Sea Grant in North Carolina

a report on the University of North Carolina Sea Grant College Program for 1976

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Yards and yards of nets filled with fish were pulled up on the beach. It had started early in the morning when Eph O'Neal put a dory in the water and encircled a huge school of fish with his net.

The beach seining brought in almost 100,000 pounds of fish that day. So many got away from O'Neal's net that two other crews were able to set nets behind his and bring in good catches. Friends and neighbors came to lend a hand as crews rushed to untangle the huge catch from the nets and get it off to fish houses.

In beach seining, a net is attached to a four-wheel drive truck. A dory carries the net out into the water, perpendicular to shore. Gradually, the small boat arches around and comes back to shore where the other end of the net is hooked to another truck. The trucks then back up zigzag fashion to bring the net to shore.

In years gone by, the nets were pulled in by hand. But no more. Gradually commercial fishing in North Carolina is modernizing. So are the state's fish houses. Part of the catch that day went to fish houses which have added con-

crete floors, freezers and other modern equipment.

But many problems still remain. There is a need for more development of the industry in general and for more sophisticated marketing. For example, the catch that day was gray trout. Fishermen got about 20 cents a pound. But the next day, the price went down.

There's another thing about that big catch. It occurred amid a major recreation area in the shadow of one of the coast's important tourist attractions—the Cape Hatteras Lighthouse. Nearby is the National Park Service camp ground where surfers congregate for annual championships.

Not far from the point where the fishing was going on, a sign on the beach limits commercial fishing so that sports fishermen can get a chance at the fish-filled waters. Offshore, along Diamond Shoals, hundreds of ships have gone down in the treacherous waters.

Cape Hatteras exemplifies many of the pressures our coastal resources face—the pressures of commercial fishing, of tourism, of development. The University of North Carolina Sea Grant College Program's job is to help North Carolinians balance the use of resources.

Advisory agents work with fishermen—both sports and commercial—to find improved techniques and equipment as well as develop new fisheries. Other agents work with the fish houses to help modernize facilities and develop new products.

Other specialists work with planners and government officials on land use management, and with the recreation industry and the public on recreation.

Behind those advisory agents are university researchers who provide the background of solid research needed to develop our coast wisely. One area both researchers and agents are working on is improving seafood marketing to even out the fluctuations in price to the fisherman and sell more fish. Another matter of interest is the circulation of water off our coast now that off-shore development seems likely.

And behind all that are 27 other Sea Grant programs around the country standing by to lend a hand—and their expertise.

Helping coastal North Carolinians make better use of their resources for improved economic and environmental well-being—that's what Sea Grant was about in 1976.

Sea Grant in '76

When times were simpler, the people of the coast had a close kinship with the elements that shaped their lives. They watched the weather—the winds, waters and skies and knew what nature had in store for their environment and their livelihoods.

But things aren't so simple any more. Unlike the weather, change comes too rapidly and too frequently—and with too many twists and turns—for people to be able to readily assess its impact. And people can't just rely on their own hands for food and shelter anymore.

Our coast is developing and changing rapidly. In 1976, more than in any of Sea Grant's previous six years in North Carolina, the program responded to specific economic and environmental needs raised by the coastal public.

For example:

—To allow coastal development to continue without further damaging the environment—and valuable shellfishing waters—through faulty septic tanks, researchers came up with promising alternatives for backyard disposal.

—To inform property owners and government about the erosion which threatens much sound-side land, researchers mapped erosion along 1,400 miles of shorelines. Other scientists confirmed that in some cases marsh grasses can be planted to slow estuarine erosion.

—To help state and local officials charged with coastal land use planning, researchers came up with a study which explains coastal ecosystems and

evaluates traditional planning tools for their coastal applicability.

Some of those coastal needs require years of work. In 1976, long-range work paid off, too:

—Four short years ago, the typical fish house was a rickety wooden building with wooden floors and little if any modern equipment. Since 1972, many of the state's seafood handlers have turned their fish houses into relatively sophisticated plants. Sea Grant agents assisted 80 to 90 percent of those plants making the multimillion-dollar changes.

—At about the same time the plants started making changes, eels were bringing 18 cents a pound for bait. Today, after four years of intensive Sea Grant advisory work, 350 part-time North Carolina eel fishermen are making about $600,000 a year for eels which are being shipped to Europe and the Orient. The average price is 50 cents a pound.

—As increasing development pressures began to strain municipal sewage treatment systems, people began to look to the ocean for safe disposal. Sea Grant-supported researchers began studying our coastal waters to see what the effect might be and where the wastes might go. This preliminary groundwork paved the way for the state to fund additional ocean outfall studies in 1976.

There were unexpected benefits to the coastal public in 1976, too:

—Septic tank contractors found a new specialty in installing the alternative systems at a cost to

homeowners of $1,500 to $2,000 each.

—The Coastal Resources Commission was able to take advantage of expertise already developed by hiring students trained in the erosion project to assess erosion in the southern part of the state.

—Two new businesses started when advisory agents began urging fishermen to insulate boat holds to protect catches. The companies have insulated 45 vessels since 1972. The average cost to the boat owner is $1,200. In addition, almost every trawler being built in the state is now being insulated.

—A few years ago, the Migrant and Seasonal Farmworkers Association was casting about to find additional employment for low-income workers and picked up the eel idea. A total of 503 cooperative members, including 118 trained and equipped eel fishermen, are now involved in some aspect of the North Carolina eel business.

It takes a lot of work to accomplish so much. Sea Grant's unique blend of research and advisory services makes it possible. In 1976, 16 research projects were funded on four campuses of the University of North Carolina. Working as go-betweens with the researchers and the public were advisory agents stationed at the coast and in Raleigh. These agents who concentrate on the practical make Sea Grant unique among research programs. The give and take makes the program both flexible and responsive to specific coastal needs—for long and short range work.

And, there are times when an immediate need or fantastic idea arises—one that can't wait for our regular funding cycle. When that happens, minigrants or project initiation funds are used to fill in the gap. In 1976, the alternative septic tank work was started in this way. Also, studies were begun or completed on the impact of superfarm drainage, on using Japanese black pine or cypress trees to slow erosion, on computerized vessel record keeping for fishermen, on eel aquaculture economics and on the economic feasibility of finfish processing.

Also in 1976, our program added two sets of hands. A new specialist in recreation joined the program mid-year and began immediately to get to know the coast and its needs. The agent worked on using live eels for bait and the economics of eeling. He also began plotting ways to assist the charter boat fleet, marinas, sports fishermen, and just plain folks who want to have fun at the coast.

A second communicator also joined the program. Getting the word on research and advisory services out to people who can use it is a key job at Sea Grant. With the additional writer/editor, we were able to increase the publications we gear to specific audiences.

It's been a busy year.

From the director

This report marks the completion of the sixth year of the University of North Carolina's involvement in the Sea Grant Program. It has been a noteworthy year in several respects.

In September, the Governor of North Carolina and the President of the University of North Carolina accepted on behalf of the program a plague designating the university as a Sea Grant College. This designation highlights excellence in the university's continuing commitment to focus its research, education and advisory resources on priority coastal concerns.

Our program efforts are people-oriented. In order to more nearly meet this important goal, we added another communications specialist to our central staff to increase information dissemination to coastal users. We also added a recreation advisory specialist to meet another specific coastal need.

Several research projects began to bear fruit during the year. As evidenced in the following pages, we were able to develop answers to knotty questions and put that information to work solving coastal problems.

Sea Grant provides a unique combination of research, education and advisory activities in marine affairs. This blend enables the university to discover new information and then see it through to actual application, thus, efficiently and effectively responding to pressing coastal issues.

Fishermen need

Fishing for a living is only as reliable as nature is capricious. Catches come and go. The weather is sometimes friend and sometimes foe.

Fishermen need every break they can get. In the case of Ephrom O'Neal, the break he needs may take the form of an oyster "farm" he can fish in protected waters year round.

The "farm" is a pontoon contraption from which trays are suspended. The trays are filled with one-half to three-quarter inch seed oysters. Oysters grow to market size in less than two years. The "farm" is anchored in a canal near a friend's home in Hatteras.

O'Neal has been working with Sea Grant marine advisory agents Hughes Tillett and Sumner Midgett on the demonstration project since the spring of 1976. The agents designed the "farm" and put out 80,000 oysters after two test gardens yielded marketable oysters in 12 months. The pontoon is of sufficient size for the agents and O'Neal to evaluate the economic feasibility of a commercial operation. O'Neal says the oysters are "doing very good."

Once the pontoon and trays are set up, O'Neal says the only costs are for labor (washing off accumulated algae) and seed oysters (about $10 a thousand). He thinks the prospects for a profit are good. Oysters bring anywhere from $7 to $30 a bushel, depending on the quality and on the market. There are about 300 in a bushel.

"If these oysters produce a marketable size," O'Neal says, "then I'm going to seed and replant" a larger volume for a commercial-size operation. And if he can produce enough oysters, O'Neal plans to open an oyster bar to sell his home-grown seafood.

Even if he has to sell on the open market, O'Neal thinks he has two advantages over other oyster fishermen: he can sell his oysters year-round, not just during the official season. And, if he doesn't like the price, he doesn't have to sell.

Sometimes the break a fisherman needs is as simple as improved equipment that takes some of the drudgery out of the job. A staked pound net, for example, is commonly used in sound fishing in North Carolina.

Yet, according to Calvin Burris of Buxton, "You've got a day to go get your stakes, and that's a hard day—cutting stakes and dragging them out of the swamps. And then you got another day possibly of setting them, maybe longer. And then possibly a day of putting in your pound."

But fishermen like Burris are learning from agents Tillett and Midgett that a floating pound net eliminates most of the work.

Says Burris, "If you've got all your anchors and so forth, you could set it within a half a day." Unlike the staked net, the floating net holds up in storms and can be readily moved.

In 1976, Midgett and Tillett traveled to Maine to

every break they can get

learn about the floating net from Sea Grant agents and fishermen there. Back in North Carolina, the agents let Burris and his partner, Johnny Williams, test a floating net loaned to UNC Sea Grant by the folks in Maine. In addition, Burris and Williams bought a floating net of their own and they are making another for ocean fishing.

Spreading the word on innovations is a part of the job Midgett and Tillett do for fishermen. In 1976, they also spent hours upon hours answering several hundred requests for assistance or information. Among other things, they helped fishermen build equipment, get loan information and find boats to buy. It was all part of the effort to make fishing a more efficient and profitable enterprise for North Carolinians.

