Sea Grant in North Carolina

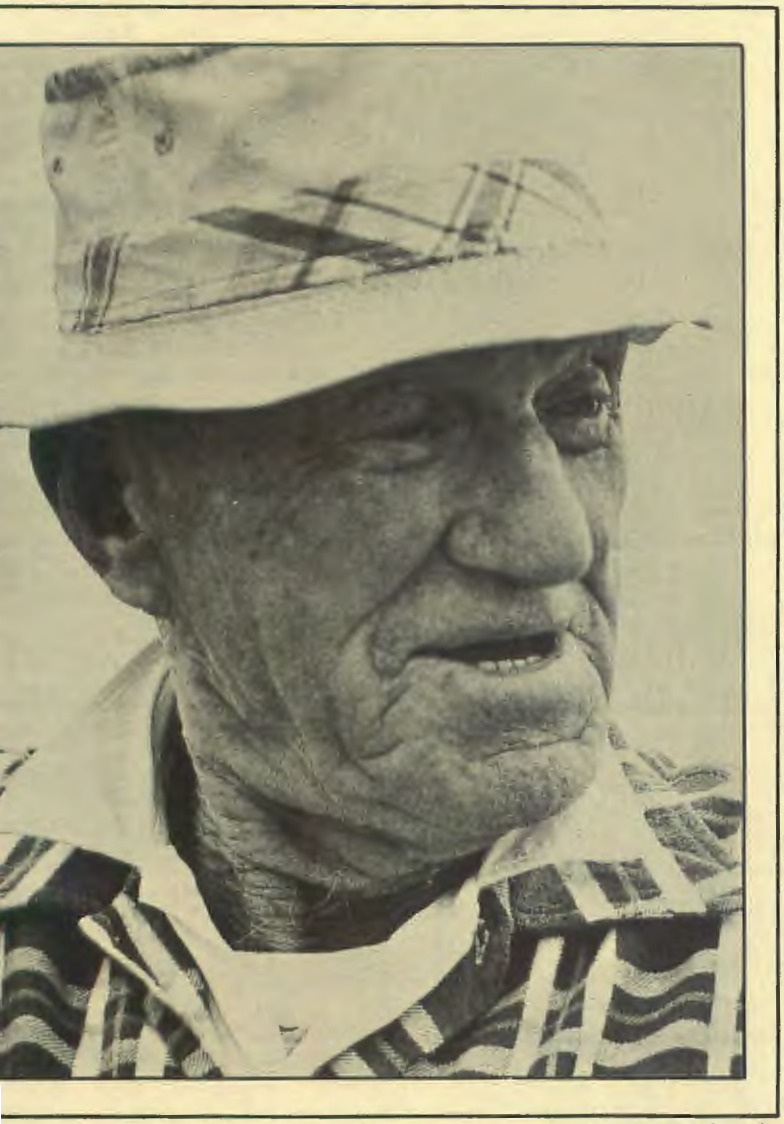
A report on the University of North Carolina Sea Grant Program for 1975

Inside

There's something about Lawrence Austin's hands that brings to mind the weather-worn live oaks outside his frame house there in Hatteras village.

It strikes you as he tromps through his yard, pointing with hands and fingers that are strong, but slightly misshapen, to the gnarled and twisted limbs of those hearty oak trees.

The more you watch Lawrence Austin's hands and hear him talk about 55 years of fishing and "back days" before



Lawrence Austin

motors came to the island, the more you realize his kinship—not only to the trees that so fascinate him—but to his whole environment. Eighty one summers and as many winters on Hatteras Island seem to have given Lawrence Austin something of a sixth sense about the forces that have shaped his life. It's a sense that probably was necessary for survival in earlier days.

Austin's son, Lawrence Lee, has followed his dad's footsteps. He lives at the old home place and even looks like his dad. And he depends on fish for his living.

But unlike his father, he doesn't appear to rely so completely on intuition. Younger Austin has machines and motors and gadgets—all of which make fishing easy by his dad's standards.

And maybe even more important, younger Austin has better communication with the world off the island. Communication has opened up a cache of information on new and better ways of doing things.

Certainly one source of information for the Austins over the past five years has been the University of North Carolina Sea Grant Program, a program with two features that make it outstanding among university and government agencies serving the coastal public. It has access to information useful to North Carolinians developed in Sea Grant Programs here and around the nation. And its advisory services agents work with the coastal public on a face-to-face basis.

Some things have changed for Lawrence Lee Austin since Sea Grant agents began working with him:

—During 1975, he harvested and sold for a good profit his first "crop" of home-grown clams. He and Sea Grant advisors have worked for the past several years to learn techniques for successfully farming clams in shallow sound waters. Income from the 1975 harvest was small, but Austin is encouraged and plans to enlarge his operation.

—For the past several years, Austin has been able to sell his fish to the state's first fishermen's cooperative where he says he gets a better price for his catch. Sea Grant advisors assisted fishermen in organizing the cooperative.

—As a fisherman, Austin knows well the hard work of pulling in heavy nets and pots. But by working with Sea Grant agents to test hydraulic power on North Carolina fishing boats, he got a taste of fishing made easy. Hydraulic systems introduced to the state's fishing community by Sea Grant advisors are already being installed on some boats.

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 1975.□

Sea Grant in '75

A year devoted to "people problems"

Two touchy issues

Environment and economy

For the first half of the 70s, talk has been about the environment and the economy—two issues that really touch people.

Sea Grant is a program that speaks to both in the coastal region of North Carolina.

During 1975, more than in any year since Sea Grant became part of the University of North Carolina in 1970, program researchers and advisory agents responded to the environmental and economic needs of coastal North Carolinians.

For example:

—Owners of a Belhaven fish processing plant credit Sea Grant advisers with guiding them to fillet and freeze instead of simply packing fish in the round. They're pleased that their plant will probably turn a profit by the time they celebrate its first anniversary.

—Coastal waterbirds, a favorite among tourists and a barometer of environmental quality, are now given special consideration in U.S. Army Corps of Engineers dredging schedules and management plans, largely because of information on the birds supplied by Sea Grant biologists.

—A major new eastern North Carolina eel fishing and exporting industry has gotten off the ground with extensive technical and scientific assistance from Sea Grant advisory services agents.

—Carolina Power and Light Co. is saving money and helping

Sea Grant research--
most folks would call it "practical"

maintain water quality by using marsh grasses to stabilize eroding intake and discharge canals at its Brunswick nuclear power plant in Southport. The company used planting techniques developed in Sea Grant-supported research.

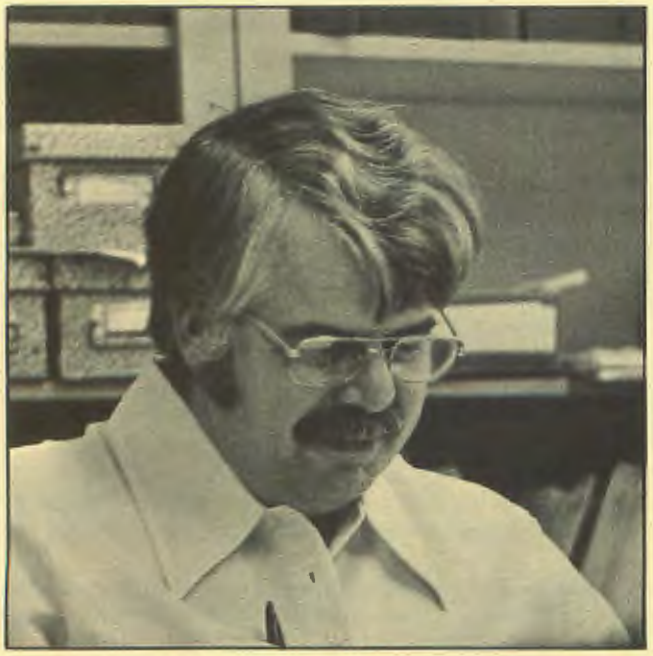
It doesn't take a very close look to see that the research Sea Grant does is what most folks would call "practical." That is, it can be used by somebody to make life better.

But before it can be put to use, people have to hear about research findings. And Sea Grant has the network to insure they do. Advisory services specialists cover the state's coast armed with information of use to eastern Carolinians.

Those same specialists also serve as a link between coastal citizens and the universities. As people turn to Sea Grant advisors with their specific environmental and economic needs, those needs can become the subject of research on university campuses. Sea Grant's direct

From the director

Dr. B.J. Copeland

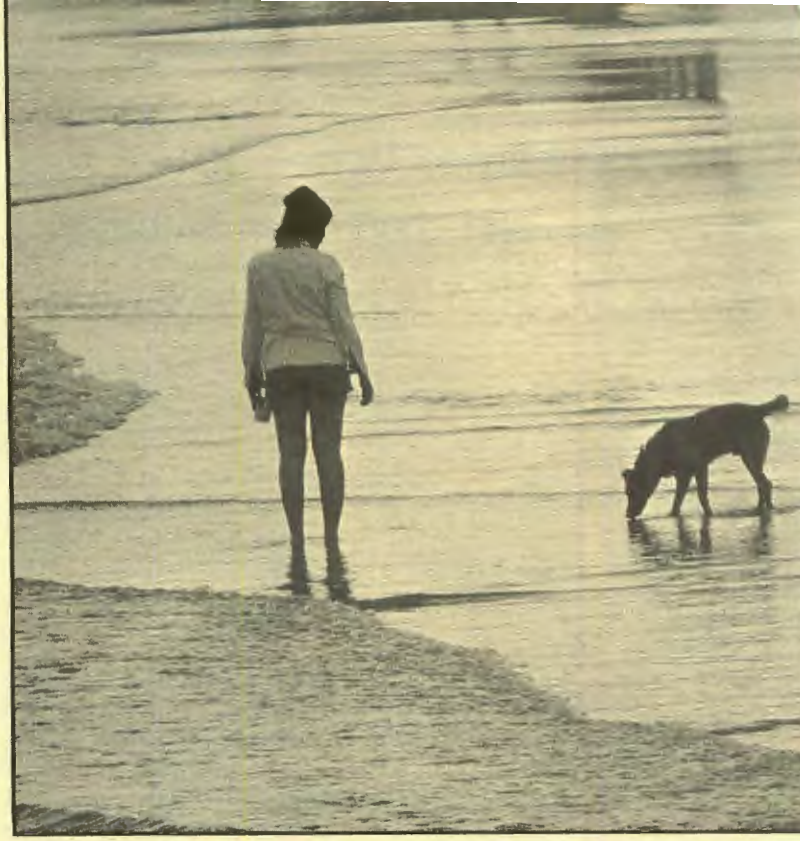


This report details the accomplishments of Sea Grant's fifth year of institutional support within the University of North Carolina. We think the UNC program has made significant progress toward achieving the level of productivity indicative of a Sea Grant College.

