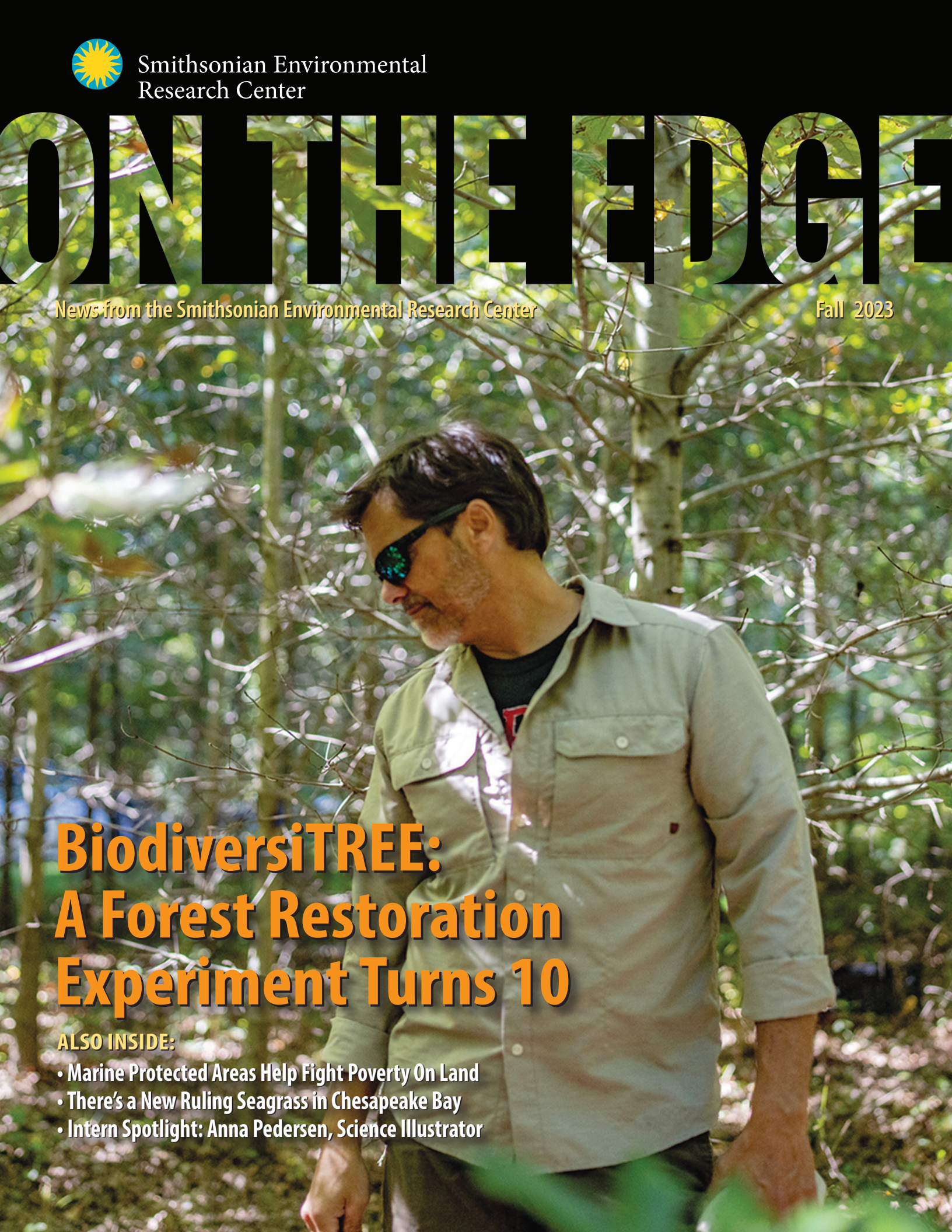
Smithsonian Environmental Research Center

ON THE EDGE

News from the Smithsonian Environmental Research Center

Fall 2023



BiodiversiTREE: A Forest Restoration Experiment Turns 10

ALSO INSIDE:

- Marine Protected Areas Help Fight Poverty On Land
- There's a New Ruling Seagrass in Chesapeake Bay
- Intern Spotlight: Anna Pedersen, Science Illustrator

DIRECTOR'S LETTER:

Life on a Sustainable Planet

America has just come through one of the most scorching summers in living memory. In June, wildfires in Canada created hazy skies on our Maryland campus and unhealthy air quality as far south as Georgia. July 3 broke charts as Earth's hottest day on record—only to be surpassed again on July 4. The National Centers for Environmental Prediction recorded a global average of 62.92 degrees Fahrenheit on Independence Day, the highest since its records began in 1979. Some scientists estimate Earth hasn't been this hot in 125,000 years.

