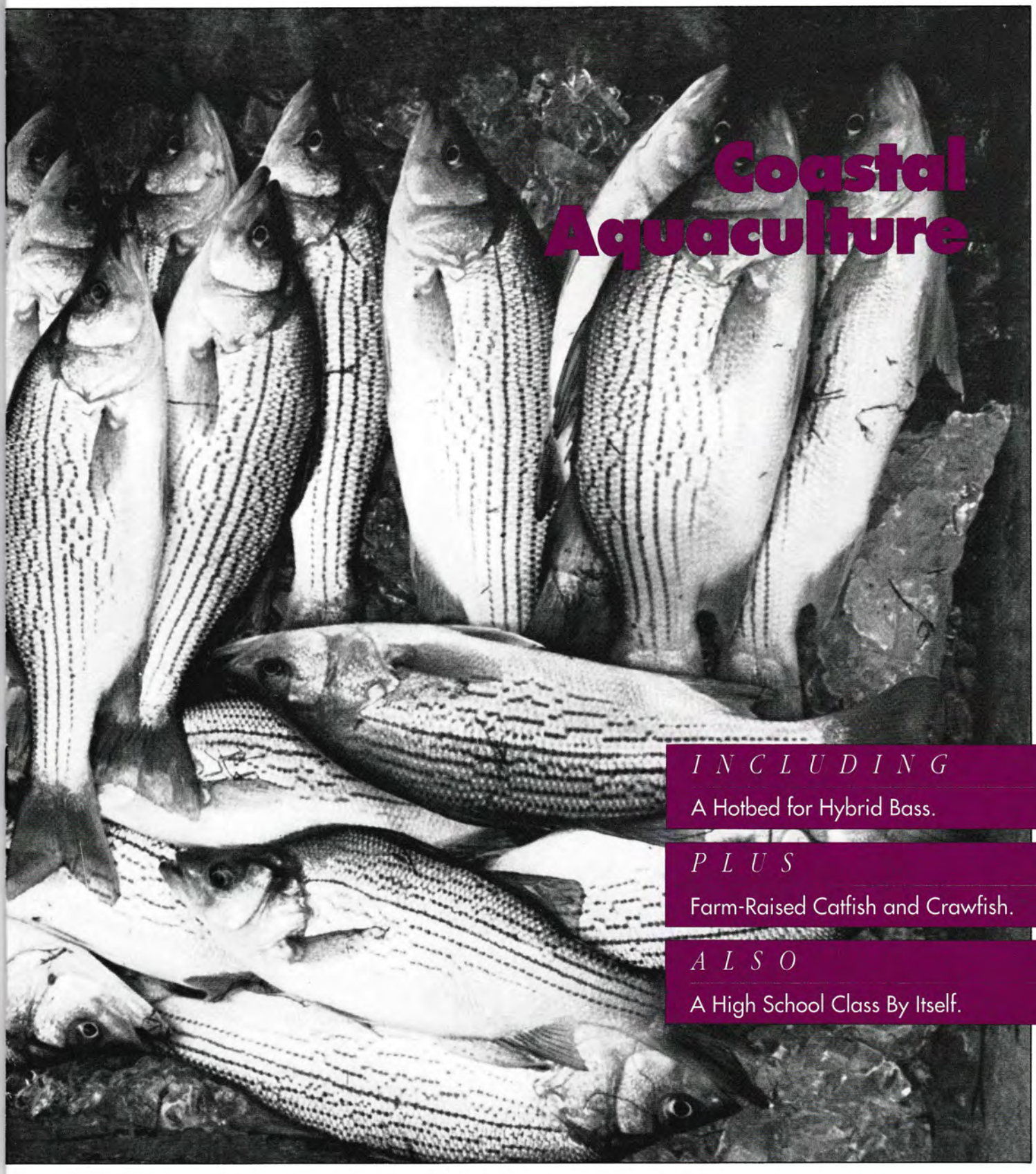
Coastwatch

UNC Sea Grant July/August 1991



Coastal Aquaculture

INCLUDING

A Hotbed for Hybrid Bass.

PLUS

Farm-Raised Catfish and Crawfish.

ALSO

A High School Class By Itself.

Coastwatch

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The University of North Carolina Sea Grant College Program is a federal/state program that promotes the wise use of our coastal and marine resources through research, extension and education. It joined the National Sea Grant College Network in 1970 as an institutional program. Six years later, it was designated a Sea Grant College. Today, UNC Sea Grant supports several research projects, an 11-member extension program and three communicators. B.J. Copeland is director. The program is funded by the U.S. Department of Commerce's National Oceanic and Atmospheric Administration and the state through the University of North Carolina.

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From The Top

Dear Readers:

Thanks for subscribing to *Coastwatch*. We look forward to providing you a year's worth of reading pleasure.

For this issue, we're focusing on coastal aquaculture.

At Sea Grant, folks frequently drop by or call to ask questions about raising hybrid striped bass, catfish or crawfish or about growing shellfish on leases.

Some are farmers looking for alternative, more profitable crops. Others are entrepreneurs searching for a sound investment that will yield substantial profits.

Many see aquaculture as the way of the future. As wild stocks of fish and shellfish are overfished or contaminated by pollution, aquaculture is frequently seen as a growing source of "safe" seafood products.

Gambling on this prophecy, many North Carolinians are digging ponds or obtaining leases to become farmers of the sea.

In Beaufort County, C.R. Edgerton learned what it takes to grow the latest entry into the aquaculture industry — the hybrid striped bass. He visited two farmers who have traded their fields for ponds.

Edgerton also traveled Carteret County backroads with Sea Grant extension agent Skip Kemp to find out why there is so much interest in shellfish culture.

Carla Burgess visited South Brunswick High School where aquaculture is part of the curriculum. She learned from a North Carolina State University scientist how to make the garden grow with some fishy byproducts. And an extension specialist showed her a barn dedicated to fish culture.

I took on the task of investigating crawfish and catfish culture. Crawfish, a long-time Cajun favorite, are finding a home in Tar Heel ponds. And farm culture has elevated the catfish from the river bottom to haute cuisine.

We hope you enjoy learning about the culture of fish and shellfish. If you would like to know more, be sure to contact the sources listed at the end of each article.

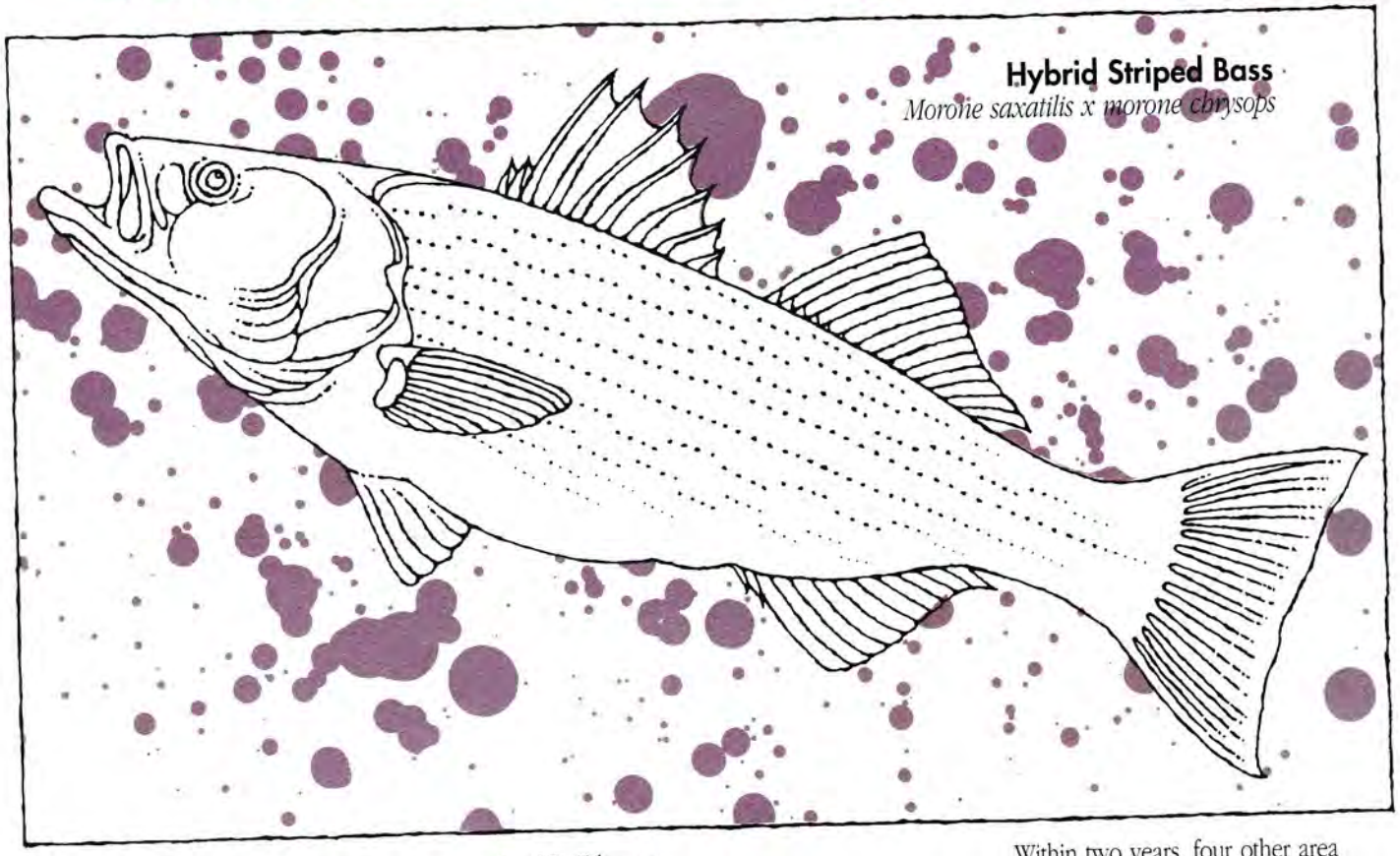
See you next issue,
Kathy Hart

In This Issue

C.R. Edgerton

C.R. Edgerton

Eastern North Carolina: A Hotbed for Hybrid Bass



By C.R. Edgerton

The striped bass is a species in danger.

Legendary for its size and strength at the end of a rod and reel, the "rockfish" is not often seen in its natural habitat.

Overfishing and poor water quality have taken their toll.

But in Aurora a hardy hybrid of this prized fish is doing quite well.

