



Smithsonian Environmental
Research Center

ON THE EDGE

News from the Smithsonian Environmental Research Center

Fall 2019 / Winter 2020

Surprise Discoveries From The "Wetland of the Future"

*Rising carbon, shrinking stems, and the new experiment
that's bringing the heat*

ALSO INSIDE:

Sustainability: How to Throw a Zero-Waste Music Festival

Chesapeake Bay: Female Blue Crabs Are Running Low on Sperm

Education: Are You Smarter Than a Broadcom Middle Schooler?



A team of SERC biologists tags blue crabs on the water. (Credit: SERC)

THE DIRECTOR'S LETTER



Earth in 2019: The Surprising Side Effects of Being Human

"That's funny..."

Science fiction writer Isaac Asimov once noted that this phrase—not "Eureka!"—is the most exciting thing a scientist can say. I've been a scientist at the Smithsonian for 40 years, and in that time I've heard plenty of variations of "Hunh...that's odd."

One of the greatest goals of science is to make the world more predictable. And yet, as scientists, we're constantly surprised. Research has a way of revealing hidden connections or unexpected consequences we never imagined until we took a closer look. Often, it's not "the exception that proves the rule," but rather the exception that reveals how a rule or ecological process works. Such surprises provide new ways of looking at a problem, insights that often unlock solutions.

That's especially true for the environment, and it's especially true now. If we want to heal our planet for the next century, we need to understand how it works. Farmers, fishers, business owners, policymakers, military personnel—we all depend on accurate predictions. We need to know how high sea levels could rise by 2050, or where the next deadly wildfire is most likely to strike. Most importantly, we need to know what actions we can take that stand the best chance of success.

This year, SERC scientists have helped uncover several unexpected ways humans are transforming their environments. High carbon dioxide is causing wetland plants to shrink? Yes—and that could be an unlooked-for blessing (see page 5). Fishing too many male blue crabs in the Chesapeake is causing some females to suffer "sperm limitation"? Yes—and that could become a problem, so I'm thankful our Fisheries Conservation Lab discovered it early (see page 4). Ocean plastic is enabling invasive species to raft across the Pacific? Check—and we've pinpointed some of the species most likely to thrive once they reach shore.

But 2019 hasn't been only about unintended side effects. I've also witnessed many positive ways people inside and outside the Smithsonian are transforming the world for the better.



Don Shappelle and Don Sennett performing at the Chesapeake Music Festival in September. (Credit: Kristen Minogue/SERC)

Our marine biologists have joined forces with Ben Lecomte and the Vortex Swim team, to study plastic in the Great Pacific Garbage Patch. This September, I was also proud to see our staff host our first event to target zero waste: the Chesapeake Music Festival. Part of the Smithsonian's Year of Music, the festival was a joint effort by SERC and the Arundel Rivers Federation. More than 400 people gathered on our hilltop overlooking the Rhode River, drinking craft beer, listening to Bay folk music and learning about the Bay's history and traditions. Everything offered was either recyclable or compostable. We were even able to convince the food trucks not to sell plastic bottled water.

The world is full of people eager to make change. Without good science, we're groping for solutions in the dark. Time and time again, science has shown us that the world is more beautifully complicated than we dreamed. Our mission at the Smithsonian is to find the hidden and unexpected connections, and use that knowledge to make the world better.

Your support enabled us to do this in 2019. You can make more of these moments possible in 2020. Because the phrase, "That's funny," is often just a few steps behind "Eureka."

— ANSON "TUCK" HINES, SERC DIRECTOR

Front cover image: SERC postdoc Genevieve Noyce (left) and senior scientist Pat Megonigal hold up a soil core taken from SERC's Global Change Research Wetland. Here, scientists are running experiments to simulate the world of 2100. See story on page 5. (Credit: Sairah Malkin/Horn Point Laboratory)

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Bog orchid *Platanthera clavellata*.
(Credit: Gary Van Velsir)

DECODING PLANT EVOLUTION, WITH RNA FROM A THOUSAND SPECIES

Green plants have flooded our atmosphere with oxygen for over a billion years. But exactly how and when each branch on their evolutionary tree emerged remains hazy. This October, nearly 200 scientists attempted to retrace evolution by sequencing the RNA—DNA's sister molecule—of 1,124 plant species.