Hawksbill sea turtle in Belize. (Credit: Gregory Piper/ Ocean Image Bank)

The real impacts of climate change are undeniable and interconnected around the planet. Even the devastating wildfires on Maui—where climate was just one of many factors at play—laid bare how fragile our society truly is. How do we chart a future when the path ahead seems so clouded?

My hope and commitment to new solutions stem from one core truth: We are an integral part of a larger planet, with all its complexity. That truth explains how humanity created climate change. But it also means that nature-based solutions are key to life beyond climate change. The expanding scope and reach of SERC's research and public engagement programs remind me that those solutions are within our grasp.

Last fall, at the United Nations' annual climate change conference known as COP27, the Smithsonian launched the Our Shared Future: Life on a Sustainable Planet initiative. It's an act of hope and defiance. Though the name is new, in reality it brings together work the Smithsonian has been doing for over 175 years, and that SERC has been leading for nearly 60 years.

The Smithsonian has always cared deeply about the health of our planet. In 1846 our first Secretary, Joseph Henry, set up a meteorology program that inspired hundreds of Americans to submit local weather reports. Since then, the Smithsonian has extended its reach around the globe. Smithsonian ecologists work to rescue endangered species, conserve reefs and wetlands, restore fish stocks, promote sustainable farming and engage youth.

You'll find some of these stories in the pages of this newsletter. BiodiversiTREE, our 20,000-tree forest experiment, turned 10 this spring. We've watched this forest grow from infancy. Nearly 100 volunteers helped us plant it in 2013, and today it's become far more than a restoration project. It's yielded new insights into how diversity can make restorations more successful: by bolstering tree survival, sheltering more wildlife and even helping forest soils store more carbon.

We're working to shore up coastal marine ecosystems as well. Across Chesapeake Bay, we're recruiting volunteer scientists to help monitor water quality in a joint project with NASA called Chesapeake Water Watch. One of them, Maria Alejandra Ceballos, has returned 30 years after working as an intern for the scientist leading the project. And in our most inspiring ocean story of the summer, we discovered marine protected areas do more than protect fish. They also combat childhood hunger and boost the incomes of people who live near them. Sustainability is a win-win for people and nature.

Of course (because we're the Smithsonian), there is always room for art. Anna Pedersen joined us this spring as our first science illustration intern. Her painting of a sustainable oyster reef, visible on page 10, now hangs in our Mathias Lab.

A 12-species plot in BiodiversiTREE in 2023, 10 years after its planting. (Credit: Kristen Goodhue/SERC)

Being part of a team as far-reaching as the Smithsonian, with nearly two centuries of work to understand our planet, sustains me through days of despair. If you feel inspired by anything you find here, we invite you to join us in creating our shared future.

- ANSON "TUCK" HINES, SERC DIRECTOR

Top Photo: Bluestriped grunts and gray snappers swim above a reef in Hol Chan Marine Reserve near Ambergris Cay, Belize. (Credit: Pete Oxford); Cover Photo: John Parker walks through BiodiversiTREE, a forest restoration experiment he created in 2013. (Credit: Stephen Voss/Smithsonian)

MARINE PROTECTED AREAS IMPROVE HEALTH, WEALTH OF NEARBY COMMUNITIES

BY PAULA JASINSKI AND KRISTEN GOODHUE

Protecting the ocean and providing livelihoods and food security don't have to be mutually exclusive. A new study, led by the Smithsonian Environmental Research Center (SERC), shows that limiting human activity in parts of the ocean can bolster fish populations and the well-being of people living nearby.

In December 2022, nearly 200 nations agreed to protect at least 30% of the planet's terrestrial and marine ecosystems by 2030—the famous "30 by 30" pledge—as part of the United Nations Biodiversity Conference. Marine protected areas (MPAs) are critical to meeting those goals. However, little research has explored whether MPAs can help achieve the United Nations' Sustainable Development Goals, especially those related to marine ecosystems, food security and alleviating poverty.

