NOAA REPORT

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Massive Dolphin Die-Off in Florida Mystifies Scientists

—By Marti Davis

On the morning of March 10, members of the marine mammal stranding network in St. Joseph Peninsula State Park south of Panama City, Fla., discovered four dead bottlenose dolphins. The next day, 11 more dead dolphins were reported. On the third day, the total climbed to 24. By mid-April, more than 107 dolphins turned up dead along the Florida Panhandle coastline. Dead fish and invertebrates and a few dead sea birds were also found in the area.

The cause of the die-off was a mystery that required an extensive investigation involving numerous scientists from NOAA and various federal and state agencies, private organizations and academic institutions.

Since the average number of bottlenose dolphins that strand along the Florida Panhandle is only eight animals per year, local marine mammal stranding network members were alarmed.

NOAA Fisheries immediately initiated an investigation into the die-off in consultation with the

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Rebecca Pugh/NIST

Fisheries biologists Gretchen Lovewell (left) and Sarah Gomez measure the carcass of a bottlenose dolphin, one of scores of dead dolphins discovered off the Florida coast.

NOAA Ship *Rude* Uncovers Sunken Colonial Artifacts

—By Lt. (j.g.) Jeremy Weirich

When marine archaeologists from Stony Brook (N.Y.) University planned a mission to map the bottom of the Hudson River and explore for sunken ships in June, they turned to NOAA.

Backed with a grant from NOAA's Office of Ocean Exploration, the Stony Brook researchers called on one of the smallest ships in the NOAA fleet, the NOAA Ship *Rude*, normally operated by NOAA's Office of Coast Survey to update nautical charts.

Although this was the first time *Rude* was chartered to support a non-NOAA academic research expedition outside its nautical charting mission, the ship was perfectly equipped for the job.

Rude has a state-of-the-art sounding system for surveying waterways that's similar to an angler's electronic "fish finder." But instead of sending out one electronic sounding at a time, the ship's multibeam system sends out more than a hundred beams almost every second in a fan-like pattern under and to either side of the vessel. When the data are processed by computer—essentially connecting the dots from one sounding to the next—the ship's team of hydrographers and survey technicians can create a three-dimensional map of the sea floor, including potential hazards to navigation,

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Rude

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that is accurate to within a meter.

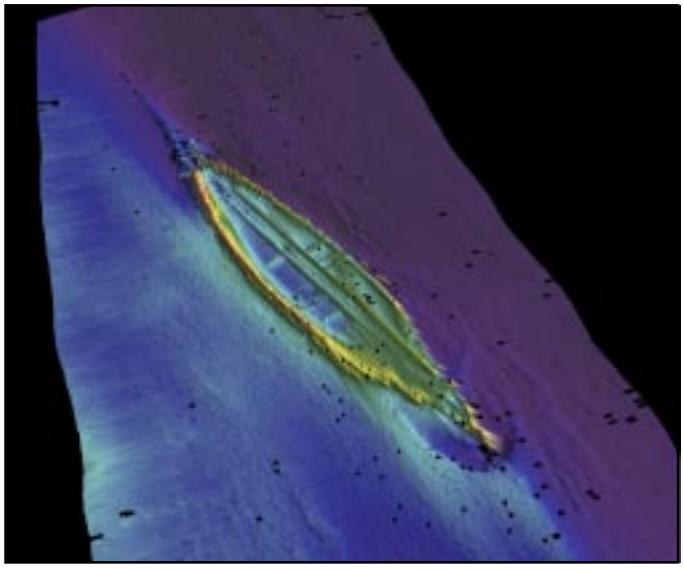
Rude also tows a large, yellow, torpedo-shaped side-scan sonar several meters behind the ship that is connected to a computer inside the ship's survey office. When combined with *Rude's* accurate positioning equipment, the towfish's sonar images and the multibeam bathymetry maps can provide vivid and precise depictions of features on the sea floor or a river's bottom. During the Hudson River cruise, the weather and water conditions were calm enough that some of these black and white sonar images were as clear as photographs.

