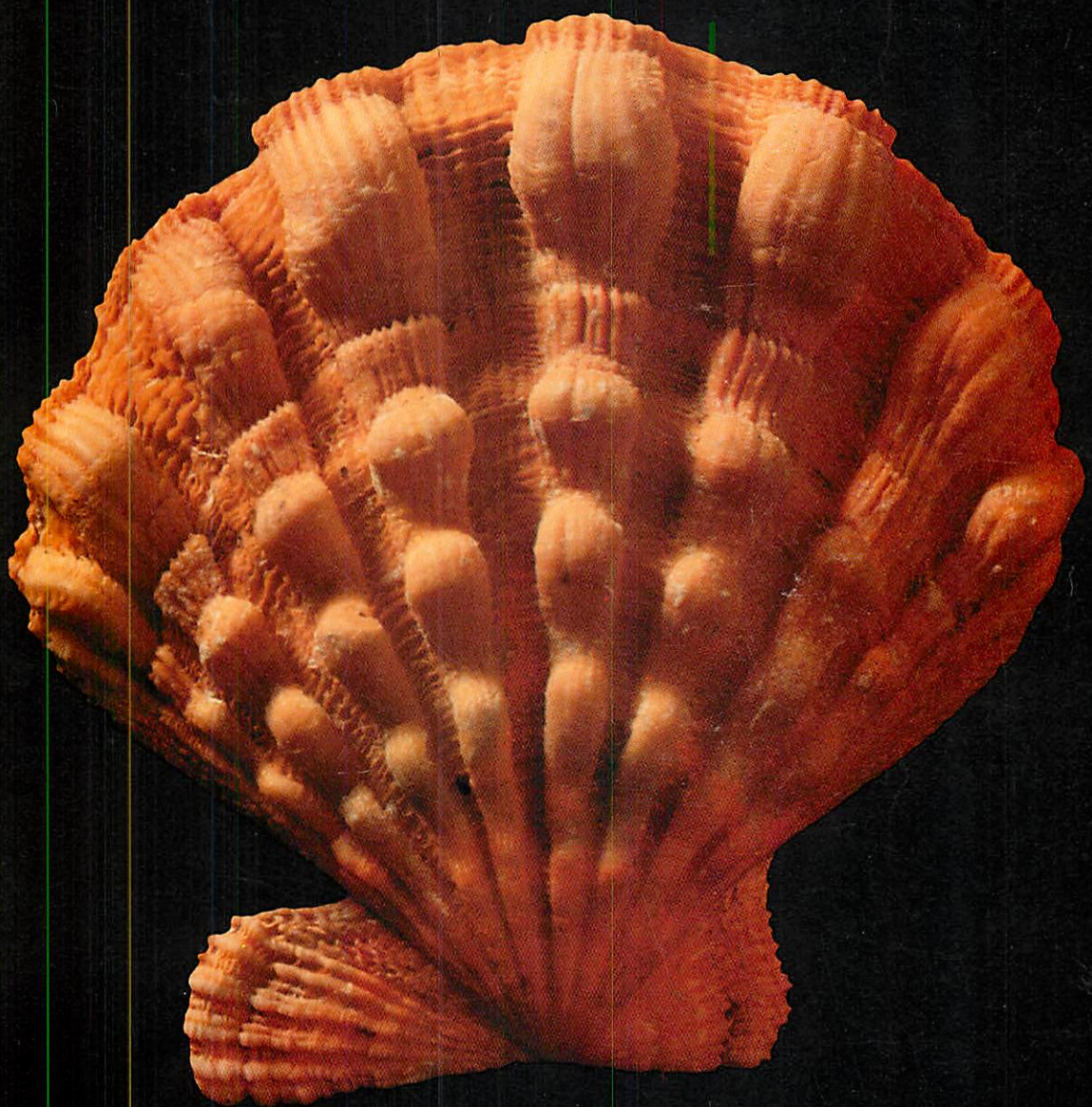
SEA GRANT in North Carolina

1979-1980



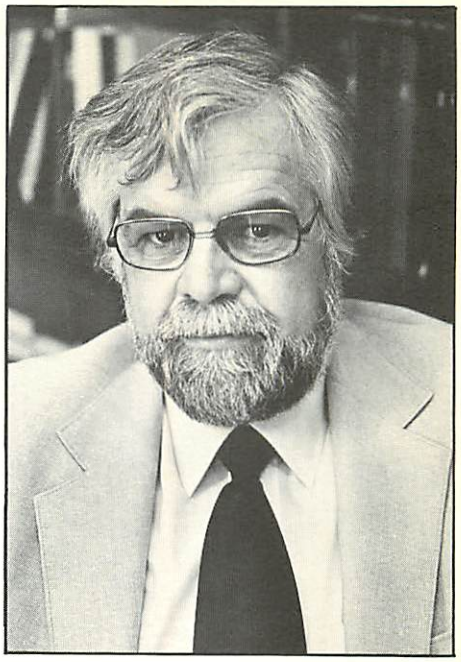
A PARTNERSHIP

Sea Grant is a state-federal partnership designed to promote the wise use and development of the nation's coasts and oceans through research, extension and education. The U. S. Department of Commerce's National Oceanic and Atmospheric Administration provides two-thirds of program support while the N. C. Department of Administration through its Office of Marine Affairs provides matching dollars on a one-to-two basis.

Sea Grant is an inter-institutional program within the University of North Carolina, a 16-member institution under the direction of a Board of Governors, John R. Jordan, Jr., chairman. William Friday is president. The university's Council for Marine Science, chaired by E. Walton Jones, UNC vice-president for research and public service programs, coordinates university marine science programs, including Sea Grant. □

ABOUT THE COVER

The Lion's Paw *(Lyropecten nodosus)* shell, with its bold, paw-like markings, houses the meat of a rare but delicious scallop. Those lucky enough to find Lion's Paw shells in North Carolina usually do so on Outer Banks beaches. This example is from the collection of the Hampton Mariners Museum in Beaufort. The color photograph is by Ken Taylor.



FROM THE DIRECTOR

This report marks the end of the first decade of Sea Grant activities in North Carolina. In 1973, the University of North Carolina established the Sea Grant Director's Office at North Carolina State University in Raleigh. And in 1976, we were designated a Sea Grant College. These milestones reflect a commitment to excellence and the continued support of the Sea Grant concept here in North Carolina.

We have invested in research in the areas of coastal conflict, environmental quality and fisheries, and our effective advisory services and education programs have applied the findings toward providing a significant economic return for the coastal sector. In just a short time, economic returns on our research investment have far exceeded the expenditures. A modest grant supporting coastal septic tank research, for example, meant millions of dollars worth of new construction could proceed, without endangering the water quality of shellfish beds. Solving this kind of problem is the type of challenge typifying the Sea Grant concept.

Advance planning and effective review have helped our work evolve into a biennial program. This enables the university to better arrange its resources and allows for the innovative, "grass-roots" creativity that lets us serve the coastal community more effectively.

The presence of Sea Grant in North Carolina during our first decade has been responsible for a major increase in our state's marine awareness. People feel they have a place to "find the facts" about marine resources. They feel they can get help with their problems through an attentive and effective advisory service. They feel they are up-to-date on the latest information through a highly regarded communications program.

These expectations will be even greater during the next decade. The stakes will be higher, as our people struggle with the complexities of survival. And, our contributions will be more sophisticated and will cover a broader spectrum. Sea Grant in North Carolina is ready for a challenging second decade.

B. J. Copeland

INTRODUCTION

One evening in September, 1933, Irvin Guthrie walked out of his house and felt water rising around his ankles. A huge hurricane was shoving water up in Back Sound, flooding Harkers Island.

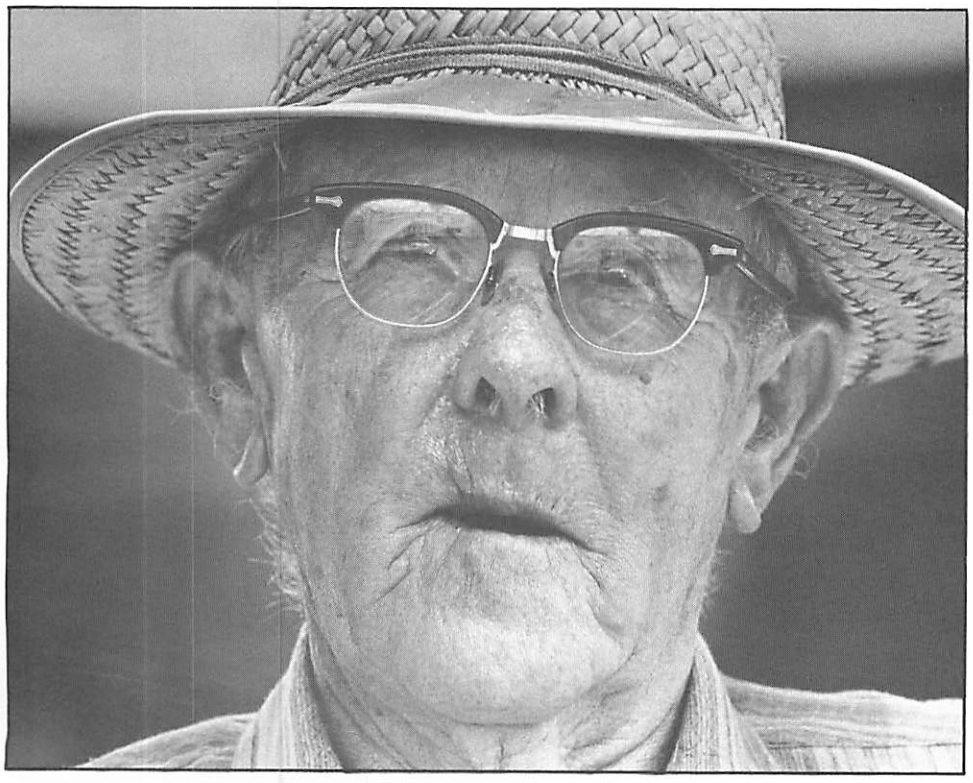
"Up in the road, somebody had a lamp lit," Guthrie recalls, "People were tying themselves together with a long rope, so nobody would get lost. They were headed for high ground."

When the storm passed, the islanders untied themselves and went home. But Guthrie's house had been swept out of his yard. His neighbors helped him lift his house back astride its underpinnings.

"Only thing is, the doors and windows never fit just right after that," Guthrie says. "Things just don't hold a straight line."

