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Slipping Away: Erosion on the Estuarine Coast

Robert Leigh got a good buy on his shore front home. At least he thought it was a good buy until he discovered his 75 by 125 foot lot was slipping into Albemarle Sound.

"I've probably lost 30 feet in the last eight years," Leigh said. "What am I doing about it? Well, a man came the other day and estimated it would take $3,000 to protect my property. I can't afford it."

So Leigh is dumping leaves and dirt and old logs in front of his home and hoping he can sell it before the next northeaster hits.

"I'm moving to the other side of the county," he said. "I like the water and all but I can't keep dumping money into this."

Next door, Leigh's father-in-law Marvin Waterfield is also fighting loss of his land. He has lost at least 60 feet in the last 12 years—and that in an area where a lot 75 feet wide by 150 feet deep sells for $10,000.

Farther north, John Stallings, farm manager for Avoca Farms in Merry Hill, is facing a similar problem. And he's almost convinced he can't stop the erosion of the farm's two and a half miles of high shoreline.

(See "Sad Tales," page 6)

Rising sea level, sinking land, low topography

The figures are startling.

For the past 18,000 years, erosion has been claiming parts of the North Carolina estuarine shore. An average of two to three feet is lost each year, with storms swiping up to 20 feet at a time: the U.S. Soil Conservation Service estimates that more than 60 million tons of earth have been eroded in the past 30 years.

"Basically, the entire North Carolina shoreline is eroding," according to East Carolina University (ECU) geologist Stan Riggs. "A few places are accreting, but that's ephemeral and local. The long-term process taking place is one of erosion.

"The reason is simple. We have a rising sea level—about one foot per century. Plus we have a good share of North Carolina—the northeast—which is sinking. A third factor which is very critical is that there is very low topography on most of North Carolina's eastern estuarine shore. This means that a very slight rise in sea level makes a very great change in elevation. With land that's only two feet above sea level, in 200 years you can see a tremendous effect."

Before North Carolina's mainland shores were considered prime property, no one worried much about erosion. The loss of land was accepted as "nature's way." But now with vacationers clamoring and paying top prices for second-home sites with water frontage, the estuarine shoreline is more valuable. So when "nature takes its course" and causes a little of the precious soil to sink below water level, there is quite an economic impact.

Riggs, ECU geologist Michael O'Connor and ECU biologist Vince Bellis have been looking at estuarine erosion, with the help of Sea Grant funds, for the past two years. They have tracked over 1,400 miles of the coast on their hardy vessel, "Sweet Agona," a 37 foot Chesapeake Bay oyster boat named after the Indian maiden of "questionable looks" who fell in love with Beggar Tom of the Lost Colony, much to his agony.

Riggs, Bellis and O'Connor have suffered similar hardship in their quest to understand the processes at work along the estuarine shores. They've battled copperheads and uncooperative boat engines, braved mats of marsh and swayed through many

Old cars, hunks of concrete and even a kitchen sink have been used—often futilely—to slow estuarine erosion. A scene on the Neuse.

: Recipe for erosion

a storm as they explored every crevice of the coast and mapped its features foot-by-foot.

The three Sea Grant researchers have learned a lot about how the coast protects itself from erosion, what people can do to help the coast protect itself and why certain areas are more vulnerable or resistant than others. By the time the three are through next year, they hope to be able to tell local officials and landowners in detail exactly what is happening on the coast and why. An erosion intensity scale—sort of a layman's guide to reading the shore—is being developed to help people on the coast predict the erosion of specific areas and plan for the future. Riggs, Bellis and O'Connor hope to be able to impart enough knowledge about erosion to let coastal residents work with an understanding of the shores.

Different rates for different banks

Riggs, O'Connor and Bellis have already discovered that different shorelines experience different rates of erosion and they have identified some major shoreline types. The sand and clay banks include low banks of one to five feet which are moderately to highly susceptible to erosion but can be protected fairly easily. High banks of five to 20 feet may be extremely erosion-resistant if they're made of tight clay or iron-cemented sand. If they're not, the high banks are subject to the same sort of erosion as low banks. Bluffs rise higher than 20 feet and erode somewhat more slowly. They lose more material per foot, though, and are very difficult to protect.

Swamp forests have negligible erosion and sediment berms are actually accreting. The area between swamp forests and low banks erodes less than the low banks but more than the forest. The grass marshes with their soggy peats are the most erodable but they protect the sandy soils behind them.

Erosion of these shores is affected by numerous other factors, which the researchers are still trying to unravel. So far, they've found that height, soil composition, water depth and offshore topography in front of the shore and the direction it faces all influence erosion. The type and density of vegetation on and in front of the bank, the breadth of the bank and the size of the body of water the bank faces also affect the rate. Man's activities can inhibit or encourage erosion.