Researchers throughout the world use similar tools to search for lost shipwrecks and other historical items. What distinguishes *Rude* is the systematic planning and detailed data processing schemes that the Office of Coast survey created to ensure that no obstruction or shipwreck goes undiscovered. Many researchers unfamiliar with hydrographic surveying are unaware of the advantages of systematic approaches, and are amazed with the results.

As it turned out, the New York researchers were no exception. "We became disciples of their approaches to surveying," said Roger Flood, the Stony Brook professor who led the team of geologists and archaeologists.

The project's goal was to systematically map the river and locate maritime archaeological remains, specifically defensive structures and vessels from the American Revolutionary War. At the onset of the war, New York City was a primary port for the rebel Colonies, which were trying to protect the Hudson highlands from British forces and maintain an open, inland trade route with New England. Numerous vessels were lost in the river during encounters between the British and a Colonial fleet of newly constructed and converted merchant ships enlisted to patrol the waters.

A previous benthic habitat mapping study sponsored by the state of New York's Department of Environmental Conservation had located several anomalies—non-descriptive mounds or bumps—on the riverbed that looked like they might be shipwrecks. State historical officers and regional marine archaeologists were called in to help assess the items, but more information was needed than the low-resolution images could provide. This led to Stony Brook's proposal to the Office of Ocean Exploration to support an archaeo-



NOAA Ship Rude

Researchers from Stony Brook University and the crew of the NOAA Ship Rude discovered the sunken wreck of what is likely a schooner in the Hudson River, as revealed in this multibeam sonar image.

Dolphin Die-Off

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Working Group on Marine Mammal Unusual Mortality Events, an interdisciplinary team of experts in veterinary medicine, marine science, toxicology and ecology.

The working group, established by Congress under the Marine Mammal Protection Act, determines if a marine mammal die-off is "unusual," helps guide the investigation and recommends which analytical and diagnostic tests should be performed.

Clearly meeting the criteria, the die-off was officially declared an "unusual mortality event" by NOAA Fisheries, thereby triggering a formal investigation.

Shepherding the effort was senior scientist Teri Rowles, the lead veterinarian and head of the NOAA Fisheries Marine Mammal Health and Stranding Response Program, who was on detail to the NOAA Ocean Service's National Centers for Coastal Ocean Science.

"Marine mammals are barometers of ocean health," Rowles said. "They can indicate the health of the marine ecosystem, which directly impacts the health of the human environment."

As state park rangers roamed the beach in all terrain vehicles to recover dead dolphins, the NOAA-led response team—including scientists from the Florida Fish and Wildlife Conservation Commission's Florida Marine Research Institute, Hubbs Sea World Research Institute, the University of Florida and the National Institute of Standards and Technology—quickly converged on the site to collect fresh samples.

The team worked with Ron Hardy, a longtime stranding network member and owner of the nearby Gulf World Marine Park in Panama City, who was appointed

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Selina Cruz/NOAA

Charles P. Guard.

Charles P. Guard Is the July Employee of the Month

—By Delores Clark

When someone mentions Charles P. "Chip" Guard's name in the Pacific, you immediately think of three things: "typhoons, El Niño and eyeball to eyeball," said Ed Young, deputy director of the Pacific region of NOAA's National Weather Service.

Guard is a warning coordination meteorologist at the Guam weather forecast office. His job is to provide education and training about severe weather and safety preparedness to community groups and local governments. But unlike most warning coordination meteorologists, his area of responsibility encompasses thousands of miles, crosses three time zones, includes one U.S. territory, four Pacific Island nations, multiple languages and a diversity of cultures spanning thousands of villages.

During the years he has lived in the western Pacific, Guard has worked as director of the military's Joint Typhoon Warning Center, as a tropical storms and climate researcher at the University of Guam and as an Air Force officer in the Philippines. During that time, he has experienced hundreds of tropical cyclones. "I've been through eight or nine eye passages and had at least 30 close calls," he said.

"His experience serves us well," said Genevieve Miller, meteorologist in charge of the Guam forecast office. "Chip possesses a special talent that enables him to communicate clearly and concisely to the many cultures throughout Micronesia and the tenacity to ensure he reaches everyone possible. A good example is what happened in Yap," she said.

