

# **Tropical**

## IN THE PATH OF DESTRUCTION

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A peck of grits and a pound of pork is not a diet which modern nutritionists would recommend for long-term subsistence. But in the wake of the destruction caused by the Sea Islands Hurricane of 1893, more than 30,000 South Carolinians lived on these weekly rations for nine months.

The hurricane had plowed its way across the Atlantic Ocean for twelve days before its arrival in Beaufort on August 27. Even so, people were unaware that the core of the storm would churn through the fragile sea islands surrounding Port Royal Sound. They were unfamiliar with the force of a hurricane until the sea claimed the lives of 2,000 South Carolinians as it washed away most of the homes and fields on the sea islands between Charleston and Savannah.

Folks today can look back at the records of that storm and take pride in the twentieth-century technological innovations in weather forecasting. Meteorologists no longer rely on sporadic telegraph reports to develop hurricane forecasts as they did in 1893. Satellites, orbiting 22,000 miles above the earth's surface, provide constant surveillance on tropical oceans, the spawning grounds of hurricanes. National Weather Service offices which dot the coastline have telecommunication systems that, in the wink of an eye, can speed messages from one station to the other or exchange information with the National Hurricane Center, the National Earth Satellite Service, and the National Meteorological Center.

Despite these fascinating technological achievements, Dr. Neil Frank, the director of the National Hurricane Center and one of the world's leading authorities on hurricanes, states that the East and Gulf coasts of the United States are "more vulnerable to the hurricane than ever be-

fore. We are faced with the awesome possibility of making a perfect hurricane forecast, yet experiencing a tragedy exceeding that of the historic Galveston (Texas) hurricane in 1900 when 6,000 people died."

How is it that we have vastly improved observational and forecasting tools, yet face the recurrence of a major hurricane disaster? A partial answer is in the high density development and correspondingly increased coastal population over much of our coastal area. Unfortunately, much of this has come within areas that are extremely susceptible to hurricane damage. The absence of severe hurricanes over the past two decades and our superior hurricane warning system appear to have given the coastal resident a somewhat false sense of security. To understand the hurricane hazard, we must understand how people perceive and make decisions about potential risks.

Almost everyone has seen what happens when the wind blows across a body of water, but few fully realize the awesome effect on water of that heaviest of wind--the hurricane. Henry David Thoreau poetically wrote in "Walden" about the role of wind stress in the generation of waves:

"A field of water betrays the spirit that is in the air. It is continually receiving new life and motion from above. It is intermediate in its nature between land and sky. On land only the grass and trees wave, but the water itself is rippled by the wind. I see where the breeze dashes across it by the streaks or flakes of light."

Last March we felt the thirty- to fifty-mile-per-hour winds which whipped up waves of five to eight feet on some inland lakes

in South Carolina. Yet such gale force winds cannot begin to match those of the hurricane. Minimum wind velocities in hurricanes exceed seventy-five miles per hour. Winds near the center of the storm may reach 110 to 225 miles per hour. Destructive waves of gigantic proportions are pushed up by the hurricane winds.

Additionally the hurricane produces a much more serious problem than just high winds and high waves and, unfortunately, very few people are aware of this hazard. It is called the STORM SURGE or TIDE, a term which refers to the general increase in sea level during storm conditions. Blown up by the high winds of the hurricane, the rise in sea level is a geophysical force represented by approximately 1,700 pounds of weight for each cubic yard of water. Waves as high as fifteen to twenty feet travel as fast as fifty to sixty miles per hour atop this storm tide.