Communications and interactions with state agencies have continued to strengthen over the years. These strong ties have enabled us to be more responsive to priority needs and, more importantly, have given us the mechanism to identify and develop relevant research and advisory efforts for the present and future. Significant in helping plan future efforts was the publication of a research and advisory planning document that sets priorities for coastal resource problems in a five year perspective. The document, published in 1975, was developed through interaction of the university, government agencies and user groups. We consider this kind of planning a continuing exercise, in which adjustments are made as needs and emphases change.

One of the more significant developments in the coastal scene during 1975 has been the increasing awareness and expanding desires of the citizenry to know more about the coastal zone, its problems and how its resources may be better used and conserved. Sea Grant has played a significant role in developing this heightened interest through our communications and advisory services networks.

Sea Grant advisory services -- face-to-face contact



contact with the coastal public through its agents is a unique feature that no other university or government program can boast.

Of course some questions take longer to answer than others. During 1975, Sea Grant supported 22 research and advisory services projects at N.C. State University, East Carolina University and on University of North Carolina campuses at Chapel Hill and Wilmington.

Many of Sea Grant's longer term research projects are yielding data useful to state and federal agencies which make decisions affecting thousands of people today and in the future.

For example:

—Data collected on offshore water circulation patterns in one Sea Grant study will help local and state officials make decisions about the wisdom of disposing of sewage in the sea off North Carolina.

—State and local government officials carrying out requirements of the state's Coastal Area Management Act are using information developed in Sea Grant studies of shoreline erosion and the legal implementation of coastal management plans.

Often coastal and marine questions can be answered quickly and inexpensively if funds are available when the questions arise. An increase in discretionary funds for 1975 gave Sea Grant the flexibility to fund projects aimed at solving immediate problems and yielding fast results. Here is a brief rundown of these projects:

—Dick Barber, a Duke University ecologist, studied the impact of drainage from an eastern North Carolina superfarm on estuarine water quality. His findings, which are of value to the state's division of environmental management, showed that conversion of swampy timberlands to agriculture seemed to have little effect on the quality of estuarine waters. Barber noted that the volume of run-off had not significantly changed but that the timing of run-off had. He also recorded a slight increase in nutrients in estuarine waters during run-off periods. Barber is continuing his study into 1976.

—Jim Easley, extension economist at NCSU, began adapting a computerized record-keeping system already in use by many farmers to the needs of fishing vessels. Tarheel boat owners who take advantage of the system when it becomes available in mid-76 should find business management and tax record-keeping easier and more accurate.

—Joe Ustach, NCSU zoology graduate student,

We have continued to develop closer ties with other coastal programs such as the Coastal Plains Center for Marine Development Services in Wilmington and coastal zone management. By all working together, we are using this heightened citizen awareness to develop a program that targets in on relevant problems.

This year, more than ever before, Sea Grant was better able to respond to immediate needs. This response was made possible by an increase in funds for short-term projects dealing with immediately critical problems. A good example is a project that is pulling together ecological determinants of coastal ecosystems and planning and management alternatives. The product of this work will be a handbook of use to local governments and state agencies charged with implementing the state's Coastal Area Management Act. Initiated with short-term project funds in 1975, this work should be completed in mid-1976, just when implementation is set to begin.

Sea Grant's higher level of recognition in North Carolina has increased its responsibility to tackle coastal problems on a broader scale. Because we have dared to become involved, we are counted on more than ever to be leaders in answering relevant questions concerning the use and conservation of North Carolina's valuable and unique coastal area. We look forward to 1976 in accepting the challenge of furthering the Sea Grant concept in North Carolina.

Flexibility to tackle long- and short-term problems

in a study of the effects of oil on the reproduction of copepods (small animals) in salt marshes found that oil spills could have a lingering effect on animal populations. His research showed that very low concentrations of crude oil reduced reproduction of the copepods directly exposed and even influenced the reproduction and growth of offspring. These findings are helpful in judging the impact of oil spills.

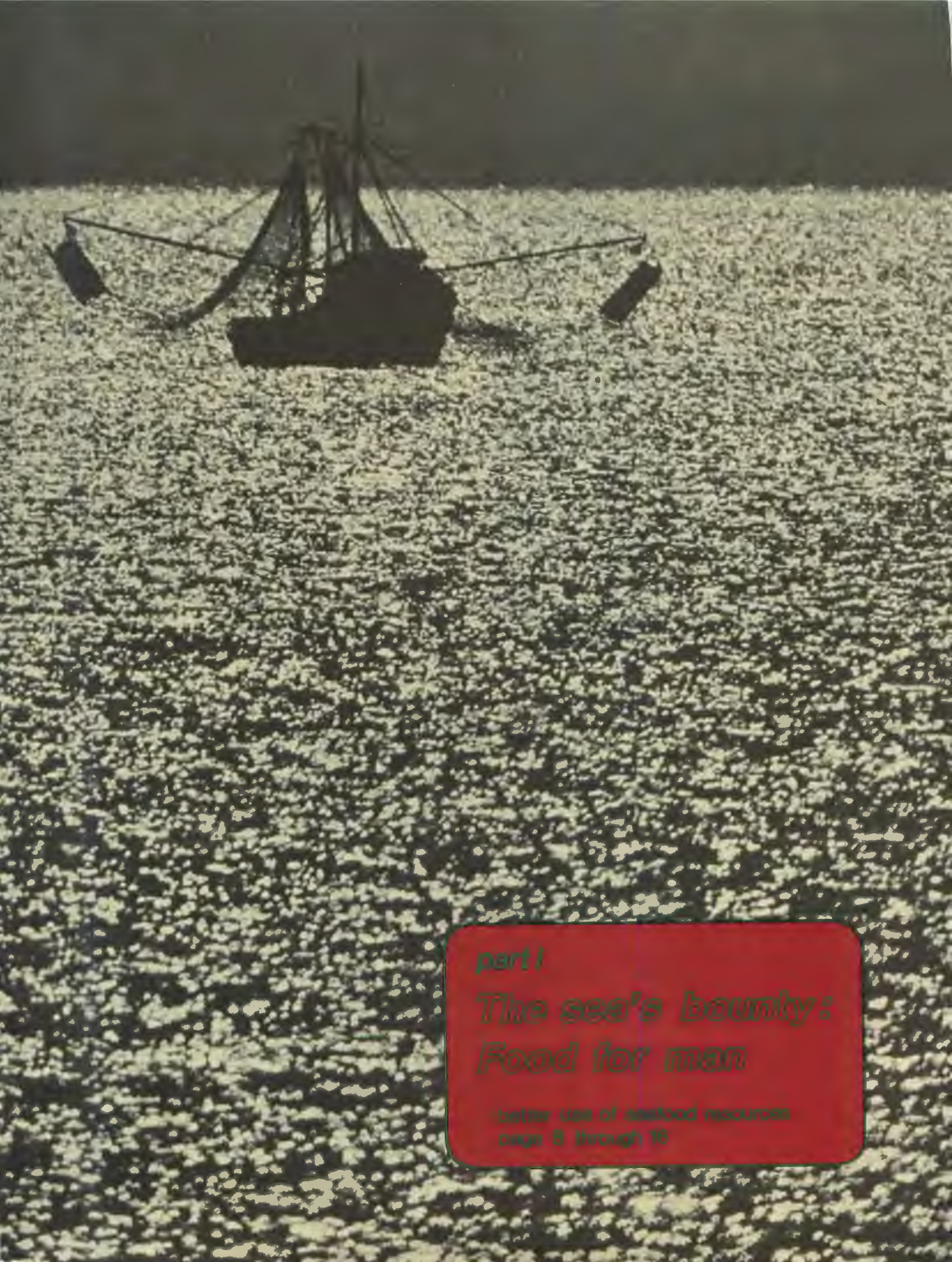
—L. E. Pietrafesa, NCSU oceanographer, reviewed the literature on offshore circulation and dispersal in the North Carolina offshore area. His review enables researchers to plan research to fill gaps in knowledge.

—In an associated study, Allen Weber, NCSU meteorologist, undertook to determine the effect of winds on offshore water circulation. Wind data is necessary in predicting and computing where effluents in the offshore area would travel.

—A grant to Simon Baker, Sea Grant land use advisory services agent, made it possible for him to employ Les Thornbury, NCSU design student, to begin production of an educational film on coastal ecological systems. Because of early funding, the film should be completed and shown while coastal citizens are making decisions about future land uses.

—David Brower of the UNC-CH Center for Urban and Regional Studies received two project grants. In one study he examined and produced a report on the tools governments can use to insure the public's access to the beach. In the other, he began work on a report that ties coastal management schemes to the specific environments which are to be managed. He calls it coastal management based on ecological determinants.

—Milton Heath of UNC's Institute of Government researched the legal aspects of development in the zone between three and 12 miles offshore. Under the same grant, David Rice examined the legal aspects of "taking" that may occur under coastal zone management.□



part I

The sea's bounty: Food for man

better use of seafood resources
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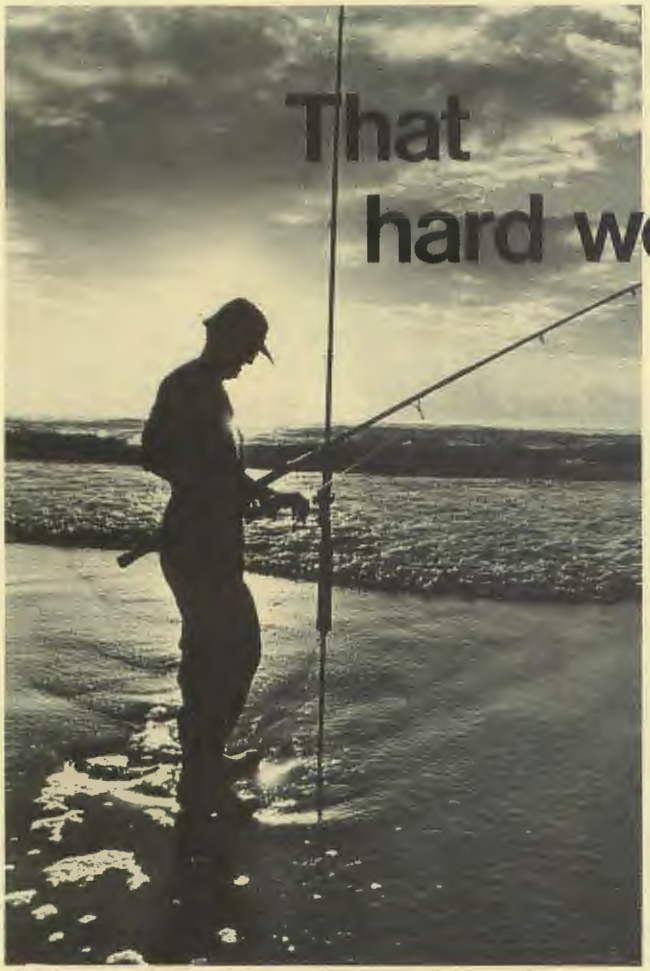


That hard working fisherman

Making his job easier

It just doesn't seem right. Here we are in an age of labor-saving machines. But somehow fishermen today seem to work as hard as ever. They don't have a lot of gadgets to make their jobs easier.

