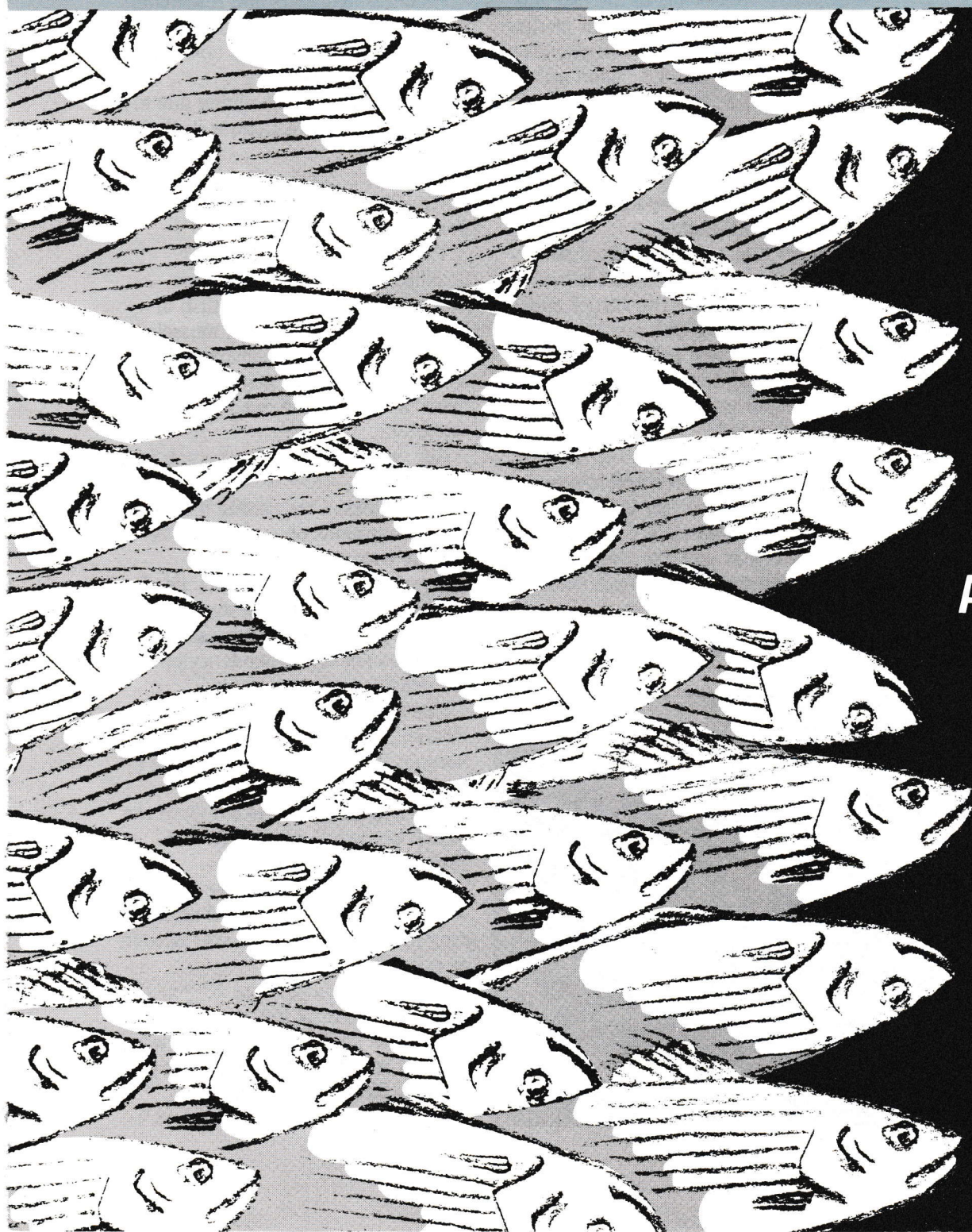




COAST WATCH



AQUACULTURE
The Catch
of Tomorrow

farm-raised fish: a growing of the nation's seafood pro

By Kathy Hart

To meet America's growing hunger for seafood last year, the United States imported almost half of the fish and shellfish dished up on dinner plates.