It's part of the One Thousand Plant Transcriptomes Initiative. SERC ecologists Melissa McCormick and Dennis Whigham contributed two North American orchids: the rattlesnake plantain *Goodyera pubescens* and the bog orchid *Platanthera clavellata*. The team found that typically, major evolutionary leaps—like flowers or survival on land—came after intense genetic duplications, expansions or contractions. The most gene expansions came with the emergence of land plants about 450 million years ago. However, the team also discovered a time lag between gene duplications and when major evolutionary changes manifest.

Link to research article: <https://www.nature.com/articles/s41586-019-1693-2>

GLOBAL CHANGE IS TRIGGERING AN IDENTITY SWITCH IN GRASSLANDS

Grasslands have sustained us for millennia. Besides providing food for livestock, they can store up to 30 percent of Earth's carbon and shelter animals found nowhere else in the wild, like zebra and bison. But today, global change is transforming their plant species.



Grasslands are home to species found in no other environments, like this baby bison.
(Credit: Kim Komatsu/SERC)

WE'RE CHANGING A BASIC WAY PARENTS HELP OFFSPRING ADAPT

Every parent wants to give their children the best shot at life. For many species, this isn't just protecting newborns after birth. Species can prepare offspring for tough conditions *before* life starts, through hormone, microbiome or sperm and egg changes. But today, humans are shifting environments so rapidly these time-honored techniques risk backfiring.



SERC postdoc Sarah Donelan in Wellfleet, Massachusetts.
(Credit: Patricia Donelan)

In a November paper, SERC postdoc Sarah Donelan examined what it takes for these parental strategies to succeed. For example, if an existing threat like drought intensifies, a drought-savvy mother could cue her offspring. But if something new like an invasive species arrives, or environmental swings become too unpredictable, parents have more trouble giving accurate cues. Given the speed and extent of human-triggered changes, Donelan said, the odds of parents giving the wrong info is especially high.

Link to research article: [https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347\(19\)30277-0](https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347(19)30277-0)

In a new study led by SERC's Kim Komatsu, ecologists examined 105 grassland experiments. Each experiment tested at least one global change factor, like rising carbon dioxide, hotter temperatures or drought. In general, grasslands could resist the effects for about a decade. But then plant species began to shift. While some grasslands lost species, many had the same number but different kinds. That turnover, Komatsu said, can transform how a grassland works.

"Is it good rangeland for cattle, or is it good at storing carbon?" she asked. "It really matters what the identities of the individual species are."

Link to research article: <https://www.pnas.org/content/116/36/17867>

FEMALE BLUE CRABS ARE RUNNING LOW ON SPERM

—UNLESS THEY DIE YOUNG

BY KRISTEN MINOGUE

If you want to save a fishery, protect females. That's been the operating logic for decades among fishery managers, and with good reason: Females carry the next generation. Throw one mature female back, and she could produce thousands or millions more offspring. But for blue crabs, the story isn't so simple.

In an October study, scientists from the Smithsonian Environmental Research Center (SERC) confirmed a potential snag is happening in Chesapeake Bay. Without enough male blue crabs to go around, some females aren't getting enough sperm to reach their full reproductive potential. If they survive past their first spawning year, they risk running dry.

WANTED: FULLY-CHARGED MALES

It boils down to one inconvenient truth: Female blue crabs have an extremely short biological clock. Unlike some crab species, a female blue crab mates for just one period in her life—within a week or so after shedding her shell for the last time. During this time, she mates with one or possibly more males and gets all the sperm she'll ever receive.

"What they get during that timeframe is all they have for reproduction for the rest of their life," said lead author Matt Ogburn.

In Chesapeake Bay, the fishery encourages harvesting more males than females. That could leave remaining males stretched thin.



Matt Ogburn, head of the Fisheries Conservation Lab. (Credit: Midge Kramer/SERC)

Ogburn leads SERC's Fisheries Conservation Lab. His team began collecting female blue crabs in Chesapeake Bay six years ago. They were looking for females that had recently mated but hadn't produced any eggs yet. They wanted to estimate how many sperm they received during mating, and compare them to crabs that had started producing broods.

