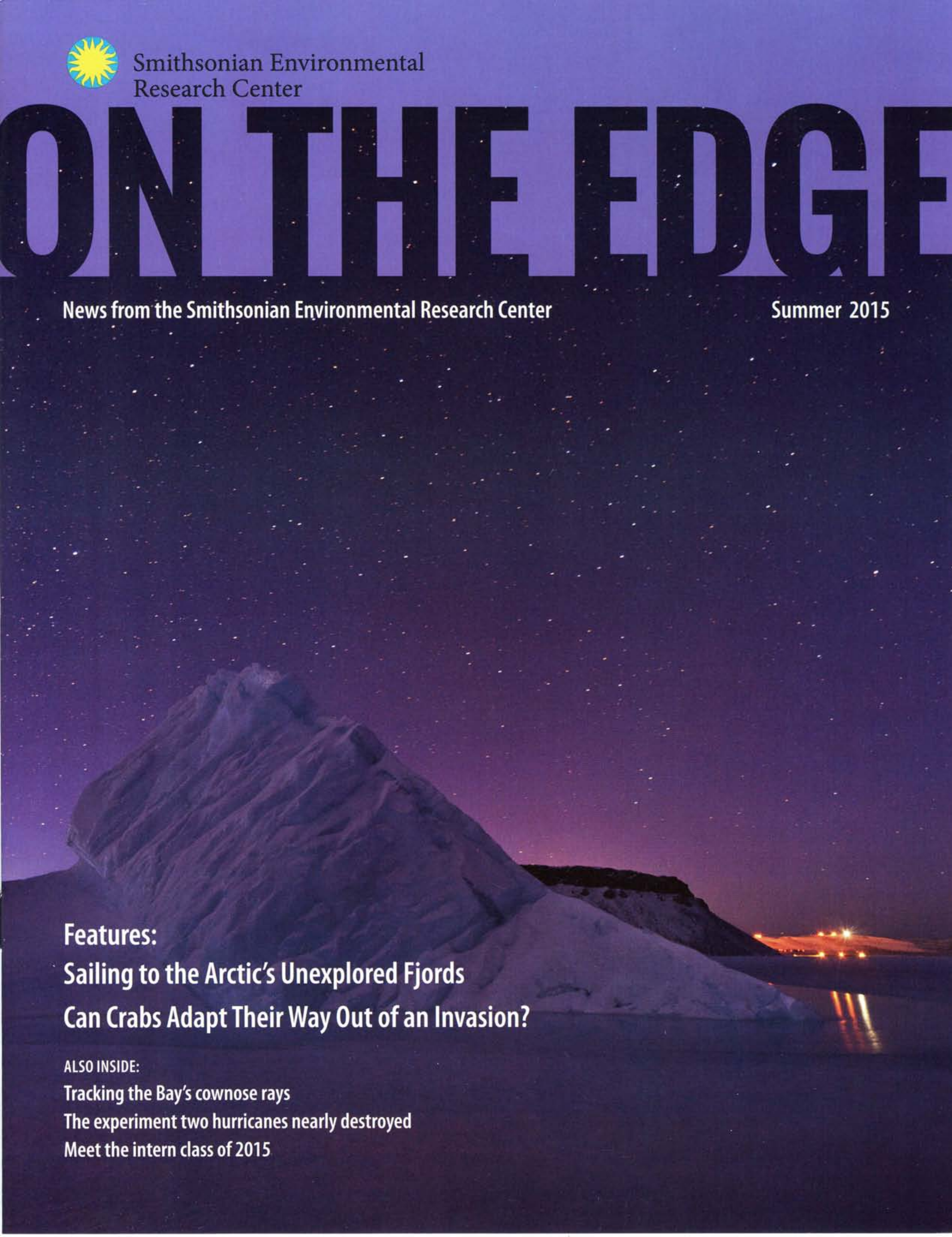
Smithsonian Environmental Research Center

ON THE EDGE

News from the Smithsonian Environmental Research Center

Summer 2015



Features:

Sailing to the Arctic's Unexplored Fjords

Can Crabs Adapt Their Way Out of an Invasion?

ALSO INSIDE:

Tracking the Bay's cownose rays

The experiment two hurricanes nearly destroyed

Meet the intern class of 2015

THE DIRECTOR'S LETTER

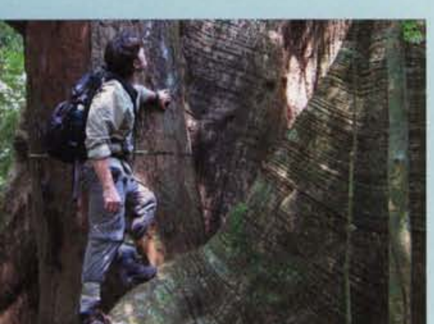
Ecology Without Borders

Photo: Kim Holzer

As we swelter in the doldrums of heat and humidity in Edgewater, Maryland, there's a sailboat that just crossed into Baffin Bay off the coast of Greenland. It entered the Arctic Circle a few days ago. Another 300 nautical miles and it will reach the Greenland city of Thule, where the sun doesn't set from April until August—and doesn't rise from November until February.