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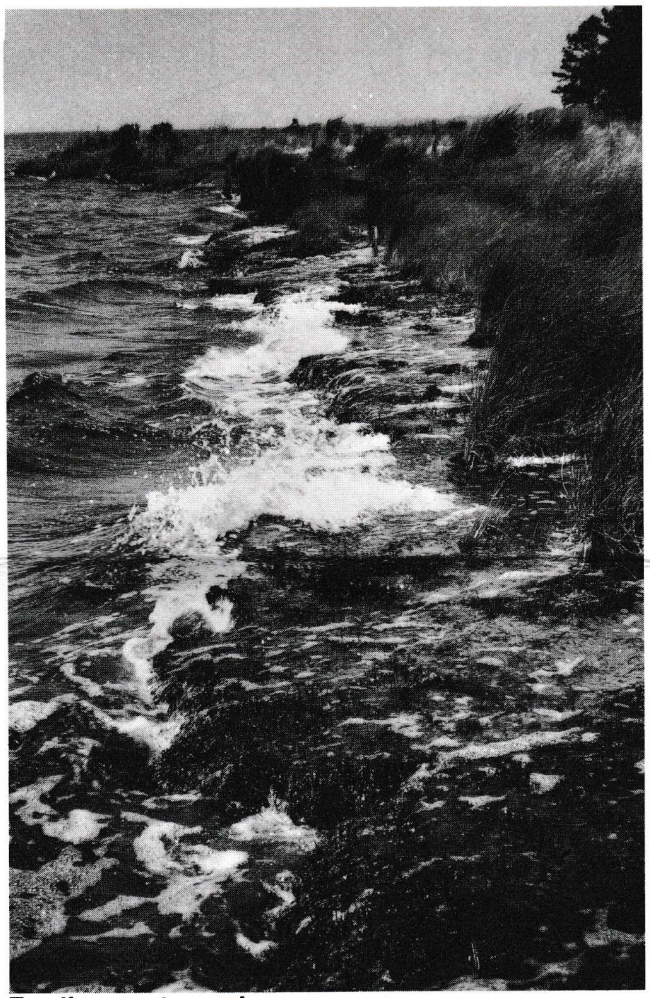


Eroding peat marsh

The options

"There's no way to stop this process, but you can slow it way down, so it's almost negligible to the landowner," ECU geologist Stan Riggs said. "One thing we're learning is that there is a whole series of different natural mechanisms which naturally slow erosion. Cypress, for example, can naturally produce a buffer against waves and catch sediment.

"One of the big problems is that most people who develop second homes are interested in clear views and a big swimming beach. So the first thing they do is cut down the cypress that block the view and clean up the grasses so they can have a sandy beach. Both the cypress and the grasses are natural protections. So pretty soon, the property is receding at a major rate, which is a major economic loss. So the people have to build a bulkhead, which is a major investment and which, had they understood the system, wouldn't have been necessary."

Another common mistake, according to the three researchers, is to clear the debris in front of an

(See "The Real Solution," page 4)

The real solution . . .

(Cont. from page 3)

eroding shoreline. The "trash" of fallen trees and branches breaks the waves and acts as a natural groin catching the sediment that erodes from the bank. It should be left, at least until some other type of bulkheading is made.

"Clean it up and you're costing yourself several feet of shoreline erosion," O'Connor said.

The shoals that often form in front of an eroding shore should also be left because they, too, slow erosion.

Sea Grant researchers are now looking at ways to copy the coast's natural protections. But the most common reaction to erosion—besides despair—is still to build a bulkhead. Between May 1975 and June 1976, requests for permits were made to build more than seven miles of bulkheading along North Carolina's estuarine shore—an investment conservatively estimated at at least three-quarters of a million dollars.

O'Connor, Bellis and Riggs have found that where built well and with an understanding of the process of erosion, bulkheading, sea walls, groins and other man-made erosion barriers are effective, especially on low-bank shorelines. They have also found, however, that bulkheads should be placed as planned units because the coast erodes in distinct geographic sections. Coves between resistant clay bluffs, for example, will erode together and should be treated as one shoreline. Otherwise, protection for just one part of the shore will only ensure greater erosion next door.

