



Everything Jersey

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A 'plume' with a view of an oceanic experiment

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BY KITTA MacPHERSON

Star-Ledger Staff

When scientists try to reinvent something, they live dangerously. They rely on custom-made, temperamental equipment and things often go in unexpected directions.

The Coastal Ocean Observation Laboratory at Rutgers University -- an oceanography group led by physicist Scott Glenn and biologist Oscar Schofield -- was reminded of that during a recent seven-day experiment off the New Jersey coast.

They set out to "tag" the so-called "Hudson plume," 500 billion gallons of cold water that spurts periodically from the mouth of the Hudson River into the New York harbor. The flow mixes clear mountain water with industrial waste, sewage, fertilizer and other household debris washed off suburban lawns. For years, many have worried about the health effects of such pollution on fish and humans. Until now, marine biologists have relied on tissue samples from fish caught along the coast to gauge pollution.

But a group of scientists, including those at Rutgers' Institute of Marine and Coastal Sciences, had a better idea -- one the National Science Foundation endorsed with a \$4.2 million, five-year grant as part of dramatic advances in the field of oceanography.

What if researchers could watch where the plume ends up in the ocean? They could see what happens to the environment when the pollution -- most likely consumed by algae -- comes to rest.

THE EXPERIMENT BEGINS

It's mid-week in early May and the scientists plan to dye the plume and watch where it flows. The dye is a non-toxic variety -- Rhodamine WT -- and disappears from the naked eye about six hours after it is dumped. Optical sensors will measure and track the red flow's reflection for nearly a week.

Biologist Robert Houghton balances himself at the stern of the R/V Cape Hatteras. He'll be the guy who dumps the 100 gallons of red dye into the ocean.

"Welcome to summer camp for nerds," Glenn, the physicist, says to a visitor.

The scientists will use an array of high-tech equipment for their experiment: shore-based radio wave sensors that detect water currents, space-based satellites that measure water temperature and detect chlorophyll (where there is chlorophyll there is algae), and a team of unmanned underwater robots to collect readings on temperature and salinity from the bottom to the top of the water column.

One of Rutgers University's unmanned robotic gliders is the RU05, a cigar-shaped device that spans 5 feet. It zigzags through the seas, descending on a diagonal path to the sea floor, then ascending at the same angle, collecting vital bottom-to-top data for researchers.

Most of the instruments will produce data to be compiled and assessed at the institute's office at Cook College in New Brunswick.

There, on the first floor, in an area the size of a grade-school classroom, Glenn and six other scientists will help guide the boat crew to the best spot to dump the dye -- one that is almost pure plume, with a strong current, and not yet mixed with ocean water. Then they will guide them as the material floats, disperses and either hugs the coast or runs somewhere else.

The center of operations is known as the COOL room, taken from the lab's official title of Coastal Ocean Observation Laboratory. Glenn is the admiral.

Schofield will position himself on a research vessel in the midst of the experiment. A biologist, he explains this kind of work never could have occurred even five years ago.

"If we didn't have Scott in the observatory, we would have a hard time finding the river and following it," says Schofield, who conducts experiments from another research vessel, the Oceanus, while monitoring the Cape Hatteras. "We almost trust the COOL room people more than the dye."

RED MARKS THE SPOT

The dye release is set for 4 p.m. on this bright, sunny day. But there are complications.

The group decides to push the drop to 6:30 p.m. after a mid-afternoon teleconference among scientists aboard the Hatteras, Oceanus and onshore team.

Then, after a vital piece of optical scanning equipment breaks, the group decides to wait until morning. Finally at 10 a.m., the dye is cast.

"We're pretty stoked," Schofield says. "We've got a good spot."

The orange-red stain spreads through the dark blue water, as scientists track it in the plume for about six hours. It holds the coast.

Meanwhile, back at the COOL room, Gregg Foti, a former software developer for AT&T and now a Rutgers student, makes predictions about the direction of the plume based on a complex computer model developed at Rutgers.

The model factors wind direction and speed, the advance and retreat of the tides, the speed of the Hudson River and its tributaries, air pressure, relative humidity and radiation, which includes heating from the sun and its reflected glare.

"It's going to split," says Foti.

The plume will hug the coast until about midnight, he says, then most of it will veer east. Such a divide is the nightmare scenario scientists dread. A ship can track only one plume. A glider might be able to help, they hoped.

The team dispatches RU07, one of its trustiest unmanned gliders, to monitor the portion that would stay the coastal course. The land-based group warns the shipboard scientists about the potential redirection to allow them to make their preparations.

The next morning, Hugh Roarty, one of the lab's glider experts, fishes the pesky RU05 glider, which had gone missing, from the Atlantic and brings it back to the lab for a good talking-to.

Through the next few days, the interactive set-up performs the way the scientists hoped.

The RU07 glider threads its way through two installations of submerged debris that serve as a fish haven, reams of microfilament (fishing line), and chaotic currents. The glider can't go the other way around the submerged junk because that would place it in shipping lanes where it would be run over. Glenn likens it to coordinating players on a football team.

The atmospheric and oceanic forecasts also prove useful, correctly forecasting the daily spin up and down of the sea breeze. This helps predict the speed of the current and therefore the speed at which the plume will move. The ocean model accurately predicts the plume will split into a near shore, onshore and offshore branch. "I have never seen more useful forecasts in a coastal region," Glenn says.

STEPPING INTO THE FUTURE

This is the final year of the experiment, so the team will take its readings and analyze the stream's behavior, concluding in 2008. In previous testing, water from the Hudson River plume has been detected in the ocean as far south as Cape May.

This time, the plume extends south to Barnegat Bay and farther east than before, Schofield says. This means that all the things the river brings -- good and bad -- can be distributed quite far.

"For that one week, we had stepped into the future," Glenn says. "And we didn't want to go back. We were totally immersed in this virtual undersea world."

The network of experimental tools is no longer experimental, the scientists say.

"Over the last few years, building the network was the experiment," Schofield says. "The network is now a science tool, not an engineering demonstration. That's why we oceanographers are ready to build the national backbone."

Kitta MacPherson covers science. She may be reached at (973) 392-5836 or kmacpherson@starledger.com.

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