A hand with records

Fishermen could also use a hand with their record-keeping. Computers at North Carolina State University (NCSU) have long assisted farmers in keeping profits, taxes and costs straight. Now, Jim Easley of the NCSU school of economics and business, has determined through test runs that the computer programs could be adapted for fishermen's use.

The system, reports Easley, is capable of adequately summarizing trip records into monthly and yearly accounts useful in tax reporting and financial analysis. Easley expects instructions for vessel records will be included in a rewritten manual on the system. The service would then be made available to fishermen for a fee. This work was supported by a Sea Grant mini-grant.

Calvin Burris, Buxton fisherman

Highlights

In 1976, marine advisory agents Hughes Tillett and Sumner Midgett:

—Answered several hundred requests for information or assistance.

—Opened a library for fishermen and coastal residents in the N.C. Marine Resources Center/Manteo.

—Maintained supplies of publications in 20 racks along the coast.

—Demonstrated the success of oyster "gardens." Two small-scale demonstration projects yielded market-size oysters in a year's time.

—Initiated a demonstration project large enough to evaluate the economic feasibility of oyster farming as a result of the successful pilot projects.

—Assisted five people in finding leaseable bottom land for clam farming, which the agents have also been developing.

—Continued advisory work on labor-saving hydraulic-powered fishing gear for small boats. Seven small boat fishermen have installed trap pullers on their boats and two trawler captains are making plans to install hydraulic-powered winches on their boats.

—Brought a floating pound net from Maine to North Carolina for demonstration. If further tests confirm early good results, the agents will show fishermen how the floating net can replace the cumbersome staked net.

—Held the following workshops on: hydraulics (1), floating pound nets (2), weather forecasting (1), clam and oyster culture (4).

The Eel Story

Thomas Ferrell, part-time eel fisherman

In about six weeks, Jake White, mechanic and part-time eel fisherman, sold 3,180 pounds of eels for 75 to 85 cents a pound. The eels were sold gutted and cleaned in a neighborhood near his home in Reiglewood, North Carolina. White figures his profit, after costs were deducted, averaged about 74 cents a pound. Not bad part-time work, if you can get it.

Back in 1972, Sea Grant advisory agents set out to assist part-time fishermen by developing a new fishery which would tap abundant supplies of some underutilized species. They chose the eel. Work with the once lowly bait has continued to the present. Jake White is among the many people Sea Grant agents assisted.

In addition to helping fishermen with designing equipment and finding buyers, advisory agents have also worked with processors on handling, plant design and packaging. In 1976, advisory agent Skipper Crow spent about 50 percent of his time responding to inquiries coming in from North Carolina and other states and countries. Other East coast states are now developing eel fisheries.

In late 1976, Crow also began to develop the fishery in the southern part of the state—that's how Jake White got involved. And Crow is also cooperating with other Sea Grant personnel to develop a bait market for undersized eels.

Eel fishing is now well established in North Carolina. Seven in- and out-of-state buyers are purchasing eels for European markets—where they are a delicacy. The price for export eels has stabilized at about 50 cents a pound. Approximately 350 part-time fishermen make $600,000 annually.

In terms of worldwide dollars connected with the state's eels for such items as transportation, fuel, investments, profits and road use taxes, $600,000 translates into $6 million. The state now makes up between seven and 15 percent of the nation's eel export.

One export company, East Carolina Industries, (ECI) is now devoting a large part of its efforts to the eel industry in trap building, fishing or exporting. The cooperative, which is part of the Migrant and Seasonal Farmworkers Association, now has 503 members, all of whom are involved in some aspect of the eel business. ECI, which seeks to find additional employment for low-income workers, has now received federal grants totaling $835,000 to develop its eel business.

Meanwhile, back at the farm

You might say Mark Silva takes his work home with him—or wherever else he happens to be. After traveling in Austria and Germany to climb mountains and look into aquaculture, Silva and his wife dropped in at Sea Grant's experimental eel farm near New Bern, North Carolina. That's when Silva began taking his work to his home in Melrose, Massachusetts. Up until a few months ago, Silva had 10 and 20 gallon tanks containing growing eels in his basement and his kitchen.

Now Silva has begun setting up his eel culture business in earnest. The 55,000 pounds of eels he hopes to market from his first crop will not be grown in his Melrose kitchen.

Silva is setting up indoor, 7,000 gallon tanks with heated recirculating fresh water systems to raise eels. "The culture," he says, "may pay for itself in a few years . . . Eel is one of the best species for culture in the world."

If all goes well, Silva says he might be able to raise one million pounds of eels a year. In addition, because "the market is a huge sort of thing, it looks very lucrative at this point." Silva is also interested in equipping other people who would like to set up aquaculture businesses.

John Foster, eel farm

A spinoff of all the eel fishing goings on is the eel aquaculture project near New Bern. The farm was developed in 1974 with the idea that the worldwide demand for eels would continue to be unmet. In the last year, the project has assisted five commercial eel farming operations, among them Silva's. Hundreds of others have requested information on the eel culture project.

Project director, Bill Rickards of North Carolina State University says he and his colleagues, Walt Jones and John Foster, have developed a reliable technique—one which can be reproduced with the same results. One quarter to one half pound eels can now be raised in 14 to 16 months. In the wild, such growth would take from five to seven years.

In addition, the researchers have perfected a feeding tray which ends waste and allows monitoring of food consumption. They have also virtually eliminated diseases, which can be real problems in the hot-house environment of an aquaculture system.

Additional studies were begun in 1976 on food conversion efficiency and growth, on fat content and composition in wild and cultured eels, and on the economics of the culture project.

Finally, the eel story takes one last twist. Young eels or elvers are trapped in the wild in the spring when they move upriver. It takes about 4,000 elvers to make a pound. In aquaculture, these tiny things are then put in the grow-out ponds to mature.

Because eel farms in Taiwan and Japan have been unable to obtain elver stocks at home, they've begun shopping for elvers in this country. When word began to spread that eels were being caught in North Carolina, the Oriental culturists began calling.

At least 10 prospective buyers contacted Sea Grant wanting over 100,000 pounds of elvers. Prices they were quoting started at $50 or $60 a pound to the middleman and went up to as much as $325 to $375 a pound delivered in the Far East. One airline has outfitted a 747 with tanks (designed by Mark Silva) to ship elvers from this country.

Richards and Crow were contacted by 10 people who were interested in harvesting elvers for the new market. At least four of the fishermen actually fished for elvers. A great deal more interest in the fishery is anticipated.

To protect spawning stocks, Rickards and Crow have begun working on regulation of the fishery with state officials.

Highlights

Fishing

In 1976, Sea Grant advisory agent Skipper Crow:

—Determined that advisory efforts over the last five years have paid off. The eel fishing industry is now well established with approximately 350 fishermen.

—Responded to approximately 200 requests for information.

—Attempted to develop a bait market for undersized eels which are culled out in commercial fishing operations.

An economic analysis done by Sea Grant recreation specialist and economist Leon Abbas revealed that, under the study conditions, a minimum of 30 pots would have to be fished to make a profit. Work-sheets were developed so that fishermen could evaluate their own situations.

Farming

In 1976, researchers at the New Bern eel farm:

—Provided technical information or advice to five eel culture businesses and one university experimental project.

—Successfully continued grow-out and culture demonstrations. Growth of elvers seems to be paralleling that from the previous year.

—Perfected an eel feeding tray which allows virtually 100 percent consumption.

—Provided information either in person or via letter or telephone to over 300 people who contacted the project for information on eel culture.

—Virtually eliminated loss of elvers due to disease.

Today, she's at the center of a de

Five years ago, she was living in Tennessee and had never touched a fish. Today, she's at the center of a rapidly developing seafood business. While she expects the business will take a few years to get on its feet, she is sure it will succeed.

It started a few years back with Alleen Cook's husband, who's now a shrimper in North Carolina. He asked if she would like to lend a hand at Leslie Lee's fish house.

First, Mrs. Cook worked selling fish retail to weekend customers. Then it got to be two or three days a week. And now she is running Lee's new retail seafood market in Wilmington. She found, she says, that she "took a liking to it."

The new seafood market at Monkey Junction on the road to Wrightsville Beach looks from the outside as though it might have once been a gas station. Inside, Mrs. Cook has had the walls cleaned and painted shiny white. Gradually, the store is filling up with the necessary equipment. One display case holds fresh iced fish, another holds live lobsters, others hold frozen seafoods and cold drinks. Mrs. Cook estimates that once all the freezers, ice machines and other equipment are installed, such a business would represent an investment of $100,000 (including the cost of the land).

Fish are brought to the market mostly from Lee's wholesale business in nearby Hampstead. Trucks moving regularly from there to northern markets bring in whatever local fishermen can't provide. In turn, Mrs. Cook buys clams and some finfish in large quantities to send to the wholesale business.

Nothing goes to waste. Scraps from cleaned fish are sent to Hampstead for use as crab bait. "We've got a place for everything," says Mrs. Cook. "The wholesale and retail complement one another."

That's a point that Ted Miller of the North Carolina State University Seafood Lab in Morehead City has been trying to make in the last year. Miller and the rest of the staff at the Lab are dedicated to improving the seafood industry in North Carolina. Miller worked closely with Mrs. Cook and Lee to set up the new retail business.

The idea is catching on. Already six new retail markets have opened in conjunction with wholesale businesses. Miller sees several advantages to the setup: the complementary businesses help smooth out the slow seasons in wholesaling; the retail outlet gives seafood businesses a way to test their products; and stocking such a market encourages the wholesale business to maintain a variety of seafoods not commonly available in fish houses.

Alleen Cook, Lee's Seafood

Finally, Miller says, the retail outlet gives the wholesaler an opportunity and the incentive to get into packaging and freezing in a top quality way. Miller and others in the state seafood industry feel that frozen products would add flexibility and more market appeal to North Carolina's products.

Highlights

The North Carolina State University Seafood Laboratory, which is run in cooperation with UNC Sea Grant and the Agricultural Extension Service, is located in Morehead City. In 1976, project coordinator Frank Thomas and staff members Ted Miller, Joyce Taylor, Dave Hill, Skipper Crow, Keith Gates and Clark Calloway:

—Worked with processors on plant improvements totaling well over $1 million. Intensive work was done with 10 companies on plant floor plans and planning for retail markets. In each of these cases, the companies were going into an entirely new operation. Others received assistance in such matters as equipment and refrigeration. Since 1972, the Lab has worked

veloping seafood business

Clams for the wholesale business

Mrs. Cook is certainly a believer. "I like to experiment with things," she says. She's learned to glaze fish in a lemon-gelatin mixture the Seafood Lab developed to lock in freshness. And she's also learning from Miller how to package different products.

