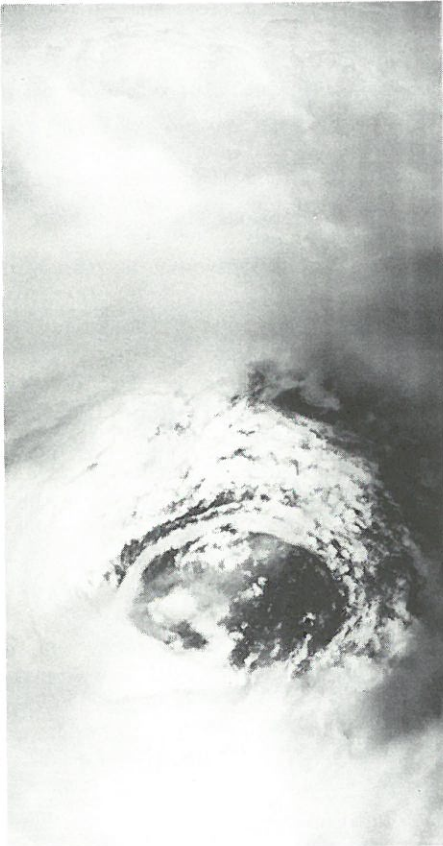




COAST WATCH

Photo courtesy of NOAA



Eye of a hurricane

Photo courtesy of the Division of Archives and History

Surviving Hazel, the hard way

The water rose. Dishes crashed and furniture bounced like billiards after a break shot. Connie Helms could feel the water lapping against the ceiling of the first story beneath her.

It was October 15, 1954. Earlier, Hurricane Hazel had been churning in the Caribbean, while Connie and her husband made their way to Long Beach, for their honeymoon. Connie never thought the storm would hurl its weight at North Carolina.

But the rains began, then the winds. Waves broke through the dunes and water covered the main road. The Helms were trapped on the island. They abandoned their one-story cottage for a two-story frame house nearby.

From the second-story windows Connie watched the fury of the hurricane unfurl. Winds ripped some houses apart. Waves toppled cement-block houses as if they were built of toy blocks. Other houses rode the waves, crashing into one another. Whirling winds made flying projectiles

out of boards, furniture and tree limbs.

As the waters rose higher and finally began lapping the first-story ceiling below their feet, the Helms realized their shelter might topple with the next crash of a wave. To escape, they pushed a mattress out of the window into waters that swirled just inches below the second-story window frame. Connie Helms perched herself on top of the mattress. She and her new husband tied themselves together with a flannel blanket. Jerry Helms dropped into the water, catching one corner of the mattress. He pushed the couple away from the house and caught a chunk of floating wall to add buoyancy to the mattress. He knew his 17-year-old bride could not swim.

A lot has happened in Connie Helm's life since that October day in 1954. She is now Connie Ledgett, living in Southport and serving as executive secretary of the Southport/Oak Island Chamber of Commerce. But her memory of

Continued on next page



A row of houses lie toppled like building blocks at Carolina Beach one month after Hazel

Hurricane Hazel has not dimmed through the years.

"We'd hoped to float to this sand dune that stood between the house and Davis Creek," Connie recalls. "But we didn't count on the winds shifting on the other side of the eye. Instead we were pushed across Davis Creek into the top of some scrub oaks that stood thirty feet off the ground."

After a few hours the waters began to recede. "It was like taking the stopper out of a bathtub," she says. "If we hadn't had those trees to hold on to we would have been sucked out to sea."

After the hurricane had spent its energies and moved on, the Helms climbed from their tree-top perch and began their walk off the island. "The area was totally demolished," she says. "The dunes were leveled. It was like a scene out of one of those nineteen-fifties science-fiction movies."

Living through a hurricane as ferocious as Hazel taught Connie a healthy respect for the storms. She knows she was lucky to live through it; 19 other people didn't. "Being in a hurricane is not a thrill," she says. "People should pay attention to the warnings issued by the National Weather Service. They may not have control over the loss of their property or the savings they have invested in it, but they do have control over saving their own lives."

But there are only a few people like Connie Ledgett—people who have experienced a hurricane—living along the North Carolina coast now. And this worries experts at the National Weather Service and the state Division of Emergency Management. They're afraid large portions of the coastal population, unaware of hurricane hazards, will not respond to hurricane warnings and evacuation notices.

John Sanders, UNC Sea Grant's coastal weather awareness specialist, says as little as 10 to 15 percent of the present coastal population have any prior experience with a hurricane. And, he says, if you allow for tourists, which can increase the population of an area like Atlantic Beach ten-fold, then an even larger percentage of inexperienced people are involved.

Sanders says coastal growth in areas such as Dare, Carteret and New Hanover counties has compounded problems. Dare County's population has doubled since 1960 (North Carolina's last encounter with a major

hurricane). The population for the town of Atlantic Beach has increased twelve-fold. Most of these residents are new to the area and new to the hazards of a hurricane, Sanders says.

In a study Sanders conducted in Myrtle Beach, South Carolina in 1979, people were asked how much they understood about hurricanes. Results showed that 78 percent of those surveyed understood that strong winds accompanied the hurricane; 33 percent

Photo by Gregg Gandy



"It was like taking the stopper out of a bathtub. If we hadn't had those trees to hold on to we would have been sucked out to sea."

—Connie Ledgett

were aware of a hurricane's storm surge—the huge waves and storm tides which may reach 25 feet or more as a hurricane moves ashore; 12 percent understood flooding accompanied a hurricane. Yet, Sanders says, nine out of 10 hurricane-related deaths occurred because of drowning and most property damage is caused by the storm surge and flooding.