To be exact, three billion pounds of seafood valued at \$4.8 billion arrived in the United States from foreign shores.

U.S. landings of ocean edibles amounted to 3.4 billion pounds.

But Americans' appetites have just begun to be whetted.

Every day, another medical study, magazine article or disease prevention organization extols the virtues and health benefits of fish and shellfish.

As a result, the public is dining on seafood at an increasing rate—13.6 pounds per person in 1984, 14.5 pounds in 1985, 14.7 pounds in 1986.

Experts estimate that U.S. per capita consumption could approach 46 pounds by the year 2000.

But to increase U.S. consumption by just one pound per person, fishermen must net an additional 700 million pounds of fish.

Seafood is showing up more often on American tables

The U.S. catch of wild fishery stocks cannot keep pace with the demand.

Fisheries managers and researchers say many of the most sought-after species—flounder, shrimp, crab—are being fished to the limit.

Other species are declining due to problems with or reductions in their habitats.

Economists predict that seafood imports will rise, adding to the U.S. foreign trade deficit.

The only relief in sight is the fledgling industry of aquaculture.

Yes, it's the farming of catfish in Mississippi, trout in Idaho, mussels in Maine, crawfish in Louisiana and shrimp in Texas that may keep our plates brimming and our bellies full in the future.

But the concept of aquaculture isn't new.

The Chinese were raising fish in ponds thousands of years ago. They saw the virtues it offered.

Aquaculture, if properly practiced, removes much of the guesswork it takes to capture wild fishery stocks. And it lessens the dependency upon unpredictable Mother Nature.

The fish farmer can control the location, abundance and timing of harvests by managing the life cycle of the fish and shellfish.

The aquatic creatures are given the best. They're fed, monitored and sheltered from predators.

Just like farmers who raise corn or wheat, aquaculturists want their fishy crop to reach marketable size as soon as possible.

Worldwide, aquaculture accounts for 12.2 percent of the annual production of fish and shellfish. By the year 2000, it is expected to reach 20 percent; by 2010, 25 percent.

In 1986, Norwegian fish farmers

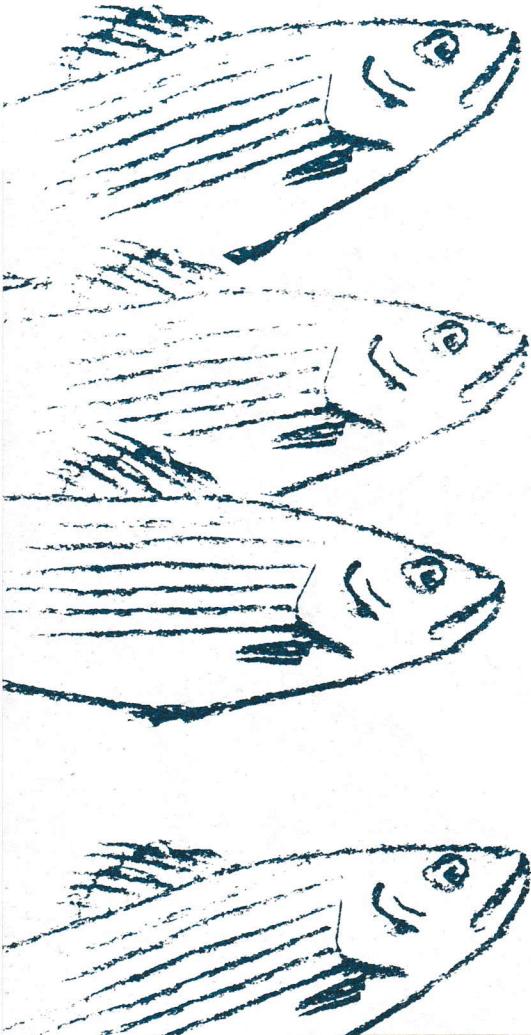


Photo from National Fisheries Institute

part duction

produced over 45,000 tons of high-priced salmon. And Canadian salmon farmers weren't far behind in their production of the pink-fleshed gourmet fish.

For Asian and Latin American aquaculturists, shrimp is the crop they're cashing in on. In Third-World country Ecuador, the shrimp culture industry has provided over 150,000 jobs and \$250 million in foreign exchange funds.