The freezers boast samples of some of the new products Mrs. Cook is planning to stock. The products are just the sort of thing the Seafood Lab folks think will sell. There are frozen shucked scallops and frozen breaded bluefish. There are king mackerel steaks and small flounder packed in five-pound boxes.

The boxes, developed by the Seafood Lab, contain several packages of about three fillets each. Mrs. Cook explains that there is enough in the box for two or three meals. "All they've got to do is pull out a package and thaw it."

As soon as display freezers are set up and labels (which are required by law) are printed, Mrs. Cook plans to get into packaging in a big way. "Anything that you package in a neat little pack you can sell. All the tourists have to do is pick it up."

She may also try selling ice chests packed with a variety of those frozen products for the tourist who wants to take a little of the coast home. Miller estimates the chests, which the Lab is experimenting with, will travel unrefrigerated for up to two days.

And that isn't all. "I'd like to have a kitchen for things like smoked mullet, steamed crabs, shrimp," says Mrs. Cook. When the time comes, the Seafood Lab staff will help her with that too, just as they helped Leslie Lee. Lee has gotten assistance from the Lab in the past on the retail market, on wholesale and retail plant design, on new products, on scalers and cutters, and on clam products. It's all part of the effort to develop the tremendous potential of North Carolina's seafood industry.

But for now, the lady from Tennessee is "real proud of what it's doing already. I think it's done real good."

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with 80 to 90 percent of the North Carolina seafood businesses which have upgraded their facilities. The result is a more sophisticated industry of modern plants with refrigerator rooms, freezers, ice machines and concrete floors.

—Had 558 extension and advisory service contacts.

—Took 119 field trips to survey plant capacities and production levels.

—Supplied 5,966 pieces of literature in response to questions. An information retrieval system was set up, with mini-grant funding, to speed handling of the numerous requests.

—Found that croaker, correctly frozen in the round, has excellent keeping properties and that use of gelatin-lemon juice glazes on fillets gives added protection for freshness.

—Participated in research experiments which increased the shelf-life of fresh iced crab to three weeks.

—Worked with Cryovac Division, W.R. Grace and Company, Duncan, S.C., to develop packaging for fishery products. The bulk storage method provides good quality raw materials for processing.

—Served in an advisory capacity at monthly meetings of the N.C. Fisheries Association's Technical and Product Development Committee. This provided a regular opportunity to keep up with and assist in tackling industry problems.

Seafood marketing comes of age

The stereotype is familiar. Seafoods caught off North Carolina are sold to one of the state's hundred or so "fish houses." From there the fish are sent by tractor trailer to markets in Virginia or New York. Then the product is returned to the state for retail sale.

The stereotype is as wrong as it is familiar. Research just completed by John Summey at East Carolina University shows that the state's seafood marketing channels are far more complex and sophisticated.

That's important information for Paul Allsbrook of the state Department of Commerce, Division of Economic Development. Allsbrook's job is to sell North Carolina seafood products by promoting the products and finding new markets. The state sells approximately 2 percent of the seafood eaten in the United States, but receives less than that percentage of the sales dollars. According to Allsbrook, there is tremendous potential for expanding North Carolina seafood marketing and there is a marked need to identify more profitable markets.

But to know where fish aren't going that they could go, you first have to find out where they *are* going. What Summey found was that a majority of all but one species studied was retailed within North Carolina without leaving the state first.

Seafood marketing in the state is broken up into three major geographic districts in Summey's study. The northern district, from Beaufort and Hyde Counties to the Virginia line, principally served out-of-state markets. That portion of their volume that did stay in-state was absorbed by coastal area markets.

The central district, south to Carteret County, served both in-state and out-of-state markets, with the proportions varying by species. The product remaining in the state was sold almost entirely in the coastal zone.

The southern district, from Onslow County to the South Carolina line, had the greatest diversity in the general markets served. Markets were both in- and out-of-state. In-state sales included a substantial volume moving into the North Carolina Piedmont and mountains. These southern North Carolina dealers appear to be the principal suppliers of fresh iced seafood to the state's inland markets.

With this valuable information, Allsbrook can now better tailor his marketing efforts. "I was surprised that as much seafood stayed in North Carolina as it did," says Allsbrook. The study "is definitely going to be an asset . . . It kind of opened our eyes a little bit." He would like to see more equal marketing ability for both retail and wholesale in the entire coastal zone.

"We need to be so much more sophisticated than we are," says Allsbrook. In order to develop the state's seafood industry, Allsbrook thinks fish houses must be willing to try to supply more distant out-of-state markets—in the Midwest, for example. Allsbrook will use Summey's information to help promote out-of-state sales from those North Carolina areas identified as comparatively weak.

Allsbrook will also concentrate on grocery stores and on in-state sales to the booming seafood restaurant business.

Through expanded markets North Carolina seafood should sell more and command a higher price, giving the state's businesses a fairer shake.

Highlights

In 1976, researcher Summey:

—Surveyed the sources and the channels of distribution used by North Carolina seafood dealers for the fresh iced seafood they handled. The seven species of seafood studied were flounder, gray trout, croaker, spot, bluefish, mullet and shrimp.

—Found that a majority of the state's catch is staying in-state and that three coastal areas serve different markets. Reports due out in 1977 will review these findings as well as the sources of supply for inland retail seafood markets.

Simple process Increases crab Shelf life

Tom Caroon lives with his work. There on the edge of Oriental, he has clustered home, seafood business and crab picking plant within easy walks of one another. Living with the business as he does, Caroon has seen the importance of keeping things well scrubbed. He knows that good sanitation is crucial to maintaining product quality—and his businesses.

The crab plant is regularly washed down with chlorine. Workers are instructed on the hazards of contamination, temperatures are carefully controlled. Every effort is taken to make Riverview Crab Company's crabmeat a quality product.

But crabmeat is a sensitive product. It has to be picked by hand. In the food business that can cause problems. So when Sea Grant researchers and advisory agents approached Caroon with the possibility of further improving sanitation and shelf life, he accepted readily.

What the North Carolina State University researchers, Neil Webb, Frank Thomas, Don Hamann and Sea Grant advisory agent Ted Miller, did sounds simple. The crabmeat, which is picked directly into packing containers, was dumped onto an inspection belt where additional shell particles were removed. The meat was then steamed a second time (the first is before the crabs are picked) to reduce contamination.

The effect was dramatic. Studies showed that the simple process increased shelf life to as much as three weeks. In some cases, that would more than double shelf life. That means that the product is viable and saleable longer. The process also reduces shell fragments, making the crabmeat more acceptable to consumers. Furthermore, the method did not detract from the "fresh product" acceptability of the crabmeat.

"Another week or two would really help us," says Caroon. "That makes a whole lot of difference in the shelf life." In Caroon's plant where sanitation was already good, the microbial count was still further reduced by the additional steaming. The prolonged shelf life of the crabmeat is an indication of the fact that microbial counts remained relatively low until the third week of refrigerated storage. The fact that this work was done under plant conditions indicates that the results can be of substantial value to the industry.

Tom Caroon, Riverview Crab Company

Because of the success of the experiment, Sea Grant advisory agents are working with the state Shellfish Sanitation Laboratory to get the new inspection and steaming method approved. They are also working with the Shellfish Sanitation Lab on other ways to reduce the handling of the highly perishable delicacy.

The industry, one of the three most important in seafood in the state, brings in about $11 million annually. Because the crab industry as a whole has tremendous potential for improving its technology and sanitation, Sea Grant personnel have worked with it for several years.

Should the state's 29 or so crab processors adopt the new steaming method, the potential value to the industry would be about $1 million annually.

The hotdog of the future--- fish?

Hot dogs and sandwich meats have long been a staple of American diets. Those products were created, in part, to put unused red meats to work. That saves protein and money.

So why aren't there similar fish products? A lot of fish gets wasted either in filleting or because certain species are bony, too plentiful or unpopular. All that protein and potential profit go to waste.

In 1976, North Carolina State University researchers Don Hamann, Neil Webb, Frank Thomas and advisory agent Ted Miller tackled the possibilities for mechanically boned fish tissue products. There has long been consumer interest in flaked fish, so the researchers thought commercial possibilities might be good.

But you just don't go out and invent a fish hot dog. First you've got to figure out what kind of textural differences you might get from different fish species once they're boned. So work in 1976 compared different species caught in different areas.
areas.

What the researchers found was that there are indeed differences among the species. That means there would be differences among the products made from those fish.

The changes seem to pop up when the fish are cooked. The heat breaks up the protein and affects the texture of the various species differently.

That set the stage for 1977 work which is being done to overcome the textural changes in order to create uniform products. This would make more species more acceptable. Researchers concentrated on rapid heating. When all is said and done, they will be able to make mechanically boned fish products of good, uniform texture.

Already, one North Carolina processor is using fish flakes in combination with other seafoods. The flakes are removed from the skeleton by a steaming process. Other processors are interested in combination products as well.

More generally, the researchers, along with graduate students and research assistants, looked at functional properties of fish tissue. They studied how tissue—boned, filleted, otherwise processed—performs as a food. Related work was done in 1976 on superchilling, aging, freshness, and tenderness. A dissertation and two theses are being prepared on this work.

Making seafoods safer

Bob Benton has thousands of acres of shellfish waters in North Carolina and all the thousands of people who eat North Carolina oysters and clams to worry about.

"What we're all about," says Benton, head of the State Shellfish Sanitation Laboratory, "(is) protection of the consuming public. If a lot of people get sick from North Carolina shellfish, we have failed somewhere."

Benton and Sea Grant-supported scientists aren't satisfied with the tests that are currently used to determine the safety of shellfishing waters. Though Benton says his office's track record is good, he would like to have current tests either validated or modified on the basis of Sea Grant research. The present standards were established on the basis of bacteriological work done 36 years ago.

One problem with that standard is that no one knows if the current bacteriological tests for fecal coliforms are an adequate indicator of enteric viruses which cause such diseases as hepatitis and polio. There is also evidence that they may not be adequate indicators of other pathogens. Pathogens either exist in the marine environment or may be introduced by land runoff.