The sailboat is carrying an instrument designed by one of our scientists to measure how much carbon dioxide is pouring into the world's oceans. The sailboat, the CO_2 instrument and the two-person crew are on a mission to track climate change in Greenland's most remote fjords. The journey will take them into changing waters of the melting ice cap. The story of the Ault vessel and its crew is chronicled on page 4 of this newsletter.

This sort of research would have been unfathomable at SERC 50 years ago. In 1965, when the Smithsonian Environmental Research Center first came into being, it was not even called that. We were the "Chesapeake Bay Center for Field Biology," with no lab, no offices and no resident staff. We were a field site where researchers came during the day to collect samples, which they then carried back to their labs in larger institutions to analyze. Many came to our site on the Rhode River, but we were not expected then to be a hub for exploring environmental change worldwide.



We evolved. By now, SERC research has touched coasts all around the globe. In this newsletter alone, you will find stories of invasive lionfish in Panama, hurricanes in Florida and cownose rays that migrate 900 miles from the Chesapeake down the East Coast to Florida and back every year. This spring we also hosted the first gathering of scientists from the Smithsonian's temperate ForestGEO network. For three days, researchers from across the U.S. and Europe shared discoveries from their forests about colonization, forest fires and prehistoric climate change.

SERC's growth depended on our grit and determination, but we also persevered and succeeded because we developed many successful partnerships. From the beginning, sister institutions like the Johns Hopkins University and the University of Maryland helped us get our small field station off the ground. Over SERC's history we have engaged many hundreds of interns and grad students from universities and colleges across the United States and other countries. The Forest Global Earth Observatory network encompasses 62 tropical and temperate forests, and while the temperate ones are coordinated by SERC, we would never be able to generate this kind of data without dedicated partners. Even now, the Greenland voyage is a partnership between SERC and two sailors who wanted to do something for the environment.

Photo: U.S. Air Force

Science thrives by reaching out to places unexplored and friends unmet. Those kinds of connections are what lead to knowledge undiscovered.

— Tuck Hines, Director

On the cover:
Lights from the Thule Air Base (right) and a sun that will not fully set illuminate an iceberg frozen in place in Greenland's North Star Bay.
(Credit: Jeremy Harbeck/NASA)

Photo: Rebekah Downward

Environmental "Forensics" Pieces Together Mysterious Phragmites Invasion

On standard CSI shows, forensic scientists solve mysteries with DNA—similar to what Ph.D. student Eric Hazelton did with SERC ecologists Melissa McCormick and Dennis Whigham, former intern Matt Sievers and Karin Kettenring. Their suspect was an invasive reed with a strange history.

A European strain of *Phragmites australis* arrived in the 1800s, but only began dominating Chesapeake wetlands in the 1980s. In a July study in Wetlands, the team examined the robustness, insect damage, and types of plants in old and young Phragmites patches. "We found that with invasions that are 10 years old, they're essentially the same as invasions that are 50 years old," said Hazelton. "Nothing changed."

But when they instead looked at the DNA in different-aged Phragmites patches, there were differences in genetic diversity. Younger patches were more diverse within each patch. Older patches were more diverse among patches, suggesting older patches established independently. When close enough to make seeds together, they founded the younger patches. This means targeting older patches before they make seeds may prevent Phragmites' spread.

Photo: Albert Kok

Yet Another Reason Lionfish Make Such Good Invaders

In the western Atlantic, Gulf of Mexico, and Caribbean, invasive lionfish decimate native fish populations with their indiscriminate appetites. But they may also be harmful to native fish they don't eat.

A June study in PLOS ONE reports lionfish in Panama are parasitized less than native fish that compete with them for food and habitat. SERC ecologist Gregory Ruiz, Smithsonian Tropical Research Institute researchers Andrew Sellers and Mark Torchin, and Brian Leung of McGill University found twice as many parasite species and three times as many parasites total in native fish compared to lionfish. Parasites also seem to damage the health of a native grouper more than lionfish. Together, these discoveries suggest that Panama parasites—far from handicapping lionfish—may actually give them an advantage in the competition for food and space.

Invasive Plants Are Not Above the Law

Since Darwin, ecologists have wondered what makes invasive plants thrive. Some thought exoticness enables them to operate by different rules than native plants they overtake. But a new study in the journal *Ecology* revealed that, no, once plants land on foreign soil, they're subject to the same environmental pressures as everything else.

Former SERC graduate fellow Nate Lemoine and a Smithsonian team scrutinized 25 SERC forest stands, examining what native and introduced species grew there and how well they did. If the most abundant plants were different, it would imply novelty was an advantage, allowing newcomers to create their own niches. But instead, they found the environment forced plants to conform, selecting plants with leaves of similar size and toughness. Native versus newcomer was irrelevant. Invaders have no built-in advantage—they succeed by obeying the house rules.

Under the Apron, Into the Genome

In mud crab DNA, postdoc Carolyn Tepolt unlocks secrets of adapting to an invasion

White-fingered mud crabs are tiny, ranging from the size of a tick to the size of a quarter. This summer, Carolyn Tepolt, a postdoctoral fellow at the Smithsonian Environmental Research Center (SERC), is using genetics to study how these crabs are adapting to a castrating, gender-blurring parasite called *Loxothylacus panopaei,* or Loxo.