Aurora is like any other small town in America.

When the guy down the road finds a new way to make money on the farm, the neighbors prick up their ears.

Three years ago, Lee Brothers successfully harvested and sold North Carolina's first batch of hybrid striped bass.

The neighbors swarmed Brothers like a bee on honey.

Within two years, four other area farming families had made commitments to raise hybrid bass in ponds.

Now some folks call this small town "the hybrid striped bass capital of the state."

"I just saw hybrid bass as a good opportunity several years ago," Brothers says. "The wild catches of striped bass were declining, and I figured the demand would be there."

He was correct.

In his first year of operation, his fish were grabbed up by fish dealers along the East Coast. The price was very good.

Now, Brothers has 30 ponds stocked with 600,000 fish. It's a job that leaves him little time for anything else.

"You don't get any sleep," he jokes. "The fish literally have to be watched 24

hours a day, especially during the summer."

Because of his pioneering efforts with hybrid bass, Brothers has become a guru to others who wish to follow in his footsteps.

But new producers mean new competition. And competition means lower prices.

"I developed my markets by trial and error and mostly on the telephone," Brothers says. "Over a period of years, I've gotten good markets, and I try to hold on to them. But there's one thing I can't change, and that's the price. If more people are selling fish, the price is going down."

When he started, Brothers was getting about $3.50 per pound for his fish. Today, it's about $2.45.

Brothers' competition comes mostly from people he's known all his life.

People like Nancy Tyndall.

"Farming is a tight business," says the 34-year-old Tyndall, sitting in a restaurant she owns next to Highway 33. "You've got to diversify. There's no way to make a good living from just selling beans, potatoes and corn."

"It's one of those projects that Sea Grant took a chance on back in the late 1970's, and it turned into something."

Ron Hodson

She's convinced her dad and mom and three brothers to set aside about 200 acres of the family farm for hybrid bass grow-out ponds.

The first of an expected 60 ponds was finished May 10 and filled with 50,000 fingerlings in mid-June.

From here, the sky's the limit, Tyndall says.

"Sure, it's a big investment," she says. "But from all we've checked into, the rewards will be great. It should pay off. That's why we're doing it."

Tom Ellis agrees.

As the N.C. Department of Agriculture's director of aquaculture and natural resources, Ellis sees a bright future for hybrid striped bass in the Tar Heel state.

"We've got about 75 ponds in production right now, and we're going to see that number grow significantly," he says. He expects about 150 ponds by this fall and 400 by next fall. Ponds average from three to six acres.

"And I think it's safe to say that this will increase even though the price per pound will go down," he says.

Ellis says the current rush to get into hybrid bass production will ease over the next few years, especially as the "less efficient people fall out" of the marketplace.

Most hybrid striped bass farmers in North Carolina purchase their fingerlings from hatcheries in other states, including Florida, Arkansas and Tennessee.

In North Carolina, only the Brothers

Continued

Holding tanks at the Pamlico Aquaculture Center, Aurora, N.C.

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C.R. Edgerton

Nancy Tyndall and her first hybrid bass growout pond.

operation produces hybrid striped bass fingerlings for its own use.

But setting up hatcheries won't become a reality until scientists can make a breakthrough with broodstock, Ellis says.

"Right now, we're getting our broodstock from the wild," he says. "What we're after is the ability to control broodstock to spawn at any time of the year. That way, we can leave the wild fish alone."

UNC Sea Grant researchers Ron Hodson and Craig Sullivan are leading the way in hybrid striped bass broodstock research (see related article on page 17). "Their work may open up this industry in three to five years," Ellis says.

"It's true; hybrid striped bass production is going to be a major industry," says Hodson. "It's one of those projects that Sea Grant took a chance on back in the late 1970s, and it turned into something."

Hodson credits the foresight of Sea Grant Director B.J. Copeland and former researcher Howard Kerby for the success in North Carolina's hybrid bass research.

"Ours was the first study to examine hybrid striped bass in ponds," he says. "All the striped bass work in the country started in the late 70s and, before we started, the hybrid had been raised in cages, but not in ponds."

From that initial research, the body of knowledge grew by leaps and bounds. By 1985, Sea Grant was extending this knowledge to farmers, and by 1987, with the help of the National Coastal Resources Research and Development Institute, the nation's first hybrid striped bass pond culture was set up on the Brothers farm.

The North Carolina coastal plain is an ideal site for hybrid striped bass production.

"We'll look back in history and point to that event," Hodson says. "That was the start."

And what a start it was.

During the winter of 1988-89, Brothers harvested and marketed his first crop of hybrid striped bass. Last year, with three other farmers hopping onto the hybrid bass bandwagon, about 120,000 pounds were produced in North Carolina. Nationally, more than 3 million pounds were produced and marketed.

"And the industry could easily expand to thousands of acres of productive water in North Carolina," Hodson says.

The North Carolina coastal plain is an ideal site for hybrid striped bass production. "We have lots of water; flat, clayey soil; and a good climate," Hodson says. "And we're fairly close to northern markets."

But there are problems.

One major hurdle in hybrid bass production is what Hodson calls "closing the loop," or having complete control of the life cycle of the hybrid.

Although total control has been accomplished with most cultured fish, a major breakthrough in that area hasn't occurred with hybrid striped bass.

"We still have to go to the wild for both white and striped bass, the two components of our breeding program," Hodson says. "We'll be able to close the loop when we have developed a domesticated broodstock. Until we do that, we can't do anything about genetic selection, which has advanced the production of other species like trout and catfish."

Until that cycle is under control, the hybrid bass industry will not advance rapidly.

"We're at the mercy of state and federal agencies who see us taking a limited resource from the wild," he says. "And, until we have domesticated broodstock, this won't get anything but worse."

Some progress has been made.

For two years Hodson and Sullivan, an assistant professor in zoology at North Carolina State University, have refined the process of administering the hormones needed for striped bass spawning. Their work has been supported by Sea Grant, the National Coastal Resources Research and Development Institute, and the N.C. Agricultural Research Service.

Meanwhile, because striped bass females spawn for the first time when they are about 5 years old, it takes longer to develop a stock of sexually mature fish that can be used in experiments.

"It may take another five years before we can close the loop," Hodson says. "That's when we'll be able to say to the farmer out there: 'Here's the way to do it.' "

Hodson and Sullivan are hoping farmers involved in hybrid striped bass production will continue their own brand of hands-on research.

"These farmers are impatient," he says. "They'll be working on developing their own ways of domesticating broodstock."

For example, Lee Brothers developed a hatchery and spawned a few fish this year.

"We had some success, but we realize it's a slow process," Brothers says. "We'll keep working on them."

Hodson says there's a difference in

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Andy Ginnett tags a mature female

hands-on research and the kind of research he and Sullivan are doing.

"They may get something to work for them, but they won't know why it's working," he says. "That's where we come in. We will be able to provide a scientific basis for broodstock development."

Tom Ellis says the state's Department of Agriculture is encouraging research into broodstock domestication.

"We need to be able to control the quality of the fish," he says. "And we need to get out of the hunter-gatherer mode and more into the agricultural side. If aquaculture can produce without competing with recreational fishermen, it makes it all the better."

Hybrid bass farming is not without pitfalls. Fish farmers must be willing to manage their ponds intensively, spend money and time, and heed good advice.

A lack of a coordinated marketing system could also hinder hybrid striped bass production in the next few years. Ellis says most hybrid bass producers in the state have to create their own markets, as Brothers did.

"And another thing is that we still don't understand all the environmental factors for hybrid bass," Hodson says. "The riskiest time is when they are harvested and handled. We still don't know enough about it."

A key to success in this early stage is for growers not to set their sights on what they're getting per pound today, Ellis says.

"As more people get into it, the price per pound will fall. But still, it's such a high quality fish, it's going to sell."

Despite the drawbacks, Hodson recommends that people interested in fish farming give hybrid striped bass a try.

"They need to ask themselves is this something they really want to do," he says. "Then they need to read everything they can about hybrid striped bass. You don't have to be a biologist or have a background in biology to do it. In fact, the only way to learn is by being willing to put in the time it takes to do it."

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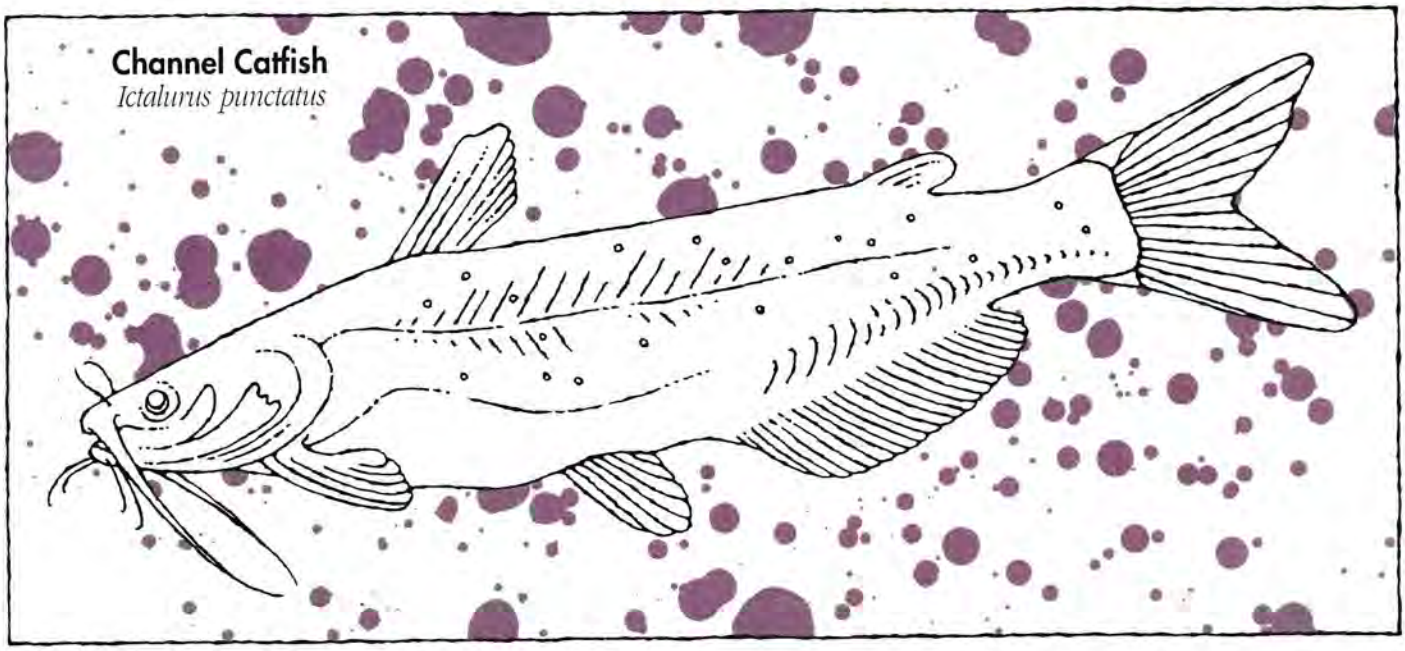
Ron Hodson checks striper eggs.