"The fact that North Carolina has not been hit by a serious hurricane in 20 years is a problem in itself," says Bob Muller, meteorologist-in-charge and area coordinator of the National

Weather Service (NWS) in Raleigh. "The public is apathetic about hurricanes. They haven't come against one so they no longer see them as a threat they need to be concerned with."

During brushes with Hurricane David and Bret, people actually flocked to coastal areas to watch nature's fireworks in action. "I think there is a tendency for people to think Mother Nature is not that cruel," says Al Hinn, meteorologist-in-charge with the NWS in Wilmington, "They don't want to think there is anything so potentially dangerous it could destroy something they've built or themselves."

Gil Clark, a hurricane forecaster with the National Hurricane Center in Miami, says North Carolina is in an area where hurricanes recurve. It's usually between Cape Hatteras and Bermuda that hurricanes swing either northeast or northwest, he says.

"Over the past twenty years most of the storms have tracked northeast, and North Carolina has been on the weak side of the storm," he says. But he points out that if a hurricane were to move into North Carolina the warning time could be very short. "Because of the latitude of North Carolina and because the state is in that area where hurricanes recurve we'd be lucky if we had twelve hours warning time," he says. "And we usually have at least twenty-four hours in the Gulf."

Clark says he advises every coastal family to work out a family preparedness plan beforehand. "They should have a definite idea of how they're going to evacuate and where they're going," he says. And for those unwilling to evacuate, "ask them their next of kin," Clark says. "That usually brings them out."

To booster coastal North Carolina's awareness of hurricanes and other coastal storms, like northeasters, the NWS and UNC Sea Grant funded a joint position for a coastal weather awareness specialist and hired Sanders to fill the job. Sanders began working with federal, state and local government officials, media representatives and local people to increase their knowledge of hurricanes. His activities have included:

- A series of newspaper columns about hurricanes distributed to coastal newspapers.

- Local workshops and presentations that encouraged individuals and

Photo courtesy of The Carteret County News-Times



Front Street in Beaufort as Hurricane Hazel struck in 1954

families to develop hurricane preparedness plans.

- An appearance on "Almanac," a television program produced by the N.C. Agricultural Extension Service, where he explained the destructiveness of a hurricane and how to prepare and respond when one is forecast.

- Schooling broadcast and print journalists along with local emergency management coordinators in a statewide workshop, "Hurricane Preparedness: A Community and Family Responsibility."

- Developing a hurricane safety checklist tailored for North Carolina use.

- Working to coordinate hurricane preparedness efforts between state agencies such as the Department of Emergency Management and Office of Coastal Management.

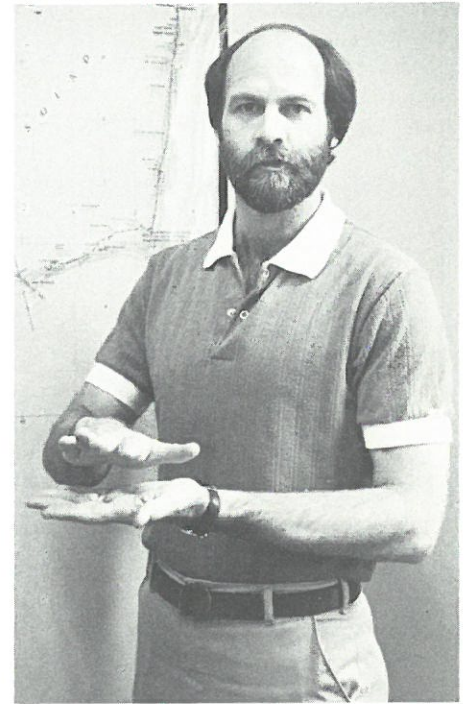
- Introducing new research and methodologies that will assist emergency management coordinators in developing evacuation plans.

- Developing educational tools that can be used in the public schools to explain what are hurricanes and how to respond if one occurs.

Sanders and Hinn both say the media has been responsive to publishing and broadcasting hurricane-preparedness stories, thus reaching more and more people about the potential dangers of a hurricane. The Marine Resources Centers at

Roanoke Island, Bogue Banks and Fort Fisher each sponsor a "Hurricane Awareness Week" in August every year. Sanders, Spencer Rogers (UNC Sea Grant's coastal engineer), meteorologists from the NWS and emergency management coordinators speak to audiences about hurricanes during the week. The Marine Resources Center at Bogue Banks also

Photo by Kathy Hart



John Sanders

is putting up a hurricane exhibit.

Sanders says he believes more people are increasing their hurricane awareness. "When I go into an area and begin to talk about hurricanes, people seem better able to respond," he says. "And they are taking a more active role in developing hurricane preparedness plans."

—Kathy Hart

Planning for the inevitable storm

A hurricane is building in the Caribbean. It begins a track northward on a course that marks its landfall as the central North Carolina coast. How do state and local emergency management personnel respond to ensure the public's safety?

