

COAST WATCH

By Steve Murray



CLAMMING

Ten years ago, hard clams were the harvest of hand clammers — those folks willing to rake or tong the bed-ridden mollusks for a few cents apiece. But things changed.

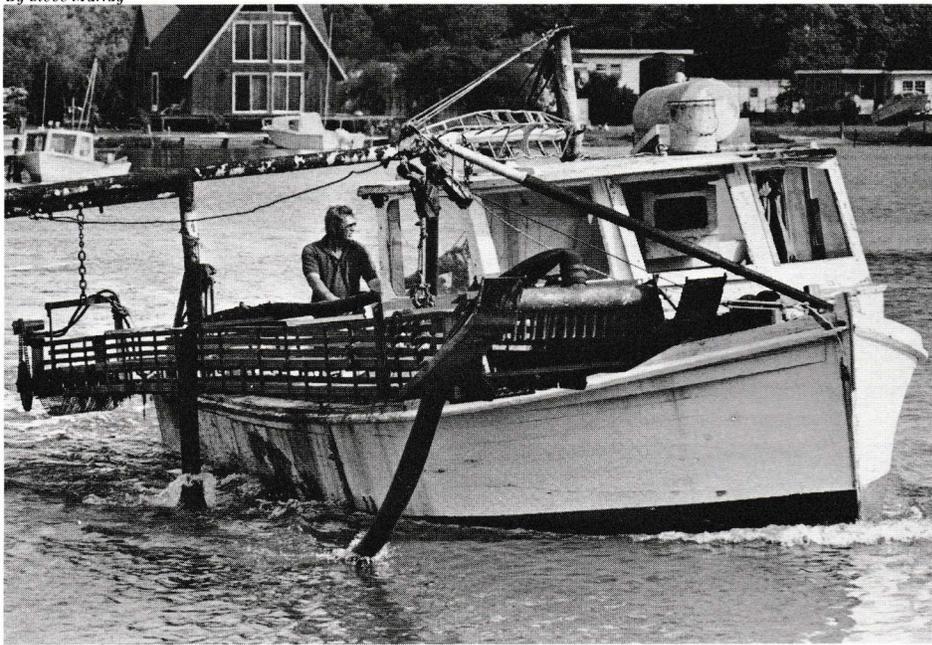
BY KATHY HART

A severe freeze during the winter of 1976-77 laid thick ice over Northern clam beds. Seafood dealers looked south to fill their orders for the bivalves, and the hard clam began living up to its

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Mechanical Harvesters vs. Hand Clammers

By Steve Murray



scientific name, *mercenaria mercenaria*, which means money. Mike Marshall, a shellfish biologist with the N.C. Division of Marine Fisheries, says fishermen were paid as much as 18 and 19 cents a pound then for the littlenecks (the smallest and most valuable clams used in the half-shell market).

With this financial lure before them, many fishermen turned to easier, more efficient mechanical harvest. In North Carolina, fishermen can mechanically harvest clams with a hydraulic dredge or a kicker plate.

Hydraulic dredges use a nozzle to dislodge clams from the sediment and a conveyor to bring them to the surface. To kick clams, the fisherman welds a metal plate to the rudder of the boat. The plate deflects the prop wash from the rudder to the sound bottom, where it plows an 8- to 12-inch wide path. A heavy net is pulled behind the boat to net the catch.

Mechanical harvest allowed fishermen to bag more clams and to reach deeper beds unattainable by hand harvest. The result? Landings doubled in 1977 from the previous year, and continued to climb until they reached a peak in 1982 of

more than 1.7 million pounds.

The advent of mechanical harvest stirred controversy within the fishery and headaches for resource managers. Hand rakers claimed mechanical harvesters were encroaching on their territory, wiping out their fishery. And resource managers quickly noticed the damage kicking did to grass beds. Grass beds are important refuges and growing areas for other mollusks, crustaceans and finfish.

To manage both problems, the N.C. Marine Fisheries Commission imposed restrictions. Clammers could not harvest more than 40 bags of the mollusks, which had to be at least one inch thick. Dredging was confined to waters deeper than 7 feet. And all mechanical harvest was limited to daylight hours on certain days (usually Monday, Tuesday and Wednesday) of the week from December 1 to March 31.