In the United States, aquaculture is in its infancy. Experts estimate that the business of fish farming contributes between 6 and 12 percent to total fishery production.

Presently most of that production (86 percent) is in freshwater species.

The Mississippi landscape glitters from the sun's reflection off acre after acre of catfish ponds. Twenty-five years ago, those ponds were as non-existent as the catfish industry.

But today, catfish farming is the nation's aquaculture success story. It accounts for over 50 percent of the U.S. cultured production.

But catfish may not be the aquaculture kingpin for long.

The production of other species is growing rapidly, and still more species are being readied.

Crawfish, for instance, used to be something only true Louisianians ate. But with the popularity of Cajun cooking, crawfish have become a hot culinary ingredient.

So hot in fact, that Louisiana aquaculturists are devoting 130,000 acres to the red-bodied crustaceans, and South Carolina plantation owners are converting abandoned rice paddies into crawfish ponds.

But whether it's catfish or crawfish, the aquaculture industry needed research to get its fish into ponds. In



These Scottish fish farmers harvest Atlantic salmon from floating net pens

the case of marine and coastal species, Sea Grant has provided much of the research support.

Sea Grant scientists spurred the production of blue mussels in Maine, redfish in Texas, crawfish in Louisiana, salmon in the Northwest and prawns in Hawaii.

Texas A&M University Sea Grant researchers are perfecting the culture of the nation's most valuable crop—shrimp. Meanwhile, Washington and Maine Sea Grant scientists "neutered" cultured oysters to keep them plump and firm year-round.

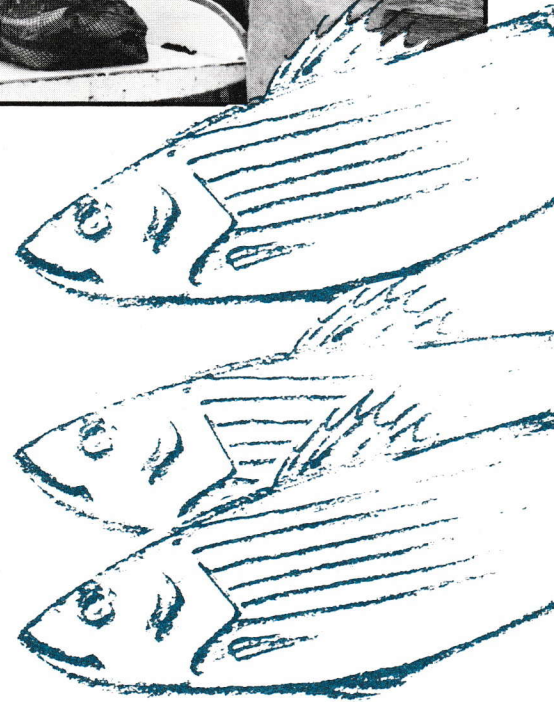
And Sea Grant scientists in North Carolina, South Carolina and Maryland collaborated on a culture scheme for hybrid striped bass—aquaculture's rising star in the Tar Heel state.

So far, trout farming, limited to the mountain area, has been the most significant aquaculture industry in North Carolina.

North Carolina ranks a distant second to Idaho in trout production in the United States. Economists estimate that trout farming generates almost \$8 million for Tar Heel growers, a figure that is expected to double in the next few years.

Otherwise the state's aquaculture efforts have been limited to a few catfish farms, bait minnow operations and clam "gardens" on private bottom leases.

But with plenty of suitable land and water resources, the hybrid striped bass looms big in North Carolina's future. The white-fleshed, good eatin'



fish could be the answer to more than one farmer's prayer.

Sea Grant spent nine years refining the hybrid's culture. Now it's ready for commercial production (see story, page 4).

The hybrid and other cultured species got a boost this summer when the N.C. General Assembly appropriated \$400,000 for aquaculture development and extension at North Carolina State University.

North Carolina and other states realize the potential aquaculture offers for economic development. Already, big corporations such as Ralston Purina, Campbell Soup and Weyerhaeuser are gambling on the industry's bright future.

So the chances are high and increasing that the next steamed oysters, boiled crawfish or pan-fried trout you slide into your mouth will be pond-raised and home-grown.

a cash crop in the making: scientists develop hybrid

By Nancy Davis

The hybrid striped bass was about to receive its toughest test yet.