For more information about hybrid striped bass culture contact Ron Hodson at 919/515-2454. Hodson's manual, *Raising Hybrid Striped Bass in Ponds*, is available for $6 from UNC Sea Grant, Box 8605, NCSU, Raleigh, NC 27695. Ask for publication number UNC-SG-91-05.

Keeping Catfish Down on the Farm



By Kathy Hart

Below the Mason-Dixon line where grits, fried chicken and iced tea reign king, there's no truer sign of regional cooking than a plate heaped high with golden fried catfish, cornmeal hush puppies and french fries.

In fact, true Southerners, those born and reared in the heart of Dixie, make pilgrimages to family-style fish camps perched on banks of muddy rivers to feed their cravings for this fried catch.

Outside of the South, the catfish's image doesn't fare so well. In other areas, the whiskered finfish is seen as a lowly river-bottom scavenger, whose muddy flavor makes it unfit for the table.

But people who think catfish aren't good eating haven't run their taste buds across a mild-flavored, farm-raised fillet fresh from the oven.

Yes, aquaculture has taken the catfish from the river bottom to the farm pond, making it a delectable choice at up-scale restaurants, in supermarket seafood counters and on the plates of a growing number of Americans.

In fact, channel catfish are the most successful aquaculture species in the United States. In 1989, 340 million pounds of the finfish were seined from farm ponds located mainly in the Mississippi Delta.

But as the popularity and use of the delicately flavored fish grows, so does interest in its culture. And North Carolina farmers and entrepreneurs, quick to see the merit and possible profitability of catfish culture, are adding more ponds to the Tar Heel landscape.

In North Carolina, catfish growers have about 1,200 acres of ponds in production. Last year, these ponds yielded 2 1/2 million pounds of catfish; this year, the harvest is expected to weigh in at 4 million pounds, says Tom Ellis, director of aquaculture and natural resources for the N.C. Department of Agriculture.

Large producers of catfish in North Carolina consider the culture of the finfish a full-time business. Their ponds measure from 10 to 20 acres, are stocked with 5,000 or more fish per acre and are intensely managed to maintain good water quality, to promote growth and to prevent disease.

Others raise catfish as a hobby or source of supplemental income.

Channel catfish is the species of choice for most culturists in North Carolina and other states. Other species can be raised but don't produce high yields.

Most Tar Heel catfish growers are specializing in grow-out production. They stock their ponds with young catfish, called fingerlings, that measure 5 to 7 inches in length. Then they raise the finfish to a harvest size of 1 1/4 to 2 pounds, says Steve Rawls, an area aquaculture specialist with the N.C. Cooperative Extension Service.

Neil and Diane Bowen, owners of Swindell Fish Farms in Pantego, have just finished harvesting the second crop of catfish from their 48 acres of ponds and are ready for their third stocking of fingerlings.

Neil says the couple has learned a lot about fish production and hard work since beginning their operation two years ago.

"A lot of people think you throw those little fish in the pond and then go back nine months later and harvest them," Neil says. "There's a lot more to it than that."

From March until November, the prime growing season for catfish, the Bowens spend long days keeping their ponds in top shape for their fishy crop.

They watch the levels of oxygen, nitrite, ammonia and pH in the ponds. They check their fish for diseases, which are common in intensive culture situations. And they keep an eye on the blooms of algae that color the water. Algae die-off in a pond can deplete the oxygen faster than a Southerner can say aquaculture.

"Water quality is our biggest concern," Neil says. "Any stress, particularly low dissolved oxygen, can cause fish to die. That's why in the summer I'm at the ponds until twelve, one or two in the morning moving aerators and checking DO (dissolved oxygen) levels."

"As our estuaries and sounds and the fish that live in them are poisoned with pollution, more people are going to turn to the quality and assurance offered by farm-raised fish."
Neil Bowen

Do the Bowens regret the day they dug their first pond?

"Absolutely not," Neil says. "We plan to hold at the acreage we have for awhile, then expand in a couple of years. We could potentially have 1,000 to 1,200 acres of ponds in production."

Neil's enthusiasm for catfish lies in the profitability of the crop.

"It's much more profitable than growing corn, beans and wheat," he says. "On farmland, you make about $200 an acre year in and year out. With catfish, you can make $200 to $1,500 an acre."

But poor management or a quirk of fate can just as easily send your bank account tumbling.

And the Bowens caution that it can take a few years of production to pay back the start-up costs.

Rawls and Ellis agree. Both tell potential growers that catfish culture can be profitable, but there are also a lot of costs, especially in the beginning.

In some cases, investors must purchase land, dig ponds, acquire equipment and buy fingerlings. Farmers, switching from the plow to the pond, sometimes come out cheaper because they already own land and some of their equipment can be converted.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"I quickly tell people interested in investing in catfish that it is expensive and has limitations," Ellis says. "I'd rather they be discouraged from the first than invest their life savings blindly."

Ellis also tells potential producers to line up a market for their catfish before they "move any dirt for their first pond."

"There is a saying in the seafood business I always use," Ellis says. "It goes 'If you don't sell 'em, you smell 'em.' "

The Bowens are contract growers for Carolina Classic Catfish Inc., the only large catfish processor in the state. All of the product they harvest is sold to the company for processing in its Ayden plant.

In fact, most North Carolina catfish producers have contracts with Carolina Classic, a company dedicated to a high quality product, Ellis says.

And when it comes to competing with all those catfish marketed from the Mississippi Delta, quality is the factor that sets Tar Heel catfish apart, Ellis says.

Catfish harvested from the delta often have an off-flavor, which can be attributed to poor quality water. But that's not the case in North Carolina.

So what does the future hold for this whiskered finfish?

Ellis predicts that in five years at least 5,000 acres of ponds will be in production. He's had five inquiries from processors considering the possibility of locating plants in North Carolina. And Southern States Cooperative Inc. is investing $3 million in its Farmville feed plant to install equipment that will produce catfish feed.

Neil Bowen is looking expectantly to the future too.

"My wife and I think we got into this business on the ground floor," he says. "We really believe catfish and aquaculture is the hope for the future.

"As our estuaries and sounds and the fish that live in them are poisoned with pollution, more people are going to turn to the quality and assurance offered by farm-raised fish."

For information on catfish culture and production, contact Tom Ellis at the N.C. Department of Agriculture (919/733-7125).

Cajun Favorite Comes to Carolina

By Kathy Hart

The national popularity of Cajun cooking has boosted the image of the lowly crawfish. The once maligned, swamp-loving crustaceans have risen to new heights in culinary use.

Until 10 years ago, most Southerners used the small lobster-like crawfish for bait. They called them crayfish or crawdads.

But in south Louisiana, where the swamps run deep and the 'gators grow big, crawfish are as revered at Cajun tables as hot peppers and red beans.

Now folks outside the Pelican State are developing a taste for this bayou favorite. And although Louisiana still reigns king in crawfish production, farmers in other Southern states are beginning to see this crustacean as a culinary delicacy and a cash crop.

Crawfish culture is the largest crustacean aquaculture food industry in the United States. In Louisiana, 70 to 100 million pounds of crawfish are harvested annually with 60 percent of that harvest coming from ponds.

Crawfish take to pond culture like babies to milk. They flourish in less than ideal culture environments. They eat a variety of plants and animals, reproduce often and numerously, and grow quickly.

In North Carolina, crawfish aquaculture is a fledgling industry, but one that is trying to make a splash among Tar Heel consumers.

At present, there are 14 crawfish producers in North Carolina harvesting from 180 acres of ponds.

These producers harvest about 100,000 pounds of the clawed crustaceans between March and the end of June, says Steve Gabel, an area aquaculture specialist with the N.C. Cooperative Extension Service. Most of their product is sold live by the pound inside the state.

In fact, the demand in North Carolina exceeds the amount of product crawfish producers can supply, says Aubrey Onley Jr., president of the N.C. Crawfish Producers Association. Those kinds of economics have farmers taking a second look at the feisty crawfish.

"It's an excellent way to diversify your existing farming operations," Gabel says. "They're a low maintenance, low cost species to raise."

And they take less technical know-how than raising catfish or hybrid striped bass, Onley says.

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But you can't just dig a crawfish pond anywhere.

Gabel says you need flat land with enough clay content to hold water. You also must be able to pump 100 gallons of fresh water per minute per acre of pond.

Ponds vary in size, but all are shallow, about 18 to 24 inches deep.

In most cases, producers stock their ponds once with sexually mature crawfish at a rate of 50 to 75 pounds per acre. At least 50 percent of the crustaceans should be female, but it is better if the ratio is 60 to 70 percent.

Unless water quality problems occur or a reproductive class is lost, crawfish will reproduce in ample numbers to restock the pond from year to year.

Red swamp crawfish is the species of choice for culture in the Southeast. It's hardy and lays an abundance of eggs. Some culturists also stock a small percentage of white river crawfish. But it is neither as hearty nor as prolific.

In North Carolina, crawfish are harvested between March and late June using traps that work and look like crab pots.

A producer never removes all of his stock. He leaves some behind to pare next year's crop. The crustaceans breed during May and June, and the female holds the sperm until she lays her eggs.

In July, the producer begins draining his ponds at a rate of an inch per day. Meanwhile, the crawfish burrow in the muddy pond bottom. Eventually, they tunnel to a moist location just above the water table.

After the pond has been drained, the producer plants a forage crop — rice, grain sorghum or sorghum-sudan grass — to feed his crawfish when the pond is re-flooded. In most cases, the crop provides all the nourishment the crawfish need, and the producer doesn't need to supplement the crustacean's diet.

