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**Proceedings From the  
Fourth North Carolina**

**Marine  
Recreational  
Fishing  
Forum**

**Marine Fisheries  
at the Crossroads**

**March 4, 1995**

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Proceedings from the  
Fourth Annual North Carolina Marine Recreational Fishing Forum

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National Marine Fisheries Service — Beaufort Laboratory  
National Marine Fisheries Service — Southeast Regional Office

This forum was convened March 4, 1995, to provide the latest information on fisheries management issues and research that affects the recreational fishing industry.

Moderated by Jim Murray, director of Marine Advisory Service for the N.C. Sea Grant College Program  
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Jim Murray is the director of the Marine Advisory Service for the North Carolina Sea Grant College Program.

The Fourth Annual North Carolina Marine Recreational Fishing Forum focuses on recent initiatives for establishing effective fisheries policy and management in North Carolina. The forum concurs with efforts by legislators to make fundamental changes in fisheries policies. The panels feature members of the recreational and commercial sectors in an effort to bring together ideas from both communities. The proceedings are published as a public record for the benefit of students, educators and interested citizens.

### Rebuilding Marine Fisheries Through Fundamental Changes in Management Programs

The State of Marine Fisheries and  
New Directions for the N.C. Division of Marine Fisheries

Jess Hawkins is a district manager for the Division of Marine Fisheries and an assistant to the director.

North Carolina is blessed with vast natural marine resources. An example is the Pamlico Sound complex — one of the largest sound complexes in the United States — which spans 2.2 million acres of estuarine habitat. The state boasts hundreds of thousands of acres of nursery areas. The influx of currents from the north and south provide a rich and productive mixing ground off the coast.

Various governmental jurisdictions have been carved to effectively manage these resources, including state and federal councils, the Atlantic States Marine Fisheries Commission (ASMFC) and the Wildlife Resources Commission. These groups face tremendous challenges in effectively managing the state's resources. They're challenged with implementing new regulations to protect an array of species. Striped bass, of course, is a species that has been protected. But new regulations also affect weakfish, summer flounder, bluefish and other species.

I want to discuss the operations and structure of the Division of Marine Fisheries in terms of 1) the division's research activities and 2) ways to improve the management structure and its effectiveness in working with the public.

Collecting reliable data on fishing effort is vital for determining the health of North Carolina's fisheries. For that reason, the division has initiated the "trip ticket program," which surveys commercial fishermen about their activities and catches. Biologists have used the information to help improve management of a variety of species, including weakfish and tuna. Without support from officials and the public, however, funding for the program could eventually be eliminated. We encourage you to support this program.

The division also coordinates a recreational fishing survey, which has expanded steadily since its inception in

1987. This survey is an extensive project that provides information on fishing harvest, effort and participation. Its sample size has become the largest in the United States, providing extremely useful and reliable data. One important aspect of the program is the basic information it provides on catches and percentages of specific species caught each year.

The division also coordinates a variety of other research programs and surveys that focus on both commercial and recreational fisheries. For example, data are gathered on the quantity, size and age of catches from the fly net, long haul and gill net fisheries.

Bycatch reduction has become an important part of the division's work. Division laboratories have generated some of the country's most extensive research on finfish bycatch reduction in shrimp trawls. The economic viability of the shrimp fishery in North Carolina makes this research extremely important. The state leads the Southeast in developing finfish excluding devices, also called bycatch reduction devices, which allow small fish to escape commercial shrimping trawls.

The division has also initiated a computerized geographic information system (GIS), which will enable the division and the public to identify valuable nursery resources, maximizing their protection and effective management. Data generated from the GIS project will help the division in its efforts to map the state's extensive grassbeds, a vital habitat for juvenile fish and shellfish. North Carolina has the second largest quantity of East Coast grasslands, behind Florida, which lends importance to this project.

Overall, extensive data are being collected. The ASMFC is targeting a variety of areas, including quotas and allocations, stock assessments and regulation. We are also working with other states to compare regulatory options.

The next part of this talk addresses the structure of the division and how the public service agency is involving the public in fisheries management. Several new projects were initiated last year, in part through new funding from the state's General Assembly.

The first change involves our approach for creating new fisheries management policy in North Carolina. We hope to produce two or three plans annually and involve the Marine Fisheries Commission, the public and other agencies in the process.

Internally, the division has also initiated a process of goal-setting. Establishing goals, objectives and priorities for three and five years will have long-lasting effects on the division's effectiveness. We look forward to Bruce Freeman, our new director, putting his imprint on this process.

We will soon hire a population dynamist, a person who will compile the data from the projects that I've discussed. This person will interpret the fishing effort data to help determine the sustainability of the resources. With good data collection, programming and interpretation, we can effectively determine optimal stock levels for sustainability.

We are also planning to hire a person to evaluate the social impact of new regulations and to evaluate social and economic aspects of the fisheries. We have often relied on comments from the public to help understand these dimensions of fisheries management. The new staff member will facilitate and evaluate this input.

These new positions are part of our effort to upgrade staff. You've heard stories about how we have had the same number of officers in North Carolina for decades, covering many acres of estuarine habitat. We recognize the need for more officers to protect our resources, so we are upgrading staff training and equipment.

A law passed this year through efforts by the Marine Fisheries Commission will help the division recover replacement costs for fishing. Replacement costs are based on the monetary values of an organism. Fishermen who catch fish illegally can now be charged fines that will be applied toward replacing that species. This law will also allow us to recover investigation costs. For example, if a group of people were charged with catching striped bass out of season after a lengthy investigation, we would be able to recover the costs of that investigation. This is a powerful tool for better resource management.

In another new development, the Marine Fisheries Commission has been separated into nine distinct committees to address specific problems more effectively. About 100 advisors serve on these committees.

We have also developed a citation program, headed by Dale Ward. The program awards certificates for species caught that are of merit and notable weight.

Nancy Fish has been hired to help disseminate information about fisheries issues. One of her projects is a quarterly newsletter, which will provide information to the public in a responsible context.

Mike Marshall is in charge of the artificial reef program. This year he will publish a guide on the reefs, with maps, Lorans and other information to help people locate the reefs.

The division is also heavily involved in one of the state's biggest fisheries issues — the licensing moratorium. The moratorium was implemented by the N.C. General Assembly to help define commercial fishermen and recreational users and to evaluate the structure of the commission and the state of marine fisheries.

One million dollars was allocated to enhance fisheries resources through the Fisheries Resource Grant Program. On March 3, the commission helped review proposals for the program. I want to emphasize that we will manage resources better if we focus on the resources first. That way, we are more likely to go forward than backward.

**Lewis Biggerstaff:** Is there any thought about a trip ticket for recreational fishermen?

**Hawkins:** We have talked about that, but most of the talk has

been about trying to inventory recreational fishermen so we know who they are. Mike Orbach will talk about creating a system to determine how many recreational fishermen we have and what they are catching. That project is several years down the road; before we can implement a trip ticket for recreational fishermen, we need to define who they are.

#### **How the Atlantic States Marine Fisheries Commission Affects North Carolina Recreational Fishermen**

**George Lapointe** is director of the Interstate Fisheries Management Program for the Atlantic States Marine Fisheries Commission.

My talk is about the Atlantic States Marine Fisheries Commission (ASMFC) and how it affects North Carolina recreational fishermen.

The ASMFC is made up of 15 East Coast states from Maine to North Carolina. Each state has three commissioners. One is the director of the state's marine fisheries agency, another is a legislator from that state and the third is a governor's appointee who is knowledgeable about local fisheries management issues.

The commission was formed by Congress in 1942 as an organization of state agencies. It is not a federal agency. The purpose of the commission, as set forth in this law, is "to promote the best utilization of the fisheries, marine, shell, and anadromous of the Atlantic seaboard, by the development of a joint program for the promotion and protection of said fisheries and by the prevention of fiscal waste in the fisheries for any cause."

This reflects the reality that fish do not honor political boundaries established by man. It also recognizes that the fisheries management practices of one state can affect every other state along the coast. Examples include North Carolina's striped bass, which can be found in Maine; redfish in Florida; and bluefish, which are found in all states along the coast.

The ASMFC was formed to coordinate communication and representation among the 15 Atlantic coast states. The organization does not have regulatory authority. Through a peer review process, the ASMFC determines whether states comply with the fishery management plans of the Atlantic Striped Bass Conservation Act and the Atlantic Coastal Fisheries Cooperative Management Act. The review process is not coordinated through the federal government. But when the ASMFC finds a state in noncompliance, the Secretary of Commerce can impose a moratorium on a specific fishery in that state.

I want to discuss four ASMFC programs that affect fishermen along the entire coast: the science statistics and research program, the recreational fisheries program, the habitat program and the previously mentioned state fishery management program.

The statistics program coordinates statistics for various projects, including the Marine Recreation Fisheries Statistics Survey, to improve timeliness and usefulness of data and help determine the health of fish stocks. The program also works with other fisheries management organizations to coordinate a single data system for the Atlantic coast.

The purpose of the recreational fisheries program is to incorporate recreational fishing interests into all ASMFC activities. Richard Christian coordinates the program and works closely with the Interstate Fishery Management Program. Projects include the Wallop-Breaux Program, which focuses on outreach programs for children such as the Take a Kid Fishing program. The recreational fisheries program also works to promote ethical angling, including catch-and-release practices.

Another coordinating effort of this program is the artificial reef program, which involves organizations all along the Atlantic coast. Each year, the reef program sponsors workshops on topics such as management zones, saltwater tournaments and statistics in an effort to disseminate information to the public.

The habitat program is headed by Dianne Stephan, who works to integrate habitat concerns into ASMFC actions. We all know that protection of habitat is vital for protecting fish. The issue is highly complex, however, because so many agencies and groups are involved in protection efforts. Fishermen and fishery agencies must become more involved in the process.

In North Carolina, one successful habitat effort that involved our commission was the removal of the Quaker Neck Dam on the Neuse River, opening 120 miles of river to anadromous fish.

The last program that I'll mention is the Interstate Fishery Management Program, which develops plans to promote effective, cooperative fisheries management along the Atlantic coast in partnership with the National Marine Fisheries Service, the U.S. Fish and Wildlife Service and the regional fishery management councils. This program has developed 17 management plans for species such as striped bass, bluefish, red drum, summer flounder, weakfish, speckled trout and Spanish mackerel. It is in transition due to the rapidly changing interests within fisheries management and the increasing public interest in changing the management process. Public law has also had an impact on the program, particularly the Atlantic Coastal Fisheries Cooperative Management Act. This law requires states to comply with ASMFC fishery management plans or else face the penalty of a moratorium on that fishery. The act is modeled after the Atlantic Striped Bass Conservation Act, which was implemented in the mid-1980s and helped to revive the striped bass population. It has forced states to make some difficult and painful choices about resource management.

Finally, I'd like to point out that the commission is increasing public involvement in management processes by

establishing citizen advisory panels. Dick Brame serves on the weakfish advisory panel and Damon Tatum chairs the striped bass advisory panel. The purpose of these panels is to include input from interested parties — recreational fishermen, commercial fishermen and conservationists — in future management plans. These panels should improve the management process and help increase fishing opportunities for anglers along the coast.

Our outreach efforts include publications such as press releases, the ASMFC newsletter *Habitat Hotline* and special brochures. Providing factual information is pivotal in enabling the public to make informed decisions about fisheries management.

How does the ASMFC affect recreational anglers? The answer lies in the importance of active management to improve fishing opportunities. We affect North Carolina by improving the fisheries, although this means sacrifice and reduced availability of fish in the short-term. Conservation and restoration often require cutting back fishing effort. One example of successful restoration involves the coastal striped bass. Next week, the commission will support a highly controversial proposal — Amendment 5 to the striped bass plan — which calls for controlled increases in striped bass harvest from Maine to North Carolina.

In closing, I would like to emphasize that the ASMFC affects North Carolina by working through state organizations to promote cooperative fishery management along the entire coast. We encourage fishermen to become involved through state agencies in directing fishery management plans. This way, we can draw upon their expertise and provide effective outreach.

**Bob Calhoun:** I have heard that Virginia's legislature is considering withdrawing from the commission. What effect would this have on recreational fisheries?

**Lapointe:** Virginia has voted to withdraw from the commission by Jan. 1, 1997. There is also interest in North Carolina and Maine to do the same. Withdrawing from the commission will harm fisheries in North Carolina, as well as other states, by reducing the level of coordination and cooperation along the coast.

#### **New Initiatives of the N.C. Marine Fisheries Commission**

**Bob Lucas** is chairman of the Marine Fisheries Commission, a member of the Atlantic States Marine Fisheries Commission and chairman of the Moratorium Study Steering Committee.

First, let me share some of the obstacles and emotions involved in working with the Marine Fisheries Commission. The issues are extremely complex because they require learning about the gear, the fisheries and how these factors are related. It is frustrating because the facts are often

contradictory, which makes reaching an informed decision difficult. It is also depressing to see people become very emotional rather than work together for solutions.

On the other hand, it is rewarding because change is possible. My greatest fear — and I hope your fear, too — is not having done everything possible to make fisheries better before leaving this job.

I want to first focus on the purpose of the moratorium. A common criticism of moratoriums is that more emphasis is placed on studying a problem than on taking action. Understanding the problem is necessary, however, because fisheries issues are complex and interrelated. Trawling, for example, was one of the first issues we dealt with. We eliminated trawling on weekends and closed 20 river bays. The result was increased trawling. Then I understood that approach would be piecemeal and ineffective. Success would require a total program, which has led to the moratorium. Limiting commercial licenses is just a small part of the program.

The moratorium process first created a steering committee of 17 people to create goals and objectives for North Carolina's waters. The committee identified three areas where information is needed in order to make recommendations to the legislature and the Marine Fisheries Commission at the end of the moratorium.

The first area involves identifying and defining fishermen, gear, gear impact and fishing efforts. We don't know how many commercial fishermen are in North Carolina, what they're doing or what kind of gear they are using. The legislature awarded the steering committee \$250,000 to study these factors. The main goal, which will be highly controversial, is to restrict commercial gear to commercial fishermen only.

The second area involves managing fisheries through two central bodies — the Moratorium Steering Committee and the Division of Marine Fisheries. Structural changes need to be made in these groups. For example, 17 people are on the commission, which is too many to agree on a consistent basis.

One positive influence is the director of the division, who was brought in unpolitically. We are also in the process of hiring a deputy director to take the director's place when he is on the road or leaves the division.

The commission is working on several tough issues. One recent decision basically led to the end of the herring fishery, the oldest fishery in our state. We let that fishery go from a harvest of 20 million pounds a year to a half-million pounds last year. The fishery is basically gone. There are several reasons why this happened, which I won't discuss here. But the debate surrounding the decision was gut-wrenching.

We are dealing with other issues involving trout and fly nets, pound nets and other gear. We are trying to establish a system of public input, which involves a committee system. A committee on finfish, for example, was formed with several members and advisers from the recreational and commercial communities. Working together, they make recommendations to the commission. This process is working now, and it can be

especially successful because meetings are set a year in advance.

Law enforcement will also be expanded. Laws are useless without enforcement, so this move is a step in the right direction. Another positive step is to take licenses away from people who violate the law. We must create the same deterrent in fisheries as for other crimes.

Governor Jim Hunt has put substantial dollars into the Division of Marine Fisheries, which has resulted in more officers, more capital, a deputy director and other benefits. This is a credit to the governor, who recognizes the need even in a time of budget cutbacks.

I will end on a positive note: Things are changing. The public is more aware of resource problems. The Moratorium Steering Committee will create a total — rather than piecemeal — program for making changes. Also, I see the Marine Fisheries Commission becoming extremely proactive in this process as it becomes more willing to tackle difficult issues and decisions. So I have been very encouraged.

The last matter I will discuss is the current proposal for regulatory reform, which could have an extremely negative impact on fisheries because it reintroduces politics into the system. I have tried to keep politics out of fisheries because political parties do not matter when it comes to protecting fish. Under the current system, when the Marine Fisheries Commission passes a law, the law is immediately enacted. With the proposed system, however, any law passed by the Marine Fisheries Commission would go to a 16-member legislative committee of eight senators and eight representatives. They would have the opportunity to pass the law, reject it or ask for more information. The process continues until the law is deemed satisfactory. The following year, the law goes to the General Assembly for a vote.

The point is that a large group of politicians will make decisions about issues that are extremely complex. The benefit of the commission's expertise will be eliminated in the process. My credibility and that of the commission will be gone. Rather than dialogue with the commission, people will turn to legislators because they will be the decision-makers. So the credibility of the commission will be gone. Also, the process is too time-consuming. It will take two years to implement permanent regulation. And the basis of the regulation will be politics.

As I close, I want to share two letters that are similar to many others I receive regularly.

The first one is from Harry Carpenter, a doctor in Belhaven: "This past season I caught just one small, lonely survivor of what used to be the most populous fish in these waters. What a shame. More than that, what a travesty that man has wrought in what was once the most beautiful estuarine system along the Atlantic coast. How can we continue to be a state that thinks so little of such a gift of nature? I beg your support in reversing this crime against nature."

From Thomason Insurers, of which Charles Poole is president: "I realize that the beach will not close if the fish are gone, but it will put a hefty dent in the economic well-being of the area as fishermen quit using local facilities. I own a home at Emerald Island and I have thought about seriously selling it due to the poor fishing in the last few years. In the past, I invited friends down to fish with me, but no longer. I don't want to see their disappointment. Again, please use your influence to place regional restrictions in forces so that we can all continue to enjoy the resources."

If you share these people's sentiment, I ask you to become involved by writing letters to newspapers and the legislature and attending meetings. If you care about the resource, it is time to take two steps forward.

**Gary Garber:** I'm from Burlington and newspaper coverage of these issues is poor. I would like to ask that the Marine Fisheries Commission become more active in getting information to the editor. There are perception problems about how to handle the issues. For example, do you put it on the sports page or is it real news? Some sports editor aren't even aware of what is going on.

**Lucas:** In New Jersey, they bring the writers together twice a year to share information. We need similar efforts here.

**Rep. Dennis Reynolds:** As one of the 28 new freshmen Republican representatives, I am concerned that regulations are stifling homeowners, builders and the businesspeople. But the fisheries sector has basically been unregulated. We (lawmakers) need input on how to implement regulations that are needed and avoid those that are harmful.

**Peter Beottger:** Is the regulatory reform you discussed taking place at the national level?

**Lucas:** This is a state initiative. It came from the Judiciary Committee, which only met twice in preparing the proposal. The bill requires elaborate procedures for public input. If the committee requires agencies to have wide public input, they should do the same for themselves.

**Tom Vass:** Where is the proposal in the legislative process, and whom should we contact to voice our opinions?

**Lucas:** The two key sponsors of the bill are House Rep. David Redwine of Brunswick County and Senator J.K. Sherron of Raleigh. The bill is in the House with the Judiciary I Committee.

**Mike Holleman:** What would be a good size and composition of the commission?

**Lucas:** That decision will come from the moratorium. But

generally there are two opinions: 1) representatives from recreational and commercial fisheries and 2) anyone who cares about the resource, with advisory groups of recreational and commercial fishermen. I prefer the second option. I think seven to nine people would be logical for the commission.

### The Recreational Saltwater Fishing License

**Michael Orbach** is a professor at Duke University and former member of the Marine Fisheries Commission.

For a year, I have chaired a committee assigned to study the possibility of a coastal recreational fishing license for North Carolina. I am going to give a brief history of that committee and where it is in the process.

In the 1993 session, the Legislative Research Commission of the General Assembly assigned the Marine Fisheries Commission to recommend whether North Carolina should issue coastal recreational fishing licenses. Bob Lucas appointed me as chairman of the committee. We decided to include broad representation with 20 members — three of whom were fishery commissioners. The others represented various segments of the fishery, such as charter boats, headboats, fishing piers, shore fisherman, inlanders, coastal residents and others.

The committee began meeting monthly in April 1994. With the assistance of the Division of Marine Fisheries, we collected data about recreational licensing practices in other Atlantic and Gulf Coast states. We found that the West Coast and Gulf Coast states generally issue coastal recreational fishing licenses, and Georgia has considered it at various times.

The committee drafted a proposal with recommendations for gathering public input on the subject. In October 1994, we organized seven meetings around the state — in Manteo, Greenville, Morehead City, Wilmington, Raleigh, Charlotte and Winston-Salem — with a total attendance of over 500 people.

In Manteo, response to the idea of implementing a coastal recreational fishing license was marginally negative. An informal vote taken at the meeting showed that about 60 percent opposed the idea. In Morehead City, the response was also negative. But in Wilmington, Greenville, Raleigh, Charlotte and Winston-Salem, responses were generally positive. There were a lot of questions, however, about why the licenses are needed, how the program should be implemented and which agency will handle it.

Many organizations are in favor of the license, including the Atlantic Coast Conservation Association, the North Carolina Wildlife Federation, the North Carolina Beach Buggy Association and the Raleigh Salt Water Sportfishing Club.

On the other hand, many citizens of coastal communities have expressed concern about the impact on tourism, which



might depend on how the license is structured. Several positive editorials have appeared in *The News & Observer* in Raleigh, the *Carteret County News-Times* and the *Wilmington Star-News*.

We gathered written comments at all the community meetings and were surprised to find that people supported the concept of the license two-to-one overall.

The Marine Fisheries Commission met to discuss this input in November 1994. Two ideas emerged from the discussion: 1) money generated from the license program must be dedicated to the interests of recreational fishermen and 2) the public would probably accept a licensing program if this approach was taken.

The commission voted to recommend creation of the licenses to the General Assembly. The recommendation was presented to the Seafood and Aquaculture Joint Legislative Study Commission of the General Assembly, which later voted to recommend the program. Our formal report went back to the Legislative Study Commission, chaired by Marc Basnight and Dan Blue. I will read the commission's resolution, which was later passed.

Our first major principle called for people who harvest fishery products in North Carolina to help conserve and enhance these resources. In the past, commercial fishermen have paid fees for licenses, but recreational fishermen have not. The resolution recommends that the General Assembly "create such a license covering the recreational harvest of fishery resources in coastal waters."

The second principle states that "the revenues from such license be dedicated solely to the conservation and enhancement of recreational fisheries, placed in a special trust fund for that purpose and disbursed under the oversight of a board of trustees composed of individuals with interest and expertise in recreational fisheries in North Carolina." This means that if such a license was created, the money would go into a dedicated fund. The disbursement of these monies would be overseen by recreational fishermen, who would be on the board of trustees.

The third principle states that "the legislation creating such license stipulate that if any of the revenues from the license are diverted for purposes other than the conservation and enhancement of recreational fisheries, the license would be terminated."

The fourth principle states that "the license be administered by the Department of Environment, Health and Natural Resources in conjunction with the board of trustees," as I mentioned earlier.

The fifth states that "such license be required of everyone 16 years of age or older with fees and special licenses available as noted in the attached." This refers to a more detailed proposal that mirrors the structure of the wildlife license, which has already been implemented.

And sixth, that "the coastal recreational fishing license be considered in light of the current North Carolina Fisheries

Moratorium Study and developed in a manner compatible with that study."

There were some significant changes made in the North Carolina legislature last November. Although the Legislative Study Commission recommended that the license be created and the idea be moved forward, there was a general feeling that it would not be appropriate to introduce legislation in the 1995 session. As a result, the commission recommended that further action be referred to the Fisheries Moratorium Steering Committee, which will consider all aspects of licensing and fisheries for recommendations to the 1996 General Assembly. This approach was seconded by the Legislative Study Commission.

The Marine Fisheries Commission will continue to get input on this idea. Right now we will wait for the advice of the Fisheries Moratorium Steering Committee about how it would like us to assist in further consideration. If any of you are interested — individually, in groups, towns or organizations — or would like to hear more about this concept or receive some kind of presentation, please let us know.

**Barry Mote:** Do you know what prompted the legislature in 1993 to ask the commission to look at a coastal license? And is any gear excluded in the taking of the resources — for instance, spear guns or anything similar?

**Michael Orbach:** The question of a coastal recreational fishing license is not new. Various bills have been introduced since the early 1980s. What occasioned this in 1993 was the introduction of another bill, which was then referred to the Legislative Study Commission. The commission felt it was appropriate to gather more input.