But to the thinking of Sea Grant advisory agents, it's time those hard-working souls got a break. This year they introduced Tarheel fishermen to the wonders of hydraulic power—a source of energy that can be used even on small boats. Some are saying it almost takes the work out of fishing.

Already at least three North Carolina fishermen are so sold on hydraulics that they've bought their own—and others say they intend to in the future.

Jimmy Meekins of Stumpy Point is one who worked with Sea Grant advisors Jim McGee,

Jimmy Meekins

Sumner Midgett and Hughes Tillet to test hydraulics in North Carolina and was sold. Besides saving work, Meekins believes hydraulic power will also give him more time to fish and fewer headaches. "It's almost trouble free," he says, adding that if something breaks down on his boat now, he has to waste at least a day getting a welder or going to Norfolk or Elizabeth City for parts. "When you're trouble free, that saves a day's work," he says.

Hydraulics: ". . . almost trouble free . . . that saves a day's work" — Jimmy Meekins

Besides that, Meekins explains, he'll be able to save money by eliminating a crew member.

Sea Grant advisory agents also believe fishermen could use more options on how they make their livings. Instead of going out in boats to haul in wild clams and oysters, why not grow them yourself in shallow sound waters where you can simply walk out to harvest them? they asked. For three years, the agents have sought the tricks of successful clam gardening and this year they branched into oyster culture.

Lawrence Austin of Hatteras, a fisherman with whom they've worked, marketed his first homegrown clams in 1975. He sold clams, that cost one cent each when they were planted, for eight cents to a local restaurant. Austin expects to expand his farm and has gotten permission to lease several acres of bottom to do so.

Midgett and Tillet continued supplying helpful information to the Tarheel fishing community by stocking 20 information/literature racks located in places convenient to fishermen and by regularly operating a mobile library throughout the state's coastal counties.

A guide to hangs and other bottom obstructions which Midgett and Tillet published is helping boat captains avoid costly damages. The log, compiled with the help of commercial fishermen, will be continuously updated.□

highlights

During 1975, Sea Grant agents working with commercial fishermen:

—convinced at least three fishermen to try hydraulic power on their boats;

—provided technical know-how to coastal residents who are cooperating with the agents in nine clam culture projects;

—began two cooperative oyster culture projects in Pamlico Sound waters;

—answered well over 100 requests for specific information relating to fishing technology;

—supplied some 350 requests for copies of a guide to hangs off the Carolinas and Georgia coasts to trawler captains;

—distributed several thousand pamphlets covering a wide range of marine related topics by regularly stocking 18 display racks and operating a mobile library throughout the coastal area.

In addition, they conducted the following workshops:

—hydraulic powered systems for small boats and backyard clam farming. Weeksville. 17 attended;

—twin trawl shrimping and vessel electrical systems. Manteo. 55 attended;

—hydraulics and pair trawling. Manteo. 34 attended;

—electric shrimp trawl. Hobucken. 25 attended;

—electric shrimp trawl. Salter Path. 28 attended.

Seafood processing

Growing and getting better

It had been a slow week at Sea Safari. Bad weather had kept fishermen in—and there were no fish for the Belhaven processing plant to buy.

But Mae Reinhardt's eyes still sparkled. In just a few months, Sea Safari would celebrate its first birthday and by then, she said, the plant would probably be in the black. For Reinhardt and other company owners—none of whom knew much about the seafood business a year ago—Sea Safari's success is a gleaming accomplishment.

Mae Reinhardt

Actually, Reinhardt confessed, when she and Topper Bateman and other owners ventured into the seafood business, they put their first efforts into the dock, a large slab of concrete that juts out into the Pungo River behind the plant.

But before they got too far along, Sea Grant seafood advisory agents came by to offer their thoughts on the matter. "They're the ones that steered us in the right direction," she said. "They showed us that what was needed was a plant for filleting and freezing, not just another house to pack them in the round."

A year ago, the Sea Safari building was only a fraction of its present size and served as a motor oil warehouse. Since then the warehouse has been converted to a cooling room where fish are held when they come to the plant. In the addition that was built on three sides of the old warehouse stand washing bins, a mechanical scaler and shrimp deveiner, cutting and packaging tables and a large freezer—all carefully laid out for efficient flow between processing steps.

Sea Safari is one of 15 new fish and shrimp handling and processing plants which advisory agents have assisted in one way or another in the past three years. The new plants, they say, are worth about $2.5 million and offer some 130 new jobs to coastal residents. And 18 finfish and shrimp processing plants have spent almost $0.9 million expanding or renovating since 1971, all of them following recommendations made by the Sea Grant team.

Better quality crab

During the year they also assisted 16 crab plants in redesigning the flow of crab in processing to assure a cleaner, better quality product. Their efforts with processors like Laurin Jarvis, manager of Engelhard Shrimp, Fish and Oyster Co., are helping the industry meet stricter government regulations. One new requirement is that cookers be built to extend into cooling rooms so that cooked crab will not be exposed to flies.

"They helped in explaining the specifications and gave me a rough idea of what I had to have," Jarvis says, adding that he "took it from there . . . Sea Grant advisory agent Ted Miller helped lay out the design of a new cooker with two doors—one to put the crab in, the other to take it out," he explains. Jarvis has a lot riding on the quality of his crabmeat. Anyone whose motto is "Crab Meat our Specialty" does.

Back at the Seafood Lab in Morehead City, advisory agents continued answering questions from a wide audience on many aspects of seafood handling. A dozen Carteret County homemakers, called Nutrition Leaders, continued monthly work sessions at the lab as they sought new uses for seafoods and tested a variety of seafood preparation methods.

Gene Crow, advisory agent who assumed responsibility for questions relating to wild eel harvesting, provided information to more than 130 interested persons, many of whom are now making extra income fishing for the slippery fish.

Estimates are that two million pounds of eels were harvested in 1975 from North Carolina waters. With fishermen getting up to 55 cents per pound for their catch, harvested eels represented significant income to North Carolinians.□

highlights

Sea Grant seafood advisory agents report that in the past three years they have provided direct assistance in plant design and processing technology to 40 finfish and shrimp processing plants. This includes:

—15 new finfish and shrimp processing plants valued at $2.5 million;

—18 finfish and shrimp processing and handling plant renovations and expansions valued at $0.9 million;

—16 crab processing plants, including one new, all valued at $200,000.

Building eel pots: one part of a growing eastern North Carolina business.

Eel exporting

A promising new coastal business

You probably don't know what it takes to get an eel ready for sale. And more than likely, you don't even care.

But if you were in Gene Ballance's shoes, you would. And you'd be seeking new and better ways to prepare the long, slippery fish for market, just like he did this year.

Ballance, manager of East Carolina Industries, a migrant laborers' cooperative in Fairfield, is knee-deep in the eel exporting business. This year, the cooperative exported several thousand pounds to mark its biggest year to date.

Almost every eel that left Fairfield in 1975 was frozen and tied in a mass of knots. Europeans demand that eels be frozen alive—and that causes the fish to knot.

But many of the eels that leave Fairfield in 1976 are in for a shock—literally. They will be frozen. But before they are, they'll be set straight with a few volts of electricity. As Ballance sees it, eels that lie flat instead of knotted will be more compact, easier to package and cheaper to ship. Besides that, overseas buyers may get a better quality product, one that is easier to thaw and prepare.

Ballance worked with Sea Grant seafood advisory agents Gene Crow, Ted Miller, Dave Hill and Frank Thomas to figure out how to go about electrocuting eels. Even though the technique was developed late in the year, Ballance says he's already had orders from Japan for electrocuted eels.

Assistance Sea Grant advisors provided to develop this new processing method is one example of the kind of help they have given as East Carolina Industries became North Carolina's top eel exporter.

A couple of years ago, they helped train the co-op's officials in pot construction. Now migrant laborers build hundreds of pots each year which they sell to commercial fishermen from North Carolina to Florida.

Subsequently East Carolina Industries acquired a tank truck designed with Sea Grant assistance which they use to pick up live eels from fishermen. In 1974, the Sea Grant team assisted in planning for a freezer. The freezer enabled the cooperative to expand into exporting.

Agents have also assisted in marketing by providing an analysis of the fat content of eels throughout the year. Europeans prefer fattier eels than do Japanese, Ballance says, and knowledge of fat content aids marketing. □

During 1975 they provided information and assistance in harvesting and handling wild eels to more than 130 individuals. They estimate that some two million pounds of wild eels were harvested from North Carolina waters during the year. In North Carolina wild eels sold for around 50 cents per pound.

This year advisors continued providing technological assistance to East Carolina Industries, North Carolina's major eel exporter. Advisory agents in 1974 had helped the cooperative install a freezer to aid in exporting eels. During 1975, East Carolina Industries recorded its biggest export year to date.

Fish is better-tasting and safer to eat if handled carefully. Researchers are seeking improved ways to detect potentially dangerous bacteria and changes in processing that will make for safer seafoods.

Making seafoods safer...

...and putting them to better use

Almost everybody has known the "joys" of a good case of food poisoning. Seafood that's "gone bad" often gets the blame. But actually, tiny bacteria that beat you to the seafood are often the culprits.

One Sea Grant project this year focused on learning more about those tiny culprits in seafoods. Two others examined additional aspects of seafood quality and use.

North Carolina State University food scientists M. L. Speck, B. Ray and N. B. Webb began research to determine the quantities and kinds of disease-causing bacteria found in seafoods and the effects of cold storage on these microbes. A major aspect of their work was devoted to developing improved methods for detecting pathogenic bacteria subjected to low temperature storage.

As it turns out, those tiny one-celled animals are a hearty group. Bacteria may continue to live in some seafoods under refrigeration—and some even survive frozen storage. Often bacteria which are only injured in cold storage are not detected by conventional methods. But when they are warmed in cooking, the injured bacteria can repair to full strength.

Scientists Speck, Ray and Webb found in tests that involved contaminating different seafoods with a variety of bacteria that most of the study

microbes died off during cold storage. Results indicated that some bacteria are more susceptible to low temperatures in some seafoods than in others.

They also made significant progress in developing better methods for detecting the pathogenic bacterium *Vibrio parahaemolyticus* in seafoods. *Vibrios* is reported to cause up to 70 per cent of all bacterial food poisonings in Japan.

To develop detection methods, researchers seek media (or mixtures) in which the bacterium under study will quickly grow and recover from injury so they can be more easily detected.

Fish coldcuts? Researchers are testing minced fish for use in bologna-like products.

The Sea Grant team found that the medium trypticase soy broth (TSB) promoted greater recovery and repair of *Vibrios* than the conventionally used medium TSB plus salt. Use of TSB could dramatically increase detection of *Vibrios* subjected to frozen storage.

Researchers are testing TSB as a possible detector of other disease-causing bacteria. They say their results are aiding in the development of a relatively simple, but more accurate, method for detecting pathogenic bacteria in seafoods. It all adds up to greater product safety for consumers.