So, Benton and Marvin Speck of North Carolina State University in Raleigh, and Mark Sobsey of the University of North Carolina at Chapel Hill, have been collaborating to test the standard tests and come up with new tests if necessary.

Benton's staff checks the samples for fecal coliforms according to standard procedures. Then samples are sent to Raleigh and Chapel Hill for further testing.

In 1976, Sobsey developed and evaluated a new method for detecting enteric viruses in oysters and clams. The method is simple, reliable and sensitive. In 1977, Sobsey will evaluate and apply his methods under field conditions.

Speck, in 1976, developed a new method for detecting other hazardous microorganisms. The pathogen that cropped up most frequently in North Carolina seafood was *Vibrio parahaemolyticus*. Speck's findings are important because the pathogen was not formerly thought to be a problem in North Carolina. Speck's preliminary tests showed as many as 20 times more *Vibrio* (a cause of food poisoning) than standard tests indicate.

Speck has detected the higher levels of *Vibrio parahaemolyticus* with what he calls the "repair method." With this method, *Vibrio* is given a chance to repair itself after processing (such as steaming or freezing). Speck has found that injured *Vibrio* can overcome even cooking and freezing. Since they multiply, any mishandling of the seafood can raise the *Vibrio* count to unhealthy numbers. In the kitchen or the processing plant, that means the reviving *Vibrio* can accelerate spoilage and cause sickness.

Some of the high counts Speck's tests have shown for *Vibrio* suggest that re-contamination is occurring during handling of the product in seafood plants. Speck and his colleagues are working with seafood plants to improve sanitation.

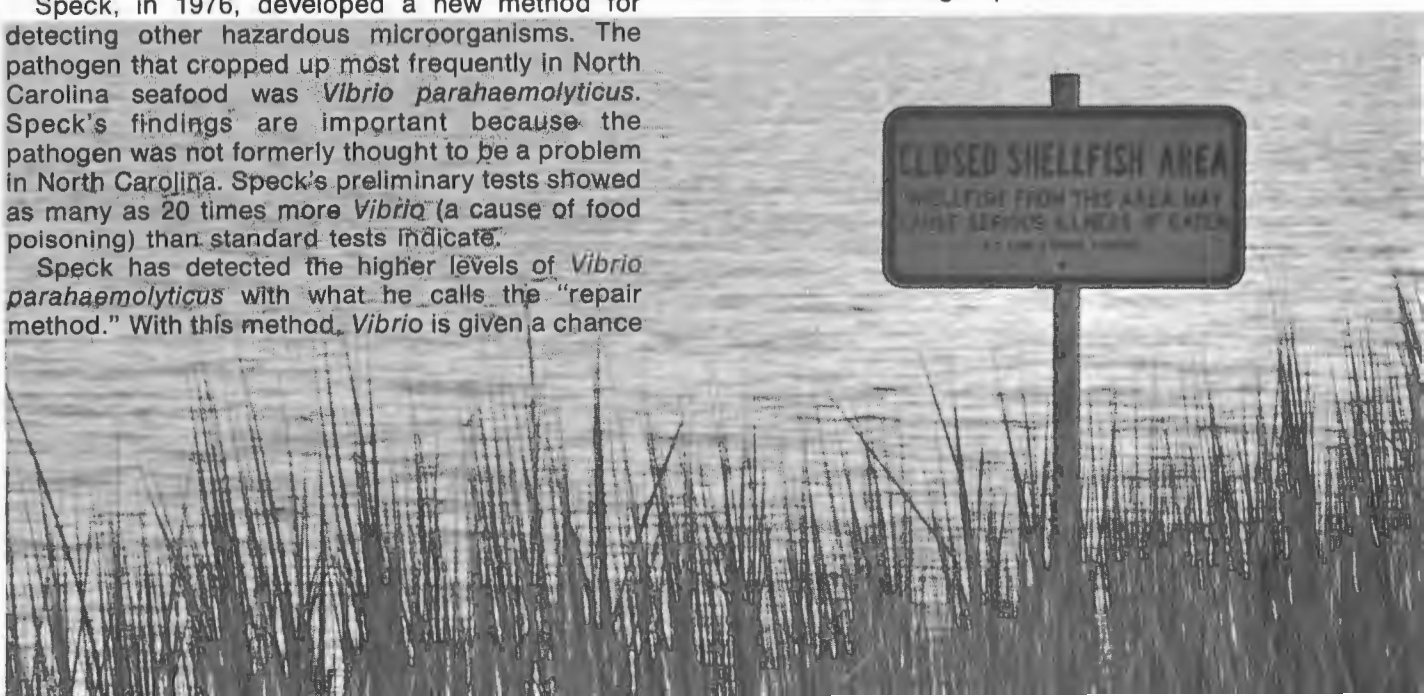
While Benton says, "We feel the plants are in reasonably good shape," he adds, "there is always room for significant improvement."

Speck, Sobsey and the staff at the Shellfish Sanitation Lab will correlate all results and further testing during 1977. After everything is completed, Benton says, "It's going to be extremely interesting to show the relationships of fecal coliforms, viruses and other pathogens.

"It could possibly denote a need for changes in the standard or give some more validity to the standards we use."

Recent explosive news about mercury and kepone in fish has pointed out the need to know what contaminants other than microbes are in seafoods. So North Carolina State University food scientist George Giddings has been looking at how processing affects both the heavy metal contaminants and nutrients in seafoods.

Heavy metals can be harmful to man and marine life. And it appears that estuaries concentrate metals. It also seems that the metals are more toxic to young forms of marine life, making the estuarine "nursery" particularly vulnerable to increased metal levels. Metals occur naturally in the estuaries and are added through pollution. With industrial



development—a source of many metal contaminants— increasing near the coast, many suspect pollution will increase.

After a year's work, Giddings has perfected much of the methodology needed to detect metals in seafoods.

Benton and his staff are assisting Giddings in sample collection. Says Benton, "We feel this will be important information." Benton's office already has plans to begin sampling of heavy metals as part of its own routine. He hopes Giddings' work can be "a guideline to us in where we need to concentrate more."

Work done on the vulnerable calico scallop has established that processing has a significant impact on edible tissue composition. One major contaminating culprit Giddings identified in the processing was the flume.

The flume uses water to carry seafood through a plant. What Giddings found was that the water used in the process stores up contaminants and that those contaminants can be transferred to the product. Giddings concludes that the water should be changed more frequently than is generally the case. The fluming medium could also be altered to promote removal of contaminants from edible tissue or inhibit the depletion of nutrients.

Highlights

In 1976, three Sea Grant-supported researchers looked at seafood safety:

SOBSEY

—Developed and evaluated a simple, reliable and sensitive method to quantitatively detect and recover enteric viruses in oysters and clams.

—Planned and began an extensive field study to further evaluate and apply this virus detection method under field conditions.

SPECK

—Developed a procedure for detecting injured *Vibrio parahaemolyticus* in seafood, especially processed seafood.

—Found the organism in greater numbers and in higher frequencies in commercial products than standard methods revealed. In many samples, the incidence of *Vibrio* was 20 or more times greater than the number detected by the recommended method. *Vibrio* was isolated in 13 percent of crabmeat samples, 29 percent of finfish samples, 35 percent of scallop samples, 65 percent of oyster samples, 68 percent of shrimp samples and 78 percent of clam samples.

—Determined that the method also served as a valuable tool in identifying the source of *Vibrio* contamination in different types of seafood during commercial processing. The data indicated where products were handled under poor sanitary conditions.

GIDDINGS

—Found that scallop processing—primarily fluming—has a significant impact on edible tissue composition and that processing can be modified to take advantage of desirable effects (removal of contaminants from edible tissue), and lessen undesirable effects (depletion of nutrients).

—Assisted the state Shellfish Sanitation Laboratory in expanding monitoring to include heavy metal analysis in addition to microbiological examination.

—Developed important methodology concerning the anodic stripping voltameter which was passed on to the National Shellfish Safety Program Chemistry Task Force.

Controlling disease in aquaculture

For a while, Jim Heerin of Shrimp Culture Incorporated had a $50,000 headache. It was a recurring headache that cost a subsidiary company, Seafarms de Honduras, that amount in monthly operating costs alone.

Seafarms de Honduras, on the Pacific coast of Honduras, is 130 acres of ponds in which shrimp are grown to marketable size. But for four or five months the progress of the farm was held up because many millions of post-larval shrimp were dying.

Heerin got in touch with Sea Grant-supported researcher Chuck Bland at East Carolina University. Bland, who has been studying the fungal diseases associated with salt water aquaculture, was able to diagnose the cause of Heerin's headache. The culprit that had been killing all those shrimp was *Lagenidium*. What's more, Bland knew just the cure, which has, according to Heerin, "proven extremely successful."

Bland has been identifying and finding controls for fungi that infect such marine crustacea as shrimp, lobster and crabs in aquaculture. The Sea-Grant supported work has been going on since 1970.

Since 10 percent of the world's seafood supply already comes from aquaculture and more will in the future, knowing more about disease-producing fungi in salty waters is essential. Some fungi are so powerful they can, in a matter of hours, wipe out an entire crop of shrimp or crab or lobster growing in confined spaces.

Bland's work has concentrated on a particularly abundant and devastating fungus called *Lagenidium*. He is now able to identiry several different species of the fungus and to control many of them chemically. And he has determined the temperature ranges at which various strains grow best.

He has also located the site of action of the chemicals in *Lagenidium*. Laboratory tests of uptake and concentration in larvae indicate that deposits in larval tissues increase in proportion to duration of exposure to the chemical. In 1977, Bland will test his findings in actual aquaculture situations. That's important information when you're dealing with products people eat.

But the work on *Lagenidium* isn't complete. Another aquaculture operation, Marifarms of Panama City, Fla., asked Bland for help in determining what was ailing its crops. Bland found that *Lagenidium* was the problem but that it involved yet another strain. He is now studying that new strain. In the meantime, treatments he recommended have cut shrimp mortalities due to fungal diseases from 90 percent to less than 10 percent.

Another fungus, *Halipthoros milfordensis*, came under Bland's scrutiny in 1976. Tests for fungicidal control using five compounds were completed. Minimum lethal dosages for each were determined and programs for further evaluation in disease situations were established.

Bland's work is continuing in 1977.