There was some question about whether this should be a hook-and-line issue only or include all recreational harvest. The committee decided that since so many people are taking resources recreationally — shellfish resources, clams, crabs and other things — they all should be included in the license. So currently, the proposal does not exempt any gears.

One issue that will come up to the Fisheries Moratorium Steering Committee is whether further licensing will be considered for commercial fishing gear. For example, specific exemptions from commercial licensing requirements are being considered for up to five crab pots or a certain amount of gill net or other gear. That subject is will be taken up. But currently, no fishing gear is exempted.

**Dick Brame** is executive director of the Atlantic Coast Conservation Association.

In the next part of the program, we'll talk about how the Atlantic States Marine Fisheries Commission implements its fishery management plans. We will hear about the angler-based management system in Texas, where you can regularly catch speckled trout more than 20 inches.

Last week, I gave testimony on the Regulatory Reform Bill, which is House Bill 192. I testified against the portion that would inject three new layers of bureaucracy into the management process. We support the public input aspects of the bill, but we oppose the direct legislative oversight. We need more people present when we testify to demonstrate to lawmakers how many people are opposed to the bill.

I also want to say that the process of hiring Bruce Freeman was untainted. Politics were not involved. One of our members, Mike Holleman, was on the selection committee. We got the best director we could find, and he is 10 times better than I ever thought we'd have apply.

In a moment, I will introduce George Lapointe from the Atlantic States Marine Fisheries Commission. But I want to say that this audience is responsible for the authority that the Atlantic States Marine Fisheries Commission has, as well as the funding for the public input and a management plan.

At the eleventh hour of the last Congress in November 1993, there was an amendment to a Coast Guard bill to give the Atlantic States Marine Fisheries Commission the authority to implement fishery management plans. It was being held up by N.C. Sen. Jesse Helms. We put out an action alert and flooded his office — literally stopped his office — with phone calls and faxes. He did not object to it, and it passed.

So when you speak, you have a lot of power.

#### Implementation Plans for Important Recreational Fisheries

**George Lapointe** is director of the Interstate Fisheries Management Program for the Atlantic States Marine Fisheries Commission.

It is important to note that of the \$3 million in Atlantic Coast Fisheries Cooperative Management Act funding, \$2 million was directed to the states. The formula is based on the number of fishery management plans (FMPs) they have and the value of the fisheries, both commercial and recreational. So a lot of that money is going to the states to improve fisheries. We will need help getting those funds again this year to continue this work.

One omission from my last talk was the implication of a state withdrawing from the commission. I didn't mention that if a state withdraws, it will still be bound to enforce the provisions of the Atlantic Coastal Act. But it will lose its voice in the management process.

I want to talk about how we implement plans and then discuss implementation plans for three species — red drum, bluefish and summer flounder.

Our planning process begins with the commission setting up a list of priorities for the species under consideration. Each species has a management board of representatives from the states with an interest in that fishery.

Striped bass is a species examined by representatives

from North Carolina to Maine. Bluefish is Maine through Florida, as I mentioned earlier. The representatives carry out the planning process or policy recommendations with the help of a technical committee, which does the scientific research, analysis and the management measures. Additionally, a citizens advisory panel brings critical public input and experience to FMP development. Then they put together a plan that goes to the full commission for approval. It goes through at least four public hearings up and down the coast, depending on what states request, and then it goes back to the commission for final approval.

First, I'll discuss the red drum plan, developed by the ASMFC in 1984. It was one of our first plans. The original plan involved states along the coast from Florida to Maryland, but this group was eventually expanded to Maine. It was enlarged because of the redfish frenzy in the Gulf of Mexico at that time and the fear that implementing management measures only in the South might have a detrimental effect on redfish through development of Northern markets.

And like many early ASMFC plans, it was a data collection plan. Many early plans simply outlined research needs to better implement fishery management plans in the states. Amendment 1 was developed jointly with the South Atlantic Fishery Management Council. One provision of the plan was to limit harvest of red drum in order to prevent the fishery from rapidly developing. It also placed regulatory burdens and authority on the state level.

There was a lot of discussion about state and federal cooperative efforts, particularly surrounding core data collection and research and analysis for long-term management objectives to rebuild overfished stocks. One difficulty with red drum management is the 18- and 27-inch size limits in a few states that allow fish taken over 27 inches. Consequently, we have very little information on adult fish, which creates trouble in the assessment process.

Another part of this amendment was controlling harvest to maintain a 30 percent spawning stock biomass per recruit (spawning stock biomass divided by the number of recruits to the stock). Spawning stock biomass per recruit is the fishing level that maintains the spawning stock at 30 percent of the level that would be present if the fishing mortality rate were zero. It is a measure for species such as red drum that we use when we don't have adequate data on adult fish.

The objectives of the plan were to assure escapement of fish by controlling fishing mortality, address the incompatibility and inconsistency among state and federal regulations, and promote cooperative analysis and collection for both biological and socioeconomic data.

Amendment 1 also adopted the goal of reaching this 30 percent spawning stock biomass per recruit with an initial target of 10 percent spawning stock biomass per recruit. And as I mentioned earlier, the difficulty in working toward this 10 percent goal is that we don't have good assessment of the spawning stock, and that reduces our confidence in those

estimates. The best estimate we have is 1 to 3 percent spawning stock biomass per recruit. So the levels are incredibly low for adults — below the initial targets of 10 and 30 percent.

To address this issue and get better estimates, an independent, multistate data collection process has begun in Georgia, South Carolina and North Carolina. The South Atlantic Council reports that a fishery panel is now targeting adult fish in terms of age, length, sex and other information needed for management. Additionally, we are going to encourage the federal government to survey adult fish so that we can get better estimates for managing red drum.

It appears that the exploitation rate on subadult fish, within the 18- to 27-inch size limit, is quite high. To rebuild the spawning stocks, we will have to use exploitation rates on those subadults to increase to 10 percent and then 30 percent spawning stock biomass per recruit.

The next step in the red drum planning process will be taken by the South Atlantic Council. One provision of the Magnuson Fishery Conservation and Management Act requires the council to put a stock rebuilding schedule into all of its fishery management plans. We have not had that in our joint plan. So later this year a stock rebuilding schedule, which will involve reductions in fisheries, will be put in place in conjunction with the Atlantic States Commission. Input from the public will be very important in this process.

There is also a recommendation to separate the management unit at the North Carolina-South Carolina border and to manage those two substocks differently because of differences between the Northern and Southern fisheries. This is a common comment about our fishery management plans. We manage as though we are managing one big unit because it's easier, but it glosses over some differences within the fishery. And again, we need public input to help with that.

As this process continues, particularly in state waters, the ASMFC plans have been able to accommodate local concerns and situations where the fisheries are different. I mention this because I was talking to Mike Street yesterday, and he said the red drum in Pamlico Sound apparently migrate very little out into the ocean. So there is a good possibility for managing those fish differently because they behave differently.

Now I will discuss bluefish, which I am more familiar with than redfish. A joint ASMFC-council (South Atlantic, Mid-Atlantic and New England) fishery management plan for bluefish was put into place in 1990. The Mid-Atlantic Fishery Management Council had tried earlier in the mid-1980s to put a plan into place, but it was disapproved by the Secretary of Commerce. The bluefish management plan was developed to address problems if the fishery were to expand significantly or if the bluefish stock were to decline. At that time, stock assessment showed that the bluefish stocks were fully exploited. And the plan noted at that time, in 1990, that the bluefish stocks had declined since peaks in the early

1980s. It noted that if the strong 1989 year class wasn't protected, the population would likely decline through the 1990s, which has certainly proven to be the case.

But the plan had two major management measures. One allowed a bag limit on recreational anglers. The plan had a framework that allowed the bag limit to range from zero to 15 fish, and the initial limit was set at 10. It also limited the commercial fishery on the Atlantic coast to 20 percent of the total annual catch. At the time, the commercial harvest was about 10 percent of the total, and the 20 percent figure was to allow for shrinkages in the fishery, which is exactly what happened. The commercial harvest has, in fact, remained relatively constant and the recreational harvest has shrunk because of declines in the stock and shifts in the fishery.

What has happened since then? The bluefish stocks have declined very dramatically. The numbers I got from the Mid-Atlantic Council show that annual recruitment to the bluefish fishery was between 75 million and 87 million fish from 1982 to 1984. That declined to about 20 million to 40 million fish in the mid-1980s, and the most recent estimates show recruitment was 4 million fish in 1993. That is a 95 percent reduction in recruitment. And the total spawning stock biomass for that same period has declined by 74 percent.

Simply, removal from the fisheries has far exceeded recruitment in recent years. Fishing mortality rates are now about double what they should be for sustainability. The 1993 estimates show that 32 percent of the stock is removed every year — that must be reduced to 15 percent to be sustainable.

As a result of this sobering information, the Mid-Atlantic Council and the ASMFC have begun a plan revision process. We just held a series of scoping meetings to consider several measures. For recreational fishermen, a proposal would reduce the bag limit. Some stock assessment officials have even set a bag limit of one, which has sparked comments from recreational and private charter fishermen about the possible negative effect. In a meeting I attended in New England, minimum size limits of 10 to 16 inches were being discussed. There was discussion about modifying the commercial fishery system, which would include changing the size limits, trip limits, pier restrictions, minimum size restriction and seasonal closure. It would also mean changing how the commercial catch is allocated among states and the various efforts of the fishery.

The plan development process has just begun with these scoping hearings to get public input on the ideas I've brought out. And if people are interested, I can provide the scoping documents. We are meeting next month in Philadelphia with the Atlantic States Commission Bluefish Board, the Mid-Atlantic Council and the Coastal Migratory Committee (which deals with bluefish) to look at the comments that came out of the scoping process. We will then come up with a draft FMP, which will go through the public hearing process. I encourage people to pay attention to that.

I'd like to tell you this will be a quick process, but the

fishery management process is slow even in the best of times. So this will probably happen toward the end of the year since the Mid-Atlantic Council is now focused on other projects.

The summer flounder FMP was first developed by the ASMFC in 1982; a joint commission-council plan was approved in 1988. Stock assessment information, then and now, shows that the summer flounder stock has been seriously overfished since 1980. Because of the high mortality rate, the majority of the harvest in both the recreational and commercial sectors targets on fish age zero to 2, which means small fish are being caught. It also means that many adults, large adults, are not surviving to spawn.

The management measures implemented in that early plan included a 4-inch mesh requirement with the caught end uptrawl and a 14-inch side mesh. However, we now know that these measures were insufficient to reduce fishing mortality, so a number of amendments have resulted. Among them is a commercial quota imposed on the summer flounder fishery, which is divided among states based on their historical landings. The quota is based on stock assessments and a review of research data by our monitoring committee. The quota is supposed to be set so that it fits within the rebuilding schedule, which is pretty aggressive for summer flounder.

The plan calls for a moratorium on entrants into the summer flounder fishery. This is something you are going to see more often among fisheries up and down the East Coast. There is a size limit of 14 inches for both commercial and recreational fisheries.

The latest amendments also included a recreational fishing season, from May 15 through Sept. 30. That may have been stretched to Oct. 15, which fishermen in North Carolina and Virginia weren't happy with because it eliminated the fall fishery. A bag limit was set at 10 fish.

These strong measures were supposed to reduce the fishing mortality rate to 0.23, which is well below the high mortality rates from 1.5 to 2.1 recorded a couple of years ago. In order to achieve that fishing mortality rate, exploitation rates on the summer flounder FMP dropped about 73 percent. Both the ASMFC and South Atlantic Council decided to implement the measures in phases to cushion the blow of this dramatic drop in exploitation.

For the first three years, a 40 percent reduction in exploitation was planned; in year four and beyond, it was set at 25 percent. The plan established a summer flounder monitoring committee to assess the data and establish quotas, bag limits and seasons for the recreational fishery.

The commercial quotas in 1994 were set at 16 million pounds, and that was supposed to drop to roughly 12 million pounds in 1995. Individuals in Virginia, however, filed a lawsuit to protest the way the quota was set, and the judge there increased it by 3 million pounds to 15 million pounds. The National Marine Fisheries Service is appealing that lawsuit. The results of that lawsuit came about not because the numbers in the plan weren't valid but because the judge

said the council used very conservative estimates in developing the fishery to rebuild the stock quickly. Thus, the judge challenged the method by which that was done.

The last thing I will mention is that the Summer Flounder Monitoring Committee just met in Philadelphia and recommended the following measures for the recreational fishery. One reduced the bag limit from 10 fish to three. Another eliminated the season, which certainly should benefit the fall fishery in North Carolina and Virginia. That will be discussed by the ASMFC and Mid-Atlantic Council at the mid-March meeting in Philadelphia.

**Wayne Lee:** When 3 million pounds were added as a result of the lawsuit, was any consideration given to spitting that amount so that the recreational community gets its share of the 3 million pounds — in other words, 40-60?

**Lapointe:** No. I think it applied specifically in the lawsuit to the commercial fishery. The implication of how that plays out in following quotas will impact both commercial and recreational fishermen.

**Joel Arington:** When the red drum plan was initiated, the spawning stock biomass ratio was under 2 percent. And you are saying that the most recent stock assessment shows it is still at 1 or 2 percent? It has been seven years with no gain in spawning stock ratio. Has the plan been beneficial or not?

**Lapointe:** It has stabilized the fishery, which is important. But it has not rebuilt it, which is the goal of the new amendment. One challenge is changing the behavior of fishermen. People will be more willing to comply with management measures needed to rebuild the stock if we can provide data that they have confidence in.

#### **An Angler-Based Management System in Texas**

**Larry McEachron** is science director for the Coastal Fisheries Division of the Texas Parks and Wildlife Department.

From the discussion I've heard today, I feel I have been transported back to 1972. These are the same comments I heard in Texas at that time. It is very interesting and I think everyone is on the right track.

Fisheries management in Texas is a success story. We have a recreational fishery with about 1 million saltwater anglers that is worth almost \$1 billion. The Texas commercial fishery with about 20,000 fishermen is worth over \$500 million; shrimp is the main species landed. Commercial and recreational fisheries are exerting heavy pressure on our marine resources. To understand the complex dynamics and processes of marine finfish and shellfish populations, it is imperative that programs are in place to generate needed data in an efficient, cost-effective manner.

There are three attitudes that directly affect the credibility of science in fisheries management. The first is the attitude that fishing cannot significantly affect populations. The scientific community has begun to address this by rejecting the long-held view that marine resources are largely inexhaustible and affected only by nature. The second attitude is that fishing is a right. There is no legal basis for this in the United States. Fishing is a privilege, not a right. The third attitude is that a problem must exist before fishing is regulated. There are many cases throughout the world where managers were unwilling or not allowed to act before a problem reached the point that regulations were too little, too late. We as managers need to become more proactive in the regulation and management process.

Texas' management philosophy began in the early 1970s and involved eight keys to success. Its cornerstone was the use of scientifically based information to develop regulations and management approaches. Second, proven management techniques were used in developing regulations. Third, research was conducted to provide information needed to make balanced management decisions. Fourth, the political process was used to garner support for management; ultimately, management was transferred from the legislature to a regulatory agency. Fifth, the public and private sectors were brought to the table at the beginning so there was no misunderstanding about the motives of the managers. Sixth, partnerships were forged to provide facilities and equipment that were not obtainable under budgetary constraints. Seventh, for overfished populations such as red drum, supplemental stocking became an integrated tool used by management. And last, there was long-term commitment from all sectors to generate information for effectively assessing and managing the fisheries.

We are involved in five broad categories of information-gathering. Due to time constraints, I will go into detail only about the first category — monitoring. However, I want to give you some information on the other four categories.

Under the categories of population dynamics and genetics, we have nine projects totaling \$239,000. Basic information such as growth and age of fish and genetic structure of fish and shellfish populations is being collected. Under special studies, we have eight projects totaling \$220,000; these projects address issues of immediate management concern and are generally of short-term duration. Finally, we have eight cooperative studies totaling \$248,000; these studies provide management information that we don't have the time or expertise to conduct.

Let's move on to the core program. Texas began a long-term coastwide monitoring program in 1974 that would: 1) provide scientifically based knowledge of fisheries status and trends; 2) contribute to knowledge of the marine ecosystem and how it is affected by human activities and natural events; and 3) provide an early warning system, thus allowing low-cost solutions to problems. It takes a sophisticated and

dedicated approach to manage fisheries. Like a successful business, we need to know the current inventory, expected additions to the inventory and what is being sold.

This is what long-term monitoring does through the harvest and resource programs in Texas. The resource program tells us what is available to catch (inventory) and what will be the additions in future years (recruitment). It tells us what, how many and where fishes are caught. To get the necessary answers for management, one needs to continuously update the information in a systematic fashion. We have done this in Texas for over 20 years and it has provided us a moving picture to explain what we are observing in the environment.

To carry out the monitoring programs, all marine waters are surveyed from Louisiana to Mexico out to nine nautical miles offshore. This program is funded at \$1.5 million per year with 136 people in eight field stations and three hatcheries along the coast. Our total fisheries budget is \$4.5 million per year.

The objectives of the harvest program are to monitor trends in sport boat fishermen, socioeconomic characteristics, landings, angling pressure and catch per effort to assess the need for and impact of saltwater fishing regulations. This program began in 1974 and includes annual surveys of private boat and charter boat fishermen. Fishermen are surveyed on 43 weekend days and 90 weekdays during each year in each of eight bay systems. This amounts to 1,014 survey days and over 10,000 interviews annually along the coast. We also conduct studies every five to 10 years of shore, wade/bank, pier and jetty and headboat fishermen.

The harvest program uses interviews with fishermen. Boat access sites, including boat ramps, marinas and other public launching areas, are inventoried and surveyed to determine fishing pressure at each site. Interview sites are selected at random but weighted by the estimated fishing pressure. The weighting causes access sites with high fishing activity to be surveyed more often than those with low activity. Although survey sites are selected to maximize the number of sport boat fishing interviews, all groups using the site are interviewed at the completion of their trip. This provides data for a wide range of coastal boating activities.

Commercial landings are monitored through 1) a seafood dealer self-reporting system cooperatively administered by the National Marine Fisheries Service and 2) on-site interviews of commercial boat fishermen combined with aerial surveys of fishing boat distribution. We also use commercial information gathered in routine sport boat surveys if commercial fishermen are interviewed. Commercial data are included in management decisions. Today, recreational and commercial fishermen are the predominant source of mortality for most species.

The second phase of our program deals with the living resources. The objectives of the resource program that began in 1975 are to: 1) develop long-term trend information on

finfish and shellfish population abundance and stability; 2) monitor environmental factors that may influence finfish and shellfish availability; and 3) determine growth, mortality and movement of selected species.

To ensure random sampling, each bay has been sectioned into one-minute longitude by one-minute latitude grids about 1 mile square. Each of the squares is further subdivided into 144 smaller squares, which we call "gridlets." With this grid system, each spot of shoreline and open bay water has a chance to be sampled. All sampling sites are selected randomly before going into the field. We use five sampling gears in the bay and the Gulf of Mexico. All organisms caught in the gears are processed.

In nearshore waters less than 4 feet deep, we use 60-foot bag seines and 600-foot gill nets. We pull bag seines for 50 feet along a preselected shoreline. We have used these bag seines since 1977. We collect 2,292 samples each year along the coast.

Gill nets are 4 feet deep with 150 foot sections of 3-, 4-, 5- and 6-inch stretched mesh webbing tied end-to-end with the smallest mesh on shore. We set these gill nets during two seasons — spring (April 15 to June 15) and fall (Sept. 15 through Nov. 15). Through a detailed statistical analysis, we determined that this is the most efficient way to get the information we needed with the dollars available. We set these nets about one hour before sunset and picked them up within four hours of the following sunrise. This gear has been routinely used since 1975. We collect 760 gill net samples each year, split equally between spring and fall.

In water more than 3 feet deep, we use two gears. The first is the 20-foot-wide otter trawl. We pull at randomly preselected sites in both bays and the Gulf of Mexico for 10 minutes. This was the best trawling time for us to get the most information, given our time and budget constraints. The second gear is the oyster dredge used in the four major oyster-producing areas of Texas: Galveston, Matagorda, San Antonio and Aransas bays. Galveston Bay produces over 90 percent of all oysters in Texas. Sites are picked at random and the dredge is pulled for 30 seconds at each oyster reef site. We conducted a detailed statistical analysis and found that 30 seconds is the best sampling time. If you pull longer than 30 seconds, and you have high availability, your dredge fills up and you don't get an accurate measure of abundance. Each year we collect 3,288 bay and gulf trawl samples and 1,080 oyster dredge samples.

In the surf, we use 200-foot beach seines and the 60-foot bag seines. We collect 250 samples each year with each gear. I believe this is the only data set of its kind in the world, which has been collected routinely since 1986.

With each of the preceding samples, amounting to over 7,600 samples per year, we take a corresponding hydrological reading (dissolved oxygen, temperature, salinity and turbidity). This equates to over 600 water samples collected each month along the Texas coast.

To determine mortality and movement of fishes, we tag live fish with an internal abdominal tag. The tag is red and each one is uniquely numbered with a yellow streamer. We make an incision in the abdomen of the fish and place the tag inside; the yellow streamer sticks out of the fish, and the fisherman who catches it sends the tag to us. Recently, we started using a yellow streamer with information on the streamer as well as on the tag, due to increased catch-and-release fishing along the Texas coast. This method allows fishermen to catch the fish, record the tag number, then send the information to us. This way, we will know that the fish has been caught and released, which provides very important information about mortality. Almost 8,000 fish are tagged each year. We have about 8 percent returned, but the return rate varies among species. Red drum consistently has the highest returns at about 15 to 18 percent.

Now I want to present some of the data that have been generated. We now have information on 285 finfish species and 145 shellfish species. I selected red drum and spotted sea trout, but I could do all 430 species if there was time.

First, let's look at the private sport boat fishing pressure, which we have been surveying since 1976. On average, fishing pressure is increasing in Texas. We have more people fishing more hours in Texas saltwater areas.

For red drum, one of our major species, we sample with bag seines every month. It's necessary to use specific months for estimating recruitment with some species. We use November through March for red drum. In 1991, we recorded the highest red drum recruitment since we began sampling. In 1994 we were above average; recruitment has been at or above the long-term average since 1990. So we believe we are in good shape with recruitment.

The gill net catch rate is a relative index of abundance of the larger individuals, generally 2 to 5 years old (14 to 35 inches long). We catch red drum in the bays up to 35 inches long. On average, we have twice as many red drum in Texas as we did in 1976, despite increased recreational fishing pressure. Although I can't offer an absolute population number, I can give information on trends. In the case of red drum, abundance has increased twofold.

One big question mark is the escapement of red drum to the Gulf of Mexico. In Texas, we weren't able to retain fish more than 28 inches long before Sept. 1, 1994. In September, we implemented a red drum tag program that allows fishermen to retain one fish if they have a trophy tag. After returning the tag, a bonus oversized red drum tag was issued. In effect, a maximum of two oversized red drum were allowed in a fishing season (Sept. 1 of one year through Aug. 31 of the following year).

We wanted to determine if increased escapement could be linked to the movement of fish more than 28 inches long into the Gulf of Mexico. From our gill net samples, we found four times as many fish over 28 inches in the 1990s as there were in the 1980s. We have increased the percentage of large

red drum present, which has led to a quality red drum fishery for the sportfisherman and increased escapement.

We've implemented additional regulations on red drum through time. By increasing the size limits and decreasing the bag limits, we have really not impacted the sportfisherman catch rate. We are catching as many fish, on average, as we were under unrestricted limits. On average, the restrictions on Texans have not reduced their overall catch.

I would like to provide a picture of how we've forced fishermen to fish for larger red drum. In the period from 1974 to 1977, we had a 14-inch size limit with no bag limit; a tremendous number of small fish were being caught. We then increased size limits to 14 inches minimum and 35 maximum, which resulted in a shift to landing larger fish. From 1981 to 1988, we changed to 16 to 30 inches, then 18 to 30 inches, and now the limits are 20 to 28 inches. So we have basically shifted fishermen's catches to larger fish. That is exactly what we wanted to do with our fishery management scheme — get the fishermen to keep the bigger fish.