Loxo is a parasitic, free-swimming barnacle that transforms mud crabs into baby-making machines. A larval female Loxo swims along until she encounters a soft, recently molted crab. She burrows into the crab and takes over its nervous system. Under a flap in the crab's underbelly, its "apron," she forms a sac resembling a small, squishy, yellow pearl. Male aprons are triangular; female aprons are rounded. The sac grows until it props open the crab's apron. To accommodate the ballooning sac, Loxo feminizes male mud crabs, widening their aprons to resemble a female's. Eventually, a larval male Loxo fertilizes the sac and, in time, wee Loxo babies spew forth. The crab, however, is castrated and does not produce its own offspring.

Where Loxo is invasive, as in Chesapeake Bay, it may parasitize up to 90 percent of an area's mud crabs. Where it's considered native, like Florida, rates are lower—usually 10 percent or less—because these crab populations have had plenty of time to adapt to Loxo. Loxo is newer in Chesapeake Bay (first detected in 1964) and its mud crabs are now experiencing the same selective pressure Florida crabs experienced.

SERC researchers have tracked Loxo's abundance in Maryland mud crabs since the 1990s. Working with the Parasite Project team, Tepolt wants to find out how Chesapeake Bay mud crab populations are adapting to their parasite. She wonders if they're evolving to be like crabs in Loxo's native range.

While earning her doctorate from Stanford University, Tepolt studied green crab adaptation using genetics. She's doing something similar with mud crabs this summer. After collecting mud crabs from nine sites along the East Coast, she infects unparasitized crabs with Loxo in the lab and withdraws genetic material called messenger RNA from their gills. Messenger RNA, or mRNA, gets its name from its job: shuttling information from genes in a cell's DNA to the cell's protein-making machinery. The mRNA in a tissue tells researchers what genes are "turned on" and producing proteins. Tepolt will compare gene activity in three groups

Top: Carolyn Tepolt presses a flashlight against a vial of Loxo larvae she'll use to infect mud crabs. The light attracts larvae. The computer screen to the right displays a magnified Loxo larva. (SERC)

Loxo parasitizes white-fingered and black-fingered mud crabs. Above, two Loxo sacs emerge from a black-fingered mud crab's apron. The double sac indicates this crab has two parasites.

Left: This Loxo larva is less than 24 hours old and cannot infect crabs yet. Right: A 2-day-old Loxo larva, ready to infect a recently molted crab.

"It's such a strong selective pressure if you're getting 90 percent of your population castrated," Tepolt said. "That's not good for reproduction."

of crabs: those where Loxo is native, where Loxo is invasive, and where Loxo is absent (including New Jersey and Massachusetts).

She's looking for signs of adaptation. "It's such a strong selective pressure if you're getting 90 percent of your population castrated," Tepolt said. "That's not good for reproduction."

Extracting mRNA from crabs is straightforward, but tedious. Tepolt first preserves all RNA in a tissue sample with a special salt solution. To look at gene activity, she only wants mRNA, which has a long tail of adenines—a subunit of DNA and RNA—so she pulls out everything with this adenine tail and sends it to a sequencing company.

The sequencing company sends back a "ridiculous amount of data," she said, which she pieces together for each crab. Because mRNA corresponds to genes of DNA, Tepolt can use the mRNA to identify what genes were active in a crab at the time of sampling. Differences in gene activity between the three mud crab populations (those with native Loxo, invasive Loxo and no Loxo) hint at how the crabs are adapting. She can also investigate whether parasitism has altered the gene sequence itself. Tepolt thinks gene sequences and activity in crabs from Loxo's invasive range may be starting to resemble those from crabs from Loxo's native range.

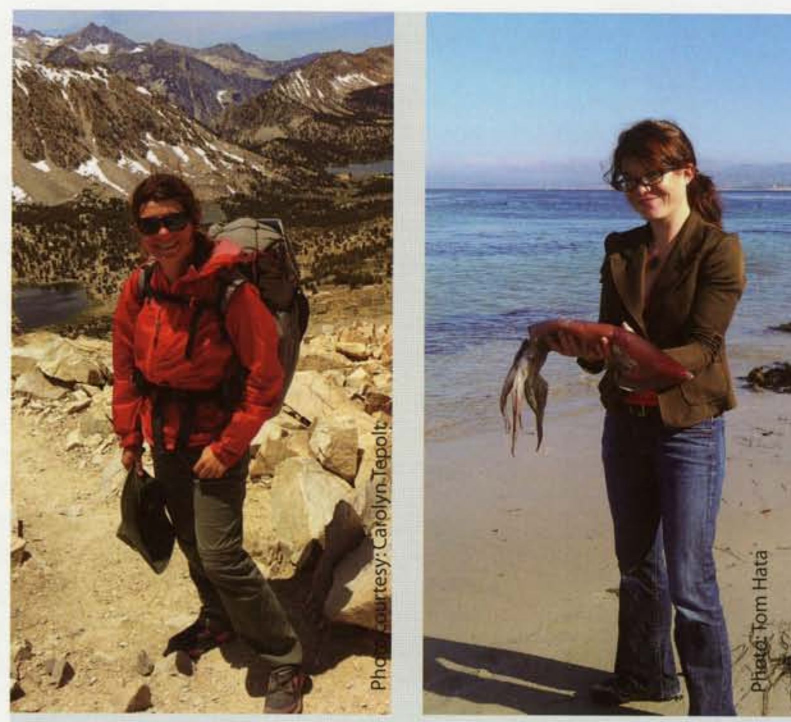
But Tepolt doesn't bury science in the lab. Before her fellowship, Tepolt solo hiked the Pacific Crest Trail in six months. She wanted a break from science after the stress of graduate school, but the novelties of the trail proved too alluring for her curious mind. She couldn't put science away.