In 1978, the commission outlawed kicking, dredging and the use of bull rakes (large heavy rakes that also damaged grass beds) from grass beds or live oyster rock.

Today clam kicking is limited primarily to Carteret County. But last year a few areas were opened in the Intracoastal Waterway in On-

low and Pender counties.

In 1984, fishermen raked, tonged, kicked and dredged 1,388,000 pounds of the mollusks for a dockside value of \$5,506,000. DMF managers estimate that 30 to 36 percent of the harvest was mechanical; the rest, hand gathered. In 1984, Marshall says DMF handed out 300 permits for mechanical harvest; of those, 21 were for dredges.

Since 1982, landings have dropped, and many believe that the clam fishery is being overfished. Unlike scallops and shrimp, clams are a long-lived species; they can live to be over 40 years old. Their harvest represents several years of reproductive investment. Consequently their stocks are not replenished as quickly as annual fisheries.

Fentress "Red" Munden, shellfish coordinator for DMF, puts it like this: "A lot of fishermen jumped into mechanical harvest when they saw the chance and the prices were good. The result is that the fishery has grown more rapidly than the resource can respond."

Declines in clam stocks have fishermen worried. Clams represent an important source of winter income, having saved more than one fisherman from financial ruin after



Hand clammers and mechanical harvesters vie for harvest areas. Mechanical harvesters would like to drop their nets and dredges in the areas traditionally reserved for raking and tonging. But hand clammers want DMF to protect the shallow-water beds needed to sustain their fishery.

a disastrous shrimp season.

Clinton Willis, chairman of the Carteret County Watermen's Association, says the declines in recent years have been drastic. He predicts that fishermen have one more year of profitable kicking harvest. His group is asking for new management schemes and more harvestable area.

Although DMF would like to open more area for mechanical harvest, "we've given them everything we can without getting into the rake and tong areas," Munden says. "We're caught in the middle. The hand rakers are not going to agree to give up any of their area for mechanical harvest, and the mechanical harvesters aren't going to be happy until we open these areas."

This year to lengthen the availability of mechanically harvested clams throughout the season, the fisheries commission gave DMF Director Robert Mahood the authority to set bag limits by proclamation. Using his authority, he can raise and lower bag limits as the need arises.

Willis says his group would like for DMF to begin a rotation system where areas periodically would be

opened and closed to kicking. This would allow stocks in closed areas to replenish themselves.

Munden says the division has talked to fishermen about a rotation system, but until now the fishermen have not been in favor of the idea. DMF also presented the rotation system to the marine fisheries commissioners.

The rotation system proposed by DMF would subdivide the area already opened to mechanical harvest. Munden says the commission wants more information on such a system, and Sea Grant researcher Charles "Pete" Peterson is conducting studies now that may help base the rotation system on scientific facts—recruitment, growth and mortality rates for various habitats.

Willis also would like DMF to move, or pay fishermen to move, clams from closed polluted areas to clean public estuarine bottom. There, they could be held "in trust" until they cleansed themselves of their pollutants and spawned. Then they could be harvested.

Munden says DMF has done a limited amount of relay in the past, but funds are generally not available for such a program. DMF has worked closely with the N.C. Divi-

sion of Shellfish Sanitation to establish criteria for temporary openings in polluted areas. When water quality standards in these areas rise to "safe" levels, the waters are open to harvest whether it's during the normal mechanical harvest season or not. And since the opening is temporary, no bag limits are set.

"With a few exceptions, there are not that many clams left even in polluted areas," Munden says.

Last summer in a legal effort to force open more harvestable area for hydraulic dredges, 18 fishermen filed a lawsuit in U.S. District Court in New Bern challenging the constitutionality of DMF regulations that limited their harvest.

The attorney general's office denied that the regulations were discriminatory and requested that the lawsuit be dismissed. No action has been taken in the case.