Sea Grant researchers had already proved the fish could be farm-raised. Now they wanted to see how their crop would fare in the marketplace.

So, in the spring of 1986, scientists Mel Huish and Howard Kerby harvested 4,208 pounds of hybrids they had raised from fingerling to pan-size in a year.

Raleigh seafood wholesaler George Earp bought the fish and packed them for shipping to Northern markets. Within two days, folks were feasting on fish that had been raised in research ponds outside of Raleigh.

Earp says he received \$1.99 a pound for the catch. And later, after the striped bass season was over, the fish sold for as much as \$3 per pound.

The hybrid had passed the test. And now, a year later, Earp is still giving the fish rave reviews.

"It's unreal. I think the hybrid striped bass will be just like the farm-raised catfish. Ten years ago if a man had told us that, we would have thought he was crazy. But it's a strong, strong business now. Down the road (the hybrid) is going to be a super big business," Earp says.

Earp isn't the only one extolling the virtues of the hybrid.

Ron Hodson, Sea Grant's associate director and coordinator of the program's aquaculture research, expects the hybrid to become a big cash crop for the state.

"I think hybrid striped bass can be to North Carolina what the channel catfish is to Mississippi," Hodson says. "With proper development, I can foresee this being a multimillion dollar industry to the farmers and

fishermen of North Carolina."

It's a pretty optimistic outlook for a fish that just a few years ago was still in the laboratory.

But behind all that optimism are nine years of intense research—most of it supported by the UNC Sea Grant Program.

It all started when natural populations of the savory striped bass dwindled.

Researchers tried to raise the striper, but it proved difficult to raise in captivity.

Then scientists figured out how to cross the striper with a white bass. The result was a hardy hybrid.

At first the hybrid was only stocked in recreational ponds and lakes. But it didn't take long for someone to come up with another idea.

Could the hybrid be farm-raised, like catfish, and fill the demand for wild striped bass?

To find out, Sea Grant assembled a team of researchers. It included Ron Hodson, Howard Kerby, Mel Huish and Ed Noga from North Carolina State University and Margie Gallagher from East Carolina University.

Nearly 10 years later, the sale of Huish and Kerby's experimental crop proved hybrids can be farmed, and they can fill the demand for stripers.

What's more, the hybrid could be a savior for the ailing farm industry. Farmers with the right resources could use existing ponds on their land or build new ones.

Already, the results of the research are paying off. In Beaufort County, farmer Lee Brothers is the first aquaculturist to try to raise a commercial crop of the hybrid in ponds. (See story, page 6.)

Brothers' fish farm is the final

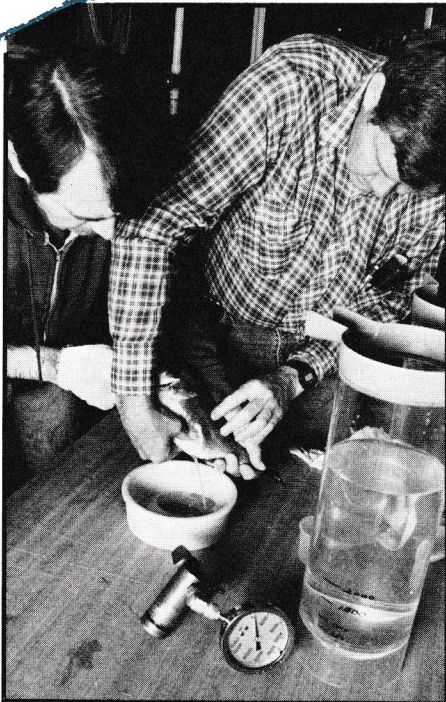
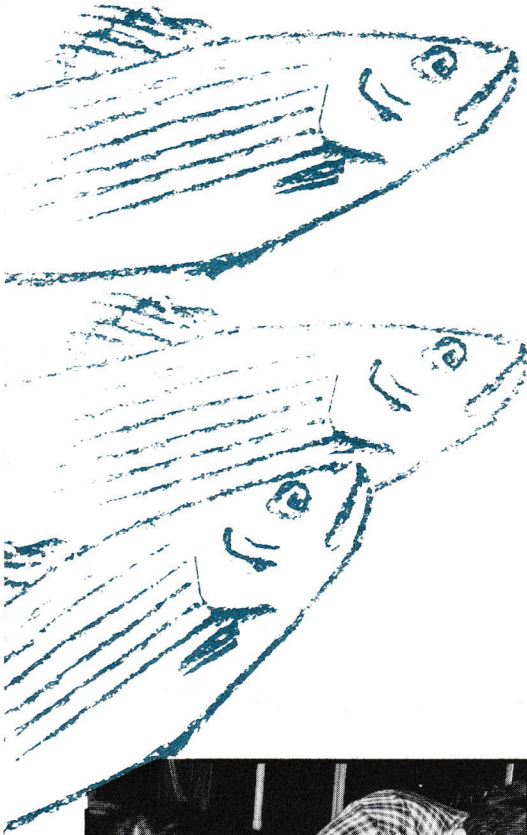