"There were mariposa lilies in five or six different colors and I thought, Is that a mutation? I could do a genetic study!" said Tepolt.

Tepolt finds science in food too. She's a cook, baker, and candy maker. She launched a food science blog, Science Fare, with other graduate students from Stanford. In one post, Tepolt describes how to make macaroni and cheese with the same special salt solution she uses to preserve RNA, sodium citrate. She includes the caveat, "The Science Fare Team does not in any way endorse eating things you find in the lab. This is usually a bad idea. Don't do this."

Good advice from a scientist parasitizing crabs in her lab.

—by Chris Patrick, science writing intern



Left: Carolyn Tepolt pauses during her trek along the Pacific Crest Trail.

Right: Carolyn Tepolt holds a Humboldt squid at Hopkins Marine Station in Pacific Grove, Calif.

Climate Change in the Arctic's Forgotten Fjords

SERC partners track CO_2 on voyage to Greenland's uncharted waters

by Kristen Minogue

How exactly does one prepare for a 100-day voyage to the Arctic? "Chaotically," says Matt Rutherford, head of the nonprofit Ocean Research Project. He's inside the Ault, a 42-foot-long sailboat embarking the next day on an 8,000-mile journey to Greenland and back. Rutherford and his partner, Nicole Trenholm, will navigate unexplored fjords collecting data for the Smithsonian Environmental Research Center (SERC) and NASA. But first they have to finish packing.

"You're always paying attention to how much water you have, how much power you have, how much fuel you have," says Trenholm, a marine scientist who joined Rutherford in 2013. "It's kind of a game."

To conserve water, they're running their sinks and showers with saltwater. The galley is stuffed with trail mix, spices, Swiss Miss cocoa and freeze-dried food. There's something else in the cabinets too: an orange box secured with bungee cords, with tubing running up to the mast. The box, and the three clear cylinders lashed to the mast, is an instrument designed by SERC ecologist Whitman Miller. It's the main reason they're making the trip at all.

Sailing for Science

This is not Rutherford's first Arctic voyage. In 2012 he completed a 310-day solo journey around North and South America.

"I knew I was never going to stop sailing, so I wanted to do it in a way that was going to give back to the ocean," he says. He launched Ocean Research Project that year to collect data for scientists via sailboat, without the price of larger research vessels that can cost up to $25,000 a day. (Rutherford and Trenholm are operating this voyage at $250 per day.)

Their first projects included surveying plastic pollution, and listening for tagged fish for SERC biologist Matt Ogburn. They wanted to return to the Arctic, but many doubted a sailboat could handle sophisticated science around the poles. That changed when they met SERC ecologist Whitman Miller.

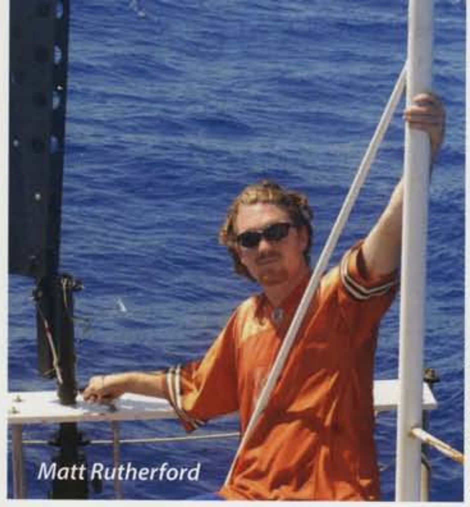
Miller studies ocean acidification in Maryland—though he prefers the term "ocean carbonization." "Really what's affecting things is the CO_2," Miller explained. As oceans swallow more CO_2 from the atmosphere, they become more acidic, bleaching corals and stifling shellfish growth. "If we didn't have changes in carbon dioxide concentrations in the water, this issue of acidification would be much less important."

Miller designed a device which continually measures CO_2 concentrations in the water. It's the three-cylinder instrument strapped to the Ault's mast, with the data box in the galley. It's not the world's first device tracking CO_2 in water. But before Miller, similar instruments could cost tens of thousands of dollars. His creation costs mere hundreds, collecting precise data without bleeding scientists dry. Though he'd stationed five on land, Miller envisioned collecting CO_2 data worldwide. When Rutherford and Trenholm offered to make his instrument mobile, he didn't hesitate.