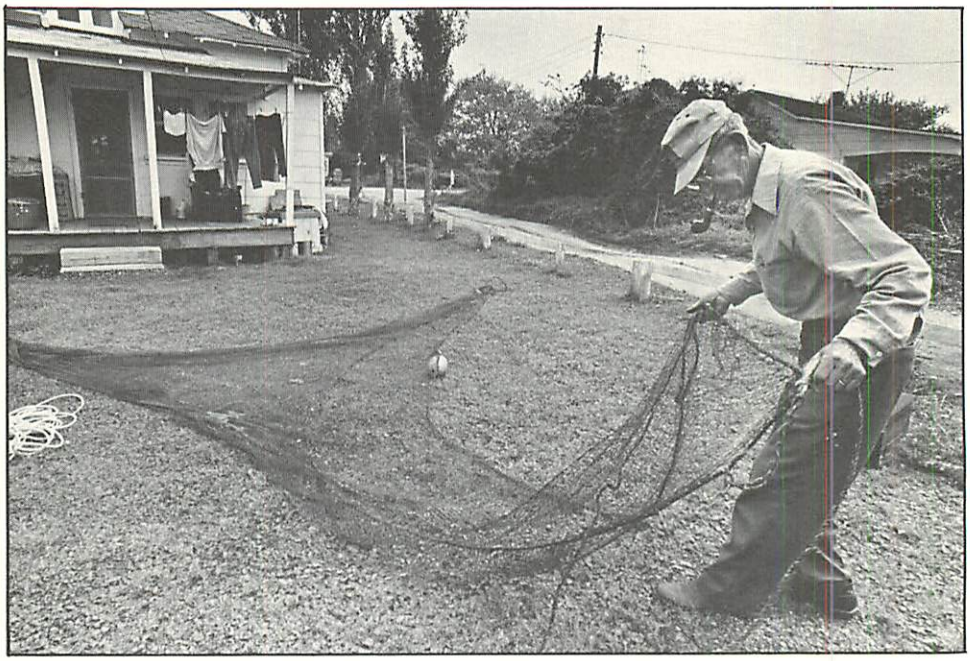
And neither does the structure of a community hold a straight line, when a storm of change reaches it. In the fertile soils of its traditions, Harkers Island has for generations raised hearty, self-reliant fishermen, and boat builders of skill and ingenuity. But when Jim Sabella, Richard Dixon, Roger Lowery and Marcus Hepburn went there to study the social fabric of a fairly typical North Carolina fishing village, they found an island besieged by change. Harkers Island, they saw, was veering from the peaceful path it once followed.

They found the scramble for new gear and bigger boats forcing fishermen into debts that restrict their freedom and quicken the pace of their lives. They found some of the closely knit families showing signs of unraveling as young men left the island for "outside" jobs. They found craftsmen famous for their wooden boats battling competition from



"Only thing is, the doors and windows never fit just right after that. Things just don't hold a straight line."

Irvin Guthrie
Harkers Island



Charlie Hancock of Harkers Island

"You have to go harder and harder to make a living. You could have a certain trawl this year, catching shrimp, and next year somebody could pop up a new idea, and the following year, you'll probably have to get a new trawl."

Ben Brooks
Harkers Island fisherman

manufacturers stamping craft out in fiberglass. They found fishermen frustrated with the problems of pollution, regulation, overdevelopment, rising fuel prices and escalating competition. They found fishermen's wives becoming reluctant to endorse fishing as a way of life for their children. And, they found some unsettling parallels between the evolution of family farms into "agribusinesses" and the trend away from one-family fishing operations like those on Harkers Island.

The researchers did find some encouraging signs. Harkers Islanders are inventive and self-reliant, and will probably find new livelihoods if their old ones disappear. And many of the islanders, especially its daughters, still cling to their family values and neighborly ways. The strength of the social order seemed to say that Harkers Island will survive. But it will never be the same.

The hope is that the numbers and statistics gleaned from studies like these will provide the state with a better understanding, not only of the natural resources along its coast, but of the human resources as well. Promoting the wise use of those resources is what the effort described in this report is all about. □

THE PROGRAM

Jim Sabella, *Department of Anthropology, University of North Carolina at Wilmington*

Richard Dixon, *Department of Sociology, University of North Carolina at Wilmington*

Roger Lowery, *Department of Political Science, University of North Carolina at Wilmington*

Marcus Hepburn, *Department of Sociology and Anthropology, University of North Carolina at Wilmington*

FISHERIES

ENVIRONMENT

The secret of clean water used to be locked in an oyster shell. When Mark Sobsey cracked that shell, he made several critical discoveries:

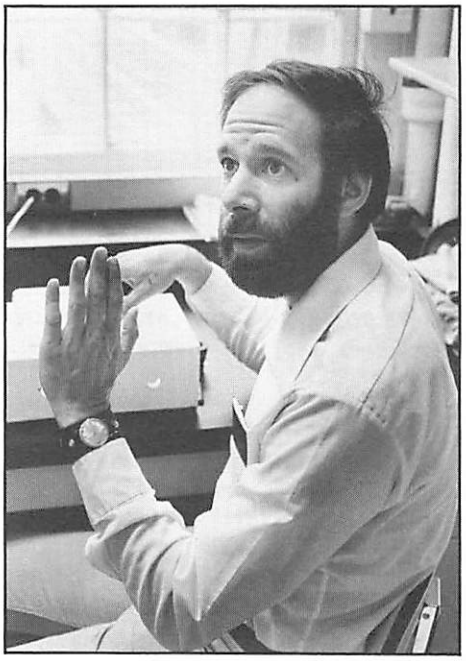
- The coliform bacteria long thought to be reliable signals of contaminated water are not totally reliable. And, Sobsey found, current standards for shellfish sanitation do not accurately indicate the presence or absence of enteric viruses, the tiny pathogens, often carried by sewage, that infect people with viral hepatitis and viral gastroenteritis. Twice, Sobsey's lab has been called on to examine oysters known to have caused outbreaks of disease. One of those outbreaks affected 150 people who had been to an oyster roast in North Carolina. In both cases, the infected shellfish had come from approved, "clean" waters. The shellfish actually met current standards.
- Having discredited the old tests, Sobsey designed a new one. His method, which he believes can be made practical for shellfish microbiological laboratories across the country, identifies the harmful viruses more accurately.
- Fortunately, Sobsey and his assistants found that their discoveries may not necessarily foreshadow more restrictions on shellfishing in the state. There are two reasons. Sobsey and others are identifying the contaminants and tracking them to their sources, the first steps in improving water quality. The second reason is provided by the oyster itself. Sobsey has found that, during winter and spring, "dirty" oysters "relayed" into clean waters can purge themselves of viral contamination in a matter of days.

Relaying has been used in North Carolina for years, but the actual rates at which the shellfish cleanse themselves, and the seasonal variations of those rates, were not known before Sobsey began his work. Using the results of Sobsey's Sea Grant study, the seafood industry may be able to relay more profitably, and officials will have some of the facts they need to ensure customers get a safer, more wholesome product.

But the oyster is not the only resource in troubled waters. Most of the state's commercially important fish and shellfish spend at least part of their lives in the estuaries, the coastal mixing bowls of fresh and salt water.

Knee-deep in the marsh of Rose Bay, John Miller's research team found the pulse of one of the state's most fertile estuaries. Their work was geared to a crucial question: Will our stocks of fish and shellfish, stressed by the declining quality of the estuarine environment, survive to feed us? Here is what they found:

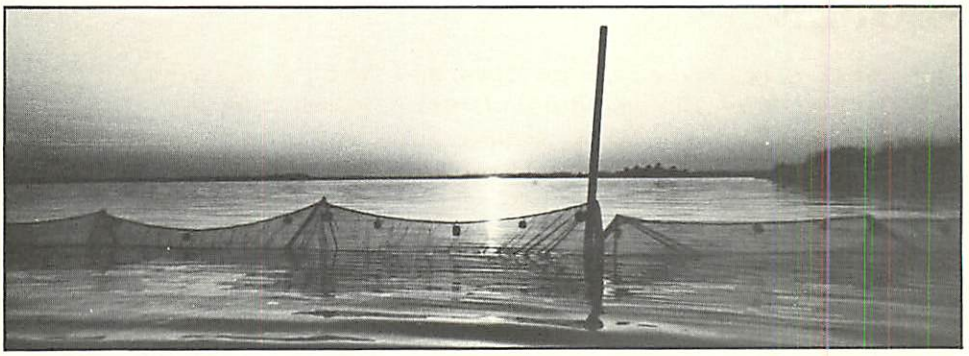
- Increases in the amount of fresh water draining into estuaries from big farms and peat mining operations will probably take a toll in young fish, especially croaker.
- Intense development and land-use practices that stir mud and silt into estuarine waters will cut the supplies of young fish that live in the marshy grass beds. Among these are juvenile sea trout, bluefish, silver perch and pinfish.



Mark Sobsey

"We've worked closely with Mark, and we feel it's a good study. What Mark's doing is going to provide the basis for better standards. We're very interested in what he's finding out."

George Gilbert
District Sanitarian
Shellfish Sanitation
Morehead City



Miller's research project at Rose Bay.

What Miller found is both good news and bad: The delicate estuarine environment is even more delicate than we thought.

"In the creeks and sounds, there just isn't the life there used to be. The small-boat fisherman here is just about out of business; the seafood in this area is just not there for them to fish. It's going to take some research to prove some of these things are problems."

Forest Williams
Pamlico County fisherman

- The best nurseries for many fish are also the most vulnerable. Miller found that in shallow water habitats, fish grow faster and their numbers are even more concentrated than once imagined.
- Trawling and dredging in nursery grounds threaten the most important source of food for juvenile spot and croaker — clam siphons. The fish feed on the siphons, which the clams can, in time, renew. But when the fragile shells of small clams are broken by fishing gear, this food source is lost.

Miller's team also found in the feeding habits of these fish several key pieces to a very complex puzzle — a plan for managing the fish that use the estuaries. So what Miller found is both good news and bad: The delicate estuarine environment is even more delicate than we thought. But, the research Miller has done may give officials some of the facts they need to protect the environment and the resources it provides.

To learn how to produce good wood, foresters have read the histories of forests in the growth rings of trees. Charles Peterson's Sea Grant work has made it possible to learn the same lessons about shellfish — in the "rings" of a clam shell.

North Carolina's commercial harvest of hard-clam meats leaped from 892,000 pounds in 1978 to 1,455,000 pounds in 1979. The reasons? People are eating more seafood, and some new methods of harvesting clams mechanically — one example is "kicking" with boat propellers — have recently made older, deep-water beds accessible.

Peterson set out to discover whether the state's clam population could stand the increased fishing. The obvious question was, how long will it take new clams to grow and replace the ones we're taking? The hitch was that nobody could accurately guess a clam's age and the clams weren't telling. Then Peterson discovered that clams and other mollusks deposit annual lines in the layers of their shells. When he cut, polished and etched the shells with acid, Peterson found what he calls "a relief map, almost like a fingerprint." In the maps, he says, "you can even see the rise and fall of the tides. There are lines matching the lunar cycle of spring tides and neap tides. And there are annual lines as well, coinciding with certain annual events, such as spawning."

What is left is to sample the state's catch well enough to say how old our market-size shellfish are, and how long it should take their numbers to rebound. And that will make it possible, Peterson believes, to better manage the state's shellfish. □

THE PROGRAM

Mark Sobsey, *Department of Environmental Sciences & Engineering, University of North Carolina at Chapel Hill*

John Miller, *Department of Zoology, North Carolina State University*

Charles Peterson, *Institute of Marine Sciences, University of North Carolina at Chapel Hill*

PEOPLE

The shrimp rig is set, the gates are open, and the big boat's engine settles down for a night of trawling. But underneath, jutting from the ocean's bottom, is the ragged shell of a submerged wreck. Suddenly, the lines snap taut. The net is hung.

It's a scene played many times each season, and most every fisherman operating a trawler has lost a rig or two on "hangs."

Cap'n Hughes Tillett grew up in Wanchese, which is the same as saying he grew up fishing. He can practically feel the ache of a torn net or busted dredge in his bones. He saw a way to help.

With Jim McGee, Tillett put together a comprehensive log book pinpointing hangs along the East Coast. From ships' logs and the memories of skippers he gathered hundreds of hangs and listed them with magnetic headings. His *Hangs and Obstructions to Trawl Fishing* has become standard equipment on many Atlantic trawlers.

