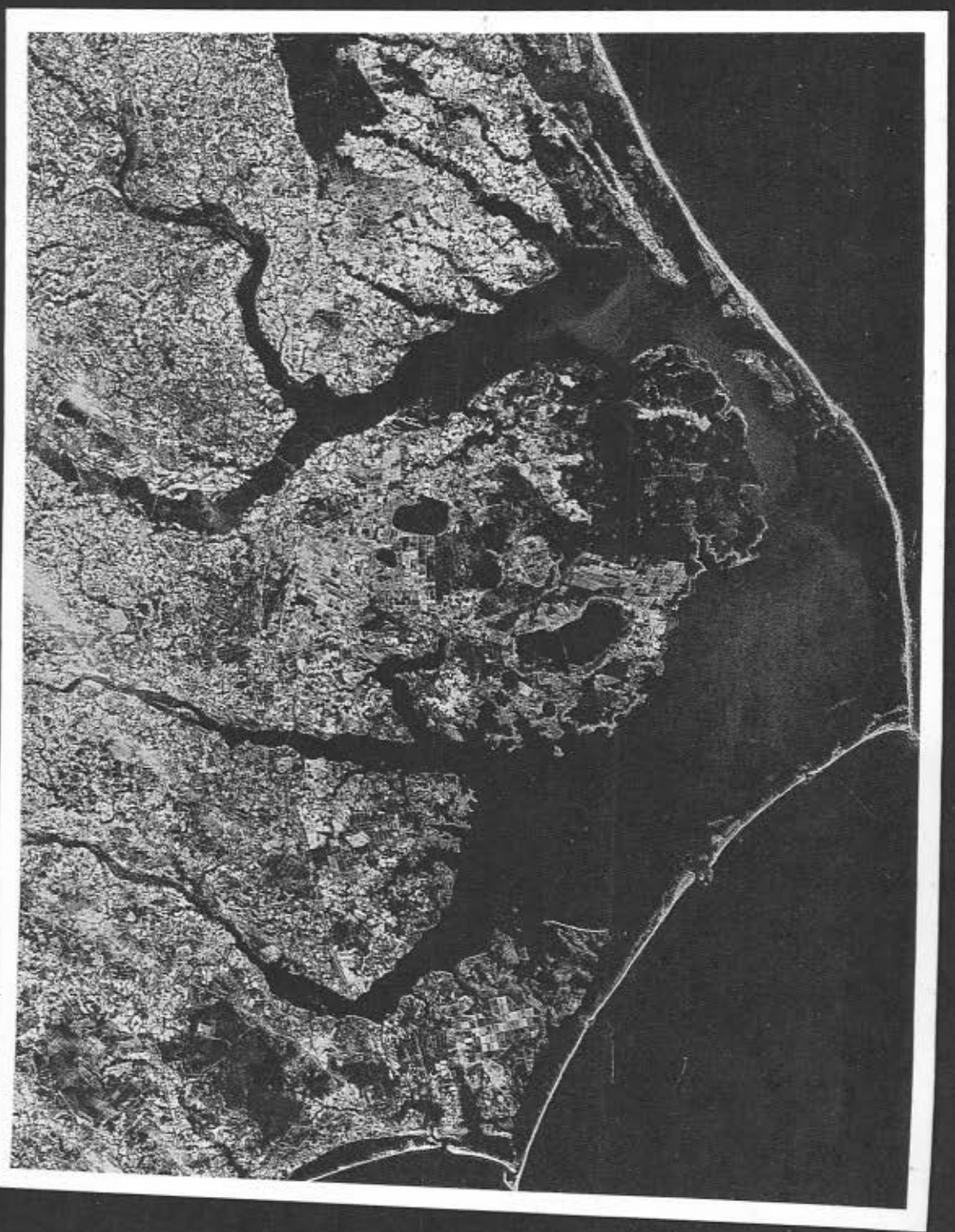
The Albemarle-Pamlico Sounds

Where the Rivers Meet the Sea



The Albemarle-Pamlico Estuarine Study

The Albemarle-Pamlico Sounds

Where the Rivers Meet the Sea

Crabber (Photo: P. Nurnberg)

Written by: Frank Tursi, Writer for the Winston-Salem Journal Newspaper

Edited and produced by: Melva Okun, Education Specialist with the UNC-CH Environmental Resource Project

Acknowledgements: We would like to thank Dr. Doug Rader, Senior Staff Scientist with the N.C. Environmental Defense Fund, for helping in the review of this document.

Copies of this book may be obtained by writing to the Albemarle-Pamlico Estuarine Study, N.C. Department of Environment, Health, and Natural Resources, Raleigh, N.C. 27611

Cover Photo: Satellite shot of the Albemarle/Pamlico Sounds (Photo: KRS Remote Sensing/ National Geographic)

A/P Study Project No. 89-12

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

To The Citizens of North Carolina:

The national significance of the Albemarle-Pamlico estuarine system can not be emphasized enough. As the second largest estuary in the nation and having a principal importance to the fisheries of the eastern seaboard, this system must command our priority protective efforts.

The Environmental Protection Agency is pleased to play a partnership role with North Carolina and the many other agencies and individuals in the National Estuary Program sponsored study. The timing is right and the political and institutional will appears to exist to reach a consensus on a Comprehensive, Conservation and Management Plan for this system, from its headwaters and wetlands to its barrier island inlets.

Your participation and enthusiasm must not wane if we are to succeed, and it is vital that we succeed.

Sincerely yours,

Greer C. Tidwell

Greer C. Tidwell
Regional Administrator

STATE OF NORTH CAROLINA
OFFICE OF THE GOVERNOR
RALEIGH 27603-8001

JAMES G. MARTIN
GOVERNOR

To The Citizens of North Carolina:

The Albemarle and Pamlico Sounds are unique and valuable resources to North Carolina. The State is committed in protecting these important ecosystems. In order to accomplish this goal, government, industry, and citizens must work together in developing and supporting strategies to conserve and maintain these estuaries.

When we protect the Albemarle and Pamlico Sounds, we assure future generations the opportunity to enjoy all the beauty and wonder these sounds have to offer.

Sincerely,

Jim Martin

James G. Martin, Governor
North Carolina

Index

Great Heron in flight (Photo: S. Taylor)

Introduction

The view from the Umstead Memorial Bridge can be breathtaking, especially early on a summer's morning. The bridge takes U.S. 64 across Croatan Sound to Roanoke Island, spanning the middle of one of the most productive fish nurseries in the world. To the left are Albemarle Sound and Powell's Point, which marks the opening to Currituck Sound; to the right, the vast Pamlico Sound stretches to the horizon.

As the sun rises above the jagged outline of the Outer Banks, a fisherman maneuvers his small boat along a line of buoys that mark his crab pots. He hauls in the first pot, shakes the crabs into a plastic barrel, adds bait and drops the pot back into the water.

He is surrounded by 2,900 square miles of water that make up the second-largest estuary in the country. Known as the Albemarle-Pamlico estuary, this labyrinth of rivers, creeks, bays and sounds provides a livelihood to the people who work on it and is a source of soothing, subtle beauty to those who live along it.

Estuaries are special places. Technically, they are where the fresh water coming down the rivers meets the salt water of the sea. To rank as a real estuary, though, it must be more than that. It must have shallow water, which the sunlight warms and penetrates to feed plants and plankton. It must have vast areas of surrounding marsh, whose tidal creeks supply the estuary with organic material. And finally there must be a good circulation that mixes the ocean's minerals with the organic matter. If all the conditions are met, the resulting brew can feed a whole chain of life that starts with microscopic plankton and ends with humans.

By all measures, the Albemarle-Pamlico is an estuary of the first order. It is one of the cradles of the ocean's harvest. More than 90 percent of the important species of fish in North Carolina depend on the estuary during some portion of their lives.

But the estuary is more than just a good fishing hole. There are the brilliant sunsets over the Pamlico River, the acres of waving needlerush along Currituck Sound, the heron patiently stalking its prey in the Neuse River or that crabber in Croatan Sound.

It is a beautiful place, which also makes the Albemarle-Pamlico a desirable place to live. Though the region generally has kept its rural character, some places in the estuary have grown tremendously in the last decade.

Growth, of course, means more people, who place greater demands and pressures on this sensitive ecosystem. Marshes have been converted to houses, marinas, motels and other residential and resort developments. Many thousands of acres of wetlands have been drained and cleared and turned into farms and tree plantations.

Growth also means more waste. The estuary is asked to absorb it all— nutrients from farms, animal feed lots and wastewater treatment plants; chemicals from urban runoff and industrial discharges; and even from the air.

That alone would tax the estuary, but it also is being fed pollutants from many miles away. The major rivers that flow to the Albemarle-Pamlico also drain large portions of the populous Piedmont sections of North Carolina and southeastern Virginia. Discharges from industries and from municipal plants mix with nutrients and chemicals from farms and feedlots, streets and parking lots. They eventually end up in the Sounds.

Beach house in Nags Head (Photo: F. Scott)

Massive fish kill (Photo: R. Carter, Washington Daily News*)*

Though in better shape than some other estuaries, the Albemarle-Pamlico is showing some disturbing symptoms of ill health. Fish catches have declined since the early 1980s, particularly for anadromous fish like striped bass and river herring. Fish diseases are common, and a disease has appeared in crabs. Algal blooms have become regular events in some of the estuary's rivers, and bacterial pollution is closing more shellfish beds in the fastest-growing counties. Underwater grasses are disappearing in some of the estuary's rivers.

All are early signs of trouble, signs you should know about since ultimately you will decide if anything should be done about them. You own a piece of the Albemarle-Pamlico estuary. Like other waters in North Carolina, the Albemarle-Pamlico belongs to all state residents. It is part of our common trust. Protection of the estuary will depend on whether enough of us, the owners, care.

It will take a partnership of owners — regular citizens, scientists and government officials — to ensure the long-term health of the estuary. This booklet is a step in helping form that partnership. We hope it gives you a better understanding of this intricate and beautiful system of water and marsh and makes you more aware of the problems. People then will support their legislators in making informed decisions about how to best protect this state and national treasure.

Building that public consensus is one of the main goals of the Albemarle-Pamlico Estuarine Study. Known as APES, this cooperative project between the State of North Carolina and the U.S. Environmental Protection Agency is funding scientific research to examine environmental problems and their effects on the estuary. It also is paying for educational materials, like this booklet, and projects that get people actively involved in the estuary's protection.

After reading it, we hope you will take the initiative and get involved. There's a lot at stake. We are among the countless creatures who have come to depend on the clean water of the estuary. We eat its bounty, and the water supports our fishing and tourist industries. It also offers us a place to live, play and relax.

Dallas Ormond, a Pamlico River commercial fisherman; Dr. Doug Rader, Senior Staff Scientist with the NC Environmental Defense Fund; Wally Jones with the Atlanta U.S.-E.P.A. office; and Jess Hawkins, biologist with the NC Division of Marine Fisheries Washington Office discuss a major fish kill on the Pamlico Sound. (Photo: M. Okun)

David and Lucy Tate, a Beaufort County commercial fishing family, represent just a part of the rich heritage of coastal North Carolina. (Photo: P. Nurnberg)

But we stand to lose more than mere dollars or a vacation spot. Dave Tate knows that. You'll meet Capt. Dave at length later. He is 90 years old and lives with his wife, Miss Lucy, in an old white house in Beaufort County. They grew up on the water and raised 12 children from what it provided.

When Capt. Dave was asked what his life would be like without the rivers and fishing, he thought the question was the silliest he had ever heard.

"Why I don't know," he said after awhile. "Fishing is all I ever knowed, and it's all I ever cared about doing. My children, they're all fishermen, too. Fishing's all any of us ever knowed."

It's a history and a heritage and a legacy that we share with the Tates and with the thousands of families like them. The water and the lifestyles it supports are part of the fiber of North Carolina. When they lose, we all do.

Albemarle-Pamlico Estuarine Study Area
(shaded area)

Beauty abounds in the sounds of North Carolina. (Photo: P. Nurnberg)

Knowing Your Sounds

Calling it the Albemarle-Pamlico estuary is a little misleading. That leaves the impression that it is a single body of water. The estuary is, in fact, six different sounds — the Albemarle and Pamlico just happen to be the largest — 10 major rivers, and creeks too numerous to count. Each is an estuary in its own right, but they connect, like a giant jigsaw puzzle, with each piece dependent on the other. They work together to form one of the most productive and beautiful ecosystems on Earth.

In size alone, the Albemarle-Pamlico is impressive. It drains more than 30,000 square miles in two states. Feeder rivers and streams flow south from the mountains and foothills of Virginia and east from the rich farmland and cities of the North Carolina Piedmont. The water drains into a shallow basin that covers more than 2 million acres of now drowned coastal plain.

The Albemarle-Pamlico as we know it today is the result of thousands of years of continuous change. Since its creation after the last Ice Age, nature has been constantly reworking the details.

Lush forests once grew where water is now. Glaciers covered much of North America then. Because large amounts of water were tied up in the ice, the Atlantic Ocean was about 250 feet below its current level, and the North Carolina landmass extended 40 miles out to the edge of the continental shelf. The rivers that flowed to the coast were rocky and wild and had wide floodplains.