For the study, published in June in *Nature Sustainability*, SERC researchers examined the impacts of MPAs in the Mesoamerican Reef region. They discovered that MPAs with the most stringent fishing restrictions helped sustain fisheries. But they also uncovered a link between marine protections and elevated incomes and food security in coastal communities nearby.

"Our study provides evidence that MPAs in the Mesoamerican Reef region have the potential to benefit both people and nature at the same time," said lead author Justin Nowakowski, SERC senior scientist and Conservation International fellow.

"Marine protected areas are hailed as a way to protect fisheries and ecosystems and promote well-being in coastal communities simultaneously," said Steve Canty, coauthor and coordinator of the Marine Conservation Lab at SERC. "This is one of the first attempts to evaluate these benefits together. Our data critically show that well-enforced, no-take zones help rebuild fish populations and that these zones are associated with higher well-being in nearby coastal communities."

The authors relied on a mix of data from ecological and social organizations, including the Healthy Reefs Initiative and the U.S. Agency for International Development.

They discovered MPAs with the highest protections had on average 27% more fish biomass than open-access zones with no restrictions whatsoever. Commercially valuable fish like grouper were even more abundant, with 35% more biomass.

The benefits for people were even more striking. Young children living near MPAs were roughly half as likely to suffer stunted growth, a key sign of food insecurity. And the average wealth index, a measure of relative household income, was 33% higher in communities near the best-protected MPAs.

"MPAs unquestionably help improve the health of reefs and fisheries and, in some cases, may positively impact the well-being of coastal communities," said Sara E. Bonilla-Anariba, a Penn State University researcher and one of the paper's authors. "However, there is an ongoing debate about the factors influencing their positive outcomes."

Much of this may be due to the "spillover effect"—the idea that when fish are allowed to flourish in one protected spot, their populations spill over to areas around the sanctuary where fishers are free to catch them. But this study could not discern whom MPAs helped most: fishing households, or households with other incomes like tourism. The power of community-led MPAs is also worth further study, the authors said.

"There is still a lot that we don't know about the interaction between marine protected areas, fisheries and human well-being," said Nathan Bennett, Global Oceans lead scientist for the World Wildlife Fund. "How do marine protected areas affect other aspects of human well-being? What factors increase positive outcomes? How effective are coastal, community-led marine protected areas?"

In the meantime, this discovery adds a few more drops to a growing wave of evidence that protecting the ocean also protects people.

"The goals of sustainably managing marine resources, increasing food security and reducing poverty in local communities do not always lead to tradeoffs—these positive outcomes can occur in the same places," Nowakowski said. "Under the right conditions, conservation interventions like MPAs may be central strategies for achieving multiple Sustainable Development Goals."

LINK TO STUDY:
https://www.nature.com/articles/s41893-023-01150-4

Center, top to bottom: Small-scale fishers float above a reef in Utila, Honduras. (Credit: Luciano Candisani); Sea fans off the coast of San Pedro, Belize, near the Hol Chan Marine Reserve. (Credit: Fabrice Dudenhofer/Ocean Image Bank); A small-scale fisher throws a net over Rock Cay in Utila, Honduras. (Credit: Luciano Candisani); Grunts and horse-eye jack fish swim above a reef in Hol Chan Marine Reserve near Ambergris Cay, Belize. (Credit: Pete Oxford)

Background: Caribbean reef sharks in Roatán, Honduras, an island in the Mesoamerican Reef. (Credit: Carlos Díaz/Ocean Image Bank)

Scientists and interns who planted BiodiversiTREE in 2013, along with roughly 100 volunteers. From left: Susan Cook-Patton, Whitney Hoot, Caitlyn Cecil, Jess Shue, John Parker, Kim Holzer and Lada Klimesova. (Credit: Susan Cook-Patton)

BiodiversiTREE: North America's Largest Tree Diversity Experiment Turns 10

BY KRISTEN GOODHUE

"Plant it and forget it for 10 years. Nothing interesting happens in young forests."

John Parker remembers hearing that advice from a colleague who worked in tropical forests. It was the summer of 2012. Parker, a senior scientist at the Smithsonian Environmental Research Center (SERC), was on the verge of planting 20,000 tree saplings on the center's campus. Once planted, his team would watch a new forest grow from scratch. He hoped the project would continue for at least a century.