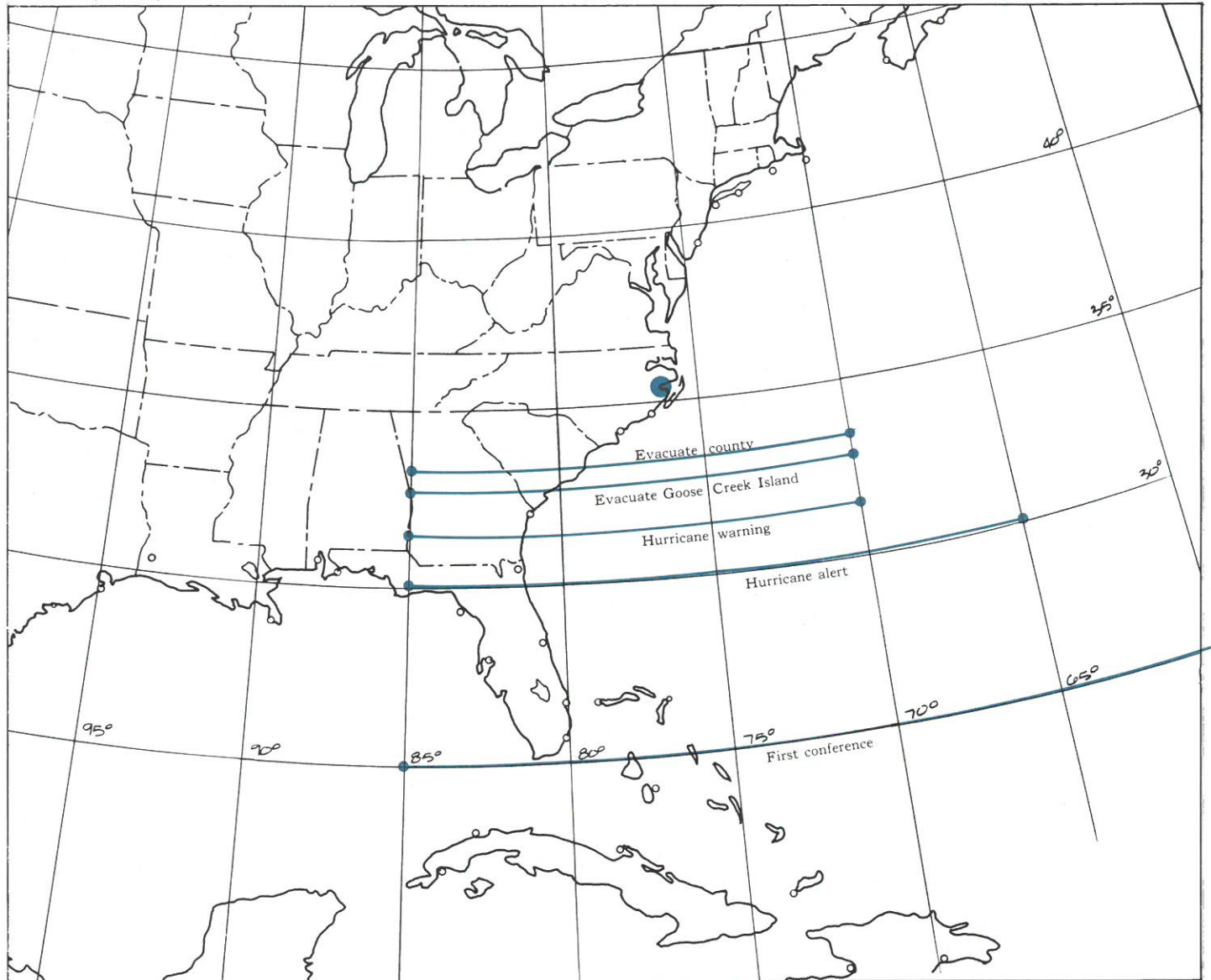
Most of the work for evacuation plans was done before hurricane season ever began. The state Division of Emergency Management developed and issued a county prototype evacuation plan seven years ago to the 18 coastal counties. From this plan each county developed its own county evacuation plan. These plans are updated and changed as situations and conditions change in the county.

The Division of Emergency Management also developed a state plan that will activate state agencies

such as the Department of Transportation, which controls the coastal ferry and bridge system, and the Highway Patrol, which would assist with traffic control. Emergency Management also is helping industries such as Weyerhaeuser to develop their own hurricane plans.

As hurricane season begins June 1, the state and county emergency management offices go into a "condition five alert" which they will maintain throughout hurricane season. If a hurricane advisory is issued for North Carolina a "condition four alert" would be established. Plans are reviewed and shelters checked. When a hurricane watch is posted (48 hours in advance of possible landfall) a "condition three alert" is set. Sheriff's

Continued on next page



Pamlico County's evacuation plan based on longitude and latitude

departments, police departments, city mayors, county commissioners, the Red Cross and others are notified. Shelter preparations begin.

"Condition two" begins 24 hours in advance of hurricane landfall. Shelters are opened. Emergency equipment and vehicles are readied. Public advisories are issued.

Twelve hours from landfall "condition one" is established. The order to evacuate beachfront and flood-prone areas is given during condition one. The decision to evacuate may be made by the emergency management coordinator, as is the case in Pamlico County, or by an emergency committee of county mayors and county commissioners, as in New Hanover County. The decision is made at the county level, not the state level.

During this condition one phase, a central emergency headquarters is established. Orders go out from the headquarters to police, the sheriff's department and the fire department for the evacuation. Evacuation shelters are in full operation. The Red Cross, county social services and health departments provide evacuees with shelter, food and medical care if needed. Other county departments also assist during the evacuation phase.

In the aftermath of the hurricane, the county provides protection from looting, damage-assessment estimates and continued operation of the shelters as needed.

Dick Simmons, emergency-management coordinator for Pamlico County, says his county's evacuation

plan is slightly different from others. The plan is based on the longitude and latitude of an approaching hurricane. Simmons says he would call for the evacuation of Goose Creek Island, the county's most vulnerable area, when a hurricane was at 31 degrees 15 minutes north latitude and between 70 and 85 degrees west longitude (about 15 hours prior to landfall).

