North Carolina Coastal Federation

The Risks of Renourishment:

How pumping sand on North Carolina's beaches can affect Sea Turtles, Mole Crabs and other Critters

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Who We Are

The North Carolina Coastal Federation (NCCF) is the state's largest non-profit organization working to restore and protect the coast. NCCF headquarters are at 3609 Highway 24 in Ocean between Morehead City and Swansboro and are open Monday through Friday. The headquarters houses NCCF's main offices, a nature shop, library, and information area. NCCF also operates a field office at 3806-B Park Avenue in Wilmington. For more information call 252-393-8185 or visit our website at www.nccoast.org.

This report was written by Ted Wilgis, the Federation's Cape Fear Coastkeeper, and edited by Frank Tursi, the Cape Lookout Coastkeeper, and Jim Stephenson, Program Analyst. All are closely monitoring beach renourishment projects in North Carolina during the time covered in this report. Wilgis and Tursi also took all of the photographs.

Cover Photo

Bulldozers work the new sand being pumped onto the beach at Fort Macon State Park in Carteret County.

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How Pumping Sand on North Carolina's Beaches Can Affect Sea Turtles, Mole Crabs and other Critters

Executive Summary

Though the evidence is still coming in, many scientists, government officials, fishermen and environmentalists are beginning to worry about the cumulative effects that widespread beach renourishment may have on a wide variety of animals that use the beaches for food, nesting and habitat.

Projects along the NC coast within the last year showed that beach renourishment could be very hazardous to the survival of endangered or threatened sea turtles, for instance. Four were sucked up by a dredge and killed in one day during a project in Carteret County. Another turtle was killed by a dredge in New Hanover County.

Pumping sand onto the beaches during the turtle-nesting season also can be precarious for turtles. Some abandoned efforts to nest last year after hitting pipes on the beach. Sand that contained too much rocks and shells deterred others, the data showed. A beach in Brunswick County purportedly renourished to create nesting habitat for turtles is now dotted with steep cliffs at the water's edge that turtles may have a tough time climbing over and is littered with chunks of marl that could hinder a nesting turtle.

Only time will tell if the renourished beach will be good turtle habitat.
The type of material being pumped onto the beach also became an issue during a renourishment project in Carteret County after scientists warned that portions of the new beach contained so much shell that turtles couldn't nest in it and the invertebrates that comprise the basis of the food chain couldn't live in it. That project highlighted the need for including specific requirements in state and federal permits about the type of sand that should be used in renourishment projects.

Such issues will only become more important if beach renourishment becomes a common strategy to combat erosion in North Carolina. Sand could be pumped onto more than 122 miles of state's oceanfront in the next 12 years, a four-fold increase in the miles of beach now being maintained. Such large-scale manipulation could pose serious consequences for the clams, crabs and other organisms that so many fish rely on for food, for nesting sea turtles and birds that depend on the state's beaches to survive, and for the public that uses the beaches to fish, swim and build sand castles.

Recommendations

The NC Coastal Federation generally doesn't oppose beach renourishment if it is part of a multi-faceted strategy to deal with oceanfront erosion and is properly planned, done in environmentally and fiscally sound ways and assures public access to the beach. A fuller explanation of the Federation's policy can be found on our website at:

www.nccoast.org/SOC2001/BeachRenourishment.htm

The beach renourishment projects done in North Carolina in 2001 and 2002, though, point to severe weaknesses in the state's permitting requirements. The NC Division of Coastal Management, which has a mandate to protect the natural resources of the state's public beaches, and the project's sponsors should insist that beach-renourishment permits:

- Require that construction periods begin Dec.1 and end March 31. Construction activities can kill wildlife, prevent them from foraging or deter them from nesting. Beach invertebrates, such as mole crabs and coquina clam, migrate to deeper water in November from where they can return to a renourished beach once the project is completed. These organisms are smothered by new sand if the project begins before their migration. Also during November, there is significant fish activity feeding on bottom invertebrates at the dredge sites. April is the peak of invertebrate recruitment and shorebird migration and an important period for larval recruitment. Sea turtle nesting starts on May 1 and ends on Nov. 15.

- Require that hopper dredging stop when waters rise above 58 degrees to avoid killing sea turtles.

- Require that sand used in each project closely match the natural sand in grain size, color and shell and silt content. The current state requirement that renourished sand be "compatible" with existing sand is too vague to afford adequate protection to natural resources. North Carolina should adopt sand compatibility standards similar to ones in Florida that protect turtle nesting habitat.