In her underground burrow, the female lays 400 to 700 eggs in August or September and holds them beneath her tail. The eggs hatch two to three weeks later but remain beneath the shelter of their mother's tail until the pond is re-flooded in late September or early October.

When the pond is re-flooded, the crawfish emerge from their burrows. During the fall and winter, they munch out on the forage crop and grow, periodically shedding their rigid exoskeletons.

By March and April, when it's time to harvest, the crawfish are a marketable size and sexually mature.

Sound easy?

It is, says Onley.

But one word of caution about the Cajun favorites: Watch the level of dissolved oxygen in the ponds. Producers should check their flooded ponds daily or every other day to make sure there is enough oxygen in the water to keep the crawfish alive. If oxygen levels get low, they should aerate the pond water.

"There's really only three ways to kill a crawfish," Gabel says. "You can poison them with an accidental spillage of pesticide, allow your dissolved oxygen to get too low or let something eat them."

At harvest, crawfish usually measure 3 1/2 to 4 inches in length. It takes 20 to 25 of the clawed creatures to make a pound.

But Onley says he trapped some crawfish in May that tipped the scales at a quarter pound each.

The production of crawfish per acre of pond varies from producer to producer, Gabel says. It depends on how intensively the producer has managed his ponds. But Gabel estimates the average production in North Carolina at about 500 pounds per acre.

For their efforts, producers could expect $2 to $2.85 per pound this year, Onley says. That dollar figure is almost double what Louisianians get for their swampy catch.

Why the difference?

North Carolina producers offer a better product, Gabel says. There's no wild catch: all Tar Heel crawfish are farm-raised.

And producers in this state purge their crawfish before they put them on the market. To purge, producers keep the crawfish alive and wet so the crustaceans will digest all of the food in their vein.

A purged crawfish translates to less cleaning before cooking for the consumer.

And what do consumers think of crawfish?

"Ninety percent of the people who try it like it," Gabel says. "But a lot of people are afraid to try something different."

The N.C. Crawfish Producers Association is working hard to introduce the Cajun favorites to Tar Heel diners. This year, the association sponsored crawfish boils at several locations across the state. At the N.C. Farmers Market in Raleigh, the association sold 1,100 pounds of crawfish in about an hour.

But in most parts of the state, the crustaceans are still a rarity on restaurant menus, in seafood markets or along grocery store seafood counters.

"People have got to tell restaurants they want to see them on the menu," Gabel says. "And they've got to ask for them at the seafood market. You have to create demand."

Meanwhile, if you get a cravin' for the Cajun crustaceans, you can contact Gabel or the Crawfish Association (telephone numbers below). They'll send you a brochure that will tell you how you can get next-day UPS delivery of live Tar Heel crawfish.

What does the future hold for these Cajun imports?

Gabel and Onley say a better image, more producers, more crawfish and the possibility of research providing an extended harvest season.

For more information about growing crawfish, contact Steve Gabel at the N.C. Cooperative Extension Service office in Edenton. His number is 919/482-8431.

For more information about buying crawfish, contact Aubrey Onley Jr. with the N.C. Crawfish Producers Association at 919/426-9980. Or write N.C. Crawfish Producers Association, P.O. Box 1030, Edenton, NC 27982.

C.R. Edgerton

What does a crawfish taste like?

Crawfish producer Dr. Clancy Ballinger of Trenton Aquaculture says their taste is most like shrimp.

Aubrey Onley Jr., president of the N.C. Crawfish Producers Association, says their taste is a cross between shrimp and lobster.

"They have a real rich flavor," Onley says.

But Joyce Taylor, Sea Grant's seafood education specialist, says, "A crawfish tastes like a crawfish."

When it comes to eating, Ballinger prefers the crustaceans cooked the Louisiana way: boiled in spices. But Onley says the way to his heart is crawfish etoufée.

How do you increase the value of a crawfish?

Allow it to shed its shell.

Buyers shell out $10 to $12 a pound for crawfish in their softened state.

Crawfish, like blue crabs, must shed their shells to grow. For a short time after they shuck their old duds, crawfish are entirely soft and can be eaten whole.

How do you find one of these cushy crustaceans?

When you harvest crawfish, you look for the signs of an impending molt and place these creatures in separate trays. When they do take it all off, you remove them from the tray and freeze them.

Aquaculture in a Class By Itself

By Carla B. Burgess

The sign outside Barry Bey's classroom proclaims aquaculture the wave of the future. With that in mind, a lot of his students are ready to "hang fin."

Take Eddie Shannon, for instance.

The 16-year-old sophomore enrolled in beginning aquaculture at South Brunswick High School last fall. It was a natural progression for Shannon.

"I've always liked fishing — it's my main hobby," he says. "I'm looking into going into the wildlife protection agency or just becoming a fish farmer."

After school, he works part-time on nearby fish farms doing whatever needs to be done — seining ponds to harvest or transport fish and cleaning the fish for sale to local restaurants. He has even helped a local fellow put in a bulkhead to control his pond erosion.

Shannon and the other students who attend Bey's vocational aquaculture classes are receiving a unique education — one that only a handful of high schools offer nationwide. At an early age, these students are getting helpful insight into the fast-growing aquaculture industry.

Shannon's classmate, Julie Lampe, 15, plans to put her expertise to work outside the classroom. Equipped with the hows and whys of aquarium maintenance, she hopes to be tending the fish tanks at the N.C. Aquarium at Fort Fisher this summer. Her goal is a career in marine biology.

In the combination classroom-and-lab, Bey's students have learned how to identify freshwater and saltwater species, how to recognize and treat fish disease, and how to manage water quality.

They have raised largemouth bass from eggs to adults. They've also reared fathead minnows, white bass, grass carp, bream, catfish, striped bass, tropical fish and frogs. They've even cultured cherrystone clams.

Outside of the classroom, they have applied their knowledge in ways that may eventually lead them to their life's calling.

When the ponds at a munitions depot at Sunny Point started drying out, it was Bey's students who joined the U.S. Army Corps of Engineers in rescuing and relocating the threatened fish.

As part of their community service duties, the students stock nearby Boiling Springs Lakes each fall with largemouth bass, bluegill and fathead minnows.

"It's become a legitimate career choice, not just an elective," Bey says of the four-year-old aquaculture program.

This model program has achieved celebrity not only in North Carolina, but nationwide. The class even captured the international spotlight last year during a television program, "Get Hooked on Aquaculture," which aired in the United States, Canada and overseas.

Bey has had no shortage of phone calls and letters from people in other states who want to know the secret of his success.

South Brunswick Principal Mose Lewis gets credit for the idea of a hands-on vocational education program about aquaculture. It made good sense in an area near 50 freshwater lakes and within 10 miles of the Atlantic Ocean.

"It had a lot of support in the community," says Bey. "Some of the first students came from fishing families."

Bey was responsible for getting the program off and running. With an associate degree in wildlife management, three years work for the N.C. Wildlife Resources Commission and the design and development of his brother's catfish farm under his belt, he plunged into his first teaching job with no fear of the water.

The program was started on less than $9,000.

"He's one of the leaders in high school education," says Tom Losordo, aquaculture specialist with the N.C. Cooperative Extension Service. Losordo has been an advisor to the program, as has Douglas Holland, president of Brunswick Aquafarms.

Carla B. Burgess

"He's into education as much as he is business," Bey says of Holland, who uses the students in the afternoon to help with his catfish harvesting. "He set up in this area because we had the available labor."

And with more than 5,000 acres of catfish ponds predicted for this locale within the next two to three years, the job market for budding young aquaculturalists looks bright.

One of the first students to complete the program is now the assistant manager at a fish farm.

"We have had some of the kids go to Cape Fear Tech and take marine biology; one girl got a job with the EPA; some others work in pet shops," says Bey.

"Some of them just go back to their families as commercial fishermen."

The most integral ingredient in South Brunswick's aquaculture program is the students, who have distinguished themselves by undertaking tough projects.

This year, they raised a tank of rainbow trout, a cool-water fish found almost solely in the mountains. The students were successful in keeping them alive despite warm climate.

But more impressive was their attempt this past spring to do a "reciprocal cross" of hybrid striped bass. In this experiment, usually attempted only by researchers and professionals, a female white bass and a male striped bass are used to achieve the hybrid.

The class decided to try the reciprocal cross because the broodstock was available. Though the spawning was unsuccessful —a trace of chlorine and uneven temperatures in the water killed the eggs — the students learned by doing.

"Even though the experiment failed, they got the learning experience from it," says Bey. "Next year, we can do it. We know the procedure now."

Bey's classes — which include a 12-week, beginning and advanced course — are a bundle of subjects in one. The program integrates science, business and even engineering. The students did all the plumbing and built all the stands for their 500-gallon circular tanks, aquariums and troughs, Bey says.

The class is not allowed to compete with local businesses, but their payoff comes in practical work experience. For example, the students maintain two ponds at nearby Walden Creek Fish Farm. They get local restaurants to buy from owner Tom Jones. With the money he makes, Jones pays the students to clean the fish.

Soon the students may have ponds to call their own. Plans are underway to construct four near the school's football field.

"They get the ideas and concepts here," says Bey. "Then they can go use what they know on the large farms."

A Barn Raising: Will it Pay Off?

By Carla B. Burgess

When it comes to studying the economics of aquaculture, North Carolina is staying in the swim of things.

At North Carolina State University, thousands of red tilapia make their home in five state-of-the-art re-circulating systems inside the largest demonstration model of its kind in the country.

It's called The Fish Barn, a project that may answer the question, "Is it economically feasible to raise fish in tanks?"

"We'll know in another year or so," says Tom Losordo in response to his own question. Losordo, an assistant professor of zoology and biological and agricultural engineering at NCSU, is the project's principal investigator and an aquaculture specialist with the N.C. Cooperative Extension Service.

In February, researchers stocked 3,375 tilapia each into four 5,500-gallon tanks and 1,800 into one 2,200-gallon tank.

Four types of biological filters, used to removed suspended solids and ammonia, are being tested in unique configurations for each tank.

Each tank can produce about 4,000 pounds of fish every six months.

Losordo says the system could be a good alternative production system for fish farmers "that don't have enough water to grow them in ponds or on the coast in an area where they can't get a permit to discharge the water to environmentally sensitive areas.

"They could run the small amount of wastewater into the sewer or use it on a garden," he says. "A thousand gallons of water would make a great lawn sprinkler and (would) be high in nitrates."

Each tank uses 100 to 500 gallons per day of new water and re-circulates 200 gallons per minute.