"When I call for evacuation I want to be pretty confident Pamlico County is going to be clobbered or close enough to being clobbered that we're in considerable danger," he says. "The hurricane can always turn out not to be as bad as we predicted and we may over-evacuate people. But in my book an ounce of prevention is worth a pound of cure."

—Kathy Hart

Finding ways To survive The storm

Family preparedness plans are just one step in the process of hurricane planning. Coastal communities and the state also have a large investment in North Carolina to protect. What do they need to plan for the next big one, the one everyone says is long overdue? Is there a better way to build a storm-resistant structure, evacuate a community, predict flooding or estimate erosion? Sea Grant researchers have been looking for answers to these questions and more to help North Carolina's coastal towns prepare and plan for hurricane.

• Survivability was the key word in Jerry Machemehl's research work for Sea Grant two years ago. Machemehl, formerly an associate professor of marine science and engineering at North Carolina State University (NCSU), set out to design a coastal structure that could withstand the battering and brutal forces of a hurricane. But first, he looked at how buildings were being built and found many weak areas.

Building codes and construction standards in North Carolina changed after the devastating storms of the late 50s and early 60s. Coastal property owners got the message when Hazel left only five of 357



Machemehl

buildings on Long Beach intact. New homes were elevated on pilings to clear storm tides and setback from the shoreline to prevent undermining by erosion. "Building codes were strengthened and upgraded," Machemehl says, "but they were basically minor improvements. The codes were still not designed for beach construction for the forces found in a coastal environment."

During his project, Machemehl did a survey of homes along the North Carolina coast and found that only 10

Photo by Spencer Rogers



The pilings on this Carolina Beach building weren't sunk deep enough to withstand the temporary erosion caused by Hurricane David

percent of the homes were strong in several areas he determined to be vulnerable to wind and water damage. He also learned first-hand about some of these more vulnerable areas when he surveyed the damage left by Hurricane Frederic in Gulf Shores, Alabama in 1979. Machemehl made the following suggestions to strengthen coastal construction: First of all, build the house above the storm surge level and sink the piles deep enough for strength. Bolt piles securely to the floor structure and cross-brace the piling structure on the sides not facing the ocean. Last, yet most importantly, tie the whole structure together, all the way from the ground to the rafters, with metal connectors.

Machemehl's work is reflected in the state building code and has been reported in journals, but his major contribution has been in defining those weak spots in coastal construction. He hopes

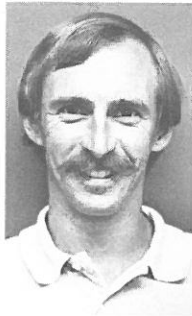
that not only will property owners follow his suggestions when building, but that architects, engineers and contractors will refuse to build anything less than a "survivable" structure. "You can't build anything that can survive a two-hundred year storm," he says, "but you can build a structure that will survive many of the forces found along the coast in lesser storms."

• Spencer Rogers has seen a lot of changes in coastal construction and design over the years. As Sea Grant's coastal engineering specialist, he's aware of the forces man must battle just to have that place at the beach. Erosion and storm damage are the worst.

Erosion eats away, on the average, about three and a half feet of coastline each year. "If a structure is to have a useful life on the beach," Rogers says,

Continued on next page

"it must be able to survive long-term erosion, a typical and natural phenomenon. A second concern is temporary erosion caused by a major hurricane or storm."



Rogers

To aid the property owner in selecting a building site and meeting the standards for federal flood insurance, the Office of Coastal Management (OCM) conducted a study to determine ocean erodible areas of environmental concern. Rogers worked with the OCM staff, mapping beach profiles and measuring long-term erosion, to determine which areas along the coast suffer the most severe changes. As a result of the study, the state chose setback standards for building which are regulated by the Coastal Area Management Act (CAMA).

As for building on the coast and surviving a storm, Rogers says that's just like flipping coins with your house—heads or tails, win or lose. He explains that in this manner: A 100-year storm has a one-percent chance of occurrence in any given year. The average useful lifetime of a residence is roughly 70 years before it wears out or is destroyed by other causes. The chances of a beach home experiencing at least a 100-year storm are roughly 50-50. Over the life of a 30-year mortgage, chances are about one in four that the beach house will be hit by a major hurricane.

With such high risks, Rogers says building to exceed the minimum construction standards is frequently a wise investment. Rogers has worked with the state in revising and updating building codes to make structures more resistant to high winds, crashing waves, storm surge, flooding and erosion.

"In building near the beach," Rogers says, "the most consistent error people make is that they drastically underestimate the degree of change that goes on. Structures cannot always survive those changes. People take learned concepts of building in Raleigh or Kansas, where the land processes are very slow events, and try to apply them to the coastal area. The surface veneer down here is always

Photo courtesy of the Division of Archives and History



This old photo shows the damages and the boats washed up in the streets of Swansboro after flooding from Hurricane Hazel

changing," he explains, "and they must keep that in mind when they build."

• Flooding is the major cause of destruction during a hurricane. The storm surge and torrential rains that accompany the storm raise the water level, flooding low-lying areas while waves and currents erode beaches, undermine coastal structures and wash out roads. Nine out of 10 hurricane-related deaths are due to drowning. Lives and property could be saved if there were some method of determining which areas flood and by how much. Researchers on a new Sea Grant project are working on just such a method.

