nests must be dug up and relocated because they were laid in areas subject to groundwater intrusion or over-wash. Ten years ago less than half (44%) of nests had to be relocated. The Turtle Team also moves nests to hatcheries. The hatcheries are used for multiple relocated nests, where they are covered with enclosures. Some visitors have noted that the hatcheries look like gardens. Because the hatching success rate of nests in the hatcheries is very good, it may be more fitting to call them turtle nest victory gardens.

At Cape Romain NWR sea turtle hatchling survival is dependent upon human intervention. We are seeking volunteers and interns to help us manage the turtle recovery program. If you are interested in joining the Turtle Recovery Team, please e-mail Sarah_Dawsey@fws.gov, for more information.

Disaster in the Gulf Who You Gonna Call?

On April 20, 2010, forty-one miles off the coast of Louisiana, the Deepwater Horizon drilling rig exploded, creating what has become one of the worst environmental catastrophes in United States history. The rig was drilling an exploratory well at the Mississippi Canyon, an underwater landform about 5,000 feet below sea level, when highly pressurized methane gas ignited, causing an explosion on the rig, the eventual sinking of the rig, and the tragic loss of 11 lives.



A Brown pelican flies by a containment boom at Breton NWR.

Photo: Tom MacKenzie, USFWS.

Months have passed and each day brings the discovery of new impacts to natural habitats such as marshes and islands along the Gulf Coast. To date, 36 National Wildlife Refuges have either already been impacted by the oil, or are at risk of impact. The damage to wildlife and habitats, and the Gulf Coast people is significant. Oil has coated formerly rich and diverse marshes, shorebird and sea turtle nesting beaches, and severely impacted the livelihoods of shrimpers, fisherman, and others who have relied for generations on the rich supply of shrimp and oysters in the Gulf Coast.

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Habitat Made Possible by ARRA Funding

When President Obama signed the American Recovery and Reinvestment Act (ARRA) of 2009, wading birds and waterfowl at Cape Romain's Bulls Island received an unexpected windfall. The ARRA Act included funding for \$165 M worth of habitat restoration on America's national wildlife refuges. Of that amount, Cape Romain NWR successfully competed for \$879,959. The funding will be used to restore water management capability in interior impoundments on Bulls Island.

Improving management options for interior impoundments on Bulls Island is more important today than ever before. The island is approximately 5,000 acres; 2,990-acres of beach, dunes ridges and swales, managed impoundments, maritime forest, and other habitat types, backed by a 2,010-acre salt marsh. It is a well-known destination off the coast of South Carolina that is cherished by hundreds of thousands of visitors each year, if you include both human and avian. Many human visitors come to walk the island's trails and view birds in the impoundments. Blue-winged teal, Black ducks, Scaup, Wood stork, Roseate spoonbill, and Snowy egrets come to the refuge because the island habitat provides just exactly what they need to survive.

Tough times and hard decisions lie ahead. Each year the island loses about 25 feet of shoreline due to rising sea levels and accelerated erosion. In years past, Jacks Pond, the largest impoundment on the island, supported far more waterfowl than today. Because there is no source of fresh water on the island, other than from rainfall and runoff from adjacent lands, the water in Jacks Pond becomes concentrated over time. Saltwater intrusion alters the chemical composition, affecting the plants and macro-invertebrate communities that would typically provide a rich food source for ducks and other wintering waterfowl during winter migration.

The perimeter levee that forms Jacks Pond is only yards away from the eroding shoreline. At the current rate of erosion, the refuge could lose the levee in about three years, or sooner with a major storm. When the levee goes, the impoundment is likely to revert to a saltwater bay with



*Jacks Pond is the largest managed impoundment on Bulls Island.
Photo: Steve Hillebrand, USFWS*

far less habitat value for waterfowl and wading birds. Sections of the levee have been lost and rebuilt numerous times. However, options for rebuilding the levee are dwindling. A replacement levee would be a costly construction project. In today's austere economic climate, some have questioned the wisdom of seeking federal funding to rebuild a levee that could be lost to sea level rise and erosion in less than a decade.