"To me it was a no-brainer," he said. After Miller, they found two NASA projects willing to bet a sailboat could step

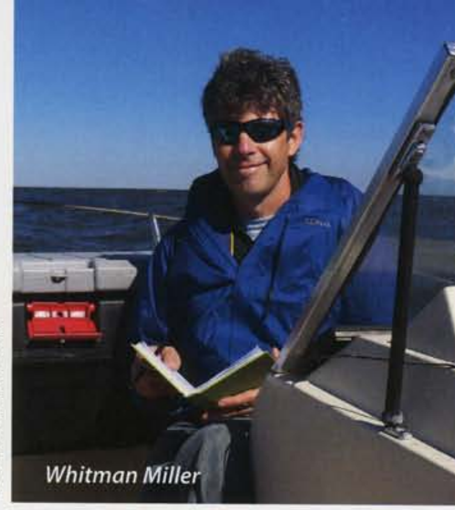
Greenland's Baffin Bay at sunset

Photo: Brocken Inaglory



Matt Rutherford

Photo: Nicole Trenholm



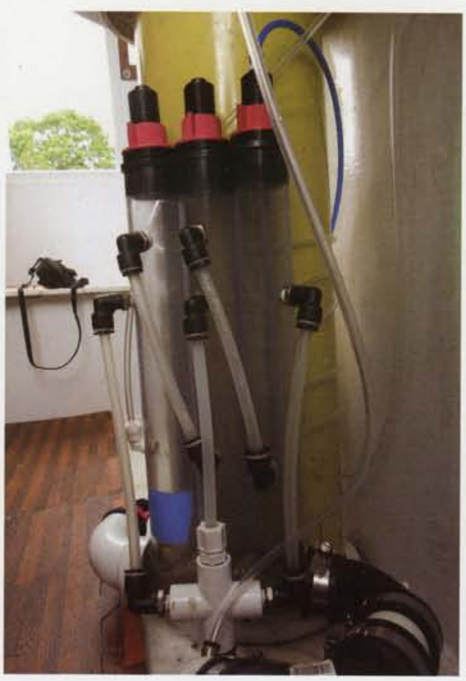
Whitman Miller

Nicole Trenholm

Photo: Nicole Trenholm

The Ault

Photo: Tom Spitzer



The CO_2 equilibrator above measures the concentration of CO_2 in the water. Its other half, an orange box that stores the data, is stashed in a cabinet in the Ault's galley.

into the Arctic research ring with the heavyweights.

Dangers of the Ice

Greenland contains one of the rarest things on Earth: uncharted waters. Many Greenland fjords have never been explored. Rutherford and Trenholm will navigate rocks, currents and 20-foot tides with only their eyes and what Rutherford calls "sailor's intuition." There will be long, sleepless nights. On most voyages only one person needs to be on watch, but the treacherous Arctic demands two.

More than twice the size of Texas, the Greenland ice cap would create an estimated 24 feet of sea-level rise if it melted completely. But the liquefying glaciers pose another threat. Their freshwater makes the oceans less salty—and more vulnerable to acidification. Saltier waters can absorb extra CO_2 without changing their acidity (pH) as much. But in freshwater, CO_2's impact becomes more drastic.

"If you add the same amount of CO_2 to a fresher water or less buffered water, the change in pH is going to be much greater,' Miller said.

All three feel they have something to prove. For Miller, the journey is a double test: first, that his instrument will work at sea for 100 days and, second, that it could one day be run by citizen scientists who, unlike Trenholm, have zero scientific training. For Rutherford and Trenholm, it's about proving a sailboat—long reduced to a mere pleasure craft—can compete in the research world.

But once they embark, their biggest enemy is time. Rutherford estimates they have a six-week window when the fjords will remain open.

"The Arctic, it ain't waiting for us," Rutherford says. "It's going to open up and, when it does, either we're going to be there or we're not. And if we're there, we can get our data. And if we're not, then everything's for nothing."

Where are they now?
Follow the Ault's journey in real time on
www.oceanresearchproject.com.

Pollution Weakens Mangroves Against Hurricanes

Dwarf mangroves grow taller but more fragile

Mangroves—the tangled trees common along tropical coastlines—are masters at protecting their territory from hurricanes. So, logically, tall mangroves should be stronger than short ones.

Except when they're not. Sometimes tall mangroves are weaker, something SERC ecologist Candy Feller discovered after two hurricanes tore through her experiments in Florida. Her team documented their surprising discovery in a new study published this May in *Ecology*.

Before the hurricanes, Feller had been running experiments in the Indian River Lagoon, a 150-mile stretch of islands along Florida's eastern coast. The lagoon shelters manatees, pelicans, dolphins, and a patchwork of black, red and white mangroves. But it is also in danger. Massive algal blooms were killing seagrasses, and other animals with them. The root cause: nutrient pollution from farms and sewers.

For eight years, Feller and her colleagues had tested how the excess nutrients impacted mangroves, the first line of defense against storms. To all appearances, nutrient pollution helped mangroves grow better, particularly nitrogen.

Photo: Anne Chamberlain

Candy Feller inspects a white mangrove stand in Florida.

