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## Scientists Comb a Ruined Coastline for Clues and Lessons

By [CORNELIA DEAN](#)

PENSACOLA, Fla., Sept. 2 - The six-seater Cessna was flying low and slow along the Gulf Coast. Two coastal researchers, straining against their seatbelts, were leaning out a gaping hole where the port side door had been removed, photographing overwashed sand, piles of seagrass and new inlets, the marks left on the region's barrier islands by Hurricane Katrina.

But then the plane banked sharply, and the researchers aimed their cameras landward, toward Waveland, Miss., or what was left of it.

"My God. My God," said Robert S. Young as he caught his first sight of what would be miles of desolate landscape where houses, stores, churches, hotels and other structures used to be.

Neighborhood after neighborhood appeared to have been raked clear, with nothing but concrete slabs to say where buildings had stood. Far into the woods, boards and beams and other remnants of these buildings lay in piles, a wrack line of debris left where the storm had dropped it.

In Gulfport and Biloxi, wrecked casino barges lay across city streets or leaned against high-rise buildings, some tilted on their sides, all with windows blown out. Where railroad and highway bridges once ran, there were only platoons of pylons marching into the water. Here and there a truck or S.U.V. moved slowly down sand-choked roads, but there were few other signs of life.

"I have been on the scene of every major hurricane" since Hurricane Hugo, said Dr. Young, a geologist at Western Carolina University who has been studying coastal storms since 1989, when he was a graduate student assigned to measure that storm's impact. "This is the worst I have ever seen."

Since Hurricane Katrina struck, much of the nation's attention has been on New Orleans, where overtopped and breached levees stranded tens of thousands of residents and left much of the city under water.

But the scientists on the plane, Dr. Young and Andrew S. Coburn, associate director of the Duke University Program for the Study of Developed Shorelines, are looking instead at the Gulf Coast, where the storm came ashore.

They and other researchers are mapping changes in beach formations, patterns of damage, debris fields, wind and water flow, and inland and offshore topography for clues about why this storm was so destructive, and so deadly.

The work is part of scientists' continuing efforts to engage coastal officials and policy makers on how to make the coast safer - and on whether some parts of the coast can ever be made safe enough.

"We have never learned that lesson," said Abby Sallenger, a scientist with the United States Geological Survey who has studied storm effects on the East and Gulf coasts for years. Dr. Sallenger does not advocate wholesale retreat from the coast, he said, but "the coastal research community should come together and come to some conclusions about where it is safer to go."

"What's happened before is you come back and you not only rebuild, you rebuild bigger," he continued, but "there are some places where you should think twice about putting up a pup tent."

Scientists who want this point to be heard, and who think Hurricane Katrina may be an ideal opportunity to make it, are eager to obtain as much good data as possible about the storm and its effects.

For example, Shea Penland, director of the Pontchartrain Institute for Environmental Studies at the University of New Orleans, said analysis of debris fields would be illuminating. "Debris tells you how high the water was, how fast it was moving, where it was going, where were the soft spots," he said.

Researchers from Florida International University and the University of Florida are studying data from 10 portable towers, fortified to survive winds of more than 200 miles per hour and equipped with instruments to measure wind speed and direction at ground level and at 15 and then 30 feet above the ground.

Much real-time data transmission was halted during the storm when cellphone systems failed, said Stephen P. Leatherman, who heads the International Hurricane Research Center at F.I.U. But instruments on the towers stored their data and researchers should be able to obtain detailed measurements, he said.

Scientists like Dr. Sallenger are also trying to improve estimates of likely hurricane impact by going beyond barometric pressure and wind speeds, the basis of the Saffir-Simpson hurricane scale, to include factors like the elevation of the landscape and the shape of the beach where a storm might strike.

Advancing this goal was one of the reasons Dr. Young and Dr. Coburn took to the air. Their chartered plane took off early Friday afternoon from the Pensacola Aviation Center here, and they spent the next four hours flying as far west as Grand Island, La., 180 miles away.