The ice began to melt about 15,000 years ago, and the ocean slowly rose. It crested the rim of the continental shelf and ate into the forested plain, pushing mud, debris and sand ahead of it. Waves and wind separated sand from the pile to form a line of dunes parallel to the beach. At some point, the ocean

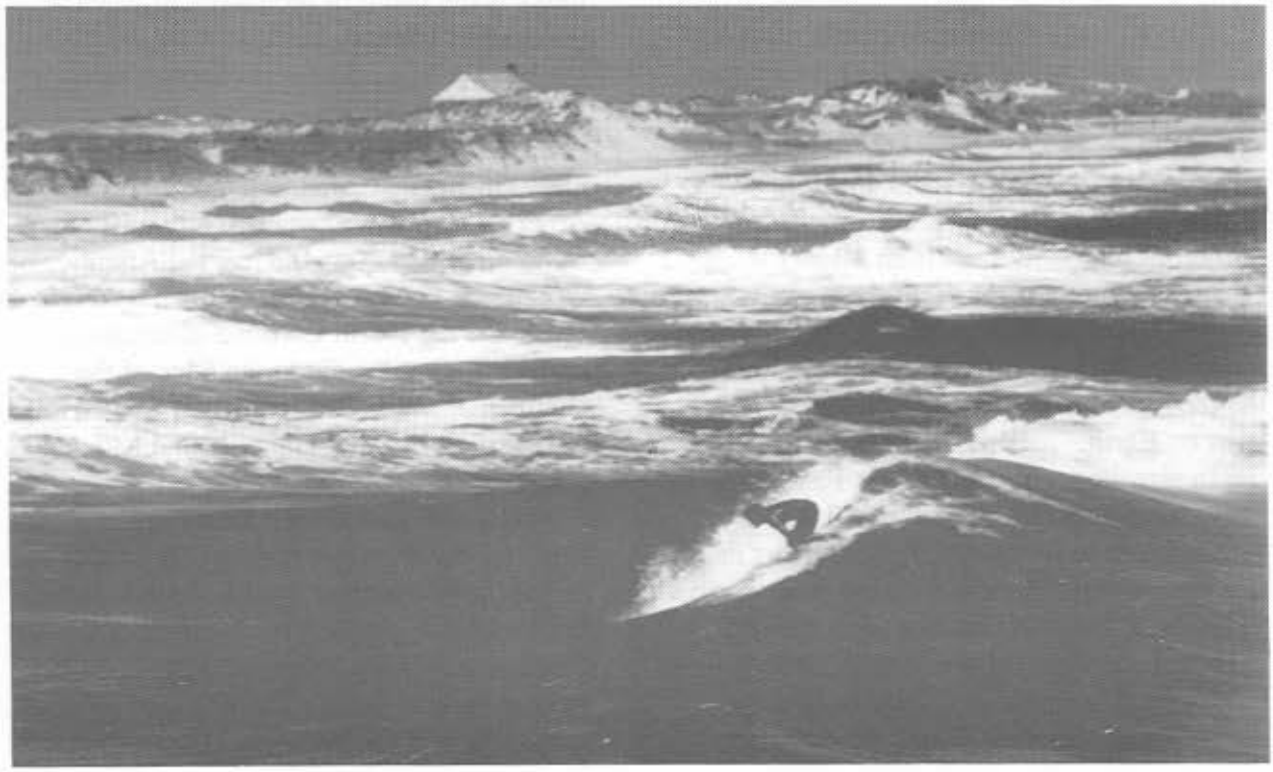
breached the dune ridge, flooding the river valleys behind it. The dunes became islands and the valleys shallow lagoons.

The largest of these lagoons, Albemarle and Pamlico sounds, dominate the estuary and are the major physical features of eastern North Carolina. The sounds and their tributaries share many traits. The water here is shallow. From Currituck Sound to Core Sound, no more that 26 feet is found anywhere with two-to-six feet being more common. Most of the land around the water remains rural, and the people share similar lifestyles: farming, fishing, logging. A common thread of history also helps tie the pieces together, and it is no accident that most of the sounds and rivers get their lyrical names from the Indians.

But the Albemarle and Pamlico systems also are very different. The Pamlico is twice the size of the Albermarle. They differ in the salt content of their water and the types of creatures they support.

Combined, the two sounds give the estuary its amazing diversity. Here, red drum cruise the choppy waters of Oregon Inlet, and largemouth bass stalk the grass beds in Currituck Sound. Each spring, river herring come in from the ocean to spawn in the Chowan River, while Atlantic blue crabs crawl out of the mud and head for the Pamlico River.

Storms beat against the barrier islands. (Photo: N.C. Div. of Marine Fisheries)



Albemarle Sound

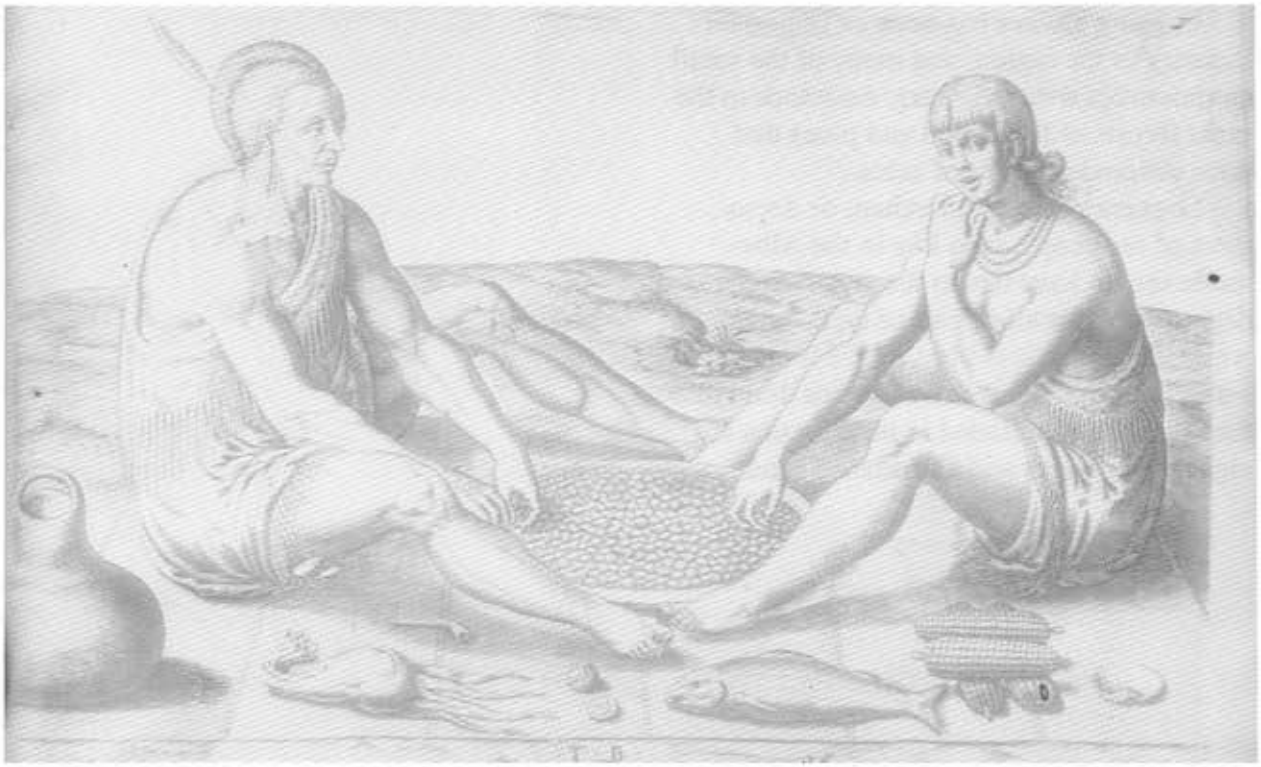
ALBEMARLE SOUND

Like a stubby finger, Albemarle Sound pokes into the swamps and marshes of northeastern North Carolina. Formed by the union of the Roanoke and Chowan rivers, the sound stretches 55 miles from Edenton to Currituck County. It's far removed from the inlets leading to the ocean, so the water is generally fresh for most of its length.

Consecutive years of drought, though, may threaten the Albemarle's claim as the largest freshwater sound in the country. With the flow of freshwater reduced, the salinity level, or salt content of the water, has risen throughout the Albemarle. The blue crab likes the new conditions and, as a result, commercial crabbers on the sound have had their best years in memory.

Anyone who has ever sailed the Albemarle knows that the water is shallow. It was these shallow waters, along with the treacherous offshore bars and shoals and the impenetrable swamps, that determined how North Carolina was settled. The islands flanking the coast had to be approached with great caution, and the Albemarle and its sister sound to the south, the Pamlico, could be crossed only in shallow-draft boats. Coupled with the unfortunate experience of the settlers on Roanoke Island, these hazards deterred later European explorers from approaching by water.

So unlike other places along the East Coast, North Carolina developed over land, by settlers moving south from Virginia. The English came down the Chowan River in the 17th century in search of game and new land. England claimed all the land between Virginia and Albemarle Sound and called it the County of Albemarle after George Monck, the Duke of Albemarle and one of the eight noblemen who owned the Carolina colony.



A John White drawing shows the earliest inhabitants of the Albemarle/Pamlico Sounds area. (Debra Engraving, John White Drawing)

Like the Indians before them, the settlers came to depend on the sound and its tributaries. They fished for herring and perch and striped bass. They built their towns on the water's edge and used the rivers and sound to move their goods in and out of the colony.

The settlers also cleared the forests and drained the swamps for their crops. Great plantations flourished by the time of the Civil War, and the region around the Albemarle was as close as any place in North Carolina came to the Antebellum South of the romance novels.

Most of the plantation homes are gone now, but the area's essential character hasn't changed. Away from the booming coastal area of Currituck County, the Albemarle region has retained its rural flavor. Corn and soybean farms dot the landscape. Towns steeped in 200 years of history sit picturesquely on river banks, their churches' steeples poking above the trees. Here and there off the roads, stately old homes are guarded by hardwood trees whose limbs are draped with Spanish moss.

Logging always has been an important industry in the region, and many of the small communities owe their early existence to the great forests of hardwood and pines that once covered millions of acres.

Logger or farmer, merchant or doctor, most of the people who live in the Albemarle region have ties to the water. Some depend on it for all or part of their living, while others use it to play. There is enough water for either. Three river basins drain into the Albemarle. Included in these basins are eight major rivers and Currituck Sound.

Much of the original forests of eastern North Carolina have been cleared and converted to farm land. (Photo: P. Nurnberg)

Captain Al Howard (left) and members of the Chowan/Arrowhead Property Owners Association have formed a Stream Watch group in the Chowan River. Citizens have helped by regularly testing nearby rivers for water quality. (Photo: L. Wurster)

Chowan River Basin. It encompasses 1,300 square miles in five counties in North Carolina and another 3,500 square miles in Virginia. The Chowan River forms at the state line at the confluence of the Nottoway and Blackwater rivers. It flows sluggishly for 52 miles in a great arc to Albemarle Sound, emerging near historic Edenton. The river's principal tributary, the Meherrin, also rises in Virginia.

The two rivers get their names from the Indian tribes — the Chowanokes and Meherrins — who lived along them at the time the first white settlers came down the Chowan in the 1600s. It was a shrewd chief of the Chowanokes who years earlier had kept the white men at bay. Ralph Lane, who was with the English explorers at Roanoke Island, took a party up the Chowan in 1585 and came upon the Indians' village. The chief, knowing that the strangers were after gold and jewels, told a fantastic story about mountains of gold up the Roanoke River. Lane hastened away.

The current at the Roanoke was much too swift and he got no farther than present-day Williamston. His food then ran out, the fierce Tuscarora Indians attacked his camp and Lane finally retreated to Roanoke Island. The chief had tricked the white men into leaving his beautiful river alone for another century.

River Herring fishermen in North Carolina have seen a decline in catches in the last few years. (Photo: N.C. Div. of Marine Fisheries)

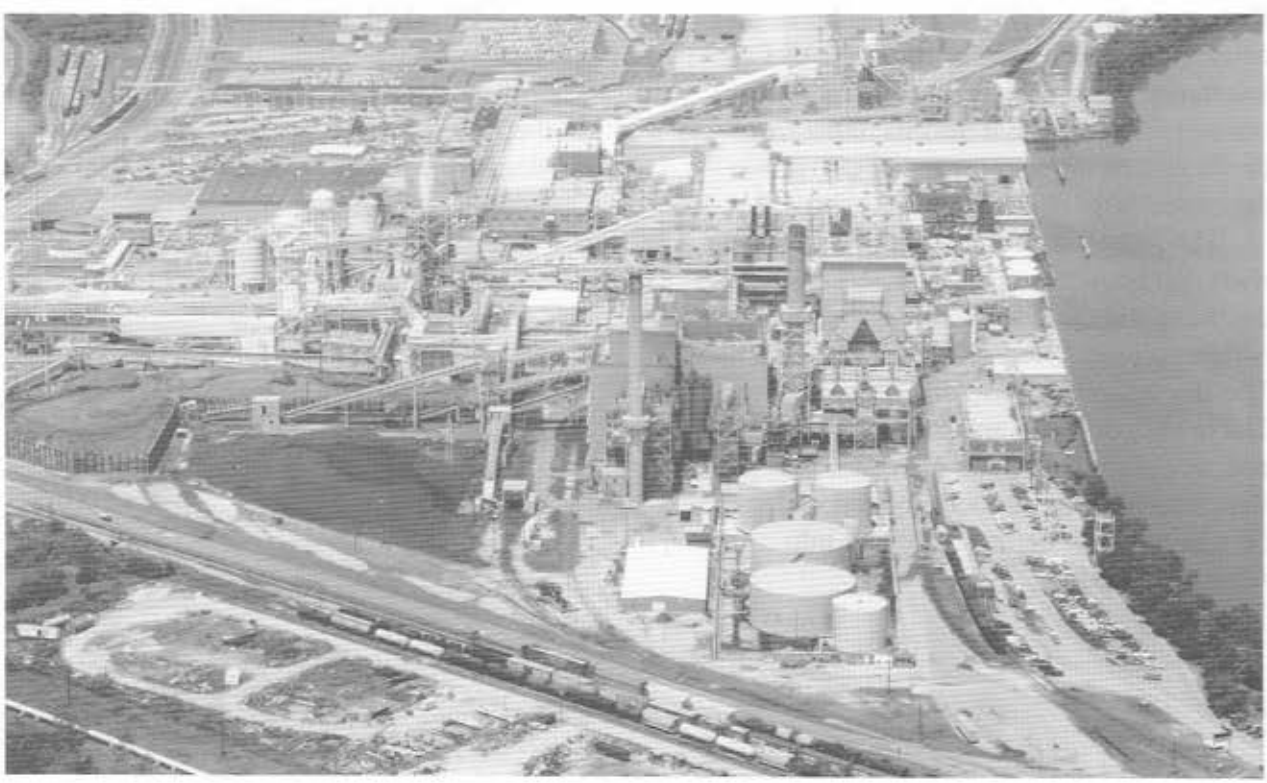
The Chowan traditionally has been the major spawning ground in the state for river herring. Called anadromous fish, the herring arrive from the ocean in the spring and fight their way upstream. The Chowan once had the distinction of having the largest freshwater herring fishery in the world. Millions of pound of fish were processed each year in plants along the river. The herring don't come up the river like they used to, and the industry they supported is about gone.