Then in September 2004, two back-to-back hurricanes pummeled the lagoon. The first, Hurricane Frances, ranked among the 10 costliest storms in the U.S. The second, Hurricane Jeanne, ripped through three weeks later.

"My initial reaction was, we've got to get there," Feller said. "We have got to get there. This is too good of an opportunity. We have to know how much damage." The worst was in what she calls the transition zone, between tall fringe mangroves on the water and smaller "dwarf mangroves" farther inland. "All the lateral branches were broken off. They were just sticks."

After the initial destruction, the team needed to know how long it took mangroves to recover. So they continued the original experiment: adding nitrogen to some mangrove plots, adding phosphorus to others and leaving the rest alone. Four years passed. They watched and waited.

Mangroves nearest the water had suffered most, losing roughly 80 percent of their leaf area index (a special term for how much leaf material an area has). But they recovered in just over two years.

However, dwarf forests told another story. Dwarf forests grow farther from the coasts. Tides don't always reach them and, when they do, nutrients have often been stripped away. As a result, dwarf mangroves barely reached four and a half feet. Their low stature enables them to harbor life that doesn't flourish on the water's edge, like wading birds that fish in the dwarf mangroves.

Nitrogen changed all of that. Nitrogen enriched mangroves grew more than three feet higher than their brethren. Their height was their undoing. Nitrogen-enriched dwarf mangroves lost almost half their leaf area index and took almost four years to recover. Lower trees lost far fewer leaves and returned to normal in a just over two years.

Photos: Anne Chamberlain

Top: White mangroves stripped of their leaves right after the hurricanes. Bottom: A white mangrove begins to regrow.

Feller believes the reason is simple: During the hurricane, most dwarf mangroves were underwater, sheltered from the damaging winds.

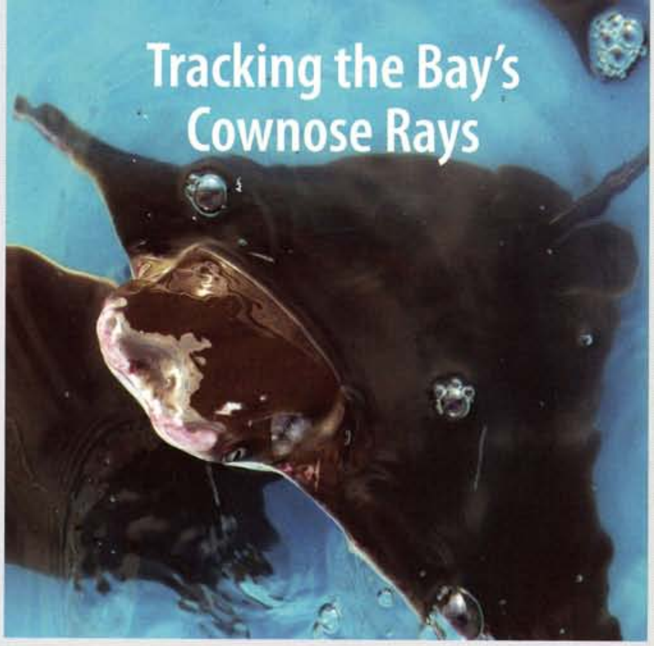
"They were below the water, which protected them," she said. However, taller mangroves faced the wind's full fury. "It's also faster, more vigorous-growing tissue, so it's possibly not as tough as older, slow-growing tissue."

There's a reason to protect dwarf mangroves: We need them to protect us. A coast may require 100 meters of mangroves to buffer against a major tsunami. Along much of Florida's coast, tall fringe mangroves extend just 20 meters. Dwarf mangroves cover the rest. If they're getting weaker, they won't be able to do their job.

"Increased nutrients are changing those dwarf trees into bigger trees," Feller said. "And the bigger trees are more productive, but they're more vulnerable too."

—by Kristen Minogue

Tracking the Bay's Cowanose Rays



It's 2 a.m. Rob Aguilar, biologist in the Smithsonian Environmental Research Center's (SERC) fish and invertebrate ecology lab, meets a group of fishermen at a pound net in the Patuxent River. The net starts at the shore and juts far into the river. Fish traveling along the shore collide with the net and follow its length into a heart-shaped net at the end—the pound.

Today, along with blue crabs and various species of fish, the pound contains cownose rays. Not ideal for fishermen, but exactly what Aguilar wants. Last summer, SERC researchers and collaborators surgically implanted acoustic tags in 31 rays to track their migration. This summer, they're tagging 20 to 25 more rays from Maryland rivers.

Though native to the East and Gulf Coasts, much about cownose rays remains mysterious. Many fishermen and oyster growers consider rays a nuisance because they eat shellfish and travel in schools in the hundreds.

"The main conflict seems to be between guys who fish for oysters—especially aquaculture oysters because there's a lot of money in that—and these rays they perceive as potentially eating up their profits," says Matthew Ogburn, SERC ecologist.

Those who see rays as profit-gobblers want fewer around. Some have attempted to establish commercial fisheries, and ray fishing tournaments are growing in popularity. Tournament organizers argue they're helping maintain populations at a healthy level, but conservation groups are concerned because rays reproduce slowly. Females give birth to only one pup per year.