C. C. Tung, a professor of civil engineering at NCSU, and his graduate assistants are refining a state-of-the-art computer model that can simulate overflow and flooding in coastal areas. Geographical data has been plugged in for six sample profiles which will be used to test the model: Browns In-



Tung

let, Kure Beach, Wilmington, Roanoke Island, Hampstead and Cape Fear. By putting in information on the speed, intensity and direction of the storm, Tung hopes the model will be able to predict not only the storm surge and height of waves associated with a specific hurricane, but also how far inland the water will move.

In the last century, North Carolina has had its share of flood damages from hurricanes. Between 1897 and 1955, 67 hurricanes caused flooding in the state. Storm surge, the rapid swell in the water level produced by winds and falling barometric pressure, reached a height of 15 feet above normal with Hurricane Hazel in 1954. The torrential rains and sudden flooding that also came with the storm accounted for most of the 100 million dollars worth of damage.

"Determination of flooding is important in helping state and federal governments, industries and residents to determine where facilities can be built without undue damage when hurricane-related floods occur," Tung says. When complete, he says the model will be made available to state and federal government agencies.

"The development of such models should eventually serve two pur-

poses," he says, "for decisions about future development and for hurricane warning evacuation efforts." Given the flood patterns of a community, local officials could make better decisions about development and enforce the building codes and federal flood insurance regulations. He says the model can also help communities make decisions about evacuation routes and timing.

• If a hurricane warning is given for your community, do you know the safest route out? How long will it take to reach "high ground" or the nearest emergency shelter? These were the kinds of questions John Stone was seeking answers to in his Sea Grant project this year. He found a relatively simple way of getting them, too.

Stone, an assistant professor of civil engineering at NCSU, was familiar with the transportation studies for evacuation which had been done for other states, such as Texas and Florida. But, the computerized models were for metropolitan areas, and the North Carolina coast is dotted with

small communities. So, Stone employed some traditional traffic-engineering methods, calculated for the worst storm possible, and considered the following factors for two sample areas: the population and its density; coastal topography; the transportation system and the number of alternate routes; and the storm with its location, intensity, speed and direction of travel. The sample areas chosen were Holden Beach and Goose Creek Island.

Both areas fared well when the simple techniques were used to judge evacuation, despite the fact that Holden Beach's estimated summer population of 10,000 has only one road out and a bridge to cross. Goose Creek residents have a bridge to cross, several low-lying roads subject to flooding and some congestion when ad-



Stone

acent communities funnel into the road out. In addition, heavy rains, low visibility, high winds, road washout and flying debris can make the usual 30-minute drive a three-hour ordeal. But congestion is the worst.

"In the coastal area, it's been said that the roadway systems have been in place for twenty-five years," Stone says. "The capacity of those roadways has remained the same, but the development of the coast has expanded astronomically and will overload the roads."

The simple techniques Stone used in his Sea Grant project can be used by any coastal community to determine an adequate evacuation time and identify critical points. In gathering the necessary population and transportation data for the evacuation study, local community officials can also become more familiar with their roadway system and what sort of planning can be done to alleviate the current problems.

—Cassie Griffin

A plan for The aftermath

What does a town do when a hurricane all but wipes it off the face of the earth? Reach for its post-disaster plan, according to the Coastal Resources Commission, and follow the guidelines for reconstruction.

The post-disaster plan idea, the brainchild of the commission, made its debut this past summer when it was introduced in Manteo and Wilmington. The reason? "After the devastation of a hurricane, it's utter chaos," says Parker Chesson, chairman of the commission. "And that's not the kind of atmosphere for making decisions about where structures are going to be rebuilt and roads relocated." Proposed guidelines were open for discussion, and the idea was well received by many of the coastal officials attending the meetings.

Chesson said that while most coastal communities have emergency evacuation plans, none had a plan for post-disaster reconstruction. In developing the idea and proposed guidelines, members of the commission studied other states, particularly Gulf Shores,

Alabama, which was devastated by Hurricane Frederic in 1979. The mayor of Gulf Shores told the commissioners that the lack of a post-disaster plan was at the root of their town's rebuilding problems. "Inadequate zoning and building codes," Chesson says, "allowed all buildings to be put back in exactly the same locations where the storm had demolished them. We don't want that here."

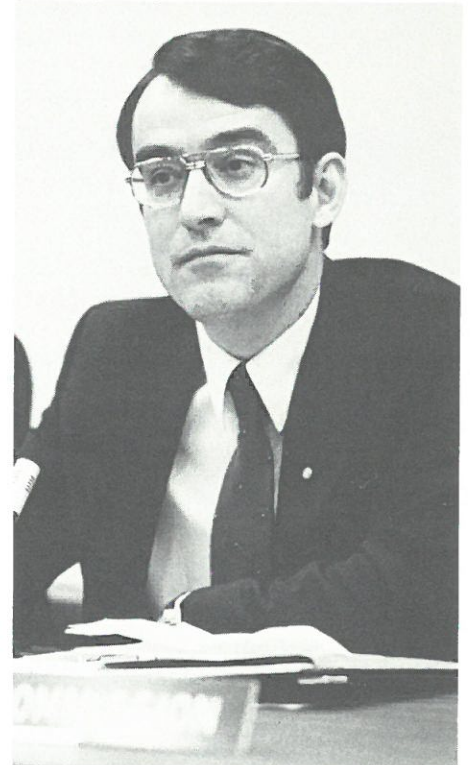
With the general policy and guidelines proposed by the commission, coastal communities are asked to establish plans which include an inventory of buildings, a list of property owners and policies for desired relocation of roads, utilities and public and private development. "These guidelines aren't going to do much for post-disaster without the local communities getting involved themselves," Chesson says, "and most local governments do want to have control over how their community is going to grow and develop."