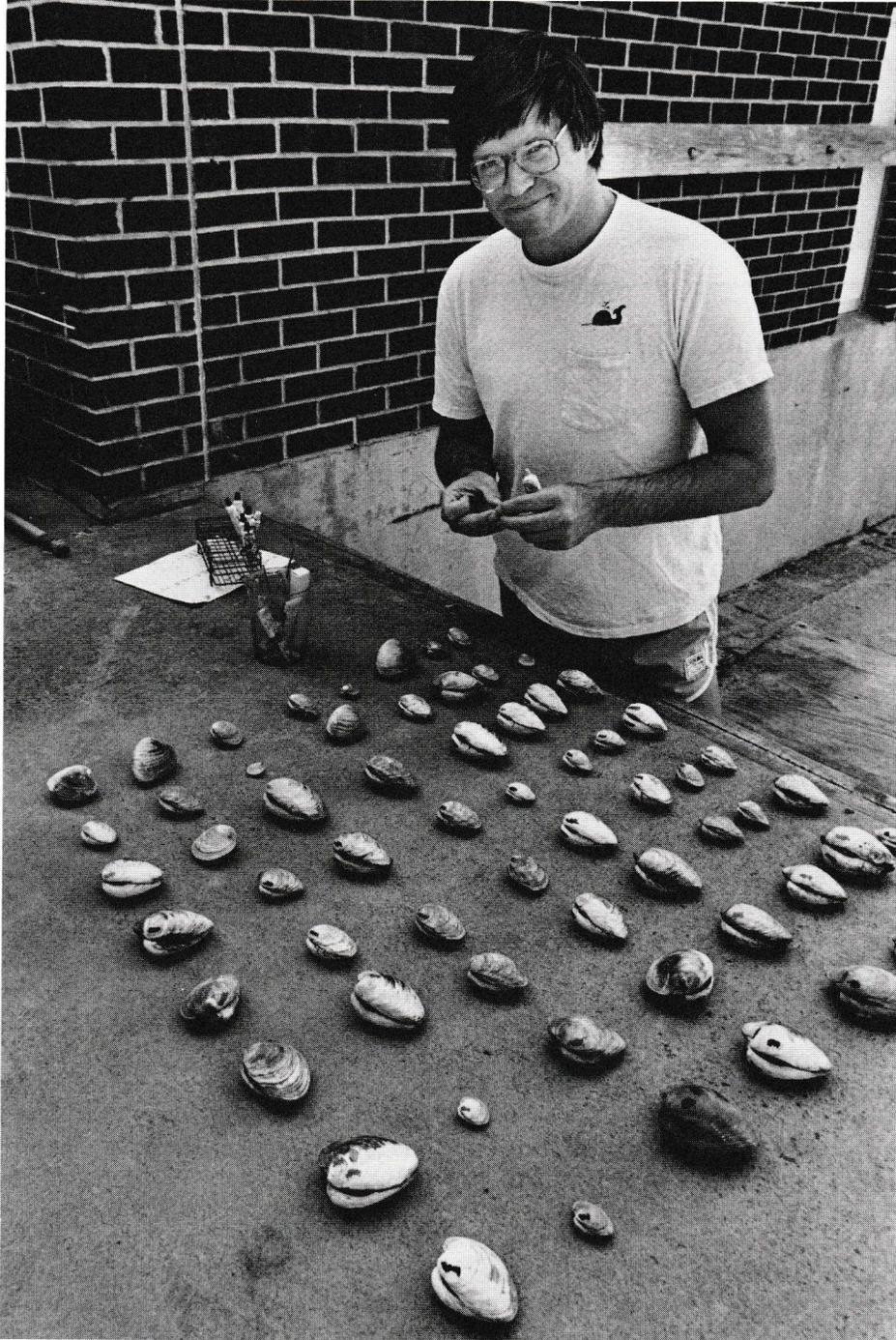
But Munden says the restrictions are needed to ensure that hand clammers, kickers and dredgers—have fair access to clam resources.

As clams become limited, the scramble for these valuable bivalves becomes more frantic. Hand clammers and mechanical harvesters want a chance to dig up this mollusk that means money.

Kicking Up More Than Clams

Studying the effects of clam kicking on seagrass

By Allen Weiss



Peterson paints clams for later identification in the laboratory

BY KATHY HART

The results can be deciphered from graphs in a scientific paper. But the real proof is a grass bed in Back Sound. Either way, the conclusion is the same: clam kicking is harmful to seagrass beds. And anything that adversely affects seagrass spells trouble, unproductive trouble.