Miller said Guard conducted a disaster management workshop on Yap, one of the Federated States of Micronesia, last fall. In April, Typhoon Sudal struck Yap with winds in excess of 124 mph, the worst storm to impact the island in over 50 years. Throughout the days leading up to the arrival of the storm and until communications were lost, Guard remained in continuous contact with the island's emergency managers.

Sudal damaged over 90 percent of the island's homes and buildings. About ten percent of those were destroyed. But, government officials and the residents heeded the warnings. Although the typhoon left 80 percent of the population in shelters without water or electricity, there was not one death or serious injury attributed to the storm.

Yap meteorologist in charge David Aranug said, "The training Chip provided and the follow-up during Sudal made him a lot of friends in Yap. He is very good at what he does."

According to several colleagues in the Pacific, Guard's phrase, "eyeball to eyeball," has become a common reference used to describe an effective way to conduct outreach.

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Peter Bergstrom/NOAA

Jamie King.

Jamie King Is the July Team Member of the Month

—By Linda Taylor

Jamie King, an associate research scientist at the University of Maryland supporting the NOAA Chesapeake Bay Office in Annapolis, Md., defines what it means to be a team player.

King is currently coordinating the agency's role and policy development on the issue of introducing non-native oysters, particularly *Crassostrea ariakensis* or the "Asian oyster," into the Chesapeake Bay. The issue is controversial because it pits a traditional way of earning a living from the bay's dwindling native oysters against a new, potentially commercial venture from the fast growing, non-native oysters.

King approached the issue with the diplomacy of an ambassador and the critical eye of a scientist, which she is. She holds a bachelor of science degree in biology and another in geology from the University of Rochester, plus masters and doctoral degrees from the University of California at Davis. King makes good use of her

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Focus On...

Dan Farrow/NOAA

Volunteers Miguel Lugo (left) and Becca Newhall secure the NOAA vessel Alosid to the offshore oyster reef they are standing on so they and other volunteers can seed the reef with bags of native oyster shells and spat.

Alison Hammer/NOAA

Volunteers wade into Chesapeake Bay with tubs of bay grasses they grew in their offices. The grasses will provide cover and food for small animals and help reduce erosion.

NOAA Volunteers Helping Restore Chesapeake Bay

—By Alison Hammer

On June 15, over 90 NOAA volunteers from Silver Spring, Md., waded into the warm, murky waters of Chesapeake Bay, some getting wet up to their necks, to plant underwater bay grasses. In all, volunteers planted 45 trays of bay grass they cultivated in 15 grow tanks distributed throughout their Silver Spring offices.

Bay grasses provide important food and habitat for fish, shellfish and waterfowl and help keep water clean.

The volunteers also planted over 1,000 plants on land bordering the bay, which will help stabilize the soil and provide cover for terrapins and other small animals, installed 45 feet of coir fiber logs to reinforce the shoreline, sprinkled oyster shell and spat on an off-shore oyster reef from a boat, built a floating dock and removed debris from Hurricane Isabel.

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Alison Hammer/NOAA

Peter Bergstrom explains the bay grass planting process to volunteers.

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This was the third year NOAA volunteers gathered at the Chesapeake Bay Environmental Center, a scenic 500-acre nature preserve consisting of a marshy wetland and woodlands surrounded by bay waters, located about five miles from the Chesapeake Bay Bridge on Maryland's eastern shore.

The wide-ranging restoration work by volunteers from all NOAA line offices this year builds on the work of a much smaller group of volunteers from the Special Projects Office of NOAA's National Ocean Service who planted bay grasses at the site the past two years.

Restoration of the site grew out of a partnership between the Special Projects Office, the NOAA Restoration Center and the NOAA Chesapeake Bay Office. It supplements on-going work by NOAA to restore Chesapeake Bay, which is severely degraded due to human impacts.

In 2002, the NOAA Restoration Center restored 400 feet of shoreline by creating two acres of tidal wetlands that serve as a nursery for fish, crabs, terrapins and horseshoe crabs. Center staff also built a 600-foot-long breakwater offshore to protect the shoreline and create additional habitat.

Jeff Shenot/NOAA

NOAA volunteers learn about the importance of protecting diamondback terrapins in the Chesapeake Bay watershed from University of Maryland student interns.