The Roanoke River Basin. This is the largest river basin in the Albemarle-Pamlico estuary. It drains almost 8,000 square miles, much of it in the mountain and piedmont sections of Virginia. In North Carolina, the Roanoke River loops lazily for about 140 miles before joining the Cashie River to form Bachelor's Bay in the western end of Albemarle Sound. Until the 18th century, the river was known as the Moratoc after the Indians who lived on its banks.

Much of the land is low-lying and flat, with forests, swamps and well-drained farmland. Tobacco and peanuts are the primary crops, and forestry is a major industry.

The striped bass, or rock fish, once was king. The most famous of the anadromous fish, stripers came up the river in the fall and winter when they were caught in great numbers in nets and with hook and line. During the last decade, their stocks have dwindled up and down the East Coast, the Albemarle included.

Weyerhaeuser Co. pulp and paper mill located on the Roanoke River in Plymouth is one of the largest pulp and paper producing plants in the world. (Photo: P. Nurnberg)



Elizabeth City has one of the finest inland harbors on the East Coast. (Photo: A. Mack Sawyer)

Pasquotank River Basin. This basin occupies the center of the Albemarle region. Covering almost 3,700 square miles in nine counties, the "river basin" includes the watersheds of seven rivers and drains sections of five sounds. It gets its name from the largest of the four rivers that flow into the north shore of Albemarle Sound.

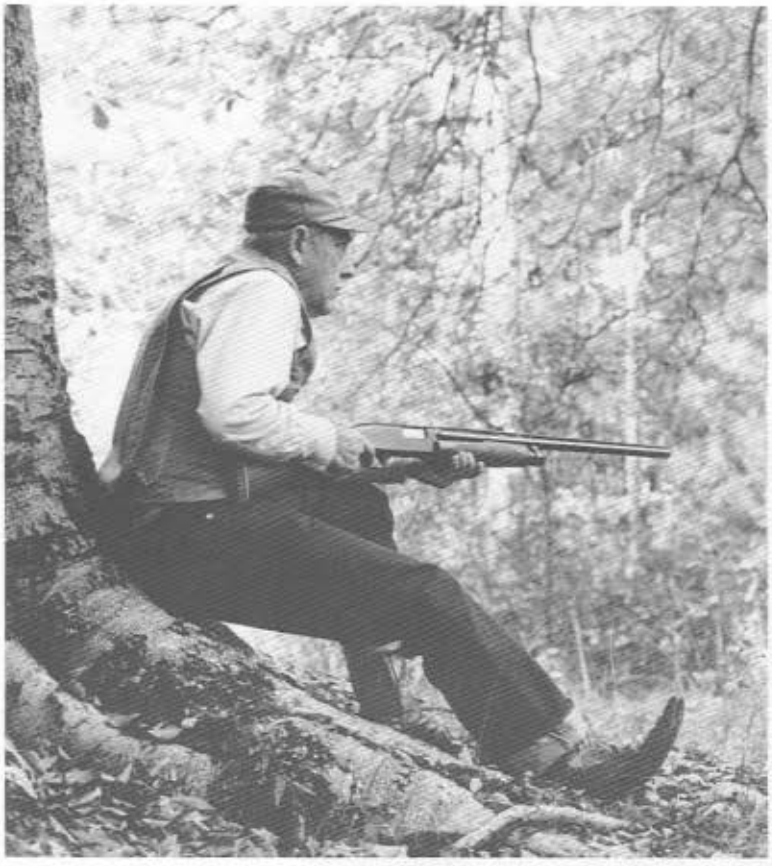
The Pasquotank is a wide, slow-moving river that begins modestly enough in the depths of the Dismal Swamp, when two tiny coffee-colored streams, Moccasin Track and The Horseshoe, join to form a little branch. The branch deepens and becomes a river and, at a place called the Narrows, the Pasquotank sheds its modesty and widens to the size of a bay before emptying into Albemarle Sound.

It was at the Narrows that men built a trading post on the river in the early 18th century. Elizabeth City still is very much a river town, boasting one of the finest inland harbors on the East Coast. It is the only town on the Pasquotank's 40-mile length and is the dominant city in northeastern North Carolina.

Tim and Linda Davis monitor the waters of the Perquimans River. (Photo: Stream Watch)

The Perquimans, Little, Yeopim and North rivers flank the Pasquotank and carve marshy fingers of land, jutting into the sound, which divides the river basin. The Perquimans is the largest of the three and supposedly was the inspiration for the ballad "Carolina Moon," since the river is famous for it's luscious, low-hanging harvest moons.

The Great Dismal Swamp, which spills over the Virginia line, is the most outstanding natural feature of the area. William Byrd, who led the survey of the North Carolina-Virginia line, said of the swamp, "Never was rum, that cordial of life, found more necessary than it was in this dirty place." Today it is about 210,000 acres, which is half the size it was when Byrd was there.



Hunting is much loved in coastal North Carolina. (Photo: N.C. Wildlife Resources)

The Alligator and Scuppernong rivers. These rivers also are in the Pasquotank River basin and drain parts of four counties south of Albemarle Sound on the peninsula of land between Albemarle Sound and Pamlico Sound.

The Alligator, much the larger of the two, cuts a deep gash in the swampy land. The river, which flows north from its source at Little Alligator Lake, is about three miles wide when it empties into Albemarle Sound.

The southern shore of the Albemarle remains largely undeveloped, though many acres of marsh on the peninsula have been drained in recent years so that large corporate farms can grow corn, soybeans and winter wheat.

The Alligator is a vital link in the Intracoastal Waterway, and yachts, hailing from Miami and Boston and points in between, cruise along it.

The historic Scuppernong starts as a black, winding stream in Washington County and broadens dramatically at the U.S. 64 bridge near Columbia. Once renowned for its perch, the Scuppernong has turned out generations of professional fishermen. The river derives its name from an Algonquin word that means "at the place of the sweet bay tree."

Scuppernong grapes are native to the area. Historians speculate that English explorers sailed into the mouth of the river in 1585, discovered the delicate golden grapes growing in profusion and took cuttings back to Roanoke Island. If true, that

would make the Scuppernong the oldest cultivated grape on the continent.

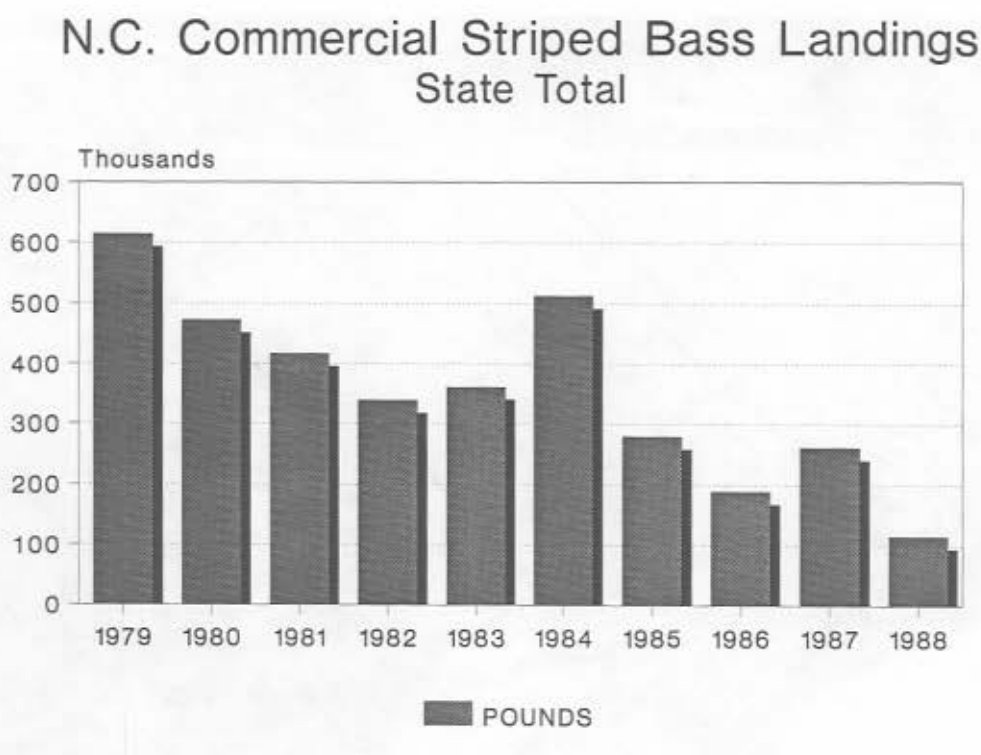
Currituck Sound. Connected to Back Bay in Virginia and extending more than 30 miles to Kitty Hawk Bay, this slender finger of water is the northern-most jewel in the estuary. Separated from the ocean by a spit of land called the Currituck Banks, the sound historically has alternated between fresh and salt water depending on the number of inlets through the banks. Inlets once were common, but the last one closed in 1828 and opened a new chapter in Currituck's history.

Within two years, the sound turned fresh. Freshwater fishes replaced the flounder and grey trout, and underwater grasses flourished. Known to the Indians as "the land of the wild geese," Currituck became an even more important stopover for migrating waterfowl. For more than a century, Currituck was the private playground of exclusive hunting clubs.

The shallow water and abundance of sea grasses also made Currituck one of the best fishing spots in the world for largemouth bass. Sports fishermen support a wide array of guide services, motels, restaurants and tackle shops. The recent droughts and diversion of salt and freshwater by humans have affected Albemarle Sound. These have raised the salinity of Currituck, and the bass fishing has suffered.

Change also has come to the Currituck Banks, which for centuries were isolated outback frequented mainly by hunters and fishermen. Northern tourists have turned the banks into lavish getaways. Big expensive houses with all the modern amenities now face the sound or ocean where just a few years ago there were dunes and marsh grasses.

Growth hasn't been contained to the banks. Sandwiched between booming Norfolk, Va., on the north and fast-growing



Dare County to the south, Currituck County is getting the spillover from both ends. Its population almost doubled in the last 20 years, making it one of the fastest growing counties in the state.

CROATAN/ROANOKE SOUNDS

These two small bodies of water link Albemarle and Pamlico sounds. Croatan Sound, the larger of the two, separates mainland Dare County from Roanoke Island. It is wider and deeper than Roanoke Sound, and its western shore is a tangle of brackish marshes and cypress stands. Roanoke Sound sits between the island and the Outer Banks. It is a favorite of soft-shell crab fishermen.

These waters have seen a lot of history. Roanoke Island was the site of England's first, but ill-fated attempts to settle America. It was on the island that the poignant story of the Lost Colony was played out. Settlers, left on the island in 1587, were gone when a re-supply ship arrived three years later. On a tree someone had carved the word "CROATOAN," which was the name of an Indian village on the Outer Banks. The fate of those settlers will remain an enduring mystery.

Replaying that mystery in the outdoor drama, "The Lost Colony," has been one of the ingredients in building a booming tourist trade in the region. Tourism has replaced fishing as the major industry on Roanoke Island and on the nearby Outer Banks. While the mainland remains virtually unchanged, Roanoke Island and the northern end of Bodie Island have become bustling resort communities.

People come from all over the country to visit the Outer Banks. (Photo: M. Okun)

Pamlico Sound

Pamlico River commercial fishermen at dawn. (Photo: Melva Okun)

PAMLICO SOUND

At 2,000 square miles, the Pamlico is the largest body of water in the world enclosed by barrier islands. The term Outer Banks takes on new meaning here since an island, such as Ocracoke, is separated from the rest of North Carolina by 25 miles of water.

Size isn't the only thing that sets the Pamlico apart from the Albemarle. With depths of 26 feet or so, it is a little deeper and has direct access to the ocean through four inlets between the Outer Banks. The constant infusion of seawater keeps the Pamlico salty, which makes it a favorite home or stopping place for many species of marine life. More shrimp, blue crabs and oysters are caught from the Pamlico each year than from any other body of water in the state, making the sound the centerpiece of the state's $1 billion fishing industry.