Amidst this conflict, SERC researchers are studying ray migration. Cownose rays live in the Bay and other East Coast estuaries, but migrate to Florida come winter. The team wants to determine if Chesapeake rays belong to a local, regional, or coast-wide population. They're tracking the rays to see if, after overwintering in Florida, they return to a specific river for the summer, wander around the entire Bay, or visit a different East Coast estuary. Their discoveries could help decide whether rays are ultimately managed as pests or creatures to protect.

"If someone comes and has a big fishing tournament here and nails a bunch of the rays here, if it's a coast-wide population that probably has a small impact," says Ogburn. "If it's a local population, you could wipe out the local population really quickly."

To tag rays, SERC researchers meet fishermen before dawn and transfer captured rays to an aerated kiddie pool. Rays have barbed stingers, so the researchers wear wristguards and puncture-resistant gloves while transferring a ray from the kiddie pool to a smaller tub of anesthetic to knock them out before surgery.

Using bungee cords, they secure the now-sedated ray to a plastic bread crate with the edges cut off—the operating table. Aguilar slices open the ray's belly, inserts a tag resembling a mini Tootsie Roll (a really expensive Tootsie Roll), and sews the ray up. The patient is released after recovering.

Every two minutes, the tags make seven clicks encoding a number unique to each ray. When a ray is in range of a receiver, about half a mile, the receiver logs that it heard that ray's number. There are several hundred receivers along the East Coast, and the organizations running them all share data with each other. This includes collaborators at the Kennedy Space Center, whose receivers log the tagged rays off Florida's Cape Canaveral.

Researchers tagged and released four rays from the Virginia Institute of Marine Science (VIMS) pier in the York River last summer, with the help of VIMS fisheries specialist Bob Fisher. These rays were recently heard back at the same pier this summer, suggesting they returned to the same place they were the summer before.

If this pattern continues, it may suggest the rays belong to regional or river-specific local populations, whose numbers could be more vulnerable. But for now, the team is listening for short clicks beneath the water, the sound of another creature returning on a long journey from the south.

—Chris Patrick, science writing intern

Photos: SERC

Top: A cownose ray popping out of the kiddie pool. Far Left: Keira Heggie and Kim Richie transfer a ray to a tub of anesthetic. Left: Rob Aguilar operates on a cownose ray.

Intern Snapshots

by Chris Patrick

This year SERC interns covered a wider range of territory than any time before. Besides research, the class of 2015 led summer camps, took on science communications and included SERC's first full-time citizen science interns. Read about some of their exploits below.

Goby Nests and Silverside Guts in the Room of DOOM

In the marine ecology lab, the Room of DOOM ("Dissolved Oxygen Oyster Mortality") is now tracking not just oysters, but fish.

On an overcast day in June, intern Laurel Martinez checks her naked goby nests, a handful of plastic bread crates hanging from SERC's dock to the Rhode River floor. Eight PVC pipes sit horizontally on the crates, each stuffed with a rolled plastic sheet. The plastic should house naked gobies, a bottom-dwelling fish. But not today.

"The mud crabs took over!" she exclaims. Martinez needs goby eggs for her summer project. Female gobies, who usually lay eggs inside dead oyster shells, will go into the tubes, lay eggs on the plastic, and leave. A male will fertilize the eggs and stay put, guarding them until they hatch.

The Room of DOOM specializes in low oxygen and high acidity, the phenomena behind the "dead zones" in Chesapeake Bay. Once the mud crabs vamoose and gobies settle in, Martinez will bring goby nests into lab to study how these problems affect egg development.

Ken Wesley, the lab's other intern, studies how these same trends affect a different fish, the Atlantic silverside. After seining for silversides, Wesley puts them in tanks of water with varying amounts of dissolved oxygen and acidity to see how these factors affect feeding. In the lab, tiny silversides eat brine shrimp, an even tinier crustacean. To determine how much shrimp a silverside eats, Wesley cuts open their stomachs and counts the number of shrimp inside under the microscope. It's a tedious process.

They chose silversides and gobies because they're the easiest to access, according to Martinez. They're also a decent proxy for how oxygen and acidity changes could affect other fish in the Bay.

"If it affects these fish, we can see how it affects other species of fish in the whole web within the Chesapeake," says Wesley.

Top: Laurel Martinez holds a goby. (Ken Wesley)   Bottom: Male naked goby. (Laurel Martinez)

Bucket Buffets Divulge Deer Preferences

In 1916, a man named Clemment Henry released four to six sika deer for hunting on James Island, off Maryland's Eastern Shore. But it turns out sika are great swimmers—by 1962 they migrated to the Delmarva Peninsula and now occupy every county of the lower Eastern Shore. Non-native sika are from Japan. They're smaller than native white-tailed deer, marked with black, and keep white spots on their sides into adulthood.

Lisa Koetke is an intern in the terrestrial ecology lab. This summer she's helping John Devaney, a postdoc, determine if sika prefer to eat Maryland's invasive plants or native plants. In clover fields on the Eastern Shore, they set up bucket buffets: 25 buckets arranged in a square, each holding a different plant species. About half are native species and half are invasive species from Japan.