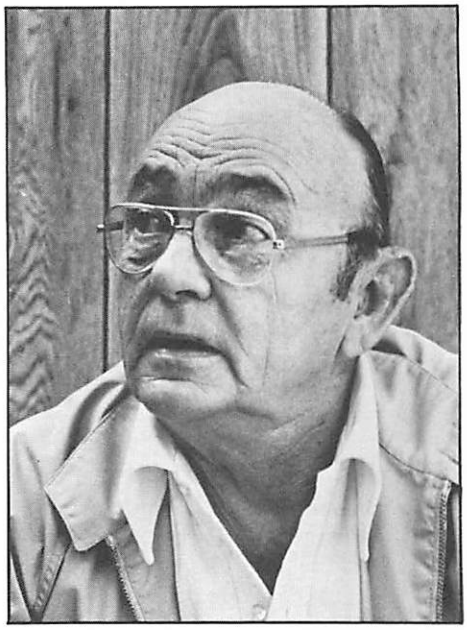
The book cost about $3,000 to print and distribute to the 5,000 fishermen who needed it. Their savings in gear and time have already amounted to many times that cost.

But in conversations Tillett, Bob Hines and Jim Bahen hear along the docks, hangs are but one worry among an army of worries, parading like headlines: Fuel Costs Skyrocket. Shrimp Harvest Down. Shellfish Waters Closed. Mortgage Rates Rising. New Fishing Regulations. Trawler Wrecks on Shoals. Storms Imperil Fleet.

Sea Grant's support of the state's fisheries was fashioned with the knowledge that, for every environmental concern, there is usually at least one people concern. Saving the clams and oysters does us little good if we lose the fishermen, the fleets, the processors and dealers that supply them.

How can we help the people in fisheries? Sea Grant attacked the problem from several directions:

- J. C. Jones' marine advisory services team went to work directly with the people on the job. Fishermen got help with improved crab pots, net reels and other labor-saving fishing gear. After Sea Grant agents demonstrated the value of new electric and hydraulic equipment for boats, fishermen used the gear to increase their incomes and improve their efficiency. Regular contacts with Sea Grant agents brought fishermen up-to-date on everything from market prices to bait supplies.



Hughes Tillett

"Some of the gear we have behind us is six or seven thousand dollars, and we just can't afford to lose it. By knowing most of these places where the hangs are, you can save yourself a lot. This hang log book Sea Grant did helps everybody, really. It keeps the cost down. We depend on it."

Dixie Daniels
Wanchese fisherman

Sea Grant's support of the state's fisheries was fashioned with the knowledge that, for every environmental concern, there is usually at least one people concern.

- Jerry Davis surveyed members of the state's seafood industry about what weather information they require. The fortunes of fishing often ride with the elements, and Davis' recommendations will help weather service personnel meet the industry's needs.
- Wayne Wescott's program of continuing education for commercial fishermen, supervised by Jim McGee, reached several hundred fishermen with workshops and training in gear, mechanics, navigation, financial management, taxes, hypothermia, on-board safety and applied meteorology.
- Sea Grant advisory staff at the NCSU Seafood Laboratory helped seafood processors modernize plants, improve sanitation and increase efficiency. At the same time, the lab worked to develop new markets and new appetites for some of the state's under-used fish. (See page 19)

And, while Sea Grant's advisory programs and education programs answered some day-to-day needs of the state's fisheries, its researchers focused on the horizon: How can we help bring a bit of order and compassion to the haphazard forces of change? The first priority was to help the state's agencies charged with managing our fisheries by providing them with solid research results. A few examples:

- John Miller and Charles Peterson studied the stocks and habitat requirements of several key groups of fish and shellfish. (See page 5.) James Sullivan and Charles Manooch studied populations of bluefish, perhaps the state's most valuable fish, and found two different groups, implying the need for more than one scheme to manage this resource.
- Capitalizing on modern computer technology, George Fishman devised a numerical model intended to help the N. C. Division of Marine Fisheries with the complicated task of composing flexible, effective management plans for the state's shrimp fishery.

Since managing fisheries means managing people, the next step was to learn something about the people being managed. What are their traditions, their ambitions, their abilities and their problems? And what can they contribute, themselves, to solving those problems? Here are some of the things we found:

- Jim Sabella and his team composed, from their research, the family portrait of an entire fishing community: Harkers Island. (See page 3.)

Since managing fisheries means managing people, the next step was to learn something about the people being managed.

- Nozar Hashemzadeh and Michael Simmons, using internships with the N. C. Department of Labor, surveyed the manpower problems of coastal North Carolina and found shortages of both skilled and unskilled labor. All the state's coastal counties but one, New Hanover, had per capita incomes lower than the state average. And, though North Carolina leads the Mid-Atlantic region in the tonnage and dockside value of its seafood, its processed seafoods bring far less than those of Georgia and Florida. Their findings reveal the need for programs designed to create better jobs and training for workers in the seafood industry.
- John Maiolo and John Bort compiled a history of shrimping in North Carolina and then went on to show the human cost of a battery of problems facing the shrimp fishery today. Maiolo's composite of the fishery's social and economic structures showed sore spots and will help officials factor into their management strategies the needs of the region's people.

A common theme among the commercial shrimpers Maiolo surveyed was the complaint that "recreational" fishermen were taking too much of the resource. Some estimate that half the state's catch is taken by part-time or recreational fishermen.

This conflict extends to include most of the state's popular fish and shellfish, and has been characterized as the "commercial guys versus the weekenders." Unfortunately, the problem is not so clearly cut. Not only are there numerous part-time fishermen who fit neatly into neither category, but many weekend sportsmen and others with "outside" jobs hold commercial fishing licenses and occasionally sell their catches. It all adds up to a headache for the N. C. Division of Marine Fisheries.

Sea Grant work by Peter Fricke and Leon Abbas applied science to the problem and offered some badly needed data on offshore recreational fishing. From their surveys and interviews they compiled profiles of sport-fishing parties and tournament fishermen. They asked recreational fishermen about such things as their trips, their catch, their expenditures and their boats. The results gave a clearer idea of the types and numbers of fish taken, and suggested some interesting conclusions: The typical fishing party spends an average of $1,000, not counting entry fees, to participate in an offshore tournament. And, personal income seems to dictate whether fishermen follow marlin, mackerel, or surf-fishing tournaments. Marlin tournaments draw the wealthiest crowds.

The findings of Sea Grant's survey of offshore recreational fishing should be useful to coastal communities trying to plan for the seasonal influx of fishermen.

The findings have been distributed to fisheries personnel, who are struggling to de-escalate the squabble over the resource. But the facts will also be useful to coastal communities trying to plan for the seasonal influx of fishermen.

Fish respect no state lines, and the problem of managing our fisheries is an inter-state concern. Because of UNC Sea Grant's unique position as a college in a national Sea Grant network, we were able to tackle some of those problems at the inter-state level. One example of this approach was the Conference on State and Interstate Fishery Jurisdiction and Management, held in October, 1979, which Sea Grant helped sponsor. About 130 fisheries specialists from across the nation discussed fisheries management, pulling together a host of fisheries-related activities, from offshore mining to coastal law. A proceedings of the conference was published by Sea Grant in March, 1980. □

THE PROGRAM

Hughes Tillett, *Sea Grant Marine Advisory Services*
Jim McGee, *Division of Continuing Education, East Carolina University*
Bob Hines, *Sea Grant Marine Advisory Services*
Jim Bahen, *Sea Grant Marine Advisory Services*
J. C. Jones, *Director, Sea Grant Marine Advisory Services*
Jerry Davis, *Department of Geosciences, North Carolina State University*
Wayne Wescott, *Division of Continuing Education, East Carolina University*
John Miller, *Department of Zoology, North Carolina State University*
Charles Peterson, *Institute of Marine Sciences, University of North Carolina at Chapel Hill*
James Sullivan, *Duke University Marine Laboratory, Duke University*
Charles Manooch, *National Marine Fisheries Service*
George Fishman, *Curriculum in Operations Research and Systems Analysis, University of North Carolina at Chapel Hill*
Jim Sabella, *Department of Anthropology, University of North Carolina at Wilmington.*
Nozar Hashemzadeh, *Department of Economics, North Carolina A&T University*
Michael Simmons, *Department of Economics, North Carolina A&T University*
John Maiolo, *Department of Sociology & Anthropology, East Carolina University*
John Bort, *Department of Sociology & Anthropology, East Carolina University*
Peter Fricke, *Institute for Coastal & Marine Resources, East Carolina University*
Leon Abbas, *Sea Grant Marine Advisory Services.*

AQUACULTURE

The "crop" is a wriggling mass of pencil-shaped fish, fattening on a meal scientifically balanced to fatten them up for market. The eminently edible American eel is still conspicuously absent from dinner tables here. Not so in Europe and Japan, where it brings a handsome price. Sea Grant work with eels has helped North Carolina aquaculturists and fishermen tap into those foreign markets and develop an otherwise-neglected resource into a million-dollar industry.

The arguments for fish-farming, or aquaculture, are convincing: It is a way to enhance the productivity of aquatic fish and plants, much the same way agriculture has multiplied the nutrition available from grains, fruits and animals. It promises an alternative to the harvest of wild stocks, which is increasingly endangered. And, it long ago proved its worth, abroad.

In this country, the age of aquaculture has waited on two things: the know-how to make it work, and the steep rise in seafood prices that would make farm-raised seafoods a comparative bargain.

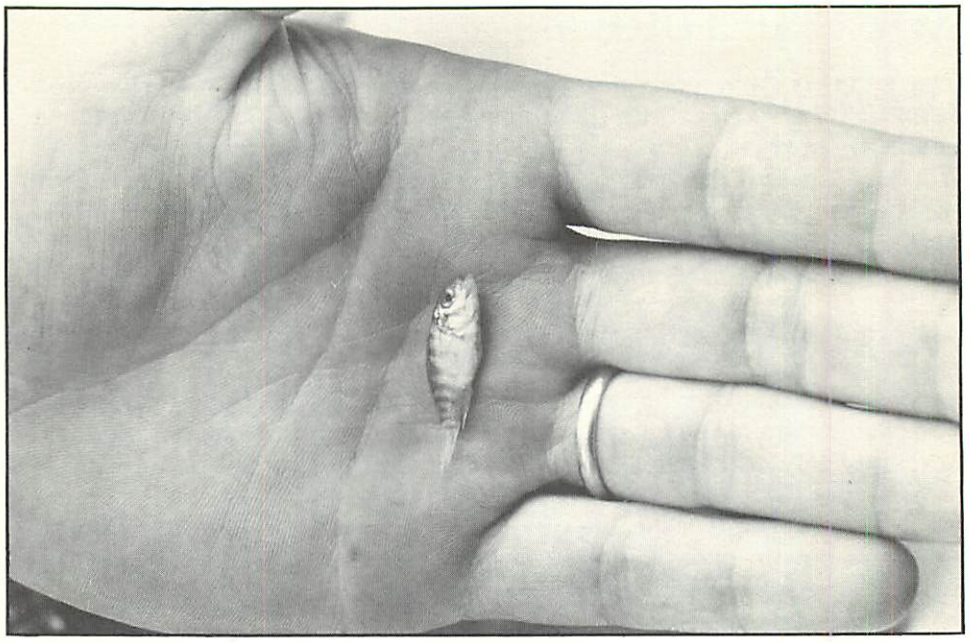
That time is here. For the research professionals at the NCSU Eel Culture project in Aurora, 1979 and 1980 were years spent preparing carefully for the explosive growth they saw coming. Using land and buildings leased by East Carolina University's Institute for Coastal and Marine Resources, project director Bill Rickards, John Foster and Jack McCauley turned their tanks and laboratories into an "aquaculture demonstration" facility designed to prove fish-farming could work in North Carolina. A neighbor, Texasgulf Corporation, showed an interest in the work and constructed 12 aquaculture ponds for the project's use.

Building on Rickards' extensive research on the eel, the project worked out details of diet, water conditions and disease control. Exchanges with experts from Japan, long the world's leader in aquaculture, helped the staff improve their techniques.