A third aspect of research under the project sought to determine the quantities and kinds of pathogenic organisms found in a variety of finfish and shellfish collected from processors and retailers. Further studies in 1976 will provide more definite quantification of these.

Improved crab quality

In another Sea Grant project related to safer seafoods, researchers N. B. Webb, F. B. Thomas and T. M. Miller surveyed the types and levels of microorganisms occurring at various points in blue crab processing. Samples from commercial and pilot processing operations were examined for microbial contaminants. Results indicate that types and levels of bacteria in fresh crab meat are important in determining the product's shelf life.

Findings which indicate that greater microbe control is needed and can be attained should help the state's blue crab industry improve the quality and extend the shelf life of its products. This data should also be helpful in improving sanitation in the industry.

Disease-causing microbes aren't all Sea Grant seafood researchers from N.C. State University had their eye on in 1975. They also took a close look at the changes crabmeat undergoes during frozen storage. According to Webb, when you chew a bite of crabmeat that's been frozen, water separates out of the meat, leaving it dry and chewy and detracting from its original good flavor. He and his co-investigators want to figure out why.

New seafood products

In another Sea Grant project, Webb, Thomas and Miller examined the functional properties of deboned fish meat. They are trying to determine if minced tissues from flounder, trout, mullet and other species will stick together. They can see deboned fish being used in cold cuts similar to bologna if it has the right functional characteristics. This research, and tests to determine the effects of washing minced fish, should help in the development of new seafood products.

One minced fish product, seafood pizza, got a favorable response from consumers who sampled it in 1975. Other applied research, carried out largely through the Seafood Lab in Morehead City, focused on new products from eel, squid and menhaden.

A series of publications based on the seafood science research are proving useful to the state's seafood processing industry. One deals with using deboned fish in seafood patties. The other focuses on seafood processing and marketing.□

An Engelhard crab picker

Marketing the North Carolina catch

North Carolina seafood on its way to market.

Paul Allsbrook must feel like he's in the grips of a very big monster—one that's too big to see in a single glance.

Allsbrook is North Carolina's man in charge of helping the state's seafood industry increase the number of people buying its wares. His job at the N.C. Department of Natural and Economic Resources is to help carve new channels for seafood to flow from the Tarheel coast.

The industry he's working with—made up of hundreds of dealers and processors of every size—is highly fragmented. Potential seafood markets are vast. And bringing all the sellers and buyers together isn't easy.

Part of Allsbrook's problem—one shared by fish dealers and processors—lies in a lack of information on where seafood now goes. Some say most of the catch goes to New York. Others point to Hampton, Va. Almost no one seems to think Tarheel fish go directly inland to Tarheel tables.

A study of seafood marketing channels by East Carolina University School of Business professors John Summey and Roswell Piper should soothe Allsbrook's headache. He seems to be feeling some relief already. "Their work on the coast is invaluable to me," Allsbrook says.

Basically Summey and Piper are finding out where the N.C. catch goes and who the middlemen are. They're also looking for inefficiencies in marketing channels.

Already they've surveyed coastal seafood dealers to find out whether fish are sold fresh, frozen or further processed and, most importantly to Allsbrook, where fish go from their plants. Preliminary results seem to discredit widely-held beliefs. They show that large quantities of fresh seafood move to inland North Carolina.

In early 1976, Summey and Piper will survey inland dealers to find out where they buy their fish.

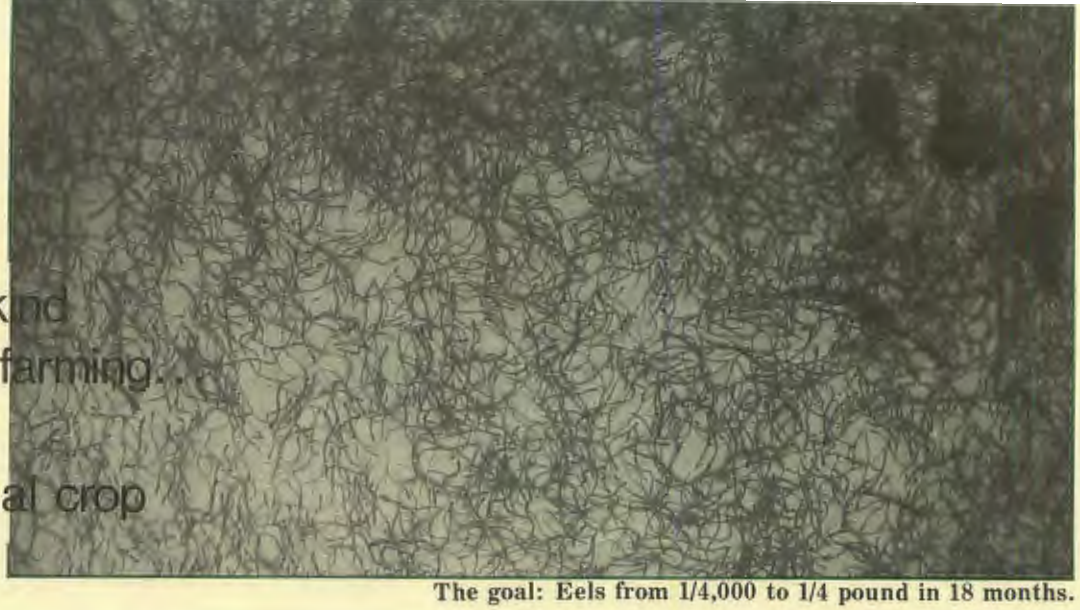
According to Allsbrook, knowing where fish go —and where they don't go—is helpful in establishing new markets. "After they complete their surveys, we can be more specific with processors in helping them sell to new markets," Allsbrook says.

New markets should produce benefits for fishermen, as well as processors and dealers, Allsbrook points out. "The more orders we can find, the better price we can get," he says.

Information on the availability of fish and distribution patterns, also to be gathered in the study, should provide useful information to potential investors in the state's seafood industry, researchers say.□

A new kind of farming...

...an unusual crop



The goal: Eels from 1/4,000 to 1/4 pound in 18 months.

Jack Smith and Jim Griffin don't foresee a pot of gold at the end of their first year of eel farming. But they do think it's going to become a money-maker for Laurel Hills Plantation, a division of Blue Channel Co. in Beaufort, S. C.

"It's not going to be like going out and picking money up off the street," Smith says. "But it seems economically feasible."

Laurel Hills' venture into eel culture is strictly new in this part of the country. The demand for eel overseas, coupled with a favorable environment here that supports the growth of an abundance of the slippery fish, seem to present perfect circumstances for a profitable new industry. "There seems to be more of a market than we can supply," Griffin notes. "It doesn't look like we would overload the market supplying two to three million pounds a year."

To help pave the way for eel farming in the Carolinas and the Southeast, Sea Grant during 1975 supported an eel culture project near New Bern on Weyerhaeuser Co. land. Researchers Walt Jones, John Foster and Bill Rickards will continue in 1976 ironing the kinks out of growing tiny young eels, or elvers, weighing about 1/4,000 of a pound at capture, to a marketable size of one-quarter to one-half pound in 18 months.

Just one year into full operation, Sea Grant's eel farm has already provided useful information to people interested in farming eels, including Smith and Griffin. "Mr. Jones has been a big help in pond construction and maintenance and with the feeding program for elvers," Smith says.

Jones, Foster and Rickards feel they made major progress this year in controlling diseases attacking eels and in diet and feeding. After losing one group of elvers to disease, they discovered that a switch from Neuse River water to well water in the ponds helped prevent disease. So far, they've successfully treated fungal infections with chemicals. Investigators also developed a new feeding tray that cuts down on wasted food and reduces pollution caused by decaying food.

Interest in farming eels has been widespread. Jones, Foster and Rickards estimate they've given some 500 people information on the project.□

highlights

Researchers at the eel farming project are studying disease control, diet, feeding, pond construction and elver capture.

This year they:

—assisted at least three companies which have ventured into eel farming for profit;

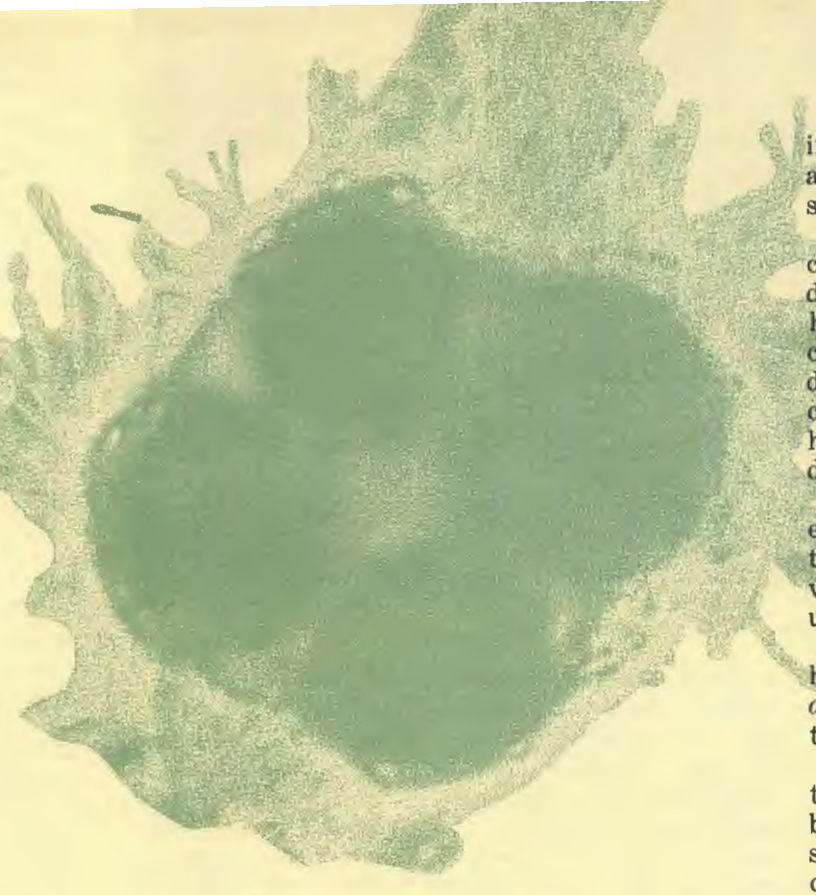
—expanded to four outdoor holding ponds and seven elver holding tanks to enable more complete research;

—developed an improved feeding tray;

—substituted well water for Neuse River water and got healthier eels;

—provided information on eel farming to some 500 people.

Researchers Rickards and Jones collect elvers from a coastal stream.



Treatments to control disease in aquaculture

To most folks, fungi are microscopic something-or-others that old Miss Logan breezed over one day in high school biology. They cause ailments like athlete's foot and ringworm, she probably said.

She should have added that there are more than 50,000 species of fungi known to man and many of these can be deadly to organisms they attack. So far only about 500 fungi from the sea have been described and fewer than 25 of those are known disease-producers.