During Hurricane Hazel, the storm tide at Myrtle Beach increased over five yards above mean sea level, stacking about five of those 1,700-pound cubes on each yard of the beach. This swollen, swirling sea with violent waves atop it demolished miles of beachfront property in South Carolina and North Carolina. A team which surveyed the damage reported that "the center of Hurricane Hazel entered the United States coast just north of Myrtle Beach, South Carolina, on October 15, 1954. Hurricane winds were recorded from Cape Lookout, North Carolina, to Georgetown, South Carolina. Grass-covered dunes some ten to twenty feet high near Cape Fear were washed away. Every fishing pier from Cedar Island, North Carolina, to Myrtle Beach, a distance of 170 miles, was destroyed. At Crescent Beach, South Carolina, all sand dunes were washed away, leaving old marsh deposits exposed. The high water line receded fifty to 250 feet and all front row houses were severely damaged or destroyed. At Atlantic Beach and Windy Hill Beach, the mean high water line receded about one hundred feet landward and more than fifty percent of the houses along the ocean front were destroyed. At Myrtle Beach, all of the ocean-front sand dunes were washed away and the high water line moved landward from thirty to 150 feet. About eighty percent of the beachfront property was badly damaged or destroyed."

Joel Chandler Harris observed the impact which the storm surge can have upon a vulnerable coastal area. Assigned by Scribner's magazine to visit South Carolina following the 1893 Sea Islands Hurricane, he referred to residents of Beaufort and the surrounding islands as a "people

who live near the danger line of the sea," for it had been the sea which had risen and tossed about ships, houses, and trees. It had been the sea which had stripped the land of its crops and had drowned 2,000 people. The survivors told Harris about the terror and strife which the hurricane produced.

John MacDonald, who weathered the storm for three days in the rigging aboard the vessel "City of Savannah," observed that "a first inspection of the devastated district was appalling, and even as the scenes of distress, sickness, and destitution became more familiar, its sadness did not wear away.

"In a few hours neat cottages were a heap of ruins, scattered perhaps miles away; giant trees lay across the roads, twisted and knotted into almost impossible shapes; corn and cotton gone, and human beings--missing. There in the marsh, a dark object is seen lying prostrate. Onward they push, waist deep in water and mud, till they grasp the inanimate object, and after a moment's silence a piercing wail announces another loved one found, dead. Go with them as they carry their dead home. Home! Where is it? Gone!"

H.L. Bailey, who lived on high ground on Edisto Island, wrote that "how we passed that night of terror, only God knows, for the winds blew, the rain fell, and the tide rose, until towards midnight it seemed as if everything was lost; but the old house stood and carried us through until dawn of another day, and then what a sight met our anxious eyes. What had been a smiling pretty village was nothing but a pile of wreckage and a mass of ruins, some houses having been washed away completely and those that remained, so badly damaged as to be uninhabitable. To make matters worse even our food had been swept away and there we were, cut off from the island on this point of land, wrecked, desolate, and hungry; some of us with only the clothing on our backs, all the balance gone; and as far as the eye could reach there was nothing to see but water and those spots from which the tide had receded covered with portions of houses, trunks of clothing broken open and scattered, drowned poultry, and every crop ruined."

Can we avoid a future hurricane disaster? Current trends in high risk development projects and an increasing coastal population which is unaware of the dangers of the hurricane would cause one to answer this question, "No."

But the sensitive genius of Archibald Rutledge may have left clues to help us solve this present coastal problem. He once told a story of physical peril which

occurred when his setter chased a raccoon into a large brackish pond. Set within a remote Carolina estuary, Dr. Rutledge observed that "all about me stretched the great lonely marsh. Here before me was this land-locked lagoon. And in the middle of this arena I was about to see enacted a little drama of the wilds. Here two natural enemies were about to meet—one much stronger than the other. Could sagacity, some form of unpredictable strategy, save the day for the weaker of the two antagonists?"

The story "Wild Dilemmas" vividly portrays the ensuing struggle that occurred as the raccoon swam to mid pond, climbed atop a slightly submerged stump or log, and awaited the confident dog's attack. Just as Dr. Rutledge's setter reached the spot, his intended prey grasped the dog's ears and shoved the head under water. When the small hands finally released their grip, the setter, "gasping pitifully," returned to shore, leaving the "wily old raccoon master of that field of honor."