As part of a large Sea Grant project to study the biology of the hard clam and the effects of its harvesting methods, researcher Charles "Pete" Peterson sectioned off plots of seagrass in Back Sound to test the effects of clam kicking. Some of the plots were left untouched and used as controls to measure against the effects of raking, light kicking and intense kicking in other plots.

In the raking and light kicking plots, seagrass biomass dropped approximately 25 percent immediately after harvest. But within a year's time, these beds completely recovered.

In the intensely kicked plots, seagrass biomass fell by about 65 percent immediately after harvest. The beds did not begin to recover for two years. And four years later, the intensely kicked plots still had 35 percent less seagrass than the control plots.

Why the concern for a bed of submerged grass? Peterson explains: "Seagrass stimulates productivity. It's part of the detrital food chain. The grasses also function as habitat for small invertebrates and other creatures. It provides a surface for the attachment of young scallops, and juvenile clam settlement is higher in grass beds. It also affects shrimp production."

The bottom line? Seagrass is an important part of the estuarine ecosystem. It provides food, directly or indirectly, refuge and habitat for the small-

est marine microorganism to the largest fish. More directly stated: Seagrass abundance can affect how many shrimp, scallops and clams the consumer can heap on his plate. Even for the clam that is being harvested, seagrass is important to the productivity of the population.

When it comes to refuge, grass beds offer added protection. Peterson learned that the whelk, one of the clam's life-long predators, can decimate a clam population within five warm-water months along sandy estuarine bottoms. But among blades of seagrass, the hard clam can more easily hide from its footed foe.

In some cases, seagrass also may help the clam in its procurement of meals. Many biologists have long believed that growth rates were higher in areas where strong currents delivered more food. But Peterson found that the reduced current flow caused by the presence of grass beds can deliver more food, in some cases, to the clam's sediment level and increase the bivalve's growth.

To test the theory that seagrass cover affected the abundance of other species, Peterson examined populations of bay scallops. He found that bay scallop density dropped as seagrass de-

clined as a result of clam kicking. But the intensely kicked plots contained even fewer scallops than expected. Peterson suspects the greater decline is caused by the patchy grass cover left after kicking. If the remaining cover were evenly distributed, scallop densities would be higher, he speculates.

At N.C. State University, Sea Grant researcher Jim Easley took an economic approach to the question of clam kicking's effects on bay scallops in grass beds. Using a computer model, Easley fed in a variety of economic, biological and fishery information. When the results were computed, Easley found that clam kicking and raking had significant negative effects on the number of scallops available for harvest in grass beds.

Does clam kicking, in a seagrass bed or out, increase next year's crop of baby clams? This was a commonly held belief among Carteret County clam kickers. They thought that clearing the estuarine bottom of larger clams made more room for baby clams. Peterson tested the notion.

He learned that the removal of adult hard clams by kicking did not enhance the recruitment of baby clams. In fact, in intensely kicked sand plots recruitment was 50 percent lower than in the

control plots. In intensely kicked seagrass beds, recruitment fell by 15 percent. Peterson attributes the decline to the disturbance of sediment caused by the kicking. "Environmental damage caused to seagrass beds and to dependent fisheries production is not balanced, even in part, by any increase in local hard clam recruitment or by any other obvious benefit," he says.

The N.C. Division of Marine Fisheries had suspected the beds' importance and the adverse effects of kicking; consequently they closed the beds to mechanical harvest in 1978. "My results added biological teeth to a policy that DMF had already been following," Peterson says. "Now they can say to the fisherman who wants a grass bed open to harvest, we have scientific proof that kicking harms the beds and beds have advantageous impacts on clams and other fisheries, especially shrimp and bay scallops."