As size limits increased, the average weight of a red drum increased. We have increased the average size of red drum landed by private boat anglers to 5 pounds from 2 pounds in the early to mid-1970s. This 5-pound average has held steady for the last five to seven years.

In 1981, we banned the sale of red drum. At that time, commercial fishermen said that recreational fishermen would never catch as many pounds of fish as they did and that fish were going to be wasted. Recreational fishermen are very efficient. Currently, private sport boat fishermen are averaging about 1 million pounds a year, 40 percent of the total landings in Texas. This suggests that, coupled with the remaining 60 percent, over 2 million pounds of red drum are being caught — the same level as commercial fishermen were catching in the 1970s prior to the ban on sale. Because recreational fishermen catch red drum very efficiently, we implemented increasingly restrictive bag and size limits. Banning commercial netting and sale of red drum was not sufficient for maintaining a quality fishery.

For spotted sea trout, we implemented a 15-inch size limit in 1990, which brought recruitment back up to long-term average levels. The impact of overfishing is most visible in spring, when most spotted sea trout are caught. A freeze in 1983 devastated the spotted sea trout population. Another freeze in 1989 reduced the population, but to a lesser extent than the one in 1983. Since 1990, the large spotted sea trout segment of the population has been stable. This includes trout from 14 inches to 33 inches long. There has been increased fishing effort, yet the population has remained stable and in some bays increased.

In the last 20 years, we basically stabilized landings and caused fishermen to retain larger spotted sea trout. Our goal was to maximize spawning potential of spotted sea trout given any environmental conditions. By moving to a 15-inch size limit, we get one and two spawns from every spotted sea

trout. As with red drum, we have doubled the average size of spotted sea trout landed by sportfishermen from a little less than 1 pound to almost 2 pounds. The size limit also helped revitalize populations after natural events, such as severe freezes. In Upper Laguna Madre, for example, 80 percent of the sea trout population died. It recovered within two years.

In Texas, we have come a long way during the last 20 years to improve coastal fisheries management. Our techniques evolved through Texas' unique environmental and management needs. Programs developed in other states must be tailored to address local issues.

Data used in management decisions must be quantifiable and defensible. In Texas, our data were challenged in court only once. Since then, attempts to discredit the data have failed prior to court due to the overwhelming content of good data.

The best scientific data minimizes the probability of opinions and whimsical notions dictating fishery management decisions. Ultimately, under the principles and complexities of optimum yield, managers must include economic and social data in the decision-making process. But the cornerstone of the management process should be sound, long-term statistically based data.

**Brame:** What specific management measures did you implement in the 1980s to revitalize populations?

**McEachron:** In 1981, the legislature designated red drum and spotted sea trout as game fish. That didn't solve the problem because there was a significant interest among nonfishermen to eat spotted sea trout and red drum. It takes time to change people's attitudes and opinions. There was a large commercial "black market" during this period for red drum and spotted sea trout.

We also implemented strict regulations on size limits and increased law enforcement. We implemented a \$5 saltwater stamp that is now \$7. The philosophy was that if we're going to have good management, the users have to pay; the only way to do that was to have a saltwater stamp in addition to our saltwater license, which the sportsmen supported.

We educated the restaurant trade. We knew there was a big black market. If there is a market for a product, then there will be illegal fishermen. That is not news to anybody here. We fostered the concept that anyone who knowingly buys a Texas red drum illegally and sells it at a market or restaurant will be severely penalized. The restaurant trade association complied by not buying the fish. That is one of the reasons why illegal fishing stopped, along with increased law enforcement.

In the 1980s, when illegal fishing was prevalent, we took over 116 kilometers (72 miles) of illegal nets each year out of the bays. Over 50 percent of Texas waters was illegal for netting at that time. Research indicated that these nets were taking large quantities of bycatch. Commercial fisher-

men were targeting black drum with their nets, but bycatch included red drum and spotted sea trout, which jeopardized our management efforts. So in 1988, we banned nets in salt water. Shrimp trawls and cast nets were exempt from the ban.

These four factors (restaurant compliance, increased law enforcement, strict recreational regulations and the net ban) significantly increased the populations of spotted trout and red drum. In fact, red drum fishing is so good that in the last five years Texas has become a fly-fishing target area for fishermen worldwide. Catch and release for red drum, which is practiced by sportfishing groups, is very popular. Many people catch 15 to 20, 25 red drum a day up to 29 inches long but do not keep them. It appears the catch-and-release ethic is strong, which is very important for managing sportfisheries.

**Brame:** What is your budget in Texas' Parks and Wildlife?

**McEachron:** Our total budget is \$4 million. The monitoring program costs \$1 million. That is why I would like to encourage a saltwater license. If you are going to have good management, you've got to have the dollars to fund it. Sportfishermen are the ones who should fund that.

In Texas, we have a \$13 sportfishing license, which allows fishing in both salt and fresh waters. If you want to fish in salt water, you also need a saltwater stamp, which costs \$7 a year. Twenty dollars is a small price to pay for the benefits. The only way to get dollars that can be dedicated to fisheries management and hatcheries is through a saltwater license.

**Garber:** If you use a stamp for the saltwater portion, but also issue a license that covers both fresh and salt water, how does the structure operate?

**McEachron:** It is basically the same. We have the Coastal Fisheries Division, the Inland Fisheries Division (fresh water) and the Wildlife Division. We also have Resource Protection, which deals with "kills and spills" events. Licenses are issued for hunting — there is a combination hunting and fishing license and you can buy a saltwater stamp. There are also turkey and other wildlife stamps that pay for research.

**Bob Goldstein:** How big is your coastal enforcement staff and how does it compare with other states? Also, how much financial support for the agency comes from licenses versus Dingell-Johnson and Wallop-Breaux money?

**McEachron:** I don't know how many people are employed in enforcement. Texas has eight major bay systems and two minor bays. There are at least two to three wardens in every bay system, which is based on county divisions. For example, in my area of Rockport near Corpus Christi, there are at least six law enforcement officers.

One of the important programs in Texas is Operation Game Thief, which features a 1-800 number for reporting violations of fish and game laws. The program has been a major deterrent because citizens can receive rewards for reports. The program has been extremely effective in terms of both wildlife and coastal fisheries. In the 1980s, the program was particularly helpful in detecting illegal gill nets. People frequently used cellular phones to report violations, which enabled a warden to pick up the net or catch the fishermen picking it up.

The \$1.5 million for the monitoring programs comes entirely from Dingell-Johnson and Wallop-Breaux funds. Texas takes the unique position of not using federal funds as primary funding. It funds its own program and uses federal funds as replacement money, so its management programs can continue if federal funds are cut. Some states don't do this. South Carolina had a problem several years ago because it used federal funds up front. When that money was cut, people had to be cut. So Texas isn't beholden to Washington, D.C. The state can carry on its management operations without somebody from outside cutting funds or dictating what it does.

**Earl Parish:** How did you set up hatcheries in Texas? And did you have an artificial reef program?

**McEachron:** We have a hatchery program that I will discuss in detail later. We have a very active artificial reef program. The number of oil rigs that are being dropped or taken out in the Gulf of Mexico is increasing as the oil fields deteriorate. Right now we have eight to 10 different offshore sites where we are dropping oil rigs, both in Texas waters and in federal waters. Fifty percent of the savings that the oil company gets by dropping a rig in place or dropping it at a site designated by the state goes into an artificial reef fund for research. Right now our artificial reef fund is about \$2 million and increasing. The largest single amount received from an oil company was \$250,000.

**B.J. Copeland** is director of the North Carolina Sea Grant College Program

Sea Grant is pleased to offer you the fourth annual recreational fishing forum. This forum has been a successful activity through time. We at Sea Grant are in the business of information, either getting it through research or packaging it so that people can use it. This forum is one way to give you the opportunity to learn the latest news about fisheries.

Our fisheries resources are very important in this state. The problem is we don't have enough of them. And so we are faced with the question of what to do next. We have habitat problems, we have overfishing problems and we have allocation problems. But I also believe we have a great opportunity.



Let me tell you a couple of things that I think are part of this opportunity.

The moratorium study is one. Bob Lucas, who is chairman of the Marine Fisheries Commission, also chairs a steering committee that is examining fisheries issues over a two-year period. During this period, the steering committee will develop a series of recommendations for managing fisheries resources. We are going to conduct studies, examine issues and come forth with recommendations by about May 1996. Your input is very much needed and welcome.

Second, we've hired the best director for the Division of Marine Fisheries in the United States. This is his third day on the job — and an opportunity to begin sharing information.

**Joan Weld** is assistant secretary of the Department of Environment, Health and Natural Resources.

It is a new day for fisheries in North Carolina. On behalf of Governor Jim Hunt and the Department of Environment, Health and Natural Resources, I commend Sea Grant for this excellent forum.

The one thing I like about fisheries is that every day is a learning experience. But this is a particularly special day because I have the opportunity to introduce to you our long-awaited new director of the Division of Marine Fisheries. First, however, I'd like to take a moment to talk about Governor Hunt's coastal agenda.

As many of you know, the governor declared 1994 as the Year of the Coast. That was in commemoration of the 20th anniversary of CAMA (Coastal Area Management Act). And now, in a time of downsizing and significant state budget cuts, the governor has proposed \$200 million in governmental cuts — over 2,000 jobs. But for the coast and our department, he has proposed an expansion budget this year. He is proposing a coastal budget that will enable this state to begin to follow through on the recommendations presented to him last fall by the Coastal Futures Committee.

In expansion money he is proposing \$5,759,000-plus, and in capital he is proposing \$4,970,000. We are excited about this budget proposal, which would provide much-needed technical assistance to local governments, farmers, fishermen, foresters and citizens. Ultimately, it will benefit each of us who holds the coast dear.

I believe that this coastal agenda is the first bold step toward restoring our marine fisheries. The coastal package emphasizes the need to address nonpoint source pollution and improve our marine fisheries resources. We know that nonpoint source pollution — runoff from agricultural fields, forests, roads and other built-upon areas — is the biggest problem facing our coastal waterways. We also know that many of our shellfish beds remain closed due to nonpoint source pollution.

Governor Hunt is asking the legislature to approve 18 new positions that would provide technical assistance for

regional nonpoint source compliance efforts and the ability to run an effective nonpoint source program throughout coastal North Carolina. These positions would strengthen the state certification program for intensive livestock operations, promote the implementation of better forest management practices and provide much-needed assistance to coastal counties and towns in developing sensible land-use plans.

Improved land-use planning is indeed a critical step in ensuring that our coastal communities and economic development proceed in a manner that protects coastal water quality and our fisheries. In addition to these local efforts, we know that basinwide management is key to fighting nonpoint pollution in all of our state's waterways.

North Carolina is already a nationally recognized leader in its basinwide water quality management program despite the fact that it lacks the information management needed to efficiently and consistently run the program. The governor's budget would include funds to establish the computer-based technology that we need to manage the information.

The state's problems with its marine fisheries resources are well-known. I am sure everyone here has a story about the dwindling and dying resource. A good nonpoint program will go a long way toward bringing back the resource.

We also understand we need to do a better job of enforcing the rules and regulations designed to protect our fisheries. Our marine patrol is very understaffed as it works to meet the increased demand for resource protection. Governor Hunt's budget addresses these problems head-on. He is recommending \$1,338,892 to support seven new fisheries law enforcement officers and another \$575,000 for boats, trailers and equipment they need to do their job. The governor is also recommending funding for a new marine patrol vessel. I understand ours is over 10 years old. A new research facility would serve as a demonstration site for shellfish culturing and fishing gear. And the extension of our existing aircraft hangar would provide more space for storage and training. Training is something that we need to improve.

Finally, the governor is recommending a half-million dollars to help build the Partnership for the Sounds. The partnership is a unique nonprofit organization that works to promote ecotourism and environmental education in the Albemarle-Pamlico region. It is an excellent model of how the environment and economic development can mutually complement each other. The Center for the Sounds is going to bring tourists and their pocketbooks to eastern North Carolina, and they are going to come because of the quality of that environment.

The continued protection, preservation and restoration of North Carolina's coastal environment is essential to the economic well-being of the region — to us, to you and to future generations. We are excited about this package. We believe it will truly make a difference to our coast and will serve as a legacy for future generations.

We have a new group of leaders in the legislature this

year. Many of them are from inland counties. They care about the coast, but they need to hear from you and know that we have a resource that is in real jeopardy. We hope to continue this coastal campaign. We may be fund-raising. We may be putting brochures together. We hope to have some posters. If any of you have creative ideas, let us know. But we want this coastal campaign to surge throughout the state — on the coast and in the mountains — because many people who don't live in the coast love it and want to be part of preserving its future.

Timing is critical. When our Marine Fisheries director position vacated last year, I knew it was time to search for the absolute best we could find in the country. That person might be a North Carolinian, but we wanted to make sure that we looked for the best we could find anywhere. We carefully put together a small search committee composed of one recreational fisherman, one commercial fisherman, one academic, one staff person, one businessperson and the chair of the Marine Fisheries Commission. We saw to it that there was absolutely no political interference in the process.

The first thing we did was list the characteristics we were looking for in a new director: no conflicts of interest; experience in fisheries management, public trust issues, law enforcement, leadership and conflict resolution; and ability to work on the state and federal levels, communicate effectively and listen, and above all, build trust with the constituencies, legislators and the business community.

We found that person — Bruce Freeman. He is a man with a wealth of experience in fisheries management, a man with integrity and vision, a consensus-builder. He is thoughtful, fair and clearly wants to take on the North Carolina challenge.

Bruce comes from New Jersey's Department of Environmental Protection, where he headed marine fisheries. He has been a research scientist. He has had vast experiences as a fisheries biologist. He has a master's degree in fisheries science and oceanography from the University of Massachusetts and a bachelor's degree in zoology from N.C. State University.

**Bruce Freeman** is director of the Division of Marine Fisheries.

I want to make a few points before giving my talk.

First, after the glowing introductions from Joan Weld and Bob Lucas, it's going to be difficult to stand up to their expectations. I feel uneasy, but I will certainly try to do the best job I can.

Thirty years ago, when I was in graduate school in Massachusetts, we had a speaker who was director of the wildlife bureau in Massachusetts. And he told us that, as we got involved in our work over the years, we would probably end up spending 5 percent of our time on biology and 95 percent of our time working with people. At that time, I thought those remarks were totally incorrect. I couldn't

believe that would be true. And to my chagrin, I find out that indeed it is true. My interest was primarily in biology. I started out as a research biologist. I did the job because I enjoyed it, and I really didn't think there would be as much time involved with people.

But it is dealing with the people, both recreational and commercial. Dealing with the resource is extremely important, but most of the time is spent building trust and confidence with people so things can be done. We are the ones who control what goes on in the environment. We do have that authority and certainly exercise that power.

My third point gets to the question that I have been asked today. With all of these problems in North Carolina, why would anyone in their right mind want to come here to take this position? I looked at this issue very carefully. I am not sure I looked at all the aspects, after hearing some developments that have occurred since I accepted the job.

But I originally came to North Carolina through the academic system. I was in the School of Forestry and I transferred to North Carolina in forestry because this was where most of the action was in the 1970s. I knew well what was going on in New England. If I wanted to continue in forestry, there were two options. One was the old-growth forests of the Northwest and the other was the Southeast. This was where many of the paper companies were moving back. And so I came to North Carolina because it was one of the best forestry schools in the Southeast.

And in my coursework, I took an elective course in ecology. A professor by the name of Tom Quay, an ornithologist, taught this course. He took us out in the field and introduced us to the life of birds. We would have to identify every bird that we saw. Some 200 miles away a bird would fly by and give some strange call, and he would say, "Oh yeah, that is the red-breasted merganser." You'd need a telescope to see the thing, and I never could understand how he identified these birds. But we had a field course that also took us to the coast, and at that time I was introduced to marine biology. I could never understand how people got paid to study fisheries and marine biology. And after I took that course, I switched from forestry into zoology, graduated in zoology and continued my graduate work in marine biology.

All fish populations exhibit some inherent variation in their natural abundance. This variation seems mostly controlled by conditions or changes in the environment they live in. The control of the environment is usually beyond man's influence, and because of this, man can do nothing except live with the variations.

However, two other factors affect fish abundance. The first is man's ability to alter or destroy fish habitat. The second is man's ability to harvest particular fish or group of fishes — the so-called fishing issue. Only the last two factors, destruction of habitat and harvesting, can be controlled by man, and this is where most of our fishery management is directed.

And while much of our attention is focused on harvesting or overharvesting, habitat destruction in the long-term is more detrimental to a fish population. We need to keep that in mind. At the same time, habitat destruction is much more difficult for us to influence. We unfortunately find it to the benefit of an individual or company to destroy a natural aquatic area by dredging or filling or by placing or allowing waste such as sewage or chemicals into the waterway.

Another concern is that two-thirds of the 300 species of fish, shellfish and crustaceans that we harvest depend on our coastal estuaries at some time in their life. Our estuaries are spawning and nursery areas for some species and food supplies for others. Without the complex estuarine system in North Carolina, it's likely that we would not have the rich abundance and the large quantity of fish life. Yet we've concentrated much of our industrialization and development in and around our estuaries and at the confluence of major river systems emptying into the sea. And it's here that many of our wastes have arrived. Our estuaries have become repositories for toxic material, petroleum hydrocarbons and synthetic organic compounds. All of these substances can greatly affect not only the aquatic organism, but man himself.

Our recreational and commercial fisheries are pursued as a common property resource, and the resource depends on the natural ability to resupply itself. However, fishermen want a stable catch, usually at levels well above the average yield. Because of this and the tradition of a perceived right to fish freely, fishermen are eventually confronted with a scarcity of fish. Many times, this leads to increased competition and conflict among the fishing groups. This is common in North Carolina and all coastal states.

As resources become increasingly scarce, more pressure is applied by commercial and recreational fishermen. Consequently, the fish population is driven down even more. While we can keep a fish population depressed at a very low level, there is little we can do to keep it elevated at a very high level. Then, the management goal is to reduce or eliminate the scarcity of a species by controlling who catches the fish.

In reality, there is no practical option of controlling nature's processes. The only control we have is to modify our activities. Thus the management process becomes one of optimizing both the use of naturally occurring fish populations and the social benefits from managing or harvesting that species. As we all know, however, the way this is done greatly affects the benefits from the fishery — commercial, financial and social benefits to the fishermen themselves.

To further complicate matters is the speed in which these events occur. We demand immediate solutions to all of our fisheries problems. In the past, as we have taken action, there has been time to observe what we have done — what has worked and what hasn't. And there has been time for reflection. Today, as fishing equipment and gear change, we find that it's changing extremely fast, almost overnight.

Nets have gone from tarred cotton to monofilament.

Vessels have gone from wind-driven boats that sail with the tide to powerboats that can leave the dock at any time under almost any conditions. Navigation has gone from dead reckoning and land sights to Loran and satellite positioning. And our recreational equipment has improved as fast or even faster than some of the commercial gear. For example, we have fast, seaworthy boats capable of speeds of 30 or 40 knots. We have access to all the electronic gear that commercial fishermen have. We have Loran. We have handheld global positioning devices. We have fish-finders, sounders in a range that can be purchased by almost anyone. In fishing tackle, we have up-to-date materials that equal anything that exists even in the space program. We have the best rods, reels and terminal tackle that money can produce. And we have equipment now that far exceeds anything we had in the past. All of this equates to efficiency, which is being better at what we do and what we like to do.

All of these technical changes occur rapidly, and we are not able to predict their effectiveness until after they've been commonly used. Often, we're not able to control some of these gears if we see control is necessary.

The problems we face are as urgent as they are difficult. Management of our fisheries is complex because of the increasingly complex economic and social benefits from fisheries, both in food production and recreation. **No longer** are environmental conditions the controlling factors over fish abundance. Today we must contend with the harvesting — man's harvesting capacity and his influence over the water as well as the quality of that water.

The type and quality of aquatic habitat and the degree of environmental pollution are growing in importance. We will only be successful in solving and overcoming our problems when we recognize that we are all part of the problem. It is not the person next to us or the person down the street — it is us. We can't point the finger any longer. We are all involved.

We are faced with some fundamental questions. Has our abuse of the known biological processes outrun our ability to use them wisely? Are we now propelling ourselves into the future and not knowing where we are going? The human mind is a powerful instrument. One of the fundamental characteristics that separates humans from all other creatures is that we are continually seeking and storing knowledge. The use of that knowledge is what makes us dominant and powerful over all other creatures and even over some of nature's processes. There was a time not too long ago when ignorance was not only our heritage but a defense against our destructiveness. Time has shown that the human mind cannot be slowed down or reversed. It can only be guided and directed. And that guidance and direction can only be done by the human mind itself.

We are now at a crossroads. If it is our will to solve and overcome the various fishery problems, we now have the knowledge to do so. The question now is, do we have the will to bring this about?

Managing a resource can be compared to a doctor treating a sick patient. The symptoms of the disease are habitat and water quality problems, but overfishing is the arterial bleeding. It is a matter of triage. You treat the most important, but you treat them all to have a healthy patient.

So we have heard enough about overfishing. It's important now to hear about the other side — water quality problems and rebuilding marine fisheries.

### **Water Quality and Habitat Protection: Basic Ingredients in Rebuilding Marine Fisheries**

#### **How Environmental Quality Affects Fish Populations**

**David Engel** is a fishery biologist at the National Marine Fisheries Service laboratory in Beaufort.

I am going to discuss how environmental quality may affect fisheries in the Southeast. My remarks will not be limited to North Carolina, but will include representative estuaries from North Carolina to Texas.

More than 95 percent of the commercial and recreational fishery catches in the South Atlantic and Gulf of Mexico are estuarine-dependent. This is the highest percentage for any region of the United States. Estuaries are important because they are both sources of food and protection for early life stages of fishery organisms. Fishery organisms such as menhaden, summer and southern flounder, red drum, spot, croaker, shrimp and blue crabs depend on estuaries at some point in their life cycles. Adults spawn offshore, and late larvae or early juveniles move under the influence of currents and tides through inlets into estuaries. They remain in the estuaries for their first year to feed and grow, using marsh and seagrass habitats for protection against predation and as food sources. When they reach an appropriate age and size, they leave the estuaries and move offshore again to repeat the cycle. Thus, estuarine habitats are essential to the survival of many fishery organisms.

Now I'm going to discuss how we, as users of estuaries and adjacent land areas, can affect estuarine animals. Human populations impact estuaries starting upriver or in the freshwater areas with agricultural and domestic land use and extending all the way to the ocean. Along this pathway, the most actively developed areas are around the brackish regions of the estuaries and on the bays and barrier islands.

I want to talk about a number of human activities that can affect fishery populations, from fishing to chemical contaminants. Other than natural mortality, commercial and recreational fishing have the greatest impacts on fish populations. The impact of fishing pressure has been documented for a number of species, including striped bass, weakfish and oysters. But through fishery regulation, it's possible to control the numbers and species of fish affected. Other factors are more difficult to control and their effects on fish popula-

tions are less defined: coastal development, habitat modification and loss, freshwater diversion, coastal eutrophication, chemical loading, marine debris and cumulative effects.

Currently, coastal development is perhaps the most significant problem confronting the Southeast. Some estimates suggest that for the United States as a whole, 70 percent of the population will live within 50 miles of the coast by the year 2000. With this movement come homes, roads, industrial sites, tourist facilities and energy production requirements. All of these activities contribute to habitat loss and alteration, freshwater diversion, coastal eutrophication, chemical loading and cumulative effects.

In the Southeastern states, there has been a significant net loss of wetlands through such alteration, especially along the Gulf of Mexico. Among other causes, wetlands have been lost through modification for oil and gas exploration, marinas and expansion of coastal communities. Those most affected are salt marsh habitats and coastal seagrass beds, both of which are important for sport and commercial fisheries.

At our lab near Beaufort, we are exploring techniques to stabilize dredge spoil islands and their adjacent nonvegetated bottom areas by planting marsh grasses and sea grasses. With these transplanting techniques, we are hoping to develop methods to rectify some of the damage from development and human activities. The results of this work have been used along all coasts of the United States and overseas.