John Parker, creator of BiodiversiTREE, in 2023. (Credit: Kristen Goodhue/SERC)

"I was pretty worried," Parker said. The early years were especially rough, as his lab worked to win small grants and recruit interns to help keep it going. "We didn't forget it," he said. "We kept the experiment running and collected data. But it was somewhat piecemeal without a big grant to hold it all together."

Just over a decade later, the 60-acre experiment—BiodiversiTREE—is a thriving mosaic of sycamores, elms, tulip poplars and 13 other tree species. It's attracted scientists from around the world. Some are former SERC postdocs returning with their students. Others are new collaborators.

Parker now sees the project as a model of "if you build it, they will come." But building it was tough.

THE CONSTANT GARDENERS

Nearly every effort to conserve life on land, on some level, depends on trees. They fight climate change, filter pollution and provide

habitat. But most tree planting efforts contain just one species. BiodiversiTREE aimed to shake up that paradigm.

The experiment contains 70 "mini-forests"—large plots with one, four or 12 tree species. That setup enables scientists to find out whether a diverse forest offers more benefits than single-species monocultures. An additional five plots were left alone to regrow naturally, revealing what would have happened with no intervention.

Parker secured funding to launch the project from John Kress, the Smithsonian's then-Under Secretary of Science and Research. In early 2013, nearly 100 volunteers joined Parker and his two staff—postdoc Susan Cook-Patton and project coordinator Whitney Hoot—to plant thousands of saplings. Even with help, the labor was grueling.

"I ended each day practically asleep on top of my dinner plate, after digging holes and hauling trees all day," Cook-Patton recalled.

Parker's team still does months of backbreaking labor every year—mowing, weeding and keeping out "volunteer trees" that could throw off the experiment. Sweet gums and tulip poplars would happily take over all the plots, which is a problem for slower-growing species like hickories.

"Keeping the treatments at one, four, 12 is definitely the hardest," said Jamie Pullen, Parker's head technician. Without this meticulous maintenance, Pullen and Parker both pointed out, preserving a true diversity experiment would be impossible.

"Probably half of our job is not 'science.' It's just keeping it alive," Parker said.

Project coordinator Whitney Hoot helps volunteer Joseph Shirley plant a maple sapling in 2013. (Credit: Kristen Goodhue/SERC)

DIVERSITY'S DIVIDENDS

Does diversity pay off? Yes—though not always in the ways Parker and his colleagues expected.

Some single-species plots, like sycamores, saw phenomenal growth. Other single-species plots barely got off the ground. Maple saplings shrank before hungry deer. Emerald ash borer reduced the ash trees to dead-looking sticks. In the poorest performing plots—hickory monocultures—a mere one in five trees survived.

Aerial photo showing the different tree plots of BiodiversiTREE. (Credit: Mickey Pullen)

However, diverse plots were far less prone to these boom or bust cycles. At least half the trees survived in diverse plots, and some saw survival rates as high as 93%. Parker likens forest diversity to a stock portfolio: It's about risk management.

Diversity brings other benefits as well: cooler summer temperatures, greater animal diversity and more carbon and water in the soil. BiodiversiTREE's second decade is shaping up to be bigger than its first, with two grants from the National Science Foundation. One will examine whether soil fungi can influence tree growth and carbon storage by comparing soil microbes in BiodiversiTREE to soil microbes in forests across the continental U.S.

"We're going to use our work here at SERC to in a sense ground truth the entire United States," said Parker.

The second grant will explore whether soil and leaf microbes in BiodiversiTREE affect enemies attacking the trees, including leaf insects and pathogens.

The "plant it and forget it" idea still rings in Parker's head occasionally. But after seeing the immense benefits diversity can have even on young forests, he's relieved he and his team persevered.

"If I'd not done anything for those 10 years, just forgotten about it and kept it alive, and then come in and measured everything, I would have missed a ton of stuff that's happening," Parker said.

Voices of BiodiversiTREE

"In my mind's eye, I can still see the open field filled with corn stubble and tiny saplings. It is such a delight to juxtapose that memory against the real sight of trees stretching ever higher towards the sky."