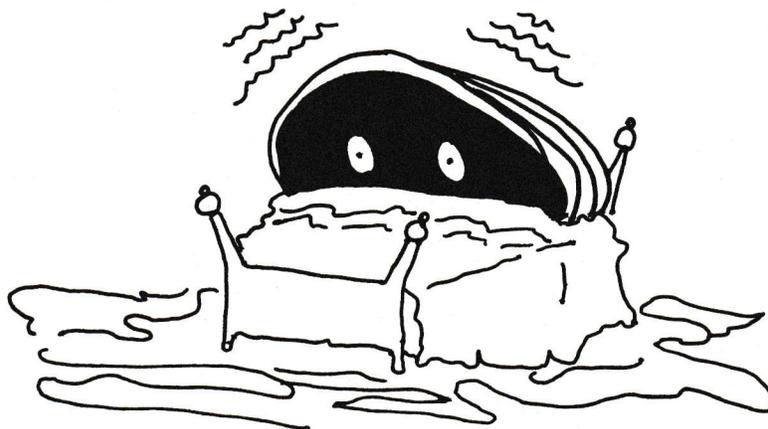
But what of the clams nestled in these grassy beds? Are they a resource lost to the fisherman? No. Many of these clams can still be harvested by use of rakes. But more importantly, Peterson believes these protected mollusks, if left unharvested, can parent the thousands of clams needed to repopulate harvestable area tomorrow.

Aging clams still active in bed

A rumor circulating among coastal fishermen had hard clams hiding shamefully in their beds. According to the rumor, hard clams became, how should we say, sexually inactive, or more delicately stated, reproductively senile, as they became older and bigger. No wonder these soft-bodied mollusks had withdrawn into their shells.

Already large clams had been labeled as tough, fit only for a pot of clam chowder. But as the rumor of their inabilities spread, fishermen lost even more respect for the larger mollusks. Clammers complained that the chowders occupied valuable bed space that would be better used by a younger, more productive set.

But Sea Grant researcher Charles "Pete" Peterson made a discovery that will gain the chowder clam new respect. He



learned that older, larger hard clams aren't reproductively senile at all. In fact, the number of gametes, or reproductive cells, a clam produces is directly proportional to its size.

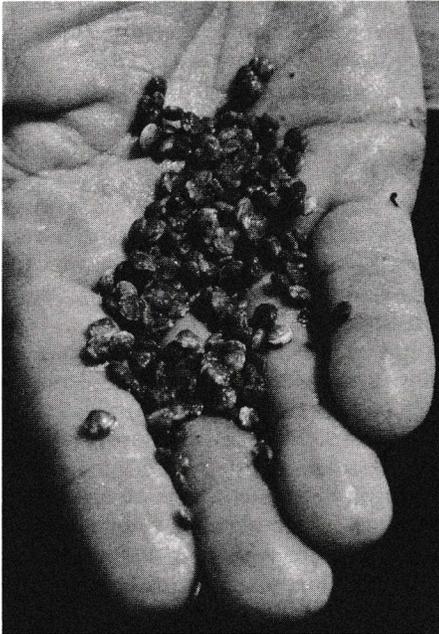
In Johnson Creek in Core Sound, Peterson dug out one large clam that turned out to be 46 years old. "It was the oldest *mercenaria* ever recorded, and it had gam-

etes to beat the band," Peterson says.

"This is important information because if we argue that undamaged seagrass beds play a significant role as natural predation refuges for a breeding stock of older adult clams, it is critical to show that they do continue to reproduce with age," he says. "Not only does the hard clam continue to produce gametes as it ages, but also the number of gametes produced increases dramatically with size and age."

PLANTING CLAMS

By Gef Flimlin



Baby clams

BY NANCY DAVIS

A juvenile clam lays nestled in its bed among the roots of seagrass in Back Sound. But danger lurks nearby. A blue crab makes its way toward the young clam. Helpless to move, the clam finds itself in the crab's strong claws. The crab picks up the clam, handles it for a moment, and then, using its claws, begins to chip away at the clam's shell. Within minutes, the crab pops the meat of the baby clam into its mouth.

The crab continues to forage in the clam bed, attempting to satiate his appetite. Just one clam won't be enough. In a short while, the crab leaves a path of destruction.

Nature is not kind to young clams. The mortality rate among three-millimeter seed clams is about 95 percent, says Sea Grant researcher Charles "Pete" Peterson. Although the blue

crab is a major predator, it is not alone in its appetite for clams; mud crabs, stone crabs, shrimp and snapping shrimp, bottom-feeding fish, moon snails and whelks also take their toll. Such high mortality rates are common among species in the natural environment, but they pose problems for clam culturists.