- Result in project sponsors monitoring biological activity on the section of beach proposed for renourishment at least one year in each of four seasons before the project and two years after renourishment. The monitoring should include at a minimum population counts of shorebirds, fish and invertebrates on the beach and at the borrow zones. Monitoring of sea turtle nesting activity should occur for a minimum of six years after a renourishment project.

- Make clear that projects are not exempt from water quality standards for turbidity and fecal coliform bacteria. Existing regulations prohibit permits from being issued if it is known up-front that projects will violate these standards. If planned measures to prevent violations do not work, appropriate enforcement is needed.

Bulldozers push sand to make dunes at Holden Beach.

Background

Sand, shells, rocks, and silt were dredged and pumped on more than 36 miles of beaches in North Carolina in 2001 and early 2002. The sand came primarily from offshore mining or the dredging of inlets, harbors or the Intracoastal Waterway. Increasingly, though, upland sources of sand are being used.

The US Army Corps of Engineers now has long-term projects at Wrightsville Beach, Carolina Beach, Kure Beach and new this past year, Ocean Isle Beach. The beaches are renourished every three to five years for 50 years. There are another dozen or so beach towns in the feasibility or design stage for the federal program. Those projects combined with others planned by private property owners and the state could mean that more than 122 miles of beaches would be renourished in the next 12 years. That comprises almost two-fifths of North Carolina's 320-mile ocean coastline.

During 2001 and 2002, portions of nearly every developed beach in Brunswick and New Hanover Counties were or will be replenished with dredge spoils.

This includes: about four miles on Figure 8 Island, almost three miles of Wrightsville Beach and Masonboro Island, about one mile of Carolina Beach, about three miles of Kure Beach, about three miles of Bald Head Island, 12 miles of Caswell Beach/Oak Island, five miles of Holden Beach, and three miles of Ocean Isle Beach.

Sources of sand include: Shallotte, Carolina, Mason, Masonboro and Rich's inlets; the Wilmington Harbor Deepening Project; and some upland sources.

About seven miles of beaches on Bogue Banks in Carteret County were also renourished in 2002 with dredge spoils taken offshore.

Sea Turtles

Endangered and threatened sea turtles could be particularly at risk during and after beach renourishment projects. The loggerhead (*Caretta caretta)*, green (*Chelonia mydas)*, kemp's ridley (*Lepidochelys kempii*) and leatherback (*Dermochelys coriacea*) sea turtles frequent the waters off North Carolina. Many of the state's beaches, from May to mid-November, are prime nesting grounds for loggerheads, a threatened species, and less commonly for green turtles.

The turtles spend most of their lives in the water where they face numerous hazards. They can drown in a fish net, choke on trash, get run over by boats, or get sucked up in a dredge. Every few years, a female turtle crawls ashore, instinctively returning to the same beach where she was born. There, she digs a hole up to two feet deep and lays about 120 soft-shell eggs that are about the size of ping-pong balls. After covering the nest with sand, she heads back to the ocean. A turtle will lay eggs several times during a season and then wait several years before nesting again.

After incubating for about two months, the eggs hatch, and three-inch long turtles make a mad dash to the sea. Only one in 1,000 hatchlings will reach adulthood. These magnificent creatures have a potential lifespan similar to humans.

They stand no chance at all if the beach isn't suitable for nesting. It mustn't be too steep or bathed in artificial light. The sand must also be the right size, color and consistency for the turtle eggs to hatch successfully.

Studies have shown that the number of turtle nests decreases on a renourished beach. At times, turtles can't crawl up the beach because of the small but steep escarpments, or cliffs, that sometimes form after sand has been pumped on the beach. The sand may also contain too much silt, shell or rock fragments that harden over time, making it difficult for the turtles to dig their nests. This incompatible material in the sand may also affect the eggs as they incubate and the hatchlings ability to escape from the nest.

Renourishment projects during the nesting season between May and November 15 also affects sea turtles. Nesting behavior in females may be changed because of construction lights and activity on the beach. The females may not nest at all, abandon their eggs in the ocean or nest in unsuitable areas. Nests that are laid in active beach construction zones may be covered up or destroyed, and hatchlings may be run over or disoriented by artificial light as they try to make it to the ocean.

During 2001 and the beginning of 2002, nine beach communities in North Carolina had ongoing beach renourishment projects. Five occurred during a portion of the nesting season. Some of these projects, as well as some new ones, will continue into the 2002 nesting. The effects of these ongoing projects on nesting turtles are significant. Last year, turtles were killed during dredging operations.

The indirect effects such as whether or not the turtles will be able to nest on these changed beaches, the cumulative

effects of some beaches receiving sand every three to four years, or the effect on the base of the aquatic food chain are still yet to be measured.