The research began to find its way into practice. Two new commercial eel aquaculture operations opened in North Carolina. One reported in one year, 7,000 pounds of cultured eels. Ten eel culture facilities opened in the U. S. with assistance from the Sea Grant project. In all, the project's staff contacted about 250 people interested in aquaculture.

"Sea Grant has done a fantastic job in developing the eel industry, particularly from the demonstration project, with the long-range goal of getting the fishermen involved in a new industry. We have worked together to knock down some of the traditional barriers between universities and state offices. We see ourselves, in the division, as the implementers, and we need all the support Sea Grant and the universities can give us. In the eel fishery, Sea Grant has done all the background work necessary to help us make a strong fishery, and now we're in a position to apply that work."

Connell Purvis
Director
N. C. Division of Marine Fisheries



A tiny striped bass x white perch hybrid. The savory striped bass is an American favorite, but its population seems to be dwindling. Could the striper be farmed?

But there were other, even more immediate, applications of the eel project's work. Through Bob Hines, Hughes Tillett and John Foster, eel fishermen learned how to catch, handle and "hold" wild eels. One eel-buying firm used Sea Grant expertise to help it set up a large eel facility in Pamlico County. The buyer reported 800,000 pounds of eels in 1980. The N. C. Division of Marine Fisheries credits Sea Grant's advisory services with helping create a $1 million-a-year eel industry in the state.

But the eel is not the only candidate for aquaculture in North Carolina. The list of likely species runs from blue crabs to coho salmon. One of these, the savory striped bass, is an American favorite, but its population seems to be dwindling. Could the striper be farmed? Probably not. At least, the wild version appeared to perform poorly under culture. But Howard Kerby and Melvin Huish found that a striped bass x white perch hybrid took readily to water tanks, and the young fish began eating dry pellets sooner than expected. The study offered some hope that, after more research, aquaculturists could raise a new fish that tasted "just as good" as its wild cousin. □

THE PROGRAM

Bill Rickards, *Associate Director, UNC Sea Grant College Program*
John Foster, *NCSU Eel Culture Project*
Jack McCauley, *NCSU Eel Culture Project*
Bob Hines, *Sea Grant Marine Advisory Services*
Hughes Tillett, *Sea Grant Marine Advisory Services*
Howard Kerby, *Department of Zoology, North Carolina State University*
Melvin Huish, *Department of Zoology, North Carolina State University*

PEOPLE/COAST

At first, you only came to visit. The swoop of gulls in the sea breeze, the sleepy-warm sand, the leap of fish against your line, brought you back again and again. Eventually, you bought a lot, opened a business and hauled in a boat, just to be there.

But nice as it was to live there, a few things gave you trouble. Your lot wouldn't percolate sewage. Your expensive off-road vehicle wasn't always welcome off the road. And real estate, rock-solid back home, moved about here on the whim of wind and sea. A casual brush with a spent hurricane called David made you wonder: Am I safe here?

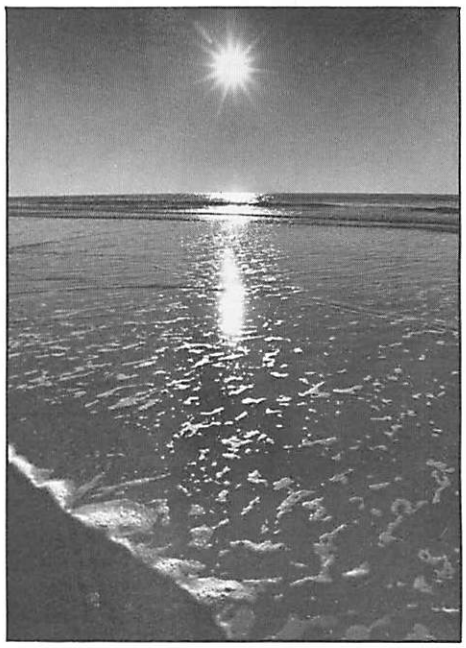
With maps, formulas and numerical models, Jerry Machemehl pitted an old-fashioned hurricane, Hazel of '54, against the typical, modern beach house. It was no contest. He found that another hurricane the likes of Hazel, whose 11-ft. storm tide caused most of the estimated $125 million in damage, would wreck about 60 percent of the coastal buildings in its path. Machemehl found several flaws weakening these buildings: too few metal fasteners, flimsy sheathing, too-short pilings and poorly secured roofing, porches and overhangs. His recommendations for strengthening buildings found their way into the state building code, into your home through the pages of *Coastwatch,* and into the advisory-service work of Spencer Rogers. Rogers took the facts about fasteners, foundations and construction materials to the contractors, building inspectors and homeowners who could put them to work improving coastal buildings.

One of Rogers' key points: pilings under beach houses are often notched so deeply, where they are attached to the floor beams, that many are badly weakened. Even the newest houses, meeting federal flood insurance guidelines, often had this flaw.

If your house was solid on its foundations, it was still no more durable than your lot. In some areas, you were alarmed to find several feet of your shoreline disappearing into the sound. Spencer Rogers was able to advise you on your alternatives, including shoreline-protection structures like bulkheads. But one variety of bulkhead was ruled out. Jerry Machemehl used a Sea Grant "mini-grant" to find out why bulkheads made of asbestos-concrete sheet materials were crumbling prematurely. He found the material "corroding" in the chemicals of the marine environment.

Sometimes the simplest answer to shoreline erosion comes from nature itself. Ernie Seneca and Steve Broome found that, in some areas, marsh grasses planted along estuarine shorelines could slow erosion by holding soils in place naturally. Seneca and Broome worked out planting and fertilization procedures and showed local extension workers how the system works. (See p. 14.) In one workshop, Seneca and Bob Hines taught 25 people how to plant the grasses and protect their lots.

Understanding shoreline erosion is largely a matter of understanding the movement of water. Several Sea Grant research teams attacked different parts of the problem, and their combined effort will make it possible, not only to use more effective erosion-control measures, but also to better follow the movement of nutrients and contaminants. Bob Weisberg, Gerald Janowitz and Len Pietrafesa devised a numerical



Understanding shoreline erosion is largely a matter of understanding the movement of water.

model that predicts, using wind speed and direction, the changing water levels in Pamlico Sound. Meanwhile, Ernie Knowles and Weisberg used sophisticated wave-monitoring gear to tie in the action waves. The studies meshed nicely with previous Sea Grant work by Stan Riggs, Mike O'Connor and Vince Bellis, who "mapped" the state's estuarine shorelines for their susceptibility to erosion. Sea Grant posters based on their work helped you calculate your own lot's erosion potential.

"There's no question in my mind that we're going to have to find some alternative measures for erosion control. With the marsh-grass approach, you have a natural system that's low in cost. Vegetation is a lot easier than concrete, and a lot less expensive."

Milton Coleman
County Extension Chairman
Brunswick County

Left: Planting being put in along Roanoke Island shoreline. June 5, 1979
Right: Same site on October 30, 1979

GAINING GROUND WITH SPARTINA

When Ernie Seneca and Steve Broome arrived there in May, 1979, much of the Brittany coast of France lay desolate and lifeless in the wake of the huge Amoco Cadiz oil spill. Miles of invaluable marshlands had been denuded, spoiling fish and wildlife habitats and opening the shoreline to erosion.

The French had invited Seneca and Broome, on the strength of their successes in North Carolina, to help re-establish the marsh. Working with French universities, the team set out some test plantings of *Spartina*, the salt-tolerant cordgrass found in salt marshes. In September of 1980, they returned to France to measure the results.

"We were trying to do what nature, on its own, was not doing," Seneca says. "In the two full years following the spill, nature had done very little to re-establish the marsh. But we were very encouraged by the plantings we had done. In the areas of best growth, where the conditions were best, we expected to see full coverage again in just four growing seasons."

Of course, a handful of scientists cannot rebuild an entire salt marsh. But the small tracts they planted indicated that, with more French involvement, some of the marsh could be restored using techniques the team developed in its North Carolina Sea Grant work. It was an example of how quickly sound research becomes valuable, internationally.

Another example came from the People's Republic of China, where marsh grass plantings are viewed as a way to reclaim valuable farmland from the sea. Seneca and Broome shared their findings with two members of the University of Nanking, who wanted to see first-hand the success of the North Carolina plantings.

Closer home, the "natural" approach to shoreline protection appealed to property owners. One Nags Head resident, with the researchers' help, planted *Spartina* after erosion had lopped several feet of soil off his property in one season. Soon after the plantings took root, they had not only slowed the erosion, but gained some ground as well.

At the Camp Lejeune Marine Base, Julian Wooten used *Spartina* to absorb destructive wave action and protect bluffs along New River.

"We've got miles of shoreline eroding here on the base," Wooten says. "I learned about Ernie Seneca's work at a program he and Steve Broome were giving. I asked them to come down and evaluate the site and advise us. One of the places we planted did very well. Personally, I'd rather see the grass used for this type of thing; it will increase the wildlife habitat there." □

Your house, then, might have been armored for storms, your shoreline shielded from erosion. But if your septic tank failed, things were tough. Coastal soils, you were told, generally don't handle sewage very well. In clay, effluents tend to surface and wash into the estuaries, where they carry some of the contaminants biologists find in their samples. In sand, the effluents can leach into groundwater and, occasionally, find their way into the neighborhood's water supply.

For coastal communities, the choice was especially bitter: either forbid new development in problem areas, or live with the health risks. Bobby Carlile and Dennis Osborne used Sea Grant support to devise two new septic systems that worked where others failed.

One system employs pumps to regulate the flow of wastes into the drain field. The other, designed for more severe cases, has its drains built into a mound of soils layered to "perc" the effluent safely.

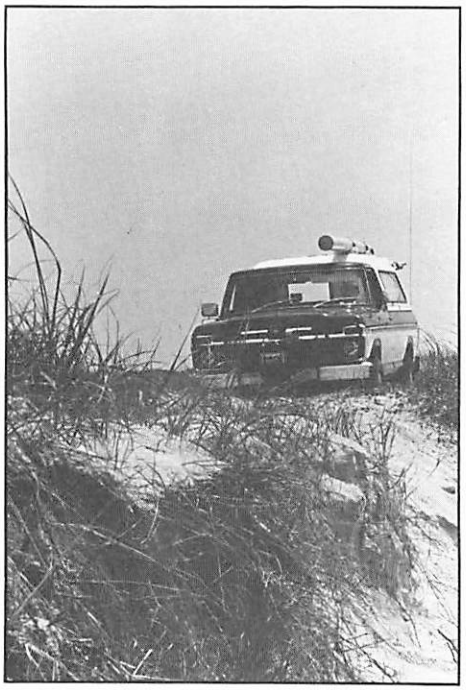
Now, five North Carolina counties require the new disposal systems for some locations, and over $4 million worth of new buildings have been started because of the improved systems. And, the system is so successful, it is being used, not only in coastal North Carolina, but in the Piedmont and in several other southeastern and Gulf Coast states.
(See p. 17.)

Even if the practical problems of securing your place here were solved, you likely worried a little, now and then, about preserving the qualities that drew you here to begin with. If you were an artist, trying to capture the scene on canvas, the birds, breakers and moonlit marsh composed themselves just beautifully. But the people — where did you fit the people?