With man seeking to increase food supplies by growing shrimp, lobster, crabs and other marine animals in aquaculture, knowing more about disease-producing fungi in salty waters is essential. Some fungi are so powerful they can wipe out an entire population of shrimp or crabs growing in confined spaces in only a matter of hours.

Dr. Charles Bland, East Carolina University biologist, is something of a modern-day pioneer in identifying and finding controls for fungi that infect such marine crustacea as shrimp, lobster and crabs. Sea Grant has supported Bland's research since 1970.

During 1975, he made major progress in finding chemicals that control a particularly abundant and devastating fungus called *Lagenidium* without harming crustacea it attacks. Bland found that two compounds—malachite green and DS 9073—of a dozen he tested may be useful in preventing or controlling *Lagenidium*. Both, Bland reports, are highly toxic to the fungus at concentrations that don't appear to bother crustacea larvae.

Before these compounds can be used outside of experiments, Bland warns, research must be done to show their long term effects on crustacean development and on levels of the chemicals that wind up stored in their body tissues.

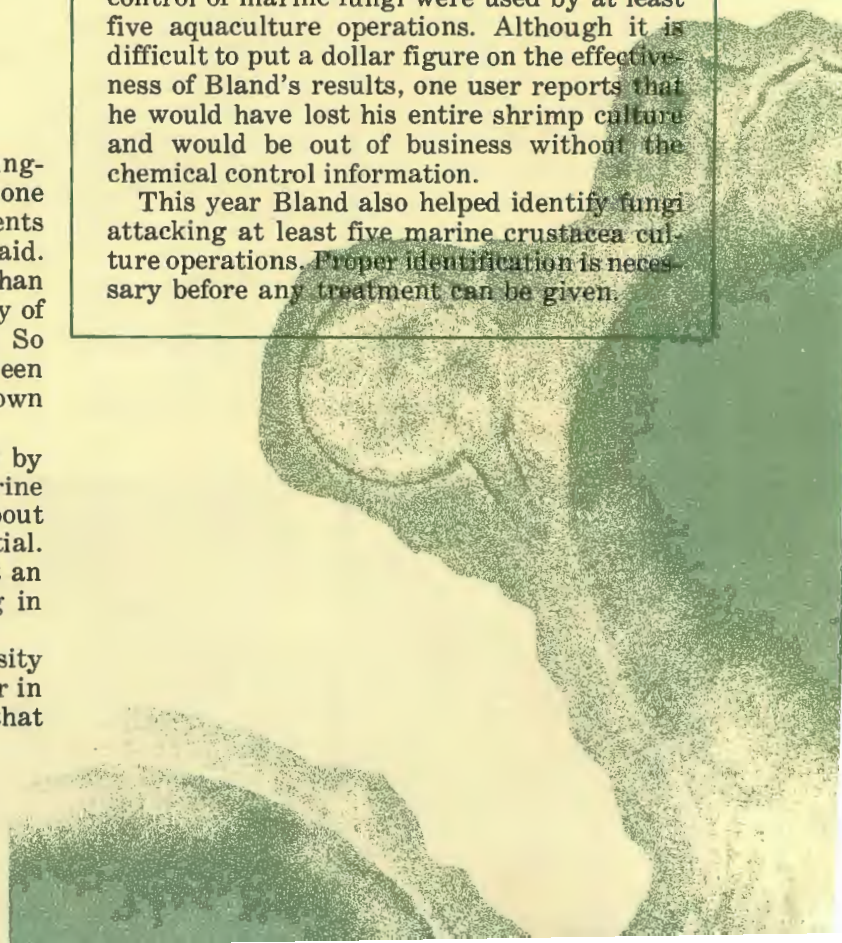
Bland also continued work this year that enabled him to distinguish among five strains of *Lagenidium* and began chemical control tests on two of the strains.

The fungus, *Halipthoros milfordensis*, that attacks brine shrimp and lobster larvae as well as blue crab adults and ova, came under Bland's scrutiny this year. Besides determining its life cycle, Bland began experiments to learn how it goes about spreading infection—information useful in charting its control. □

highlights

During 1975, Bland's findings on chemical control of marine fungi were used by at least five aquaculture operations. Although it is difficult to put a dollar figure on the effectiveness of Bland's results, one user reports that he would have lost his entire shrimp culture and would be out of business without the chemical control information.

This year Bland also helped identify fungi attacking at least five marine crustacea culture operations. Proper identification is necessary before any treatment can be given.



part II

The land, the sea... ...and man

better use of living and non-living resources

page 20 through 30

People *use* the North Carolina coast

Sea Grant wants to help them use it *wisely*

North Carolina will begin implementing its Coastal Area Management Act in 1976. During 1975 Sea Grant provided information and services to citizens and to government officials charged with putting the act into effect.

For local governments

Tools to carry out planned growth

The N.C. Coastal Area Management Act (CAMA) directs local governments in 20 coastal counties to draw up broad land use plans. Guidelines spell out specifically what must be included in the plans. And the law says that all local plans must be approved by the state.

But the Act stops there. It doesn't require that local governments implement their plans and it gives no direct guidance on how to go about legally enforcing management outside of designated areas of environmental concern.

For most North Carolina counties, a comprehensive land use plan is a new animal, one they're not sure how to tame for their purposes.

A Sea Grant project completed in 1975 should provide local governments with some insight into how they can insure that their plans don't become dust-catchers down at town hall.

Dr. Tom Schoenbaum, law professor at the University of North Carolina-Chapel Hill, analyzed legal tools that local governments have traditionally used to control development to determine if those tools could also be used to implement coastal management plans.

He concluded that such traditional tools as zoning, subdivision regulation and taxation could be effective—if they are used in combination and if they are strengthened.

Taken alone, traditional legal tools have weaknesses, Schoenbaum explains. But used in a scheme that complements land use goals, these familiar techniques can offer the muscle local governments need to put their plans into effect, he says.

Just as a knowledge of the resources, the forces acting upon them and their capacity to tolerate man's activities is essential in developing management plans, so it is in choosing policies to implement them, Schoenbaum asserts.□

The vocabulary of coastal management

For most North Carolinians, coastal area management is a whole new idea with a whole new vocabulary.

Sea Grant land use advisory agent Simon Baker this year tried to help coastal citizens and planners better understand the new jargon—and the reasoning behind it—through workshops and a publication.

By the end of the year, he had also overseen the beginnings of production of a film aimed at translating management into language non-scientists can understand.

Primarily, Baker focused on a phrase that pops up often in the new language: areas of environmental concern or AECs. In March, he sponsored a symposium featuring scientists who have researched the dynamics of such possible AECs as dunes, wetlands, estuaries and historic sites. Baker compiled their speeches, written in terms the scientifically unsophisticated can understand, in a Sea Grant publication.

The film he is overseeing also attempts to explain the delicate nature of certain coastal areas and why they may need special protection.

Baker also began other projects this year to ease the tasks of local and state planners. A directory of all available aerial photography of 44 eastern North Carolina counties which he compiled should prove helpful to planners in ordering and using air photos. Another study takes a look at land use implications when storms strike the coast. A third effort begun by Baker is the mapping of current land use and vegetation on the state's barrier islands. Such mapping today will allow us to trace future changes in land use, he says. □

highlights

Land use advisory agent Baker this year:

—sponsored a symposium on coastal development and areas of environmental concern which 60 university scientists, local and state officials and citizens attended;

—brought the chief planner from Oregon's Coastal Conservation and Development Commission to North Carolina to speak at the symposium and to confer with some 15 technicians and administrators of the Departments of Administration and Natural and Economic Resources about Oregon's experiences in designating areas of environmental concern;

—published a proceedings on coastal development and areas of environmental concern and initiated production of a film on the same subject;

—compiled a directory of aerial photography for 44 eastern North Carolina counties and described uses of air photos by planners and government officials.

Below the surface

Marsh productivity and the role of bacteria

You've probably heard it all before.

Salt marshes are important and need protection. They provide nutrients and nursery for many of our favorite seafoods. And if we cover those swampy grass lands with more beach houses and motels we just might cut into our food supply.

Scientists say it's true. But a scientist worth his salt doesn't make a statement without facts and figures to back it up. Two teams of Sea Grant researchers spent this year adding to their store of facts and figures on just how valuable marsh really is.

One team looked at the relationship between marsh grass productivity and the productivity of marsh animals—animals that serve as food for many fish. Ultimately this should help them establish the true value of marsh to man. Knowing its

true value can aid in making wise decisions about future uses of marshlands.

In addition, they're testing to see whether man can manipulate the number and size of marsh animals by controlling marsh grass production. If they find it's possible, man may be able to influence fishery productivity, they theorize.

The other team looked at the food value of decaying marsh grasses, called detritus. Researchers suspect that bacteria on the detritus provide most of the nutritional value to marsh animals which feed on the dead plant matter. They're testing their suspicions to determine the nutritive role of bacteria in the food chain.

Predicting marsh productivity

When you're talking about the productive value of any piece of land, a logical first question is: What is the annual yield? Since man doesn't acutally harvest marsh grass—like he does corn—figuring yield is more difficult.

But researchers Alan E. Stiven and Edward J. Kuenzler of UNC Chapel Hill's Curriculum in Ecology believe they have refined a model that enables them to compute and predict annual marsh grass productivity for every coastal North Carolina county. So far, they report, the model's computations have compared well with field measurements.

Already their data is being used in coastal management decisions. According to the researchers, state and local officials and planners have used their marsh production projections to assess the importance of marsh as they begin designating areas of environmental concern under the Coastal Area Management Act.

According to their calculations, an acre of North Carolina's salt marsh yields an average of 6,213 pounds of dry vegetation annually. Citing the contribution of marsh to fishery production, Stiven and Kuenzler estimate the amount of marsh vegetation that makes its way into the state's sounds each year is approximately 270 million pounds, an amount that represents some 30 per cent of all marsh vegetation.

Productivity varies by marsh

A major aspect of Stiven's and Kuenzler's research is to determine if man can manipulate the productivity of marsh animals by controlling levels of marsh grass productivity. This year they collected data on grass and animal productivity in three marshes which are located in the same geographical area. Researchers found that both grass and animal production vary in each of the three study marshes and each fluctuates yearly.

This baseline data is providing information needed in experiments to measure the degree of dependency of two animal populations on grass productivity. During 1975, they began experiments by building nine enclosures, some with a control number of marsh plants and animals, some with more than the control and some with less. As they monitor the enclosures during 1976, Stiven and Kuenzler should be able to gain more insight into the degree of dependency of marsh plants and animals.

Their information should enable scientists to

. . . this information should help man gauge the true value of swampy marshlands. . .

place dollar values on the worth of an acre of salt marsh as it relates to fishery productivity. Added to aesthetic appeal and environmental quality afforded by marshes, this information should help man gauge the true value of those swampy grasslands.