The ARRA project will allow refuge staff to improve water management capability on interior impoundments that are not likely to be lost to sea level rise in the near future. Better water management means better habitat for migratory birds on the island, an essential component of the refuge's establishing purposes for migratory birds and endangered species.

Disaster in the Gulf, Who You Gonna Call? continued

Sea birds have been oiled when swimming or diving for food in oil laden waters. Sea turtles swim through contaminated areas on their way to nesting beaches. Food sources for birds, sea turtles, and other aquatic life have also been lost due to oil and oil dispersant contamination.

When the call for help went out, Service employees rose to the occasion with a force of strength, expertise and skills. By July 13, 2010, more than 740 USFWS employees had been deployed to support efforts on the oil spill. Many were deployed for air and boat operations and foot patrols in search of oiled or injured animals. Others went to collect and relay important information from Command Centers to the local and national media, or up through the management chain to the Service's Washington Office and Department of Interior. Administrative officers purchased badly needed supplies, maintained records on employee work hours, and supported travel needs.

Eleven employees from South Carolina Lowcountry Refuges have been deployed to assist in the oil spill response effort. Cape Romain, Ernest F. Hollings ACE Basin, Santee, and Waccamaw National Wildlife Refuges have sent managers, administrative officers, biologists, maintenance staff, and fire technicians to work 12 to 17 hours each day, for a minimum of 14 days, often under extreme weather conditions. They responded with enthusiasm, joining thousands of others from a number of different Federal agencies, already deployed in the Gulf. SC Lowcountry Refuges will continue to support the effort as the disaster in the Gulf unfolds.

To learn more about the Fish and Wildlife Service's involvement in the oil spill crisis go to <http://www.fws.gov/home/dhoilspill/index.html>

Bird's Eye View Prompts Study of Cape Romain's Salt Marsh

While flying over the salt marsh in Cape Romain's Wilderness Area, scientists from Boston University and the University of Houston spotted something unusual. New creeks were forming in the marsh along Horsehead Creek, and this caught their attention because most tidal creeks in salt marsh are sinuous. They meander through the marsh grasses. The new tidal creeks were unusually straight. This chance observation by migrating scientists ultimately led to an important scientific study on the impacts of sea level rise on Cape Romain's salt marsh.

Zoe Hughes, of Boston University and Steve Pennings of the University of Houston, and their team of scientists, first conducted a geospatial analysis of the area using aerial photographs that dated back to 1968. They found the tiny newly formed creeks on the historic images and tracked them over time. The results were surprising. They discovered that after the creeks appeared at the edge of the marsh they grew rapidly, extending into the marsh grasses at a rate of about 6.2 feet per year.

The scientists next examined the composition of the soil in the marsh, along with the landscape of the research area. They measured the speed at which water flowed into the creeks during high tide, and then out during low tide. They found that the creek heads were lower in elevation than the surrounding marsh. Scientists also discovered that a common crab in Cape Romain's salt marsh is contributing to the advancement of the creeks. Burrowing marsh fiddler crabs eat the roots of marsh grasses, creating depressed bare areas that fill with water during high tides. As the water level recedes during the lowering tide, water rushes off of the marsh surface into the depression, which focuses the water from all around into the top of the creek. The water scours and erodes the tidal creek as it flows down the creek on its way to the receiving ocean. The crabs then move further into the marsh, eating the roots of healthy marsh grasses, and creating new depressions.

Marsh ecosystems are dependent upon a steady supply of incoming sediments, living healthy marsh grasses, and a detrital build-up of grasses over time. This is the process that maintains the elevation of the marsh. Because the soil particles are very fine in Cape Romain's marsh, it is more likely to compact and

subside. As the marsh subsides and sea levels rise, tidal creeks form, cutting through the marsh grasses at a rapid rate, as the tidal creeks advance into the marsh. Scientists believe all these factors combined are responsible for the extension of tidal creeks into Cape Romain's salt marsh. Their article, *Rapid headward erosion of marsh creeks in response to relative sea level rise*,* was published in 2009 in the scientific journal *Geophysical Research Letters*.