Highlights

In 1976, researcher Bland:

—Completed tests for the fungicidal control of the fungus *Halipthoros* using five compounds.

—Discovered the temperature ranges at which various strains of *Lagenidium* grow best. This is important for aquaculture, especially for those operations which use heated waters.

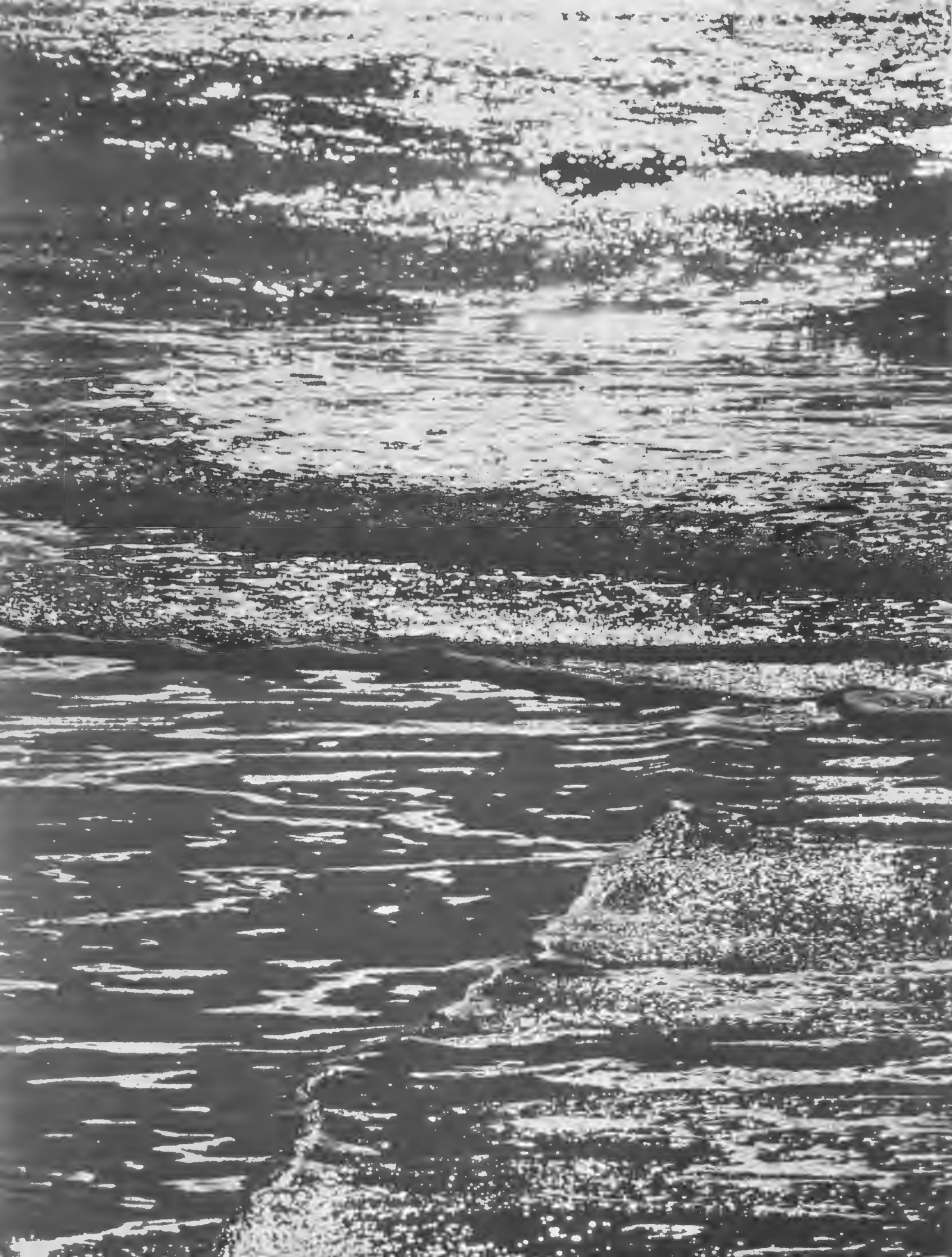
—Found three chemicals which inhibit growth of *Lagenidium*. Both the chemical and the heat factors are crucial in devising treatment programs.

—Discerned considerable difference in the modes of infection and growth of various strains of *Lagenidium*. Taken with other information, this leads Bland to believe the various strains are, in fact, different species.

—Determined the site of action of two chemicals in *Lagenidium*.

—Saved one company further monthly losses of $50,000 in operating expenses.

—Completed an outline for a manual entitled "Identification, isolation and control of fungi affecting aquaculture." The manual is due out in 1977.



Planned growth

. . . legal questions

• In Raleigh, state officials are grappling with tough legal and environmental questions in their effort to implement the Coastal Area Management Act.

• In local government offices from Currituck County to Brunswick County, officials are struggling to match dynamic coastal systems with traditional growth management tools.

As always with something new, there are countless questions, countless doubts—and never enough time or manpower to deal with them.

Sea Grant has stepped in to assist the state as it attempts to implement the 1974 Coastal Area Management Act, to designate the critical Areas of Environmental Concern, and to assist local governments in their efforts to implement required broad land use plans.

Tom Schoenbaum, law professor at the University of North Carolina at Chapel Hill, worked closely with state officials in their efforts to draw up a coastal management act. In 1975 and 1976 he worked, under Sea Grant support, with officials charged with implementing the Coastal Area Management Act (CAMA). By consulting with them, Schoenbaum was able to anticipate and research many of the ques-

tions that arose. Some of his findings were incorporated into position papers published by state officials.

Explains Amos Dawson of the state Attorney General's office, "We just don't have the time to do the in-depth research that needs to be done." Dawson found Schoenbaum's thoughtful analysis particularly helpful in the publication *Coastal planning: the designation and management of areas of critical environmental concern*. That work concluded that all constitutional and administrative problems of implementation can be overcome by careful preparatory work at the administrative level.

. . . management tools

State and local governments dealing with questions of planning and growth management also got a hand from David Brower of the Center for Urban and Regional Studies at Chapel Hill.

Brower was the principal investigator for a Sea Grant-supported project in which scientists, lawyers, planners and government officials collaborated to draw up a publication entitled the *Ecological determinants of coastal area management*. The two-volume study gives a detailed explanation of the different coastal ecosystems. In addition, there is a lengthy listing of governmental management tools. Each tool is evaluated for its coastal application.

The study was made available to a wide range of coastal and state officials. A random sampling shows:

—In Currituck County, manager Graham Pervier used the publication in preparing the county's land use plan for CAMA;

—In Brunswick County, planner Michael Nugent used the information on land use controls for implementation of CAMA planning;

—In Pitt County, Greenville planner John Schofield used the information for an environmental inventory and management plan, though Pitt County does not come under CAMA.

. . . aerial photos, more

Finally, Sea Grant land use management specialist Simon Baker spent 1976 answering specific needs raised by the coastal public. Most of those were connected with CAMA.

To assist planners in drawing up land use plans in counties where massive "superfarms" have moved in, Baker arranged a workshop. Planners for Dare, Hyde, Tyrrell and Washington Counties, all of which are feeling the impact of the big farms, met with economists from North Carolina State University. The economists outlined the impact of the farms on county and local governments.

According to Tom Richter, of the state Department of Natural and Economic Resources, the session "gave the planners a reminder of a different aspect of planning that they don't normally carry around in the front of their heads."

Another way planners were assisted in their efforts—both for CAMA and for other planning purposes—was through workshops on aerial photography. According to workshop participant Ronald Wayne Brown of the Wilmington/New Hanover planning department, aerial photography is useful in mapping, in soils analysis, in housing and population counts and even in downtown revitalization.

To assist state agencies in acquiring needed research and to assist graduate students in search of relevant topics of study, Baker began in 1976 to draw up a list of research priorities. He will act as a liaison between students and state officials.

Highlights

In 1976, researcher Schoenbaum:

—Published findings on the legal implementation of planning under CAMA. The major conclusion is that only a "systems approach" involving the coordination of many different governmental powers will work.

—Published another report to help coastal planners through the maze of constitutional pitfalls encountered in dealing with the regulation of critical environmental areas. The major conclusion is that problems may be overcome by careful administrative work.

In 1976, researcher Brower completed a two-volume study which explains coastal ecosystems and available management tools.

In 1976, land use management specialist Baker:

—Organized and conducted, in cooperation with the American Society of Photogrammetry, a symposium on remote sensing in the delineation of coastal wetlands (150 attended).

—Arranged a workshop for coastal planners on the economic impacts of superfarms (14 planners attended).

—Published a handbook on how aerial photographs are made and used.

—Held workshops on "An introduction to aerial photographic interpretation and remote sensing" (57 attended).

—Completed preliminary work on a list of coastal research needs to be circulated to North Carolina graduate students.

—Wrapped up final details on a film being done on the critical areas of environmental concern. The Coastal Resources Commission planned to use the film at public meetings on the areas.

J. G. Smith supervises drainage and clearing at Open Grounds Farm. Here he is pictured with a pipe which will be used in the farm's drainage system.

One of the farm's dozens of pieces of heavy equipment, this back hoe clears vegetation from a drainage ditch. The ditches will surround each square mile of the farm.

Superfarms, superquestions

Three years ago when Livio Ferruzzi came to this country from his native Italy he spoke no English. But he did understand the common language of farming. Before coming to this country, he was general manager of what was then the largest farm in Europe.

One of the reasons Ferruzzi came here was that the European farm used drainage ditches similar to those now being used in coastal North Carolina. Ferruzzi is general manager for Open Grounds Farm near Beaufort.

The idea isn't so new. Ferruzzi remembers seeing maps from the 1500's of a farm with drainage canals. But when miles of wide drainage canals are used to convert swampy forests into farm fields, which speed runoff into coastal waters, state officials get nervous. There are over two and a quarter million acres of the swamp forests within 40 miles of the North Carolina coast. Thousands of those acres are being cleared for "superfarms." And the 43,000-acre Open Grounds Farm isn't the largest by a long shot.

What concerns state officials and Ferruzzi is the impact of converting forest land to agriculture. In particular, explains Page Benton of the Department of Natural Resources and Community Development's Division of Environmental Management, the concern with farms the size of Open Grounds is the impact on surrounding waters, especially shellfish waters.