North Carolina is "out in front," Chesson explains, with the post-disaster plan, and with good reason because of federal cutbacks in relief funds. He says that it is going to be much easier for towns to get help in reconstruction if they show wise use of

the funds and a cooperative plan of action with state and local government agencies.

—Cassie Griffin

Photo by Jim Page. NRCD



Parker Chesson

Hurricane Safety Checklist

According to John Sanders, you can never be *too* prepared for a hurricane. As Sea Grant's coastal weather awareness specialist, he has spent the last year and a half working with the media, communities and government officials to increase their understanding of hurricanes and the damages and

hazards associated with severe storms. To help individuals prepare for a hurricane and protect their property, Sanders developed a hurricane safety checklist tailored to the North Carolina coast.

STEP 1. Is your home on land which is less than 20 feet above sea level?

If yes, go to Step 3.

If no, go to Step 2.

STEP 2. Do you live within two miles of the ocean or one mile of a sound or river?

If yes, go to Step 3.

If no, go to Step 4.

STEP 3. You live in an area which is vulnerable to flooding during a hurricane. Because nine out of 10 hurricane-related deaths are due to drowning, you should use the following checklist to prepare for a hurricane emergency. You should make decisions now about where you will go if you have to evacuate, how you would get there and how long it would take you to move to safe shelter.

A. If a *hurricane watch* is issued for your area, take the following precautions:

1. Drive to a nearby gas station and fill your tank.

2. Store or tie down all outdoor objects, such as garbage cans, outdoor furniture and garden tools.

3. If you own a boat, moor it adequately. Remember that tides can increase from 10 to 20 feet above normal. Take this into consideration when securing lines. If your boat is small enough, move it onshore. Fill the boat with water or tie it down to keep it from being blown about by the hurricane winds.

4. Tape or board up the windows of your house.

5. Pack valuable papers such as deeds, wills, insurance documents and contracts, to take with you.

6. Prepare a survival box containing a medical first-aid kit, special medication which you or other members of your family may need, rope, flashlight, transistor radio, extra batteries, containers of fresh water, water purification tablets, non-perishable foods, one change of clothing and sleeping bags.

7. Contact friends, relatives and/or neighbors to let them know of your plans. Monitor radio and television reports for updates on storm conditions.

B. If a *hurricane warning* is issued, prepare to evacuate. Take the following steps immediately:

8. Shut off the main power switch and main gas valve. Elevate your appliances, such as refrigerator, stoves, washer, dryer and freezer, above the floor to minimize water damage. Cover the refrigerator and freezer with newspapers and blankets for insulation

and to prevent food spoilage.

9. Go through the checklist once more and make sure that you have completed all of the steps.

10. Evacuate. If you are handicapped and/or need transportation, call your local office of Emergency Management.

STEP 4. You may be able to ride out the storm in your own home. However, if you live in a mobile home, you should go back to Step 3 and plan to evacuate. (Even mobile homes which are anchored and have overhead braces are vulnerable to wind damage.)

A. If a *hurricane watch* is issued for your area, take the following precautions:

1. Drive to a nearby gas station and fill your tank.

2. Store or tie down all outdoor objects, such as garbage cans, outdoor furniture and garden tools.

3. If you own a boat, moor it adequately. Remember that tides can increase from 10 to 20 feet above normal. Take this into consideration when securing lines. If your boat is small enough, move it onshore. Remember to fill the boat with water or tie it down to keep it from being blown by the hurricane winds.

4. Tape or board up the windows of your house.

5. Check the batteries for your flashlight and transistor radio. Make sure you have extra batteries.

6. If you require special medication or prescription drugs, make sure that you have an ample supply before the stores close.

7. Store plenty of fresh water in containers. Make sure that you have several days' provisions of non-perishable foods.

8. Contact friends, relatives and/or neighbors to let them know of your plans. Monitor radio and television reports for updates on storm conditions.

B. If a *hurricane warning* is issued, take the following steps immediately:

9. Shut off the main power switch and main gas valve. Cover your refrigerator and freezer with newspaper and blankets for insulation and to prevent food spoilage.

10. Go through the checklist once more and make sure that you have completed all of the steps. Then, go indoors and stay indoors. Brace all doors to prevent wind damage. Monitor storm reports with your transistor radio. Stay indoors until an official all-clear notice is given.

One family's plan for hurricane preparedness

This past spring, seventh- and eighth-grade students at Pamlico Junior High School in Bayboro took Sanders' checklist and developed their own family checklists. As part of a year-long focus at the school on hurricane preparedness, this project had students working with Sanders, their parents, teachers and local emergency management officials. An example of one student's work is listed below.

Plan for a home on land less than 20 feet above sea level.

A. Do the following in case of a hurricane watch:

1. Drive 1.6 miles to Grantsboro. Fill car and truck gas tanks. This takes approximately 12 minutes.
2. Put two bicycles, one push mower, 13 tomato planters, two ladders, one radio antenna, one wheelbarrow and two sawhorses in garage. Put spare lumber under two-story storage shed.
3. Move boat and trailer next to two-story shed. Secure boat to trailer and trailer to building supports. Fill boat with water; then put hose in garage.
4. Get 4' x 5' sheet and 5' x 9' strip of plywood from second floor of shed. Get nails and hammer from garage and board up picture window. Get masking tape from garage and tape 13 small windows in the house, eight in the shed, and five windows in the garage.
5. Get deeds, insurance and birth certificates from top drawer of the file cabinet in the master

bedroom. Get car title from bill holder on dining table. Pack all of these in the smallest blue suitcase in the attic.