Dodging 'Dozers

"Bald Head Island - Crawl #80: Turtle came ashore in renourished area – Tracks hidden by bulldozer tracks. Turtle nearly hit by bulldozer multiple times. Nested in pure mud. After nested couldn't find ocean and ran into parked bulldozer."

"Bald Head Island - Crawl #81: Turtle crawled up 30' from dredge pipe and ran into them. She had a pipe over her head at one point that was held up by a front-end loader. Probable reason for false crawl."

Those descriptions come from reports submitted by sea-turtle monitors from the Bald Head Island Conservancy. In a report to the Corps, the Conservancy documents numerous such instances and other effects on nesting turtles and hatchlings. Because Bald Head Island receives consistent annual monitoring and comprises a significant amount of turtle nesting habitat, it provides some clear examples of nourishment's effects on turtles.

The pumping of sand onto Bald Head Island extended into the middle of turtle nesting season – from Feb. 23 to July 4, 2001, and continued 24 hours a day, seven days a week. Slurry pipes snaked along the beach, which was crawling day and night with bulldozers and other heavy equipment and lit by construction lights. Monitors documented 77 turtle nests and 125 false crawls, or double the normal ratio of nests to false crawls, which are signs that a turtle crawled up the beach but didn't lay eggs. Normally, 108 turtle nests are counted on Bald Head, one of the most important nesting places for turtles in North Carolina. Nesting seemed to increase slightly as soon pumping ended. However, machinery was back on the beach in early September and a dredge was stationed just off of the beach until the end of the month. Two nests hatched during this time, and the hatchlings had to navigate past construction activities to reach the water where the dredge was sucking up sand.

About three miles of Bald Head Island beach received sand from the Wilmington Harbor Project. The Corps is permitted to place sand from this project on the beaches of Brunswick and New Hanover counties for 18 straight

months and through two consecutive turtle nesting seasons.

Caswell Beach and Oak Island also received sand from the Wilmington Harbor Project. It was placed on about 9.6 miles. Pipes, heavy equipment and construction lighting were also present on the beach at Caswell during the nesting season.

A turtle nest behind a dredge pipe at Caswell Beach.

The Caswell Beach volunteer nesting monitors received advance notice of where the pipelines would be placed, and they were able to relocate 25 nests. They moved the nests into an area that had no pipes blocking the turtles' and hatchlings'access to the beach and ocean. Scientists, though, consider that risky, because relocated nests can become too concentrated in one area, making them vulnerable to damage and destruction from one storm.

A pipeline was eventually laid between the relocated nests and the ocean. The volunteers worked with the contractor to set up an elaborate system to get the hatchlings over the pipe and to the ocean once they hatched. The volunteers noted that the hatching rate was very high (86%), and the pipe in front of the sanctuary may have protected some nests from some very high tides. The Caswell Beach volunteers also indicated that they had no nests after July 23, which is unusual. The volunteers also stressed that this beach activity should never be conducted during nesting season again. This was strongly echoed by the Bald Head Island Conservancy.

Homeowners on Holden Beach bought sand from a source off the island. Large dump trucks delivered the sand and dumped it onto the beach. Bulldozers, then, pushed the sand into shape. This work also extended into the sea turtle nesting season. Holden Beach received a permit to place more sand on the beach during the winter and in the spring of 2002. To maintain the ecological and recreational qualities of the beach, it is imperative that sand used for beach nourishment be compatible with existing grain size and type. Forty-two nests were counted on average on Holden Beach from 1989-2000. In 2000, there were 35 nests and 44 false crawls. In 2001 there were 19 nests and 31 false crawls. This is more than the usual 1:1 ratio

Dead Turtles

A beach nourishment project in Carteret County on Bogue Banks was temporarily shut down in December 2001 after dredges killed four sea turtles (two loggerheads and two endangered Kemp's ridleys). The Corps also reported that a hopper dredge killed one loggerhead on April 30, 2001, during the Wilmington Harbor Project.

Bald Head Island reported eight sea turtles stranded through November 6. Of these, two loggerheads found in April (same time and area as the turtle reported killed by the hopper dredge) showed unnatural signs of mortality.

Can They Dig It?

Steve Johnson, the former sea-turtle program coordinator for NC Wildlife Resources Commission, has noticed that false crawls are common after renourishment projects. "If the sand is not compatible, they have trouble digging and decide not to nest," he said. Sand containing too much silt or fine shell material can become compacted over time, which makes nesting difficult. It can also affect the ability of hatchlings to emerge from the nest.