Salt marshes are among the most diverse and productive habitats on earth. The salt marsh at Cape Romain yields the perfect combination of habitat, water quality, and vegetation to support healthy populations of oysters, shrimp, and crab. The Diamondback terrapin feeds on Salt marsh periwinkles and Blue crabs, and the secretive Clapper rail consumes shrimp and crabs, fish, mollusks, and insects. The salt marsh food web feeds and shelters birds that travel through the Atlantic Flyway on their seasonal migrations, and provides food for the fish and sea turtles that travel the Atlantic Seaway.

Will Cape Romain's salt marsh be able to adapt to the rising sea levels and achieve equilibrium? Only time will tell. Thanks to scientists from Boston University and the University of Houston, Cape Romain NWR is functioning as an outdoor laboratory that will promote better understanding of this situation.

In time, scientific studies will help refuge staff find the solutions for mitigating the impact of sea level rise on the birds, fish, and turtles that depend on Cape Romain NWR.

*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, *Geophys. Res. Lett.*, 36, L03602, doi:10.1029/2008GL036000.



Rapidly advancing tidal creeks are dissecting Cape Romain's salt marsh. Photo courtesy of bingmaps.com

Climate Changes Everything

A Black-necked stilt forages for tadpoles and tiny fish in Jacks Pond on Bulls Island. Her long reddish-pink legs flash in distinct contrast to a white belly and black wings. Just two weeks ago, she laid a nest by the water's edge, unaware of the potential hazard to her breeding ground just a few hundred yards away. She is joined by several other stilts, all nesting around the perimeter of Jacks Pond.

She and her cohort rely on a rare oasis of brackish water on a barrier island surrounded by the dynamic and energetic Atlantic Ocean. The only barrier between the protected brackish water impoundment on the refuge, and the Atlantic Ocean, is a slender levee that is separated from the ocean by only yards.

Each year, 20-25 feet of the ocean-facing shoreline on Bulls Island disappears, swept away by rising sea levels, and erosion.

In the first five months of 2010, the island lost 11.5 feet of shoreline. Considered a natural process, erosion on these barrier islands has been accelerated in recent times by the effects of rising sea levels due to climate change. In this region of coastal South Carolina, relative sea level rise has been 3.2 millimeters per year, equaling more than a foot in the past century.


Cape Island is a barrier island in Cape Romain's 29,000 acre Class I Wilderness Area, and the site of more than 1,000 Loggerhead sea turtle nests each year. Wind and waves and intense storms have flattened Cape Island, eliminating dunes and severely limiting nesting options for loggerhead sea turtles and island-nesting birds. For the past 23 years, Refuge Biologist Sarah Dawsey has worked diligently to improve nesting success for Loggerhead sea turtles. Nests that are laid in areas prone to high tide wash-over, or in low-lying areas subject to intrusion by groundwater are dug up and moved to safer ground. Today the hatch rate averages 78%. Before the nest relocation program, hatch rates were only 25%.

South of Charleston near Adams Run, SC, Ernest F. Hollings ACE Basin National Wildlife Refuge supports waterfowl, wading birds (including the endangered Wood stork), neotropical

migrants, a variety of raptors, and a myriad of non-migratory animals and diverse plant communities. Located in the lower coastal plain, the refuge wetland management units and bottomland forests, swamps and marshes are likely to be affected by rising sea levels in the future. Most of the refuge is low lying land less than 10 feet above mean sea level. The refuge includes 26 miles of freshwater riparian habitat and more than 60 miles of dikes, causeways, and roads that have the potential to be damaged by rising sea levels. Many of the refuge's waterfowl impoundments and other wetland habitats would undergo dramatic conversions from freshwater systems to brackish and then to saltwater if salt water from rising seas extended up the South Edisto River and the Combahee River to the refuge's delicately balanced freshwater impoundments.