In a single mating, a male crab could give a female anywhere from 770 million to 3 billion sperm. While that may seem like a lot, Ogburn's team discovered female crabs lose up to 95% of that sperm in the next couple months, before they even have a chance to fertilize any eggs. (The reason for that is still a mystery.) The team estimated it takes about four sperm to fertilize one egg. Consider that the average brood has roughly 3 million eggs, and that healthy females can produce three broods a year, and those sperm can run out pretty fast.



A female blue crab can produce broods like this three times a year, each with millions of eggs. But if male crabs are in short supply, she may not have enough sperm to fertilize all her eggs. (Credit: SERC)

The good news is that even in the worst-case mating scenario, most female crabs should get enough sperm for at least one year of spawning. If they're lucky enough to make it to year two (only about 15% do), then things start to get tougher.

In their field surveys, the scientists found that a female that reached her second year of spawning had, on average, 15 million sperm left. That's enough to fertilize at least one more brood. But at three broods per year, it wouldn't allow her to fertilize another year's worth of eggs.

SECOND-YEAR DROUGHT? FIRST-WORLD PROBLEM

However, there's a bigger obstacle facing female crabs in the Chesapeake. Most don't live long enough to experience a second-year sperm drought.

Before spawning, female crabs must migrate to the saltier waters of the lower Chesapeake Bay, which provide better habitat for their larvae. A summer sanctuary in the lower Bay spans nearly 600,000 acres to protect them. Watermen aren't permitted to take females out of that sanctuary during the peak of spawning season, from June until mid-September.

So far, the team's evidence suggests the sanctuary is working—if females can make it there. But many get caught or eaten on the way. According to Ogburn, the vast majority of females caught outside the sanctuary haven't even had the chance to reproduce once. Of those that survive the journey, most will die before their second year.

"There's been talk in the past about protecting the migration corridors, to allow more females to get into this one sanctuary," he said. The current management strategies have helped the crab population recover from record lows in the 1990s and 2000s, Ogburn added. Migration corridors may be an option to increase the population further or respond to future declines in the fishery.

All totaled, the team estimated sperm limitation is causing a 5 to perhaps 10% decrease in blue crabs' reproductive output in the Bay. Ogburn said that doesn't pose a major problem yet. It means they caught it early, and now managers can watch out for harvesting males too intensely in the future.

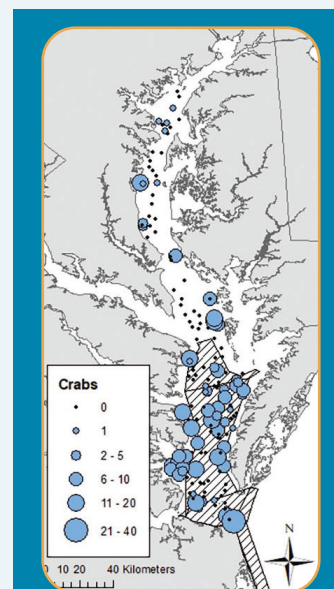
The bigger threat to females, of course, is dying before producing any offspring. For now, the ones who run out of sperm are the fortunate few.

Link to research article:

<https://www.int-res.com/abstracts/meps/v629/p87-101/>



Technician Kim Richie prepares spermathecae (the organs where female crabs store sperm) for sperm counting. (Credit: SERC)



The Chesapeake summer spawning sanctuary (striped) protects females from harvesting from June to mid-September. (Credit: SERC and Marine Ecology Progress Series)



When carbon dioxide spikes, wetlands grow shorter stems aboveground and more roots below—which makes them better at resisting sea level rise. But at the same time, rising temps stir up microbes in the soil that could turn the story upside-down. Go inside two fall discoveries from SERC's Global Change Research Wetland, home to experiments that mimic the year 2100.

Double Discovery from the "Wetland of the Future"

BY KRISTEN MINOGUE

Carbon Dioxide Brings Shrinking Stems...

For most plants, carbon dioxide acts like a steroid: The more they take in, the bigger they get. But this fall, SERC ecologists discovered something strange in marshes. Under higher carbon dioxide, instead of producing bigger stems, marsh plants produced more stems that were noticeably smaller.