The question is far more than an artistic one, and it occupied much of Sea Grant's effort in 1979 and 1980. Let's say you owned an off-road vehicle that took you to the fish and the scenery. Alone, your "ORV" might have posed no threat to the natural landscape. But as the off-road traffic multiplied, communities began to be alarmed about rutted dunes and beaches. Was there really any harm? Paul Hosier provided the Sea Grant research, and here is what he found:

- Dramatic increases of ORV use have meant North Carolina's beach traffic is some of the heaviest in the nation. Along one three-mile stretch at Ft. Fisher, Hosier found some 200 vehicles on the beach, dunes and marshes — at one time.
- In carefully controlled experiments, Hosier found that just a few passes of an ORV could kill dune and marsh grasses, upsetting natural contours and laying the soil bare to erosion. The dunes, anchored by grasses, are important reservoirs of sand, helping protect coastal property.
- And, since heavy vehicles compact the soil, they also damage underground stems and roots, and plants recover slowly, if at all.
- Heavy ORV traffic on beaches tends to increase rodent and small-animal populations there, probably because their predators leave the areas.
- Hatchling sea turtles, whose species are increasingly in danger of extinction, tend to be trapped and sidetracked by ORV ruts, increasing the chance they'll die before they can reach the sea.
- Local ORV ordinances vary widely — from outright bans on off-road driving to no policy at all, making each community's enforcement job difficult.

Hosier took a step beyond his research to help solve the problems. His pamphlet on ORVs, "Making Tracks," published by Sea Grant, was used both by communities trying to deal with the problems of ORVs, and by driving clubs interested in helping their members be better informed. He worked with several beach communities trying to help them plan driving



Just a few passes of an ORV could kill dune and marsh grasses, upsetting natural contours and laying the soil bare to erosion.

Since heavy vehicles compact the soil, they also damage underground stems and roots, and plants recover slowly, if at all.

policies. And, he drew up a set of recommendations intended to help eliminate some ORV hazards:

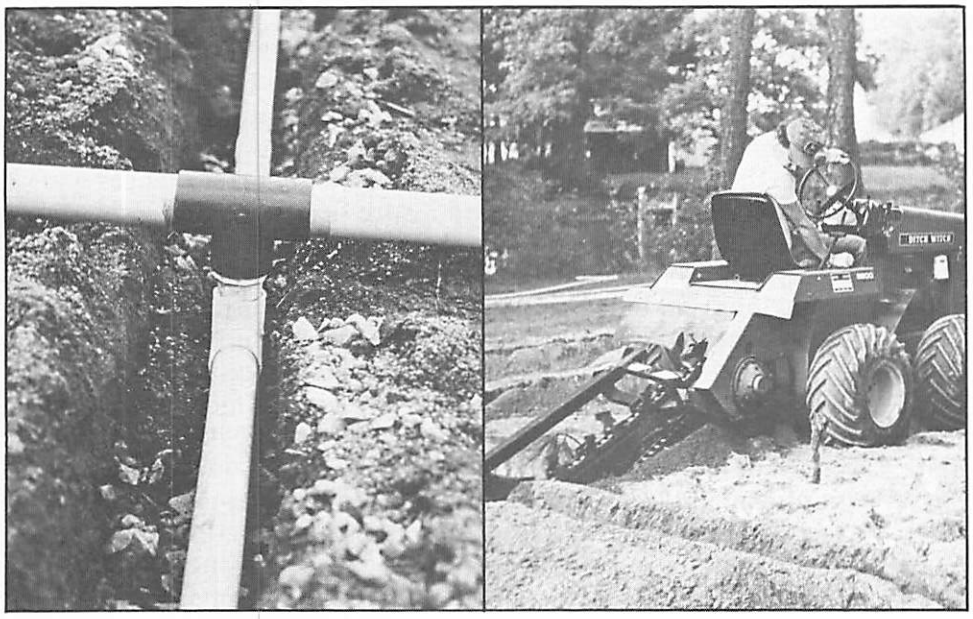
- ORV use should be restricted to the inter-tidal, "wet-sand" part of the beach, where driving seems to do the least damage.
- ORV use on inter-tidal beaches should be suspended from May 1 to October 15, when people and animals are out in throngs.
- Colonial waterbird nesting areas on the open beach should be clearly marked.
- ORVs should be strictly prohibited in coastal dunes.
- ORV "crossovers" through the dunes should be constructed with a protective surface, spaced widely along the beach, and carefully sited to reduce the potential for "blowouts," breaches in the dune line caused by storms.

What about the dunes spoiled already? Spencer Rogers showed that leftover Christmas trees, recycled, could help repair some of the damage done by ORVs. The trees trap wind-blown sand and form the skeletons of new, growing dunes. At Rogers' invitation, 100 New Hanover County residents, supplied with 300 donated trees, plugged gaps in the dunes along local beaches. Sea Grant researchers Steve Broome and Ernie Seneca provided beach grass to be planted by area youth groups, including the Ocean Science Institute. The grasses will help anchor the new dunes and will allow others to rebuild.

Hosier's findings that ORVs threaten some of the state's waterbirds are not surprising, since the birds are sensitive to disturbances of any kind. And, if the image of a pelican or egret airborne over a marsh seemed at odds with the sprawl of commercial development, it was. Development, beach traffic and sightseers disrupted bird populations and threatened others.

Applying their earlier Sea Grant research on colonial waterbirds, Jim Parnell and Bob Soots put together an inter-state workshop designed to lay the groundwork for waterbird management. Because any such planning requires not only state but regional cooperation, Sea Grant was the logical catalyst. The workshop drew 50 experts who spelled out guidelines and suggested areas for more study. (Sea Grant published a proceedings of the conference.) Some of Parnell and Soots' work is already being applied: The U. S. Army Corps of Engineers has used the

(Continued on page 18)



"In small communities of 30 or 50 homes, these new systems are much more cost-effective than a big treatment plant. They make it possible to have houses, and not endanger shellfish waters. They have been invaluable to us. We have used them on problem tracts of land, in about sixty communities and private sewer systems, and about fifteen-hundred residences."

Barret Kays
Sunbelt Planning

Left: Joint in low-pressure system
Right: Trenching

A PROBLEM OF PLUMBING

In 1979, the 500 youngsters at Camden Middle School in Camden County were about to be turned out of their classrooms. The school's over-taxed septic system was failing and health officials were telling the school it would have to build a $50,000 treatment plant.

"Things were backing up, and we were pumping raw sewage right into the marsh," recalls Doug Renegar, principal at the school. "There was no way we could afford that treatment plant. The alternative would have been to shut down the school for a while."

But when Bobby Carlile learned of the school's distress, he went there and found a site in the schoolyard suitable for a modified version of the low-pressure septic systems he developed with Sea Grant support. With health officials' approval, Carlile's team helped install the new system. The cost? Less than $5,000.

"They did a fine job," Renegar says. "It's been working fine, and we didn't have to close the school." Camden's problems aren't unusual, and about 600 other North Carolina schools will soon be required to upgrade their sewage-disposal systems to meet health and environmental standards. In many of these cases, the new systems Carlile developed will work well and save money.

And schools, though among the most needy, are not the only beneficiaries of the work. The town of Seaboard, N. C., used the alternative systems and reduced the typical homeowner's sewer bills from an estimated $40 a month to just a few dollars. Similar systems saved money at a large church camp and in neighborhoods and communities up and down the coast.

Because the research team spread word of the new systems through workshops and conferences, many counties wrote the alternative designs into their health codes and began conducting their studies, modeled on those done by the Sea Grant team.

The economic benefits of the work — in new construction and direct savings — are estimated well into the millions of dollars. But there are environmental payoffs as well. Using Mark Sobsey's work in the viral contamination of shellfish, the team devised tests to see how well the new systems protected sensitive estuarine waters. Unlike many traditional systems, the alternative designs did not allow effluent into the run-off.

The designs work so well that, with their increased use, some shellfish waters closed because of contamination may eventually be reopened.

Says Dennis Osborne, Carlile's research assistant: "These systems allow for drainage and landscaping of areas, and for the development of land previously classed as unsuitable." □

Jim Bahen and purse net

team's expertise to help it protect colonial waterbirds in the Wanchese Harbor area, and to make the birds feel at home on some otherwise unproductive sites, like dredge-spoil islands.

You wanted to know how to live here wisely, in harmony with the natural order. But you also wanted to have fun, — it was one of the reasons you came here. Sea Grant tried to help you do just that. Dennis Regan put together sportsfishing classes, scuba-diving conferences and offshore nature cruises, and introduced a sure-fire bait fish — hickory shad — to tournament fishermen and charter-boat operations. Jim Bahen split time between professional and recreational fishermen, conducting programs ranging from bait-rigging workshops to a "Fishing School for Kids." One of Bahen's hits was a plan that gave fishermen daily weather information on the location of the fish-rich waters of the Gulf Stream.

While Sea Grant agents tried to help you get the most out of your leisure time, Leon Abbas was encouraging the economic health of the state's recreation industry. Several of his projects paid off, including:

- With Abbas' initiative, the North Carolina Marina Association was formed, and soon grew to 30 members. The association built a program that keeps its members up-to-date on business-management practices, legal issues and boating trends.
- Abbas also helped organize a similar group of boat dealers, the North Carolina Boat Dealers Association, and advised them on promotion and planning.
- Several publications Abbas helped prepare, including a set of fishing charts for sportsmen and the *Vacation and Weather Guide to Coastal North Carolina,* helped encourage tourism and recreation in the state. □

THE PROGRAM

Jerry Machemehl, *Department of Marine Science & Engineering (until August, 1980), North Carolina State University*

Spencer Rogers, *UNC Sea Grant Marine Advisory Services*

Ernie Seneca, *Department of Botany and Soil Science, North Carolina State University*

Steve Broome, *Department of Soil Science, North Carolina State University*

Bob Hines, *UNC Sea Grant Marine Advisory Services*

Bob Weisberg, *Department of Marine Science & Engineering, North Carolina State University*

Gerald Janowitz, *Department of Marine Science & Engineering, North Carolina State University*

Len Pietrafesa, *Department of Marine Science & Engineering, North Carolina State University*

Ernie Knowles, *Department of Marine Science & Engineering, North Carolina State University*

Stan Riggs, *Department of Geology, East Carolina University*

Mike O'Connor, *Department of Geology, East Carolina University*

Vince Bellis, *Department of Biology, East Carolina University*

Bobby Carlile, *Department of Soil Science, North Carolina State University*

Dennis Osborne, *Department of Soil Science, North Carolina State University*

Paul Hosier, *Department of Biology, University of North Carolina at Wilmington*

Jim Parnell, *Department of Biology, University of North Carolina at Wilmington*

Bob Soots, *Department of Biology, Campbell University*

Dennis Regan, *UNC Sea Grant Marine Advisory Services*

Jim Bahen, *UNC Sea Grant Marine Advisory Services*

Leon Abbas, *UNC Sea Grant Marine Advisory Services*

Mark Sobsey, *Department of Environmental Sciences & Engineering, University of North Carolina at Chapel Hill*

SEAFOOD

Tyre Lanier drops a breaded, shrimp-shaped morsel into a crackling-hot, deep-fat fryer. In a moment, the shape browns and the aroma is filling the lab.

When the sample is ready, Lanier chews it attentively.
"Now that's shrimp," he says.

Actually, the sample was only part shrimp; the rest was pure impersonation. Lanier began with a Japanese invention called "surimi"— washed, minced fish — and added small, "high-count" shrimp for flavor. He ground them together into a paste, and heated the mixture in a mold. The result was a replica, but its flavor and texture fooled more than one panel of tasters.

Why surimi shrimp? Unlike other "refabricated" seafoods, Lanier's shrimp were mostly fish, and therefore rich in protein. But the cholesterol count was lower. The surimi's "springy" texture closely matched that of fresh seafoods. And, the shrimp used in the mixture could be the inexpensive Indian variety.

When the new product reaches the market, as Lanier predicts it will, it would probably sell for about half the price of whole shrimp.

Research by Lanier, Don Hamann and Frank Thomas worked out details of the texture, chemical structure and "binders" for surimi. Their findings answered many of the basic questions industry had about the product. In fact, five major food companies have contacted Lanier about his surimi work.