– SUSAN COOK-PATTON, senior forest restoration scientist at The Nature Conservancy

Credit: Susan Cook-Patton

More than anywhere else in BiodiversiTREE, the forest canopy shows the most striking contrast between diverse and single-species plots. In single-species plots, trees race each other to the top. They grow tall and narrow in their quest for sunlight. However, diverse forests are more likely to contain both shade-tolerant and light-hungry species. Here, trees can grow wide and full. They stretch out their branches, creating shadier, more complex canopies that offer refuge for wildlife.

Single-species sycamore plot in BiodiversiTREE. (Credit: Susan Cook-Patton)

"When I got here, there was no shade out here. No shade…Now, I would say we have almost more plots with canopies than without."

– JAMIE PULLEN, SERC head technician

Credit: Stephen Voss/ Smithsonian

As the canopies grow, they create their own microclimates within the forest plots. More diverse plots have more moderate temperatures, keeping it cooler in summer and warmer in winter. They also retain more water in the soil and the air. Wildlife feel the differences too, Pullen pointed out. Mosquitoes didn't used to be a problem in the early years of BiodiversiTREE, when the landscape was uniformly hot and open. Now, the humidity is drawing the insects to diverse forest enclosures.

"All trees have a microbiome, just as we do….One of the potential benefits of a diverse forest is that diversity may support healthy microbiomes which can ultimately help trees to perform better."

– ERIC GRIFFIN, assistant professor at Warren Wilson College

Credit: SERC

Eric Griffin studies the bacteria and fungi that live in tree leaves, known as "leaf endophytes." When he began his research as a SERC postdoc, he expected more diverse tree plots would harbor more diverse fungi. But the opposite proved true. When his team dug deeper, they discovered it was the harmful, disease-causing fungi that were less abundant inside the leaves of diverse plots. Today he has joined four other lead scientists in a National Science Foundation grant to study the larger forest food web, from microbes in the roots, to leaf chemistry, to leaf-eating caterpillars and other insects.

Background: One of five plots allowed to grow naturally in BiodiversiTREE (Credit: SERC)

"... If you build it, they will come."

- John Parker, referring to how BiodiversiTREE has become a magnet for ecologists

Credit: Abby Robinson/ Univ. of Maryland

"As a scientist...we keep our methods the same to keep everything similar. But it's challenging when the environment you're working in is changing. And this forest is definitely changing."

– KARIN BURGHARDT, assistant professor at the University of Maryland

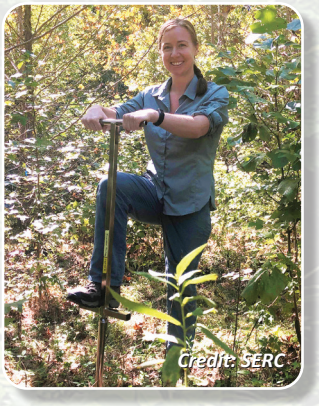
Three years after the trees were in the ground, Karin Burghardt began the first animal studies in BiodiversiTREE. She first searched for caterpillars using trees as host plants, and then branched out to spider predators. Diversity proved to be a boon for spiders, who found refuge in the shadier canopies during summer. But the caterpillars were, well, complicated. Diverse plots have consistently hosted more caterpillars overall. But the number of different caterpillar species using the plots is changing. For the first four years of her project at SERC, Burghardt found more caterpillar species using trees in diverse plots. But in the last two years, caterpillar species in single-species plots have begun to catch up. It's a testament to how much even a few years' growth can transform a forest ecosystem.

12-species plot in BiodiversiTREE. (Credit: SERC)

4-species plot in BiodiversiTREE. (Credit: Susan Cook-Patton)

"Many studies focus on, oh, let's see how fast we can accumulate aboveground biomass. But there's the flipside. Soils are really important sinks for carbon."

– RACHEL KING, postdoctoral fellow, National Center for Ecological Analysis and Synthesis



Credit: SERC

BiodiversiTREE contains 75 forest plots—and Rachel King has excavated soil cores from all of them. Inside the hundreds of samples she processed during her SERC postdoctoral fellowship, she hunted for carbon. On average, she discovered single-species monocultures were far more likely to lose carbon from their upper soils, especially in the early period right after planting. Meanwhile, the 12-species plots held onto nearly all the carbon in their top layers. The reason is still a mystery. But if fast-growing monocultures trigger a loss of soil carbon at the beginning, that could offer a powerful incentive to plant more diverse restorations.