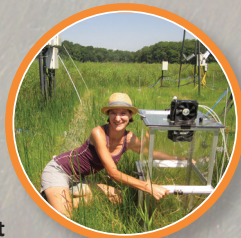
"I don't think anybody expected this," said Meng Lu, who lead the new discovery after crunching 30 years of data. For years, scientists had known carbon dioxide was bulking up the total biomass of marsh plants, so it seemed natural to think

individual plants were getting bigger too. "But that's not the case in a marsh."

Lu, now a research professor at China's Yunnan University, made the finding while a SERC postdoc. Lu realized inside high-carbon dioxide chambers, where scientists are experimentally raising carbon dioxide to levels possible by the end of the century, the biomass of all marsh sedges rose 20%. But surprisingly, individual stems shrunk 16%.

The stems are shrinking because of another ingredient plants need to grow: nitrogen.

Without enough nitrogen, extra injections of carbon dioxide won't spur the plants to grow bigger stems. Instead, they'll spread their roots farther belowground to draw more nitrogen from the soil. And because most marsh plants are "clonal" (they can reproduce by copying themselves), they send up more stems aboveground as their roots spread. This means *more* plants rather than bigger ones.



This may be good news for the marsh and people nearby. Having a thicker wall of stems—even shorter ones—buffs up the marsh's defenses. A dense marsh is good at absorbing energy from hurricanes and storms. Denser roots, another side effect of high carbon dioxide, could be another plus. Roots enable a marsh to build soil. When a marsh builds soil, its entire elevation goes up, giving it a chance of outpacing sea level rise.

"Accelerating sea level rise is a threat to marshes worldwide," said SERC biogeochemist Pat Megonigal, who oversees the Global Change Research Wetland. "The possibility that marshes will be able to trap more sediment at the same time is reason for a bit of optimism."

...and SMARTX Brings The Heat

Just a few weeks after Lu's "shrinking stems" discovery, another SERC postdoc revealed a twist. What happens when the marsh heats up?

Enter SMARTX ("Salt Marsh Accretion Response to Temperature Experiment"), the wetland's newest field experiment. Using infrared lamps and underground wires, ecologists are heating patches of the marsh 1.7, 3.4 and 5.1 degrees Celsius higher than today (about 3.1, 6.1 and 9.2 degrees Fahrenheit). These temperatures mirror three possible futures scientists predict for the next century.

Postdoc Genevieve Noyce watched marsh sedges grow for two years. What she saw surprised her. With just the lowest warming (1.7°C), plants became thirstier for nitrogen and grew more roots. But at higher temps, that stopped. Root growth dropped back to normal.

Noyce remembers her first reaction to the data: "Oh, shoot, did I screw something up? Why does it look like this?"

The answer was in the soil. Plants get nitrogen from soil microbes. Scientists have long known that when soil heats up, microbes get excited. But a mere 1.7 degrees warmer wasn't enough for these microbes.

"The microbes aren't responding with the low temperature," Noyce said. "It's only once you get up to 3.4 degrees of warming."

Once it got hot enough for microbes to crank out more nitrogen, plants didn't need so many roots. Porewater samples from the marsh confirmed Noyce's theory: At lower warming (1.7 degrees), nitrogen in the water dropped, meaning plants were absorbing nitrogen faster than microbes could replace it. But at higher temperatures, with microbes energized, porewater nitrogen rebounded.

For many plants, extra nitrogen could be a boon. Without the pressure to grow so many roots, they're free to grow more green stems, capturing more carbon for photosynthesis. But marshes need roots to survive against rising seas.

The Paris Agreement aims to keep Earth below 2 degrees Celsius of warming. Noyce's work suggests that could be a sweet spot for wetlands: At that range, wetland plants could still grow deep roots, increasing their odds of outpacing sea level rise. But somewhere above that, soil microbes begin to awaken. Wetlands may look lush aboveground thanks to extra nitrogen, but they'll be more fragile below where it counts.