Twenty minutes north of Georgetown on Highway 701, you'll find the Waccamaw National Wildlife Refuge, home of South Carolina's mystical blackwater forests. A new Visitor Center sits perched atop Yauhannah Bluff, overlooking Yauhannah Lake and the scenic Great Pee Dee River. Climate change has brought droughts to the region, reducing the outflow of fresh water from the Waccamaw, Black, and Great Pee Dee Rivers. The reduced flow allows ocean waters to intrude further inland, up the rivers. The impacts are dramatic. Mature forested wetlands and remnant antebellum tidal freshwater rice fields are slowly succumbing to the increased salt levels. A victim to the salt intrusion is the majestic Bald cypress tree, an important component of Waccamaw NWR's forested wetlands. These trees provide critical nesting sites for the Swallow-tail kite, a species listed as threatened in the State of South Carolina. Trees are dying off one by one, and new salt tolerant species of wildlife and vegetation are appearing. One of the most noticeable changes in vegetation is the migration of *Spartina* or "cordgrass", a very salt-tolerant marsh grass, further inland. The cordgrass is overtaking the banks of blackwater systems that were once ruled by cattails and rushes.

Santee National Wildlife Refuge is SC Lowcountry Complex's inland refuge. It is not directly affected by sea level



Rising seas and accelerated beach erosion carve away 20-25 feet every year on Cape Island. Photo: Steve Hillebrand

rise or increasing salinity in freshwater impoundments, but the changing climate has impacted refuge habitats. Santee has several freshwater impoundments that support concentrations of wintering waterfowl each year and once supported some of the largest migratory waterfowl numbers in the south Atlantic region. Throughout the upland forest, painted buntings flit through shrubby margins to open fields where they commonly forage along wooded edges. Wood ducks are common and raise their broods in refuge wetlands near the banks of Lake Marion.

One of the most compelling challenges brought about by climate change at Santee NWR is that of overall rising temperatures. Warmer temperatures in northern ranges are causing shifts in migration patterns of waterfowl and other birds. This allows them to remain at northern locations longer, contributing to dwindling duck and geese numbers at Santee. In addition, higher temperatures may enhance conditions for exotic pest species, which coupled with drought conditions, will leave the refuge much more susceptible to degraded habitats. The consequences are not bright for wetlands and other water-dependent native plants and animals that are presently abundant at Santee NWR.

Climate change has and will continue to impact the birds, turtles, and other animals that live and thrive in the Lowcountry. While many species will be able to adapt to changes in temperature and precipitation, many will not. On National Wildlife Refuges, managers are taking steps to address the changes to achieve the best possible outcome so that the birds, turtles, and other animals that Americans love and cherish will continue to exist for future generations. To learn how the Fish and Wildlife Service is addressing climate change across the nation, go to the national website at <http://www.fws.gov/home/climatechange/>

Cape Island

In 2009, Fish and Wildlife Service Geographic Information Systems technicians gathered all the aerial photographs they could find for Cape Island. They digitized the images using ArcGIS software, and then applied the software's geometric features to outline the Island. The area of the island was calculated and baseline information from the oldest image was compared to later images taken in 1979, 1994, and 2006. The results confirmed what refuge employees have long recognized. Cape Island is losing ground. Literally.

Cape Island's beaches and dunes provide vital habitat for nesting Loggerhead sea turtles, shorebirds and sea birds. Although the island has survived numerous hurricanes, and centuries of wind, waves, and tides, its survival has not been without cost.

In years past refuge staff ordered aerial flights of the refuge so that they could compare photographs from year to year. Aerial images provide snapshots in time that offer a unique perspective on the changes over time. When GIS technology became readily available, it was hailed as a blue ribbon management tool because that is when managers were able to make accurate measurements of the refuge's



A Loggerhead nest barely escapes overwash from the high spring tides. Photo: Steve Hillebrand, USFWS

islands, and to orient the islands on the seascape.

Although a small amount of sand has accreted on Cape Island's north end and on the south end, overall, the island has lost ground. In the 52-year period from 1954 to 2006, Cape Island shrank from 1,434 acres to 1,087 acres, a net loss of 24.2%. The greatest rate of loss occurred from 1979 to 1994, when the island lost 23.2% on the ocean-facing side. Many South Carolinians remember 1989 as the year when Hurricane Hugo slammed into the South Carolina coast. The effects of Hugo could be clearly seen on aerial images captured after the event. The losses didn't start with Hugo, however. Losses were occurring even before the massive storm assaulted the coast. Those losses continue today. From 1994 to 2006 another 75 acres of Cape Island disappeared. Similar losses of ocean-facing shoreline have been noted on Raccoon Key and Bulls Island.