"The whole idea is to make it an energy-efficient and water-efficient system," he says.

But set-up costs can range from thousands to millions of dollars. That's why Losordo advises aspiring aquaculturalists to observe with optimism, but proceed with caution.

"All I say is wait. Let us spend the money first," he says. The N.C. Fish Barn represents about a $150,000 investment.

The project is a joint effort of the N.C. Department of Economic and Community Development's Energy Division, N.C. Cooperative Extension Service, N.C. Agricultural Research Service and NCSU's College of Agriculture and Life Sciences.

On this early summer morning, Losordo has just led a tour of the barn for some N.C. Teaching Fellows. He's given more than 25 tours since its opening.

"It's used as a teaching facility for whoever wants to learn — a farmer, entrepreneur or students," he says. "The whole idea behind the project is to demonstrate state-of-the-art technology and educate the public.

"We're demonstrating technology and evaluating technology at the same time," he says.

Come fall, researchers will harvest their first crop of tilapia, which will be test marketed in the United States and Europe by corporate sponsors. Losordo says tilapia can bring $1.25 to $1.35 per pound wholesale, and up to $5 a pound from gourmet restaurants.

The Fish Barn will be stocked with a second crop through the fall and winter, and researchers will attempt hybrid striped bass production next summer.

Other researchers, including some from other Sea Grant programs, are conducting experiments at the facility. A Louisiana State University researcher developed a prototype bio-bead filter that is being tested with the re-circulating tanks. "It's the first two of this size to be tried in the world," Losordo says.

This summer and fall, Losordo is conducting workshops that include a lecture on the theory behind the technology and four hours in the fish barn.

For more information about The Fish Barn, contact Losordo at 919/515-7587.

The New Greenhouse Effect: Growing Fish and Vegetables Side by Side

By Carla B. Burgess

With all the talk about chemicals in our food, excessive use of water and too much agricultural waste, it's easy to wonder if we can sustain ourselves without ruining the world.

A research group at North Carolina State University has slow-cooked a partial solution in a greenhouse.

It's called integrated aquaculture-vegeculture. It employs all those concepts that have become politically correct in the 90s — "recycling," "organic," and "conservation."

The brainchild of Mark McMurtry, who received his Ph.D. in horticultural science from NCSU, the system involves growing fish and vegetables in a symbiotic relationship.

"Mark came up with the idea of intermittently applying fish waste to a sand bed and allowing this water to drain back into the fish tank," says Doug Sanders, a N.C. Cooperative Extension Service specialist who is project coordinator and professor of horticultural science at NCSU.

The pump removes fish feces and uneaten food that accumulates at the bottom of the tank, reducing the ammonia which can kill the fish. The wastewater is pumped into a planted sand bed that filters out the nutrients, simultaneously fertilizing the vegetables. The clean water is aerated and returned to the fish tank.

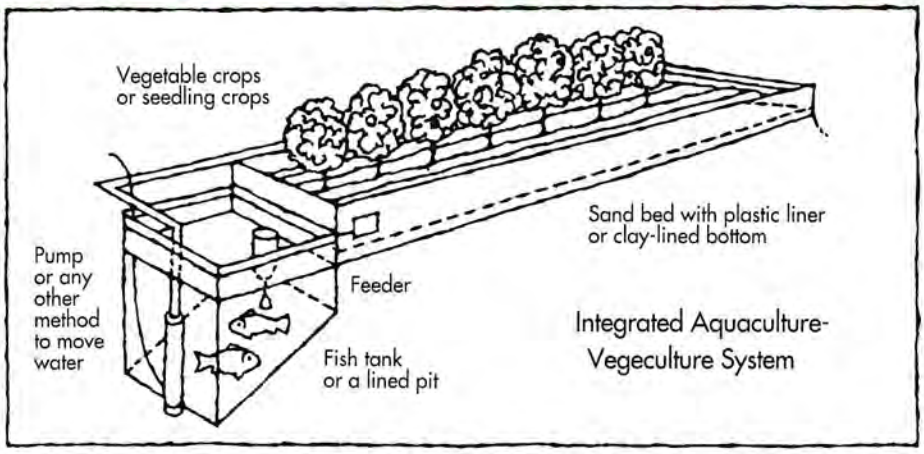
"The biofilter is the sand bed with the plants," Sanders says. "It cuts the ammonia and nitrate level in half, which is a reasonable level for the fish."

The system has produced tilapia, a hardy, disease-resistant fish native to West Africa, and tomatoes, cucumbers, lettuce and basil.

"We were able to grow all of these crops without any additional nutrients, and sometimes without liming or adjustment of the pH," Sanders says.

The system is profitable too.

According to a paper written by McMurty, Sanders and Sea Grant aquaculture specialist Ron Hodson, a one-half acre integrated greenhouse system can gross up to $240,000, a net profit of about $24 per square yard per year. A conventional vegetable greenhouse nets about 50 cents per square yard per year.



For each half acre, the integrated system can produce 92,400 pounds of fish, 110,000 pounds of tomatoes and 149,600 pounds of cucumbers per year.

It also provides year-round production of food with minimal water consumption.

"Water is added only to make up for evaporation and plant transpiration," says Sanders, adding that the water is recirculated 100 to 300 times. A given gallon of water is recycled repeatedly, staying in the tank 12 to 38 days.

The system conserves land resources through its intensified culture. It works in areas with poor soil and climate, and adapts to almost any region or culture.

It can be expanded for commercial use or scaled down for the backyard. McMurtry has drawn up a plan for high school teachers to use in developing demonstration projects for their students.

"It teaches symbiosis, re-circulation and conversion of nitrogen," says Sanders.

And what high-tech equipment would a teacher need?

"An aquarium, Rubbermaid dishpan and a pump," he says.

It can also teach small countries how to get more from their fishes and loaves.

The inhabitants of the small African country, Namibia, might use the system to raise their own native tilapia and produce a vegetable crop to feed their people. Sanders and McMurtry are working on a project that would export the system there.

But like any new idea, Sanders says it will take more time and experience to provide conclusive results to the public.

"I think it's something that has real potential," he says. "It will require a careful marketing plan to do this. There is a growing demand for tilapia."

The research group is working on a new project to develop culture practices for "continually planting and harvesting fish and vegetables," Sanders says.

Meanwhile, a cooperator in Beaufort County plans to construct a 1/4-acre demonstration system near Bath.

"While we'll be doing some experimentation, their aim is to make it commercially feasible," Sanders says.

For more information about re-circulating systems, contact Sanders at 919/515-3283, or write IAVS Research Group, Department of Horticultural Science, Box 7609, NCSU, Raleigh, NC 27695-7609.

A Boom in Backyard Shellfish Farming

C.R. Edgerton

By C.R.Edgerton

When it comes to shellfish, everyone wants to get into the act.

Clam and oyster culture claim more adherents than any other type of aquaculture in the Tar Heel state.

"There's more demand for clams and oysters," says Tom Ellis, director of aquaculture and natural resources for the N.C. Department of Agriculture. "That makes shellfish aquaculture a more viable enterprise than ever before."

About 300 people hold shellfish culture leases in North Carolina's public waters, Ellis says. "That's more than all the other forms of aquaculture combined, including trout, catfish and hybrid striped bass."

Clams, oysters, even scallops are being raised in mostly small operations up and down the Tar Heel coast.

Yet, shellfish culture is still in its infancy, at least technologically.

"We're still in the gatherer stage with shellfish," Ellis says.

And there are other problems. Fish are raised primarily on private land, but shellfish must be cultured in public waters.

"The shellfish producer must prove that what he's doing is benefiting the public," Ellis says. "That's why there's a requirement for a certain amount of production on each lease."

Then there are poachers. Thieves. Ruthless people who prey on a shellfish lease when no one's looking.

"The law has been changed in recent years to protect shellfish aquaculture as a commercial enterprise and the penalties for poaching are high," Ellis says. "But that still doesn't stop the thief."

And if that's not enough, environmental factors like pollution and disease can often ravage a shellfish operation. Most dreaded among oyster farmers are MSX and dermo, two killer diseases.

"It's hard to work an oyster bed, invest in all that time and money only to have it all destroyed by diseases," Ellis says.

When one considers the time it takes to get a shellfish lease (on the average about six to eight months), the monetary and time investment and the chance for poachers and disease, shellfish aquaculture doesn't sound like a viable enterprise.

"I wouldn't go that far," Ellis says. "Like I said, there's more demand than ever for clams and oysters. And, when you consider that the average price for a bushel of clams is about $55, it looks a little more attractive."

And sometimes it works on a large scale.

Doug Brady, owner of Otis' Fish Market in Morehead City owns the state's largest shellfish production operation. His lease includes 10 acres of shellfish bottom.

He is the only shellfish culturist to have taken advantage of a new law that allows leasing not only the bottom but the water column too.

Hundreds of thousands of clams and oysters are reaching market size on the Brady lease at Harker's Island.

But there's a cost factor involved in leasing the water column that most small-timers can't afford.

In addition to the $5 per acre fee for leasing the bottom, Brady pays another $500 per acre for the right to use the water column.

For that money, he's allowed to grow oysters off the bottom in bags suspended in the water. He also has permission to fence in his lease, effectively protecting the site from poachers and recreational water users.

"It's expensive to do it that way," says Sea Grant marine advisory agent Skip Kemp. "But if you're a big time operator, you can do it."

Kemp says Brady's operation is the exception in the shellfish business. "I don't think there's going to be any spurt of large operations coming in," he says. "In fact, we're encouraging small-time operations."

Meanwhile, Kemp and others involved in shellfish culture are trying to persuade lawmakers to change legislation in favor of shellfish leaseholders, especially oyster growers.

"The law needs to change in how oyster culture methodology is defined," Kemp says. "Oysters grow better when they're kept off the bottom and grown in modular containers. Now, the law doesn't allow that unless a water column lease is obtained. And that can be expensive."

One state that has responded to the particular needs of oyster growers is Florida, where culturists are allowed to use up to 12 inches of the water column without acquiring an expensive lease.

A free water-column permit is available to Tar Heel shellfish growers only if the use of the water column is experimental and in small amounts. The permit does not allow commercial-sized ventures.

Meeting the Big Sweep Bunch

Big Sweep is back with a brand new bunch of friends to help tackle the problem of trash in our oceans, rivers and lakes. We call them "The Big Sweep Bunch."

Litter is not only ugly, it can be harmful or even deadly to living creatures.