Links to research articles:

High CO₂ and Shrinking Stems (Nature Climate Change): <https://www.nature.com/articles/s41558-019-0582-x>

Soil Warming and Nitrogen Supply (Proceedings of the National Academy of Sciences): <https://www.pnas.org/content/116/43/21623.full>

Top to Bottom: In the SMARTX experiment scientists heat up marsh plots to different temperatures, ranging from 5.1°C hotter in the front of this photo, to 3.4°C, 1.7°C and no extra heating in the back. (Credit: Genevieve Noyce/SERC); Meng Lu measures green blades of sedge in the Global Change Research Wetland. (Credit: Maria Sharova/SERC); Genevieve Noyce sits beside an experimental chamber at SMARTX, SERC's global warming experiment, when it was first being set up in 2016. (Credit: Heather Soulen/SERC). Background: Global Change Research Wetland. (Credit: Thomas Mozdzer)

INTERN

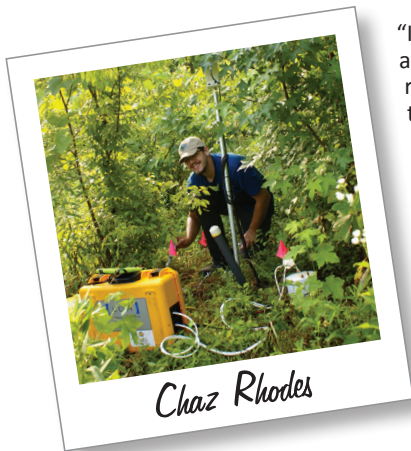
SNAPSHOTS

CHAZ RHODES: How Gassy is the Ground?

BY ALISON HAIGH

When it comes to forests, most people think of soil as a static ingredient for growing trees. But talk to any forest ecologist or soil scientist, and you'll get a radically different idea about dirt. Soils are living, breathing ecosystems. Their most abundant residents—microbes—help make forests the largest carbon sink on the planet.

However, sometimes soils produce methane, an even more potent greenhouse gas than carbon dioxide. SERC intern Chaz Rhodes spent his summer trying to untangle the soil's complex and often confusing carbon budget. Working with SERC postdoc Paul Brewer, he helped design equipment that acts like high-tech straws, carefully sipping air trapped within the soil.



Chaz Rhodes

"It's mostly PVC, epoxy, and tubing—pretty simple, really," Rhodes said. Now those straws are installed in over two dozen sites. Aboveground, a series of colorful tubes stick out of the lush undergrowth. Belowground, each tube connects to a probe that creates an empty chamber to collect gas, which the team later analyzes in lab.

Two different microbes determine whether forest soils will release or trap methane. *Methanogens* emit methane, and *methanotrophs* consume it. In waterlogged soils, methanogens can flourish and make the soil burp out more methane. Trees, on the other hand, absorb water through their roots, creating a drier, more oxygen-friendly environment where methane-trapping microbes can thrive.

The samples Rhodes and Brewer took this year are the start of what Brewer hopes will be a 30-year project. Over those 30 years, Brewer hopes to identify how a growing forest affects methane production in the soil.

Editor's Note: An earlier version of this article mistakenly said "Methanotrophs emit methane, and methanogens consume it." Methanogens emit methane, and methanotrophs consume it. The staff regrets the error.

Above: Chaz Rhodes samples gases in the soil with the equipment he helped design and install. (Credit: Alison Haigh/SERC); Top right: Alex Kane prepares to put stakes inside a ginkgo plot to help the trees grow properly. (Credit: Quinn Burkhardt/SERC); Bottom right: Lily Bennett fixes some technical issues in one of the ginkgo chambers. (Credit: Alison Haigh/SERC)

GINKGOS: The Scientists' Time Machine

BY QUINN BURKHART

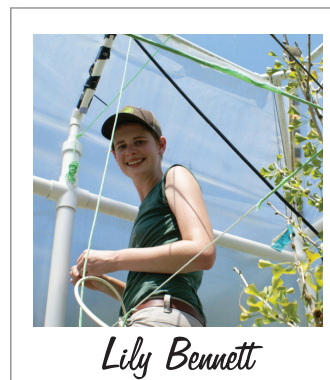
When the word *fossil* comes to mind, the first things many people think of are dinosaurs. But even though dinosaurs are long extinct, we still walk under the shade of a special fossil that grew in the dinosaurs' time. We call this "fossil" a ginkgo tree: an ancient plant offering a glimpse into the future.