Freshwater diversion in North Carolina has not been a problem, but in other areas of the Southeast, such as Florida, it's a major problem. In eastern North Carolina, the long-term effect of planned water diversion from Lake Gaston to eastern Virginia is not known. But we hope that it will not be as severe as the problems in Florida. There, the Everglades are starved for fresh water, which is excessively drained or diverted at their northern margins for real estate and agricultural development. Most of the fresh water has been redirected to the Atlantic Ocean or the Gulf of Mexico. In recent years, environmental conditions in and near the Everglades have changed for the worse. For example, there have been noxious algal blooms, and the sea grass meadows in Florida Bay are dying. Currently, there are plans to re-establish more normal freshwater runoff patterns from the Everglades into Florida Bay. Our laboratory is involved in ongoing studies of Florida Bay, and I am working with a study to examine how re-establishing freshwater inputs will affect the possible movement of agricultural chemicals and metals, such as mercury, from the Everglades into the bay.

Coastal eutrophication is a problem that was spoken to very eloquently by the last two speakers. Point source discharges and sewage treatment plants can be controlled and monitored. But nonpoint source runoff, probably a greater problem, is difficult to measure and control. With the increasing number of housing developments in the coastal areas of North Carolina, problems related to nonpoint source runoff have intensified. In addition, there has been the

development of "mega-farms" along the coast. An example is Open Grounds Farm in eastern Carteret County, which uses best management practices. It is located in an area where excessive clear-cutting and other activities have taken place, and water quality has been degraded. Even though there is no direct evidence that the farm is a cause for concern, it is perceived by local residents to be the source of their environmental problems because of its size. Overall, however, smaller farms tend to be major contributors through the overuse of fertilizers and pesticides. Recent large releases of waste from large-scale livestock and poultry producers have impacted local estuaries and caused the public to call for the strong control and regulation of large agricultural operations. If, however, best management practices were used routinely at all levels, the effects of nonpoint source runoff would be minimized and the need for regulation reduced.

Chemical loading and marine debris are two of the most publicized contamination problems in estuarine and coastal areas. When you think of chemical loading, you think of giant industrial plants that dump large quantities of contaminant chemicals into the environment. In Texas, we have been working with other federal and state agencies to mitigate the effects of mercury contamination to Lavaca Bay by the Aluminum Company of America. The Alcoa facility on Lavaca Bay operated a chlor-alkali plant for about nine years. Mercury was used as a floating electrode in the process. In normal operations, about 60 pounds of mercury per day were discharged in its liquid effluent into Lavaca Bay. These discharges led to mercury contamination of the bay's sediments, which have been linked to mercury contamination among fish and shellfish living there. Concentrations of methyl mercury in edible muscle were measured in excess of 1 part per million (ppm), the Food and Drug Administration limit. Fish in the contaminated area of the bay had 3 to 4 ppm methyl mercury in the muscle. In 1992, we were asked to find out why mercury contamination of red drum, black drum and blue crabs was restricted to the most contaminated section of Lavaca Bay rather than the entire bay system. We examined the sediment mercury concentrations, life histories, feeding strategies and food supply and were able to explain the process leading to the elevated tissue mercury concentrations. Basically, these fish move little while they are in the estuary; they eat the animals from a limited area, which in this case was contaminated with mercury. Thus, the life histories of the fish and the local mercury contamination were responsible for observed differences in mercury contamination among red drum and black drum in the different areas of Lavaca Bay.

Oil spills also tend to be spectacular examples of contamination. In the Gulf War, 589 million barrels of oil were spilled into the Persian Gulf, causing extensive coastal damage. While that situation was deplorable and catastrophic, millions of barrels of oil were being spilled into the Gulf prior to the war during the course of normal oil shipping

operations. Closer to home, we looked at power boat use in North Carolina and estimated how much oil and combustion products were released into the water. The results were surprising. Based on boat registrations in 1990, we calculated that about 85,000 gallons of oil were released into North Carolina's coastal waters. Since then, the number of boat registrations has continued to increase, suggesting that even more oil is being put into our coastal waters.

Plastic debris is another type of pollution caused by human activities. Turtles and whales have died from eating plastic bags that clog their gullets or block their intestinal tracts. Birds and fish become entangled in discarded gill nets. This type of pollution is entirely preventable — not through regulation but through concern and common sense. We all share the coastal environment and we have an impact. But we can help solve this type of problem.

The cumulative effects of habitat loss, eutrophication, chemical contamination and other problems are impacting our coastal resources. Organisms are exposed to mercury as well as PCBs, low dissolved oxygen, and fluctuating salinities and temperatures. For example, blue crabs in certain areas in North Carolina have shell disease that causes holes or ulcers in the shell. The holes may be caused by a combination of factors that allow erosion by bacteria, which normally inhabit the surface of its carapace. Many crabs are found alive in pots in extremely bad condition. Finfish also have been shown to have degenerative diseases. Ulcerative skin lesions and carcinomas have been found among fish from North Carolina estuaries, but in general they're most common in areas with large industrial and urban inputs. And they're probably caused by multiple causative agents.

The complexities are monumental as we look at the big picture to evaluate the possible impact of contaminants on recreational and commercial fisheries in the Gulf of Mexico. To do this, we divided the gulf into four sectors and are trying to identify contaminants of concern in the sediments. We're using the monitoring information that is currently available and relating it to fish kills and fishing closures along the coast.

When we use measurements from pollution studies, they typically fall under three categories of effects: disruption of neural-endocrine systems, biochemical responses and physiological responses. We also find that the time scale is short and the scope is small. While it's possible to detect alterations in the health of individual organisms by such means, it's difficult to predict effects at the community and population levels. If blood chemistry is changed for an individual fish, for example, is the population of fish threatened? As yet, we cannot say. To be useful, studies should be conducted for extended periods of time and take into account normal cycles in growth and reproduction. Sadly, in most cases this type of data does not exist, so the best we can do is estimate.

I've discussed physical alterations, disease, natural stressors and chemical contaminants. But underlying these

factors are the problems of human population growth and development. I hope we are not so shortsighted that we decrease regulations, which control the negative impacts of these last two factors. They will both increase in the future. As a member of the planning board in Morehead City, I see that people are moving to the coast. So we must maintain our vigilance. We have met the enemy, and it is us.

#### **An Environmentalist's View on Rebuilding Marine Fisheries**

**Dave McNaught** is executive director of the Pamlico-Tar River Foundation, a regional environmental organization.

I am not going to say a lot about the Pamlico-Tar River Foundation or the issues that our organization deals with. Instead, I am going to talk about my favorite subject of all — I am going to talk about myself. But in doing that, I would like to emphasize a single word that is vitally important to this forum. That word is collaboration.

I am not like you. I am not a commercial or recreational fisherman. I am an environmentalist, a "tree hugger." Recognizing the differences in my perspectives and yours is, in fact, the very reason that the planners of this forum have chosen to include me on their agenda. The method to their madness is that they understand the fundamental fact that fishery management is not one-dimensional — it is carried out in a complex social arena that incorporates interactions of not just hundreds but thousands of individuals and variables.

The environment and our marine fishery resources are not being killed by one single thing. Rather, they are dying the death of a thousand cuts; and we, the people who don't like those cuts and who wish to protect the resource, are the ones who are inflicting those cuts. If we hope to resolve environmental problems, we can't go on doing the things we have always done. We will have to change what we do and how we behave.

Some of the problems in Florida and Texas that have been discussed today are also prevalent here in North Carolina. We have ulcerative mycosis. We have the toxic dinoflagellate that peels the skin off fish and is responsible for about 25 to 30 percent of the fish kills in the Pamlico and Neuse rivers. The problems we're talking about are not remote, they are not distant. They are very much here. We need not look very far for problems or for cures.

But again, the purpose of my comments is to emphasize the idea of collaboration, not just among people who have the same viewpoint, but among many people with very different and sometimes divergent perspectives.

About me. I am not a fisherman. I don't own riverfront property. I don't own a boat. I don't even eat fish or any kind of seafood. I don't have children or grandchildren. I don't have all the reasons that you have to protect our fishery resources. Nonetheless, I — and many people like me — want to help you protect these resources. I am here today

because environmentalists are going to be your most important allies. Fishermen are going to be my most important ally because, despite our differences, we have similar visions for the future of North Carolina's resources. We want clean rivers and a healthy fishery.

In modern America, issues are often played out in a context of divisiveness and a heightened sense of "them versus us." The media and others exaggerate our differences, but the bottom line is that we all ultimately want the same thing. If we sat down and talked about what we would like to see in 20 or 50 years on the coast of North Carolina, we would be amazed at how sympathetic our visions are with one another. So the reason that I am telling you that I am different is not to say that you should become some sort of hippie altruistic tree hugger, nor that I necessarily have to become a fisherman or a hunter to appreciate the environment from your perspective. The real point is to recognize that when people try to persuade you that I am your enemy and that those damned environmentalists are the enemy — that they are just there trying to ruin business — that is not the case. The truth is that the only way to do good business is with a healthy environment.

We have a legitimate crisis regarding fisheries in eastern North Carolina, and we need to resolve it. I use the word "crisis" advisedly. Almost every one of the speakers today used the word "crossroads." That is essentially what a crisis is. A crisis is not as many people characterize it. It does not mean that we are in an out-of-control situation. It means that we are in a situation where we are very much in control but at the point of decision. And that is where we want to be because the decisions we make today are going to dictate the kind of natural resource systems we have on the coast of North Carolina in 10 and 20 years.

You can't wait 10 and 20 years to make those decisions. The decisions we make today are going to ultimately determine whether we have a coast that enables future generations to enjoy the opportunities and benefits of a healthy environment or we have a coast that is plagued and periled by natural resource systems that no longer function as they should and we find ourselves in a fix-it mode. After the fact, the cost of repairing the environment is much more expensive than protecting it in the first place.

For example, the same day that the Environmental Management Commission (EMC) adopted an inadequate plan to address nutrient pollution in the Tar-Pamlico — one of the most severe problems in eastern North Carolina — there was a newspaper headline saying it would cost \$5.3 billion to restore the Everglades in Florida. I don't want to imagine a generation down the road having to spend billions of dollars to restore the Tar-Pamlico natural system. If we would simply do what is necessary to protect it today, we shouldn't incur those costs. Being good environmentalists basically means being good economists. We must work together to support the ecosystem that supports us.

As I have suggested, collaboration is the answer to these problems. Collaboration is the answer because: a) these problems result from cumulative impacts rather than a single causative factor and b) we, each in our own way, contribute to the causes.

We cannot compartmentalize these problems. We can't adjust one behavior here but continue to use economic interests to rationalize other behavioral patterns that have adverse impacts on the resources. We must fundamentally change what we value and then integrate our lifestyles around our common goals.

But are we collaborating already? No.

When I go to Marine Fisheries Commission meetings, there are few if any environmentalists there. Conversely, when I go to meetings of the Coastal Resources Commission or the EMC, the commercial and recreational fishermen are conspicuously absent. Fishermen and other environmentalists — I say other because we are all environmentalists who want clean water and healthy rivers — should be present and raising hell at all three commissions, but they aren't.

I know some of you go to those meetings, as I have. I remember one in Greenville back in 1991 about hog farms. Since then, environmental degradation linked to hog farms has become a major public issue. But in 1991, they had a hearing about the regulation of hog farms and only one recreational fisherman was present. Only one environmentalist was there. But 498 farmers were there saying, "How dare anybody impose regulations on hog farms." Now, we have witnessed the consequences of our failure to speak up at those earlier hearings and the state's failure to adequately protect North Carolina waters from hog wastes.

My point is that collaboration is not happening, and the reason is there are too many forces in our society that compel us to believe we can resolve these problems piecemeal. In other words, if you are a bass fisherman, all you have to do is protect bass fish. That is absurd, isn't it? Just as with Quail Unlimited or Ducks Unlimited, if you think you are going to protect what you want to by simply protecting that specific species, it isn't going to work. The reason it isn't going to work is because of what the environmental community has been arguing and pushing on the public's agenda for the past 20 years. It's crucial to recognize the ecological interdependence of all species and all elements of a natural system. We know this to be a simple fact. And the only way we are going to deal with this is if we deal with it in a holistic fashion.

Fishermen, for example, should attend a public forum on water quality at Swift Creek, where they are talking about protecting the dwarf wedge mussel and the Tar River spiny mussel. Fishermen must stand beside environmentalists and tell the EMC that it's important to protect these mussels in Swift Creek. Swift Creek in the Tar-Pamlico watershed has among the highest levels of water quality based on biodiversity of any major tributaries on the Atlantic coast. Yet it has no special protective status from the EMC or from the

Division of Environmental Management. Swift Creek has not been politically "designated" High Quality Waters or Outstanding Resource Waters despite the fact that biology and chemistry tell us that it is highest quality and assuredly an outstanding resource.

The point is that fishermen should be right there with the environmentalists trying to protect areas and resources even though the specific resource might be a mussel or something other than the species you fish for. Meanwhile, forces in our society work aggressively to convince you that I am your enemy or that you are my enemy or that somebody else is or that Jerry Schill is Dick Brame's enemy. That isn't the answer. The answer is unfortunately difficult. It means legitimately working together, and collaboration is not easy.

I am going to shift here with a wild analogy that George Will has offered about American democracy. Will, who is a baseball fan, says that democracy is like baseball. That's because neither one of them is about winning. But our society has been driven more by another popular leader, Vince Lombardi. Does everybody remember Vince, coach of the Green Bay Packers? For those of you who aren't sports fans, he said, "Winning isn't the most important thing — it is everything." Unfortunately, I think Vince Lombardi has had more influence on our society than George Will. And so we practice democracy in America as if it were a matter of winning, and we think that in a democracy we must beat the other guy. And that is what is beating us, because the end result is a failure to protect our environment. Environmental protection is not the domain of self-righteous radicals like Dave McNaught, nor is it the domain of the Republican Party or the Democratic Party, nor is it the domain of the commercial fishermen or the recreational fishermen.

The fact of the matter is, protecting our natural resources, our fisheries resources, is the domain of everybody in this society. It is, in fact, the purpose and function of democracy. Essentially, we can all work together because we all have the same goal.

Again, I am not motivated to protect that river so that you can catch the fish you want to catch. And you may not be motivated to protect that river because I happen to like to watch the sunsets there. Everybody has got their reasons. We have different motives, different intensities. But the bottom line is that if we look deep enough, we are going to find out that we all have the same underlying ambition and vision of coastal North Carolina, and we better work together to make the decisions today that will lead us to that shared vision.

### Estuarine Stocking Programs

#### The Feasibility of Stocking Fish

John Miller is a professor of zoology at N.C. State University.

The questions I want to answer are, "Will stocking or

culture and release of juvenile fish, sometimes called ranching, help rehabilitate fish stocks in North Carolina?" And, "If so, what are the best candidates?"

I will consider these questions by giving you some background on principles of production, determinants of productivity and management strategies. Then I will consider North Carolina species and systems characteristics — that is, what do we know, what don't we know and what do we need to know? Finally, I will present a whirlwind world tour on case histories of successes and failures — why some failed and why some succeeded. And I'll discuss their relevance to North Carolina; that is, what we might learn from others' attempts to do the same thing we're contemplating today.

First, we need to consider the possible causes for the decline in North Carolina's fish stocks. There is 1) overfishing; 2) a decline in overall production due to habitat loss, possibly caused by pollution or some other reduction in carrying capacity; 3) climate cycles that temporarily cause natural reductions in fish, called natural variability; 4) possible genetic changes; 5) a possible increased mortality from diseases, more predators and so forth; 6) and a possibility that fish production may have shifted to species that are not quite as interesting to us — to less desirable species.

The possible solutions, the effectiveness of which depends on the causes, are: reducing exploitation and allowing the stocks to recover, repairing or improving the habitat, channeling more production into desirable species and stocking. We need to examine the evidence for the causes before we consider the possible solutions and estimate the likelihood for success in North Carolina.

Scientists can never prove anything. They operate, like myself, by observing some phenomenon. Then we come up with guesses or suggest possible causes for whatever we are observing. We then consider the evidence, either through observation or through experiment. We estimate the probability of being wrong, and if the probability of being wrong is low, we accept the guess as right. If it is high and we are wrong, we reject it and test another guess.

The point is, scientists can never prove they are right, only that they are wrong. So all scientific facts that you have ever heard are simply best guesses that have been objectively tested — that is, evidence collected to disprove them. If we can't disprove the guess, we accept it as fact until proven wrong. So "scientifically proven," which we have all heard, is an impossibility.

Managers then take these accepted-as-true guesses, consider applications of those "facts," including the costs and possible benefits. They estimate the risk if they are wrong and then they implement the best management practices. That is the ideal scientific approach to management. My conclusion is that, up to now, fisheries management has been mostly a religious exercise. The crossroads, as I see it, is to put the fish back into fisheries management.

The world of science is full of jargon. It's hard enough

to understand the principles without the equivalent of a foreign language. Some terminology is necessary, but I'll try to keep it to a minimum. Here is what I have come up with.

Managing a fish stock is like managing a savings account with the objective of living off the interest. The objective is to sustain yourself by making withdrawals equal to the interest. Actually, we must spend a little bit of that interest to maintain the account — a service charge. So we can't spend all of it. The available yield is the total interest minus the service charge. If the withdrawals never exceed the interest minus the maintenance charge, the account will yield an excess forever. Since that yield is the product of the balance and the interest rate, the yield can go down because the interest rate falls, the balance is reduced by too many withdrawals or the service charge increases.

In fisheries, the fish stock is the balance, recruitment is the interest, natural mortality is the service charge and fishery yield is that portion of the interest or production that can be harvested. That is a portion, and only a portion, of the total production — what is left after natural mortality.

In an unfished population, the stock is at its maximum size in relation to the carrying capacity of the environment. It is composed of many large, old and slow-growing individuals. The stock is more or less stable, with natural mortality being balanced by recruitment.

In a sense, natural mortality and fishing mortality are in competition. As a fishery develops on that species, the harvest should be the difference between the total yield and the yield necessary to compensate for natural mortality — in other words, that which can be safely harvested. We sometimes refer to the amount that can be safely harvested as the excess yield or excess production. If we take too many fish that are too small, we waste potential yield. That is called growth overfishing, sort of equivalent to early withdrawal of a CD. If we continue to increase the yield, we risk going broke since the stock cannot maintain itself. That is called recruitment overfishing. And that is the point at which the stock is in trouble.

But clearly, to manage either our savings account or fish stock, we must know the balance, or stock size; the interest rate, that is, the recruitment or population growth rate; and the withdrawal rate, or the mortality rate. Imagine trying to manage a bank account without knowing how many people are writing checks for how much money. That is, in my opinion, the most compelling reason for a marine license.

The twist we have to deal with in fisheries is that, unlike our savings account, there is an upper limit to the stock size and consequently the yield, called the carrying capacity, which is set by the environment. As a population approaches that carrying capacity, its growth rate declines — either natural mortality increases or recruitment decreases or both because resources become limited.

The good news is that the maximum yield is obtained when the population is kept below that carrying capacity —



that is, a fished population — because the growth rate is not depressed by limiting resources. And it is composed of more intermediate-sized individuals with faster growth rates.

Different environments have different carrying capacities, or sustainable yields. Even in the same environment, the carrying capacity could vary from year to year. So while a particular system like Pamlico Sound might have a characteristic long-term carrying capacity, both natural mortality and recruitment vary. And depending on the species, the harvest needs only to exceed this variable excess yield for a short time to cause a population crash.

In short, there is no sustainable yield except that which is set low enough to prevent overfishing in a poor year. That is equivalent to managing a savings account with a variable interest rate and making withdrawals appropriate to the lowest interest rate. In both cases, until we can forecast the interest rate or recruitment in the fisheries case, it is absolutely essential to have a buffer. Fishermen have to remember this and be tolerant if it seems too low a quota has been set in a particular year.

A species' year-class strength can vary annually and long-term. The carrying capacity of any system is also different for different species, adding to the manager's difficulties. In other words, the fishery manager must manage many accounts simultaneously, and those interact because they use common resources. Because of this, overharvesting one species may result in another's increase to the point where the first cannot recover if harvest is reduced or even curtailed completely.

That is apparently what happened in the 1940s when we lost the world's largest fishery off our coast at the time — 10 million metric tons per year in the California sardine. It was apparently replaced by a northern anchovy, a much less harvestable species. And the sardine did not recover even after a complete moratorium on sardine fishing, another risk of going broke.

Returning to our central question, how can we rebuild a depressed stock? There are several management options, including culture and release of juveniles, which work in some cases but not others. Why? Because it depends on the cause of the depression, which I've discussed. For example, if the adult habitat is limited or if pollution is the cause for decline, stocking juveniles will not increase the stock. The stock will not increase if predators increase in proportion to the stocking effort — that is, if the stocked juveniles attract more predators — or if the stocked individuals are genetically inferior. These are all documented reasons that some attempts to restock various species have failed around the world.

Rehabilitation by stocking should work if the stocked juveniles are not competitively inferior and predation does not increase. It will work if the supply of juveniles is the cause of the depression, if recruitment overfishing is occurring. There are several reasons to believe the supply of

juveniles might be limiting in Pamlico and Albemarle sounds and therefore stocking might work.

First of all, the dominant species in Pamlico Sound spawn offshore up to 50 miles and must migrate by riding currents through narrow inlets to get to juvenile nursery areas. They also have to find the narrow inlets in our Outer Banks and the nursery areas where they mature, later to come back out and spawn.

Since they are less than a half-inch long when they make that migration across the shelf, the distance they travel is like a person swimming around the world in 30 days. More than 99 percent die before reaching their juvenile stage. The average lifetime of a typical marine fish is less than a week. From this perspective, releasing hatchery juveniles in the sound is like bypassing these high-mortality stages.

Also, there is less reproduction when adults are overfished. While the reproductive capacity of most marine fishes is enormous — a single spotted sea trout female may lay a million eggs in a single spawning — most stocks now seem depressed to the point that even their high fecundity is inadequate. At first it seems ludicrous to attempt to augment Mother Nature's reproductive capacity, but sufficiently depressed stocks, a high mortality of larvae and the difficulty of reaching the sounds may make this feasible.

Let's examine the evidence for our sounds. What is the evidence that the carrying capacity is not already reached and, consequently, stocking additional juveniles would not simply result in higher mortality? Remember, as scientists, we can only reject the alternative — that the carrying capacity is reached.

Where do Albemarle and Pamlico sounds rank among lagoons in terms of fisheries yields? The answer is that they rank among the lowest of 274 lagoons around the world. There is no reason why the potential yield should be this low, suggesting that these sounds might be able to support more fish. Alternatively, if they are already near capacity, we would expect to see evidence that growth or survival is lowest in sounds where the abundance of fish is highest. That would suggest that the carrying capacity is being approached at these high abundances of fish, and therefore stocking additional fish would be unlikely to increase the stock.

These data, which are about 10 years old from one of our Sea Grant-sponsored projects, show no evidence of growth depression even at the highest abundances found in Pamlico Sound. Since 1984, the numbers of fish have probably declined even further, so the probability of the carrying capacity being reached is lower. On the other hand, it is also possible that the capacity of Pamlico Sound has been reduced by pollution or direct loss of habitat.

As far as I know, these are the only data on growth and survival versus abundance for our sounds. Someone should recheck to see whether habitat loss has kept pace with overfishing, but I doubt it. And if the jetties are built at Oregon Inlet and further cut off the supply of larvae, it will

be even more likely that juvenile abundance is below the carrying capacity and colonization is limiting. So it appears from data available that Pamlico Sound could support additional juveniles.

Albemarle Sound appears even less likely to be near its carrying capacity, although the data base is poorer. The arguments are as follows. In a study we did, the growth rate of spot and other species was the same in Albemarle Sound as it was in Pamlico Sound, suggesting that the food supply is there and is adequate. Further, the abundance of several species was lower in many nurseries in Albemarle and, as in Pamlico, there was no evidence of depressed growth rate or survival or high abundancies.

Third, until the 1970s, the rate of commercial fisheries production per unit area was about the same as the rate of Pamlico. The capacity was apparently there, although the species composition was different. It was largely shad, herring and striped bass. Today, the fish fauna is dominated by anchovies, white perch and catfish, which are all resident species and less desirable.