6. Pack a survival box. Include flashlight, radio, spare batteries, blankets, rope, fire extinguisher, a change of clothes, desired non-perishable food, fresh water and water purification tablets. (If you have none, they are available at local drug stores.)
 7. Contact neighbors, friends and relatives and tell them of your plans.
 8. Lower radio tower in back yard.
- B. If a hurricane warning is issued, take the following steps immediately:
1. Raise all appliances up on concrete blocks. Insulate refrigerator and freezer with blankets.
 2. Shut off main power switch in utility room. Breaker box is next to washing machine.
 3. Go through checklist. Make sure all steps are completed.
 4. Pack survival box and suitcase of important documents in car. Drive 5.4 miles to nearest shelter—Fred A. Anderson School in Bayboro. This takes 8 minutes.

Hubert W. Buck
Eighth Grade
Pamlico Junior High School
Bayboro, North Carolina

Photo by Tommy Baab, *The News and Observer*



Pamlico Junior High School students check the contents of a hurricane evacuation survival box

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454).



There's a new threat to some of North Carolina's water supplies, but it's not drought or a toxic chemical. The culprit is an aquatic weed, *Hydrilla verticillata*.

Ron Hodson, Sea Grant's associate director and an NCSU zoologist, is leading a research project aimed at finding ways to control the weed, which has appeared in 15 lakes and reservoirs around Raleigh. Officials are worried that the weed will spread as it has in Florida, where it clogs waterways with a thick mat of vegetation, choking out recreational boating and fishing. The threat to Raleigh-area water supplies is serious, Hodson says, since hydrilla infestations can lock up as much as 60 percent of the water in a lake.

Hodson and his team, which includes Neil Rhodes, David DeMont and Melvin Huish of NCSU, and Graham Davis of East Carolina University, are setting up test enclosures in several Wake County lakes. In the enclosures, the team will test an integrated approach to weed control that includes the use of herbivorous fish, periodic draw-downs to lower water levels, and applications of approved herbicides. When their studies are complete, the team plans to recommend hydrilla-control measures to the City of Raleigh and the Water Resources Research Institute, both of which funded work on the project.

Hydrilla, which is not native to the U.S., probably came here from South America as a plant for aquaria. It was

found growing in Florida in 1960. No male hydrilla plants have been found in the U. S., and the weed produces no seed here. Even so, it proliferates through several forms of vegetative reproduction. Once established, the hydrilla takes root in the lake or river bottom, forms a tuber there, grows to the surface, and shades out its competition.

So far, the only hydrilla reported in North Carolina has been in Wake County, where heavy infestations have troubled three lakes in the William B. Umstead Park. Hydrilla has also found its way into Lake Wheeler, a municipal reservoir for Raleigh.

Hodson says the public can help control the spread of hydrilla by taking care not to transport it out of an infested area. A single sprig carried off on a boat or trailer can live to start a new colony, he says. He also cautions people not to discard any exotic plant or fish in such a way that it can survive to reproduce.



Sea Grant researcher, Tyre Lanier, has added an international perspective to his project this year. Takayuki Akahane, a biochemist from Tokyo, Japan, is spending a year in the United States working with NCSU's Department of Food Science on Lanier's surimi research.

Surimi, which is washed and minced fish, is popular in Japan, where it is the base of a variety of seafood products. In his Sea Grant work, Lanier has combined ground shrimp with surimi to produce a shrimp-shaped seafood that not only fooled a panel of tasters, but also sparked the interest of several major food companies. But, there were still unanswered questions about surimi, so Lanier welcomed a link to Japan's surimi know-how.

Taka is running several tests on Lanier's surimi to find a new additive source and to measure changes in fishmeat quality. At present, sugar is being added to surimi products to im-

prove gel properties. While the Japanese like a hint of sweetness in their surimi, Americans balk at the taste and added calories. Taka is testing a solution that he hopes will halt the process of muscle changes during storage and in that way preserve the fresh quality of the fish meat.



Wayne Wescott, UNC Sea Grant's new marine advisory agent, has joined Hughes Tillet in the Sea Grant office at the N. C. Marine Resources Center on Roanoke Island.

Wescott, a native of Manteo, brings a solid base of experience to the Sea Grant program. He received his undergraduate and masters degrees in business administration from East Carolina University. He has worked as a commercial fisherman and managed a fishing cooperative in Dare County. Wescott has also been an extension education and training specialist for commercial fishermen under a Sea Grant education project. With the project, he planned, developed and scheduled courses and workshops to help fishermen learn about new types of gear, new fishing methods, marine finances and more.

If you'd like Wescott's help, give him a call. The number is (919) 473-3937.



In May 1979, much of the Brittany coast of France was ruined by an oil spill from the huge *Amoco Cadiz*. Miles of marshlands were destroyed, valuable fish and wildlife habitats were spoiled, and the shoreline lay open to erosion. Ernie Seneca, a botany professor at North Carolina State University, was called in to help re-establish the marsh, using several grass-transplanting techniques he developed during a Sea Grant project. Two years later, the same site is

on the way to a recovery.

This past summer, Seneca was awarded the Gulf Oil Corporation Conservation Award for 1982 for his work in France, similar work along the North Carolina coast and his work with students on campus. This prestigious award is given each year to 10 professionals and 10 non-professionals who do work in the field of conservation. Each recipient is given a cash award, a bronze plaque and a pin. Seneca couldn't attend the awards ceremony this summer in Washington, D.C. because of a return trip to France to restore another coastal area.