Alex Kane

This summer, three SERC interns studied a large plot of ginkgos hiding along one of SERC's gravel roads. Alex Kane, Lily Bennett and James Sappington worked alongside Richard Barclay, a botanist who studies ancient plants at the Smithsonian's National Museum of Natural History.

Ginkgos belong to a genus of trees that appeared on Earth 190 million years ago, which makes them perfect for predicting how plants today will respond to climate change.



Lily Bennett

"Because they show a long history of surviving multiple, very different eras of climates, they're one of the only types of plants we could use to see how huge amounts of carbon in the air might affect plants later," Sappington said.

The interns helped Barclay grow ginkgos in plastic chambers—some pumped with carbon dioxide up to more than double today's levels—to study how extra carbon dioxide affects their growth. Barclay collects leaves from the chambers as part of a massive online citizen science project called "Fossil Atmospheres," where online visitors examine ancient and modern ginkgo leaves for signs of different climates. The interns had their own personal projects as well. Bennett's, for example, involved growing baby ginkgos in the plots with seeds from ginkgos planted in the 1930s.

"It's pretty impressive, just looking at this entire production of research," Kane said. "To think I get to be part of it is just awesome."

Want to go deeper? Learn more about Fossil Atmospheres, and become an online citizen scientist, at www.si.edu/fossil-atmospheres.



Other food vendors included a small local community center, with whom festival planners worked to buy compostable supplies. Being sustainable isn't always cheap, especially for small businesses. One case of 1,000 16-ounce compostable clear cold cups can cost \$89. That same case in plastic costs just \$52. The planners helped them procure these items. They also persuaded vendors to sell canned beverages instead of bottled water.

Another major component was creating a single waste zone. Manned by a volunteer team, the waste tent sheltered recycling bins, composting bins and the single office-sized trash can. Volunteers not only monitored waste to prevent mixed materials, but answered questions about composting, recycling and sustainability. Another tent covered a "water zone" where attendees could refill their reusable water bottles for free.

While the Chesapeake Music Festival might not become an annual event, SERC and the Arundel Rivers Federation showed that with dedication and planning, even a small organization can throw a large-scale event with sustainability at the forefront. We're extremely proud of the day's success, and are grateful to every volunteer and staffer who made it happen!

A longer version of this article originally appeared in the Smithsonian newsletter *Sustainability Matters*.

One small bag that could fit into an office-sized trash can. That's all the waste left after a concert with more than 300 attendees, over 50 staff and volunteers, eight performing groups and four food vendors. Surrounding it, eight recycling containers and four composting bins waited for pickup. By and large, the first Chesapeake Music Festival achieved its goal of near-zero waste, to the exhausted but happy relief of its organizers.

Months of effort went into that lone trash bag: working with vendors, buying supplies, and encouraging visitors to bring their own water bottles to reduce single-use plastics.

Part of the Smithsonian Year of Music, the Chesapeake Music Festival on Sept. 14 included performances from Don Shappelle, That West River Band, Washington Revels Jubilee Voices and other folk singers from around the Bay. But when the Smithsonian Environmental Research Center (SERC) and the Arundel Rivers Federation teamed up to hold it, they had an even loftier goal: Make it zero waste.

The first big steps were with food vendors. Festival coordinators found two—The Green Bowl and GoGanics—already committed to sustainability. They used compostable materials, sourced produce locally, and (in GoGanics' case) even ran the truck with their spent fry oil.

Top: The lone trash bag from the Chesapeake Music Festival, in front of green composting bins, and blue bins and bags for recycling. (Credit: Sarah Wade/SERC)

Families listen to music at the Chesapeake Music Festival, on SERC's hilltop overlooking the Rhode River. (Credit: Kristen Minogue/SERC)



Washington Revels Jubilee Voices. (Credit: Kristen Minogue/SERC)

Are You Smarter Than a Broadcom Middle Schooler? BY KRISTEN MINOGUE

Six teams. Three and a half hours. An assortment of PVC pipes, propellers, batteries, duct tape and pieces of foam that resembled something from swimming pool noodles. This October, 30 of the most talented middle schoolers in the U.S. worked to turn these materials into remotely-operated underwater vehicles (ROVs) and test them from SERC's docks.