There was very little air traffic, and that was good, said the pilot, Gene Giles, better known as Skip, because it was not clear that air traffic control was operating normally.

When the small plane crossed paths with military helicopters, as happened two or three times, the researchers held on as Mr. Giles wigwagged to signal he had seen them. At one point, the plane banked sharply to avoid a C-130 that was coming in over the Gulf, heading for a landing at Biloxi.

One of the first places the researchers photographed was Dauphin Island, a 15-mile strip of sand at the mouth of Mobile Bay. Dauphin Island is regularly breached by coastal storms, and its mainland bridge was knocked out in Hurricane Frederick in 1979. Many coastal researchers regard it as an outstanding example of unwise coastal development.

"We paid \$38 million for a new bridge," after the hurricane, said Orrin H. Pilkey Jr., director of Dr. Coburn's program, who has been an ardent advocate of retreat from hazardous coastlines since his parents experienced Hurricane Camille on this coast in 1969.

"There was a brief period when they debated not rebuilding the bridge," he said in a telephone interview, "but they did, and development skyrocketed

on."

Even on its east end, where elevations are relatively high and the island's dune system is relatively robust, there were clear signs of storm damage. A row of groins stood out in the water, the beach they were meant to protect having eroded away behind them. A sea wall of rock riprap was out to sea. The ocean had overtopped it.

But it was on the west end of Dauphin Island that devastating storm damage was most apparent.

This part of the island had long since been without protective dunes. Some houses were simply gone, leaving nothing but pilings.

In places, the island's one road was obliterated. And everywhere, there were huge fans of sand on the island's back side, sand that had washed over from its ocean beach, leaving stranded houses seemingly wading on pilings into the surf.

On a developed barrier, like Dauphin Island, this sand movement is a disaster. "It's as if the island is sliding out from under the houses," Dr. Young observed as the plane flew over them.

But on undeveloped islands, it is a normal and advantageous response to rising sea levels - as sand washes toward the back of the island it is, in effect, retreating away from the ocean.

Sand that washes from the ocean sides of the islands is deposited in their marshy bayside fringes, where it is left in large fans. Eventually, this sand is colonized by beach grass and other plants.

New marshes form on its landward fringes. The island will look the same; it will just be farther landward.

Dr. Young and Dr. Coburn could see this process at work as the plane flew over Petit Bois, Horn and other uninhabited islands of Gulf Islands National Seashore - more evidence, Dr. Young said, that damage to barrier islands is largely a matter of interference by people, "a human tragedy," as he put it.

"It's amazing how much better natural shorelines look after a storm than developed shorelines," he said.

Once the plane reached Waveland, Miss., however, there was little to feel good about.

When a storm like this makes landfall, pushing a wall of water with it, nothing along the beachfront will survive the assault, even structures built to withstand high winds. "Nothing can withstand waves," Dr. Pilkey said.

Under assault by a storm surge, most structures simply fall apart, and their debris batters buildings behind them, "missile-ing," Dr. Pilkey called it.

"Stuff is thrown back into the next house and it doesn't have a chance," he said.

Eventually the debris piles up and forms a kind of dike, which breaks the action of storm water and offers some protection to structures behind it.

Dr. Coburn and Dr. Young have seen this kind of wrack line of debris before. But this time, they said, it was unusually far inland, testimony to the hurricane's strength.

When coastal scientists survey storm damage, they often speak cynically about people who have chosen to build their houses in harm's way. This time, for Dr. Coburn and Dr. Young, it was different.

"It's hard to be callous," Dr. Young said as Mr. Giles sent the plane on another sweep along what remained of the Gulfport, Miss., shoreline. "People lived here. People's lives are scattered around down there."

Dr. Sallenger, of the Geological Survey, said he hoped that as events unfolded in coastal Mississippi and nearby, the realization of what occurred there would bring scientists and policymakers together.

"There are a lot of smart people from the research guys to the engineers to the people who build these things," he said. As people consider how and what to rebuild, he said, "Let's just do it better."