Nutrient value of detritus

In another project, Sea Grant-supported scientists developed ways to learn more about the nutritive value of detritus and the role of bacteria which colonize it in the marsh grass food chain.

Research was led by former North Carolina State University ecologist John Hobbie and conducted in the field by NCSU zoology graduate students Leon Cammen, Parke Rublee, Bruce Dornseif and William Bowden.

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

Researchers felt they overcame a major hurdle when they developed techniques allowing them to count bacteria on detritus and to determine which parts of the detritus are actually used by small marsh animals.

The task of directly counting bacteria can be done by using epi-flourescent light—which bacteria reflect—and isotopes C^{14} and N^{15}, researchers found. And by marking sediments where marsh grass grows and detritus is produced with a pigment, it is possible to trace the decaying marsh grass as it moves through the digestive tracts of marsh worms, organisms which are important links in the lower levels of the food chain.

Some scientists suspect that the detritus itself provides little nutrition for the animals. Instead, they believe, bacteria on the detritus may provide major nourishment. The Sea Grant researchers believe their techniques will enable them to determine if this is true.

They also began work this year to determine how quickly detritus decomposes and what changes occur in the nutritive value of detritus as it decays.

Both Sea Grant marsh studies complement research at the Atlantic Estuarine Research Center of the National Marine Fisheries Service in Beaufort. Work there aims at modeling coastal ecosystems for predicting marsh animal production and for management of these ecosystems. □

A scientific look at shoreline erosion

Determining the governing processes

If you took a boat in and out of the nooks and crannies of North Carolina's mainland shoreline, you'd see everything—up to and including the kitchen sink—being used to stop erosion.

That's what East Carolina University geologists Mike O'Connor and Stan Riggs and biologist Vince Bellis found. With funding from Sea Grant this year, they mapped the shorelines of five northeastern North Carolina counties and measured what they saw against old aerial photographs. The purpose of it all was to determine how fast areas erode and what causes one spot to wash away quicker than another. Their goal is to come up with recommendations on how people can best control shoreline erosion.

While mapping is a major aspect of their research, their ultimate aim is to understand the geological and biological processes which govern shoreline erosion.

From the looks of things, property owners are desperate to guard their lands against erosion. Some are willing to spend $20 per foot to protect their lands with concrete or wooden bulkheads. Others pile tons of heavy concrete blocks on their eroding banks. Many just use trash—old limbs, tires, soda machines, nets and even household garbage—to keep their lands intact.

Property owners have good reason for their desperation. O'Connor, Riggs and Bellis say the mainland is being eaten away an average of two to three feet per year. Storms can take away 15 to 20 feet in a single blow, they add.

Erosion of the state's estuarine shores is considered such a serious problem that eroding areas are being given the special designation as "hazardous" in local and state land use management plans.

Data compiled by the Sea Grant team has already helped planners in drawing up local land-use plans. Sue Kulick, a community planner with the Department of Natural and Economic Resources (DNER), says the researchers' data represents the best information available for delineating eroding areas. Their research "will help a great deal in managing changing land use in this area," Kulick adds. According to Tom Richter, also of DNER, the erosion data is helping establish realistic setback lines.

Folks try protecting their property from erosion in a lot of different ways, Bellis, O'Connor and Riggs found. Modest cottages are sometimes guarded by expensive concrete slabs, while more elaborate homes are protected only by piles of debris.

The researchers determined that there are three broad types of shorelines. Grassy shorelines without protection appear to erode most rapidly at a rate of six to 20 feet per year. Exposed sand and clay banks lose up to eight feet per year. And shorelines bordered with swamp forest show almost no erosion, they found.

No one type of erosion control method is best for all shoreline types, the researchers say. During 1976, they hope to determine which controls are best suited to the different shoreline types.

One of their goals is to provide small property owners information on how fast their lots are eroding. Previous erosion studies have provided only average rates for longer swatches of shoreline. Researchers hope that data they collected this year on erosion rates and biological and geological factors governing erosion will help land owners make wiser decisions about how they will use their lands and control erosion on their shorelines. □

Using grasses to halt the land thief

Oriental's earliest settlers must have known the wiles of that sneaky neighbor of theirs. They must have watched the friendly old Neuse River—that neighbor that brought them fish and transport and tourists—making off with their land.

Folks today call that kind of thievery erosion.

Joe McCotter, manager at Oriental's Sea Vista development, is a man concerned about erosion, one who has watched that "friendly" giant lop off 15 to 20 foot chunks of shoreline in a single year.

A couple of years ago he and his company moved to stop the thief with a 3,000 foot concrete bulkhead guarding the yards of a couple of swank vacation homes on the end of Easy Street. But bulkheading the development's many miles of canal and river bank at $20 to $30 per foot just wouldn't have been practical, he says.

This year Sea Grant researchers, working with McCotter and some Sea Vista property owners like Carvie Oldham, put up another kind of defense. They pitted marsh grasses one-on-one against the greedy Neuse waters. So far, it looks like the grasses are holding their own—and holding onto the soils. At only seven cents per square foot, McCotter feels the grasses are a bargain.

"We're tickled to death with the way the grasses are growing," McCotter says.

For North Carolina State University botanist Ernie Seneca and soil scientist Steve Broome, planting grasses like those they put in last summer at Sea Vista isn't new. Carrying on the work they did with veteran soil scientist W. W. Woodhouse, Seneca and Broome have been re-establishing marsh with marsh grasses—and thereby slowing erosion—for the past two years. Before that, they focused on planting beach grasses on dunes to slow erosion on those protective mounds. This year they continued perfecting the art of stabilizing erosion on shorelines and dunes with grasses.

"We're tickled with the way the grasses are growing." Joe McCotter.

The Neuse River there in Oriental isn't easy to beat, the researchers found. To get marsh grasses to grow along Sea Vista's river banks, Seneca and Broome had to situate a breakwater of old tires off shore from the plantings. So far, the tires are providing the punch needed to slow the waves and allow the grasses to flourish.

In an experiment along Sea Vista's winding canals, the researchers met with their greatest success to date in establishing plantings of a grass called *Juncus roemerianus*. They're continuing monthly plantings of it and other kinds of grasses to learn the best time to plant.

Marsh grass planted in 1974 on canal banks at Carolina Power and Light Company's Brunswick nuclear power plant near Southport continue to grow, Broome and Seneca report.

Broome and Seneca didn't lose sight of their experimental beach grass plantings. They found that running beachgrass is an effective stabilizer when planted in combination with American beachgrass. Principal values of running beachgrass are in stabilizing sandy coastal areas—such as foredunes—and in mixed species plantings, they say. Already commercial growers have begun stocking running beachgrass and have supplied it to Carolina Power and Light Co., Currituck County developers and some private lot owners who have employed Seneca's and Broome's planting techniques. □

Two-year-old marsh grass plantings at Pine Knoll Shores are rebuilding eroded areas.

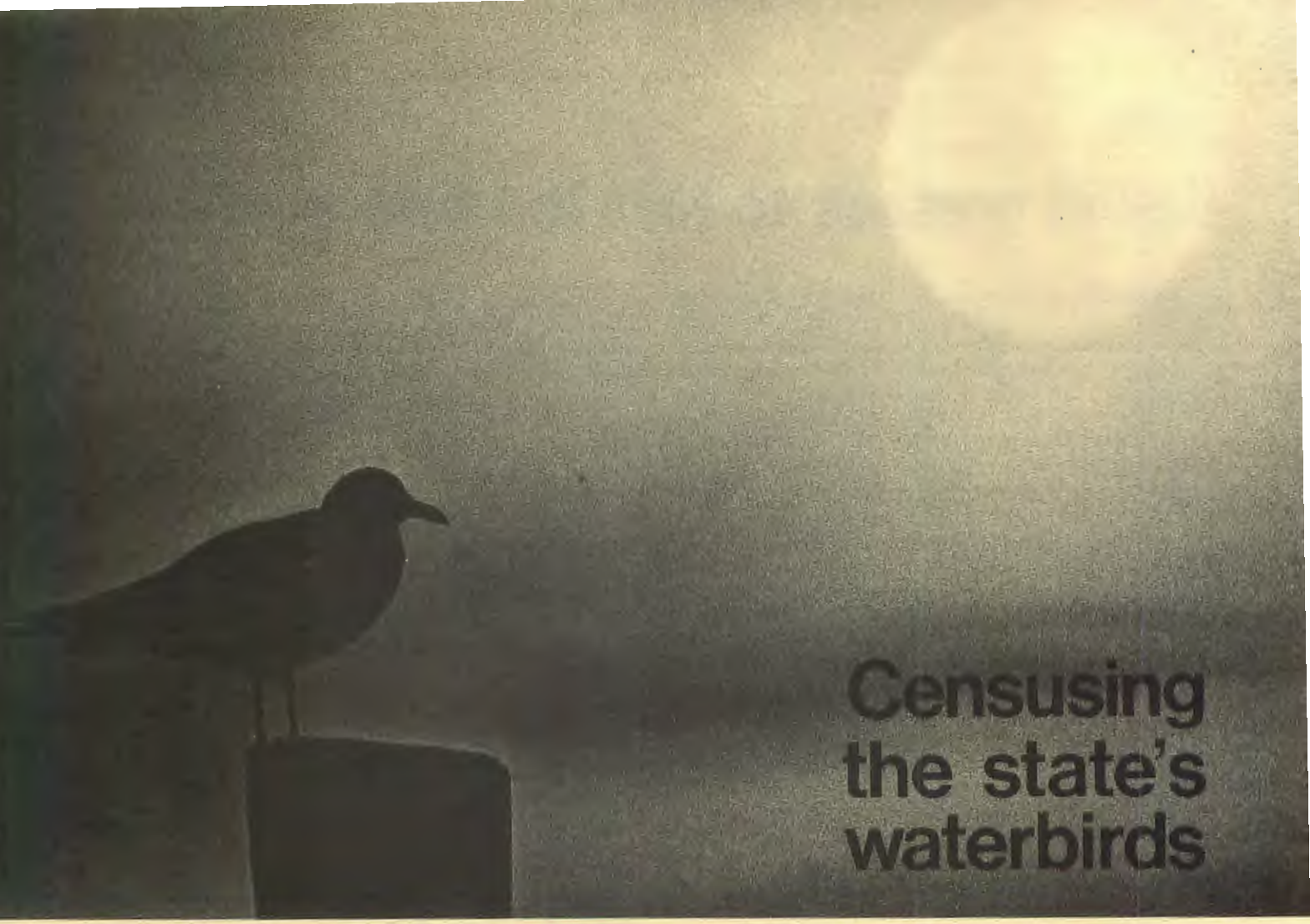
highlights

During 1975 the researchers' work produced these major benefits:

—Carolina Power and Light Co. and several private developers and property owners saw erosion on their coastal shorelines slowed with plantings of *Spartina alterniflora*;

—one developer using the grass reports that planting grasses costs about seven cents per square foot. A concrete bulkhead runs up to $30 per foot, he says;

—several developers, private beach lot owners and Carolina Power and Light Co. planted running beachgrass to slow erosion of sandy areas.