Widgeongrass Replaces Eelgrass as Chesapeake's Dominant Seagrass

BY REBECCA LATOURELL (Virginia Institute of Marine Science) AND KRISTEN GOODHUE

*Widgeongrass (*Ruppia maritima*) has replaced eelgrass as the dominant Chesapeake seagrass, partially because it can withstand higher temperatures.*

*Eelgrass (*Zostera marina*), once the dominant seagrass in Chesapeake Bay, has struggled in the face of rising temperatures. (Photos: Alyson Hall)*

There's a new boss taking over the Chesapeake's underwater plant scene. Widgeongrass has expanded to become the most abundant seagrass in Chesapeake Bay, thanks in part to its ability to withstand hotter temperatures that come with climate change.

Scientists reported the discovery this May in *Proceedings of the National Academy of Sciences*. The former frontrunner—eelgrass—has seen its territory cut in half over the past few decades as it struggled to cope with marine heat waves and poor water quality. Meanwhile, widgeongrass terrain has expanded to 2.5 times its former size. Once confined to shallow brackish waters until the mid-1990s, widgeongrass has benefited from measures to slash nutrient pollution. The authors also chalk the rise up to widgeongrass's high temperature tolerance and long-lasting seeds.

"Ideal widgeongrass conditions have fueled two record-setting peaks for Chesapeake Bay seagrass cover," said lead author Marc Hensel, a postdoctoral research associate with the Virginia Institute of Marine Science (VIMS). "In fact, much of the nearly 300% increase in Bay plants since the mid-1990s has been widgeongrass expansion into areas that eelgrass has vacated."

Stories of seagrass comebacks have injected much-needed hope for restoring Chesapeake Bay as a whole. In 2018, members of the same team reported a four-fold recovery of the Bay's underwater plants. But the discovery of a species shift adds a new layer, pointed out Jonathan Lefcheck, former SERC ecologist and lead author of the 2018 study.

"Our past work showed a record-setting resurgence of underwater grasses in response to nutrient management," said Lefcheck, who also coauthored the latest study. "But now we are seeing that the story is vastly more complex and, in fact, is still being written."

However, the shift has some negative consequences that are concerning managers. While widgeongrass is resistant to heat waves, it is extremely vulnerable to spring rains, which can bring huge influxes of nutrient- and sediment-loaded water into the Bay.

"Widgeongrass has shorter, thinner blades than eelgrass," Hensel said, "which makes it more vulnerable to springtime runoff events because sunlight can't reach the short blades through the clouded, nutrient-loaded water."

Widgeongrass's tendency to fluctuate also jeopardizes its ability to provide consistent habitat for underwater animals, like blue crabs and black sea bass.

This isn't the first time climate change has triggered a shift in dominant, habitat-forming species. Mangrove trees now grow in areas historically dominated by salt marshes and oyster reefs. Invasive Pacific oysters are replacing native blue mussels in the Wadden Sea. And macroalgae are exhibiting dominance over hard corals in the Caribbean and Indo-Pacific.

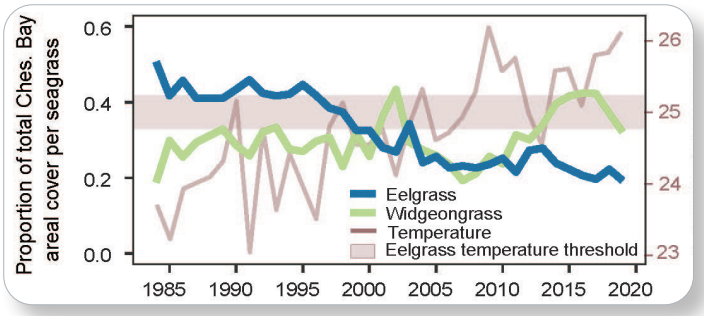
The seagrass study highlights the importance of not treating all seagrasses equally. Pitfalls can occur if managers lump habitat-forming species into single stocks, such as "hectares of seagrass" or "acres of marsh."

Meanwhile, vulnerability to local pollution—and not climate change—may make widgeongrass easier to protect than eelgrass, the authors pointed out.

"Heat wave stress is uncontrollable on a local and regional level," said coauthor Chris Patrick, an associate professor at VIMS. "But managing the amount of nutrients that enter the Bay from the watershed during a rainy spring is something that we can actually control."