High relative sea level rise in the Cape Romain area contributes to higher tides which accelerate erosion rates. Many other factors are also linked to barrier island changes, including sediment disruption from dams in the watershed, wind and waves from storm events, and the stark vulnerability of low-lying barrier islands. Today, thanks to GIS technology, managers can predict where those losses are expected to occur, calculate how many linear feet of shoreline the islands will lose, and factor those changes into decisions regarding their management strategies for refuge species.



Shoreline loss on Cape Island since 1954 (blue), 1979 (yellow), and 1994 (green). 2006 aerial photograph courtesy of the South Carolina Department of Natural Resources.

Highs Across the Low

- New website for Lowcountry Refuges! Go on-line and read all about your national wildlife refuges in the Lowcountry. <http://www.fws.gov/screfugescomplex>
- New Facebook page: *Friends of Cape Romain National Wildlife Refuge*. Feel free to post your comments and pictures of Cape Romain. Check out the Youtube video of the Lighthouse Tour!
- Every year Ernest F. Hollings ACE Basin's 3,500 acres of impounded marsh and green-tree reservoirs support 25,000 ducks and geese, a variety of wading birds, raptors, and the ever present American Alligator.
- During their long migration from South America to the Arctic, 18- 22 species of shorebirds gather on Cape Romain. When birds concentrate in large numbers, they are more susceptible to environmental disasters, such as oil or chemical spills, or catastrophic habitat losses due to hurricanes.
- From 1970 to 2008, average temperatures rose 2°F in the southeastern U.S. There is some evidence that waterfowl are shifting their ranges in a more northerly direction to adapt to rising temperatures. An increasing trend of summer drought from 1958-2007 has dramatically impacted Santee NWR's ability to manage freshwater impoundments for waterfowl.
- The salt marsh in Cape Romain's 29,000 acres of Class I Wilderness is showing signs of impact from rising sea levels. Newly forming tidal creeks can be seen on bingmaps.com.
- New faces! Birds that were not common to the Santee Refuge area, such as fulvous whistling ducks, sandhill cranes and wood storks, have been spotted in greater numbers on the refuge.
- Casino Creek, a tidal creek on Cape Romain was originally named for the cassena (yaupon) that grew on land alongside the creek. The name of the creek morphed over the years.

Adapting Environmental Education to Climate Change

As the physical impacts of climate change influence wildlife species to adapt and modify their migration patterns, Sewee Center educators Julie Binz and Patricia Lynch are adapting the curriculum to include lessons on that subject.

“One of the best ways to teach children about climate change is to help them understand how it affects the places that animals depend on for food and shelter,” Binz said.

Although Cape Romain’s vegetation, trees, birds, turtles, and other animals are relatively resilient in the face of nor’easters, high and low tides, and the continued wind and waves of the Atlantic Ocean, a rapidly changing climate may produce changes in habitat that outpace the rate at which dependent species can cope.

One learning tool that Binz and Lynch recently incorporated involves lessons that inspire questions.

“If sea level rises, would the salt marsh grasses still be able to live in the marsh or would the marsh turn into open water without grasses?”

Students also learn about climate change by playing a card game. The game focuses on the natural and manmade hazards that expose sea turtles to changes in habitat. Cards dealing with climate change, such as accelerated beach erosion due to sea level rise, and temperature changes that affect the male to female ratio of sea turtles, have been added to an existing lineup of hazard cards for depredation and habitat loss.

The curriculum includes lessons on how increased hurricanes can damage Red-cockaded woodpecker nest trees, how pests like the pine beetles and certain fungi thrive in higher temperatures, and how temperatures affect reptile nest hatch rate. Also, lessons look at the loss



SEWEE Association educator Julie Binz introduces a lesson on how climate change affects Loggerhead sea turtles.



In the Sewee Visitor & Environmental Education Center sandbox, children pretending to be biologists, dig up a Loggerhead sea turtle nest, photo by Julie Binz.

of nesting habitat in coastal areas, and its effect on shorebirds.

While the U.S. Fish and Wildlife Service carefully considers solutions for mitigating the loss of habitat caused by climate change, it is also vitally important that environmental education include lessons on how climate change impacts the natural world.

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