Photo by Scott Taylor

Ron Hodson and Howard Kerby strip eggs from female white bass

Sea Grant striped bass

phase of a coordinated research effort that began when Sea Grant scientists proved they could produce 1½-pound marketable fish within 18 months.

But that wasn't enough. Hodson knew that culturists like Brothers would have plenty more questions.

So he set out to refine methods for managing the crop.

Hodson created two scenarios. In the first, a farmer might want to grow hybrids on a small scale. He would use an existing pond and avoid the cost of additional equipment such as an aerator to keep oxygen levels high.

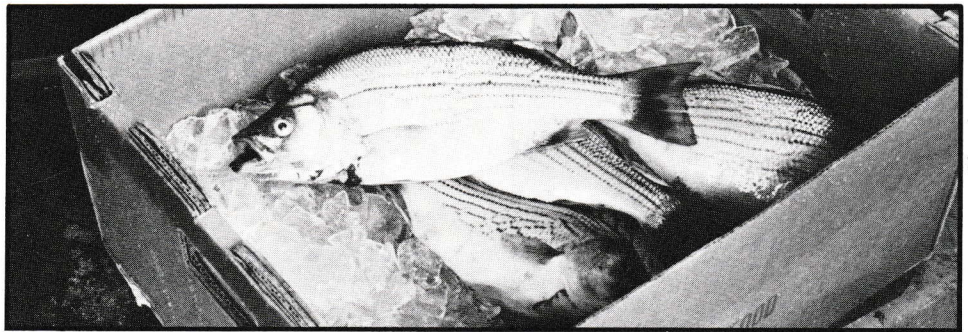
On such a small scale, Hodson found the farmer could stock about 1,000 fish per acre.

At the other extreme was a farmer willing to spend thousands of dollars on new ponds and equipment. He would stock about 10,000 fish per acre. At the end of the first year, he would harvest the fish, sort them according to size, and restock them at 4,000 to 4,500 fish per acre. If all went well, the farmer could expect to harvest as much as 5,000 pounds of fish per acre at the end of the second year of growth.

Once Sea Grant researchers proved that hybrids could be farmed, they concentrated on producing hardier, faster growing fish.

That meant going beyond just crossing striped bass with white bass. Kerby and Huish learned how to genetically manipulate the fish in an attempt to improve production and to develop a domesticated brood stock.

Sea Grant researchers are still at work on this problem. If they succeed in developing a brood stock, it will alleviate the need to collect scarce wild fish and will streamline the production of hybrids.