Censusing the state's waterbirds

Mrs. Edna Appleberry

Mrs. Edna Appleberry doesn't hesitate. She'll tell you in no uncertain terms that there just aren't as many birds these days.

She's not to be doubted. Mrs. Appleberry, North Carolina's dean of birding, has had an eye on the birds around Wilmington for most of her 81 years. She says her vision has dimmed now and birdwatching is more taxing. But for sure, her memories haven't faded. Times were, she says, when you frequently spotted birds you rarely see anymore.

You probably couldn't find a scientist to disagree with Mrs. Appleberry. But scientists aren't content unless they can put numbers on things. They'd like to know how many fewer birds there are today. And they'd like to be able to see how today's birds stack up against those 10 years from now.

Knowing bird populations is important in seeing that they don't dip to dangerously low numbers. And they also serve as an environmental barometer, scientists say. A change in the number of birds in an area could be an early signal of subtle environmental decline.

Besides, birds are economically important. Tourists visiting the North Carolina coast to birdwatch bring with them dollars that boost the coastal economy.

Biologists James F. Parnell of the University of

North Carolina at Wilmington and Robert Soots of Campbell College are the first to try to determine how many birds nest on the Tarheel coast. For them, 1975 was the year to figure out how to count the birds.

Their Sea Grant-supported censusing study complements research they have conducted since 1971. Under earlier Sea Grant awards, the scientists determined relationships between vegetative growth on dredge islands and bird species nesting there. Conclusions from that study, as well as bird population data, are important in determining future uses of the coastal area.

In establishing techniques to be applied in 1976, Parnell and Soots sought counting methods that are accurate, easy to repeat and not overly disturbing to the birds. They found the following:

—Aerial photography yields accurate counts for royal terns and other birds that nest on sparsely vegetated grounds;

—Total ground counts (counting every nest by walking through the colony) are best for small colonies which can't be counted from the air;

—Total ground counts are too disturbing for large colonies;

—Two techniques, strip censusing and the point center-quarter method, provide good estimates of large colonies in tall grasses;

—Total nest counts along with counting adults flushed from nests in thickets may provide a reliable census of birds such as herons.

Parnell and Soots are combining their Sea Grant work with another project supported by the U.S. Fish and Wildlife Service which focuses on counting the state's heron population.□

highlights

During 1975, Parnell and Soots:

—established reliable techniques for censusing royal terns. Using aerial photography, they counted some 17,000 royal tern nests on the North Carolina coast;

—designed censusing techniques and collected data that should enable wildlife conservation agencies to more accurately assess endangered species;

—received the Governor's Award for Environmental Education presented by the N.C. Wildlife Federation.

An arrangement designed to protect waterbirds

James Wells, civil engineer with the Corps of Engineers, sounds proud of the arrangement between his office in Wilmington and researchers Parnell and Soots. It's an arrangement that protects waterbirds from the devastation of the dredging machine.

Already the arrangement has saved several bird colonies. With Parnell's and Soots' information on bird colony locations and timetables, Wells has on several occasions called off the dredgers and sent them elsewhere for another job until the birds finished nesting. To head off future "close calls," Parnell and Soots now help schedule dredging to coincide with the birds.

James Wells

Also because of this arrangement, birds are now considered in the Corps' management plans and environmental impact statements. "Very definitely," Parnell and Soots have influenced the Corps' consideration of the birds, Wells says.

The bird study has reached well beyond Wilmington. Their findings, presented at a December workshop at the Waterways Experiment Station, Vicksburg, Miss., should help the Island Harbor Development Project there plan future research.

They've also helped at least one coastal North Carolina county devise a local land use plan as called for by the state's Coastal Area Management Act. Parnell and Soots provided Brunswick County planners with information on the location and importance of breeding birds in the county—information useful in establishing areas of environmental concern.□

Our next dumping grounds?

Every year more tourists bring more dollars to North Carolina's coastal communities. Those extra dollars make local folks feel good.

But tourists also bring headaches, often the kind that make some local and state officials wince in pain.

One that's been bothering some officials lately is the problem of getting rid of increased quantities of human wastes. Septic tanks and local treatment plants are taxed to capacity. It's time for a new solution.

Already, some officials are casting a hopeful eye to the ocean as our next dumping grounds.

Trouble is, nobody's really sure what would happen to sewage if we sent it through large pipes or outfalls into the sea. Some say the Atlantic just might bring the sewage right back to our beaches.

North Carolina State University oceanographer Leonard Pietrafesa and civil engineer C. C. Tung began research this year to find out if ocean outfalls would solve or create more problems for the North Carolina coast. Sea Grant provided the lion's share of funding for the research which also had support from the U.S. Energy Research and Development Administration, the National Aeronautics and Space Administration and the N.C. Board of Science and Technology.

By looking at such factors as water circulation, winds and the effects of the Gulf Stream, and by doing some mathematical gymnastics, they hope to accurately predict the destination of sewage pumped off the Tarheel coast. Research this year focused on Onslow Bay, an offshore area between Morehead City and South Carolina. Their data and predictions will provide information state and local officials need to determine if the oceans are a good receptacle for wastes.

Pietrafesa and Tung, assisted by NCSU geoscientist Allen Weber who with Sea Grant support is examining the wind's influence on water circulation, are combining field observations with computer modeling. Both should provide a picture of what's happening in Onslow Bay, Pietrafesa says. The model will enable them to predict circulation patterns as winds change and the Gulf Steam shifts.

Preliminary findings, Pietrafesa says, show that Onslow Bay is a highly energetic area where effluents could be moved rapidly throughout the waters. Water temperatures change dramatically deep in the Bay. Such differences in temperature could also have an impact on where effluents travel, researchers believe.

The Gulf Stream, bordering the eastern edge of Onslow Bay at the Outer Continental Shelf, also affects water movements. One part of their research aims at figuring to what degree the Gulf Stream influences Onslow Bay and could influence the dispersion and destination of effluents.

Researchers actively began research in July, 1975. More conclusive findings should be available after another year of data collection.□

Counterattack on marine borers

It's for sure the old pier had seen better days. Barefoot little kids used to race up and down its strong, straight boards. Old men and women sat for hours there in the sun, waiting for a nibble on their lines.

But now the pier slopes. It leans dangerously toward the water and signs warn folks to keep off.

Borers can destroy 12″ wooden pilings in only eight years.

The pier's sturdy pilings are crumbling, sort of like the tired legs of old codgers who gathered there to talk about time when . . .

You might guess the pier dates back to the 30s or 40s. But when it comes to age, piers—and other wooden structures in the marine environment—can be deceptive.

Certainly the salty water and the rush of waves take their toll. But a group of marine creatures commonly known as woodworms are due much of the blame for damage to wooden structures.

According to the owner of one coastal construction company, woodworm damage probably costs North Carolinians more than $2 million annually. Creosoted pilings 12 inches in diameter can be expected to last only about eight years in the Beaufort-Morehead City area, he says.

Attempts to control woodworms or marine borers by treating wood with toxic chemicals haven't proven successful.

That's why North Carolina State University wood scientist Michael P. Levi went to work with Sea Grant support this year to find a better way to stop borers. Levi believes that one control method lies in another of man's favorite materials—plastic. Plastic injected into wood, Levi says, may stop the borers by presenting a physical barrier and interfering with the bacteria and fungi in the wood, which may be what the worms are after.

Part of Levi's research centered around testing wood injected with low concentrations of plastic (methacrylate) and radiating the wood to solidify the diluted plastic.

To test his theory, Levi placed wood samples—some injected with plastic, some treated with chemicals and others left untreated—in locations from Virginia to South Carolina. Even though his work will not be continued under Sea Grant support in 1976, Levi plans to keep an eye on the samples. They should reveal the effectiveness of various treatments, extent of borer damage in various locations and types of destructive borers.

If Levi's theory is proven—and if plastic can be injected inexpensively—the results of his work could save millions on coastal and marine wood repairs.□

highlights

Researcher Levi sought improved control of marine woodworms by using wood impregnated with plastic.

In his first year of study:

—tests showed that dilute solutions of plastic can be used in wood—therefore reducing costs of this method;

—a type of borer, formerly thought to be of no economic significance north of Florida, was identified here.

On the coast

Taking a "total" approach to insect management

Doug Dillon was in the middle of a crisis. The washing machine at his New Bern home had begun belching smoke and he had been summoned from work to fix it.

In other words, it wasn't a good time for Dillon to talk on the phone to a stranger from Raleigh—especially one who wanted to talk about mosquitoes and how folks down in Craven County get rid of them and if some training workshops on insect control that Sea Grant put on last year helped out.

Doug Dillon

But Dillon talked. And mostly he talked about the workshops. "I cannot say enough for the good of this program," he said. "I can't think of anyone who didn't benefit from it."

Dillon, a Craven County sanitarian, and 30 of his coastal counterparts attended fall insect control workshops led by Sea Grant-supported entomologists Dick Axtell and Jim Dukes and instructed by T. D. Edwards and R. L. Tatman, research technicians, all of N.C. State University. Most of those who attended the fall sessions, held in three coastal locations, had been to an earlier spring series.

The workshops stressed the need for a "total" control program using modern insect pest management techniques. Much of the information needed to design a total program was tested in North Carolina by Axtell and Dukes under earlier support from Sea Grant and the N.C. Agricultural Experiment Station.

A total program, they told workshop participants, includes monitoring pest populations, cleaning up breeding sites, using chemicals that kill insect larvae and, as a last resort, using chemicals to kill full-grown adult insects.

The need for monitoring

Monitoring when and where insect outbreaks are most severe provides the information needed to fashion a total program, Axtell and Dukes say. Instead of using costly pesticides simply on a regular calendar basis, they advise using a variety of control methods and spraying only when outbreaks are worst.

To effectively control insects, the Sea Grant team believes, you've got to know something about their biology and life cycles and the conditions they need to multiply. And you've got to be able to tell the differences in species.

For some participants, many in the insect control business for years, seeing mosquitoes and biting flies under the microscope at the workshops was an eye opener. Some were surprised at the number of different mosquito species.

During the sessions, they got first hand experience identifying mosquitoes and biting flies and in using a variety of monitoring methods. Participants were instructed in formulating pesticides to treat specific problems and in using ultra low volume equipment, which is largely replacing the old fogging truck.

"One of the many values of the program," Dillon said, "was to put it on a practical, working basis. It was designed to show an efficient control program. All we'd have to do is plug in and go through with it," he added.

Maurice Edmondson, Manteo mosquito control supervisor, echoed Dillon's enthusiasm, saying the workshops had helped pest control operators in his county. "I'm sure they're doing a better job now," he said.

Besides offering the training sessions, the Sea Grant team continued helping coastal counties set up monitoring programs.