Like the raccoon of this story, we must use wisdom and planning to minimize the awesome forces of the hurricane, its wind, storm surge, and gigantic waves. We will not be able to eliminate future hurricane losses. There are already too many hotels and condominiums built too close to the "danger line of the sea." There are too many houses, businesses, and trailer parks which occupy low-lying, flood-prone areas along the coast. But we can reverse the present trend in high-risk development projects. We can begin to plan and build new coastal communities in low-risk areas and maintain programs to ensure that coastal residents will know not only how to respond to a hurricane emergency but also how to help tourists move to safety.

By doing these things we can save billions of dollars and hundreds, possibly thousands, of lives. To reduce the economic and social impact of future hurricanes, we must employ sagacity.

#### INDIFFERENCE TO THE WARNING

With great concern for public safety, forecasters and researchers at the National Oceanic and Atmospheric Administration's (NOAA) National Hurricane Center (NHC) in Coral Gables, Florida, have watched the Atlantic and Gulf coastal zones swell with new residents during our recent "lull" in hurricane activity. Many residents, unfamiliar with the forces of the hurricane system, have moved into areas which may be affected by a hurricane storm surge and widespread coastal flooding. As the potential for a hurricane disaster has increased, warnings from the NHC have expanded in scope.

Few, if any, transportation networks in coastal areas are designed for the large traffic volumes which would occur during a major evacuation. Studies have indicated that an optimum hourly evacuation rate is 600 vehicles for each lane of highway. Thus it would take about ten hours to evacuate 6,000 families from a flood-prone area with one single-lane road. Other studies have shown that a delay of four to five hours occurs between the evacuation notice and peak evacuation.

The "best" NHC forecast product on hurricane motion is the twelve-hour forecast, but for many coastal areas even a twelve-hour advance warning will not be enough time for evacuation. For example, the Tampa Bay, Florida, region estimates that they need to begin evacuation of people from flood-prone and hazardous areas at least fourteen to seventeen hours before the storm.

Additionally, elevated storm tides and storm-generated waves can pound structures near the beach and inundate large areas of low-lying land. Some coastal roads could be subject to flooding and become impassable hours before the center of the hurricane comes on shore. Can such vulnerable areas be identified so that plans can be developed to avert disaster? Will people in these vulnerable areas respond quickly enough and leave hazardous areas in time? These are questions for which answers must be found.

Recent experiences have shown that other major problems also exist. In September 1979, as Hurricane David approached the United States mainland, the city of Miami initiated its emergency plans. One shelter was crowded with 2,000 elderly people but had only one nurse to provide for their needs. Fortunately for this nurse the electrical power did not fail (a situation which happens often during a hurricane), for she had only one flashlight and its batteries were untested. Food for many of the Miami shelters did not arrive, while in others, as much as \$250,000 worth of food was consumed by evacuees within the first hour of the shelter openings.

In Florida and South Carolina, few people carried emergency medical kits, transistor radios, flashlights, candles, fresh water, canned drinks, canned food, and blankets. This placed increased demands on the resources of the emergency shelters and



placed the evacuees at increased risk had they become stranded and unable to reach a shelter.

Confusion occurred in South Carolina as conflicting information on shelters was disseminated by emergency workers. People were sent to shelters which were closed or were open without supervisors. At shelters in Florida and South Carolina, order and discipline were not maintained by evacuees. There were accounts of arguments, some fights, and people forcibly taking food from others.

The evidence suggests that people no

longer understand their responsibilities to ensure their own safety and welfare during a hurricane emergency. Because of this apparent indifference on the part of many coastal residents, we are more vulnerable to future hurricane losses than at any other time in our nation's history. Hence, the best possible forecast and advance warning from the National Hurricane Center, by itself, will not be able to guarantee safety for individuals in areas vulnerable to storm surge damage and flooding. Only if the individual citizen combines this forecast with quick, sensible, and effective response to the hurricane threat, can hurricane-related fatalities continue to be minimized.

#### REFERENCES AND FOOTNOTES

1. John Sanders is the coastal weather awareness specialist for the University of North Carolina's Sea Grant College Program. Further information on hurricanes and the hurricane hazard may be obtained by writing to him at the UNC Sea Grant College Program, 105, 1911 Building; North Carolina State University; Raleigh, North Carolina, 27650.

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