Just-harvested hybrid striped bass

Photo by Nancy Davis



Ron Hodson and lab assistant inject white bass with hormones

Photo by Scott Taylor

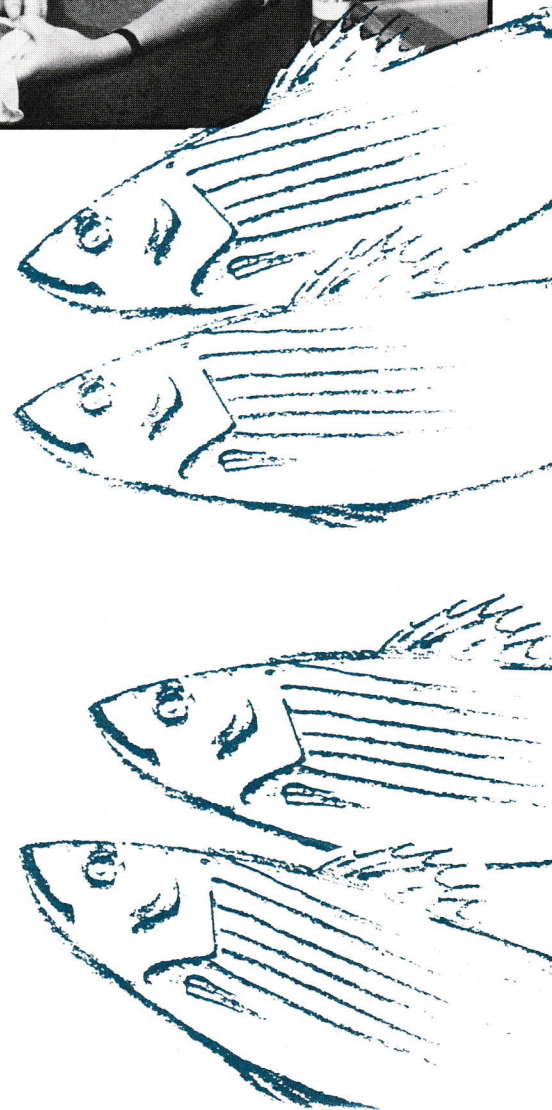
One of the biggest expenses in a culture operation is feed for the fish. The proper feed is not only cost effective for the culturist; it also results in faster-growing fish.

In her laboratory, Gallagher is determining what the hybrid's protein requirements are so she can recommend the proper protein/energy ratio for a feed.

And at the NCSU School of Veterinary Medicine, Ed Noga is working to assure that disease will not be a problem for fish held in such close quarters.

When Huish and Kerby sold their crop of hybrids, they proved the fish was marketable. But the real payoff for Sea Grant's hybrid research will come in the fall of 1988 when Brothers begins to harvest his first crop.

If he is successful, the state will have a new industry.



farmer raises a fishy crop

By Nancy Davis

harvest if everything goes well.

Eventually, the optimist in Brothers wins out. Like any farmer, he's not discouraged by the prospect of a failed crop.

"I'm not scared to take a chance," he adds. "I take one every year farming. If I can keep (the fish) alive until I sell, I'll be happy. It will be something that I can look back on my life and say I've done something."

Brothers' father Harvey is helping with the fish farm. He says it's his son's nature to experiment.

When Brothers was a youngster, he and his brother used a chemistry set to build a bomb. "They blew up the end of my tobacco barn," Harvey recalls.

Brothers reminds his father that his fish experiment should have more constructive results.

Ron Hodson, Sea Grant's associate director, believes that Brothers' operation could be just what the state's fledgling aquaculture industry needs. A successful harvest will encourage others to try fish farming. And the new industry could offer farmers an alternative to the fields.

If fish prove to be a moneymaker, Brothers says he'll forget all about corn and beans.

"I've always wanted to do something like this," he says. "This is right down my line. I love the water."

Last year after Brothers decided aquaculture was the way of the future, he spent several months traveling to other facilities and reading everything about fish farming that he could find.

His research indicated that declines of wild striped bass had left an unfilled demand for as much as 10 million pounds of the fish per year. The hybrid could help fill that void.

Realizing that Brothers' success could mean a new industry for the state,

Hodson obtained a grant from the National Coastal Resources Research and Development Institute (NCRI).

The grant will be applied to Brothers' project to help produce information that will help other growers assess the costs and potential profits of growing hybrids. And it will provide a chance to study the impact a large volume of fish will have on the demand and price structure of the market.

As part of the NCRI grant, Sea Grant will use Brothers' farm as a demonstration project for potential aquaculturists.

Brothers constructed his first ponds this spring. He dug three three-acre ponds, filled them with water and stocked them each with 30,000 hybrid fingerlings.

By late fall, he will seine the ponds, sort the fish according to size and restock them in three new six-acre ponds where they'll remain until harvest about a year later.

Until then, Brothers is taking notes about everything—whether it's the oxygen level in the ponds or how the fish are feeding that day.