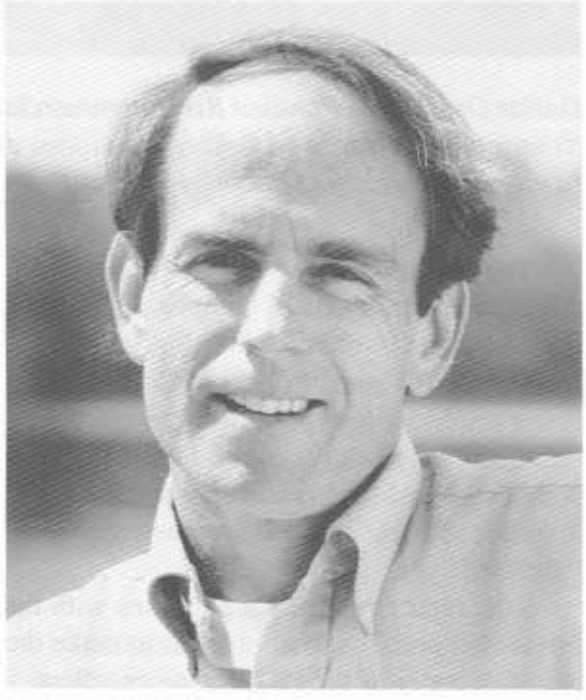
The Indians who lived along the Pamlico's shore knew all about its bounty. They were from several tribes. The Pomouiks were the most numerous, and they left their name on the big sound and on one of its major tributaries.

As in the Albemarle region, there are no big cities and few large towns in the Pamlico system. Farming, commercial fishing and forestry remain, as they have for centuries, the major occupations in the region. Much of the farming activity is centered on the Albemarle-Pamlico peninsula, between Albemarle Sound and Pamlico Sound and the Pamlico River. Large corporate farms of thousands of acres have been carved from the marsh land. In the resort area of the Outer Banks, tourism, of course, is the most important industry.

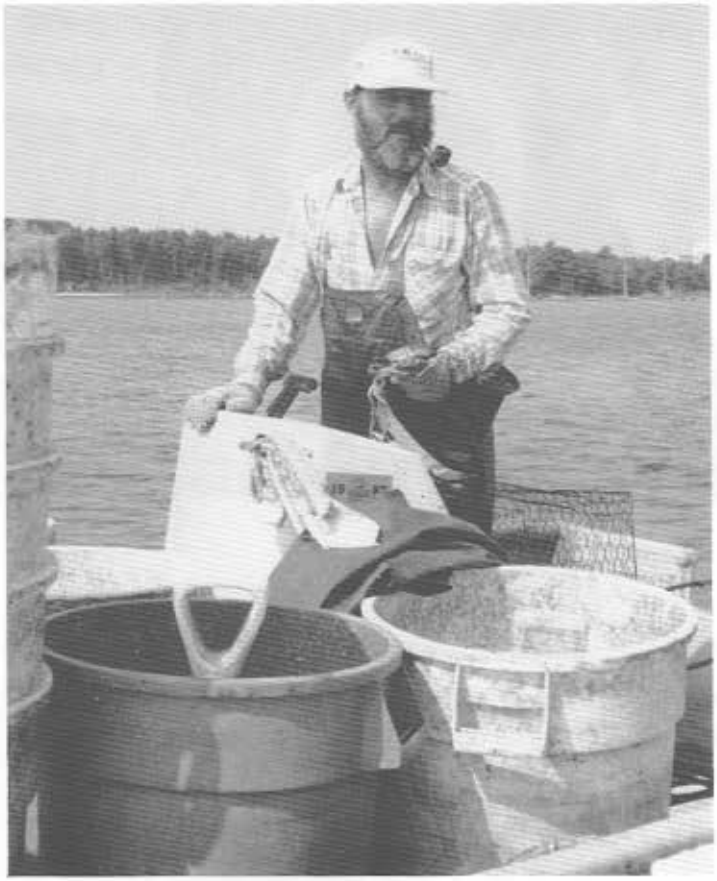
The Pamlico is fed by two river basins, the Tar-Pamlico and the Neuse, whose watersheds include portions of the Piedmont section of the state.

William Cobey, Secretary of the newly formed Department of Environment, Health, and Natural Resources, speaking at the annual meeting of the North Carolina Coastal Federation. (Photo: M. Okun)

Dr. J. Parker Chesson, Jr., President of the College of the Albemarle in Elizabeth City, has chaired the Albemarle Citizen Advisory Committee for the APES study.



Dr. David McNaught, Executive Director of the Pamlico-Tar River Foundation, has worked on several of the APES public participation projects. (Photo: P. Nurnberg)



Dallas Ormond, a Pamlico River commercial fisherman, has observed fishing conditions deteriorate on the Pamlico. (Photo: M. Okun)

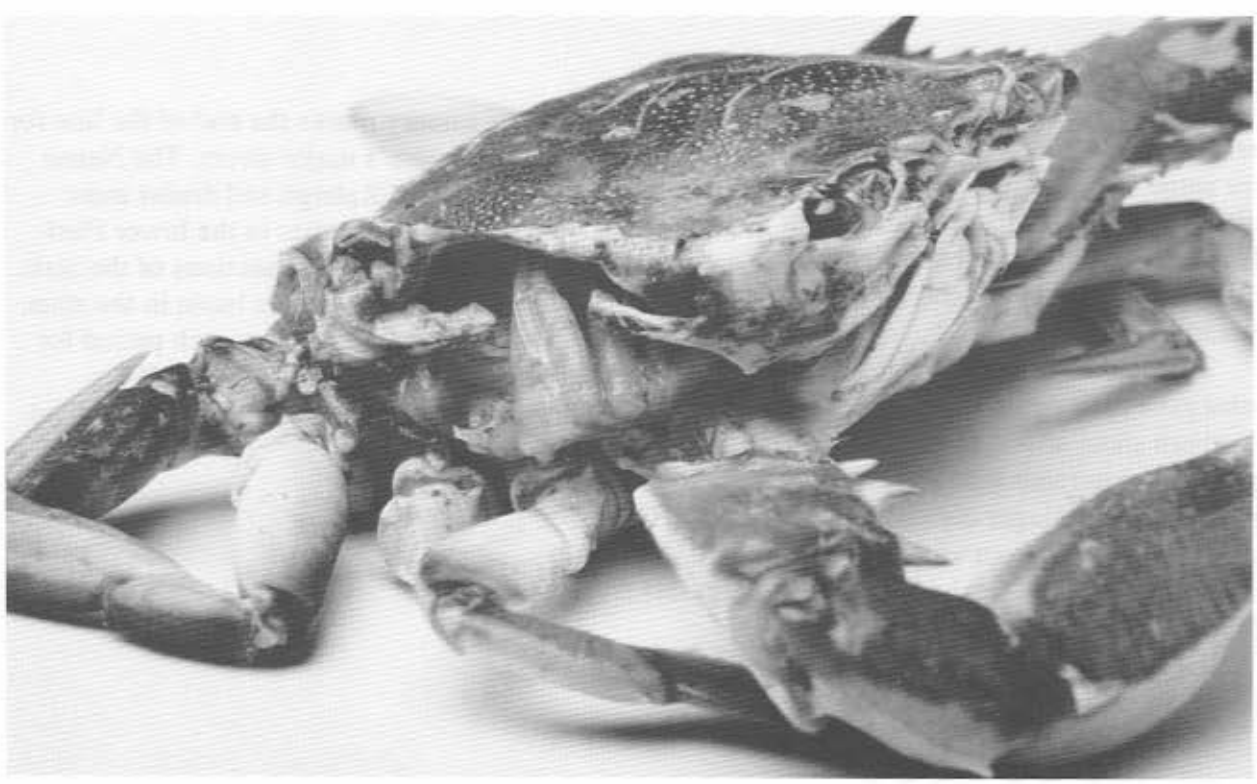
Tar-Pamlico River Basin. Covering 5,400 square miles in 16 counties, this is the fourth-largest river basin in the state. The freshwater Tar starts in Person County and flows southeast for 180 miles through the rich farmland of the northern Piedmont. It widens at Washington and finishes the final 39 miles to Pamlico Sound as the broad Pamlico River.

Salt water from the sound mixes with the freshwater coming down the Tar to make the brackish water of the Pamlico an excellent estuary in its own right. The eastern Pamlico region contains significant numbers of primary nursery areas which support much of North Carolina's marine fisheries. The river has supported generations of fishermen, some of whom delight in telling stories about the days when sailboats dredged the shallows for oysters.

The sailboats and oysters are gone, and the crab is king now. The river is among the leaders in blue-crab landings each year, and small crab-packing houses dot the river bank.

The Pungo River cuts a T-shaped slash in the marsh on the north side of the Pamlico. Once known for its succulent oysters, the river, like the Alligator to the north, now boasts expensive pleasure boats which travel along the Intracoastal Waterway.

Blue crabs are plentiful, however, some in the Pamlico River area have been caught with sores that have eaten through their shells. (Photo: P. Nurnberg)



The southern shore of the Neuse River Basin is dominated by the Marine Air Corps Station at Cherry Point. Competing uses by the military, industry, fisheries, and retirement communities present major challenges. (Photo: U.S.M.C.)

The Neuse River Basin. The broad estuary of the Neuse swings in a gentle U for some 50 miles from the grand old colonial capital of New Bern to its mouth in Pamlico Sound. Its shores are marked by marshes and cut by numerous tributary streams.

This is the land of the Neusiok Indians, who gave their name to the river. The northern shore still is somewhat isolated, and farms alternate with pine woods, and small fishing villages coexist with subdivisions "with waterfront views." The southern shore is dominated by the Marine Air Corps Station at Cherry Point.

The estuary marks the end of the line for one of the state's major rivers. The Neuse begins north of Raleigh and drains more than 6,100 square miles in the lower Piedmont and Coastal Plain sections of the state. It is the third-largest river basin in the state.

Neuse River crabs are much prized for their size, and the river traditionally is among the state's leaders each year in blue crab landings.

CORE SOUND

Compared to the other sounds in the Albemarle-Pamlico estuary, Core Sound is a mere ditch. Narrow and shallow, the sound is hemmed in on the north by the eastern knuckle of Carteret County and on the south by the Core Banks, uninhabited barrier islands that are part of the Cape Lookout National Seashore and connected on the southwest to Bogue Sound.

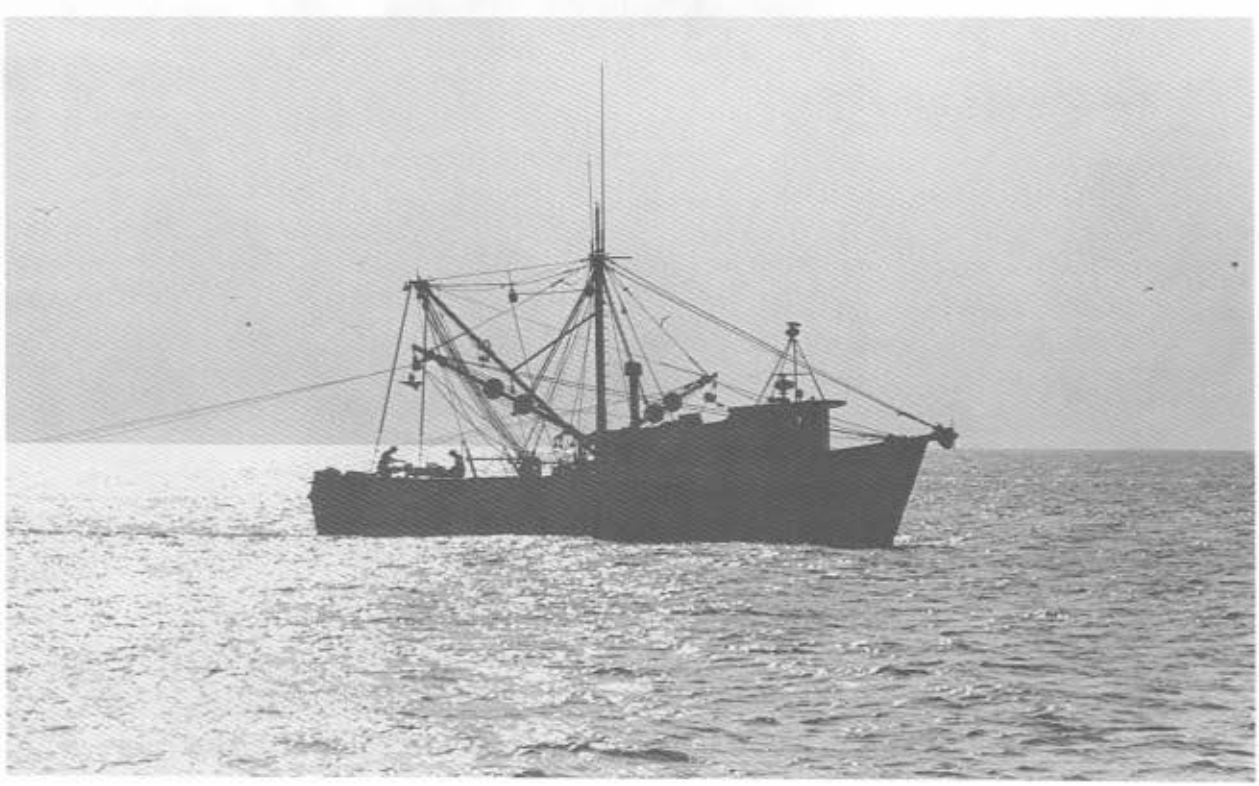
Named for the Coree Indians, the sound and its surrounding land has maintained some of its wild and primitive nature. Shore birds usually outnumber the surf fishermen on the isolated banks, and the small communities face the sound, with little but lonely savannas behind them. The residents fish for shrimp, blue crabs, spot and mullet and, in the fall and winter, they harvest clams, oysters and scallops from the sound's waters.