Clam gardening is a form of aquaculture in which seed clams are purchased from a hatchery, then placed on estuarine bottom leased from the state. The clams are protected until they reach a marketable size.

Peterson says, "The only remaining unsolved problem in the technology of 'clam gardening' . . . is predator prevention."

In 1983 and 1984, Peterson approached the clam mortality problem from several angles. He wanted to know at what size a clam becomes invulnerable to predators, and if clam gardening could be made economically viable through manipulation of seed clam size, season of planting and the use of anti-predation structures.

Peterson began by bringing his subjects into the laboratory. He served various sizes of clams to crabs to find out at what size the clams become invulnerable. He found that crabs easily make a light meal of small clams, crushing the shells with their claws. When offered a larger clam, the crabs simply chipped away at the edges of its shell until they reached the meat. Although the crustaceans will handle a large clam, they may eventually reject it in favor of a more manageable meal.

In a previous study, Peterson found that a clam's environment determines its rate of growth; the mollusks grow faster in some areas than in others. For example, growth rates for clams at sites in the North River and Newport River were three times higher than at sites in Bogue Sound.

In turn, growth rates affect the rate of predation. In areas with slow

growth rates, it takes longer for clams to become less susceptible to their natural enemies.

Peterson measured growth rates for clams in 10 sites. Then he gathered data on clam mortality in those locations, and tested some theories.

Peterson knew that for a period during the winter, hard crabs remained relatively inactive. At the same time, unlike clams growing in northern waters, the mollusks continue to grow here during colder months. Peterson hypothesized that seed clams planted in the winter would grow large enough by spring to be relatively invulnerable to crab predation.

At his test sites, Peterson planted three sizes of seed clams and grew them through the winter, with little loss to predation. The next step will be a cost analysis. Since price varies for the different sizes, Sea Grant economist Jim Easley will weigh those costs against the rate of survivorship. Culturists need to know which size seed clam will give them the best return for their money.

Peterson tested another theory: could caging out predators improve hard clam recruitment enough to render it an economically viable alternative to clam hatcheries? To find out, he erected exclosures in a variety of habitats. In particular, he tested a light mesh webbing designed to exclude predators from clam beds. The webbing proved effective, but before Peterson recommends its use, he wants Easley to evaluate its cost effectiveness.

In another Sea Grant project, marine advisory agents Gary Van Housen, Bob Hines and Randy Rouse and fishermen Gary Culpepper and Mark Hooper are testing the possibility of using crab shedding tanks during the off-season for holding seed clams. Fishermen could buy the smaller, less expensive clams and hold them until they reach a sufficient size for planting.

THE BACK PAGE

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



In early April, uncontrollable blazes roared through eastern North Carolina destroying thousands of acres of forestland. High winds, warm temperatures, low humidity and dry soils combined to create one of the worst fire seasons in 50 years. The Pungo fire, which was the largest, burned more than 96,000 acres in Hyde, Tyrrell and Washington counties. Its flames devastated the forest's flora and destroyed much of the fauna.

"Generally speaking, fires are beneficial to a lot of species of animals and plant growth, but this fire covered such a large area that the majority of game in the center of the fire was killed," says Carl Betsill, small game and migratory bird program coordinator for the N.C. Wildlife Resources Commission. Betsill saw the largest impact on animals the size of raccoons and smaller that could not escape the flames. Unless they were near the fringe of the forest, most of these animals were killed. Heat and smoke from burning peat killed even the burrowing animals.

Deer populations suffered also, says Scott Osborne, deer project leader for the commission. About 20 percent of the deer in that area died, with another 20 percent injured by the fire.

The loss of animals is very brief, however, says Osborne. Since the fires, habitats have recovered quickly. One of the first things to come back, he says, is bracket fern, followed by shrubs and aquatic vegetation. "This is

better for the animals," says Osborne. Nutrients from the fire enrich the soil and create fertile feeding grounds and good cover.



During the winter, North Carolina's coastal marshes and sounds provide an ample supply of food for migrating birds such as ducks, geese, gulls and willets. But other birds call the Carolina coast home, too. Many of the same birds that inhabit other areas of the state, also frequent coastal backyards. For those birds, finding food is not always as easy as a stop at the nearest marsh.