To help the state grapple with the question immediately, Sea Grant gave Duke University Marine Laboratory scientists Dick Barber and Bill Kirby-Smith a mini-grant. The two began intensive studies of Open Grounds Farm.

What the researchers found was that the only detectable change in the South River due to development of the surrounding watershed by Open Grounds Farm has been in the quality of the fresh water entering the head waters of the system. There has been a small but significant increase in nutrients as a result of the changes. However, to date, there have not been any detectable changes in the standing crop of phytoplankton in the river as a result of this increase in nutrient load.

As the Barber/Kirby-Smith work indicates, Page Benton cautions that the final verdict on the impact of superfarms is years away. But according to Robert Carter of the Environmental Management Commission, the researchers "are providing us a very good data base" for measuring farm impact. That information is being used in the formulation of commission policy on large agricultural enterprises.

One effort that Benton says has already paid off is the 50- to 60-acre "pond" which was built to hold runoff, especially during construction. Barber and Kirby-Smith's work was instrumental in the company's decision to build the pond.

For now, the farm has 3,000 acres in cultivation and 3,000 head of cattle. Ferruzzi expects a total of about 30,000 acres will ultimately be used with the rest of the land being left for buffer zones and canals.

Highlights

In 1976, researchers Barber and Kirby-Smith:

—Found dissolved nutrients were significantly higher, especially when associated with storms, in farm runoff when compared to natural swamp forest waters. However, average nutrient values were low relative to deep ocean water or river water draining from agriculture/urban land.

—Found farm runoff of nutrients has resulted in periodic nitrogen enrichment of the upper estuary, though phytoplankton blooms associated with the elevated nutrients have not been observed. The accelerated input of detritus may be important in the future nutrient dynamics of the upper estuary.

Waste disposal...

In winter, our coast is a place where snow geese feel free to amble across the highway, where restaurants and motels close, where locals rest up for the summer rush.

Come summer, the populations of coastal counties soar. In Dare County, for example, the population catapults from a winter average of 7,900 to a peak summer total of 100,000.

While that means prosperity for local businesses, it means problems too, not the least of which is the proper disposal of increasing amounts of human wastes. Right now septic tanks handle most of the load. Municipal treatment systems are few and far between.

Joe Stokes, Dare County sanitarian, foresees that within five years the septic tanks will begin to tax the land's ability to purify. When that happens, development in Dare County may come to grinding halt. Similar situations, in some cases more acute, plague officials in other coastal counties.

Many people, Stokes among them, look to the ocean—the very thing that draws all those summer people—for a solution to growing disposal problems.

Ocean outfall of treated (and sometimes raw) sewage is not a new idea. Outfall has been used elsewhere for many years. But never before has an outfall pipeline stretched out from North Carolina's shores.

To determine where the treated sewage might go if it were dumped off North Carolina, Len Pietrafesa, North Carolina State University geoscientist, has for the last three years been examining ocean currents off the state's coast. In addition to Sea Grant funding, he has also received support from the Energy Research and Development Administration, and the National Aeronautics and Space Administration.

Pietrafesa has stationed complex moorings 40 to 150 miles out in the ocean to collect data on water temperature, salinity, currents and winds. He is doing intensive studies of the circulation in Onslow, Raleigh and Long Bays. Thus, basic information concerning dispersion and circulation of water has been collected for the first time off North Carolina's coast.

As an added bonus, Pietrafesa's moorings also recorded the passage of Hurricane Belle over the state's Continental Shelf waters. Since designers working on ocean outfall or any other shelf development would have to design for the extreme times, this new information will be tremendously valuable.

Highlights

In 1976, researcher Pietrafesa and his colleagues:

—Collected basic information concerning dispersion and circulation of water off North Carolina. This information had never before been collected on the state's Continental Shelf. Within the context of these results, outfall studies have been funded by state government and the Coastal Plains Regional Commission.

—Collected data on Hurricane Belle as it

. . . the consequences of growth

The road twists through farm fields and little crossroad towns. Several miles from "civilization" the road passes flag-bedecked gates and a guard house. It descends into a pine wood and gradually the development begins to show through the trees.

Trailers and some houses are lined up along canals that make many waterfront lots. At the road's end is Albemarle Sound, a clubhouse, tennis courts, and a swimming pool. A perfect little getaway place with all the conveniences of home.

Except that for over a year property owners were unable to set up their dream homes because local health officials had to deny septic tank permits.

As in much of the coastal zone, the soil at Holiday Island is unsuitable for conventional septic tanks. There are 1,200 lots at Holiday Island. And, says county health officer, Vernon Squires, the soil is mostly tight and clayey. Such soils interfere with proper treatment by inhibiting the movement of wastes away from the septic tank.

As a result, says Squires, "We had to give disapproval on lots that did not pass (county health septic tank regulations). I'm sure that quite a few were disapproved."

At least 80 percent of the state's coastal soils are unsuitable for conventional septic tanks. Years of development are taking their toll. Pollution, largely from septic tanks, keeps thousands of acres of shellfishing waters closed. In some areas, drinking water supplies are threatened.

In the summer of 1976, Bobby Carlile of the Soil Science Department of North Carolina State University (NCSU) came to Sea Grant with a way to solve the septic tank problems at places such as Holiday Island. The idea seemed so good and the need so great, that Carlile was given project initiation funds to get underway immediately.

Carlile and his associates, Larry King, Larry Stewart of NCSU and Mark Sobsey of the University of North Carolina at Chapel Hill, installed several kinds of experimental systems:—the low pressure pipe, which uses numerous one-inch pipes buried very near the soil's surface; the septic renovation levee, which uses a man-made mound above the soil's surface to filter effluent; a modification of a conventional system using a newly developed V-shaped trench and filter sand in the trench to maximize surface area; and one modified conventional system with shallow placement of the trench and improved lot landscaping.

Now, says Vernon Sawyer, "We're just kind of keeping our fingers crossed." In addition to the 10 experimental systems, the county board of health has authorized another 50 permits for Holiday Island. Those permits will go to private landowners who wish to install Carlile's systems. That means construction worth an estimated $1,500,000 can get underway on $500,000 worth of property.

And it means three private contractors have a new specialty. Using the researchers' plans, the contractors have already installed 25 alternative systems at a cost of $1,500 to $2,000 to each homeowner. (That's compared to $1,200 for conventional systems.)

Howard Maxwell, Holiday Island spokesman, says he hopes the new systems will succeed "because that has been a major development problem."

Maxwell isn't alone. Squires says the systems "very definitely will" have application elsewhere, "if they're proven to be effective. There's no doubt about it." That means hope for shellfishermen as well as homeowners.

In 1977, Carlile and his colleagues will expand their work to include other coastal counties and other soil conditions.

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passed along and over the North Carolina continental margin. These data are the first of their kind and will help the state to better manage the coastal zone during hurricane season.

—Began preparation of two research reports. These reports will be made available to public agencies and private concerns interested in Continental Shelf development.

—Collaborated with scientists doing similar studies elsewhere on the East coast.

In 1976, researchers Carlile, King, Sobsey and Stewart:

—Began experiments with alternative septic systems, and initiated a program to sample and analyze affected surface waters.

—Began studies in a cooperative effort with Pender County health officials. This county has some of the most severe septic tank problems.

—Received inquiries from over 25 county sanitarians and planners regarding the new methods.

Erosion: 'one of the biggest' coas

Each year, coastal property owners spend thousands of dollars to protect their land from estuarine erosion.

The only problem is that:

—Erosion and shoreline recession are inevitable along much of the North Carolina coast;

—And, therefore, in many cases, the money is wasted.

What's more, developers unwittingly compound erosion problems by destroying vegetation which is a natural barrier to erosion or by designing or building faulty bulkheads.

Those are among the findings of East Carolina University researchers Stan Riggs, Mike O'Connor and Vince Bellis.

"Erosion is certainly one of the biggest problems on the coast," says Mike Black who heads up the North Carolina Coastal Resources Commission's section on Areas of Environmental Concern. Indeed, erosion is such a problem nationally, Black reports, that the federal regulations on coastal zone management set up an assistance program for states to develop planning to deal with erosion.

To help planners and homeowners in North Carolina grapple with erosion, Riggs, O'Connor and Bellis have spent the last two years mapping estuarine erosion county-by-county. The Sea Grant-supported work has revealed erosion rates that average over two feet a year but go as high as 15 feet a year.

In 1977, the researchers will publish maps which spell out their findings. Already, coastal property owners and officials have dropped by to see the maps.

The shoreline inventory of almost 1,400 miles in 13 coastal counties shows:

—Almost 50 percent of the shoreline is marsh. The next most common shoreline type is low bank (32 percent), then swamp forest, high bank and bluff.

—The ranges of annual erosion for those shoreline types in feet are: bluff, 0 to 8; high bank, 0

Marsh erosion

tal problems

to 12.5; low bank, 0 to 13.2; marsh, 0 to 8.5; swamp forest, 0 to 15.

—Special shoreline features which tend to slow erosion—cypress or marsh fringe on bluff or bank, or sand aprons on marshes—showed up in just over 23 percent of the shoreline mapped.

—Severe bank and bluff erosion showed up in almost 15 percent of the land mapped, while significant accretion appeared in only 2.3 percent of the shoreline mapped. Almost 8 percent of the shoreline showed modification.

—Primary land uses were forest (38 percent), marsh (22.8 percent), agriculture (4.8 percent), residential (9 percent), recreational (3.2 percent), commercial (2.5 percent).

The facts and figures are broken down on a county-by-county basis which enables local governments to make major coastal land use management decisions. For example, the researchers point out, it is interesting to note that the Bertie County shoreline consists entirely of swamp forest and sediment bank. More than half of the sediment bank is protected by a secondary cypress fringe. Since the swamp forest has negligible shoreline erosion and since the cypress fringe is a natural shoreline protection mechanism, Bertie County has a severe erosion problem along only 20 percent of its shoreline.

Contrast the Bertie County situation, the researchers continue, with that of Pamlico County which has a 260-mile shoreline consisting mostly of marsh. Approximately 83 percent of the Pamlico County shoreline has major erosion problems.

Erosion had been considered more of a problem in the northern parts of the state than in the south. But the Coastal Resources Commission (CRC) wanted to be certain. So, the commission hired several students who had worked with Riggs, O'Connor and Bellis to take a close look at erosion in the southern counties.

Using the researchers' methods, the students made some surprising findings. Erosion caused by boats in the Intracoastal Waterway was found to be a much more significant problem than had been expected. The CRC will use this information in implementing the Coastal Area Management Act.