Finally, there is a mechanistic explanation. Albemarle Sound, even more so than Pamlico Sound, is difficult to colonize by migrating ocean-spawned larvae despite its proximity to Oregon Inlet. Owing to its orientation, when the storm winds blow and bring sea water and fishes into the Pamlico Sound, they also pile up water at the southeastern edge of Albemarle Sound so sea water can't flow in with the fishes. In fact, in a recent study we placed current meters around Roanoke Island and found that sea water rarely flows into Albemarle. It does so only under special circumstances, which is one reason why Albemarle is less salty than Pamlico. In sum, Albemarle seems even less likely to be limited by the carrying capacity than Pamlico.

There is an alternative explanation, however, for the recent decline in production in Albemarle — water quality. Water quality needs to be clearly eliminated as a factor since it might also foil attempts to restock the sound. In my opinion, Pamlico and Albemarle sounds are most certainly as healthy as Galveston Bay, where stocking redfish seemed successful. We should never neglect to defend our sounds' water quality, but we should also never use it as an excuse for not vigorously managing our fisheries on a professional level.

Now let's look at the species. Basically, there are four types of life cycles.

First, there are marine fishes, which migrate upstream as adults and spawn in fresh water in the spring. The young of these hatch there and drift downstream into the estuary. They include striped bass, alewife, herring and shad.

Second are resident species, which complete their life cycle in the estuary. The bay anchovy, killfish, white catfish, silverside and white perch are examples.

Third are nearshore or estuarine spring and summer spawners. These include gray sea trout, weakfish, spotted sea

trout, red drum, silver perch and blue crab. Their young also move into nursery areas, but they don't have to move as far.

The fourth type of life cycle are the fall and winter offshore spawners. The larvae ride currents into the estuaries through inlets, transform into juveniles and spend at least their first summer in bay nursery areas. Then, depending on the size and species, they may remain in the sound until they mature and migrate offshore to spawn. Some, however, may migrate out early. That is the life cycle of the dominant species — spot, croaker, summer and southern flounder, menhaden, mullet and shrimp. All are very tolerant of high and low salinity.

Species in North Carolina vary with respect to the position in their range. North Carolina happens to be at a big zoogeographic break, and there are several species that reach their southern limit here. Others reach their northern limit here. Still others, such as the flounder, are more or less at their mid-range in North Carolina.

This situation is crucial to reproduction because species near their range limits are less likely to be adapted to the environmental conditions there and may be limited by temperature. They are also more likely to exhibit strong year-class variation with annual variation in climate or other factors. Consequently, successful stocking or other rehabilitation efforts of a species in one place does not necessarily mean it will succeed in others.

In general, range considerations have received far too little attention in fisheries management. For example, many North Carolina species are highly migratory, and it does make a difference what happens elsewhere. The exploitation of bluefish in Florida is bound to have an effect on North Carolina just as flushing the toilet in Raleigh will have an effect on Pamlico Sound.

Let's look at several stock rehabilitation efforts around the world. My recipe for success has four ingredients — the environment, species, release characteristic and pilot studies.

The environment should be below its carrying capacity for the species being contemplated; otherwise, the introduced fish will die. The good news is that most species show no signs of saturation. You never see stunted marine fish, and you rarely see density-dependent growth around the world. Also, most stocks are now well below historical unfished sizes — the capacity at least was there at one time.

Second, the system should be more or less closed, just as Pamlico and Albemarle sounds are closed. They are actually lagoons rather than open coastlines. Obviously, if you are going to stock fish in a system, you want them to stay long enough to be harvested. The highest returns worldwide are in Italian lagoons, which are screened off to prevent predators from coming in and to prevent the juveniles that are stocked from going out. And when the Italians doubled the number of juveniles that they put into those lagoons, they doubled the production — 100 percent return, in other words.

As other evidence, the Norwegian fjords and Danish

bays have better returns from stocked plaice than the open coasts of England. The main reasons are that predators tend to inhabit the bays in England more than the fjords, and the fjords and Danish bays are more closed. Now, this obviously depends on the migratory behavior of both the target species and the predators, which tend to be more numerous in open systems.

The French, for example, made a big mistake. They opened a channel to solve a sewage problem, which raised the salinity, attracted more marine predators and the fish production went down because the predators liked the higher salinity water. One exception to this rule — and this indicates our ignorance — is the red sea bream in Japan, where there was a 14 percent return of stocked juveniles three years later on an open coastline. That obviously depends on a species' ability or tendency to stick around.

Needless to say, there is no point in stocking fish in a polluted system. But you have to consider tolerance limits of the species and factors such as salinity and temperature on growth. In general, if you're stocking a species in an environment where it formerly flourished, these factors pose fewer risks, unless of course that system has become polluted.

In terms of predation, dumping juvenile fish into any estuary will probably attract predators. Salmon, for example, that were stocked off Vancouver Island attracted small sharks, which don't normally eat juvenile salmon. The same thing happened when cod were stocked off Norway without dispersing them. In the case of the juvenile Japanese flounder, predators were not successful in eating the flounder, but they chased them and limited their growth. In general, predators are less numerous in low salinity areas of estuaries. So stocking fish that are normally tolerant to low salinity water, such as spot, croaker or flounder, should be more successful from the predation point of view.

Competition is a factor. Another reason to scatter the individuals when you release them is to prevent them from depleting local food supplies. Of course, high numbers of other species that eat the same thing will have the same effect. Studies have already shown significant effects on the return of juvenile pink salmon when they were stocked in different places in the estuaries.

An extreme case of this is hatchery pink salmon. This fish is actually replacing wild stocks of pink salmon in Prince William Sound, and juvenile competition is one hypothesized reason. In any case, starvation is less likely when fish are released where the food supply is greatest in relation to the abundance of fish.

That brings me to another topic — genetics. Ordinarily, most hatchery-reared fish are considered genetically inferior to wild stocks. So it's a puzzle why the Prince William Sound hatchery-reared salmon are replacing the wild fish. That phenomenon is so much of a concern that the Norwegians have established a salmon gene bank for the hatcheries to preserve the genetic diversity. The trend is becoming a

concern to fisheries biologists worldwide. Another concern is disease resistance, since there is some evidence now in Scandinavia that hatchery releases are actually spreading disease among the wild stocks of cod and salmon.

In terms of species consideration in our recipe, the production should be limited by recruitment. Most stocks of interest are probably now limited by the number of young they can produce. Where stocking mullet in Italian lagoons produced a 100 percent increase in production, there is a clear indication that stocks were limited by recruitment.

All animals are presumably best adapted to their environment at the center of their distribution. So perhaps a lot of problems could be circumvented by staying away from their range limits, although that's where many species are showing most signs of being overfished. The southern flounder, for example, is nearer to the northern edge of its range in North Carolina than the summer flounder, which is near its center. So summer flounder, from that point of view, is a better candidate for stocking than southern flounder. But for the same reason, red drum rehabilitation may work better in Texas than in North Carolina.

Finally, the species should aggregate for harvest. That seems rather obvious, but in fact, most unsuccessful experiments have used fish that tend to leave the ranch. For example, bluefish, which migrate up and down the coast, would seem to be a worse candidate for stocking than flounder. And no doubt, salmon stocking has been so successful because of their habit of predictably returning to their natal streams, where they can be readily harvested. Striped bass show the same tendencies. The Norwegians found that with both cod and salmon, ranching them in fjords or salt ponds produced the greatest recovery rate because they were more closed.

Fish should be released at a size and time when predation is minimal. The Japanese found that both red sea bream and Japanese flounder were decimated on release if they were not kept in ocean pens for two months before release. Release of juvenile salmon at the wrong time also stimulated bird predation. And furthermore, the best returns of Japanese flounder were observed when they were released at a smaller size than normal for that time of year, apparently because food was more available and predators were less interested.

Also, fish should be released when food and temperature are optimal. Food and temperature conditions vary seasonally in North Carolina estuaries, and releases when both are optimal should bring more success. In the case of food, it's important to consider the number of competing species as well as the amount of food for that species. Ideally, they should be released into unoccupied areas or dispersed after an acclimation period. I have already discussed these factors in the case of salmon, cod and flounder.

All new species being contemplated for ranching must be tested for these effects. In fact, most species need pilot studies before launching a full-fledged hatchery program.

Even with pilot studies, however, we should expect some surprises. Except for a handful of marine species, we know little about stocking attempts. Red drum, striped bass and salmon are the exceptions, not the rule. In fact, most species cannot even be cultured in the laboratory, let alone in mass culture systems for release. But even after the culture techniques are worked out, it's a big jump to mass culture, so no one should expect quick results.

And it would be expensive to ranch any marine species. One project in Japan, involving red sea bream, brought a 14 percent return of 3-pound fish three years later. The cost for one prefecture to release 40 million juveniles was \$15 million. Since those sell for \$45 a pound in Japan on holidays, the cost was justified, but most prefectures in Japan experience about a 3 percent return, which is insufficient. Ranching is in its infancy, and costs will go down as experience is gained.

Finally, I want to take a summary look at Albemarle and Pamlico sounds.

Both sounds are semi-enclosed, which means that released juveniles should remain there, although many species migrate out in the winter, especially those at the northern limit of their range.

Second, many species migrate in as larvae, making them more likely to be limited by the juvenile stage than any others. Thus, it seems possible that several species in our sounds could be jump-started with juvenile releases.

Third, there is evidence that the systems could support additional fish biomass; that is, the sounds are under their carrying capacity. Incidentally, the failure of many historical attempts at stocking should not be used as evidence against stocking today. Since then, we have learned much about cultivating, and stocks are much more likely now to be below the environment's carrying capacity.

And finally, unlike more Northern systems, there are several viable species to choose from.

On the negative side, the sounds have a long water residence time compared to more open coasts. Pollution from upstream tends to accumulate in these systems more than in open systems, which are flushed regularly by the tides. Incidentally, effluent from hatcheries is a significant factor. Steps must be taken to prevent excess nutrients from reaching the sounds if we start ranching fish. There is already evidence of oxygen problems in the summer and fall. Also, mass culture of larvae is not done for most species, and much pilot work needs to be done. Striped bass and redfish are the exceptions, not the rule. But since we already know how to culture them, they might be most easily used in a pilot study.

In closing, let me point out that even if fish ranching is successful in North Carolina, there will still be allocation problems. Hatcheries may delay tough decisions, but they won't eliminate them. In Japan, a ban on sportfishing is being considered because sportfishermen are perceived as taking too many of the released fish from the commercial people,

who own and fund the hatcheries. So even though I could be cautiously optimistic about ranching in North Carolina, it is not going to solve our allocation problems.

I hope I have convinced you that while there is reason to expect success in ranching fish in North Carolina, the factors are complex. Much more careful thought should be put into the subject before we jump headlong into the fish ranching business. We would do well to learn everything we can from other ranching projects and avoid repeating their mistakes.

**Vass:** Is there evidence that any type of salmon could be cultured on our coast?

**Miller:** No, there is not.

#### The Red Drum Stocking Program in Texas

**Larry McEachron** is science director of the Coastal Fisheries Division of the Texas Parks and Wildlife Department. (Texas Parks and Wildlife Department economist Robin Reichers collaborated on this presentation.)

Stocking red drum is a successful component of Texas' management efforts. A dramatic decline in abundance due to overfishing resulted in a three-phased approach to recovery. Details of the first phase, the monitoring programs, were presented earlier in this forum. The second phase enacted restrictive regulations to reduce fishing pressure. Today in Texas there are no nets, limits of three red drum per day and a minimum of 20 to 28 inches in size. With the red drum trophy tag program, which we implemented in September, fishermen may keep one red drum a year over 28 inches. And third, a hatchery program was started to enhance the fish population.

Our hatchery program began in 1971. Texas was the first state to document that stocked red drum survive in the wild, based on bag seine and gill net samples. One-inch long fingerlings were stocked in St. Charles Bay in spring and summer, when natural red drum of this size are not present. Fish spawned in September 1978 grew and began to show up in our bag seine and gill net samples. Fish spawned in fall 1979 also began to show up in samples later that year. The 1 million fish stocked in the summer were identifiable by their length. Conclusions from this study provided impetus to expand the hatchery program. Based on the success of this initial research, the first full-scale hatchery dedicated to marine stocking was implemented in 1983 in Corpus Christi.

Our hatcheries consist of spawning and incubation facilities and 59 acres of production ponds. Broodfish are held in 3,400-gallon tanks in environmentally controlled rooms. Water is recirculated and the quality is maintained by mechanical sand filtration, biofiltration and ozonation. Our plan to maintain genetic diversity has the key components of collecting fish along the coast, maintaining 140 to 180

broodfish annually, exchanging 25 percent of the broodfish annually and completing extensive genetic surveys.

Broodfish are subjected to a 150-day photoperiod-temperature maturation cycle. This allows two spawns a year with a 30-day spawning period between each cycle. Spawning occurs at a water temperature of 77 F and 11 hours of light. Fertilized eggs are buoyant, and they float to the top of the circular tanks, where they are skimmed off the surface, carried into the egg collector and collected by dip nets. We volumetrically count the eggs, then transfer them to 238-gallon incubators, where they hatch within 24 hours.

Thirty-six to 40 hours after hatching, larvae have developed mouth parts, distinct eye pigmentation and a complete digestive tract. These first-feeding larvae average one-tenth of an inch long and are ready for stocking into rearing ponds that are filled with sea water.

Inorganic and organic fertilizers are applied by hand to produce a phytoplankton bloom that feeds a copepod population, a primary food source for the larval red drum. Larvae are stocked in the ponds five to 10 days after fertilization.

We monitor dissolved oxygen, salinity, temperature, zooplankton densities and fish growth rates in all ponds. Larvae remain in the ponds for 30 days or until they reach a target size of about 1 inch. Once fish reach the target size, we drain our ponds and fish are collected in the kettle. We harvest them with dip nets, and then we transfer them to hauling tanks for stocking into Texas bays.

Hundreds of stocking sites are selected yearly by bay system biologists. The strategy is to dispense the fish into as many good sites as possible. To date, more than 140 million fingerlings have been stocked into Texas coastal waters.

To assure quality of the stocking program, we determine the annual relative density index of red drum in the bay systems. This comes from the monitoring program that I described earlier. We select suitable stocking sites after researching the most viable sites. We also use up-to-date culture techniques, changing as the technology changes.

Since 1990, between 25 million and 30 million fingerlings have been stocked each year. About half of the production is stocked in spring and early summer when wild fish about 1 inch long are not present. The rest are stocked in late summer and fall when wild fish of the same size can be found. This method maximizes the potential for survival through time, given all the various environmental conditions of the Texas coast. To further enhance survival potential, no more than one trailerload is stocked at any one site within a bay system in a year.

Since verification of survival in St. Charles Bay, other studies have further documented that stocked red drum survive. Analysis of the bag seine catches in St. Charles Bay revealed that 1979 and 1981 catches in this stocked bay were significantly higher than in the adjacent unstocked bay. In 1980, we did not stock and the catch rates were similar between the bays.

A gill net study showed that catches of 2- to 5-year-old red drum in a stocked bay were consistently higher than those in an unstocked bay. The study examined 3-inch, 4-inch and 5-inch gill nets, seasons, number per hour and number per gill net per hour. We stocked in 1983 and began catching these fish in fall 1984, primarily in the 3-inch mesh. These fish showed up six months later in the 4-inch mesh and one year later in the 5-inch mesh. This trend was not observed in the unstocked bay. In fall 1985, the 3-inch mesh began to catch fish from our second stocking, and these fish also began to move into the 4-inch mesh as they became older.

Angler data revealed that the landings were higher in the stocked bay than the unstocked bay. The number of red drum harvested from the stocked bay increased 100 percent over the historic mean between 1979 and 1984. Meanwhile, there was a 27 percent increase in the number of fish landed in the bay that was not stocked. Sportfishermen, however, fished 45 percent more man-hours in the unstocked bay.

From 1990 to 1993 "out-of-phase" red drum were followed in Upper Laguna Madre. In 1991 and 1992, we followed stocked fish for up to eight months following stocking (after that, they weren't valuable to our bag seines). These fish were collected during the routine sampling that I described this morning. No extra samples were taken. Twenty-one percent of the fish caught in our routine random sampling were stocked fish.

In September 1993, oxytetracycline-marked red drum were stocked in Upper Laguna Madre when wild red drum would be present. Oxytetracycline (OTC) lays a mark on the fish that fluoresces under ultraviolet light. Through June 1994, 79 red drum were caught in the sampling. Of the 63 red drum available for examination from these bag seine catches, 21 percent were marked fish. Two fish were picked up in a routine trawl sample in deep water in late January about two miles from the stocking site; both had the OTC mark. Eight others were caught in some special bag seine samples that we took, two of which were marked. The largest marked fish was caught in a bag seine on April 10, 1994. We received verification last month that a second OTC marking study conducted in Galveston Bay in fall 1994 documented an initial marked fish recovery of 46 percent.

A preliminary statistical analysis of our stocking and gill net data reveals that four Texas bays have a positive correlation. This means that when we stock, subsequent gill net catches go up. If stocking is working, a positive relationship should be detected between stocking density and relative abundance in years after stocking.

Based on all Texas research to date, we believe we're achieving enhancement of 20 to 30 percent. The main theme throughout the evaluation process is that red drum are surviving and stocking works.

A key question that needs an answer is what kind of benefits are being received from the stocking program and how might these benefits be measured? Ideally, all benefits

could be quantified in a dollar amount and then a cost-benefit analysis could be run. Included would be a quantifiable dollar measure of the contributions of the stocks and a measure of the total value received by anglers in the fishery.

While willingness-to-pay techniques are available to measure total economic value and bioeconomic models could be used to measure the effects on stocks and subsequent economic effects, Texas has not yet completed this type of comprehensive analysis. However, I am going to present three approaches to measure the importance of the red drum fishery in Texas and to estimate the value of stocking.

The first approach is a cost-versus-benefits measure of the stocking program. This is an expenditure accounting approach that would be used by legislators and administrators to measure cost and benefits of a program. The second approach determines anglers' willingness to pay for a red drum trophy tag that would allow landing a fish greater than 28 inches long. The third approach measures the importance of catch items, specifically the catch of red drum on the satisfaction of anglers on a trip.

The question of cost versus benefits is constantly raised. Questions arise about whether stocking hatchery fish is the best use of resource dollars, especially when stocking programs require capital investment to build hatcheries.

In Texas, the number of harvested stocked fish is still considered the value that has not been directly figured out. Our ability to estimate this number is coming closer to reality. We have a study in progress that is using a gene marker in red drum that we hope will allow us to quantify the ultimate magnitude of enhancement. However, we can use several scenarios to come up with a relative range of numbers based on survival estimates from our juvenile studies.

Having two factors in the costs-versus-benefits equation permits the calculation of a break-even point, which is the number of fish that enter the creel to produce a 1-to-1 cost-benefit ratio. Based on this ratio, we proceeded to estimate the number of fish that must survive to be landed.

Included in the cost-benefit ratio is a measure of the cost associated with producing red drum. The operating costs — which included salaries, facility operation, costs of fish production and depreciation — have ranged from \$1.1 million to \$1.5 million or 5 to 12 cents per fish. Averaging the years gives us an estimated \$1.325 million in annual operating expenses.

The dollars or benefits received per fish have been calculated two ways to give a range of possible benefits. The first approach takes the direct expenditures associated with saltwater fishing in Texas from the 1991 U.S. Fish and Wildlife Service report. Then, based on the percent of anglers who say they are targeting red drum, an estimate of expenditures associated with angling for red drum is calculated.

Based on Texas boat angler surveys, 13 percent solely targeted red drum, 31 percent targeted red drum and spotted sea trout, and 7 percent targeted red drum and another

species. Of the 38 percent who targeted red drum and other species — including spotted sea trout — we assume that one-half or 19 percent of the total angling trips were attributed to red drum. Thus, 32 percent of the boat anglers are targeting red drum. Interestingly, this on-site creel survey closely resembles information obtained in our annual mail surveys. In these studies, red drum is listed as the first preference by 34 percent of the anglers who responded to the survey.

This approach results in \$613 per fish when total dollars attributed to red drum are divided by total number of red drum landed by boat anglers. This value will decrease if fish landed at lighted piers, jetties and shore-based areas are factored into the equation.

The second approach to calculating benefits relies solely on data from the harvest survey for boat anglers that I described earlier. We estimate total number of man-hours spent fishing in salt water and total number of red drum landings and we obtain expenditures per trip. Using this information, we can partition total number of man-hours spent fishing for red drum, assuming man-hours spent for each type of fish is equivalent per trip. Next, by determining the average dollars spent per hour and the total number of man-hours spent for red drum, we have another way of estimating total dollars spent for red drum angling. This total divided by the number of fish landed gives a value of \$199 per red drum for sport boat anglers.

Now, by assuming a 1-to-1 cost benefit ratio, we can solve for the number of stocked fish that must be landed. With \$613 per fish, there would have to be 2,166 fish landed — or less than a .01 percent survival of 30 million stocked fish. In other words, 1.2 percent of the estimated sport boat landings would have to be stocked fish.

At \$199 per fish, which we believe is a better estimate, a 1-to-1 ratio would be achieved if 6,658 fish were landed — or a .02 percent survival of stocked fish. This equates to 3.6 percent of the total current sport boat landings. This approach assumes that anglers are receiving the same value for all fish regardless of size or quantity landed and the expenditures for red drum fishing would not be spent or substituted into other fishery activities if red drum were not available.

The next approach is based on a willingness-to-pay study. Specifically, we were trying to find out how likely anglers would be to pay for a trophy tag allowing them to keep red drum over 28 inches long. Those who said they'd be willing to purchase a tag was greater than 70 percent at \$3 per tag; that number decreased to about 20 percent at \$50 per tag. This study revealed that 50 percent of the people would purchase a tag if priced at \$14.14. As might be expected, those who were targeting red drum would pay more than those who were not. Also, 45 percent of those who originally said no to the value they were asked to accept or reject changed their answer to yes if the tag revenue were dedicated to fisheries management, specifically hatcheries.

The third approach is an attempt to measure angler

satisfaction and the relative contribution of its various components because, as this quote points out, "The principal goal of recreation management is to maximize user satisfaction consistent with certain administrative, budgetary and resource constraints." In past studies where fishing satisfaction has been measured, items used to describe aspects of satisfaction have been split into catch and noncatch items, or situational and subjective items. Specifically, we chose to use the catch and noncatch components. Catch items are catch per unit effort, total number of fish caught, number of red drum caught and number of spotted sea trout caught from our harvest surveys. Noncatch items are expenditures spent on a fishing trip, number of trips taken per year and number of people in a party. These data were collected from 1987 to 1989 on our coastal harvest survey and included over 8,000 interviews of anglers per year.

Using a path analysis approach, which is a type of statistical analysis, we have basically decomposed the effects these independent variables have on total trip satisfaction and the indirect effects they have through other independent variables. The higher the number, the higher that factor is in the satisfaction of the angler. When focusing on the magnitude of total effects, both direct and indirect, the catch items have the greatest impact on satisfaction, whereas the noncatch items appear to have a smaller impact. When looking at the direct impacts, total number of fish and the number of red drum landed have a greater impact on total satisfaction. Landings of red drum and spotted sea trout have significant indirect effects through total number of fish landed. Red drum and spotted sea trout have near the same overall effect, but red drum has a much greater direct effect. This could be attributed to the less frequent catch of red drum versus spotted sea trout on the Texas coast.

While these three approaches do not give us the definitive value of a stocking program, they do support the idea that the red drum fishery is very important in Texas, and management efforts to ensure its continuance is valuable to the state. Additionally, this work will enable us to eventually calculate the number of fish that survive and reach a fishable size, the percent that are caught and their value.

Further, the results of our study reveal that because of the high value placed on red drum, relatively few hatchery fish need to be caught by recreational fishermen to have a positive economic impact. Also enforcing the high value placed on red drum fishing is the fact that Texas has received support from anglers and other groups to pay \$14 million for a new hatchery, which is under construction in Freeport on the upper Texas coast. Funds for the hatchery are coming from angler-based and other funds.

This is a direct result of having scientifically documented a biological impact that corresponds to the anglers' perception of better fishing. Our credibility as managers is elevated to a level where we have support from the public, private and political sectors for our present and future

management programs. It is impossible to place a monetary value on this support, but it is an important component in the overall cost-benefit documentation.