Koetke and Devaney check recordings from motion-activated cameras on the buffets' perimeters to make sure sika are the ones eating plants from the buckets—not the raccoons who occasionally "photobomb" the footage. They'll measure how much of each plant the sika eat to reveal if these non-native swimmers are a curse or a blessing for Maryland's native flora.

Left: Sika deer.   Right: Lisa Koetke sets up motion-activated camera.

Citizen Science: Below-Freezing Days Equal Fewer Bluebird Eggs

Since 2008, three devoted citizen scientists have monitored Eastern bluebirds in SERC's 48 nesting boxes. They check each nest weekly, recording the number of eggs laid and hatched. But recently the nest boxes have seen fewer bluebird eggs and hatchlings. Citizen science intern Caroline Kanaskie analyzed seven years of data to find out why.

The best year for bluebirds since data collection began was 2012, with 222 eggs. In 2013, the number fell just two short of that. But last year, the number of eggs laid plummeted to 170.

To explain this drop, the strongest relationship she's found so far is between the number of bluebird eggs and the number of days with average temperatures below freezing. It's an inverse relationship—the more days below freezing, the fewer eggs laid. There were many more days below freezing in 2014, which may explain the sharp decline in the number of eggs.

Below-freezing days may affect bluebirds' food. "If the berries are frozen, they can't get to them," Kanaskie said. "That's kind of the end."

Kanaskie hasn't seen the data from 2015 yet, but noted that this past winter had 47 days below freezing. "With that kind of winter, I would expect our bluebird numbers to be pretty low," Kanaskie said.

Kanaskie also wants to expand and publicize the bluebird project. But she recognizes that it's not hers. "I'll only be here for two more months, but [the citizen scientists] will be here for a really long time. I want it to go in the direction they want."

Top: Male bluebird in a nest box. *(Matt Storms)* ***Bottom: Bluebird eggs.*** *(Caroline Kanaskie)*

Education: Inspiring "Science Ninjas" at Camp Discovery

"Camp Discovery!" shouts education intern Josie Whelan.

"SCIENCE NINJAS!" a dozen 6- to 8-year-old campers respond as they strike ninja-esque poses. This is a callback, used by three education interns—Henry Lawson, Addie Schlussel, and Whelan—to grab the attention of talkative future first- and second-graders at Camp Discovery. The interns designed Camp Discovery, a week of visits to SERC's forests, fields, docks, and wetlands, to foster understanding and respect for nature in campers.

Today is Bug Day, and the campers are collecting insects. After the callback, the interns and 12 campers trek along a gravel road into SERC's woods. They're joined by Free Kashon, an intern studying insects in the terrestrial ecology lab, who teaches the campers where to find bugs.

When bug collection begins, most of the Science Ninjas begin furiously scratching the dirt and gravel with the ends of their bug nets. Soon enough, excited shouts ring through the forest as campers catch ants, beetles, and butterflies.

In the final minutes, 7-year-old Emma, who had "never catched a bug," scrambles to find one. Fortunately, 8-year-old Gavin helps her find and transfer a roly-poly (which isn't an insect, but a crustacean) into her net. Later, the campers look at insects under the microscope at the Reed Education Center. They display a mixture of excitement and disgust, comparing a butterfly's wings to fabric and gasping at the hairy appearance of a roly-poly.

The goal of Bug Day is to teach the students all about insects: where they are, what they look like, and why they're valuable. The week also included fish seining, frog catching, and looking through oyster baskets. The education interns are leading three other environmental camps after Camp Discovery, each for a different age group. But they'll be hard pressed to find a better callback line.

Want to know which lab's interns used selfie sticks for science? Visit the SERC blog at http://sercblog.si.edu.

Left: Addie Schlussel with camper. *(SERC)*
Middle: Campers Vivian and Gordon look for insects. *(SERC)*
Right: Caroline Kanaskie during archaeology dig. *(Mary Horabik)*

SMITHSONIAN ENVIRONMENTAL RESEARCH CENTER
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Keynote Lecture: Tom Horton

Wednesday, October 14, 7 p.m.

Mathias Laboratory

Join environmental writer Tom Horton Wednesday, October 14th, at SERC's keynote 50th-anniversary evening lecture. Horton will reveal lessons learned during his 43 years covering the Chesapeake: what's changed, what questions still need answers, and what it may ultimately take to save the Bay.

The talk is free and open to all. A dessert reception in the Mathias Atrium will start at 7 p.m., followed by the lecture at 8.

Tom Horton is an award-winning environmental journalist who has written about the Bay for more than 40 years. Born on Maryland's Eastern Shore, Horton has authored eight books, including the *Turning the Tide*, *An Island Out of Time* and *Bay Country*. His writings have appeared in the Baltimore Sun, National Geographic, Rolling Stone and the Smithsonian. He also works as an environmental studies professor at Salisbury University. For his most recent project, he is filming a documentary on blue crabs, inspired by the 1976 bestseller *Beautiful Swimmers*.

Photo courtesy of Tom Horton

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