As for the Riggs-O'Connor-Bellis information, it should go a long way toward filling the need Mike Black points out. Estuarine erosion is a particularly knotty problem because of private land ownership, Black says, so one of the major jobs is simply to warn people of the problems of erosion. That way, developers and landowners can make more informed decisions.

High bank erosion

Highlights

In 1976, researchers Riggs, O'Connor and Bellis:

—Mapped 1,083 miles of estuarine shoreline (out of a total of 1,400 mapped to date).

—Continued their analysis of U.S. Army Corps of Engineers dredge and fill permits, thus identifying the areas of most intense shoreline modification. Between June, 1975 and June, 1976, nearly eight miles of estuarine shoreline bulkhead requests were received by the Corps. This represents an annual investment of $800,000 to $2,000,000, depending on the cost of the bulkhead.

—Made field observations of the natural processes which retard shoreline erosion. Bald cypress was found to be an excellent erosion retardant. A mini-grant allowed Bellis to study optimum requirements for seed germination and seedline growth. Studies showed that plants larger than first year seedlings should be used in further experimental plantings. The North Carolina Forest Service has agreed to grow several thousand cypress seedlings for this purpose.

—Provided planners and state officials with information on estuarine shorelines for implementation of the Coastal Area Management Act.

—Gave numerous papers and presentations on estuarine erosion to groups ranging from the Bath Ruritan Club to the annual meeting of the Association of Southeastern Biologists.

Bogue Sound bulkhead just prior to planting in April, 1974 (top) and the same area in October, 1976 (bottom).

Marsh grasses

It was, simply, a "horrible mess." B. L. Hathorne couldn't think of any other way to describe it. There at the edge of the trees in his backyard, the waters of Bogue Sound had carved away a mighty chunk of sand. Dead trees littered the beach. The slope of the land to the water's edge was bumpy and uneven. Except for a few weeds, there was no vegetation. Hardly a beach-side paradise.

What Hathorne was discovering is something that countless landowners in coastal North Carolina have been learning the hard way: our estuarine shores are eroding.

While man can't stop the rising waters and receding land, he can, with a little ingenuity, slow them down by the judicious planting of marsh grasses.

North Carolina State University botanist Ernie Seneca and soil scientist Steve Broome have been taming erosion with grasses for several years. They began with dunes, then worked on reestablishing marshes and now they've turned their attention to saving estuarine backyards.

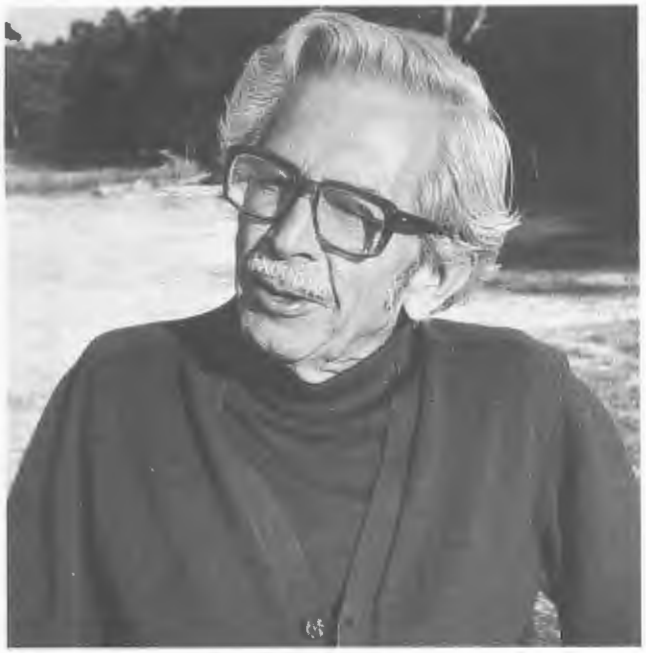
So when the researchers approached Hathorne about experimental plantings in his backyard, he took them up on it. Planted in the summer of 1976, the grasses have already established themselves.

Hathorne's yard, which now gently slopes to the shore, is covered with grass. The grasses have halted erosion. Hathorne says in some places sand has even begun to accummulate. The grasses, he adds, "are obviously doing the job."

Revegetation of the area was accomplished by planting three types of grass. This was a demonstration of the restoration of natural patterns of vegetation and the use of vegetation as an alternative to bulkheading. With time, research shows the planted marsh will acquire all the flora and fauna of a natural marsh.

Trees may help on the beach

can slow sound-side erosion



B. L. Hathorne, homeowner

The cost of planting a strip of marsh grasses along a shoreline is much less than installing a bulkhead. That adds up to a lot of money when prices of $35 to $70 a linear foot for bulkheading are compared to about a dollar a foot for the grasses. Of course, the grasses have the added advantage of creating more habitat for our valuable marine creatures.

Work similar to that done for Hathorne was done at two other homes in Pine Knoll Shores in 1976, at Camp Don Lee near Oriental and along the Intracoastal Waterway to protect an archaeological site for the Corps of Engineers. The researchers have found that while the grasses generally have a high rate of success, they sometimes fail for inexplicable reasons.

So, the researchers are continuing their work in 1977 to determine the factors which influence grass establishment. With that information in hand, property owners will be able to evaluate their own property to determine if the grasses will solve their erosion problems.

Highlights

In 1976, researchers Seneca and Broome:

—Demonstrated the value of salt marsh creation on dredged material. *Spartina alterniflora* plantings on the Cape Fear River have been monitored for five years. Evidence indicates the manmade marsh has taken on all the characteristics of natural marsh.

—Demonstrated the value of transplanted marsh grasses for shore protection. Plantings of *Spartina* have completed three growing seasons. The 50-foot wide plantings have prevented a lengthy bulkhead from being undermined. At several points, elevation has increased as sediment has been trapped by grass.

—Attempted to stabilize eroding shorelines at three residences in Pine Knoll Shores. Two cases proved successful while a third requires additional planting and growing time.

—Stabilized sands along dredge fill beach at Camp Don Lee near Oriental.

—Received 266 requests for information on their work.

Another possibility for harnessing the blowing sands lies in plantings of Japanese black pine. Researcher Ewald Maki of North Carolina State University is testing the black pine to see if the tree can be used for landscaping and shelter on the Outer Banks.

It looks as though the black pines can tolerate salt spray and sand blast damage much better than the native loblolly pine. The spray and the sand blast damage are the major enemies in any effort to establish protective vegetation on the Outer Banks. Despite these two enemies, the black pine manages to retain vigorous green foliage quite near the ocean.

Four experimental plots of the trees were planted from Fort Macon to Kitty Hawk in 1976. Seeds taken from different elevations and latitudes in Japan were used. Preliminary results show mixed success in the test plantings. This may be partially due to the fact that the plants had broken dormancy before planting. The testing is continuing with minigrant support in 1977. Maki is hopeful that the variables can be understood so that homeowners and developers can use the trees to protect themselves and their property from the elements.

An eye on the birds, An eye on the environment

Imagine having to maintain 500 harbors and 25,000 miles of waterways. Keeping sand and sediment from clogging up the nation's harbors and waterways is one of the U.S. Army Corps of Engineers' major jobs.

Worse than imagining the job itself is trying to figure out where to dump all the "spoil," the sand and sediment that are dredged up from the bottom.

"Where we dump is a major problem," says Dr. Handley Smith of the Corps' Waterways Experiment. "It's the number one environmental problem in the Corps." So the Waterways Experiment Station is trying to develop a United States management plan for dredge islands.

It turns out that birds are as interested in dredge islands as the Corps is. Birds are important because they act as barometers of environmental well-being. Since birds are at the top of most coastal food chains, a drop in their numbers can often signal problems farther down the food chain in the estuary. Of course, birds are important coastal tourist attractions, too.

Enter Jim Parnell and Bob Soots, bird lovers extraordinaire. Parnell, of the University of North Carolina at Wilmington, and Soots, of Campbell College, have spent two years under Sea Grant funding doing field studies of birds.

Their aim, after one more year of field studies, is to come up with a baseline count on the number of colonial birds in the North Carolina estuary. That way, future generations will have something to go by in determining environmental well-being through bird counts.

Parnell and Soots discovered in their work that the birds really like the dredge islands. So, for several years, the two have been working with the Wilmington District Corps of Engineers to plan dredging schedules so as not to disturb nesting birds.

They also began working with the Waterways Experiment Station in its effort to tackle the environmental problems of dredge island management. Says Handley Smith, their work "is the most definitive to date. It has been of great value. Were it not for that work we would not have been able to carry on our work without several years of advance work."

Parnell and Soots are assisting with the formulation of a series of research projects designed to determine the nationwide importance of dredge islands to birds. As a direct result of expertise developed during the Sea Grant work, Soots has been employed on a part-time basis by the Experiment Station for professional guidance. Parnell has obtained a sizable research contract from the

Waterways Experiment Station to study the effect on bird populations of diking dredge islands.

Meanwhile, of course, the counting goes on in North Carolina. In 1975, Soots and Parnell perfected a variety of counting techniques designed to avoid disrupting the birds. In 1976, the researchers put those techniques to work counting *all* the colonial birds in the state's estuaries. The 1976 counts may have been somewhat lower than might be expected because heavy rains caused increased mortalities and failure to produce offspring.

And the numbers are:
COLONIAL GROUND NESTING BIRDS (terns, gulls, skimmers, brown pelicans)
Breeding colonies—266
Nests—38,519

WADING BIRDS (ibises, herons, egrets)
Breeding colonies—152
Nests—13,549

After counting one last time in the summer of 1977, Parnell and Soots will compile an atlas of North Carolina colonial coastal birds.

Highlights

In 1976, researchers Parnell and Soots:

—Completed a second year of field studies.

—Completed the first of two full sets of estimates of breeding numbers of all colonial bird species in the North Carolina estuary.

—Became closely involved in formulating, planning, supervising and conducting research funded by the Waterways Experiment Station of the U.S. Army Corps of Engineers.

—Broadened information coming in by coordinating Sea Grant work with a U.S. Fish and Wildlife Service Project.

—Assisted the Wilmington District of the U.S. Army Corps of Engineers in its efforts to protect sea birds from dredging and dredge island diking. In several cases, Parnell and Soots' information led the Corps to decide against diking particular dredge islands. Only one small colony is known to have been lost in 1976.