When Sept. 21 rolls around, these five litter busters will be there with trash bags to help keep our shores safe for wildlife and human life too! You can join them.

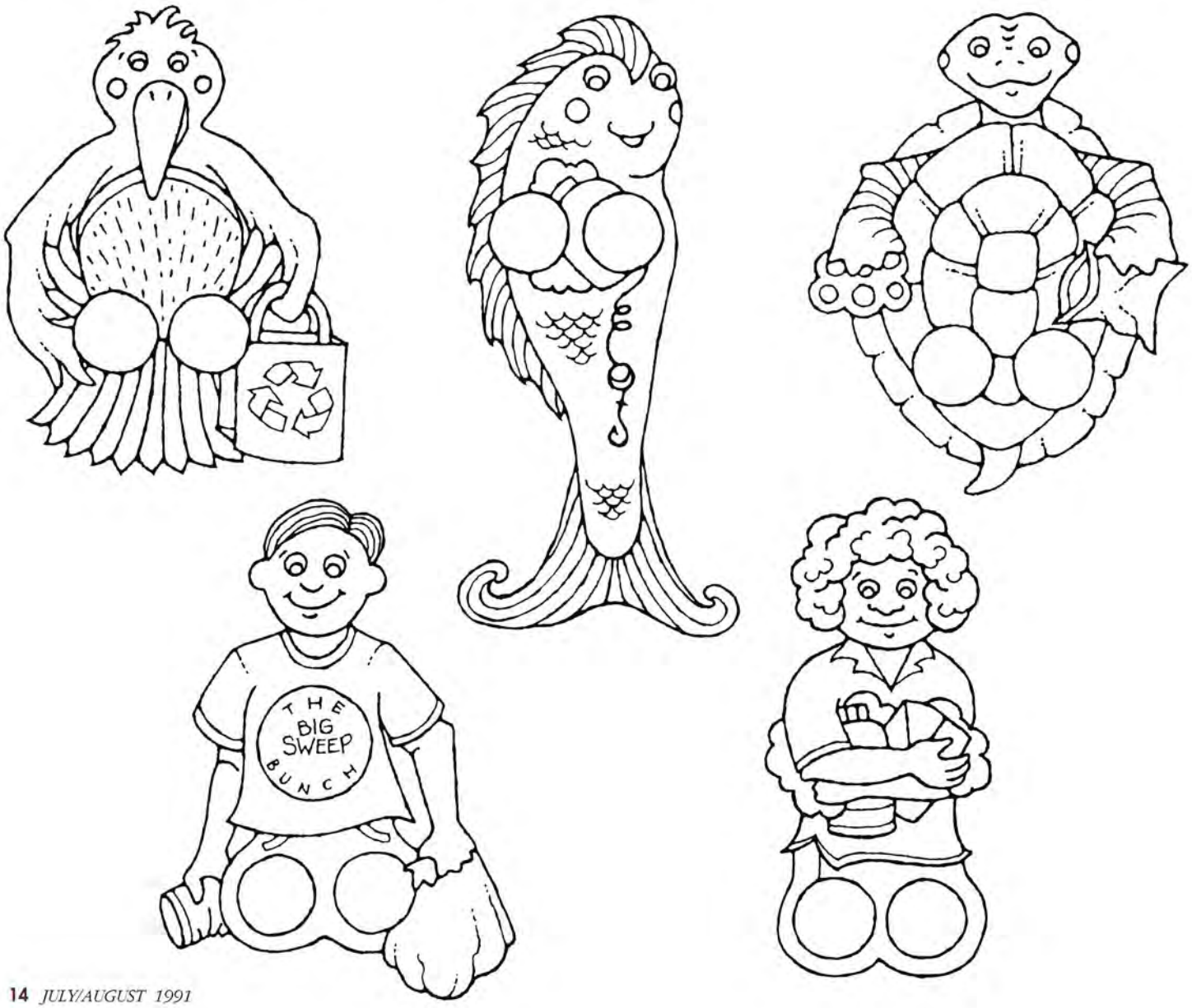
We've provided these finger puppets for you and your friends to play with. Just get a parent or a teacher to photocopy them on thick paper, enlarging them so that they're about 5 inches tall. Color them; carefully cut them out; and they're ready to go!

Our girl, boy, fish, turtle and bird haven't been named yet. Think of some creative names for these heroes of the environment, and use them in your puppet shows. Write and tell us what you named them. We'd love to hear your ideas!

Our address is The Big Sweep, Box 8605, North Carolina State University, Raleigh, NC 27695.

Have fun!

Carla B. Burgess



From Sound To Sea

Natural Wonders of the Coast

Striped Bass: A Heritage of Good Taste

Twenty-five years ago, anglers could wade knee-deep in the Hatteras surf, cast a line just beyond the breakers and expect the tug-of-war it took to haul in a 40-pound striper.

Not anymore.

Stripers, more correctly known as striped bass, have suffered sharp declines in populations all along the East Coast during the last 20 years. The reason? Pollution, overfishing and loss of spawning habitat.

In fact, populations became so scarce that federal and state fishery resource managers along the Eastern Seaboard slapped a bevy of regulations, restrictions and moratoriums on the recreational and commercial capture of stripers.

Everyone was interested in rescuing the fish that meant so much to sportsmen, commercial fishermen and the history of this nation.

From his Jamestown settlement in Virginia, Captain John Smith made early note of the abundance and size of the striped bass he found in the rivers of the Chesapeake.

"The Basse is an excellent Fish, both fresh and salte," he wrote. "They are so large, the head will give a good eater a dinner, and for daintinesse of diet they excell the Marybones of Beefe. There are such multitudes that I have seene . . . so many as will loade a ship of 100 tonnes."

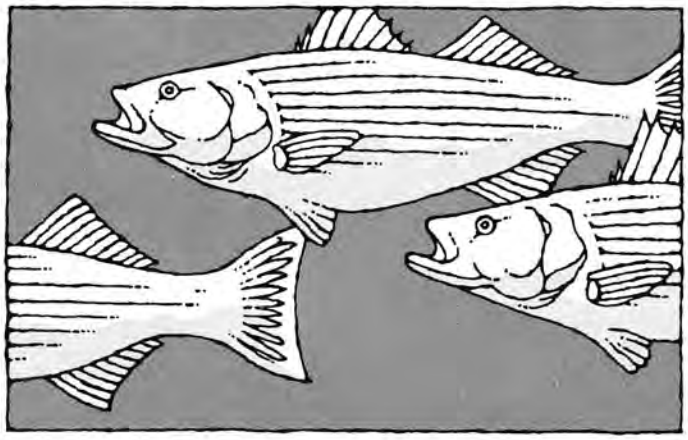
The Plymouth colonists also found the striped bass in ample supply and made them a regular part of their diet. In fact, they preferred the stripers to salmon.

The Massachusetts colony became so zealous in their consumption and use of striped bass as a fertilizer for farm crops that harvests diminished. In 1639, the Massachusetts Bay Colony ordered that neither striped bass nor cod could be used as fertilizer.

A subsequent act in 1670 declared that income derived from the Cape Cod striped bass, mackerel and herring fisheries be used to build a free school. This legislation resulted in the first public school in America. It was made possible largely through the sale of striped bass.

After the colonial period, striped bass were abundant along the East Coast. Prior to the Civil War, stripers became a fashionable sport fish, and after the war, associations of sportsmen dedicated to their capture were formed in New England.

Stripers are distributed along the Atlantic Coast from the St. Lawrence River in Canada to the St. Johns River in Florida. Biologists divide East Coast striped bass into nine populations,



which are associated with their spawning rivers. Two of the populations, Roanoke River/Albemarle Sound and Cape Fear, call North Carolina home.

Most striped bass are dark olive-green to dark gray along their backs, silvery along their sides and white on the belly. They have seven or eight dotted dark stripes along their sides.

Striped bass, like salmon, are anadromous. They move from the ocean up rivers to spawn in fresh water.

Spring is spawning season for stripers. They like to choose river areas where the water is fast-moving or turbulent.

One large female striped bass is surrounded by several smaller males. The bass begin thrashing the water in a courtship ritual fishermen call "rock fights." During the fight, the female releases 3 million to 4 million eggs that the males fertilize.

If not caught, striped bass can grow to be large. A seven-year-old fish can weigh 20 pounds and measure 36 inches in length. By the time a striper reaches the age of 14, it can weigh 40 pounds and measure 40 to 42 inches in length.

The largest striper ever caught tipped the scales at 125 pounds. It was caught in Edenton in 1891. Biologists estimate that the fish measured at least 6 feet in length.

Although sportsmen love to haul in the big stripers, it's the smaller ones that make better table fare. Striped bass are best eaten when they weigh 6 to 8 pounds. As the fish grows heavier, its flesh becomes more coarse.

Today, because of catch restrictions, it's rare to see a striper grace the table. But fishery resource managers are hoping that fishery restrictions and hatcheries will once again boost populations of this popular fish.

Kathy Hart

Encouraging Oyster Culture

As he drives past a mountain of wood chips at the Morehead City port, Skip Kemp's eyes brighten for a moment.

"Hey. Oysters like to settle on wood. If I could use wood chips for cultch material. . ."

He fishes a notebook from his hip pocket and writes, steadying the steering wheel with his other hand.

"If I don't write it down, I'll forget it," he says, laughing. "I must be getting old."

Ideas are a major part of Kemp's job. As a Sea Grant Marine Advisory Service agent, he's expected to help others come up with better ways to use coastal resources.

Recently, he assembled his years of practical and applied research into a manual on how to raise hard clams on leased estuarine bottom.

The manual, published by Sea Grant, is going like hotcakes.

These days, Kemp is concentrating on growing more and better oysters on that same estuarine lease.

"We've pretty much got clams down pat," he says. "Now, we want to grow more oysters."

He pulls into the driveway at Charlie G. Brown's home near Harker's Island.

Brown walks with Kemp to the shallow sound bottom behind the house. The tide is low, and several clam and oyster beds are exposed to the morning sun.

He calls the Brown "farm" an ideal situation. "The water is right; the bottom is sandy. It's just that, until now, there was nothing for the oyster spat to settle on. Since we laid out this cultch material, this place will be productive for oysters."

He turns over a few cultch shells. Oysters are forming in clusters on some of them. The method seems to be working.

C.R. Edgerton

"We've got a long way to go to in oyster culture," Kemp says. "But we keep working on it."