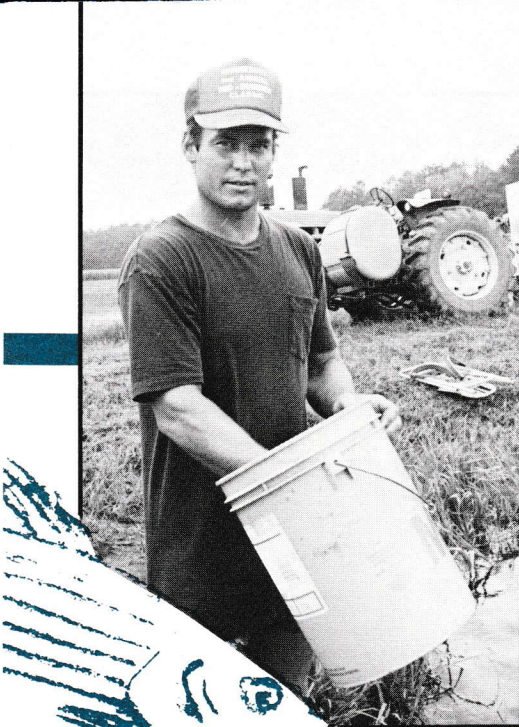
The daily diary should help him next time around, and it could serve as a guide for new aquaculturists.

Even if his first year is not a financial success, Brothers intends to keep trying. It's not a farmer's way to give up after one bad year, he says.

He hopes that within two years, he will have sold his first crop, and some other folks will be encouraged to join him in the new industry.

Even Brothers' father, who has spent a lifetime farming, thinks aquaculture is going to be more profitable than agriculture.

He adds, "If I was a young man and I could get up enough money, I'd try it. But I'd wait and see how Lee did first."



Lee Brothers

When Lee Brothers took over his family's 800-acre farm near Aurora six years ago, the outlook for agriculture was dim.

Each day television news brought word of falling prices, failed crops and foreclosures.

But Brothers was determined not to become one of the statistics.

"I started looking at another way to make money because farming was so depressed," he says.

Now, he thinks he's found the answer.

Alongside rows of corn and beans in the fertile Beaufort County lowland, Brothers is raising hybrid striped bass in ponds.

If he succeeds, he will be the first aquaculturist in the state to produce a commercial crop of the fish.

Brothers has named his new venture Carolina Fisheries. And he admits it's risky.

Nobody has ever raised hybrids for food on a commercial scale in North Carolina. And even though he studied marine biology in college, this is his first attempt at raising fish.

One moment, he doubts he'll ever harvest his first crop.

"I'm not pessimistic at all," Brothers says. "But I keep it in the back of my mind that I could walk down here one day and those fish could all be belly up."

The next moment, he's adding up how many pounds of fish he could

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities—on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.



During peak seasons, fishermen often spend long hours on the water. And there's not always enough time for sleep.

But going without rest can affect a fisherman's performance. In some cases, a lack of sleep can lead to injuries.

When people are tired, they become careless, inattentive and less capable of making quick decisions, says Rick Steiner of the University of Alaska Marine Advisory Program. Lack of sleep can cause irritability, depression, disorientation and a loss of concentration.

Although most North Carolina fishermen don't stay away from the docks for days at a time, the odd hours can wreak havoc on sleeping patterns, says Bob Hines, a Sea Grant marine advisory agent.

Researchers say the only sure-fire cure is sleep. Naps, particularly between 2 a.m. and 6 a.m., can help.

When that's not possible, they prescribe the following measures:

- Rotate crew members so they don't perform the same task continually.
- Exercising and listening to high-spirited music can increase arousal.
- Brushing your teeth or taking a quick shower can help keep fishermen awake.
- Crew members should help each other out by keeping a conversation going.

Researchers who have studied sleeping patterns don't recommend the use of amphetamines or excessive amounts of caffeine.

"The buckets of coffee consumed by many a tired-eyed skipper can lead to some serious problems in the gastrointestinal and cardiovascular systems," says Steiner.



Three Sea Grant specialists recently won awards for outstanding achievements.