**Richard Dana:** How long has Texas had the saltwater stamp and what is the cost?

**McEachron:** The price of the saltwater stamp was recently raised to \$7. We have had a saltwater license since 1954 and a saltwater stamp since 1983. The stamp was implemented after red drum became a game fish in the early 1980s.

**Dana:** When that was first proposed, was there public opposition to it?

**McEachron:** There was opposition, but there was a lot of support, especially when we made sure that the revenue was dedicated to coastal management. We wouldn't have had the support to do that without a clause in the legislative package. Sportsmen would not support more money for saltwater fishing and saltwater stamps if the revenue was going elsewhere. It was dedicated to the area and increased our law enforcement and coastal fisheries personnel. We now have 136 in the Coastal Fisheries Division.

**Dana:** At this point, there is no or very little opposition?

**McEachron:** There are always people who complain about having to pay for a fishing license. Our philosophy is that fisheries management is very expensive and if you want to get something of value, you must pay for it.

**Dana:** What is the administrative cost for the saltwater stamp?

**McEachron:** I don't know the exact administrative cost, but we wouldn't have the stamp if we weren't getting a positive return on our money.

**Goldstein:** Does Texas or any other state provide hatchery restitution?

**McEachron:** The only way we provide it is for research purposes. We have provided red drum larvae and fingerlings to researchers all over the Gulf of Mexico and to several on the Atlantic coast. We are not selling them — it is for research purposes.

**Goldstein:** Have you considered the cost benefits of specialized regional hatcheries that would allow states in the Gulf and Atlantic areas to share production costs? For example, if you were to produce red drum for a number of states and North Carolina produced flounders for other states, would that be more efficient than each state or pair of states having its own hatchery system?

**McEachron:** It all depends on genetics. Our genetic research documents that red drum are very heterogeneous, or mixed, and there is basically one population in the Gulf of Mexico. We also found little difference between Atlantic fish and Gulf of Mexico fish. Red drum are ideal because you can move them to different areas. We are conducting genetic mitochondrial DNA work with flounder. They are very homogeneous, which means they are specific to certain areas. So it depends on the species. I don't think that would work genetically.

We are also stocking spotted sea trout, which vary genetically. There are select stocks in bay systems. Last year, we stocked 2.5 million spotted sea trout fingerlings, and we are improving the culture techniques in the ponds. If we do mass spotted sea trout stocking, our main thrust comes after freezes to see if we can bring the population back quicker, which we believe we can. We will work on a bay-to-bay basis with fish from a bay system. Only spawns from these brooders will go back into that specific bay system for spotted sea trout.

You have to be careful with the genetics of all the fishes to avoid doing damage. In Texas, we follow strict protocols to maintain genetic diversity. We want to avoid problems such as the one involving salmon in the Northwest.

#### Hard-to-Identify Fish

**Fritz Rohde** is a biologist supervisor (ichthyologist) for the N.C. Division of Marine Fisheries.

I will discuss how to identify groupers, tunas, flounder and amberjacks and the current rules and regulations that involve these species. I also urge you to get *Atlantic Coast Fishes*, a book that is part of the Peterson Field Guide series.

I will start off with the groupers — the larger and more common ones that you're likely to see. First is the gag grouper, also called the gray grouper. When it becomes large, it's called the charcoal belly or black grouper. We are not sure why, but this species is tied to the estuary. When the eggs and larvae are spawned offshore, the larvae are carried by the currents into the estuaries where they develop in the eelgrass and oyster beds. There is a 20-inch size limit, which is a state and federal size. It is basically an elongated grouper with a gray-green color and various markings that we call kisslike markings on the body.

Next is an uncommon fish in North Carolina waters — the true black grouper. It is very abundant off Florida. It has a sort of rusty-brownish body color with many small spots. When smaller, this grouper has blocks on its body with light parts between them and the fins are edged with black. This grouper also has a 20-inch size limit.

Next is the scamp grouper. This grouper, along with the gag grouper, is probably the most prominent grouper caught. It also has a 20-inch size limit. Its maximum weight is 8 to 10 pounds. The larger fish has irregularly shaped extensions

throughout the tail. The smaller fish, about 20 inches, usually has a smooth tail. There is a yellow mark in the corner of the mouth and a series of spots on the body.

The yellowmouth grouper is a similar fish. It also has a yellow marking in the corner of its mouth, but it has a pale body with very faint spots. And the extensions on the tail are more regular, diamond-shaped, unlike the scamp's, which is smooth or has a few extensions. It has a 20-inch size limit.

Another common fish in North Carolina is the yellowfin grouper. Fishermen call it fireback because of its reddish coloration. It is called yellowfin because the right pectoral fin is bright yellow. It is a very colorful fish. It is not as common as the scamp or gag, but you can catch it. It also has a 20-inch size limit.

The third most abundant grouper is the red grouper. The body has a pale pink-reddish coloration, not too many markings and occasionally some spots on the side of the head. There is no saddle on the back. The term "saddle" refers to the top part of the tail. It also has a minimum 20-inch size.

In deeper water, the snowy grouper is common. When small, it has a greenish coloration with white spots on the body and a prominent black saddle on the tail. As it gets larger, however, it loses the spots and the saddle and takes on a grayish coloration. It most often occurs in very deep water of about 100 fathoms or more. However, headboats have collected them in years past, and they have basically been fished out in shallower waters.

One of our rarest groupers is the Warsaw grouper. It has a gray-brown color, and the main difference between it and the large snowies is the second dorsal fin. The dorsal spine in the Warsaw is very elongated and much longer. It has 10 dorsal spines instead of 11, which the snowy has. Because of its scarcity, the South Atlantic Fishery Management Council decided that only one of these fish is permitted per boat. They have gotten quite large in the past, up to 300 pounds. Currently, however, they are very uncommon.

All the above groupers count toward your bag limit, which is five fish per person per day.

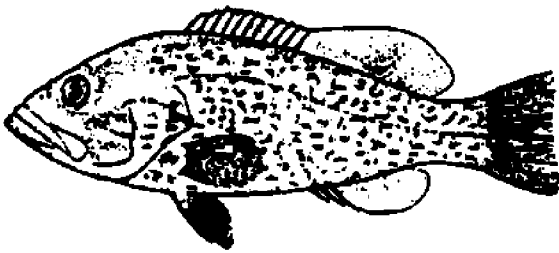
Another North Carolina grouper is the speckled hind, which most people call a Kitty Mitchell. It is also uncommon and falls in the one-fish-per-boat category. Generally, the fish you see will be a reddish-purplish color with white spots, but small fish are yellow with white spots or blue spots.

The next three groupers I will discuss are called strawberry groupers. They are small and usually reach 2 pounds maximum. The first is the rock hind. It has a tannish-green body with red spots. Cherry spot grouper is another name. One key character is the three black blotches right below the dorsal fin. The red hind has a pale pink body with many dark red spots. It does not have the blotches on the back like the rock hind does, and the fins are edged with black.

Less common is the coney, which has several color phases and is a very pretty fish. You can have an orange, a yellow or a bicolored orange-and-brown color. It has many

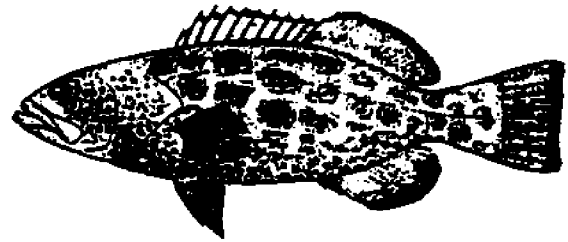


Groupers



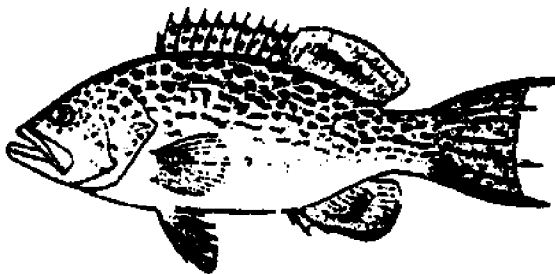
Gag

- Irregular markings on body
- Gray-green body color
  - Commonly caught
- Minimum size: 20-inch TL (state and federal regulations)



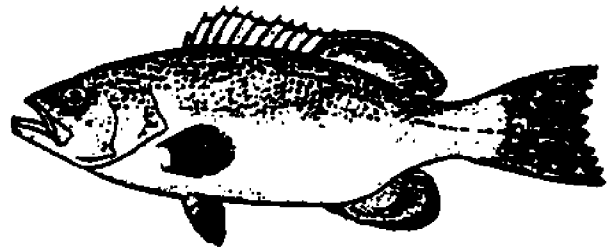
Black Grouper

- Rectangular blocks on body
- Reddish-brown body color
- Many small brassy spots on body
  - Rarely caught
- Minimum size: 20-inch TL



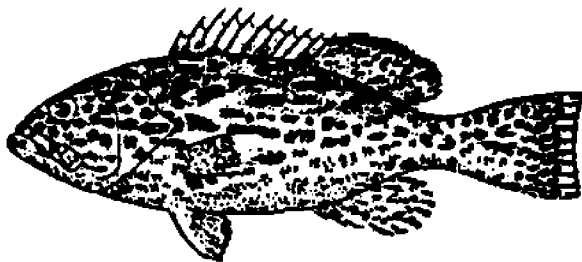
Scamp

- Brownish body with widely separated spots
  - Yellow in corner of jaw
- Large adults have irregular extensions on tail fin
  - Commonly caught
- Minimum size: 20-inch TL



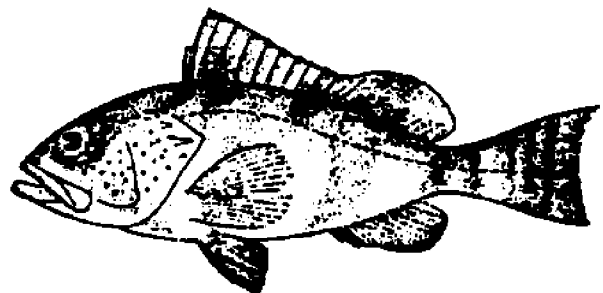
Yellowmouth Grouper

- Brownish body with many small spots
  - Yellow in corner of jaw
- Large adults have regular extensions on tail fin
  - Rarely caught
- Minimum size: 20-inch TL



Yellowfin Grouper

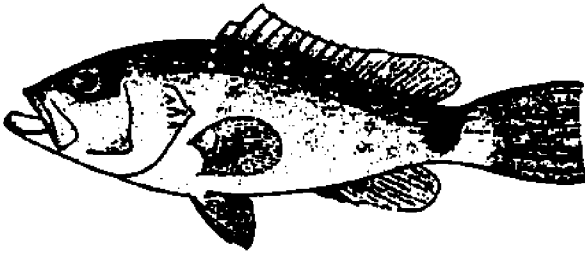
- Red upper body, pectoral fin with yellow edge
  - Many small spots on body and fins
    - Uncommon
- Minimum size: 20-inch TL



Red Grouper

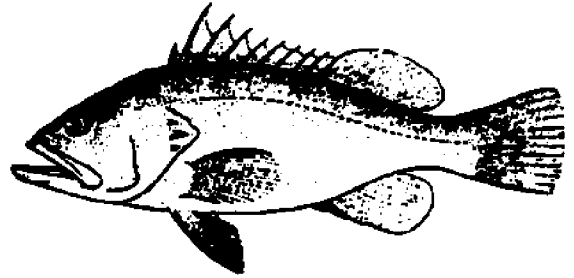
- Brownish-red body
- No saddle on back before tail fin
- Minimum size: 20-inch TL

Groupers



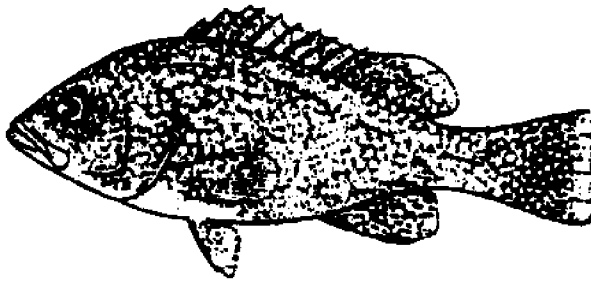
**Snowy Grouper**

- Greenish body with white spots (lost in large adults)
  - Dark saddle on back before tail fin
  - Eleven dorsal spines
  - Uncommon



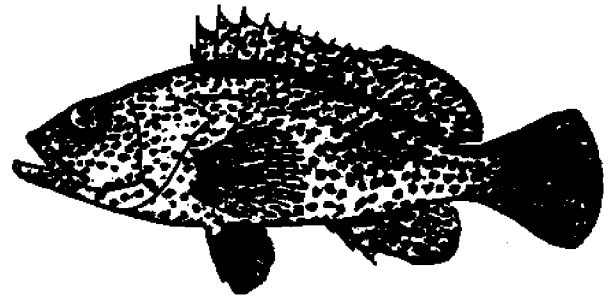
**Warsaw Grouper**

- Dark gray-brown body
- Ten dorsal spines, second longest
- Rare — only one fish per boat (state and federal regulations)



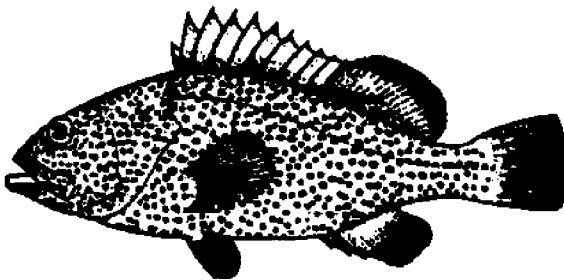
**Speckled Hind  
(Kitty Mitchell)**

- Reddish-brown to purple body with many white spots
  - Young are yellow with blue spots
  - Only one fish per boat (state and federal regulations)



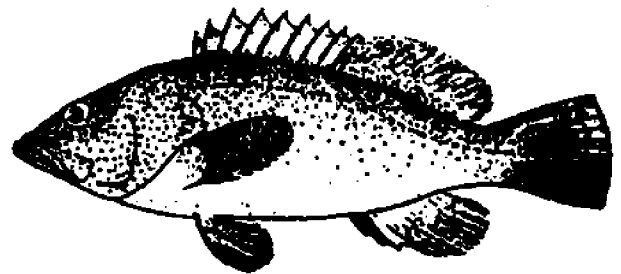
**Rock Hind**

- Greenish body with red spots
- Three blotches below dorsal fin
- Usually less than 14-inch TL



**Red Hind**

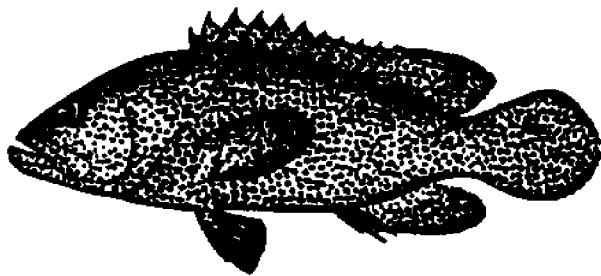
- Pale pink body with dark red spots
  - No blotches on back
  - Fins edged with black
- Usually less than 17-inch TL



**Coney**

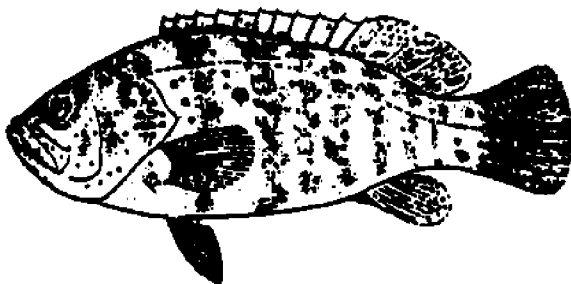
- Orange, yellow or red body with blue dots
  - Two black dots on back before tail fin
  - Two black dots on chin
- Usually less than 12-inch TL

### Groupers



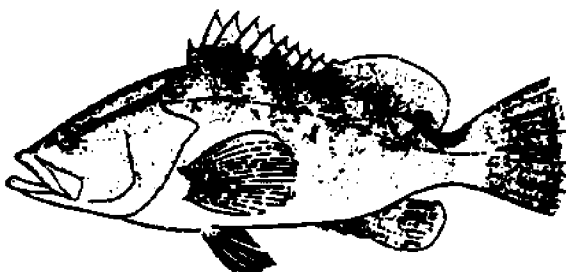
**Graysby**

- Brownish-red body with many dark spots
- Three to four spots (white to black) along back below dorsal fin
  - Tail fin rounded
- Rare — usually less than 10-inch TL



**Jewfish**

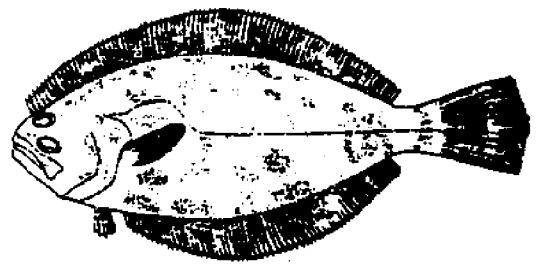
- Greenish-gray body with many small black spots
  - Tail fin rounded
- Very rare — no possession (federal regulation)



**Nassau Grouper**

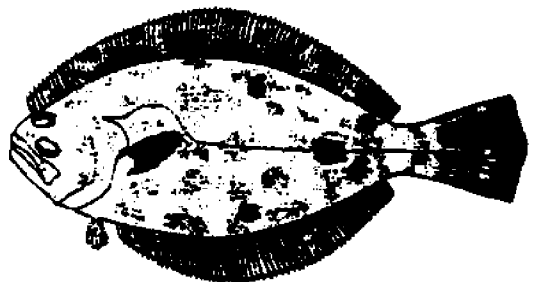
- Pinkish-brown body with dark saddle on back before dorsal fin
- Stripes on head form a tuning-fork design
- Very rare — no possession (federal regulation)

### Flounders\*



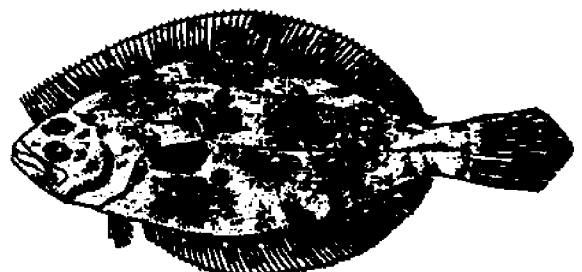
**Southern Flounder**

- Dark blotches, not ringed
- Gill rakers, lower arch, eight to 11
- Primarily in lower salinity waters



**Summer Flounder**

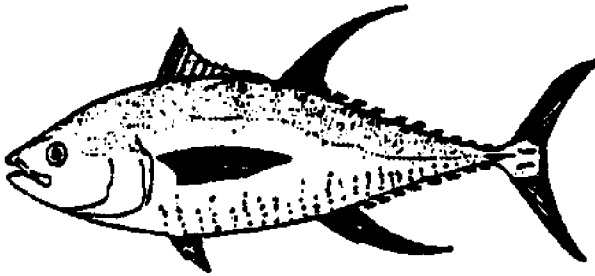
- Many ocellated (ringed) spots. Five large ones form two triangles
  - Gill rakers, lower arch, 13 to 18
  - Ocean and higher salinity waters



**Gulf Flounder**

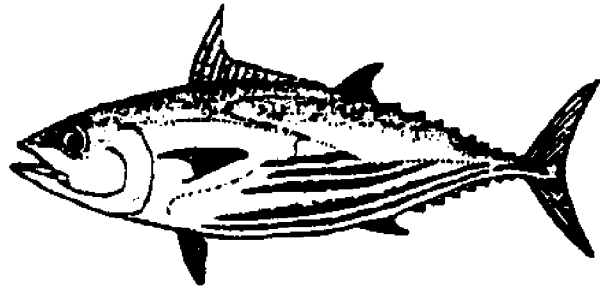
- Three prominent ocellated spots
  - Gill rakers, lower arch, nine to 12
    - Primarily in ocean
- \* minimum size: 13-inch TL (internal); 14-inch TL (ocean)

Tunas



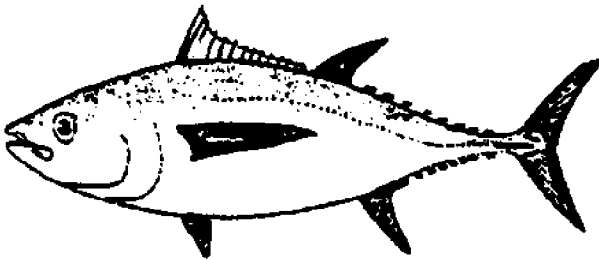
**Yellowfin Tuna**

- No striations on bottom surface of liver
  - Fins elongated in large adults
    - Finlets bright yellow
- Twenty-six to 34 gill rakers on first arch
- Minimum size: 22-inch FL (state regulation)



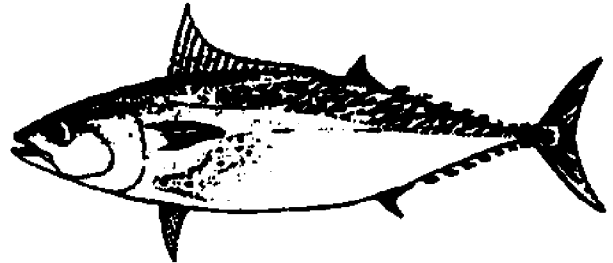
**Skipjack Tuna**

- Four to six stripes on belly



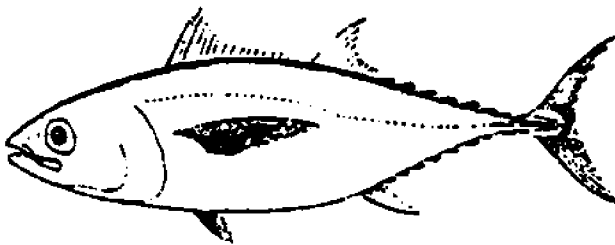
**Bigeye Tuna**

- Striations on bottom surface of liver
  - Fins not elongated in large adults
    - Finlets yellow
- Twenty-three to 31 gill rakers on first arch



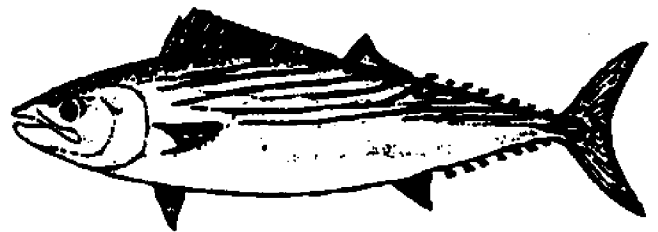
**Little Tunny**

- Spots below pectoral fin
- Diagonal wavy bars on back



**Blackfin Tuna**

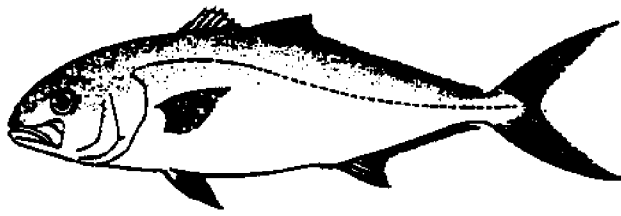
- No striations on liver
  - Finlets dusky to black
- Nineteen to 25 gill rakers on first arch



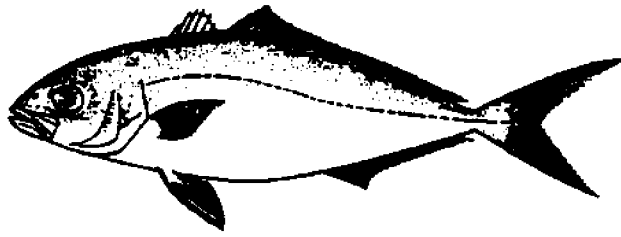
**Atlantic Bonito**

- Dark, oblique stripes on back

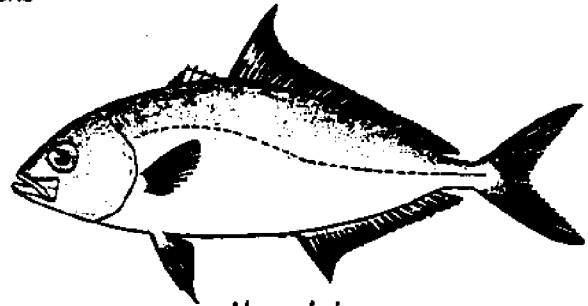
## Amberjacks

**Greater Amberjack**

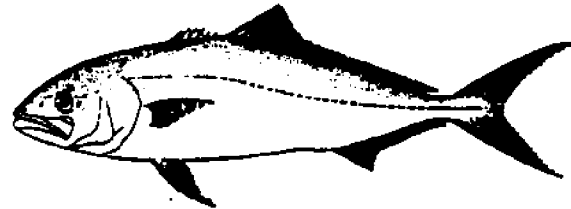
- Large eye
- Back part of jaw hump-shaped
- Gill rakers, 11 to 19
- Greenish body
- Jaw extends to back of pupil
- Minimum size: 28-inch FL (state and federal regulations)

**Lesser Amberjack**

- Large eye
- Back part of jaw straight
- Gill rakers, 23 to 26
- Pinkish body
- Jaw extends to front of pupil

**Almaco Jack**

- Deeper body with elongated dorsal fin lobe
- Dusky body
- Gill rakers, 22 to 24

**Banded Rudderfish**

- Small eye
- Back part of jaw slightly hump-shaped
- Gill rakers, 14 to 17
- Greenish body
- Anal fin less than one-half length of dorsal fin
- Jaw extends to back edge of eye

blue spots all over the body. It has two black spots on top at the back of the tail and two spots underneath the chin.