Since then, staff from the NOAA Restoration Center, the Maryland Department of Natural Resources and the Chesapeake Bay Environmental Center have been monitoring conditions at the site.

When Hurricane Isabel hit the bay in September 2003, a seven-foot-high tidal surge flooded the entire shoreline and destroyed a house and trailer at the site. But the hurricane moved very little sediment and uprooted only a few plants.

In addition to helping restore the bay, the event was an opportunity for NOAA staff to get out of their offices and perform some hands-on field work.

"NOAA has served in a leadership role in accomplishing significant coastal restoration activities throughout the nation, especially supporting the restoration of the Chesapeake Bay," NOAA Fisheries head William Hogarth told volunteers. "Here is an opportunity for NOAA headquarters staff from different offices to interact, learn new skills and have fun while working side-by-side in a natural setting."

Peter Bergstrom/NOAA

Volunteers (front to back) Tisa Shostik, Marti McQuire and Liz Fairey plant wetland plants near a coir fiber log that volunteers installed earlier in the day to help limit shoreline erosion.

Dolphin Die-Off

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by NOAA Fisheries as the on-site coordinator for the unusual mortality event.

The first 12 dolphin carcasses were trucked to the Florida Marine Research Institute's marine mammal necropsy facility in St. Petersburg, Fa. When so many dolphins were discovered that it was no longer feasible to transport the 700- to 1,000-pound animals to laboratories, the response team conducted necropsies in the field.

"You get to the point where you think you're finished for the day, and another dolphin comes in," said Sarah Wilkin, a NOAA fisheries biologist who works in the Marine Mammal Health and Stranding Response Program and was part of the on-site response team.

Human health was also a concern.

"The bottom line is, people doing necropsies in the field are taking all the precautions they can in terms of protective clothing and gloves, but we still have to be very careful," Wilkin said. "At first, you have no idea why the animals are dying. A disease from a virus or bacteria could possibly endanger an investigator's health."

Investigators often coped with difficult field conditions, recovering dead dolphins floating in the water and from the shores of islands in remote locations, while enduring bad weather and biting insects.

Biotoxins and morbillivirus first topped the list of potential suspects because of their roles in previous dolphin die-offs that occurred in the same area during the 1990s. But an early test quickly ruled out morbillivirus. Tests for other viruses and bacteria were also negative, strengthening the case that a biotoxin could be the cause.

Scientists from the investigation team analyzed the tissues and stomach contents of the dolphins, as well as water samples and prey species collected in the area of the die-off. Results from these tests indicated that a harmful algal bloom had poisoned the dolphins.

High levels of brevetoxin, the biotoxin produced by the dinoflagellate *Karenia brevis*, also known as "red tide," were detected in the stomachs and blood of several dolphins. Low levels of domoic acid, the biotoxin produced by the diatom *Pseudo-nitzschia delicatissima*, were detected in the stomachs, urine and feces of some dolphins.

"Toxins produced by [harmful algal blooms] are now recognized as one of the leading causes of marine mammal mortality events," said Quay Dortch of the Center for Sponsored Coastal Ocean Research of NOAA's National Ocean Service.

Blooms of *Karenia brevis* have been documented in the Gulf of Mexico since the 1500's and are a natural part of the Gulf ecosystem. Similarly, *Pseudo-nitzschia* have been reported in the Gulf of Mexico since early in the twentieth century.

However, what researchers found to be most perplexing about this marine mortality event was that no red tide bloom was evident in the immediate region and that the dolphin mortalities occurred in a relatively short window of about one month.

Analyses of water samples and satellite imagery did not detect a *Karenia* bloom, and found only low to intermediate levels of *Pseudo-nitzschia*.

Little is known about the bottlenose dolphin population along the Florida Panhandle, but brevetoxin was suspected to be the cause of a dolphin die-off in the area in 1999 and 2000. Scientists are also not even certain what constitutes a lethal dose of brevetoxin in dolphins.

Nélio Barros of the Mote Marine Laboratory examined the stomach contents of the dolphins to see what they had eaten and if their food was contaminated. "Most of the prey were species of fishes that dolphins normally eat," Barros said. "The big variable in all this is that we don't know where or when the prey had picked up the toxin."