Joyce Taylor, Sea Grant's seafood education specialist, received the

1987 J. Keith Porter Award from the Mid-Atlantic Fisheries Development Foundation.

Taylor competed with seafood consumer specialists from New York to North Carolina for the award. She was chosen for her extensive seafood education program for consumers.

For years, Taylor has touted the virtue of seafood with seminars, publications and interviews with the media. In the past year, she traveled across the state conducting workshops on seafood selection and freshness, care and handling, and nutrition.

Marine agent Jim Bahen took on the job of teaching commercial fishermen about the unpopular turtle excluder devices. He also was instrumental in implementing marine weather reporting and sea surface temperature programs for fishermen.

For his service, Bahen was selected as one of North Carolina State University's Outstanding Extension Service Award recipients for 1986-1987.

On August 7, the National Marine Education Association presented its annual President's Award to Lundie Spence, Sea Grant's education specialist. Spence, who shares the award this year, received a plaque honoring her services to the organization and its membership at the annual conference in Kingston, R.I. Spence was president of NMEA in 1984.

There's been a lot of coming and going at the Sea Grant Aquaculture Lab in Aurora.

In May, advisory agent Randy Rouse

resigned to pursue an endeavor in private industry. And in June, lab technician BeLinda Hoots moved to the Midwest.

Now the lab is under the care of Dave Bova and Luke Wood.

Bova has a degree in marine biology from the University of Miami. He has several years of experience with a Delaware firm that produced striped bass for a restocking program.

Wood is a 1987 graduate of North Carolina State University's Department of Biological and Agricultural Engineering.



They say necessity is the mother of invention. Sea Grant agent Bob Hines and a Marshallburg crab shedder agree.

Early this spring, the crabber built a system for shedding soft-shell crabs. But the water in his shedding trays remained too cool for the crabs to molt.

So Hines and the fisherman devised a solar water heater for the system. With a 4-by-8 foot box, some glass and plenty of piping, they built a collector. They wanted it to heat the water to 70 degrees and induce the crabs to shed.

The collector worked, but it had some problems.

"The materials we used were not ideal," Hines says. In addition, problems with leakage and the small surface of the collector complicated the operation.

But Hines isn't giving up yet. On sunny, but cool days in early spring the collector raised and stabilized the water temperature in the trays, he says.

When outside temperatures ranged from 45 to 55 degrees, temperatures in the tanks reached 55 to 60 degrees. "We were able to get it up to and over 70 degrees some days," Hines adds.

Artificial seaweed has taken hold as a prospective method of erosion control.

In theory, the long strips or tufts of fiber act as underwater sand fences that build sandbars. But tests in North

Continued on next page

Carolina, other states and Europe consistently have shown that artificial seaweed is ineffective in controlling wave-induced shoreline erosion.

Spencer Rogers, Sea Grant's coastal engineer, examines this alternative in a new publication, *Artificial Seaweed for Shoreline Erosion Control?*

In it, he addresses the development, experiments, problems and improvements of artificial seaweed in the past 25 years.

For a copy, send your name, address and \$1 to Sea Grant. Ask for UNC-SG-WP-86-4.

The Florida Sea Grant College Program has produced a two-part videotape about yellowfin tuna. Part I describes fishing methods and gear for yellowfin tuna. It illustrates the construction, deployment and retrieval of mid-water

longline gear used to harvest yellowfin tuna.

Part II describes on-board handling and grading for yellowfin tuna, including killing, cleaning, chilling and icing the catch.

To buy the set of tapes, send \$15 to Sea Grant Advisory Program, G022 McCarty Hall, University of Florida, Gainesville, Fla. 32611.

There was something fishy about the pasta served at a fleet-blessing celebration in Georgia this summer.

Instead of the traditional pasta found in macaroni salad, visitors were surprised to learn that they were eating surimi.

Yao-wen Huang, a Georgia Sea Grant researcher, concocted the macaroni out of menhaden surimi produced by Zapata

Haynie's Reedville, Va., pilot plant.

Huang's dish got good reviews. Reita Rivers of Georgia Sea Grant has participated in several taste tests of the new product. She says it has no fishy flavor and a texture very similar to the real thing.

Huang plans to test market the fish pasta in ethnic areas in Atlanta.

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