Here are a few of Kemp's tips on how you can raise oysters — for your own use or for sale — on leased estuarine bottom.

• Check the area to see if there are oysters already there. If there are a few, chances are the site will be good for oyster culture. Contact the N.C. Division of Marine Fisheries, and tell them of your intentions. They'll tell you if your site is closed because of pollution or disease. They'll also tell you if salinity levels are high enough for oysters.

• DMF will check your site for shellfish culture. If it's a natural shellfish bed containing 10 or more bushels per acre, they won't grant you a lease. Otherwise, they'll recommend that you apply for a lease. The non-refundable application fee is $100, and it could take about six to eight months for approval. If approved, the lease fee is $5 per acre per year, with renewal required every 10 years.

• When you have your lease, plant cultch material — shells or marl to which small oysters can attach. Oyster shells are best for cultch. Put the cultch out in summer when oysters are spawning. Contact DMF for facts on relaying oysters from polluted areas.

• Monitor and manage your lease. "You can't just leave them out there without putting some work into the lease," Kemp says. Keep the cultch clean and free of silt and other material.

• Harvest your oysters in two to three years. "It's not a fast process by any means, and the grower should be patient," Kemp says. Oysters will grow faster if they are growing off the bottom, but that requires a water column lease, which is $500 per acre per year.

• Sell your oysters to individuals or to restaurants if you have small amounts, or to seafood dealers if you have larger quantities. Dealers pay less. Do a little legwork, and find out when prices are higher. Leaseholders can sell when the season for natural harvest is closed, and they can also sell oysters smaller than the 3-inch size limit for natural oysters.

If you're interested in oyster culture, contact Kemp at his office in Atlantic Beach. His number is 919/247-4007.

C.R. Edgerton

Field Notes

Insights into Current Sea Grant Research

Secrets of Striper Spawning

They call it squeezin' season.

Every spring Sea Grant Associate Director Ron Hodson and North Carolina State University zoologist Craig Sullivan become midwives, directing the birth of thousands of hybrid striped bass fingerlings.

It all takes place at the Pamlico Aquaculture Center in Beaufort County.

And it's all part of a program designed to control the life cycle of the striped bass. With that kind of control, broodstock — fish used for breeding purposes — can be domesticated. With domesticated broodstock, the infant hybrid striped bass industry could take off like a space shuttle.

But why "squeezin' season?"

Striped bass females and white bass males are caught in the wild during spawning season in North Carolina lakes and rivers and brought to the center.

There, they are injected with hormones that will increase the spawning urge and encourage the ripening of the female eggs. Males are injected with hormones to increase sperm production.

Then Hodson and Sullivan begin their watchful vigil. In about 36 hours, the fish are ready for the careful hands of the researchers.

When their eggs are ripe, the female fish are anesthetized and their lower bodies are squeezed. The eggs, resembling a frosty lemon-lime drink, are deposited into a metal tray. The sperm from the male fish is mixed with the eggs until Hodson and Sullivan are sure fertilization takes place. The fertilized eggs are then placed in cylindrical jars where they are held in suspension by circulating water, much like they would be in nature. In two days, the eggs hatch into "fry."

Scott Taylor

It's a complicated process that Hodson and Sullivan hope to make easier.

The best way to simplify it, they say, is to develop domesticated broodstocks and methods for spawning them on demand. Discovering this secret will give the hybrid striped bass industry the lift it needs.

"This is what we call 'closing the loop,' " says Hodson. "It means having complete control of the fish, from start to finish."

Unlike most other fish that are farmed, the striped bass presents some unusual problems in the creation of domesticated broodstock.

"Striped bass is considered more difficult to domesticate than white bass, and that's what we're concentrating on," he says. "The specific details of spawning have been totally unknown. We don't know what reproductive hormones control the process. Those kinds of things."

Hodson and Sullivan's research will focus on three areas: developing reliable methods of reproducing broodstock on demand using injectable hormones; acquiring a basic working knowledge of maturation of striped bass; and using the new knowledge to shift the spawning season to desired times.

Gaining this much control of the life cycle of the striped bass would have a threefold advantage over current methods, Hodson says.

First, broodstock supplies would be guaranteed. Hatchery operators would have a reliable way of predicting spawning times and approximating the numbers of fingerlings that might be available.

Second, the impact of hybrid striped bass aquaculture on wild stocks of striped bass would diminish significantly.

And third, controlled spawning would open the door to year-round production of fingerlings and selective breeding of superior genetic strains.

C.R. Edgerton

The Aft Deck

A Bulletin Board of Updates and Events

First Citizens Bank Joins Cleanup

First Citizens Bank has been named the title sponsor for Big Sweep '91. The Sept. 21 cleanup will now be called the First Citizens Bank Big Sweep '91.

The bank will aid in the production of promotional materials that will encourage public participation. Its branches, which number more than 300 statewide, will serve as distribution points for Big Sweep brochures that will provide site locations and contacts.

In addition, First Citizens employees will be out in force on cleanup day to help clear litter from our state waterways.

"We're extremely pleased to have First Citizens Bank become part of The Big Sweep '91," says coordinator Lundie Spence, Sea Grant's marine education specialist. "We're happy that they are concerned about environmental issues, particularly the problem of litter in our state's waterways.

"By joining our cleanup effort, First Citizens is helping The Big Sweep make a commitment to the people of North Carolina to reduce waterway litter," Spence says. "That's a commitment to be proud of."

Stop by a branch of First Citizens Bank at the end of August to pick up a brochure. And take a moment to thank the branch manager or teller for helping to make The Big Sweep possible.

Other sponsors of this year's event or educational efforts include: ALCOA, R.J. Reynolds Tobacco Co., N.C. Wildlife Commission, N.C. Wildlife Federation, N.C. Beer Wholesalers Association, MCI and Texasgulf Inc.

The Big Sweep is coordinated by: UNC Sea Grant, N.C. Division of Coastal Management, N.C. Parks and Recreation, N.C. Division of Environmental Management, N.C. Division of Water Resources, N.C. Wildlife Commission, N.C. 4-H, Keep America Beautiful, Keep North Carolina Clean and Beautiful, Western North Carolina Development Association, WGHPiedmont 8, WRAL-TV, WSOC-TV, WLOS-TV, WWAY-TV and WITN-TV.

C.R. Edgerton

Big Sweep '91 Set for Sept. 21

The First Citizens Bank Big Sweep '91, the nation's largest statewide waterway litter cleanup, will be held Saturday, Sept. 21 from 9 a.m. to 1 p.m.

More than 18,000 volunteers are expected to turn out at approximately 200 sites across the state to remove debris from our shorelines — lakes, rivers, creeks, estuaries and beaches.

We want to rid our waterways of litter because it can be harmful to people and wildlife. Every year, birds become entangled in abandoned fishing line and die; turtles strangle after eating discarded plastic bags; and fish become ensnared in six-pack yokes.

On Big Sweep day, volunteers collect two things: litter and data. As they bag their trash, they record their finds on data cards. The collection of this data is an important part of Big Sweep because it helps organizers pinpoint the types and sources of North Carolina's waterway litter.

If you want to volunteer on Sept. 21, stop by your local First Citizens Bank branch at the end of August and pick up a brochure with the cleanup sites. Or phone The Big Sweep MCI hotline at 1-800-27-SWEEP after Aug. 1. Volunteer operators will be standing by to direct you to cleanup sites in your area.

If you know of a waterway that needs a thorough cleaning, contact Big Sweep headquarters at the Sea Grant office in Raleigh at 919/515-2454. We'll direct you to a regional coordinator in your area.

If you have other questions about the cleanup or would like to support the cause by purchasing a T-shirt, contact us at 919/515-2454.

We hope you'll be a part of the First Citizens Bank Big Sweep '91. It's good, clean fun.

"Don't Leave Your Butt on the Beach"

Cigarette butts were the most prevalent item bagged on beaches during fall 1990 cleanups along the shores of 26 states and three U.S. territories. Volunteers collected 531,828 butts, or the equivalent of 26,591 packs of cigarettes.

Although many smokers are obviously using our nation's beaches as ashtrays, Lundie Spence says the use is probably unintentional. Spence is coordinator for the First Citizens Bank Big Sweep '91 and Sea Grant's marine education specialist.

"Many people think filters are paper and will easily degrade," says Spence. "They flick the butts aside without a second thought."

But the truth of the matter is that most cigarette filters are made of cellulose acetate, a synthetic material that is classified as plastic. And plastic lasts for decades.

"We feel smokers just need to be

educated about the problem," Spence says. And R.J. Reynolds Tobacco Co., one of the world's largest manufacturers of cigarettes, agrees.

R.J. Reynolds is joining the First Citizens Bank Big Sweep '91 with a "Don't Leave Your Butt On the Beach" campaign that the company is launching at 30 selected beaches across the nation. Wrightsville Beach is one of the designated beaches.

They will be using billboards and tentcards in local businesses to display their cleanup message.

"We're happy that R.J. Reynolds is joining us." Spence says. "It's nice to see a company such as RJR work with their consumers to make them aware of our litter problem. It's such a positive, pro-active stance."

How to Stay Tuned to Big Sweep '91

If you want the latest news about the First Citizens Bank Big Sweep '91, tune in to one of the television stations helping to coordinate this event.

In Greensboro/High Point/Winston-Salem, turn to WGHPiedmont 8 for news, features and updates about the Sept. 21 cleanup. In the Triangle, watch WRAL; in Wilmington, WWAY; and in the northeast, WITN. For mountain viewing, catch the evening news on WLOS, and in Charlotte, WSOC is the station to watch.

This year will be second year most of these television stations have helped to bring more information about The Big Sweep to North Carolina citizens.

"Each station has made a commitment to help their viewers become more environmentally aware," says Kathy Hart, Big Sweep publicity coordinator and *Coastwatch* editor. "The stations have helped us make so many more people aware of this cleanup. Their involvement has been invaluable."

Seafood and the Environment Symposium

Sea Grant's seafood extension specialist David Green has organized a multi-faceted Seafood and the Environment Symposium to be held in Raleigh Sept. 29 through Oct. 3.

The four-day symposium will kick off with a reception Sunday night. The Tropical and Subtropical Fisheries Technology Conference will meet from Monday through noon on Tuesday. Attendees will exchange information about the latest developments in seafood technology from production to utilization.