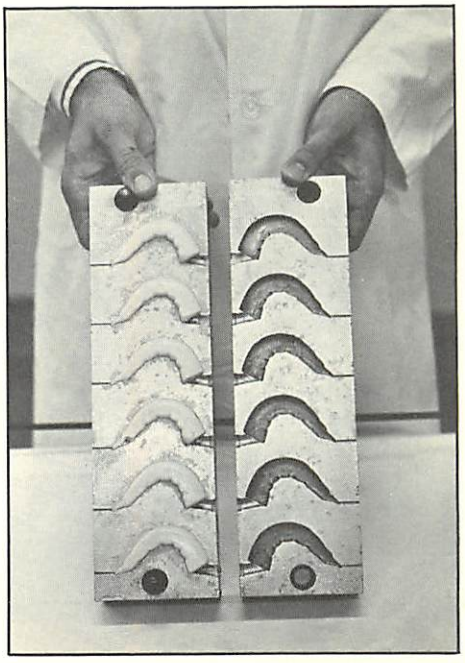
Surimi figured in the Sea Grant research of Lanier, Hamann and Thomas for several reasons:

- Surimi's popularity in Japan, where it is the base of innumerable seafood products, suggested a number of applications here at home.
- Its versatility and high protein content made it adaptable, not only to seafood dishes, but to such things as luncheon meats and sausages, as well.
- It offered possible relief to the soaring prices of popular seafoods, but, at the same time, promised additional income to fishermen, who might at last find markets for the wasted portions of their catches. (Surimi can be made from little-used fish.)

(To help bring international attention to minced-fish technology, Lanier and the department organized a major seminar, held in December, 1980, that drew food scientists from 12 countries. UNC Sea Grant helped sponsor the conference.)

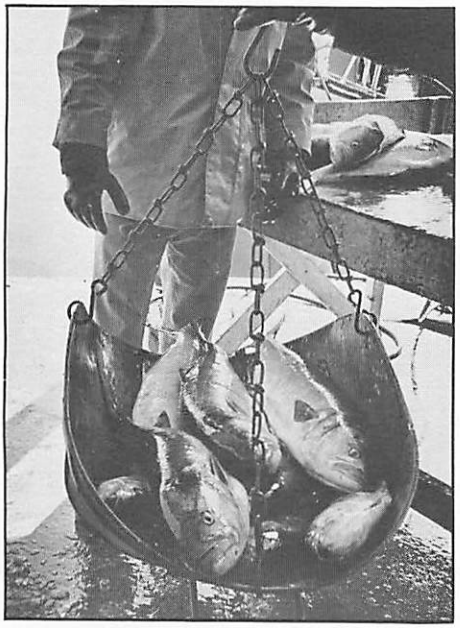
The use of "under-utilized" fish seemed to promise some relief for several problems crippling the state's seafood industry:

- Too many of our fish are either wasted or sold for pennies because the market for them is weak. As a result, fishermen and seafood processors suffer, and a lot of good food never reaches consumers.
- As Nozar Hashemzadeh and Michael Simmons found, the state's processed seafoods are lagging behind other states'. (See page 9.)
- Rising fuel costs are making fishing trips costly. Fishermen are finding it hard to afford the luxury of hunting only one or two species.



"We're running out of fish at a rapid rate, and there are many under-utilized species that can be brought up to first-rate public acceptance, through the application of this technology. The work that Tyre and the Food Science Department are doing with surimi is the only work of real importance on this subject in the country."

Jack Hice
Research Associates
Charlotte, N. C.



Fresh fish sell well, but alternatives are good too:

"It was harder than I thought to start this smoked fish business. I came to the Seafood Lab with a brand-new idea for a brand-new product. They got me started."

Dick Barlow
Reef-Lite

Much of Sea Grant's effort was devoted to helping solve these problems, and not only with the development of products like surimi. In the case of the state's plentiful finfish, the market has been especially rigid. Fresh (unfrozen) fish were about the only ones selling. That restricted the reach of much of the state's catch to about a day's drive from the dock. And, since fishing goes in spells and spurts, there were alternately scarcities and market gluts. The "fresh-fish" syndrome makes it impossible to inventory stock, and products deteriorated rapidly. Sea Grant advisory agents found that this fickle market was the commercial fisherman's number-one complaint.

Lanier and Frank Thomas went to work on one solution. They suspected that modern freezing techniques could retain freshness in seafoods far longer, and, with the right packaging, ensure better fish than much of the "fresh" stuff. Most fish, they found, could even be thawed and re-frozen safely, with the right controls. Using three package designs marked "previously frozen for your protection," the team tested its products' appeal in supermarkets, and let consumers be the judges. All the fresh-frozen fish did well, and a rigid foam tray with a clear plastic lid proved the most popular container.

The findings had immediate applications. One seafood handler is already planning to put some of the research team's ideas to use in its seafood marketing.

Another aspect of the seafood-quality problem occupied the Sea Grant work of Bibek Ray, who focused his microscope on a particularly pesky micro-organism: *Vibrio parahaemolyticus.* Some strains of *Vibrio,* which is common in seafoods, cause food poisoning. Ray collaborated with Mark Sobsey (see page 5) on finding the role of enteric viruses in shellfish. Like Sobsey, Ray found current standards lacking. Some harmful strains of *Vibrio* were going undetected. Ray more closely defined differences in the strains, and devised a more accurate test. He also helped state officials train shellfish sanitation workers in the detection of microbiological hazards in crabmeat.

Nowhere was the direct application of seafood research more in evidence than at the North Carolina State University Seafood Laboratory in Morehead City. Through Sea Grant staff at the lab — Frank Thomas, Joyce Taylor, Sam Thomas and Dave Hill — some of the newest and best ideas about seafoods went out to meet the public:

- The lab began the job of turning North Carolina skates and rays, long "trash fish" plaguing fishermen, into something of a silk purse. The lab found ways to handle, market and prepare the meat, which is protein-rich and delicious, in a variety of dishes — even pizza. The lab processed over 10,000 pounds of cownose ray and developed products ranging from ray creole, frozen in boil-in bags, to ray canned in tomato sauce. Using International Telex communication, the lab conducted market surveys in several foreign countries, where it hopes the fish will catch on.
- Other under-used species, including shark, eel and octopus, proved themselves irresistibly edible in the lab's test kitchens. Recipes and handling procedures for these seafoods went out to the public through regular publications, workshops and demonstrations.
- The lab continued to advance the technology of seafood canning, smoking and de-boning, with the goal of helping modernize the state's seafood processing industry. The lab drew plans for the renovation or construction of fish houses, crab-picking plants and processing operations. Reef-Lite, the state's second smoked fish plant, opened with the lab's help near Swansboro.

But whatever growth the seafood processors manage is restrained by one stubborn obstacle: How do you dispose of the huge quantities of wastes?

At the Seafood Lab, some of the newest and best ideas went out to meet the public.

Untreated seafood wastewater is a sort of warm, fishy soup. Most small processors have neither the land nor the equipment to dispose of the wastes in such a way that meets new health and environmental standards.

Allen Chao used a waste-treatment method borrowed from the poultry industry and seemed to find one solution to the problem. Chao's idea was to filter wastes through semi-permeable membranes that trapped most substances but allowed water to pass. The water, he found, could be recycled into the processing plant, where much of its heat would be retained, saving energy.

That still left the problem of the sludge: Could it be used, too? Chao found that if the sludge was treated, it could yield products ranging from fertilizers to pet foods. With more research, Chao's Sea Grant findings could make it possible for processors not only to meet regulations, but also to refine some of their wastes into profits. □

THE PROGRAM

Tyre C. Lanier, *Department of Food Science, North Carolina State University*

Donald D. Hamann, *Department of Food Science, North Carolina State University*

Frank B. Thomas, *Department of Food Science, North Carolina State University*

Nozar Hashemzadeh, *Department of Economics, North Carolina A&T State University*

Michael Simmons, *Department of Economics, North Carolina A&T State University*

Bibekananda Ray, *Department of Food Science, North Carolina State University*

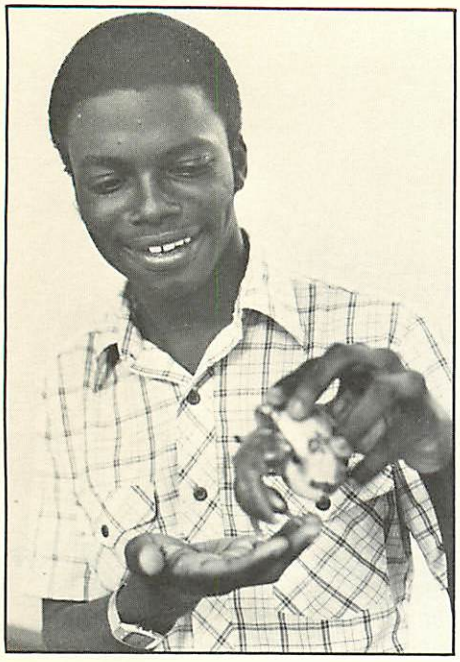
Mark D. Sobsey, *Department of Environmental Sciences & Engineering, School of Public Health, University of North Carolina at Chapel Hill*

Joyce Taylor, *Research Technician, North Carolina State University Seafood Laboratory*

Samuel Thomas, *Seafood Specialist, North Carolina State University Seafood Laboratory*

David Hill, *Seafood Agent, North Carolina State University Seafood Laboratory*

Allen C. Chao, *Department of Civil Engineering, North Carolina State University*



"The pages in the book don't look anything like the real thing."

William Carr
Enloe High School
Raleigh

"Eventually, we run into most of the teachers involved in Sea Grant's programs. Because of the positive reaction we get from teachers, we're satisfied the work Sea Grant is doing is worthwhile. It's the kind of ongoing program we need."

Clinton Brown, Consultant
Division of Science Education
N. C. Department of Public Instruction

EDUCATION

With tarantulas, tree frogs and curly tailed lizards tucked safely away in baggage, 17 youngsters and their instructors flew home in August, 1980, from Andros Island in the Bahamas.

For William Carr, a 14-year-old student at Raleigh's Enloe High School, it had been more an adventure than a field trip. There in the Caribbean, as he snorkled amid a rainbow of fish over a coral reef, the dry particulars of textbooks began to breathe life for Carr.

"It's very important to actually see these things," he says. "The pages in the book don't look anything like the real thing."

The point of the trip was to show a group of students — in this case "junior naturalists" and "junior curators" of the N. C. Museum of Natural History — how scientists work in the field. The museum sponsored the trip.

Lundie Mauldin used the exceptionally rich variety of Andros life to help her telescope the lessons of marine science into a few well-packed days. While the students jotted notes on waterproof slates, she showed them examples of such things as food chains and adaptive coloration.