This region is known as "Down East," which is meant to set it apart from the rest of growing Carteret County. Life along Core Sound is more settled than it seems to be elsewhere in the county, more like it used to be.

People and the Sounds

Coastal North Carolina has grown tremendously during the last 20 years. Tourists flock to the beaches in ever increasing numbers, and almost 200,000 people have moved to the coast since 1960. Dare County, which includes the commercial heart of the Outer Banks, has been the fastest growing county in the state, while Currituck and Carteret counties haven't been far behind. The focus has shifted inshore, along the sounds and rivers, as developable land on the ocean becomes scarce, and thus,

Shrimp boat (Photo: Univ. of NC Sea Grant Program)



Public service announcements for television and radio were produced with APES money to encourage citizen involvement. (Photo: M. Okun)

People fishing off the banks of the Pamlico River in Washington. (Photo: M. Okun)

Menhaden with ulcerative mycosis which has eaten away at their bodies. (Photo: N.C. Div. of Marine Fisheries)

more expensive.

More people put more pressure on the ecosystem. Residential and resort developments squeeze out vital marshes. Farms and feed lots bleed pollutants into the water.

There are also the pressures placed by people inland. The shallow sounds act as settling ponds for their feeder rivers and streams, which drain large populous portions of two states. Much of the inland area is growing rapidly as well.

Clearing the Land. On the peninsula between Albemarle Sound and the Pamlico River more than 600,000 acres of marsh have been drained and cleared for tree plantations and large farms. Other coastal marshes and bogs have been turned into subdivisions, motels and condominiums. Along the upstream rivers and creeks, freshwater wetlands, called pocosins, have been disappearing at a dizzying rate.

Marshes are the estuary's lifebelts, its storehouses of food. Organic material from marshes washes into the estuary, providing the first link in the food chain. Since they also offer shallow water and protection from predators, many marshes are productive breeding grounds for several species of marine creatures.

They also are wonderful buffers and natural filters. Storm runoff moves slowly through a marsh, and much of the pollutants are removed before reaching the estuary.

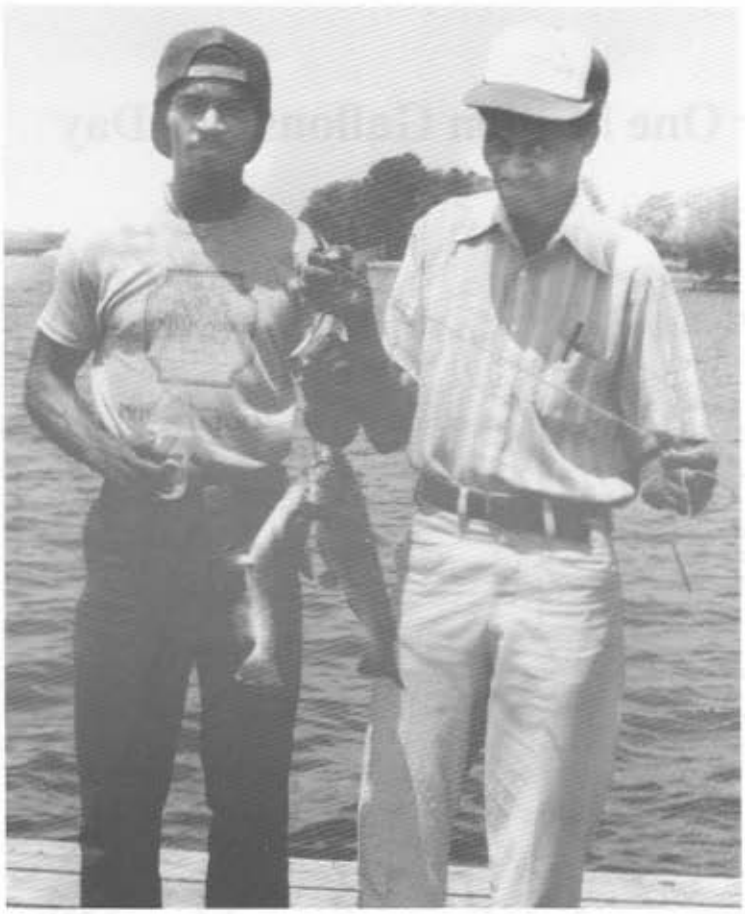
Those advantages are lost, of course, when marshes are drained and filled and replaced by concrete and asphalt. Rain washes quickly off concrete and asphalt. Pollutants in this so-called stormwater runoff wash into the estuary. The huge drainage ditches that line fields and tree lots change the hydrology of the land and send large amounts of sediments, fertilizer, pesticides and fresh water on a beeline to the estuary's fragile nursery areas.

Moving Wastes. All of North Carolina's rivers move waste. We routinely dump our treated sewage and industrial byproducts into rivers and streams, and we inadvertently let toxins and chemicals from agricultural and urban runoff seep into them. In the case of the Albemarle-Pamlico, much of the wastes comes from many miles away, and even from another state. Pollution enters the water in two ways. Scientists and government officials call them point and non-point sources. Point sources are as the name implies: wastes that are discharged from a place that can be pinpointed, such as a pipe. Municipal wastewater treatment plants, industrial plants and even public schools are types of point sources. A great deal of money has been spent by governments and industries during the last 20 years to build and improve treatment plants, and the state has a complex system to permit and monitor every point source. There are about 850 permitted point sources in the river basins that drain the Albemarle-Pamlico estuary.

Non-point sources of pollution are more ubiquitous and much more difficult to identify and manage. These include: runoff from farmland, feedlots and cleared land; residue from automobile exhausts; runoff from streets and parking lots; pollutants in the air; and failing septic tanks. Non-point sources are the most significant source of pollution in the state and cause a variety of problems in the water.

Water treatment and wastewater treatment plants provide a vital function for maintaining good water quality. Citizens are encouraged to visit their local plants to better understand how they function. (Photo: Greenville Utilities Co.)

Dischargers of Over One Million Gallons Per Day



Fishermen on the Pamlico River (Photo: M. Okun)

Supplying Food and Fun. Fishermen for centuries have reaped the bounties offered by the Albemarle-Pamlico. The estuary has supported generations of commercial fisherman and delighted many millions who fish for fun and sport.

More people are fishing the estuary than ever before, and the equipment they use keeps getting more sophisticated and efficient. There are indications that some species, such as the popular flounder, are being overfished, and commercial crabbers find they must use twice as many pots as they did a few years ago to catch as many crabs.

Mending nets at home (Photo: N.C. Div. of Marine Fisheries)

Symptoms of Stress

Albemarle and Pamlico sounds and their web of tributary rivers and creeks are in better shape than some other estuaries in the country. The land still is largely rural, and there are no big cities sprawled on the shore.

There are warning signs that our estuary is feeling the strains of the demands we put on it.

Declining fish catches. Total commercial fish catches, both industrial and edible, have declined more than 60 percent since the record harvest of 1981. Fish that traditionally come from the ocean each spring to spawn in the rivers — called anadromous fish — have dwindled in numbers.

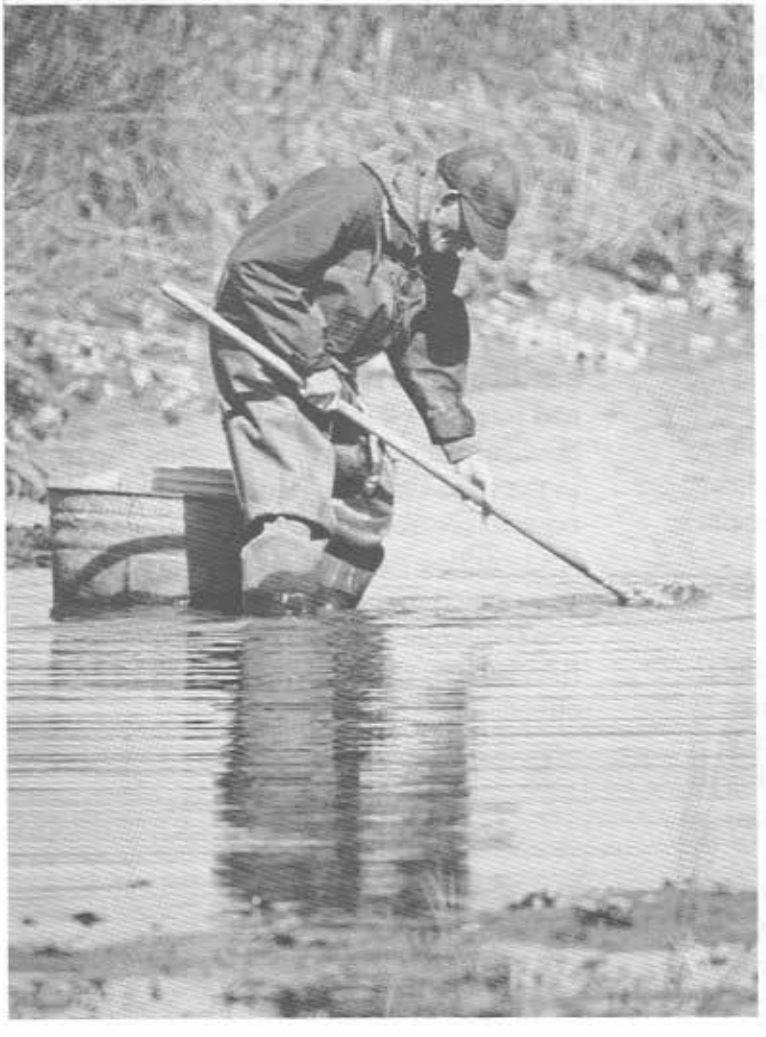
The striped bass, known as rock fish, is the most famous casualty of the lot. The big fish traditionally appeared in Albemarle Sound in the winter and spring, and most headed to the Roanoke River, the fish's major spawning ground in the state. The number of fish caught in Albemarle Sound has dropped steadily during the last decade, and scientists think that 1988 was the first time striped bass have successfully spawned in the state since the mid-1970s. An agreement to control the flow of the Roanoke River during the spawning season may have contributed to the successes.

The populations of other anadromous fish, such as river herring, also have declined.

Diseases. "Red sore" disease, which actually is a variety of different diseases, has become common in fish in the Albemarle Sound. A fungal disease strikes fish in the Pamlico River. Called ulcerative mycosis, the disease eats holes in its victims and sometimes reaches epidemic proportions in menhaden, at times infecting 90 percent of their population.

Another disease — this one caused by bacteria — has been eating through the shells of blue crabs in the Pamlico River. It first appeared in 1987, and usually is found in lobsters, shrimp and other crustaceans that live in polluted water.

Algal blooms. Massive blooms of blue-green algae occur almost every year in the Chowan and Neuse rivers. Fed by excessive amounts of the nutrients phosphorus and nitrogen, the algae form thick, scummy mats on the surface of the water. The Pamlico also experiences frequent algae blooms. When these algae die and decompose, they rob the water of its oxygen. If the weather's right that can lead to anoxia, or what the fishermen call "dead water," which kills fish.



Two parasites, MSX and Dermo, are effecting the production of oysters in North Carolina. High water temperatures and salinity levels make oysters more vulnerable to these two parasites. (Photo: S. Taylor)

320,000 acres of estuarine acreage have been closed to shellfishing in North Carolina. (Photo: S. Taylor)

Shellfish bed losses and closures. About 25 percent of the state's commercial shellfishing waters routinely are closed because of pollution. In fast-growing counties, like Carteret and Dare, the number of acres closed since 1984 has more than doubled. Urban and agricultural runoff and discharges from wastewater treatment plants, industry, marinas and overflowing septic tanks threaten shellfishing areas.

In the Pamlico River, productive oyster beds have retreated 10 to 15 miles downriver, possibly because of changes in the river's salinity level.

Underwater grasses. Thick stands of wild celery, or Vallisneria, once made up about 90 percent of the underwater vegetation in the Pamlico River. Very few stands can now be found in the Pamlico and they have disappeared from the central portion of the river. This parallels similar mysterious disappearances in other estuaries, such as Chesapeake Bay. Weather and pollutants are thought to contribute to the grasses' disappearance.

Captain Dave Tate and wife Lucy enjoy the day. (Photo: P. Nurnberg)

The Pamlico: One River's Story

Sunny days in January stir something inside the people who work the Pamlico River. Most probably had notions similar to the one Dave Tate had that day when he poked his head out the door of his house in Pamlico Beach. Snow covered the ground, but the sun shone brilliantly, promising the warmest day in a week. "Captain" Dave glanced up into the cloudless sky and, with a smile creasing his weathered face, said it would be a good day to start making stakes for his nets.

The stirrings pull at all commercial fishermen in the winter, and they've been tugging at Capt. Dave a little longer than at other fishermen. He's 90 and, the good Lord willing and if, more importantly, his wife, Miss Lucy, doesn't raise too much of a fuss, he fishes his pound nets each spring, just like he has for the last 72 years.

They've been good years, mostly. Fishing paid for the house that he and Miss Lucy live in. It's taken care of the bills and provided for the dozen children.

In Capt. Dave's day, a man could make a decent living fishing the river. The shad and herring ran every spring back then. Sailboats dredged for oysters, which could be found from Bath Creek down to Rose Bay, and a fisherman with a hot spot and a strong back could catch 30 boxes of speckled trout in a haul net on a fall day.