Tuesday afternoon, participants will receive a short course on water quality, pollution prevention and regulations on seafood residues/wastes. Tuesday night, exhibitors will be on hand to display the latest in food processing equipment and ingredient supplies.

Wednesday, the focus shifts to pollution prevention in the seafood industry as the 1991 Seafood Environmental Summit begins. The summit will focus on water quality and waste reduction in the seafood processing industry.

Fishermen, seafood dealers, processors, government personnel and researchers should attend. The registration fee is $160.

For more information about the conference, contact David Green at the NCSU Seafood Laboratory in Morehead City at 919/726-0254.

Sea Grant Publications Are Winners

S.E.A. LAB: Science Experiments and Activities is a winner. Judges for the Society of Technical Communication's International Publication Competition presented an Award of Merit to Sea Grant for its high school curriculum guide for science teachers.

The award was based on the writing, editing and design of the 200-page book. *S.E.A. Lab* also won a Distinguished Technical Communication award from the Carolina Chapter of the STC. This award qualified the book for the international competition.

Coastwatch also won a Carolina Chapter Award of Excellence.

Scott Taylor

Big Sweep Lauded as Environmental Success

The Big Sweep continues to bolster its national reputation as a significant environmental event.

The nation's first statewide waterway litter cleanup has been accepted for listing in the 1991 *Environmental Success Index*, a unique clearinghouse of environmental information made available to key public and private decision makers.

Being part of the ESI means that Big Sweep will be promoted as a model program.

Tina Hobson, spokesman for the ESI, says Big Sweep's application was subjected to "a rigorous verification process" before being chosen for listing.

Now policymakers, politicians, citizens' groups, and public and private organizations will be able to apply the knowledge gained by Big Sweep volunteers to their own litter cleanup campaigns.

And there's more.

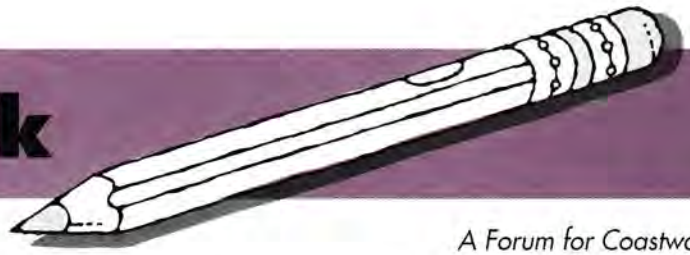
The Big Sweep has again won the prestigious Take Pride in America national award.

For the fourth straight year, The Big Sweep has been recognized with one of the nation's top environmental kudos.

The award was presented in Washington, D.C. on July 22.

"Of course, we're very proud of what The Big Sweep has accomplished over the years," says Lundie Spence, Sea Grant's marine education specialist and coordinator of the annual waterway cleanup. "And we're always striving to do more to make our environment cleaner and safer."

Back Talk



A Forum for Coastwatch Readers

Coastwatch wants to hear from you on topics relating to the North Carolina coast. Letters should be no longer than 250 words and should contain the author's name, address and telephone number. Letters may be edited for style. Send all correspondence to *Coastwatch*, UNC Sea Grant, Box 8605, North Carolina State University, Raleigh, NC 27695. Opinions expressed on this page are not necessarily those of UNC Sea Grant employees or staff.

A Future Surf Fisherman?

Dear Editor,

I have been a *Coastwatch* subscriber for so many years I can't remember. This is an excellent publication, and I will be pleased to continue under the paid magazine concept.

However, I'm writing you for another purpose. We have been vacationing on the Outer Banks, specifically Ocracoke, for the last 15 years. This year I would like to take up surf fishing. This is where I hope you can help me.

I know nothing about surf fishing. What equipment do I purchase? What fish do you catch? Where and how do you catch them? And last, but not least, when you catch a fish how do you know what you caught and if you can eat it?

Could you please send me information about the above, or point me in the right direction to get this data.

A surf fisherman to be,

Robert C. Ashman, Muncy, Penn.

The best place to learn about surf fishing is in the surf. Fishing is a fine art, one that can't be taught entirely from books.

You need to talk to the experts, those men and women who spend a good portion of their time and effort practicing the art. Ask them. They'll tell you what kind of equipment you'll need and what type of bait to use. They'll show you how to cast a line, tie a leader, cut a shrimp, slice a squid.

But don't be surprised if they refuse to show you their favorite fishing holes. No fisherman is expected to go that far.

Sea Grant can help you in one area, though. If you're not sure whether the fish you've caught is edible, send for our publication "Recipes With a New Catch." Our series of brochures on underutilized species can help also. The recipe book is $2. Ask for publication number UNC-SG-86-06. The brochures are $2 for the two sets. Ask for publication numbers UNC-SG-85-09 through 85-18 and UNC-SG- 86-13 through 86-18.

Finally, you might want to contact the folks at North Carolina State University who sponsor the annual Sport Fishing School. There are two sessions each year. For information, contact Mac Currin, Box 7617, NCSU, Raleigh, NC 27695-7617.

A Few Encouraging Words

Dear Editor,

Enclosed is my check in the amount of $12 for a subscription to the "new" *Coastwatch*. The format sounds great and I wish you every success.

Thank you for the "old" *Coastwatch*. It has been most interesting and educational.

Neil A. McNeil, Fayetteville, N.C.

Concerned About Oyster Clusters

Dear Editor,

I would like to see an article on digging clams and gathering oysters. I am always concerned about where it is safe (i.e. non-polluted) and not damaging young clams and oysters. I hear people say they get clusters of oysters. It seems to me that the mature oysters should be broken away from the young ones on the cluster with the young oysters and the cluster thrown back to grow.

I have enclosed my check for the subscription. I think *Coastwatch* will be a successful magazine if you can show people how to use coastal resources in such a way that we can preserve and grow rather than destroy.

Keep up the good work.

Elisabeth Mikulewicz, Wilmington, N.C.

Harvesting oysters and other shellfish in polluted waters is prohibited by law. These waters are usually clearly marked by warning signs erected by the state's Division of Marine Fisheries. The division monitors the waters to make sure illegal harvesting is not taking place.

Often, the division will allow relay of clams and oysters from polluted to non-polluted waters. These shellfish can be harvested and sold only after they purge themselves of pollutants (24 to 48 hours).

Oysters do grow in clusters and, unfortunately, some people harvest them without regard to size. North Carolina law forbids the harvesting of oysters less than three inches long. If someone finds a cluster of mixed sizes, the smaller ones must be broken off where feasible and returned to the water.

For more information concerning fish and shellfish regulations, contact the N.C. Division of Marine Fisheries in Morehead City at 919/726-7021.

The Book Store

Publications to Enrich Your Coastal Library

It's time for teachers to start thinking about new rosters of students and lesson plans. As you plan for the school days ahead, why not add a little marine science to your classroom curriculum? Sea Grant has a wealth of marine science curriculum guides for teachers from kindergarten through high school.

ELEMENTARY EDUCATION

There's no better way to learn than by doing.

And that's the concept behind Sea Grant's *Coastal Capers: A Marine Education Primer.* This booklet offers 20 hands-on activities that teach grade-schoolers about the coast.

For instance, children learn how to weave a marine food web and how to clean up an oil spill of their own making. By designing their own aquatic creatures, children learn how fish adapt to their environment.

The activities sharpen student skills in science, mathematics, language arts, social studies and art.

For a copy of *Coastal Capers*, write Sea Grant. Ask for UNC-SG-84-05. The cost is $3.50.

AN EARLY EDUCATION ABOUT LITTER

Many of our adult patterns and habits are set in childhood.

That's why The Big Sweep, North Carolina's statewide waterway litter cleanup, began its educational effort with grade-schoolers.

Ripples: A Big Sweep Elementary Activity Guide is a collection of 16 activities that teach children about the effects of litter in our aquatic and marine environment.

Children can solve a litter crossword puzzle, simulate animal entanglement with a rubber band or learn how to turn their trash into treasure.

The activities are designed for 9- to 11-year-olds. But some of the ideas can be modified for younger or older children.

Ripples is ideal for use in the classroom, Scout meetings, 4-H gatherings or church school — anywhere children can be taught stewardship of our aquatic resources.

For a copy of this Big Sweep guide, write Sea Grant. Ask for UNC-SG-90-02. The publication is free, but please enclose $1 to cover postage.

MANUALS FOR MIDDLE SCHOOL

For middle school science and social studies educators, Sea Grant offers four marine education manuals designed to bring the coast to the classroom.

Each manual has a similar format. Activities and laboratory exercises provide students with hands-on experience. Additional resources, films and references are listed.

* *Unit One, Coastal Geology* (UNC-SG-78-14A) focuses on plate tectonics, development of North Carolina's coastal plain, and the wind and water movements that shape the barrier islands and sounds.

* *Unit Two, Seawater* (UNC-SG-78-14B) concentrates on tides, waves, ocean chemistry and seawater biology.

* *Unit Three, Coastal Ecology* (UNC-SG-78-14C) provides an introduction to marine organisms in North Carolina — where they live, the adaptations that allow them to live in these areas and the interrelationships of marine organisms and their habitats.

* *Unit Four, Coastal Beginnings* (UNC-SG-78-14E) centers on the past cultures of coastal people. It explores anthropological techniques used to study old cultures, Indian culture prior to 1585, early explorations of North Carolina and patterns of colonial settlement.

All of the manuals are available from Sea Grant. Please specify which you are ordering. Unit One costs $3.50. The other units are $2 each.

HIGH SCHOOL EXPERIMENTS

From designing a dichotomous key for seashells to learning about salinity stratification in the estuary, understanding marine concepts can be an exciting part of high school science.

Sea Grant has a manual, *S.E.A. Lab,* designed to help high school chemistry, biology and physics teachers add marine science concepts to their curriculums.

The 200-plus page book includes 60 activities that will help students learn about the physics of waves, the biological clocks of ocean creatures and the behavior of gases in the marine environment. And there's lots more.

For a copy of this illustrated manual, write Sea Grant. Ask for publication UNC-SG-90-01. The cost is $12.

When ordering Sea Grant publications, please include your mailing label from Coastwatch or the customer identification number that appears above your name. This will speed delivery. Also be sure checks are made payable to Sea Grant unless otherwise specified.

Send all publication requests to: Publications, Sea Grant Box 8605, North Carolina State University, Raleigh, NC 27695. If you wish to order multiple copies or need further assistance, contact Carole Purser, publication distribution manager, at 919/515-2454.

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