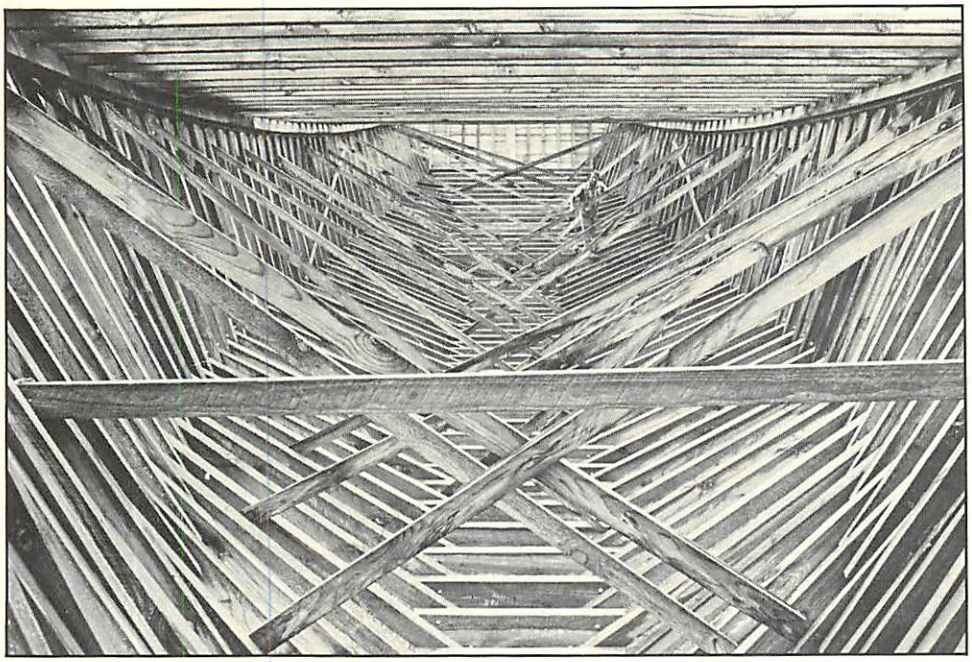
But the group came home with more than their notes and a few wiggly souvenirs. "It gave us an idea of what it's like to be a scientist," Carr says. "And it let us see how everything fits together. Everything is related."

Sea Grant's education programs were designed for people like William Carr — students about to inherit a world rich in both resources and perplexing problems. The goal was to equip these students with a working knowledge of the coast — one that will let them use and preserve its resources wisely. We reached those students in several ways:

- Lundie Mauldin's teaching manuals and successful teacher-training workshops helped put marine science into hundreds of North Carolina classrooms. In her summer workshops alone, 120 teachers dealt first-hand with marine science and coastal issues. Hundreds more, ranging from science teachers to vocations instructors, took time to soak in coastal topics in Mauldin's workshops throughout the year. Mauldin's marine education newsletter was mailed periodically to about 1000 educators across the state.
- Mauldin also spread the epidemic of marine education among several more key groups: Education students from five of the state's college campuses, preparing to do their "inservice" teaching, learned that the coast is not just a subject for science class, but for art, language and history classes as well. Vocations teachers took advantage of a workshop on marine careers. Teachers of handicapped and exceptional children discovered special ways to communicate the wonders of fish, sands and marshes.

And, there is evidence that, because of Mauldin's work, many of these teachers are using their new knowledge in the classroom.

- With Sea Grant support, and Carolyn Hampton's guidance, three student interns worked their way through masters programs in education, with an emphasis on marine science. The idea was to school education's future policy-makers in the ways of the coast.



Sea Grant gave students a working knowledge of the coast, one that will let them use and preserve its resources wisely.

- Dalton Proctor and Don Stormer began developing, with a Sea Grant "mini-grant," materials that will enable 4-H leaders across the state to build marine science into their program. (From their initial work emerged a major Sea Grant project to train 4-H leaders.) By 1985, about 80,000 young people will be exposed to marine and coastal studies through their 4-H activities.
- Sea Grant's internships program, coordinated by Norman Anderson, made it possible for three university students to advance their studies towards careers in the administration of marine-science education. □

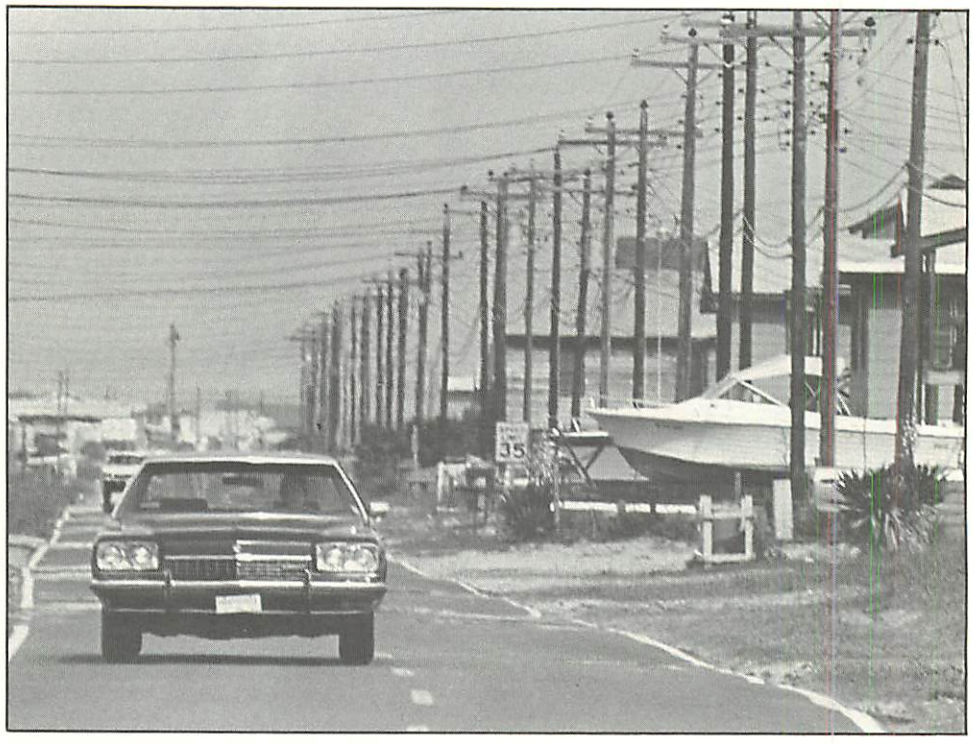
THE PROGRAM

Lundie Mauldin, *Sea Grant Marine Advisory Services*
Carolyn Hampton, *Department of Science Education, East Carolina University*
Dalton Proctor, *N. C. Agricultural Extension Service, North Carolina State University*
Don Stormer, *N. C. Agricultural Extension Service, North Carolina State University*
Norman Anderson, *Department of Math and Science Education, North Carolina State University*

PROJECT STANDING

N — Project initiation
C — Project continuing
F — Project completed
R — Project redirected
T — Project terminated

PROGRAM MANAGEMENT		1979	1980
MD/A-1	Administration and Development	C	C
MD/A-2	Project Initiation and Rapid Response	C	C
MD/A-3	Program Communications	C	C
COASTAL STUDIES			
R/CZS-13	Vegetation for Shoreline Erosion Control	C	F
R/CZS-15	Building Technology In Hazard Zones	F	
R/AO-1	Surface Wave Prediction	N	R
R/AO-2	Measurement of Nearshore Physical Processes	N	C
R/MP-4	Effects of Vehicles on Barrier Islands	N	F
ESTUARINE STUDIES			
R/ES-23	Alternative On-Site Waste Disposal	C	F
R/ES-25	Control of Enteric Viruses in Oysters	F	
R/ES-27	Physical Studies of Pamlico Sound	C	F
R/ES-28	Rangia Clams as Food	N/F	
R/ES-29	Management of Juvenile Sciaenid Fishes	N	F
R/ES-32	Viruses and Bacteria in Shellfish		N
R/MP-1	Shrimp Management Alternatives	C	F
R/MP-2	Waterbird Management Techniques	N/F	
R/MP-3	Sociology of Recreational Fishing Offshore	N	F
R/MP-4	Shrimp Fishery Socioculture		N
R/MP-5	Hard Clam Management Information		N



FOOD FROM THE SEA

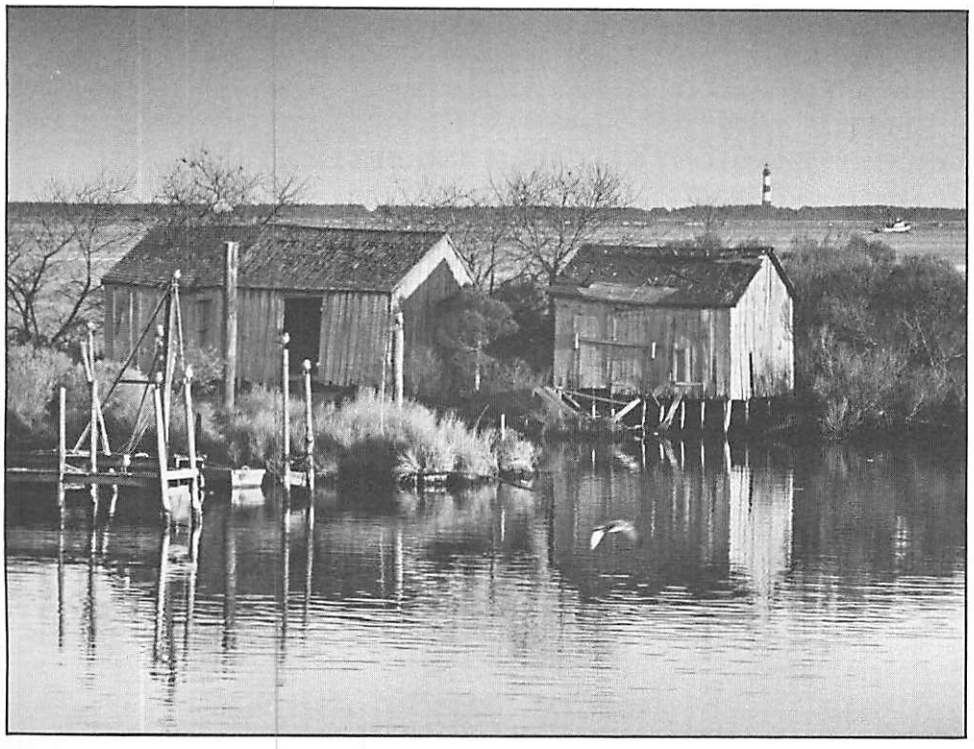
R/SST-6	New Seafood Products	F	
R/AF-8	Potential Algae Harvest	N/F	
R/AF-9	Marketing of American Eels	F	
R/LS-11	Socioculture of Fishing Communities	F	
R/SST-7	Seafood Packaging	N	C
R/SST-8	Hazardous Microorganisms in Seafood	N	T
R/SST-9	Microbiological Evaluation of New Products	N/F	
R/SST-10	Minced Fish Process Development		N
R/SE-1	Ultrafiltration of Seafood Wastewater		N
R/AF-10	Nutrition and Culture of Eels	N	F
R/AF-11	Culture of Hybrid Fish	N	C
R/MP-6	Bluefish Population Structure		N/F

MARINE EDUCATION

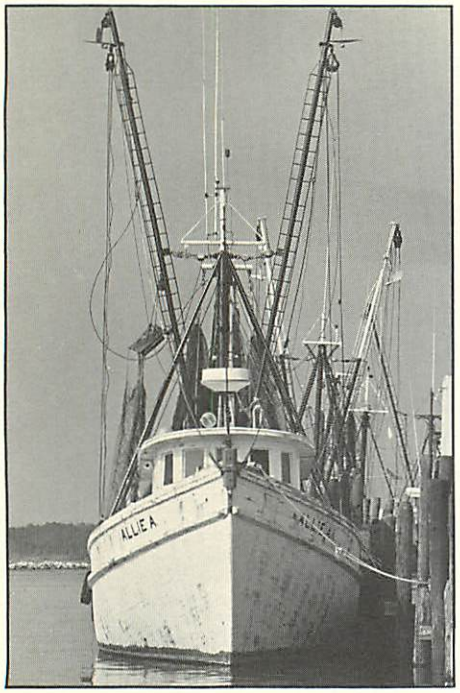
E/MD-1	Leadership in Marine Education	N	F
E/MD-2	Marine Education Training		N
E/LS-2	Ocean and Coastal Law	N/T	
E/CE-1	Continuing Education for Fishermen	N	C
E/GS-3	Fellowships and Interns	N	C
R/LS-12	Technological Changes vs. Manpower Needs		N

MARINE ADVISORY SERVICES

A/EA-10	Marine Advisory Services	R	C
A/EP-1	Weather and Sea Information		N/F



The hope is that the numbers and statistics gleaned from studies like these will provide the state with a better understanding, not only of the natural resources along its coast, but of the human resources as well.