—Provided information on nesting colonial birds on North Carolina's beaches to personnel at the Cape Hatteras and Cape Lookout National Seashores.

—Received the North Carolina Wildlife Federation's Governor's Award in Environmental Education.

The 'corn fields' of the coast

If our coastal roads were lined with corn or rich fields rather than marshes, then perhaps we could envision how incredibly productive those marshes are.

In fact, estimates of marsh productivity show that the marsh can yield more than twice as much as the most productive agricultural crops. And marshes don't even have to be cultivated.

The marsh is the crucial nursery ground for most of the state's commercially important seafoods. A decade or so ago, there was tremendous development pressure on the North Carolina coast. Jim Brown, of the state's Division of Marine Fisheries, estimates that between five and 10 percent of our marshes were filled in. Scientists are concerned about the effect of marsh filling on seafood production.

Though coastal development has continued, Brown says dredge and fill regulations have put a stop to marsh filling. But he adds that while studies have been done on marsh productivity in other states, relatively little is known about marsh productivity in North Carolina.

To help coastal decision-makers make more informed land use management decisions, researchers for two Sea Grant projects have been taking a look at how marsh productivity directly relates to consumer populations and to what extent consumer populations are able to use the nourishment available in the marsh. This work coincides with work being done by the National Marine Fisheries Service Atlantic Estuarine Research Center in Beaufort.

Researchers Alan Stiven and Ed Kuenzler, of the University of North Carolina at Chapel Hill, in studies of various populations of mussels and snails, determined in 1976 that increasing population density decreases growth. And decreases in detritus inputs—detritus is decaying marsh grass—decreased the amount of consumer growth. Thus there is a relationship between marsh production and primary consumers of marsh detritus. That in turn would have an effect on consumers in the seafood population.

Taken together, these two findings will enable researchers to quantify the value of different marshes.

But the detritus isn't the whole story of marsh productivity. It isn't the detritus itself that is important to food chains so much as the bacteria which live on the detritus. It is these bacteria which nourish the marsh consumers. In 1976, researchers Leon Cammen and Parke Rublee, working with John Miller of North Carolina State University, determined that bacteria counts were much higher than expected on the detritus. The counts indicated bacteria on detritus supports a tremendous amount of life, and that consumers of the bacteria are very efficient eaters. Studies of the worm *Nereis succinea*, which is an important part of the food chain for many fish, showed that the deposit feeder digested about 60 to 70 percent of the bacteria that passed through its body.

The findings provide the link in the detrital food chain that explains how fish and shellfish actually receive nourishment from the marsh grasses.

With the techniques they have worked out and this information, the researchers will be able to define the quality of marsh productivity.

Highlights

In 1976, researchers Stiven and Kuenzler:

—Found *Modiolus* mortality is largely related to the levels of density and food (detritus) in two marshes. This suggests that this population is resource-limited in that it is responding to both increased density and increased detritus.

—Worked with a graduate student attempting to examine some of the controls on *Spartina* productivity.

In 1976, graduate students Leon Cammen and Parke Rublee, working with John Miller:

—Found that they could make direct counts of bacteria using acridine orange stain and epifluorescent illumination. This breakthrough enabled the researchers to find out exactly how much bacteria is on detritus.

—Made direct counts of total bacterial numbers and estimates of bacterial standing crop in a salt marsh and on *Spartina alterniflora* detrital material. These counts, which indicated very high bacterial populations, represent the first application of this method to salt marsh sediments and marsh grass.

—Developed a method for determining the feeding rate of deposit-feeding animals using fluorescent paint as a marker in the gut. Direct counts of the bacteria in gut contents of *Nereis succinea* indicated that about 60 to 70 percent of the bacteria were digested as sediment passed through the worms.

Students tackle real life problems

The halls of academe are fine. But give a student a chance to get out in the real world to work on real life problems and he or she will jump at it every time.

Sea Grant, unlike many university programs, gives students a chance to gain that kind of experience working on bachelor's, master's and doctoral degrees. In turn, Sea Grant benefits from their research and technical assistance.

In 1976, 160 students participated in one way or another in Sea Grant-supported work. Nine of those students worked directly on University of North Carolina doctoral requirements through Sea Grant. Another 16 were able to fulfill master's requirements this way. All 25 are producing theses or dissertations on their Sea Grant-related work. The rest—both undergraduates and graduates—assisted as technicians in program work.

One student, Robert Carrick, of the University of North Carolina at Chapel Hill, received one of three Sea Grant Association awards given nationally in 1976. Carrick was honored for his work on the development of a simple method for the detection of enteric viruses in oysters. Carrick, whose thesis is now completed, worked with Mark Sobsey's project to test the standards that are currently used to determine shellfish safety.

Design student Les Thornbury completed writing, filming and editing a film for Sea Grant on the areas of environmental concern called for in the Coastal Area Management Act. The film, to be shown on public television, explains the coastal environment, its vulnerability and the efforts that are being made to plan development. Thornbury worked on the design project under Sea Grant land use management specialist Simon Baker.

Four of the students who worked on the *Ecological determinants of coastal area management* project are now using their work on the project in their present work. Edwin Chester is an attorney in Portland, Me.; Glenn Dunn is on the staff of the North Carolina Coastal Resources Commission; Roger Pratt has joined the state's Office of Marine Affairs; and Mary Joan Pugh works with the Brunswick County Planning Department.

Among the students fulfilling their graduate requirements through Sea Grant-related studies are:

Cindy Blanck, East Carolina University, is completing a thesis on cypress germination. Blanck was working with researchers studying estuarine erosion. The researchers observed that cypress trees are natural erosion retardants. So Blanck set out to determine, with mini-grant support and the researchers' guidance, what conditions the cypress would require for backyard cultivation.

Parke Rublee and Leon Cammen, North Carolina State University, have worked together on a study of bacteria and the nutritional quality of estuarine detritus. Their work has made tremendous breakthroughs which have enabled them to document the nutritive value of the salt marsh for the first time. Both are working on dissertations explaining their methodology.

Some of the others are working in the food sciences, on fungal diseases affecting aquaculture, on Japanese black pine for stabilization, on offshore circulation patterns and on bird populations.

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GENERAL INTEREST

The metrics are coming. A pocket-size metric conversion chart.

Your home septic system: success or failure? Tips on maintaining conventional septic systems with information on new treatment systems.

North Carolina's underwater harvest. A poster depicting the major fishery resources in the state.

Sea Grant in North Carolina, a report on the University of North Carolina Sea Grant program for 1975.

University of North Carolina Sea Grant College Newsletter. A monthly newsletter on Sea Grant and coastal issues. May be obtained free of charge upon request.

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1235 Burlington Laboratories
North Carolina State University
Raleigh, North Carolina 27607

Project standing -- 1976 and 1977

		Status 1 Jan. 1976	Status 1 Jan. 1977
PROGRAM MANAGEMENT			
MD/A-1	Administration & development, Copeland, Rickards	C	C
COASTAL ZONE STUDIES			
R/CZS-2	Marsh regeneration on dredge spoil Seneca, Broome	C	F
R/CZS-7	Onslow Bay physical studies, Pietrafesa	C	F
R/CZS-8	Shoreline erosion & accretion Riggs, O'Connor	C	C
R/CZS-10	Ecological determinants of coastal management, Brower	N	F
LEGAL & SOCIO ECONOMIC STUDIES			
R/LS-4	Legal aspects of coastal zone studies, Schoenbaum	C	F
R/LS-9	Fresh seafood marketing in N.C., Summey	R	F
ESTUARINE STUDIES			
R/ES-18	Detritus-based food chains, Stiven, Kuenzler	C	F
R/ES-19	Bacteria and the quality of detritus, Miller	C	C
R/ES-20	Coastal bird populations, Parnell, Soots	C	C
R/ES-22	Detection methods for enteric viruses in shellfish, Sobsey	N	C
FOOD FROM THE SEA			
R/SST-1a	Fish muscle properties, Hamann, Webb, Thomas, Miller	C	F
R/SST-1b	Crab meat quality, Hamann, Webb, Thomas Miller	C	F
R/SST-3	Hazardous microorganisms in seafood, Speck, Ray	C	C
R/SST-4	Seafood contaminants, Giddings	N	C
R/AF-5	Eel aquaculture, Rickards, Jones	C	C
R/AF-6	Fungal diseases of aquaculture, Bland	N	C
EDUCATION & ADVISORY SERVICES			
A/EA-1	Land use advisory services, Baker	C	C
A/EA-3	Continuing education for fishermen, McGee	C	C
A/EA-4	Seafood advisory services, Thomas, Miller	C	C
A/EA-6	Recreation advisory services, Abbas	N	C

N—Project initiation
C—Project continuing
R—Project redirection
F—Project completed

Sea Grant budget--1976

	NOAA Grant Funds	State Matching Funds
Marine resources development		
Living resources other than aquaculture	40,518	22,914
Marine law and socio-economics	7,411	8,004
Marine technology research & development		
Resources recovery & utilization	67,818	36,102
Marine environmental research		
Research & studies in direct support of coastal management decisions	46,219	46,604
Pollution studies	28,163	10,990
Environmental models	43,329	21,413
Advisory Services		
Extension programs	153,467	84,317
Other advisory services	5,628	3,160
Program management & development		
Program administration	142,447	33,996
TOTALS	**535,000**	**267,500**

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, William A. Johnson, chairman. William Friday is president. The University's Council for Marine Science, chaired by E. Walton Jones, UNC associate vice-president for research and public service programs, coordinates university marine science programs, including Sea Grant.

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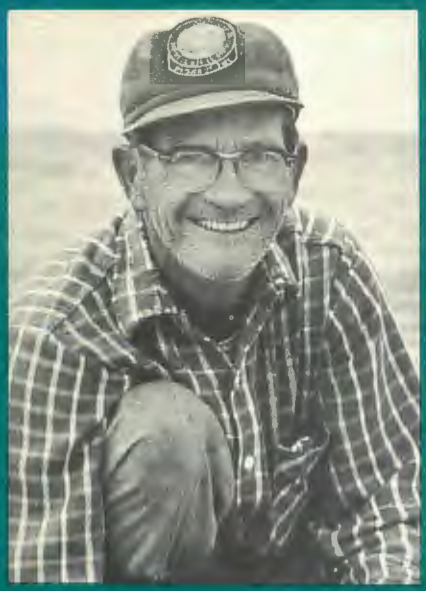

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