Plans had been to continue the coastal insect pest control advisory and research program through 1976. But funding was cut off at the end of 1975 as the result of a decision on the federal level. □

highlights

During 1975, Sea Grant-supported entomologists Axtell and Dukes:

—conducted three spring and three fall training sessions for coastal pest control operators in Wilmington, Morehead City and Manteo;

—31 trainees from 13 counties, four townships and one state agency attended the three fall workshops;

—21 trainees (68 per cent) at the fall sessions had been to earlier spring sessions or to the 1974 pilot training course;

—Of those who attended, all counties and towns have adopted at least some part of the techniques discussed during the sessions.

part iii

Sea Grant and students

A team where everyone scores

If you take a group of college students and pair them up with Sea Grant, you get the kind of teamwork that lets all the players score.

Students win bachelor's, master's and doctorate degrees—and the knowledge that comes with them—plus a lot of good experience.

And Sea Grant gains from research and technical assistance students provide.

This year some 130 students from four University of North Carolina campuses participated in one way or another in Sea Grant-supported work. Of those, three earned advanced degrees. Thirty are in some stage of earning higher degrees by working directly with Sea Grant researchers. And others—both undergraduates and graduates—assisted as technicians in Program work.

Already graduates of the UNC School of Law who were enrolled in Professor Seymour Wurfel's 1975 law of the sea class have assumed positions in the legal community. Amos Dawson, a former student of Wurfel's, is serving as ocean law expert for the N.C. Department of Natural and Economic Resources. In this capacity, Dawson is closely involved in implementation of the state's coastal management act. Two other ocean law students now hold law clerk positions with judges on the N.C. Court of Appeals and the U.S. Fourth Circuit Court of Appeals. These are among more than 100 practicing lawyers who have studied ocean law under Wurfel since he first obtained Sea Grant support in 1971.

The 15 students studying ocean law this year produced seven Sea Grant publications bearing directly on legal problems facing North Carolina's coastal and marine arenas. Their publications contributed to an understanding of legal problems in coastal areas—and provided their authors with sound research experience in this specialized field.

UNC law student Ronald H. Rosenberg assisted with research led by UNC law professor Thomas

Schoenbaum. Together they examined and produced a report on legal tools local governments can use to implement coastal zone management. Rosenberg is now employed by the U.S. Environmental Protection Agency.

Some 15 landscape architecture students at North Carolina State University were enrolled in courses taught by Sea Grant land use advisory agent Simon Baker. With instruction on coastal management philosophies and techniques, they should be better prepared to carry out future responsibilities as planners and architects.

Three North Carolina State University students completed requirements for advanced degrees working directly with Sea Grant support during 1975.

J. T. Lyon's master's thesis research compared epiphytes (a form of plant life) on natural and man-planted *Spartina alterniflora* marshes. His work, done in association with Sea Grant researchers E. D. Seneca and S. W. Broome (who himself earned a Ph.D. on a Sea Grant project in 1974), further justifies establishing man-made marshes since results showed that planted and natural marshes are comparable in epiphytic production.

Oceanography student C. R. McClain, working with Sea Grant researchers L. J. Pietrafesa and C. C. Tung, based his Ph.D. thesis on a study of the interaction of bottom sediments and wave fields in Onslow Bay. According to Pietrafesa, information from this study is important in determining where sludge from ocean outfalls will go.

In a study of crabmeat quality, C. H. Isley examined enzymes at work in raw and processed crab. Neil Webb, food scientist in charge of the Sea Grant project, says Isley's data will be helpful in figuring out why crabmeat texture undergoes change during freezing.□

Graduate student Leon Cammen washes down grasses as part of research on the nutritive role of bacteria in marsh.

highlights

This year:

—some 130 students on four University of North Carolina campuses participated in Sea Grant-supported work:

—30 students were enrolled in classes taught by Sea Grant-funded faculty at N.C. State University and the UNC law school;

—three students earned advanced degrees working under Sea Grant-supported researchers, with one receiving a Ph.D. and two getting master's degrees.

At least three students receiving educational and technical experience through Sea Grant are now employed in resource-related fields: one is ocean law expert for the N.C. Department of Natural and Economic Resources; one works for the Environmental Protection Agency; and one works in quality control at a meat packing company.

Publications--1975

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To order:

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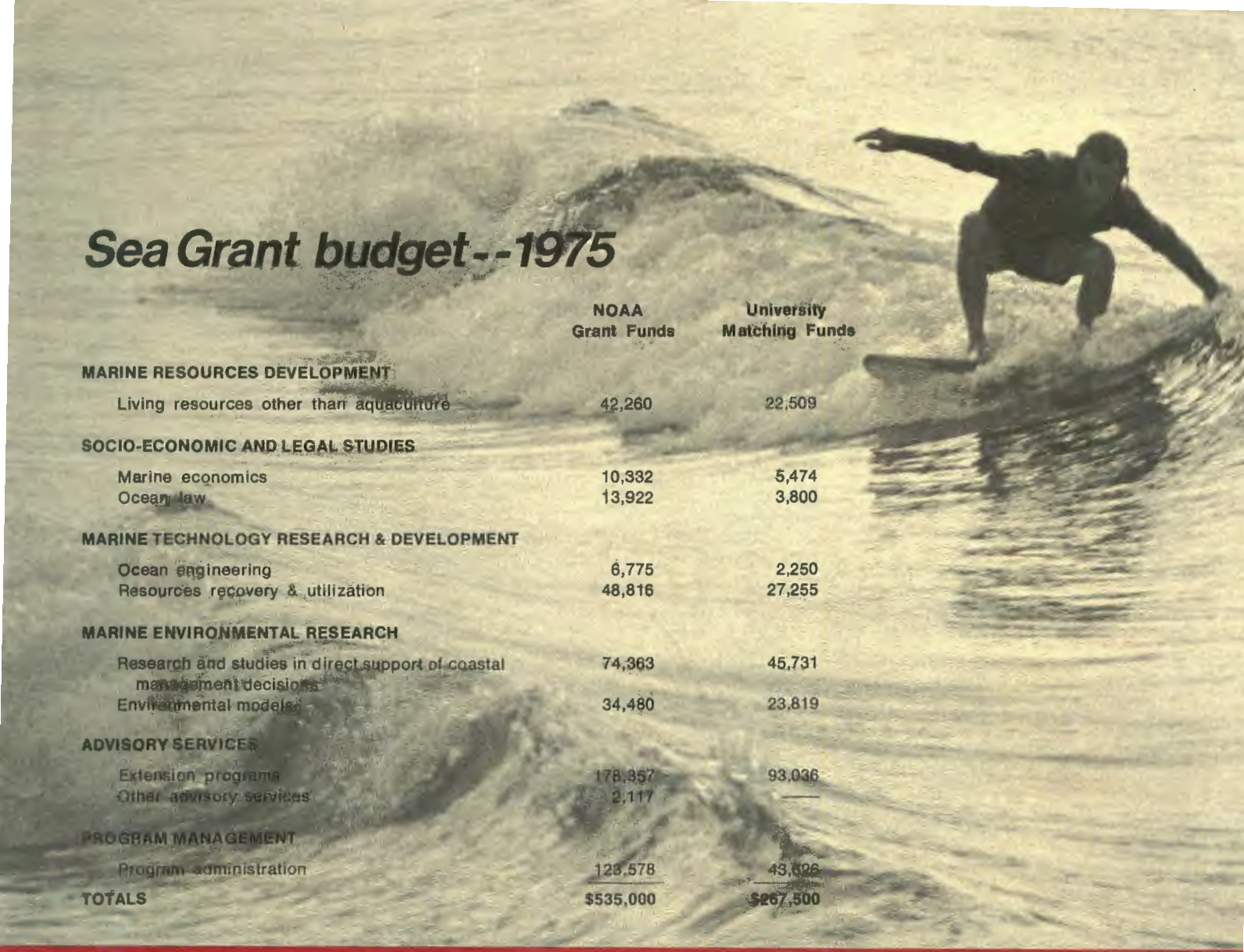
Raleigh, North Carolina 27607

Project standing -- 1975 and 1976

Project group		Status 1 Jan. 1975	Status 1 Jan. 1976
PROGRAM OPERATIONS			
MD/A-1,	Administration & development, Copeland & Rickards	C	C
AQUACULTURE & FISHERIES			
R/AF-2,	Crustacean fungal parasites, Bland	C	F
R/AF-5,	Eel aquaculture, Rickards	N	C
COASTAL ZONE STUDIES			
R/CZS-2,	Dune & dredge spoil stabilization, Seneca & Broome	C	C
R/CZS-4,	Insect pest management, Axtell & Knight	C	T
R/CZS-6,	Wood preservation, Levi	N	T
R/CZS-7,	Physical studies of Onslow Bay, Pietrafesa & Tung	N	C
R/CZS-8,	Shoreline erosion and accretion, Riggs, O'Connor & Bellis	N	C
LEGAL & SOCIO-ECONOMIC STUDIES			
R/LS-1,	Marine resources legal research, Wurfel	C	F
R/LS-4,	Legal aspects of coastal zone management, Schoenbaum	N	C
R/LS-9,	Fresh seafood marketing in N.C., Summey	N	R
ESTUARINE STUDIES			
R/ES-18,	Detritus-based food chains, Stiven & Kuenzler	C	C
R/ES-19,	Bacteria and the quality of detritus, Hobbie	N	C
R/ES-20,	Coastal bird populations, Parnell & Soots	N	C
SEAFOOD SCIENCE & TECHNOLOGY			
R/SST-1,	Fish muscle properties, Webb, Thomas & Miller	C	C
R/SST-2,	Crab meat quality, Webb, Thomas & Miller	C	C
R/SST-3,	Hazardous microorganisms in seafood, Speck & Ray	N	C
R/SST-4,	Publication series, Webb, Thomas & Miller	C	T
EDUCATION & ADVISORY SERVICES			
A/EA-1,	Land use advisory service, Baker	C	C
A/EA-3,	Continuing education for fishermen, McGee	C	C
A/EA-4,	Seafood advisory services, Thomas, Miller & Webb	C	C
A/EA-5,	Insect pest management advisory services, Axtell & Knight	N	T
A/EA-6,	Recreation advisory services	N	C

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



Sea Grant budget--1975

	NOAA Grant Funds	University Matching Funds
MARINE RESOURCES DEVELOPMENT		
Living resources other than aquaculture	42,260	22,509
SOCIO-ECONOMIC AND LEGAL STUDIES		
Marine economics	10,332	5,474
Ocean law	13,922	3,800
MARINE TECHNOLOGY RESEARCH & DEVELOPMENT		
Ocean engineering	6,775	2,250
Resources recovery & utilization	48,816	27,255
MARINE ENVIRONMENTAL RESEARCH		
Research and studies in direct support of coastal management decisions	74,363	45,731
Environmental models	34,480	23,819
ADVISORY SERVICES		
Extension programs	178,357	93,036
Other advisory services	2,117	——
PROGRAM MANAGEMENT		
Program administration	123,578	43,626
TOTALS	$535,000	$267,500

Credits

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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. Dees, 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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