State permits say that sand used for beach nourishment must be "compatible" with the replaced sand and "suitable" for nesting sea turtles. The definition of either word, though, is left to the discretion of officials at the NC Division of Coastal Management. As a renourishment project on Bogue Banks

Fist-sized chunks of marl littered the beach at Oak Island

in Carteret County showed, though, the state isn't too eager to make the call.

Scientists in February 2002 raised alarms about the amount of shell that was being pumped onto a portion of the beach at Pine Knoll Shores. The black, shelly hash, they feared, could harden the beach to the point that sea turtles and feeding shorebirds would have a hard time burrowing into it. Large, jagged shell fragments could also puncture delicate sea turtle eggs.

State officials only went out to inspect the beach after the scientists complained and almost two miles of beach were covered. Sand samples submitted to the Corps by the project's contractor revealed that the average shell content for that stretch of beach was 40 percent, almost four times more than what scientists estimate to be natural. In some places, the shell content was as high as 60 percent, almost double the Corps' threshold of 35 percent shell.

No one in authority, though, expressed any concern that the shell pumped on the beach exceeded even the Corps' liberal allowance. "We didn't think it was nearly that drastic," said one state official. The colonel in charge of the Corps' regional office in Wilmington said the beach was one of the best he had ever seen.

High Hurdles for Turtles

Such an endorsement should have come as no surprise. After all, what's a little shell on the beach compared to all those rocks?

The Oak Island (Long Beach) Sea Turtle Habitat Restoration Project in Brunswick County involved pumping about 1.3 million cubic yards of sand from Yellow Banks across Oak Island to the beach.

Three-foot high scarps at Oak Island

The project was about 2.3 miles long and cost about $11 million, though that amount may increase. The primary purpose, according to the Corps, was to create and restore sea-turtle nesting habitat. Protecting beachfront buildings was merely a byproduct of the project, the Corps maintained.

As work on the project extended beyond the targeted completion date and into the first month of sea-turtle nesting season, the ocean uncovered large fields of fist-sized and smaller rocks of marl. The contractor had evidently sucked up a considerable amount of marl at Yellow Banks and deposited it on the beach. A bulldozer was dispatched to collect the rocks, but they kept reappearing throughout the winter. The contractor has billed the town an additional $2 million because the rocks damaged the dredge and delayed work.

Escarpments are also worse on renourished beaches, as the projects on Oak Island and elsewhere showed. These steep slopes of sand at the water's edge prevent turtles from crawling to preferred nesting sites. Scarping occurred throughout the renourishment

Dark renourished sand contrasts with natural dune at Pine Knoll Shores.

projects during the nesting season. Some of the scarps were more than 100 feet long and 1-3 feet high. The responsible towns and contractors eventually smoothed out the scarping, but some of the scarps reappeared with each tide and others remained for more than a week. Scarps more than 18 inches high interfere with nesting turtles, according to the Fish and Wildlife Service, and should be leveled.

Mole Crabs and other Critters

Scientists note that the mole crabs, coquina clams and other creatures that live in the sand in the surf zone are a critical part of the food chain. They are the main food for a host of bird and fish species and are critical to the survival of young pompano, flounder, bluefish and other commercially important species that ply the surf just off the beach.

Dumping tons of sand on the beach undoubtedly kills everything that lives there, but the creatures are thought to reproduce quickly and colonize nourished beaches from adjacent ones within a few months.

However, scientists note that the recovery rate depends on how closely the sand pumped onto the beach matches the existing sand and how often the beaches are renourished. Charles "Pete" Peterson, a biologist at the University of North Carolina's Institute of Marine Sciences, found that the densities of the two most common sand creatures – mole crabs and coquina clams – were as much as 99 percent lower on a section of renourished beach in Carteret County than on an adjacent natural beach 10 weeks after the renourishment project ended. He concluded that the filled beach had too much silt and too many shell fragments for the critters' liking, though the content of both met the requirements set by the Corps.

"It fit the criteria they allow. That's the key," Peterson said. "If people have confidence that the Corps' criteria are protective of the organisms that live there, that study totally disproved that."

Beaches that are nourished on a regular basis become what Peterson calls "industrial beaches" because they stop functioning like a natural beach. The sand of a nourished beach will eventually wash away, leaving behind the heavier shell fragments. The shell content of the beach increases with each nourishment, Peterson said.

"So the beach is fundamentally altered in its composition," he said. "I could live with that when 11 or 12 miles of beach are being nourished, but nourishing 120 miles could have dramatic effects."

The NC Marine Fisheries Commission, the state's major regulatory agency on marine fisheries issues, outlined the potential dangers in November 2001 and declared in a policy statement that "the array of large-scale and long-term beach alteration projects currently being considered for North Carolina constitutes a real and significant threat to the marine and estuarine resources" of the state.