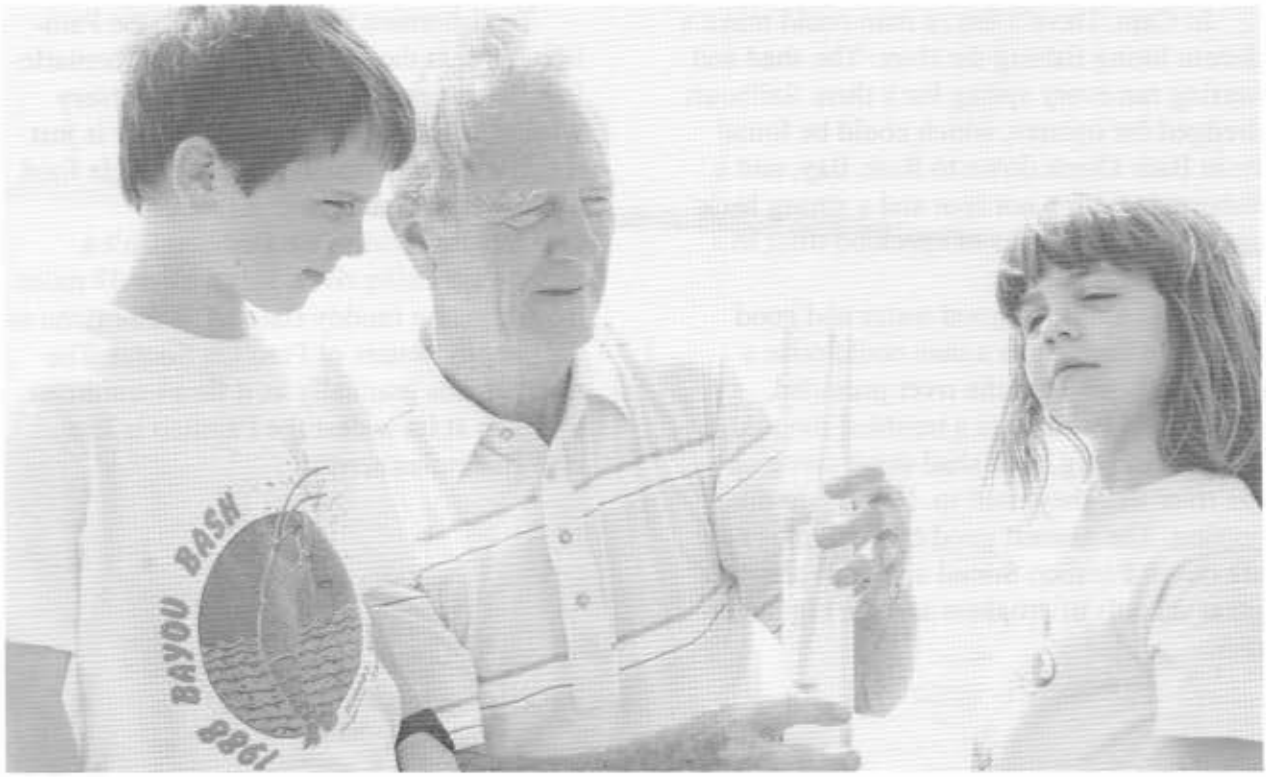
It was a time of good water and good fishing, a time when a man could raise a dozen kids on what the river provided.

But the Pamlico is a troubled river now. The roe and big buck shad don't come up the river like they used to. Neither do the herring. The nearest good oyster lumps now are out in Pamlico Sound and gone are the great schools of croakers and the big butterfish.

To fishermen like Dave Tate, the Pamlico River is the heart of the vast Albemarle-Pamlico estuary. It is a great fish nursery where the mix of fresh and saltwater is just right, where the marsh grasses provide food and cover to countless creatures.

Geographically, the Pamlico isn't a terribly imposing river. It is a mere 39 miles long from the muddy flats off Washington to the choppy waters of Pamlico Sound. The river widens gradually as it flows southeast, but even at its widest the Pamlico is less than five miles across.

Pound net on the Pamlico River at dawn (Photo: M. Okun)



Generation to Generation. Retired opthamologist and lifelong resident of the region, Dr. Tad Larkin, is one of the nearly 80 citizens who participate in the citizens monitoring program. Here he shows his two grandchildren, Tim and Amy Boyer, how to measure the salinity in the water. (Photo: P. Nurnberg)

In a strict sense, the Pamlico is a settling pond for the Tar River, which drains 16 counties in the rural piedmont section of the state. This is farm country, mostly, where tobacco and corn are the main crops and where chicken farms and animal feed lots are common. There are no big cities in the river basin and only a few industries.

But from the fields and farms and feed lots come the chemicals phosphorus and nitrogen. These organic nutrients are found in any fertilizer and in animal wastes, and they wash into the Tar with each rain. Eventually they settle in the slow-moving, shallow Pamlico.

A river needs a certain amount of phosphorus and nitrogen to remain healthy and productive. Too much, though, can trigger a chain reaction of side effects. The nutrients encourage algae to grow, and that growth can be explosive when the weather's right. When they die, the massive algae blooms can deplete the water of its oxygen — dead water, the fishermen call it — which then suffocates fish.

Water also enters the Pamlico from the surrounding land. Thousands of acres of marsh on the peninsula between the Albemarle Sound and the river have been drained in the last decade. The ditches used to drain the land may have altered the hydrology. Instead of filtering slowly through the marshes, nutrient-laden runoff now rushes down the ditches into creeks and bays. Too much fresh water is really just another pollutant to a brackish river like the Pamlico, and the evidence now suggests that it may be altering the salinity levels of some of the Pamlico's most important fish nursery areas.

Farmers along the Tar and Pamlico rivers can't shoulder all the blame, though. Rain also washes off city streets, parking lots, lawns and golf courses. The runoff carries fertilizers, pesticides, toxins and heavy metals, much of which eventually finds its way to the Pamlico.

Add to these non-point sources of pollution the discharges from wastewater treatment plants and industries.

Like Pogo, then, we have met the enemy and it is us.

But there is hope.

News stories about the Pamlico's troubles have focused attention on the river. The Albemarle-Pamlico Estuarine Study, or APES, has funded educational programs and has gotten people actively involved in caring for the river by underwriting a citizens' monitoring program, which puts people out on the water taking samples.

APES also has put scientists on the water to study the Pamlico's most vexing problems. From that knowledge will come a fuller understanding of how the intricate

Fish kill (Photo: R. Carter, Washington Daily News)

Texasgulf Chemicals Co. is located in Aurora along the Pamlico River. (Photo: Texas Gulf)

ecosystem works and a better blueprint of how to manage it in the future.

That future depends on everyone in the Tar-Pamlico river basin. Toward that end, the state has expanded programs that protect watersheds and those that help farmers pay for conservation measures that reduce runoff from feed lots and cut erosion.

Industries also have become more aware of their effects on the Pamlico. For example, the Pamlico's major industry, Texasgulf Chemicals Co., is taking steps to curb what it discharges into the river. The company, which owns a huge phosphate mine and fertilizer plant on the south side of the Pamlico, legally dumps about 3,000 pounds of phosphorus into the river each day. Texasgulf has agreed to a state permit that will require the company to virtually eliminate the phosphorus and reduce drastically the amount of fluoride that it discharges into the river.

All are good signs. And maybe they bode well for Dave Tate's grandchildren. Later in life they, too, may be able to poke their heads out the door on that first winter morning that hints of spring and think of setting their nets.

"Yes, sir," Capt. Dave said, that wizened face peering up into a beautiful, January azure sky. "It'll be a good day to cut those stakes."

How You Can Help

Lena Ritter got involved. A shellfisherman on Stump Sound, Mrs. Ritter worried that development of an island in the sound would pollute the water and jeopardize her way of life and her heritage. At first she didn't even know all the names of her county commissioners. She learned. For five years she and her neighbors fought the proposed development. The developers finally dropped their plans after failing to get the necessary state permits, and the island was bought by the state and preserved.

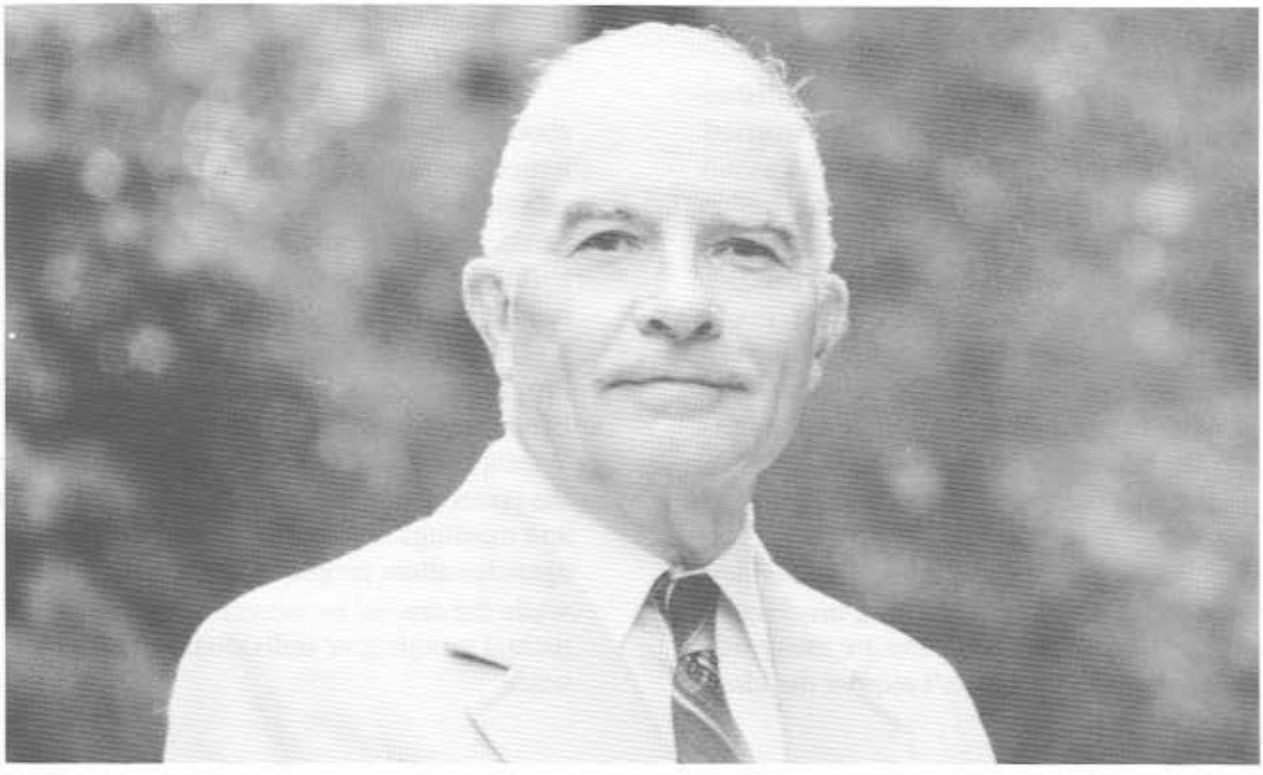
As Mrs. Ritter and others like her have proved time and again, getting involved makes the difference. There are many ways to do that and most don't require the kind of energy and commitment that was needed of Mrs. Ritter.

Just being informed helps. Knowing about the estuary and keeping up with the issues that affect it lead to a better understanding of the estuary's problems and needs. And understanding is the first step in building the public support the estuary will need if it is to be protected.

Taking the initiative is the next step. Programs, such as the Albemarle-Pamlico Estuarine Study and the state's Stream Watch, offer ways to get directly involved in the protection of the estuary. Public hearings and meetings required by government agencies allow people to speak their minds, while the coastal conservation and environmental groups give individuals a collective voice.

Lena Ritter from Stump Sound worked with her neighbors to protect Permuda Island. (Photo: D. Rolfe)

To Get Involved, Call 946-6481



Ralph Heath, Raleigh-based groundwater hydrologist, has worked on several water quality issues in the coastal area. He works with people from Hatteras to help them protect their aquifer which provides drinking water for the area.

The following are brief descriptions of some of the ways people can get involved.

APES: The Albemarle-Pamlico Estuarine Study wants your help. In fact, its success ultimately may hinge on how actively people participate in its programs, since education and personal involvement are critical ingredients to building the consensus the estuary will need.

The study pays for workshops and meetings to educate people about the estuary. It funds booklets, public service ads on television and radio, and slide shows. A quarterly newsletter helps keep people informed. APES's most important public program, though, may be the citizen's monitoring network, which will train people to take water samples and thus get actively involved.

The study's two regional Citizens' Advisory Committees also offer people an opportunity to be more active. The committees help guide the direction of the study by deciding which public-participation projects get money. The members welcome public comments.

At the very least, get on the APES mailing list. Contact the coordinator of the public-involvement portion of the study. The newsletter provides dates of public meetings and answers to any questions. The address is: Albemarle-Pamlico Estuarine Study, 1424 Carolina Ave., Washington, N.C. 27889. 919/946-6481.

Stream Watch: This state program allows citizens groups to "adopt" a body of water and then actively look after it. The state provides maps and technical help, and the groups volunteer their time. They monitor any planned developments along the water and watch for problems. Suspected violations of regulations are reported to state agencies. The Stream Watch program also offers small grants for educational materials and stream clean-ups. The program is coordinated by the N.C. Division of Water Resources, P.O. Box 27687, Raleigh, N.C. 27611. 919/733-4064.