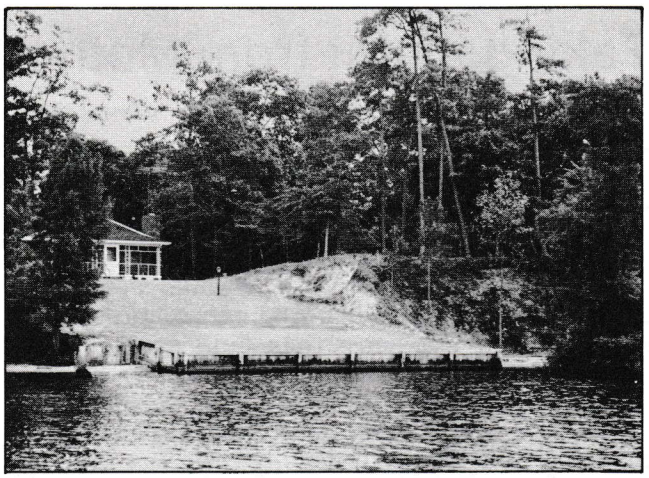
Advantages and disadvantages

Slowing erosion may make some landowners happy, but it also has its disadvantages. It may mean the loss of sandy beaches. Erosion provides the sand that makes the beaches in the estuaries, Riggs explained. Slow erosion and you risk cutting off the replenishing sand supply.

"Everyone wants a beach, but there's not a lot of sand in the estuaries. So at some point you can do yourself in."

Slowing erosion may also hurt the seafood industry since erosion of the peats in the marshes is probably an important means of recycling carbon and nutrients for the salt marshes. If you slow erosion too much, you risk cutting the productivity of the salt marshes which feed many of the commercially important seafoods which, in turn, feed the fishermen of the coast.

One answer to erosion problems is to "let 'er rip" and move development out of the way. Many counties are now trying to figure out "setback lines" beyond which it would be illegal to build. The problem with setbacks, according to O'Connor and Riggs, is that it is very difficult to choose the line since different areas of the coast erode at different rates. They hope their final information will reveal where setbacks could be set since their data should show where development could occur most safely.



A common error: clearing a stable shoreline and making it vulnerable.

Still another suggestion is to make the natural erosion barriers—cypress headlands and fringe, resistant clay bluffs, swamp forest, peat marshland—areas of environmental concern under the Coastal Area Management Act. This would mean any development there would have to meet state guidelines.

"We're not taking any stands on whether to bulkhead or to let nature take its course," O'Connor said. "But we can show what is likely to happen in an area and assign success probabilities to different modifications. And we can provide an education for people which can allow them to make the right decisions. I've always maintained that people who are informed tend to make the right decisions."

Losing ground

Taking a hint from Mother

You shouldn't try to fool mother nature, but sometimes it pays to steal from her.

Sea Grant researchers Steve Broome, Ernie Seneca and Vince Bellis are taking nature's ideas for protecting the estuarine shores and experimenting with planting grasses and trees. They figured if it worked naturally, it would work with a little help from man, too. And natural protection would be less expensive than bulkheading, they reasoned.

"We've 'proved' it works, at least we've proved it works in some places," said NCSU soil scientist Broome. "And we say it usually costs less than $1 a linear foot." Broome and Seneca have been planting marsh grass on eroding estuarine shores for the past two years. They have 11 test sites, some of which have been successful and some of which haven't.

Leroy Voris, is a Pine Knoll Shores resident who lives in back of an experimental *Spartina alterniflora* and *Spartina patens* patch facing Bogue Sound. The plot is working and Voris is extremely satisfied with the venture.

"It's been very gratifying. We were having some erosion, but we didn't want to bulkhead. We prefer the natural shoreline, as long as it doesn't wash away. The grass seems to be doing fine and we enjoy the big white herons that come in. There have been a lot more birds since the grass was planted."

Seneca and Broome also planted grasses near Uncle Henry's Oyster Bar at Masonboro Sound. The Army Corps of Engineers was having erosion problems in the intercoastal waterway there and wanted to try grass planting. So far, it seems to work.

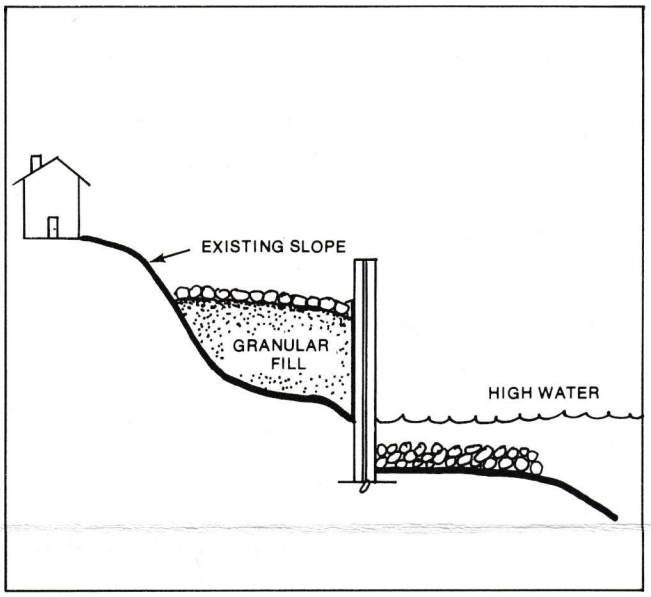
Doubly good

"By using a natural substance such as *Spartina* you accomplish two things at once," said David Frankensteen, a fishery biologist with the Corps. "*Spartina* is one of the most productive systems in the world in terms of energy and biomass and it provides detritus for all the little estuarine organisms which eventually go into the commercial fish species. So we're contributing to the detrital food chain as well as preventing erosion."