And last of the small groupers is the graysby. Its maximum weight is usually 1 pound. It has a brownish-red body with many darker reddish-brown spots. Along the base of the dorsal fin are three spots of a white or a black color. The tail fin is rounded, unlike the others, which are more squared.

All these groupers are counted in the five-fish bag limit. It is illegal to possess the other types of groupers: the jewfish and the Nassau. You probably won't see them, but they do occur in the state waters beyond three miles. Two years ago, we booked our first two confirmed records of jewfish. One was bang-sticked off Holden Beach, and one was caught in a shrimp trawl. They get quite large. They have a grayish body with many, many black spots all over and a well-rounded tail fin. The jewfish is extremely rare.

The Nassau grouper is sometimes confused with the red grouper. It has the same pinkish-red coloration, but there are two main differences. The Nassau has a black saddle on the

back and a marking like a prong or tuning fork on the forehead, which runs down the middle of the head and toward the eyes. These markings differentiate it from the red grouper.

The second group I will discuss is flounders. We have two minimum catch sizes: 13 inches in inside sound waters and 14 inches in the ocean. The season is currently closed in the ocean. It should open up May with an eight-fish bag limit.

Three main species are caught, but the southern flounder is the most common species caught inshore, in the sounds and rivers. It is a plain-colored fish, and it may have some black blotches on the back. Another common flounder, the summer flounder, has a series of spots that are ocellated, or ringed, by a bright orangish color. It also has a lot of other spots, but the ocellated spots stand out.

A very dark summer flounder looks like a southern flounder. The best way to tell them apart is to open up the gill arch and count the number of gill rakers. The southern flounder has fewer gill rakers (nine to 10) than the summer (15 or more).

The last species is the Gulf flounder, which is found

predominantly in the ocean. It has three ocellated spots that form a triangle.

Among the tunas, the bluefin, yellowfin, bigeye and blackfin are most commonly caught. The two most confusing are the yellowfin and the bigeye. The best way to tell them apart is to look at the liver as you cut a fish open. There are no striations or lines on the underside of the yellowfin's liver, while the bigeye has many such markings.

In the yellowfin, the second dorsal fin gets quite long and it is a bright yellow, while the bigeye dorsal stays short and is a yellow to dusty color. The yellowfin also gets lined markings on the belly, which the bigeye does not get. The bigeye, true to its name, does have a large eye, but it is all relative. You need both fish side-by-side to tell them apart. The bigeye also has a slightly deeper body. I have read that in live specimens the bigeye has a blue band along its side.

The third tuna, the blackfin, is probably the most distinctive of the three. It has no striations, but all its fins and finlets are a dusky to black coloration. There is no yellow.

The tuna family has three smaller members: the skipjack tuna, which has four to six stripes running along the belly; little tunny (also called the false albacore in the past), which has some distinctive black spots in the area between the pectoral fin and the pelvic fin and wavy markings on the back; and the Atlantic bonito, which has dark, oblique stripes on its back.

The next group is now under regulation by the federal government — the amberjacks. All amberjacks look very similar, which causes confusion. Recently, a commercial boat was given a citation for having an undersized greater amberjack, which turned out to be a banded rudderfish. I think officials have since eased enforcement of that regulation.

But there are some slight differences that differentiate the amberjacks. Easily differentiated is the Almaco jack, which has a deeper body than other amberjacks, a second dorsal fin, which is much higher, and a dusky gray black coloration to the body.

The lesser amberjack is an overall pinkish color. Fishermen call it amberines. The upper jaw, the upper mandible, is straight and comes to the front of the relatively large eye. The greater amberjack has a humped mandible and large eye. The banded rudderfish has a straight mandible and a small eye.

The greater amberjack and the banded rudderfish have been difficult to identify. We examine the shape of the mandible to determine whether it is humped or straight. We also look at the mandible's relationship to the eye.

The best way to differentiate these fish is to measure the ratio of the anal fin. The length of the anal fin is less than half of the dorsal fin in the banded rudderfish, while the anal fin is larger in the greater amberjack.

The amberjack regulation strictly applies to the greater amberjack. Currently, we don't differentiate among the flounders. All size limits for flounders are geared toward the summer flounder, which is in serious trouble. We don't

appear to have problems with the southern flounder, the inshore type. Some people have asked why we haven't lifted size limit regulations on the southern flounder and imposed a 14-inch limit on the summer flounder. The reason is that people can't tell them apart. So we limit all three species.

Moving back to the gag grouper, it has an elongated body, grayish-green coloring with small kiss markings. It is the grouper most commonly caught by recreational fishermen. All groupers change sex as they get older — that is, they start as females and turn into males. Some people are very concerned that the sex ratio of fish, particularly gag grouper, has been altered so that there aren't enough males to take care of the females. Currently, there is an intensive study sponsored by both state and federal governments to sample the sex ratio of these fish.

The black grouper has a brownish body with a lot of little spots. Smaller fish have a bricklike pattern on their bodies, and all the fins are black. The yellowfin grouper is called a fireback by fishermen for obvious reasons.

The scamp is a commonly caught fish. When it's small, it doesn't have extensions on the tail like the larger ones have. It has a very smooth tail in the back. There is a slight yellow coloration at the jaw.

Similar to the scamp is the yellowmouth grouper. It has a deeper body, sometimes more yellow in the jaw, no or few spots on the body, and the extensions on the tail fin are much more regular.

The red grouper has a pinkish body with no markings. The small snowy grouper, the kind you will probably see in shallow waters, has white spots on the body with a black saddle. The Warsaw grouper has an elongated second dorsal and is a very dark gray fish.

The speckled hind or Kitty Mitchell is small. It starts out life with a yellow color that changes to olive green. Finally, it turns to the typical adult color — purplish with white spots.

Now, I'll describe the strawberry groupers. The first grouper is the rock hind, which is greenish. The red hind is pale pink with red spots, while the graysby is reddish-brown with spots and a round tail. The colorful coney is orange-colored with blue spots.

As for flounders, the summer flounder has a series of ocellated spots. It tends to have an orangish-coppery color. The southern flounder has a plain color, but occasionally a darker blotch appears on the body. One way to differentiate fish is to count the number of gill rakers. Gill rakers are under the gill cover of the fish. The gills face backward, while the gill rakers, small projections, point forward. Gill rakers help keep debris out of the fish's esophagus and body.

The ocellated flounder — also called the four-spot flounder in the past — is a less common flounder that is occasionally caught. Another is the windowpane, which is usually as thick as a piece of paper.

Flounders such as the summer, southern and Gulf are called left-eyed flounders. The coloration and eyes are on the

left side of the body. The right-eyed flounder is more common off New Jersey, Delaware and New York.

Now, I'll move to tunas. The yellowfin has an elongated second dorsal, striations on the side and the yellow finlets. The blackfin is smaller, all of its fins are dusky coloration and it has no yellow. The skipjack tuna has stripes along the belly. The little tunny has black spots and wavy markings on the back. And the Atlantic bonito has stripes on its back.

One of the more difficult fish to identify is the lesser amberjack. It has a pinkish body coloration; its jaw is straight and comes about to the front of the pupil; and it has a large eye. The greater amberjack has a rounded snout and a humped mandible, which comes to about the middle or back of the eye; the anal fin is about the size of the dorsal fin; and it has a slightly smaller eye.

The small almaco jack keeps a dusky black coloration when it gets older, but the dorsal fin gets much longer.

The banded rudderfish has a more pointed snout than the greater amberjack; the jaw is still slightly humped, but it comes to the back of the smaller eye; and the anal fin is short.

#### Tarpon Fishing in North Carolina

Owen Lupton is a marine occupations teacher at Pamlico County High School.

I will take you back to how I started tarpon fishing. It was Sept. 25, 1971. I was 24 years old and had fished all over Pamlico Sound as a commercial fisherman since I was 8. I was basically on the water every day, all summer long, day after day. At that time, I had never seen a tarpon in Pamlico Sound. I was jigging for gray trout in the Neuse River right off the steel tower. Anybody who has ever been to the Neuse River knows where it is.

I had a call on my CB radio. So I laid down my rod with the lure overboard. It was a small Hopkins lure. A few minutes later, I walked back to the rod to wind it in. When I picked it up, wham. Something took off with it and then came up on the top. I asked the boy with me, "Was that a cobia?" He said, "I don't know what that is." It was just going and going.

Eight or 10 folks were fishing in a big circle on top of the oyster rock, and all of a sudden this tarpon came out and just hung 10 or 12 feet in the air. And right then, that image was burned into my memory. No videotape, no 35-millimeter camera, nothing could capture that or take it away from me. It is forever there. And it was like when I met my wife. My mouth was real dry and my hands were real sweaty, and I had fallen in love with a tarpon just like that. I had no idea I would catch one.

That went on for about three jumps and then the little split ring between the lure and the hook broke, and I lost the fish. But it didn't make any difference. Seeing all those trout

fishermen gather around that 115-or-so-pound tarpon jumping — I can still see the drops of spray frozen in midair.

That is what sportfishing is about. Anytime I go fishing and it doesn't turn my crank, then I will quit. It doesn't make any difference if I am croaker fishing or dolphin fishing or tuna fishing. If I don't enjoy going, I will just quit and go do something else.

Over the next four or five years, we hooked a few fish accidentally. This was about the time that the gray trout and big croakers were making that run back in the Pamlico Sound in the early 1970s. And we hooked two or three tarpon jigging, again with Hopkins lures. So that is one way you can catch them. I don't know what kind of result you guys will have, but they will hit a Hopkins lure off the bottom. We were just jigging and hooked two or three like that.

Then a friend and I discovered that while everybody else was catching gray trout that were 2 or 3 pounds, sometimes 4 pounds from jigs, we could go in the sound with live bait, small croakers and live lines and just drift along for them. We were catching gray trout 8 and 9 pounds where everybody else was catching them 3 or 4 pounds.

In the process of catching some of those gray trout, we also hooked two or three tarpon on live bait with live croakers. And we also hooked two or three on trout that had hit lures and hit fish and we were bringing them in. We lost some tarpon — we never landed one. We didn't really know what to do. Our gear was too light; it was basically trout-type fishing gear.

And so in 1976 — almost 20 years ago — one of my students and I decided we were going to master tarpon fishing because some people had said we couldn't catch those fish. They are spawning. They don't feed when they are in the rivers. And like most fishermen, they didn't know what they were talking about. Most fish have to eat, just like most human beings do. And so we set out and said we were going to do this.

We read every book we could get hold of and listened to all the experts — and the world is full of them. Anyway, we finally decided the way to catch them was on a bottom reef with cut bait, like catching cobia or red drum. That was one method being used in Florida at the time.

So we went out to Pamlico Sound. This was before the days of Loran, at least for the kind of boat we had. We really didn't know where to go. We were in the process of hanging some of those tarpon while trout fishing — we had seen a few fish roll and knew they were around. We would run off Swan Island out toward the Brant Island Shoal light, which we could see most days. And we didn't have very sophisticated equipment or depth finders. We probably had an old flasher on the boat or something. And when the bottom would change from hard bottom to soft bottom, we would stop, start fishing and hope that we would see some fish.

Eventually we learned some things about that. Most people don't see tarpon because they don't stay in one place

long enough. The faster the boat, the more territory you try to fish. And so most people tend to run to a place, stay five minutes, get impatient, then crank up and go somewhere else.

We found that if we sat quietly and drifted along for a half-hour, we'd begin to see some fish. On a calm day, we very rarely fished unless we saw fish. I like to see the fish, and I would invest an hour or two running to a different place, drifting and looking around rather than going and setting up my gear in a place where there might not be fish.

And so in 1976, we caught and landed the first fish close to Brant Island Shoal. We killed that fish. It was one of two that I have killed in 20 years of tarpon fishing, and it weighed 90 pounds. We actually brought it in because we knew everybody was going to say, "Oh, they didn't catch that fish. That's another one of those fishing lies."

You know, I've discovered that's one thing about both sportfishermen and commercial fishermen — neither of them has a corner on lying. If commercial fishermen could sell all the stuff they've talked about on the radio, they would all be rich. And the same thing is true of sportfishermen.

So we brought that one in. It weighed 90 pounds, which is about the average size of most tarpon in Pamlico Sound. Now, last summer we did find a body of fish way up in the Neuse River that were in the 40- to 50-pound range — they were the smallest fish I'd ever seen in Pamlico Sound. But there was also a fairly large school of them above Oriental. We caught and released some of those fish.

The only other fish that I ever killed was one we were trying to lip gaff — and that's one of the things I want to emphasize to you. It is better not to try to gaff these fish in any shape, form or fashion. If you try to lip gaff them, invariably somebody is going to be excited. What happened to this fish was the boy hit it in the gill raker and tore it loose, and the blood was flying, and we were convinced that it was better off in the boat. Of course, the fish probably thought it was better off in the water. I imagine it had a better chance there to survive than it did where we put it, because it certainly died there. That fish weighed about 90 pounds.

I have never killed another fish. In fact, we don't even bring the fish in the boat anymore. We bring them to the boat, put a nylon glove on our hand, reach over and grab the fish in the mouth. If we can, we take the hook out of its mouth. If we can't, we cut the leader as close as we can and let it go.

If you bring the fish in the boat to take pictures, you have got to knock a lot of slime off of it. These fish are heavy. They are hard to lift over the railing of the boat without dragging them. You are going to put that railing through their internal organs. It is going to push against them hard and probably do some damage. Also, they have a very nasty habit of turning their bowels loose every time they get in a boat. And if you have ever smelled that, you won't want to smell it again. So we don't boat the fish. If we want to take a picture, we try with a video camera while they jump or a 35-millimeter at the side of the boat. I did make an exception

last summer when I carried my nephew, who was blind. He caught a fish, and we put it in the boat and took some pictures. I thought that was a case worth him having some pictures that he could show to his friends. Not too many blind people have ever caught a tarpon, but he caught three that day in the Neuse River.

So that is how I got started. Now let me describe how, when and where. The fish normally begin to show up to the east about July 1. That's not to say that there aren't a lot of fish on the north side of Brant Island Shoal. And then there's the entire half of Pamlico Sound, where nobody tarpon fishes as far as I know. I do know that haul netters on the upper end of the sound catch them in their nets sometimes.

That's one good thing. This fish isn't under any commercial pressure. And even in a haul net, it'll jump over the net most times. Pound netters hate to get tarpon in their nets because they have been known to jump into the boat. So they're even hard to keep in a pound net. Trawlers very seldom catch tarpon, and now with the turtle excluder devices, they go right through.

So we have one fish here in North Carolina that is not being threatened by commercial fishing in any shape, form or fashion. And if the recreational fishermen will use their heads, if they won't destroy it, they have a wonderful resource. If it is destroyed, recreational fishermen won't have anybody to blame but themselves.

Now, these fish start to the east and come up the river in July. By August, many times, they are off South River and on up. I have caught them in late August at the John Lawson bridge in New Bern. In fact, people have told me they've seen them in October on a full moon chasing mullets at the New Bern bridge. The same is true in the Pamlico River. These fish will come all the way up in late summer to Washington.

Like I said, there is a lot of the sound that we don't normally fish. Most of our fishing is confined south of Brant Island Shoal, up the Neuse River and a little over in Pamlico River. We had it very good for a long time, folks. A half-dozen of us knew how to catch fish, and nobody else even knew they were there. When people came by, we would lay down our rods in the boat. We would wind them in and leave. We would do whatever was necessary to keep people from knowing that we were catching tarpon. We would even cut the lines to keep the fish from jumping.

But of course, what happens is you tell your best friend. And your best friend has a best friend whom he tells. The next thing you know, you've gone from a half-dozen to a dozen to 25, and now they've started a tarpon tournament. It's a good tournament. But I was very much against it and furious because the man who started it was someone I'd carried fishing. I really felt betrayed.

But the concept of the tournament was good because it doesn't allow gaffs. It doesn't allow the fish to be taken into the boat. There is no weighing. It's strictly judged by how



many fish you can release, and it's all verified by an observer. There isn't the greed that you see at some tournaments because first place only brings \$3,000. I'm not here to push the tournament. I'm just saying that it's set up well.

I tried to put the tournament out of business the first year by boycotting it. The really knowledgeable fishermen said they weren't going to fish it. And nobody did the first year. But last year I figured I couldn't put it out of business, so I fished the tournament. If anybody was going to make money off of it, I might as well. So we fished the tournament and finished second. We had a fish that would have put us in a tie for first place and first-place money.

Those fish were typical of what happens with a lot of tarpon fishermen or people who are fishing for tarpon for the first time. It takes them an hour, two hours, three hours, four hours to get a fish to the boat. They try to play the fish so delicately to keep from losing it that they ultimately are going to lose it anyway.

We caught the first fish in eight minutes. The second fish was to the boat in 10 minutes. The third fish on the second day we had to the boat in 12 minutes. This is on 30-pound class gear. I like to use a TLD 15 or a Daiwa LD 50 lever drag with the drag set at 7 to 8 pounds, a quarter of the strength of the line. We use a 100- to 200-pound test leader. In fact, we lost the fish that day of the tournament because we dropped down to a 100-pound test leader, and it swallowed the hook far enough that it chafed the leader in two right at the boat.

These fish can be caught quickly. It doesn't have to take two or three or four hours to get one in. If you put maximum pressure on the fish, fight it hard, get it to the boat and release it quickly, it will be in good shape. I have caught some on bass casting tackle. I was really a glutton for punishment initially. I thought it would be fun. It took me a couple of hours, and the fish were wanting to roll belly up when I got through. So I figured that wasn't good for the fish.

Basically, we go with 30-pound test gear on a heavy 6- to 7-foot rod. I like to use an ugly stick. And you can catch these fish quickly. I have caught two fish in the last 20 years that I was fairly sure would have broken the state record — close to 200 pounds, I believe. I didn't bring either of them in. I have caught three others that I thought were over 150 pounds.

Back then, it was more important to keep the secret than to have a state record fish. If I was to catch one now that was close to 200 pounds, I might bring it in since the cat is out of the bag and everybody knows the story of tarpon fishing. If I'd been asked two years ago to give this talk, I wouldn't even have admitted that I knew there was a tarpon in Pamlico Sound. But I think we have a good opportunity for people to have something they can enjoy. Over the years, we have probably caught 400 or 500 tarpon. My son caught his first one at age 10, and he has been catching them ever since. Of course he is a big kid now, about 6 feet 2 inches and 240

pounds, so he can put a lot of pressure on a fish. But a woman can do the very same thing with that class of gear.

I have seen people go out there with stand-up tuna sticks and fishing Penn Internationals and 80-pound test, but that is overkill. I mean, if you can catch a fish in eight or 10 minutes, why do you need anything heavier than this? You really don't.

So what kind of bait should you use? Most any kind of cut bait will catch fish, and live bait works as well. A few fish have been caught with fly rods, a few on mirror lures and so forth — at least they've been hooked. But the basic standard is to go out, set up and fish with cut bait. If I had a choice of bait, and I could get fresh bait, I would take spots. But I have caught them on fresh croakers. I have caught them on gray trout. I have caught them on speckled trout. I have caught them on bluefish. I have caught them on Spanish mackerel. I have caught them on sand perch, pinfish and almost anything that you can get.

By the way, the Division of Marine Fisheries people are doing their job. If they come to you, they are going to check your cooler to see if you have any undersized fish. So if you are saving bluefish or gray trout or whatever for bait, you'd better be sure they're big enough.

And then you have a problem. If you cut those fish in two and put them on the hook, you can't really prove that they were the legal size. And so if you are going to use one of those fish that is restricted in size, you should cut the side off for a fillet and leave the head and tail intact so you can prove that it is actually legal size, because they will check you.

In Pamlico River last year, I had one gentleman check me on two different days, and of course it didn't hurt my feelings. He was doing what he was supposed to do. He was very courteous and cordial, but you need to be aware. Don't catch an undersized fish and think you can cut it up, put it on the lure out on the bay and get by with that because they may ask you to wind in your rod and reel to see what kind of bait you are using.

These fish seem to stay around until about the end of August. I would say that prime time is from July 4th until Labor Day. But as I said, the first fish I ever caught was in late September, so a few fish stay around later. I have been going across Pamlico Sound many years, king mackerel fishing out of Ocracoke, and have occasionally seen tarpon in late September rolling and feeding on menhaden that are probably preparing to migrate to the ocean. So they are around fairly late. But normally, by the time Labor Day comes and goes, most of our fishing is directed toward puppy drum, speckled trout or king mackerel, and there isn't too much pressure on the tarpon.

**McPherson:** What type of tackle do you use?

**Lupton:** I use 30-pound test line. I have a good friend who may be the best tarpon fisherman in the state. He uses Penn

spinning reels, 850s, with 30-pound line, 100- to 200-pound test monofilament leader. You can go to a braided cable-coated leader. I have probably caught 100 on cable-coated leaders in years past. I would rather have monofilament because it won't kink if you miss a strike. However, almost any time you catch a fish, you are going to have to replace your leader because its mouth is rough enough to fray it.

Most people are using four rigs to fish with, and they're fishing just like you would for red drum or cobia with a fish-finder rig. I like to use a 7/0, 8/0, 9/0 Mustad offset hook, nickel-plated with a turned-back shank, and that is snelled on. Then you have a snap on the other end and a line that will slide up and down.

If you were going to live-bait fish, of course, you could cast without any weight on it. As far as I know, nobody has tried slow-trolling like you do for king mackerel. I don't see why that wouldn't work except for, perhaps, the noise of the outboard.

One thing I've noticed is that if you're anchored somewhere, hook a fish and need to chase it — sometimes you will get a fish hot enough that you will have to turn loose and go after it — you can start up and idle off real slow and quiet without bothering the fish. I have come back, hooked up to my anchor ball and had fish on again in five minutes. But if you get many boats doing that, especially if you have people who run up, stay for five or 10 minutes and leave, that seems to disrupt the fish. You don't need much movement.

In fact, in Louisiana it's my understanding that they don't even use outboards in order to be quiet. They use above-water exhaust on inboard boats so that they can be as quiet as possible. They catch a lot of fish by trolling, and they catch them on something like a Big Sassy shad. They are about 8 inches long. So that's another option.

I do know of one or two fish that were caught on a kite with live mullet just like you would sailfish in Florida. Another two or three were caught on live bluefish using balloons like the old float fishing for king mackerel years ago.

**Speaker:** At what depth do you usually fish?

**Lupton:** Most fish we find are in an average of 20 feet of water, right out in the open part of the sound. It isn't too often that you find them up on the shoal. There are some places where they do that, and probably at night they'll be more in the shallower water than in the daytime.