Government agencies: Local, state and federal governments have various agencies that manage different activities in the estuary. The state's Division of Environmental Management, for instance, is responsible for protecting the water, while the N.C. Division of Coastal Management enforces development rules in the coastal counties. The federal Army Corps of Engineers has jurisdiction over most wetlands, while cities and counties set zoning regulations.

The process can be very bewildering to the uninitiated and explaining it would

Enjoying the good life on the coast of North Carolina (Photo: S. Taylor)

People from all over North Carolina and the rest of the country enjoy riding the ferries. (Photo: M. Okun)

require another booklet. The citizen's guide written by the N.C. Coastal Federation does a good job explaining how the government regulatory process works. To work, people must first take the initiative to make themselves heard. That's what consensus building is all about. If enough people want something done, it will get done. County commissioners do respond to packed meeting rooms. Attending government hearings and meetings is important. Each agency lets people participate in the decision making through a public-hearing process, and most allow written comments to be made on proposed permits.

The agencies also publish minutes and agendas for meetings, which are available to the public. Those agencies that have enforcement powers encourage people to report suspected violations of regulations.

Citizens groups: There are at least 20 organizations involved in issues concerning the estuary. Some are small and limit their activities to one river or county, while others cover the coast or the entire state.

Regardless of their scope, citizens groups often can accomplish more than individuals can. Most groups have good contacts with government agencies and with the media, and they provide information to their members through newsletters and educational programs. Some have technical analysts who keep track of permits and proposed development plans. For a detailed explanation, see A Citizen's Guide to Coastal Water Resource Management, a booklet written by the N.C. Coastal Federation and paid for by APES. It is an excellent description of various government programs that protect and manage the coastal environ-

people can participate in the process. It also gives the addresses of all citizens' groups involved in coastal issues. For a copy, write the N.C. Coastal Federation, Hadnot Creek Farm, 3223-4 Highway 58, Swansboro, NC 28584. 919/393-8185. The Citizen's Guide provides a complete list of groups you can contact for more information.

The sounds area of North Carolina is rich in history. This marker is in Bath. (Photo: M. Okun)

DDD

Dissolved oxygen: Oxygen that is dissolved in the water. Fish and shellfish absorb this necessary element from the water with their gills. When levels of dissolved oxygen become low because of hypoxia or anoxia, fish and shellfish either leave an affected area or die.

EEE

Estuary: Coastal waters almost enclosed by land where fresh water from the rivers mixes with seawater pushed up by the tide. These protected bodies of brackish water are rich in life. In fact more than 90 percent of North Carolina's important commercial species of fish spend at least some of their lives in estuaries.

Eutrophic: A body of water that is rich in dissolved nutrients, such as phosphorus and nitrogen, but is often shallow and seasonally deficient in oxygen.

NNN

Nitrogen: This element is found in the atmosphere and dissolved in coastal and marine water. Called a nutrient, nitrogen is needed by plants and animals for making proteins. Too much of it, though, spurs algal blooms that can lead to anoxia.

Nonpoint-source pollution: Includes nutrients and chemicals from farms, lawns, city streets and parking lots and from malfunctioning septic tanks. They are washed into rivers and streams with each rain and are carried into the estuary. Unlike pollutants discharged from a pipe by factories and cities, this source is difficult to trace, measure and control.

Nursery areas: The shallow fringes of the estuary where the larvae and juveniles of many species of fish and shellfish grow. Nursery areas offer these aquatic youngsters a nurturing environment where there is plenty of food and protection from predators.

Nutrient enrichment: The addition of valuable nutrients, such as phosphorus and nitrogen. Farmers often enrich, or fertilize, their fields with nutrients to spur plant growth. If washed from the land, these same nutrients can overly enrich the water and trigger algal blooms.

Development in the coastal area (Photo: UNC Sea Grant)

PPP

Peat: Partly decayed plant matter found where ancient swamps once existed. If removed and dried, peat can be used as a fuel. It is abundant on the peninsula between Albemarle Sound and the Pamlico River, but controversy over environmental effects of mining has surrounded possible mining.

Phosphorus: A valuable element and nutrient in coastal and ocean waters, it is used by the plants that form the basis of the aquatic food chain. Too much phosphorus and nitrogen in a body of water can contribute to anoxia.

Photosynthesis: The process by which plants make organic matter by using carbon dioxide, water, and sunlight.

Phytoplankton: Floating, usually microscopic, plants that can photosynthesize. They are basic producers in the aquatic food chains.

Plankton: Tiny animals and plants that drift in ocean and coastal waters and form the basis of the marine food chain.

Pocosin: Algonquin Indian word for "swamp on a hill." Pocosins are freshwater swamps, or wetlands. Though poor in nutrients, pocosins support unique plant and animal communities. They also act like a sponge in filtering pollutants from runoff and recharge the groundwater.

Point-source pollution: Pollution entering coastal waters and streams at a specific location, such as a pipe. It can be measured and is regulated with state-issued permits. Such sources include discharges from wastewater treatment plants and industries.

RRR

Red tide: A bloom of dinoflagellates that looks like a red, brown, yellow or green stain in coastal and ocean waters. The blooms can produce paralyzing toxins that can kill fish. Some of these toxins are concentrated in shellfish, such as clams, oysters and mussels, and can harm people who eat the shellfish.

Turbidity: Sediment suspended in the water, which can look cloudy or dingy. Turbidity can create a chain reaction if it prevents sunlight from penetrating the water. Plants wouldn't have enough light for photosynthesis, and plant production would decline. Eventually higher creatures in the food web would be affected.

UUU

Ulcerative mycosis: A fungal disease that causes external ulcers in menhaden and other species of fish. At times, as much as 90 percent of the menhaden in the Pamlico River are stricken with the disease.

WWW

Wetland: Any area that is saturated or inundated by water. These include swamps, saltwater marshes and bogs and pocosins. They often serve as important nursery areas for fish, provide wildlife habitat and help filter pollutants from the land.

Tools of the Trade

A carpenter needs a hammer, a saw and a framing square to make a living. The tools of the trade for the commercial fisherman in North Carolina are nets and various kinds of dredges, pots, rakes and tongs.

Commercial fishermen use a variety of nets to capture the wide range of fish that inhabit our coastal water.

Gill nets are set in shallow water to catch mullet, trout, croaker and flounder. The webbing is large enough for the fish's head, but not its body. When it tries to back out, the fish is caught behind the gills. The nets may be several feet deep and more than 100 yards long. Stake gill nets are staked at various points, and sink nets are anchored only at the ends. Gill nets can also float.

Pound nets are the most intricate system of nets that fishermen use. Netting, called the leader, extends from the shoreline and bars fish from swimming past. Instead, fish follow the net to a heart-shaped funnel of netting, called the heart, which channels them into the square "trap" where, once in, the fish can be considered safely caught. Pound nets are used to catch many species of fish, especially flounder, grey trout, croaker and river herring.

Circular **cast nets** collapse over fish when thrown from a boat, pier or from the shore. They frequently are used by sport fishermen to catch small bait fish.

To herd or encircle large schools of fish, fishermen rely on seines. A variety of seines are used but the main idea is the same: A circle of netting is wrapped tighter and tighter around a school until the fish are concentrated in the middle where they can be scooped out. "Beach seines" are set in a semicircle against a beach or river bank. In deeper water, two boats encircle the school of fish. Combined with spotters in airplanes, **purse seiners** are very efficient at catch-

Working and living off the waters (Photo: UNC Sea Grant)

ing menhaden. Seines are used to catch menhaden, river herring, flounder, spot, croaker and trout.

Trawls are v-shaped nets that are pulled behind a boat. Fish, crabs and shrimp are swept into the wide mouth of the net and accumulate in the "tailbag." The net is held open during towing by wooden planks, or "doors," on each side of the net. Floats keep the top up and a lead line ensures that the bottom of net stays there. Some fishermen pull a "tickler chain" in front of the net to stir fish or shrimp off the bottom. The trawl periodically is winched aboard to empty the catch by untying the tailbag.

Oysters, clams and scallops are dug from the bottom with **dredges**, metal-framed baskets made of either iron or nylon webbing or a combination of both. A "raking bar" along the bottom of the metal frame may be smooth for scallops or may have teeth to dig out shellfish partially buried in the mud or sand.

Pots are wire baskets used to catch blue crabs and eels. The crab pot is a nearly cubical cage made of steel wire. Conical funnels allow the crab to enter the lower section of the pot, where bait is placed in a finer mesh cylinder, called the "bait box." Halfway up the pot is a wire partition in the shape of an inverted V. Crabs naturally swim upward when trying to escape, and they enter the top section and can't get out of the pot. Eel pots work in a similar manner.

Some shellfishermen use **tongs** and **rakes**. Oyster and clam tongs are made of two long wooden handles joined like scissors. Attached to the end of each handle is a small basket with teeth. Fishermen work the handles back and forth and the baskets dig shellfish from the bottom. Rakes look like the garden variety with a small basket attached to scoop clams from the bottom.

Two- to five-pronged spears, or **gigs**, sometimes are used to catch flounder in shallow water, especially at night. Flounder gigging is popular with sport fishermen.

Many sport fishermen in North Carolina use small trawls, gill nets, pots, rakes and seines to catch fish, shrimp, crabs, oysters and clams. Use of such commercial gear by sport fishermen is far more common in North Carolina than in any other state on the Atlantic coast.

Common Species

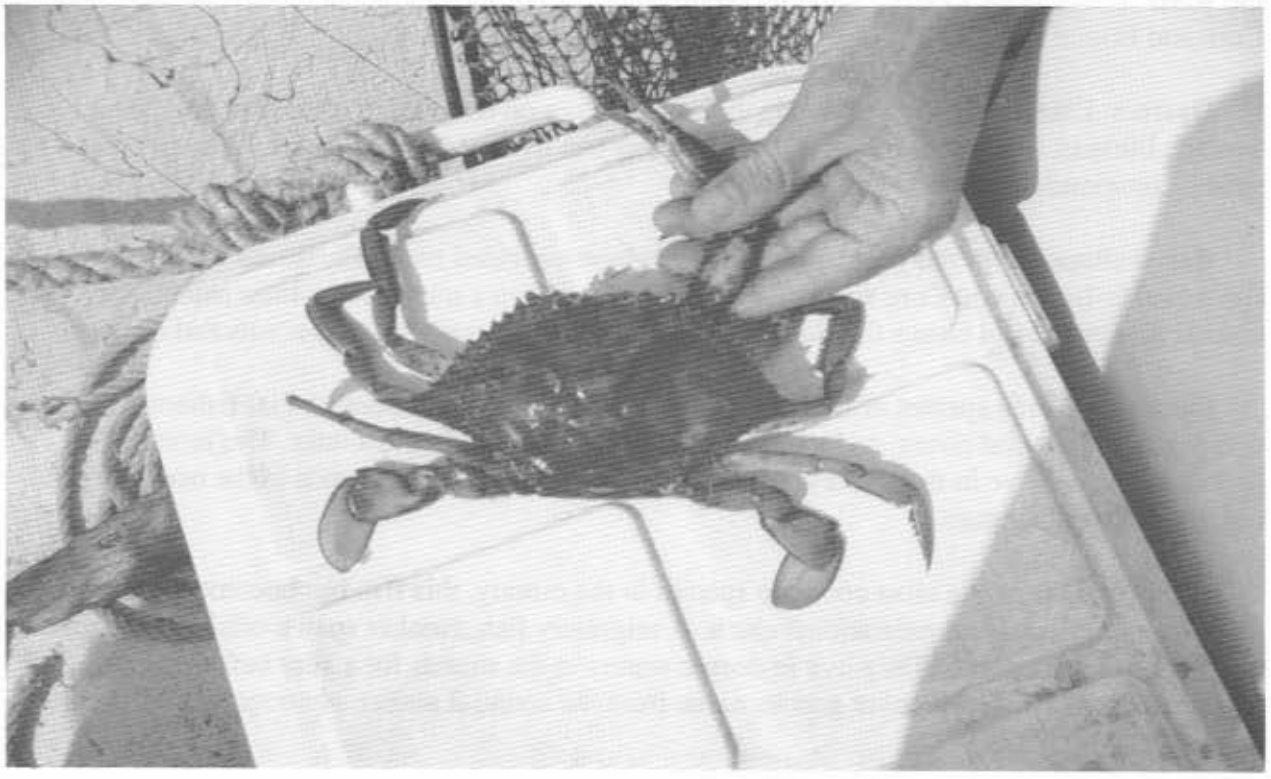
The river and sounds of the Albemarle-Pamlico estuary abound in life. Here are some of the more common economically important species found in the estuary:

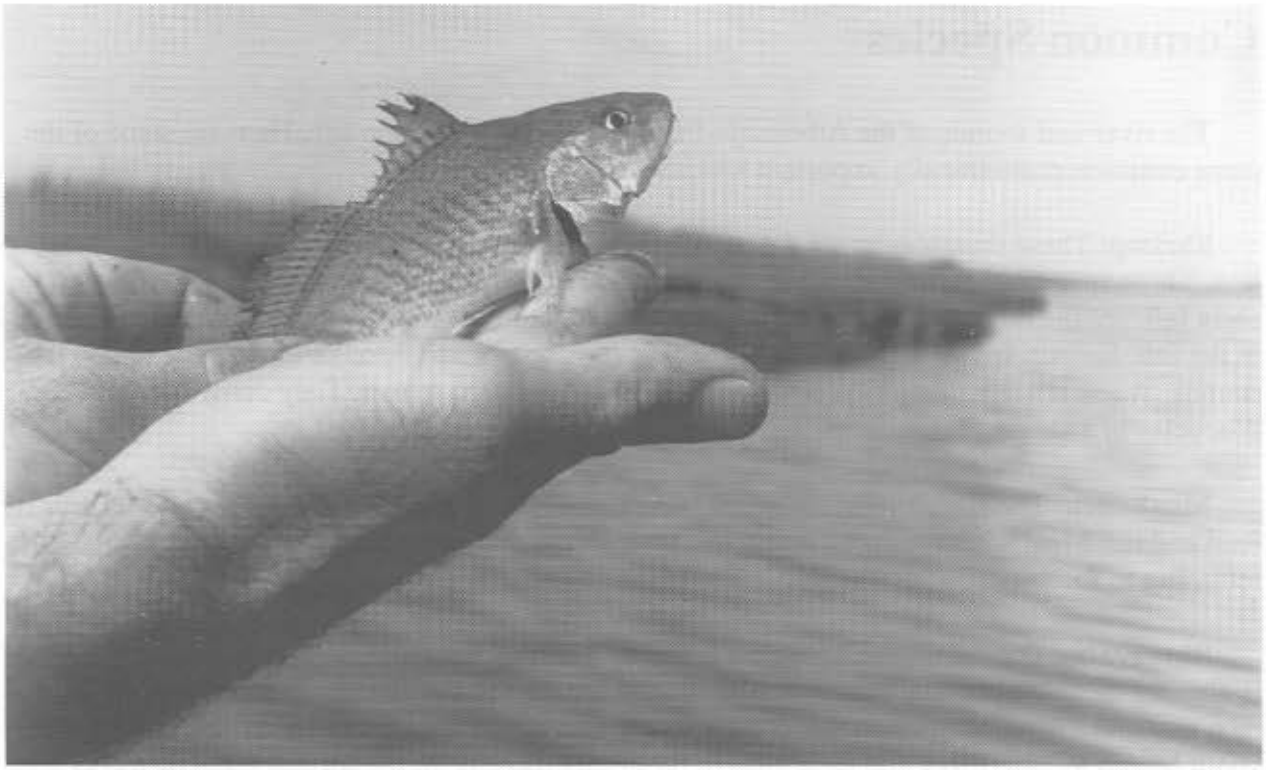
Shrimp: These crustaceans are the most valuable commercial fishing catch in North Carolina. Three species of shrimp are caught in the state. Brown shrimp, taken in the summer and early fall, are the most abundant. Pink shrimp are caught in the fall and spring and white shrimp in the fall. Shrimp spawn offshore, but currents carry their larvae through the inlets and into the sounds. When reaching maturity, shrimp return to the ocean to spawn. They complete their lifecycles in a single year.

Menhaden: The state's most abundant commercial fish, menhaden are processed into animal feed and oil. Menhaden spawn offshore, and their larvae and juveniles grow in the estuary before returning to the ocean.

Blue crabs: The combative blue crab is one of the most ferocious predators in the estuary. It is also the most commercially sought after marine creature in the state and supports more fishermen and processing plants than any other species. Fishermen use pots to catch blue crabs from about March to November and trawl nets in the colder months. In the spring, fishermen also catch crabs that are about to shed their shells to grow. The soft crab that emerges from the old shell is a prized delicacy. Blue crabs spawn near the inlets to the ocean and spend most of their lives in the estuary.

Bluecrab (Photo: M. Okun)





Croaker (Photo: N.C. Div. of Marine Fisheries)

Hard clams: Unlike most other creatures in the estuary, clams spend all their lives there. And they can live 30 years. All of that time is spent on the bottom where they filter food from the water. Hard clams support a major commercial fishing industry in the winter, especially in Core and Bogue sounds.

Oysters: Like clams, oysters spend their entire lives on the bottom of the estuary. Their average lifespan is about three years, but an oyster can live for 10 or 12 years. They are harvested commercially from October to March.

Bay scallops: Over the years, these shellfish have provided much Christmas money for fishermen in Bogue and Core sounds, where they have been a traditional winter catch. The muscle that opens and closes the shell is eaten and not the viscera, as with clams and oysters.

Flounder: Three species of flounder are caught in the estuary. Commercial fishermen use nets in the sounds and rivers, and trawlers catch them offshore in the winter. The larvae and juvenile flounder live in the estuary, while adult fish move from the sounds to the ocean depending on water temperature.

Croaker: One of the most common species in the estuary, this fish has become more important as a commercial and recreational catch. A migratory fish, croaker spawn offshore and move into the estuary as larvae. They live in deeper waters in the sounds for a year before returning to the ocean as adults. The croaker gets its name from the sound it makes when removed from the water.

Grey trout: Also called weakfish, this is an important commercial and recreational species. Commercial fishermen use long haul sienes and pound nets to catch them during warm months and gill nets in the winter.

Spot: Rarely weighing more than two pounds, spot are an important panfish for commercial and sport fishermen. They are not as abundant as the other migratory fish, croaker.

Striped bass: Known as rock fish in North Carolina and the Chesapeake Bay, striped bass were once an abundant commercial and game fish. Called anadromous fish, the stripers live in salt water and move up freshwater rivers in the spring to spawn. Poor water quality, and other environmental factors in the estuaries have reduced striper populations all along the coast. Dams along the Roanoke River, the main spawning ground in North Carolina, control the flow of the river, making it difficult for the fish to successfully spawn.

River herring: Once a major spring catch in the Albemarle Sound, river herring have declined sharply in recent years. An anadromous fish like the striped bass, the herring's decline has been blamed on problems in water quality and quantity in the rivers where they spawn. The fish also were caught offshore in large numbers by foreign fishing fleets in the early 1960s and late 1970s.

Mullet: This fish was once the center of a major industry along the beaches of North Carolina. The fish were netted in the surf and then cleaned, salted and packed in barrels for markets inland and in the North. The demand for mullet today is limited, but it is still a local favorite

Striped Bass (Photo: N.C. Div. of Marine Fisheries)

along the Albemarle and Pamlico sounds. Spawned offshore, the larvae ride currents to the estuary, where they stay until they are about five inches long. Then they move back to the ocean.

Eels: These are the long-distance travelers in the estuary. Eels spawn in the Sargasso Sea, which is southwest of Bermuda, and in six months to a year the young eels, or elvers, find their way into the estuary. They move up the rivers where they remain for the next 6 to 13 years. They return to the Sargasso Sea to spawn and then die. A favorite dish in colonial times, eels are no longer in much demand in America. Most eels caught in North Carolina are sent to Europe and Asia.

Where crop fields are adjacent to waterways, fertilizers and pesticides run into the streams. This results in problems for the sounds where all the run-off ends up and settles out. (Photo: USDA - Soil Conservation)

Dead Water

Scientists call it anoxia, but fishermen have a more fitting name: dead water.

It is a layer of water that forms along the bottom of rivers and sounds that is so depleted of oxygen that it can not support life. Fish and crabs run before it. Those caught in nets and pots die. Flounder have been known to back halfway up a bank to escape the water's clutches. Fish walks, they're called. Crabs will scurry on to dry land, and eels will lay their heads on the bank gasping for air.

Dead water always has been a problem in the deepest parts of Albemarle-Pamlico estuary during the summer. Now, in some rivers, dead water can occur just about any time.

Researchers are looking into the reason why anoxia is occuring more frequently, but they already know the dynamics that lead to oxygen-depleted water.

The estuary is separated from the Atlantic Ocean by a string of barrier islands that have few inlets to the ocean. Tides, then, have little effect on much of the estuary. To move and mix water around, the estuary depends on the wind and on the flow of water coming down the rivers that empty into it.

During hot, dry summers, water movement slows drastically. With little rain, runoff is low, so there isn't much fresh water entering the estuary to push things along. Then all that's needed

are a few of those famous Eastern North Carolina "dog days," when the wind is calm and the air stifling. The water begins to stratify, or form horizontal layers. The warmer, fresher water coming downstream settles atop the cooler, saltier — thus denser — water.

Water requires constant circulation and contact with the air to recharge the oxygen in it. There is always plenty of dissolved oxygen in the upper layer, thanks largely to the exchange that takes place at the surface and to plants and algae that produce oxygen through photosynthesis.

The story is different in the saltier, lower level. Very little photosynthesis goes on down there because not enough sunlight filters through. With no mixing with the upper layer, the oxygen that is used up by fish and bottom-dwelling species, such as clams and oysters, isn't replaced.

Dead water is the certain result.

Then come a couple of days of thunderstorms and high winds. The layers mix, and the dead water disappears.

That's how it used to be. Nitrogen and phosphorus may be changing that. Large quantities of those organic nutrients enter the estuary from upstream. They are in the discharge from wastewater treatment plants and industries and in the runoff from farm fields and animal feed lots. The nutrients encourage algae growth and settle in the sediments.

Vegetation helps anchor the soil and sand, preventing erosion. (Photo: M. Okun)

Massive fish kill (Photo: N.C. Div. of Marine Fisheries)

The algae make oxygen in that upper level, but they also use it in their own biological processes. As they die, the algae sink and decompose, which uses up oxygen. All the while, bacteria work on the nutrients on the bottom, burning up even more oxygen.

Scientists call this nutrient loading, and it may be the reason why dead water is no longer just a summertime happening in some parts of the estuary and is no longer limited to just the deepest portions of rivers and sounds.

The most extensive known episode of dead water ocurred in August 1984 when 100 square miles of water in the the Neuse and Pamlico Rivers and Pamlico Sound went anoxic.

Life of the Croaker

The mother croaker casts 500,000 eggs into the warm waters of the Gulf Stream in the cold of early December. The eggs hatch in a few days, but the tiny croakers don't stand much of a chance in the open ocean. Their lives depend on whether they make it to shallow coastal waters, like the Albemarle-Pamlico estuary 100 miles away.

Like many other creatures, croakers depend on the safety and food that the coastal rivers and sounds offer. They spend most of their lives there, coming in as small larvae and leaving as adults for the ocean where they spawn to begin the cycle anew.

Flounder and spot live similarly, but none is as common or takes a hook more readily than the croaker. If you've ever dropped a fishing line anywhere in the estuary, chances are that you've reeled one in. After listening to the sound one makes when pulled from the water, you also know how the croaker got its name.

Just getting to the end of a fishing line isn't easy for croakers, whose lives start rather uncertainly in the hostile Atlantic. Unable to swim, the larvae that hatch in the Gulf Stream hitch rides on ocean currents that take them westward. They bombard the N.C. coastline in the winter and ride through the inlets that separate the barrier islands. Once in the sounds, the larvae settle to the bottom where other currents push them to the protected nooks and crannies along the shoreline.

Others have the same idea. Young spot, menhaden and flounder also seek the protection of the sounds. Baby blue crabs are already there. The great nursery comes alive.

Food for the baby croakers and the others comes with the spring rains, which wash vital nutrients down the rivers and into the estuary. Coupled with warming temperatures and sunny

Outfall from Rocky Mount Municipal Wastewater Treatment Plant. (Photo: P. Nurnberg)

days, the nutrients spur the growth of phytoplankton, which, in turn, nurture zooplankton, the larval croakers main food.

So nourished, croakers quickly grow to juveniles and graduate to more substantial fare — small shrimp, worms and clam siphons.

The estuary also offers protection from most large predators. Adult fish tend to avoid the shallow waters because of its rapid salinity and temperature fluctuations.

By August, then, the croakers have grown to about 5 inches and are ready for deeper water in the sounds. They remain in the estuary for another year. Croakers usually reach sexual maturity during their second fall. Then they return to the ocean to spawn.

It's a beautiful day for surf fishing. (Photo: N.C. Div. of Marine Fisheries)

Clean Water Act

Like other states, North Carolina has built its programs to control water pollution around the federal Clean Water Act, a landmark law that started the nation on a course toward cleaner rivers and streams.

Congress passed the Federal Water Pollution Control Act in 1972. Amendments to the act five years later gave the law its popular name.

The Clean Water Act mandated that states clean up their surface waters. The law offered a range of regulations and management strategies to help states do that, and there was more than the usual amount of government red tape and grumbling by local officials who resented the federal muscle. There was, however, also a great deal of federal money involved.

As an incentive to adopt stiffer regulations, states were offered grants to build or improve municipal sewage-treatment plants. The federal money covered up to 75 percent of eligible costs.

Two sections of the act had the biggest effect on curbing pollution. Section 402 required that so-called "point sources" of pollution receive National Pollution Discharge Elimination System, or NPDES, permits. Point sources are places where cities and industries discharge waste into rivers and streams. The permits place limits on each pollutant.

In North Carolina, the NPDES program is administered by the state Division of Environmental Management, which issues the permits, inspects plants once they're operating and checks the monthly self-monitoring reports that each permit holder is required to file.

Section 404 of the Clean Water Act requires a permit from the U.S. Army Corp of Engineers

before dredge or fill material can be dumped in surface waters, including wetlands.

The act also recognizes that runoff from farms, parking lots and streets — called nonpoint pollution — is a growing problem, and it encourages states to adopt stricter land-use measures and programs to reduce soil erosion and stormwater runoff.

For doing all that, North Carolina cities and towns have received about $700 million from the federal government since 1973 to build or improve their sewage-treatment plants. The federal money has been cut back severely since the mid-1970s, though, and will be phased out totally after 1994.

Industrial discharge going into the Roanoke River (Photo: P. Nurnberg)

Susan Smith, a Fayetteville student, attended Coastal Awareness Day at the NC General Assembly in Spring of 1989. (Photo: C. Seward, Raleigh News and Observer)

HELP SAVE
THE SOUNDS
FOR MY
GENERATION