Seneca and Broome intend this year to find out what exact conditions are needed for *Spartina* plantings to successfully slow erosion.

Meanwhile, ECU biologist Vince Bellis is experimenting with using cypress and tupelo trees as natural erosion barriers. He has planted trees in the laboratory, in the swamps and on the beach. He has also planted on the beach behind inexpensive bulkheads to give the trees time to flourish. The lab plantings are booming, the swamp trees have all died and success varied on the beach.

Research is continuing.



A typical bulkhead

Bulkhead booboos

Bad bulkheads are easy to spot.

The purpose of a bulkhead is to hold soil to the shore. When bulkheads fail, it's obvious: the soil slips into the water and the bulkhead eventually follows.

Bulkheads generally fail by water eroding behind the wall either from the sides or the bottom. If the bulkhead isn't protected or placed deeply enough, water will dig under the wall and make it fall. Water in the soil behind bulkheads must be able to drain or the weight may push the bulkhead over. If the draining water isn't filtered, the soil will escape with the water leaving the bulkhead without any back support.

Bulkheads also fail when inadequate side walls allow water to cut behind and steal the back supporting soil. Inadequate tiebacks, or anchoring systems, can also make a bulkhead give. And if the wall material is too flimsy it can simply be broken by the waves.

So how do you do it right?

"You can't give a canned design that will work everywhere. A bulkhead is an engineering problem that needs to have an engineered design that is site specific," according to Jay Langfelder, engineer and director of the NCSU Center for Marine and Coastal Studies.

Building a bulkhead is expensive—costs range from $20 to $200 a linear foot—and many people cannot afford to add an engineer's fee to a small bulkheading project. Langfelder urges anyone building a bulkhead to choose a contractor with care. Walk around and see a few bulkheads he or she has built before.

(See "Bulkhead," page 6)

Bulkhead lore . . . helpful clues and an address for more

(Cont. from page 5)

It's also useful to know a "few things to think about" that can apply to any bulkhead project. The first thing to consider is what forces will be working on the bulkhead. How deep should the pilings be driven, what type and size pilings do you need? Do you need to add wing walls to avoid side erosion and how far back do they have to go? How strong must the wall sheets be? Do you need tiebacks? How many and how deeply should they be buried?

What materials will work best? Make sure you use corrosion-resistant hardware such as wrought iron and galvanized steel and be sure all wood is treated for use in the water.

And, again, always make sure a filter medium is behind the walls. Filter cloth keeps the soil behind the bulkhead while allowing water to pass through. Be sure there are no cracks in the wall. Always be sure that heavy equipment is kept off the wall.

Understand what is happening to your shoreline before you begin work. Many homeowners overbuild their bulkheads while others seriously underbuild. And remember that portions of the coast are acting as units. Try to work with your neighbors or local government to get comprehensive shore erosion action.

For more hints on bulkheading write for "Help Yourself, a discussion of the critical erosion problems on the Great Lakes," available from the U.S. Army Corps of Engineers, 536 South Clark Street, Chicago, Illinois 60605.

Closer to home, Sea Grant has appropriated money for a coastal engineer to start work after the first of the year. We'll let you know when he or she is here and ready for questions.

Sad tales of erosion

(Cont. from page 1)

Stallings has tried planting exotic cypress and grasses and building jetties and still the shoreline recedes, dropping tons of soil into the sound.

"Nobody knows what we could do," he said. "A bulkhead would probably work but the cost would be prohibitive. You're talking about more than the farm would sell for."

The stories could go on for pages. There's the Lane farm in Perquimans County which has one of the highest rates of estuarine erosion in the state: it's lost 150 acres since 1950. Elsewhere, there's the old house pump sitting in the middle of the sound where a house once also sat. There's Batts Island which in 1749 had 40 acres covered with orchards and houses and is now reduced to a shallow shoal and a lonely cypress snag.

"Estuarine erosion is quite a problem," said Thomas Harrell, of the Chowan County Soil Conservation Service office. "It's a problem and if someone comes up with an answer for it, we'd like to know about it."

Come one, come all

Three free workshops on an "Introduction to Aerial Photoghaphic Interpretation and Remote Sensing" will be held from 9 a.m. to 4:30 p.m. on:

- Dec. 7 and 8—Marine Resources Center near Manteo
- Dec. 16 and 17—Marine Resources Center, Pine Knoll Shores
- Dec. 21 and 22—Marine Resources Center, Fort Fisher

For more information call Simon Baker at 919-737-2578.

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