Turbidity clouds the ICW during Oak Island project.

Other Effects

Oak Island (Long Beach) Sea Turtle Habitat Restoration Project

- No sedimentation and erosion plan or practices in place before construction began. The state notified the Corps in January 2001 that it had failed to submit an erosion and sedimentation control plan to the NC Department of Land Resources and that it had not installed buffers and other measures to control erosion. The contractor began installing erosion-control devices.

- The wall of the dike on Yellow Banks was breached, and a spit of land was pushed without authorization into the tidal waters of the Intracoastal Waterway, which under state coastal rules gets special protection as an Area of Environmental Concern. The state ordered the Corps' contractor to stop work in February 2001 and eventually fined the Corps $500.

- The contractor's action caused a turbidity plume, carrying crud and scum, to extend over much of the waterway. After receiving complaints, state inspectors took later tests in February. The unofficial field test indicated a turbidity level almost twice the state standard. Official results, though, were below the standard and no violation was recorded.

- As the wet slurry of sand in the dunes began to dry, a 1.8-mile moat formed between the front row structures and the dunes. The project included the construction of an 11-foot high dune that ended before meeting up with oceanfront structures. The Town of Oak Island first pumped the water into the ocean. But water from the dunes, tides and rain continued to fill the moat. The town then pumped the water into large septic tank trucks, but water still filled parts of the moat. Finally Oak Island officials bought sand and hauled it in with dump trucks to fill the moat. The sand, orange in color, was from an off-island source.

Wilmington Harbor Deepening and Channel Realignment Project at Kure Beach

- Swimming advisory posted. Sand was pumped onto Kure Beach in May, also during sea turtle nesting season. The sand was dredged from an area of the Cape Fear River that is closed to shellfishing because of bacterial contamination. As a result, the NC Division of Shellfish Sanitation posted swimming advisory signs on the beach. Loss of an existing use, such as swimming, violates state and federal water

Turbidity from dredging clouds the water at Ocean Isle.

quality standards, which is illegal. No Notice of Violation was issued, however.

Monitoring

According to the Corps, all beaches that will or have received sand as part of their sponsored projects have monitoring for sea turtle nests, and the nests are relocated as appropriate. All beaches that have received sand are tilled as required, and all scarps over 18 inches high and over 100 feet long are leveled as required. In addition, the Corps will monitor the environmental effects of renourishment at eight places on the Brunswick beaches for six weeks and then again several months later. Bird surveys, water-quality sampling, and collecting organisms in the ocean will be part of the monitoring.

A seven-year study at Juniper Island, FL has shown that nesting success for loggerhead turtles on renourished beaches was significantly lower than on the natural beach for two seasons after

project completion. While nesting success improved after two seasons, the proportion of hatchlings that failed to exit the nest continued to be significantly greater at renourished beaches than at undisturbed areas. The Florida Atlantic University researchers concluded that renourishment has a negative effect on nesting.

While it is said by many proponents of beach nourishment that they are creating more habitat, especially for sea turtle nesting, one has to wonder about the true cost and quality of this habitat. Short-term direct effects on sea turtles and the alteration of the natural sand on North Carolina beaches are being demonstrated already. Long-term effects on the populations of sea turtles, shore birds and the invertebrates that live in the sand are yet to be seen. Much more unbiased, peer reviewed, comprehensive

monitoring is needed, and until we have that in hand, we should proceed cautiously. The regulatory agencies should insist on a cumulative impact study for the increasing number of projects and enforce standards on material compatibly. Otherwise, the sand we love to feel between our toes and the creatures we care about might soon change and possibly disappear.

Appendix

Loggerhead Sea Turtle Nesting Activity in North Carolina, 1989-2001

BEACH	Totals '89-00	Average '89-'00	Nesting Activity 2001
Bald Head Island	1,299	108.2	77
Bogue Banks	356	30	22
Carolina Beach	63	5.7	6
Caswell Beach	708	59	59
Figure 8 Island	88	11	5
Ft. Fisher State Recreation Area*	106	9.6	18
Holden Beach	508	42.3	19
Kure Beach	51	4.3	6
Masonboro Island*	89	14.8	26
Oak Island	801	66.8	41
Ocean Isle Beach	267	26.7	14
Sunset Beach/Bird Island*	91	15.2	8
Wrightsville Beach*	74	7.4	7
TOTAL	**4,501**	**401/33.4**	**680**

*No active beach renourishment projects during the nesting season in 2001.
Source: NC Wildlife Resources Commission