As the entire Florida Panhandle area is only equipped to handle its anticipated average number of dolphin mortalities per year, investigators were forced to be creative, using cleaned kitchen knives when scalpels ran low and store-bought plastic tubs to preserve samples.

"The response and investigation team members dropped whatever they were working on to get fresh samples from the site," said Fran Van Dolah, coordinator of the Analytical Response Team at the Ocean Service's Center for Coastal Environmental Health and Biomolecular Research.

"The difficult task was to maintain this effort throughout the three-week period that the dolphins were continuing to wash ashore, and resources and people became a limiting factor," said Blair Mase-Guthrie, the NOAA Fisheries marine mammal stranding response coordinator for the southeast U.S.

On June 16, NOAA and the Florida Marine Research Institute released an interim report on the dolphin unusual mortality event to Congress and the public. Brevetoxins were implicated as the most likely cause of death. Other possible causes of the die-off are being investigated, with a final report due sometime in early 2005.

"We need to learn as much as we can from the sad deaths of these dolphins," Dortch said, "in order to protect human and ecosystem health from the threat of harmful algal blooms."

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Rude

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logical survey of the river north of the Tapenzee Bridge, near the area of West Point, N.Y. The scientists specifically requested the use of *Rude* and its high-resolution sonar mapping capabilities.

Whether searching for wrecks or conducting a hydrographic survey for navigation, *Rude's* routine is always the same—cover the entire navigable area first, then further investigate specific features.

Rude left West Point and its working grounds of Long Island Sound June 7 and began the week by acquiring side-scan sonar images over the entire research area. To do this, the team created survey lines in a navigational software package that accounted for how far the sonar could see on either side of the ship. The ship then steered the lines up and down the river, one right next to another, similar to mowing the lawn, until the crew was confident that the area was completely covered. For quality assurance, the ship completely covered the area twice, offsetting the lines to compensate for blind spots and providing two independent images of any features on the bottom.

After the team processed the side-scan sonar data to target suspected shipwrecks and other historical remains, navigation software guided the ship so that it could acquire the more precise multibeam data directly over the features of interest.

Because any wreck or obstruction could pose a hazard to navigation, *Rude's* hydrographers were careful to investigate the entire survey area, as the project was designed so that the archeological data could also be used to update NOAA navigation charts of the Hudson.

The researchers discovered several dozen potentially historic remains during the project.

According to Daria Merwin, the project's maritime archaeologist from Stony Brook University, about a third of them are quite possibly from the Colonial period, although it's hard to know for sure until the wrecks are further investigated visually by divers. Of particular interest to the archaeologists were the remains of what may be a nineteenth century schooner, partially buried upright in the soft river sediment. Its ribs and boat timbers were clearly identifiable by *Rude's* multibeam system.

Rude also identified features in the river not seen by earlier researchers, including the remains of *chevaux de fraise*, sunken wooden caissons with projecting iron spikes that served as obstacles to British forces moving up the river. No longer deemed dangers to navigation, these rectangular remains are difficult to distinguish from the prevailing bottom features. Without *Rude's* sonar equipment and mapping expertise, these features would have gone undiscovered.

"What the *Rude* did in one day would have taken archaeologists a week," Merwin said.

Disproving suspected items can often be as important as discovering new ones. During the return transit up river, the researchers asked the ship's crew to investigate a few suspicious anomalies located during the previous, low-resolution study. Since *Rude's* multibeam system provided much more detailed information compared to the previous Hudson River study, previously featureless targets on the river bottom became much clearer, like turning on the wipers to look through a rainy windshield. Many targets turned out to be rocks or modern debris, such as barges or cabin cruisers, but this information saved the marine researchers time and resources.

The Stony Brook researchers plan to follow-up with investigations this fall that will include scuba dives on some of the targets located by *Rude*. Visual assessments of these items by the divers, along with precise hand measurements, will help describe the condition, composition and structural components of these wrecks, possibly leading to their identification. The researchers will collaborate with archeological divers from the Lake Champlain Maritime Museum, who are accustomed to working in conditions similar to the Hudson River.

