VIMS Beach Research Reveals Erosional Hotspots

By David Malmquist

VIMS researcher Jesse McNinch likes the beach. But his trips there are anything but leisurely visits with umbrella and Frisbee. This spring, he'll be driving along an Outer Banks' beach in a 5-ton amphibious vehicle, using a high-tech sonar system to map the sandy seafloor and its underlying geology.

"Mix sand, seawater, and energy over any time scale, and I am intrigued," says McNinch. The focus of his current research is to better understand how the muddy substrates that underlie many sandy East Coast beaches contribute to "erosional hotspots." McNinch and his colleagues believe that these ephemeral patches of accelerated erosion may be hindering efforts to protect and replenish beaches all along the Eastern seaboard, and that they contribute to erosion on other sandy beaches worldwide.

McNinch's interests extend offshore as well. In 1999, he and colleagues used their geologic expertise and high-tech instruments to help explain the surprisingly fine preservation of a shipwreck discovered in the shallow waters of Beaufort Inlet, North Carolina in 1996. This vessel is thought to be *Queen Anne's Revenge*—the flagship of Blackbeard the Pirate, which ran aground off Beaufort in 1718.

Erosional hotspots are short stretches of sandy beach that suffer severe erosion during storms. Rapid removal of sand from a hotspot can undermine sea walls and topple nearby structures. Shortly after a storm passes, hotspots refill with sand, leaving little or no evidence of their previous existence.

Traditional measures of beach erosion, which entail pre- and post-storm surveys of a beach profile, can completely miss a hotspot's presence. The recent discovery of these features required the development of high-tech research tools that allow scientists to monitor beaches continuously—even at the height of a storm—and in three dimensions. These tools include time-lapse video cameras; sonar instruments capable of simultaneously measuring water depth, seafloor topography, and the thickness of underlying sediment layers; and amphibious vehicles capable of deploying the sonar equipment even in high seas.

Using these and other tools, McNinch, along with colleagues from North Carolina State University, the U.S. Geological Survey, and Oregon State University, discovered the phenomenon of erosional hotspots during a recent beach study at the US Army Corps of Engineers' Field Research Facility in Duck, North Carolina.

VIMS researcher Jesse McNinch is using a 5-ton amphibious vehicle to study erosional "hotspots." The vehicle can reach speeds of 5 knots in the water and operate up to 5 miles offshore.

Their observations at Duck suggest that hotspots are caused by a complex chain reaction that begins when large storm waves expose muddy patches beneath the sandy surf zone. Exposure of these muddy patches causes changes in bottom currents that alter the configuration of offshore sandbars. Whereas the sandbars that front most Outer Bank beaches run parallel to shore, sandbars near mud patches swing perpendicular to the shoreline and begin to grow shoreward. During fair weather, these perpendicular bars replenish sand to the shore face. But when another storm arrives, they act like open gates that allow large waves to pound and quickly erode the shore.

To test this idea further, McNinch has secured funding from the Army Research Office for a three-year field project to study erosional hotspots at Kill Devil Hills, North Carolina. This beach is particularly conducive to study because it displays both short-term hotspot behavior and long-term, chronic erosion, and has been slated for renourishment by the Army Corps of Engineers. To monitor the beach, McNinch and his team will install five computer-controlled video cameras on the roof of a local motel. These will provide a 2-mile-long panorama of hourly daylight images during the duration of the project. McNinch's team will also periodically map the beach's three-dimensional structure from a sonar-equipped amphibious vehicle.

The Corps is particularly interested in McNinch's work because hotspots have the potential to damage Corps seawalls, hinder Corps beach replenishment efforts, and disrupt military maneuvers. Especially troubling to the Corps and other shoreline management agencies is that the computer models they currently use to predict the longevity and cost of beach protection projects fail to incorporate hotspot dynamics.

"Nearshore sediment-transport models assume a fairly uniform distribution of bed roughness and sediment characteristics, and a sufficient supply of sediment," says McNinch. "Our findings at Duck contradict these assumptions and suggest that sand may be limited and that exposure of older, non-sandy substrates commonly occurs in the surf zone."

McNinch notes that the U.S. will spend about $1.3 billion on beach renourishment over the next decade, and believes that many of these projects may include an erosional hotspot that will lead to shorter than expected project duration and higher maintenance costs.

By establishing a methodology for recognizing hotspots and identifying areas where they may develop in the future, McNinch anticipates that his work will bring immediate benefits to both civilian and military coastal engineering communities.

For further information about hotspot research at VIMS visit http://www.vims.edu/physical/hotspot/

Brill Named as CMER Faculty

Dr. Richard W. Brill, National Marine Fisheries Services (NMFS) Honolulu Laboratory, will join VIMS in March 2002 as Director of the VIMS/NMFS Cooperative Marine Education and Research (CMER) Program. Brill, a fisheries biologist, is internationally recognized for his extensive research on the physiology of tunas and other highly migratory fishes. The CMER Program provides a senior level NMFS scientist to serve as a full-time visiting professor who also functions as a liaison between the university and NMFS.

Dr. Richard W. Brill (left).

Brill's primary research interest is in the physiological ecology of fishes (including sensory biology) and how these relate to movements, distribution, population assessments, and other fishery management issues. He plans to continue this research at VIMS and to develop projects that will include both faculty and students. "I also plan on teaching courses on fish physiology and to provide assistance to students who would like to include physiological questions as part of their research," Brill said.

According to Dr. John Graves, Chair of VIMS' Fisheries Science Department, "The Department of Fisheries Science has long recognized a need for a fish physiologist. We are very fortunate to have an individual of Rich Brill's caliber on our faculty. He brings an internationally recognized program to VIMS, and his ties to several large research programs will provide many opportunities for VIMS faculty and students."