Let me tell you quickly about moon phase. Most people like a dark moon because tarpon have fairly big eyes, and they tend to feed more at night than other fish do. Some of the best fishing I ever had was on full moons right in the middle of the day. Everybody has an idea of what the best day and time is.

The best time to go is when you can go. If I could pick an ideal time, it would be on a dark moon, on a morning

when I get up and the wind is out of the northwest. In Pamlico Sound, a phenomenon occurs with a northwest wind that blows fairly hard until 10 a.m. and then it lays out right slick. And you can see tarpon for miles. They look like mirrors if you can get everybody quiet. You can see them for a mile away rolling in the sun. I have seen them a thousand at a time in schools coming by.

I have also been out there all day long and not seen any. I've caught 30 cownose rays at a time and never seen a tarpon, so it isn't all fun. And the black flies sometimes will carry you off. But if you get quiet, normally you can stop and drift along until you see some fish. If you don't see any after 30 minutes and you have two or three boats working together, that gives you an advantage. If everybody will scatter out until they find the fish, you can work together.

That was one of our reasons for not wanting to tell anybody about it. One, we were selfish, like most fishermen are. We had a good thing going, and we didn't want anybody to know it. But two, we didn't want it to be ruined. We didn't want people to come down and compete, carrying the fish to the scales so they could get their name and picture in the paper standing beside a dead fish. We didn't want that.

I have come basically to ask you not to kill the tarpon. Everything I have said is honest as I know how about tarpon fishing. I haven't told everything I know, obviously. You have to learn some of it yourself.

**Speaker:** Are these migratory fish? I hear 40 pounds, 50, 60 and 100 pounds, but never a word about little ones.

**Lupton:** We never see any little ones. In fact, I was talking to Jess Hawkins of the Division of Marine Fisheries earlier, and he said they've never found any larval tarpon in Pamlico Sound. Ernie Richardson said they saw just a few small ones — 5, 10 or 15 pounds — around South River this year. These fish don't just stop at North Carolina. A good friend of mine said last year that charter boats saw these fish by the thousands — school after school rolling — above Oregon Inlet off the monument, headed toward Chesapeake Bay. They couldn't catch them on anything. They threw everything they had, and that day they didn't catch them.

**Vass:** I have caught them down at Fort Myers on the bridge above the sound there. I feel like the little ones might be way down south.

**Speaker:** I am with the Division of Marine Fisheries. Two years ago, one of our biologists cast bait for mullet on one of the canals alongside the road near Atlantic, and he caught a tarpon that he now has in a jar. He didn't catch another fish. So the little ones do come into North Carolina.

### Striped Bass Management in North Carolina

Harrel Johnson is the northern district manager for the Division of Marine Fisheries.

Striped bass management in North Carolina is probably one of the most controversial activities of the last decade. In order to understand this management process, it's extremely important to also understand that there is a state-federal process that goes on through the Atlantic States Marine Fisheries Commission (ASMFC).

There is a complexity of management scenarios that involve several states. North Carolina plays a critical role because it is a wintering ground for the offshore migratory population. And as a result of this coastwide management plan, we have a success story. Many of you have read it in the newspapers, and you have read about the recovery of the striped bass population up and down the Atlantic coast.

We are dealing with growing pains as we come out of a period of regulatory restriction. During part of the recovery period in the ocean, North Carolina did its share of regulation and even implemented a moratorium. No striped bass fishing occurred in the ocean during that time.

But there are also dual jurisdictions. We have an ocean population of fish, and some of that is shared by everyone. At the same time, individual states have their own populations.

An important issue for North Carolina is the extent to which its striped bass population contributes significantly to the offshore migratory population. Several states south of us contend that their striped bass populations do not contribute significantly to any offshore migratory population — they are river breeders and remain there. Some tagging projects have attempted to address that question.

We have opted, through management and regulation, to follow the coastwide management plan of the ASMFC.

North Carolina has not kept up with other states as far as restoring inside populations. We are in a lag phase, but there is some good news. There is a public perception that our striped bass population in inside waters has been restored. It has not yet. It is, however, much improved.

One way to determine the success of management on striped bass populations, especially inside, is to establish what we call the juvenile abundance indices (JAIs). In this sampling program, we go out every year after spawning and determine an abundance index for the number of young that appear to have been produced. Over time, the JAI of North Carolina for striped bass has been very variable. The conditions that recreational and commercial fishermen are fishing now have resulted from the 1988 and '89 year classes of striped bass that were produced. Most of the legal fish being caught today resulted from these two year classes. ASMFC management has two requirements before we can declare a population recovery. One is a running three-year average that is set at a level better than the long-term

average. With the production of the '93-'94 JAI, North Carolina has accomplished that.

We must also reduce our fishing effort below a certain level. This is the second milepost we have to pass in managing striped bass in inside waters. North Carolina is having a hard time doing that. Some states, such as Maryland, opted to go for total moratoriums — reregulate and start over again. The N.C. Marine Fisheries Commission decided against that. Instead, it decided to regulate by degrees and ration back on recreational and commercial fishermen until our fishing effort reached an acceptable level. We are still working on that.

The third milepost is the one that gives us the biggest problem — we must have a wider distribution of age groups in our spawning population. A sampling of fish in Albemarle Sound, for example, shows that the spawning population does not meet that requirement. So before we can declare Albemarle Sound recovered, we must wait until the '88 and '89 year classes of fish are fully recruited into the spawning grounds and develop some age. Then we can hope that the '92 and '94 year classes bring us through.

It's important for everybody to realize that several management entities were developed through the efforts of the U.S. Fish and Wildlife Service, the Wildlife Resources Commission and the Division of Marine Fisheries to create a striped bass management plan for North Carolina's internal waters. Two distinct management units were developed: one for the Albemarle Sound area and one for the Roanoke River. These areas are managed separately but in concert as much as possible. A third management unit is covered under the plan and includes all other waters in North Carolina as well as other striped bass populations.

Each of those populations and management units is assigned a poundage quota, and the fisheries' season harvest is regulated on the basis of those quotas. The commercial quota for Albemarle Sound is 98,000 pounds and the commercial quota in the ocean is 96,000 pounds. Recreational fishing is allowed in the ocean with a 28-inch minimum size limit, one fish per person per day from December to March. In the Albemarle Sound area, the recreational quota is 29,500 pounds, split equally between a fall and spring season.

With the amount of recreational fishing effort that we have, the fall fishing season rarely lasts more than 30 days. This year, the season lasted only six days before the entire quota was caught. We reserved another 15,000 pounds for the spring season, which opened March 1.

The Roanoke has a total quota of 29,500 pounds, which is managed by the Wildlife Resources Commission. It also opens the Roanoke River for recreational harvest on March 1. The rest of the state is under a commercial quota of 25,000 pounds. We have not exceeded that quota since it was implemented. Recreational fishing is usually set at three fish per person per day at an 18-inch minimum size and usually

runs for a longer period. This past year, for instance, the Neuse River, Cape Fear River and Pamlico Sound were open all year.

### Saltwater Fly-Fishing

Howard Cummings is an attorney in Raleigh and recreational fisherman.

Fly-fishing in North Carolina can be frustrating because of the conditions. When you go down to the coast and weather conditions aren't right, sometimes it's hard to fish conventionally. It's harder to fish with flies because the wind has got to be just right and the fish have to be in a certain place. But you stick with it and figure out how to locate fish, and it's rewarding because it makes each fish that much more enjoyable. Each fish is that much more of a challenge.

Don't take a fly rod and expect to locate fish. If you can see Spanish mackerel breaking or puppy drum tailing, that's fine. But if you go somewhere and you're not sure any trout are there, then pick up a mirror lure, grub or other type of bait and try to locate the fish. When you locate the fish, that's the time to switch over to fly tackle.

I had a nine-weight outfit when I started. With this outfit, you can catch speckled trout, Spanish mackerel and puppy drum. If you have an outfit that you're comfortable with for bass fishing, then use that rod as a beginning place. If you don't, then borrow one to test. Fly tackle is more difficult to get used to than a spinning rod or casting rod. Anybody can use a spinning rod, but fly rods vary more in comfort and casting ease.

I would recommend that you start with a 10-weight outfit. Fly rods are designated by line weight. With a 10-weight rod, you can catch puppy drum, speckled trout, little tunnies and large bluefish. You can also go offshore and catch dolphin. I wouldn't use it for fish much over 40 pounds. If you decide to purchase a fly rod, you might find that local stores sell rods for up to \$400, but an expensive rod or reel isn't necessary. One basic reel is the Pfluger Medalist, which is easy to clean and costs about \$40.

There are two basic groups of fly rods. The first, the eight- or nine-weight, can be used for speckled trout, puppy drum, Spanish mackerel and small bluefish in moderate conditions. The 10-, 11- or 12-weight is for bigger fish or windy conditions. An 11- or 12-weight line is necessary for bigger dolphin, white marlin or sailfish.

For backing, I use 200 yards of 20-pound test for an eight- or nine-weight outfit. For 10-, 11- and 12-weights, I use 300 yards of 30-pound test backing. The tippet class should also be appropriate for the backing. On an eight- or nine-weight outfit, for example, with 20-pound test backing, a 12-pound class tippet is appropriate. If the tippet is not the weakest link in the outfit, you risk losing your fly line if the tippet doesn't break before the backing does.

If you are only going to buy one fly line, I recommend a floating line. A floating line floats and has a saltwater taper with the weight in front. By making permanent loops in the fly line, you can make a loop-to-loop connection and change fly lines quickly. To keep lines organized, mark them with a felt tip paint pen. I dye lines green because I prefer green to the colors produced by manufacturers such as orange and purple.

In the butt section of the leader, I use a needle knot or a nail knot to connect the butt to the fly line. These are described in all knot books. For a leader without a heavy shock section, 40 percent will be butt with 20- to 30-pound test. With a heavier outfit, I also use a nail knot, although some people prefer a loop connection. A 50-pound test butt section is necessary to turn over some of the really big flies.

Rigging seems complicated, but saltwater fly-fishing should not be so complex that it is unmanageable. If it is, you will become discouraged. You can use conventional knots, cut them off and tie others.

You should keep a supply of heavy tippets because when you pull a section of 50- or 100-pound test off a spool, it will not be straight. Go into your back yard and string up about 20 or 30 feet of this heavy mono between a couple of trees and pull it tight with a bungee cord. Leave it for a couple of days, then cut it into sections.

Cut a piece of PVC about 18 inches long and fill it with these cut sections so when you pull one out, it will be perfectly straight and ready to rig with. I put two marks 12 inches apart on the PVC pipe so that my leaders will be IGFA-legal (International Game Fish Association).

The IGFA book issued yearly has a wonderful section on tying knots, leaders and other information. Once you've bought the outfit, take it in the yard and cast with it. Take an old fly, cut the hook off and cast in the grass. Practice working with the outfit so you will be prepared before you go fishing. You don't want to practice on a charter boat, especially since the trip might cost up to \$700.

Practice stripping a fly line fast. Practice using both hands as you strip it, since it is faster than using one hand at a time. The only way to catch Spanish mackerel is stripping fast. At Cape Lookout, for example, you can sometimes catch Spanish fly-fishing better than trolling. You can throw the fly across the jetty and strip it back as fast as possible.

**Speaker:** What kind of knot would you use on your fly?

**Cummings:** I use a figure-eight knot, also called a hangman's clinch. You can pull this knot down on the fly and the fly won't swing, or you can use your thumbnail, pull it back a bit and allow the fly to swing.

**Speaker:** You don't leave a loop in the eye?

**Cummings:** Sometimes I do. It depends on the fly. If I wanted

more of a jiggling motion, then I leave the loop on.

If you are going to fish for bluefish, take some wire. You don't need much wire in front of the fly because the fish's mouth will not reach that far. Some 4 to 5 inches of wire is enough with a haywire twist in each end. Leave a loop on the other end and use an Albright knot. If you use heavy enough wire, you can tie directly to it and it won't break.

To choose a fly, you must first find out what the fish are feeding on or what type of lure is catching them. For example, if I am having fish hit on top because I have located them with a type of popper such as a Pop-R, then I switch to a popper in the appropriate color and size.

**Speaker:** Have you caught flounder?

**Cummings:** I have not caught them on purpose, but flounder will hit most any of these flies. You can use an eight- or nine-weight outfit and pull it along a good sandy bottom.

**Speaker:** Will the fish strike hard?

**Cummings:** Yes. I have caught them on plastic worms when I was bass fishing in brackish creeks and they seemed to hit it hard. They don't mouth it as much as they do a strip bait. Fly size may be more important in imitating bait fish than color. Buy a long fly and trim it to the length of the bait.

#### Tagging Speckled Trout — One Club's Effort

Ernie Wilkinson is president of the Carteret County Sport-fishing Association and member of the Saltwater Light Tackle Club.

The Saltwater Light Tackle Club began forming a year and a half ago with a focus on trout, drum and flounder. To gather new information and enhance the fishery, we began discussing a tagging program for speckled trout.

We found a company in Texas called Fishtrackers that produced tags and cards, and we initiated the project. To teach club members how to tag trout without killing them, we held classes. We discovered that one of the most difficult aspects of trout tagging is convincing people to tag the fish since the numbers they catch on a given day is often limited. Fortunately, we have become more successful at this. Also, it's difficult to retrieve information from tagged fish that are caught. In the past, people often sent the tag to Texas rather than to our organization. Through our fishing tournament, we hope to raise funds to print tags that will instruct people to send the information directly to us. That will hasten the information-gathering process.

About seven years ago, we discovered that we were catching trout year-round and the trout didn't leave the sounds to go directly to the jetties, as we once believed. We hoped the tagging project would help prove this theory.

So far, we have retrieved about 4 percent of our tags, which have returned slowly. We expected to receive more during the winter, but we haven't. The tag producer in Texas may have received information that he hasn't sent us yet.

In the beginning, one of our members tagged a trout in the Neuse River near Campbell Creek. Thirty-one days later, the same trout was caught in Rudy Inlet off Virginia Beach, showing a growth of 2 inches. We were skeptical about the information since it seemed to be such a high rate of growth.

Then we received two more tags. One was caught in the same place it had been tagged 61 days later, but it had not increased in size. The other was caught 45 miles from where it had been tagged eight months earlier, and it had grown 2.5 inches.

Next, we received a tag from a fish that had been recaptured 25 days after being tagged in the same location. The tag showed that the fish was the same size as when it was caught. Another fish was caught 30 days after it was initially tagged, two miles away. This fish had grown 1 inch after moving from what is called the haystacks toward the Fort Macon jetty. Finally, another tag was returned from a fish originally caught in the Neuse River. It was caught again in the Nags Head surf 61 days later, showing a growth of 2.5 inches.

I believe this information will change commonly held perceptions about the migrational patterns of speckled trout. The Atlantic Coast Conservation Association is interested in helping fund this project through a grant, and two fishing clubs — in Southport and Nags Head — would like to help.

We have drawn three possible conclusions from this project: (a) few tagged fish are being caught by anglers; (b) if they are being caught, they have not been turned in yet; and (c) the fish that are moving are larger, showing a rapid growth rate.

The typical return rate for tags is 5 percent, so we hope to improve from 4 percent. One concern is that Morehead City is a small area, stretching 12 miles to the cape, 12 miles up the Neuse River and about 7 miles down. So it's possible that the same people are catching the tagged fish. One of the club's members has tagged about 100 fish.

The more people we have in the tagging program, the more information we'll get back. But we are planning to expand the field since it's possible that the Morehead trout travel and the Wrightsville Beach trout do not. The Nags Head trout may be going to Virginia or some other location.

The club's members are novice taggers, but we have been amazed by the information we're getting. One member, who has kept records on trout for 20 years, cannot believe that these trout are moving outside the 2-mile area where they are originally being caught. Another man believes that the trout are seeking warmer or cooler water. I think that a fish caught and tagged in August and recaptured 30 days later at Virginia Beach is probably following a school of menhaden or mullet. We don't have answers yet, but we invite help from anyone interested.

**Speaker:** Your low tag return rate may be caused by the commercial fisheries that pick up tagged fish.

**Wilkinson:** We have been told that. That is also why it becomes difficult for a fisherman to tag and return a 21-inch trout, rather than keep it.

**Dale Ward:** What is the cost of the tags and the necessary apparatus?

**Wilkinson:** Our apparatus is simple and handheld. An applicator is placed on the end of a broom handle. We sell these at cost and distribute the tags free. We may need to start charging in the future. Any member of the Saltwater Light Tackle Club of Morehead can supply them, and our central number is at Joe Shoop's Bait and Tackle Shop. It's important to take our class on tagging so you don't kill the fish.

It appears that the tagging process has not had a detrimental effect on the fish. We have not found signs of infection or growths — they seem to be healthy fish. Biologists have explained where to apply the tags, which is just underneath the dorsal fin, which I call the backbone. You turn the tag and pull it back so it catches on one of the bones and the applicator is removed. The tags are stainless steel.

**Speaker:** Is there any correlation between the size of the fish and the growth rates?

**Wilkinson:** No, however, we haven't had many tags returned from fish over 20 inches. Of 593 tags returned, only four were from fish over 20 inches. We understand that could be a problem with the project, but as we receive more results and people become more interested, we hope to pass that hurdle.

Television shows on tagging have also stimulated interest in the project. But it still requires effort from people to participate, particularly if they're afraid they won't catch their limit. We've also learned from biologists how to quieten the fish by covering it with a moist towel. We try to treat the fish nicely: cover, measure, tag and put it back in the water as quickly as possible.

**Speaker:** Were most of the fish tagged in the warmer or cooler part of the year?

**Wilkinson:** Most of them were tagged in the late summer or early fall, although many were tagged during other times of the year.

#### How Recreational Fishermen Can Help Federal and State Enforcement

Michael Ervin is a marine patrolman with the Division of Marine Fisheries in Morehead City.

I am going to discuss how recreational sportfishermen can help law enforcement do its job better. First, the most important assistance is to report violations. We have 1-800 numbers throughout the state, which operate seven days a week, 24 hours a day. This is our primary source of communication throughout the state and the coast. Violation reports, which are kept strictly confidential, are helpful if they include simple but thorough descriptions: the type and location of violation, a description of the boat and name of the person. A simple detail may help us find the person.

Next, it's important for anglers to understand the two distinct ways of measuring a fish: total and fork lengths. The total length is measured from the tip of the snout with the mouth closed to the point of the compressed tail. The fork length is from the lower jaw to the middle of the fork.

I also want to touch on the mutilated finfish law. In short, it says that the head and tail must remain attached to any fish subject to a size or bag limit while it is on a boat, pier or shore. This law prevents unsporting fishermen from cutting up fish in violation of size and bag limits. Its limits ensure that enough mature fish survive to reproduce and sustain the population for future generations.

Of course, you may still immediately cut, bleed and scale a fish. But leave the head and tail attached in case an official checks you.

**Speaker:** Is it acceptable to strip something, fillet the fish, but keep the head and tail?

**Ervin:** Yes. Many people clean bluefish on the pier or on the surf. The problem is that when we come up to people, they sometimes have strips of the fish. They will cut out the belly and throw the head and tail away, so we have nothing to go by.

**Speaker:** But if the fillet of a blue is 14 inches itself, then would you necessarily have to keep the skeleton?

**Ervin:** Yes, because the regulation does not specify size limits. According to regulations, you must keep that.

**Speaker:** Along those lines, after *The News & Observer* article about the state of marine fisheries in North Carolina, do you have problems getting any of your cases prosecuted? Are any judges throwing the cases out and saying, "Hey, this is ridiculous. I don't believe in the law."

**Ervin:** I can only answer that for myself, and I have not had any such cases. I have worked from the North Carolina-Virginia line to the South Carolina line. I have had the chance to work all the way through the state and I have not had that problem.

**Cummings:** I am a prosecutor in Raleigh and I had to go down to Plymouth one time to pinch-hit in district court. A Marine Fisheries official was there with some cases. One involved failure to tend to eel pots and another involved robbery of crab pots.

Apparently, in one of the cases, the judge felt that commercial fishermen were too good of voters to find them guilty. But in the other, he didn't have any problem finding the violator guilty. I don't think the fact that the law is a state fisheries regulation will determine the judge's decision. It depends on who the defendant is.

**Speaker:** What kind of radio equipment do you generally carry on your boats?

**Ervin:** It depends on the size of the boat. On our johnboats, our smaller boats, we use handheld walkie-talkies.

**Speaker:** Do you use VHF radios?

**Ervin:** Yes.

**Speaker:** What channel are you all on?

**Ervin:** The channel varies in each area, each district and among the officers.

**Speaker:** I ask that because I'd asked the prior director to check into an area where I had seen many undersized fish being caught. I was unable to get anything but a telephone. I want to be able to make reports by radio. You need to look at monitoring a channel in every town. Every area should have the same channel.

**Ervin:** That's a good idea. In the past, they tried to monitor the VHF office for that purpose. Since it wasn't required, however, it became a headache and more than they could handle properly.

**Speaker:** I think the division does want to help in enforcement. But almost everyone has a VHF radio.

**Ervin:** Many people, especially sportfishermen in the ocean, are buying cellular phones. We have had many violation reports through those, but not everybody has a cellular phone. Budget constraints have also limited our ability to equip each officer with a VHF radio.

**Speaker:** I would assume your larger boats have them and you could at least scan. Among the problems with complying is the patchwork of regulations and involvement of three or four different agencies. And it's difficult to know the rules, to know how to comply with them and make sure your competi-

tor is complying. Anything that can systematize the system and ensure that everyone knows how to contact the agency would help solve the problem. It could be modeled on the highway patrol.

**Speaker:** What is the 800 number?

**Ward:** 1-800-682-2632.

**Ervin:** The numbers are on the regulations chart.

**Speaker:** The chart attempts to reconcile the state and federal regulations for all regulated species. It's updated after every commission meeting.

**Ward:** I distribute the sheet to marinas and other places. One of our goals, if funding is possible, is to display these sheets where people pull up to boat ramps.

**Speaker:** Most people I see violating fisheries regulations are tourists who are doing it out of ignorance.

**Speaker:** A lot of the problems that I have seen are with people on the piers.

**Ward:** It is posted at every pier. I don't know how much good that does.

**Speaker:** I want to bounce a concept off of you that came from our involvement in the search for a new director. We learned that New Jersey has a volunteer force of 2,000 people who work in a variety of areas, from enforcement to education. The state has also doubled the size of its enforcement agency with an auxiliary program similar to deputies. Volunteers go through the same training as you. They carry a weapon and they are deputized. New Jersey has a division enforcement officer and a volunteer on every patrol boat. You need two people, particularly in some backwaters or when you catch somebody doing something really bad. That has worked very well in New Jersey. Maybe we can see it in North Carolina. Most of the people in the program are retired.

**Speaker:** There is no salary?

**Speaker:** There is no pay. It is volunteer work.

**Speaker:** Like a Coast Guard auxiliary or something similar?

**Speaker:** Yes, except these guys have teeth. The Coast Guard auxiliary can't write you a ticket.

**Speaker:** I would rather have them on the board of education than as deputies.

**Speaker:** They do go through the same training as the enforcement officers.

**Speaker:** Yes, but you have to have control over somebody like that.

**Speaker:** Are they duly appointed officers?

**Speaker:** They are deputized. They can be involved in enforcement.

**Speaker:** So basically they are duly appointed officers of the court and they are volunteers?

**Speaker:** Right.

**Ervin:** I know what I had to go through to become certified. In 1987, it took me 17 or 18 weeks, working Monday through Friday. And the department had to pay for the course and to issue uniforms, weapons and other things. It seems like everything we try to do always goes back to the budget. And that might be the greatest excuse that has ever been made up.

**Speaker:** Bruce Freeman said that program has worked well. One of the biggest problems and most constant complaints that I hear from the Division of Marine Fisheries is that it doesn't have enough people. That effectively doubles your force.

**Ervin:** That is true. We have to regulate 2.7 million acres of water.

**Speaker:** With what — 54 people?

**Ervin:** Recently, we have increased by about five officers. I think we have 61 officers now. That is the first increase in about 15 years. There are 4,000 coastline miles divided among 61 officers. When I was in Elizabeth City, I worked five counties. There is just no way to be every place at one time with so many people catching fish.