Seneca's Sea Grant work, which he conducted with Steve Broome and W. W. Woodhouse, Jr. of NCSU's Department of Soil Science, has led to two Sea Grant publications, *Planting Marsh Grasses for Erosion Control* and *Building and Stabilizing Coastal Dunes with Vegetation*.

Lundie Spence, UNC Sea Grant's marine education specialist, was named president-elect of the National Marine Education Association at its annual meeting in San Diego in August. She was elected to the position by 1400 fellow marine educators. She will succeed Prentice Stout, the marine education specialist for the University of Rhode Island Sea Grant Program, as president in 1983.



Want to learn how to cast a line, build a trap or photograph a wild animal? Plan to attend National Hunting and Fishing Day activities, to be held September 25,

from noon to 6 p.m., at the N.C. Marine Resources Center on Roanoke Island. The event is being sponsored by the Pea Island National Wildlife Refuge and the center. Admission is free.

Lundie Spence, UNC Sea Grant's marine education specialist, will be on hand to present a program on sharks and to cook a shark casserole for the group to sample. A representative from the Smithsonian Institute will talk about marine-mammal strandings. And, there will be demonstrations on fishing, trapping, hunting, training dogs, photographing wildlife and more.

If you're interested in contributing a

display about outdoor recreation or in demonstrating a special technique—say, fly-tying, duck-calling or bait-rigging—call Bonnie Woodall at the Pea Island National Wildlife Refuge, (919) 987-2394.

Jim Murray, UNC Sea Grant's Marine Advisory Services (MAS) director, was elected chairman of the MAS leaders at a meeting of the Sea Grant Association in Washington, D.C. in July. He will be responsible for arranging next year's MAS agenda for the association meeting in San Antonio and serving as a spokesman to the Council of Sea Grant Directors.



Hurricanes got lots of attention from the media during Hurricane Awareness Week, August 2-5, and Sea Grant people figured in several of the stories and newscasts. John Sanders, Sea Grant's weather awareness specialist, appeared on a number of TV news shows, explaining the forces of hurricanes and how people can prepare for them. Spencer Rogers, Sea Grant's coastal engineer, and John Stone, a NCSU

civil engineer who recently completed a Sea Grant study on hurricane evacuation, also served as sources for several news stories and telecasts during the week.

Cassie Griffin, of Sea Grant's communication's staff, appeared on a Havelock cable-television program, interviewing students from Pamlico Junior High. The students talked about the things they had done to prepare their families for a hurricane.



Sea Grant Today, published by the National Sea Grant College Program, is free for the asking. This bimonthly publication, which is aimed especially

at industry, includes articles written by communicators, researchers, marine advisory agents and educators throughout the Sea Grant network. A list of new Sea Grant publications is also included in each issue.

For your free subscription, write *Sea Grant Today*, Food Science and Technology Building, Virginia Tech, Blacksburg, VA 24061.

Continued on next page

Coastwatch is a free newsletter. If you'd like to be added to the mailing list, fill out this form and send it to Sea Grant, Box 5001, Raleigh, N.C. 27650.

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- Lawyer
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Coastal property owner yes no Boat owner yes no



Would a mountain trout raised in coastal waters taste as sweet? According to Sea Grant staff at the Aquaculture Demonstration Project in Aurora, the answer is yes. In an experiment begun last December, Johnny Foster and Randy Rouse, both of the project, stocked two 1/2-inch mesh cages with 870 mountain trout weighing about 2.5 ounces and measuring six inches long each. Foster and Rouse hung the cages from their pier in South Creek, which runs by the Aurora lab.

Melvin Huish, an NCSU zoologist who has been conducting Sea Grant research at the Aurora site, helped the project secure the young trout, which were provided by the U.S. Fish and Wildlife Service.

During a fish kill in the Pamlico River in late December, 429 of the trout died. Though the exact cause of the kill has not been determined, fisheries experts believe either a virus or an algae bloom triggered the kill, Foster says.

The remaining fish were fed a commercial trout feed and 420 trout were harvested in late May. The average weight then was 9.3 ounces and the length 10 inches, the normal harvesting size for mountain trout. And the flavor, Foster says, was excellent.

More work is planned to see if trout could be raised commercially in coastal North Carolina.



It takes careful planning to help any expanding industry avoid growing pains. That's why Sam Thomas and Dave Hill are working on some flexible building designs for seafood processing houses.

Thomas and Hill, both with Sea Grant advisory services at the NCSU Seafood Laboratory, are designing a multi-use building for the Wanchese Harbor Seafood Industrial Park. They have been working with Bruce Strickland of the Department of Commerce and Robert Williams of the North Carolina Seafood Industrial Park Authority on the building plans. Thomas says the basic building can start as a small fish house and grow with the owner's business into a large seafood processing plant. Plans also allow for flexibility in the transition from one owner to another, or from one type of processing business to another.

And, while Thomas and Hill spent some time at the drawing board, their colleague at the lab, Joyce Taylor, took her work on the road. Some dozen workshops later, groups from across the Carolinas had gotten some help with seafood preparation and nutrition, plus a taste of such fare as fish-flake salad and baked clams. Frank Thomas, project director at the lab, chimed in with advice on buying and cleaning fresh seafood.



Albemarle Sound Trends and Management is the latest in Sea Grant's series of technical reports. The report is the proceedings of a conference held March 3 at the College of Albemarle in Elizabeth City.

The conference, which attracted about 150 participants, invited scientists and leaders to review the sound's water-quality problems and to assess current management alternatives. It was sponsored by the UNC Water Resources Research Institute and Sea Grant. For a copy of the proceedings, write UNC Sea Grant. Ask for publication UNC-SG-82-02.

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