BUDGET

1979

	NOAA*	STATE
MARINE RESOURCES DEVELOPMENT		
Aquaculture	$ 55,784	$ 27,575
Living Resources Other Than Aquaculture	19,678	15,543
Marine Law and Socio-Economics	52,297	27,735
MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT		
Ocean Engineering	10,369	5,597
Resources Recovery and Utilization	92,591	52,621
MARINE ENVIRONMENTAL RESEARCH		
Research Supporting		
Coastal Management Decisions	102,413	50,460
Pollution Studies	53,011	25,381
Environmental Models	13,519	6,528
Applied Oceanography	78,408	32,474
MARINE EDUCATION AND TRAINING		
Other Education	26,196	5,932
ADVISORY SERVICES		
Extension Programs	274,053	170,338
Other Advisory Services	168,211	26,910
PROGRAM MANAGEMENT AND DEVELOPMENT		
Program Administration	57,290	20,852
Program Development	36,180	32,054
TOTAL	**$1,040,000**	**$500,000**

1980

MARINE RESOURCES DEVELOPMENT		
Aquaculture	$ 59,806	$ 32,177
Living Resources Other Than Aquaculture	61,765	38,708
Marine Law and Socio-Economics	19,659	10,457
MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT		
Resources Recovery and Utilization	100,847	54,454
MARINE ENVIRONMENTAL RESEARCH		
Research Supporting		
Coastal Management Decisions	59,097	28,378
Pollution Studies	65,432	25,729
Environmental Models	14,415	7,036
Applied Oceanography	94,393	46,721
MARINE EDUCATION AND TRAINING		
Other Education	53,577	6,082
ADVISORY SERVICES		
Extension Programs	328,460	179,779
Other Advisory Services	90,017	27,924
PROGRAM MANAGEMENT AND DEVELOPMENT		
Program Administration	63,332	22,365
Program Development	34,200	42,690
TOTAL	**$1,045,000**	**$522,500**

*National Oceanic and Atmospheric Administration

PUBLICATIONS

GENERAL INTEREST

Abbas, L. and M. D. Mordecai. How to use Eels as Bait. UNC-SG-80-01. Free.

Bahen, J. and M. D. Mordecai. How to Hang a Gill Net. UNC-SG-79-03. Free.

Baker, S., K. Jurgensen and R. Gourley. Hurricanes on the Coast of North Carolina. Poster. No publication number. Free.

Caudle, N., K. Hart and C. Griffin. Coastwatch. UNC Sea Grant newsletter. No publication number. Free.

Diver's Emergency Card. No publication number. Free.

Hart, K., How to Build a Crab Pot. UNC-SG-80-03. Free.

Hosier, P. and T. Eaton. Making Tracks, A guide to off-road driving at the coast. UNC-SG-79-06. Free.

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Mordecai, M. D., K. Jurgensen and V. Worthington. A Look at Sea Grant in North Carolina 1978. Annual report. No publication number. Free.

Regan, D. and V. Worthington. Wreck Diving in North Carolina. UNC-SG-78-13. Free.

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Taylor, J. A. and F. B. Thomas. Fish Flakes: Seafood Stretchers. UNC-SG-79-01. Free.

The $10 Holding Tank. Blueprint. UNC-SG-BP-80-1. Free.

Vacation and Weather Guide to Coastal North Carolina. UNC-SG-79-02. Free.

Waterproof Fishing Map for Beaufort and Masonboro areas. No publication number. $1 all requests.

ESTUARINE STUDIES

Cammen, L. M., U. Blum, E. D. Seneca and L. M. Stroud. Preliminary Energy Budget for a Salt Marsh in the Cape Fear River Estuary, North Carolina. UNC-WP-80-3. $2.25.

Earnhardt, T. W. and C. Grant. A Study of Federal and State Legislation Concerning the Construction of Proposed Oil Refineries. UNC-SG-80-2. $1.

Everhart, S. H., J. F. Parnell, R. F. Soots and P. D. Doerr. Natural and Dredged Material Nesting Habitats of Gull-Billed Terns, Common Terns and Black Skimmers in North Carolina. UNC-SG-79-05. $2.50.

Galloway, G. E. Assessing Man's Impact on Wetlands. UNC-SG-78-17. Out-of-print.

Parnell, J. F. and R. F. Soots, Jr. Atlas of Colonial Waterbirds in North Carolina Estuaries. UNC-SG-78-10. $7 all requests.

Parnell, J. F. and R. F. Soots. Summary Proceedings of a Workshop on the Management of Colonial Waterbirds. UNC-SG-80-06. $2.

Riggs, S. R., M. P. O'Connor, V. J. Bellis and T. A. Duque. Estuarine Shoreline Erosion in North Carolina. Posters. No publication number. Free.

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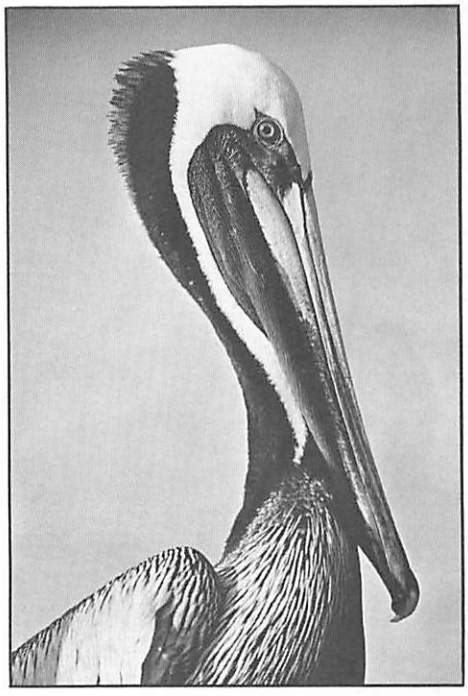

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EDUCATION

Mauldin, L., D. Frankenberg and J. Bazzolo. North Carolina Marine Education Manual. Unit Four. Coastal Beginnings. UNC-SG-78-14-E. $2.

FOOD FROM THE SEA

Fishman, G. S. and M. Cohen. Modeling Growth-Time and Weight-Length Relationships in a Single Year-Class Fishery. UNC-WP-79-1. $1.50.

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UNC Sea Grant February, 1980

COAST WATCH

Hurricanes: when the roofs fly and the floors float

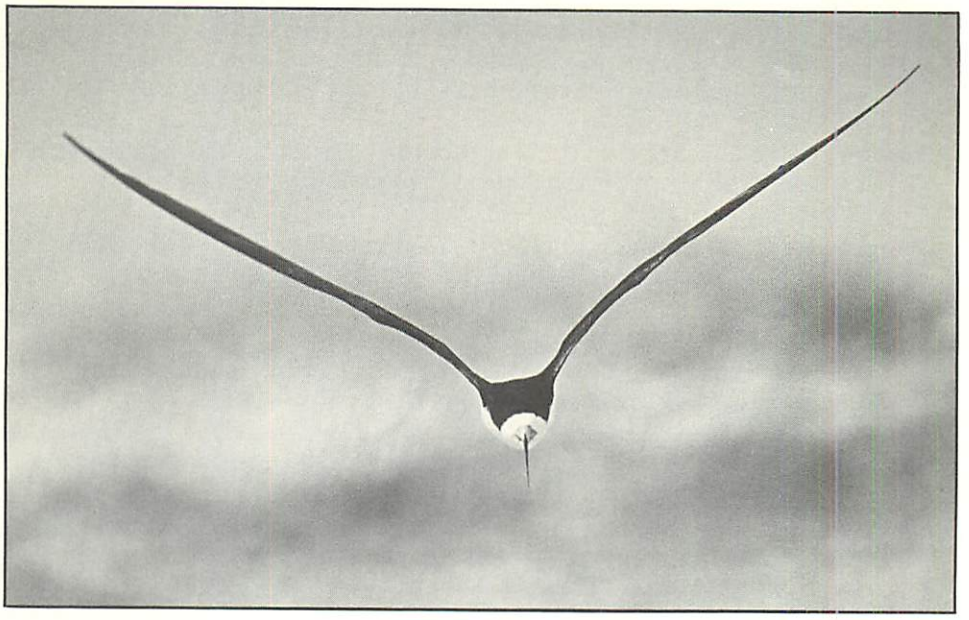
Even the best research wilts on the vine unless it reaches the people who need it. Sea Grant's communications effort spread the word both in print and in the airwaves.

With a fresh new design and broader scope, Coastwatch *replaced the* Sea Grant College Program Newsletter *in 1979. By late 1980, the list of* Coastwatch *subscribers had grown from about 5,000 to almost 20,000.* Coastwatch *reported Sea Grant work, but also the issues and personalities of coastal North Carolina.* (Coastwatch *is published 10 times each year, and is free for the asking from UNC Sea Grant.)*

"Seascope" a monthly series of four, one-minute radio programs, reached listeners through 30 coastal radio stations.

For more technical audiences, Sea Grant's technical reports, working papers and advisory service bulletins dispersed research results and "how-to" information.

And, the quality of these publications remained high. Twelve UNC Sea Grant publications, including Coastwatch, *won awards from the Carolinas Chapter of the Society for Technical Communications in 1979 and 1980. Two of these,* How to Hang a Gill Net, *by Jim Bahen and Mary Day Mordecai, and the* Atlas of Colonial Waterbirds, *by James F. Parnell and Robert F. Soots, won awards in the society's international competition.*



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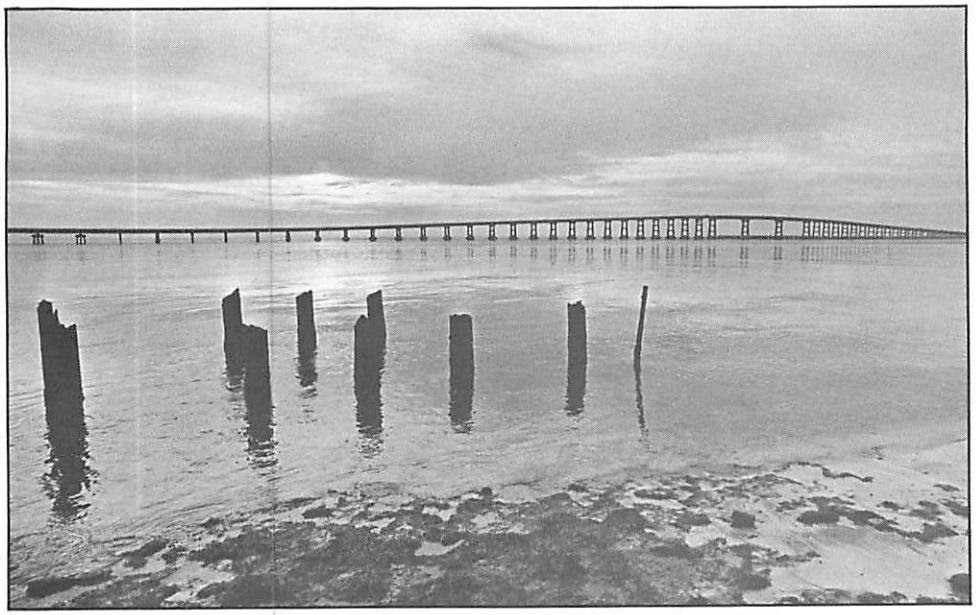

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CREDITS

Sea Grant in North Carolina, 1979-80 was written and edited by Neil Caudle. It was designed by Mary Margaret Wade.

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