Should you help these feathered friends in their search for food? James Parnell, an ornithologist at the University of North Carolina at Wilmington, says bird food can provide a helpful supplement when other food is hard to find. Parnell cautions that consistency is important. "Don't begin feeding them in the fall and then halfway through the winter quit, because those birds will have become dependent on you. But as long as you maintain the feeding program through the winter, then it probably is very helpful," says Parnell.

Parnell advises feeding the birds a commercial mix, usually a combination of sunflower seeds, cracked corn and millet. You can alter the mix as you learn more about the birds' preferences, says Parnell.



Take a look at North Carolina's coast from a new perspective—from the legal side. Beginning this fall, Sea Grant will offer a free, quarterly newsletter addressing coastal legal issues such as water use rights, development and offshore oil leasing. Edited by Walter Clark, Sea Grant's coastal law specialist, *Legal Tides* will tackle pertinent coastal legal questions as they arise.

It will emphasize a whole spectrum

of jurisdictions, says Clark, from the oceans to the coast to the rivers and sounds. "Within each of those is a multitude of problems that can affect North Carolina," says Clark. International, national, state and local issues can have an impact on our resources. "For example," he says, "an issue that falls under state jurisdiction right now is settling ownership claims regarding submerged lands under state waters."

Clark, attorneys and others involved in the questions concerning North Carolina's coast will write the articles for the newsletter. To receive *Legal Tides*, send your name and address to Walter Clark, UNC Sea Grant, Box 8605, N.C. State University, Raleigh, N.C. 27695-8605.

UNC Sea Grant has recently published the preliminary results of a three-pronged multidisciplinary research effort aimed at studying the effects of freshwater drainage on estuaries. Much of eastern North Carolina's fertile lowland must be drained to be farmed. The freshwater drainage from these fields often is funneled into the estuary, sometimes into primary nursery areas.

The report, *Water Management and Estuarine Nurseries*, details the work of Wayne Skaggs and Wendell Gilliam on land use alterations and runoff, Leonard Pietrafesa's research on the response of estuarine circulation patterns to freshwater runoff, and John Miller's findings on the response of juvenile fish and shellfish to freshwater input.

For a copy of this free report, write Sea Grant. Ask for publication UNC-SG-WP-85-2.

In a recent study of North Carolina schools, it was found that a low proportion of high school blacks and women were enrolled in college preparatory mathematics and science courses. Consequently, fewer blacks and women enter these fields of study in college.

Continued on next page

The Consortium for Minorities and Women in Mathematics and Science recommended that funds be provided to the University of North Carolina Mathematics and Science Education Network for a pilot program designed to increase the participation of blacks and women in these classrooms.

UNC Sea Grant will provide \$5,000 toward the pilot program, which will initially involve a coordinator who will work to obtain government, corporate and foundation funds to further the program. Once support for the project is obtained, the program will begin its work with minorities and women in grades 6 to 9 to increase their interest and skills in science and mathematics.

UNC Sea Grant Director B.J. Copeland has been selected to serve on the advisory council of the National Coastal Resources Research and Development Institute in Oregon. The mission of the institute is to "initiate, develop and support research, education and demonstration projects that promote economic development and diversified use of the nation's marine and

coastal resources, consistent with maintenance of environmental integrity and with due regard for social responsibility and consequences."

Copeland was one of 12 candidates chosen for the council because of his expertise in the field of coastal and marine resources.



The face of the coast is changing. Increased development has spurred the need for better planning and controlled growth in the coastal areas of North Carolina.

To help address this issue, Simon Baker, a professor in the Department of Geography and Planning at East Carolina University in Greenville, has written *A Land Use and Land Cover Classification of the North Carolina Barrier Islands: Level III*.

This new publication offers a detailed classification system for mapping land use and land cover on the barrier islands, expanding the two-level system previously adopted by the U.S. Geological Survey. Seven

additional categories of land use and land cover are described in the text and illustrated with more than 100 aerial and ground photographs. Coastal managers, planners, business owners and government officials can use this information to make quick and positive classification decisions and as benchmark data against which future changes can be measured. It is compatible with the national classification and mapping system of land use and land cover.

For a copy of Baker's book, write Sea Grant. Ask for UNC-SG-85-03. Cost is \$3.50.

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