MASTERS. Out of nearly 3,000 applicants, 30 finalists are chosen. But once they arrive, the idea of solo science disappears. Here, great science depends on working as a team.

"All 30 of us, we're all strangers with each other," said Hannah Shu, a 2019 Broadcom student from California. "The first day we didn't know each other at all. I think the hardest thing in my opinion was working with someone that, you have no idea who they are."

The program still contains some traces of competition. A series of prizes waits at the finish line, ranging from \$2,500 to \$25,000. But Broadcom's arguably greatest impact is intangible: the empowerment from finding kindred spirits.

"A lot of these kids come here and they find their people," Ramadorai said. "They find their fellow researchers and their fellow engineers and scientists that just love doing this, just as much as they do."

Teachers: Want your students to do hands-on STEM challenges?

The students were part of Broadcom MASTERS (short for "Math, Applied Science, Technology and Engineering for Rising Stars)." Every year, a panel of judges identifies the top 30 middle school science students across the U.S. to do hands-on science in Washington, D.C. The program lasts just under a week, and includes medical, computer and engineering challenges plus visits to Congress.



the D.C. area, so by the time they reach SERC, the six teams have already learned to collaborate.

SERC has hosted the Broadcom engineering challenge for four years. The engineering challenge is the last one students face in

Qualifying isn't easy. First, students must do well in their local science fairs. The top 10% of those students are invited to apply for Broadcom

This year also saw Broadcom's highest number of female students: 18 out of 30 according to Raeva Ramadorai, program manager for Society for Science & the Public, which runs Broadcom MASTERS.



Top L-R: One of the Broadcom teams, including Hannah Shu (second from left), examines a vial of sediment their remotely operated vehicle (ROV) collected; Five Broadcom students test their ROV at the SERC docks; Broadcom students gather on the SERC dock after finishing the engineering challenge. (Photos: Kristen Minogue/SERC)



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Donor Spotlight: HANNON ARMSTRONG

INVESTING IN THE FUTURE OF ENERGY®
BY KRISTEN MINOGUE

Climate change is transforming all facets of society—and that includes business, from small family-owned stores to international corporations. But businesses are also key to solving it. As the first public company in the U.S. dedicated solely to financing climate change solutions, Hannon Armstrong is among those leading the charge.

This spring, Hannon Armstrong was the first to join SERC's Corporate Leaders Program, a new initiative SERC launched in 2019 to bring together forward-thinking business leaders. Hannon Armstrong and its president, Jeff Eckel, already had a history of being environmental pioneers: In 2013, when they launched their initial public offering on the New York Stock Exchange (NYSE: HASI), they became the country's first public company to focus exclusively on investments that reduce carbon emissions or increase resilience to climate change. Last year the company invested \$1.2 billion in renewable energy, energy efficiency and other sustainability projects, which they estimate will save nearly half a million metric tons of carbon dioxide emissions per year.



Their investments also saved 1.6 billion cumulative gallons of water in 2018, roughly equivalent to eliminating water consumption in 14,000 U.S. households.

"We're pleased to have Hannon Armstrong as part of our new Corporate Leaders team," said SERC director Anson Hines. "They're actively developing financing for green technology and finding affordable solutions to climate change."

Corporate Leaders commit to donating at least \$2,500 annually to SERC's research and education programs. As members, a team of Hannon Armstrong employees was able to join SERC scientists in the field this July for a staff Citizen Science Day at the Global Change Research Wetland (pictured). Members can also use SERC facilities for corporate meetings, network with other environmentally conscious business leaders, get behind-the-scenes tours of Smithsonian museums and participate in broader Smithsonian corporate events.

Do you know a business working to advance sustainability?

To join the Corporate Leaders Program or learn more, contact Brian Magness at magnessb@si.edu or (443) 482-2205. View more details at <https://serc.si.edu/corporate-leaders>.

Above: Hannon Armstrong staff help SERC scientists at the Global Change Research Wetland in July. (Photos courtesy of Hannon Armstrong)

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