"The multibeam data will provide a good 'walk through' for the divers prior to going into the water," Merwin said. "They will already know the length, width and some structural features of the wrecks so they can concentrate on investigating more detailed features of the site." This will save divers valuable time in conditions that are inherently difficult to work in due to low visibility and rough currents. Accurate geographical positioning information will also send divers directly to sites instead of forcing them to spend valuable bottom time searching."

Wrecks are more than just obstructions. There are stories behind every sinking.

"It was great to have the opportunity to learn the history behind the items we're investigating," said Lt. Todd Haupt, *Rude's* commanding officer.

"Although safe navigation is the Coast Survey's primary mission, we try to reach out to all users in the ports and harbors we work in," Haupt said. "This gave us another chance to show others—in this case, a group we normally don't work with but who use our data—that we're ready to make an extra effort to help out. Judging by the scientists' reactions, I think we did just that."

Guard

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"For the past decade, Guard has consistently reminded us of the importance of staying in touch with users, talking to them 'eyeball to eyeball' to understand what they need and how they can help us develop the products in a form that is usable," said Eileen Shea, climate coordinator at the East-West Center in Honolulu. "This has become the model of service to National Weather Service clients in the Pacific."

Guard is also recognized for his El Niño research. According to Reggie White, meteorologist in charge at Majuro, an atoll in the Republic of the Marshall Islands, Guard and colleagues at the Weather Service's Pacific ENSO Applications Center correctly forecast the 1997-1998 El Niño, predicting it would bring drought to the Marshall Islands. "They convinced the RMI government and FEMA to purchase hundreds of water catchment tanks for the outer islands," White said, "and they were right."

Guard set out to become a marine biologist. Raised in Arizona, he was mentored by an employer who would drive them three hours to dive off California. After first pursuing a marine biology degree at Arizona State, he switched to chemistry because "biologists were good at describing but not explaining why certain phenomena occurred." When he couldn't find a job after graduation, he returned to school and graduated from the University of Hawaii with a masters degree in meteorology.

Guard said he admires former President Ronald Reagan and his philosophy to do what's right. "That's one reason why I like what I do," Guard said. "The bottom line is that as meteorologists, we are saving lives."

King

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coordination skills as she works with several NOAA line offices and the public and legislative affairs offices to bring a "one NOAA" approach to the non-native oyster issue.

King's love of the marine environment carries over into helping the community. For 14 years she's worked with and has served on the board of the Our World Underwater Scholarship Society, a non-profit organization that promotes educational initiatives for young people who love the marine environment and want career direction. The society provides year-long scholarships that send scholars on field trips to experience first-hand the underwater world.

When King was herself a society scholar, she said, time spent with members of a group called the "Massachusetts Moray Wheels," who used scuba diving to escape the confinement of their wheel chairs and explore the ocean, gave her insight into the importance of living her own life outside the box.

King said she doesn't take the easiest route with her students, but works with them to really uncover their personal interests. "This organization helps you find the work that you truly love, not just what sounds good," King said. "I figured out what I wanted for a career because of the hands-on experiences I had early on. Now I am doing exactly what I set out to do—helping to bridge the gap between science and natural resource management."

In her spare time, King said she travels. Her love of travel began early with family camping adventures to almost every state in the United States. In high school, King received an exchange student scholarship to Peru, where she said she was able to gain an appreciation of cultural richness and become fluent in Spanish. Her more recent travel destinations have included the islands of Bonaire, St. Croix, the Dominican Republic and Puerto Rico, along with Mexico and Indonesia.

Where will she go next? "Panama, Costa Rica or Australia," she said with a smile. Perhaps there are some oysters in need of her attention there, too.

Long before she'd ever thought she'd work for NOAA, she participated in two missions to Aquarius, the underwater habitat and laboratory operated by NOAA's National Underwater Research Program—first as a support diver when Aquarius was deployed off St. Croix in the U.S. Virgin Islands and later as a scientist-aquanaut, living in Aquarius for ten days at a depth of 60 feet off Key Largo, Fla. King and three other scientists studied reef fish. After the underwater work was finished, it took 24 hours for her body to decompress so that she could safely return to the surface.

King said the experience recalled her dreams of living underwater. "When I was a child, I wanted to have gills so I could stay underwater and not return to the surface." Years later, it seems fitting that she's working for the agency that made her dream come true.

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