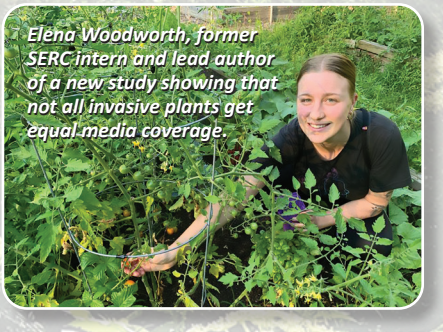
LINK TO STUDY:

https://www.pnas.org/doi/10.1073/pnas.2220678120



Over the past 35 years, temperatures have exceeded what eelgrass can tolerate, and widgeongrass has begun to replace it. (Credit: Study authors)

Above, center: Marc Hensel (front) prepares to measure widgeongrass and eelgrass photosynthesis with Caitlin Sughrue in Hungar's Shoal, Virginia. (Credit: Alyson Hall)



Elena Woodworth, former SERC intern and lead author of a new study showing that not all invasive plants get equal media coverage.

The Media Isn't Covering Invasive Plants Equally. Here's Why.

BY LAILA HURD, SERC science writing intern

When it comes to media coverage, not all invasive species get equal treatment. A new study found that out of 209 invasive plant species in the United States, half the media coverage over the past decade centered around just 10 species. Additionally, 80% of media coverage focused on only the top 25 invasive plants.

For John Parker, a community ecologist at the Smithsonian Environmental Research Center (SERC) and senior author of the paper, the study began at his uncle's lake house. Unknowingly, Parker's uncle had planted several invasives.

"I said something to the effect of 'You know, that's going to spread,'" Parker recalled. "Then that piqued his interest. His eyes lit up a little bit. Honestly, it all started from that couple of interactions like that, to see what made people actually interested in invasive species."

INVASIVE PLANT "PERSONALITIES" – WHAT DRAWS ATTENTION?

Parker's team turned to the internet to identify which plant traits drew media coverage and Google searches. For example, invasive plants like kudzu, coined "the vine that ate the South," are abundant and conspicuous enough to hold attention. Others, like giant hogweed, pose health risks like skin irritation. The researchers found that the more personal the interaction with the plant, the more likely it will stick in the public eye.

"That loss of control is something that people worry about when you're thinking about invasive plants," Parker said. "This idea that if I put it in my yard it's going to take over everything, and it's a hassle for me personally, the landowner. I think that stresses people out. But if it's something that's one or two steps removed from them, they can move on."

However, it's not uncommon for invasive plant species to fly under the radar. That's especially true for ornamental and agricultural plants. Japanese barberry, a particularly spiky bush used in home gardens, is available at Home Depot even though it spreads into native environments.

Disproportionate media coverage left a gap in the public's knowledge of several other invasive species. Elena Woodworth, former SERC intern and lead author of the paper, highlighted the importance of noticing that knowledge gap.

"Initially we went in expecting to see local occurrences—like if you encounter the plants out in nature, that might be what makes you interested," she said. "I think we were expecting it to be the ecological factors. So it was a little surprising to see that the media was such a big factor in it."

SPREADING AWARENESS, NOT INVASIVES

Reconsidering which invasive species require attention, and how those species get managed, will require an overhaul of media coverage. Woodworth noted that people may be missing some basic information about invasive species and their potential uses—like plantain, which has medicinal properties.

"People know what they look like, but they don't know their name," Woodworth said. "And they also have these uses. And they are almost considered to be native, because they've been here for so long." She acknowledged that there's a delicate balance between using invasive species and not encouraging their growth too much.

When profit is a barrier to gathering information on invasive plants, rethinking the ornamental plant industry may help as well.

"I would suggest rather than trying to keep them for that monetary value, to replace them with native species," Parker said. "We can find species in the native subset that can do mostly the same things."

By showing the link between public interest and media coverage, this research shows a pathway to fixing the knowledge gap.

"People do pay attention when they read things and see it," Parker said. "We've just got to get more news in front of people's faces—whether or not that's through social media or traditional news sources."

LINK TO STUDY:

https://link.springer.com/article/10.1007/s10530-023-03101-8

Water spinach (Credit: Plague)

Phragmites australis (Credit: SERC)

John Parker, head of SERC's Terrestrial Ecology Lab, specializes in native and invasive plants.

Kudzu (Credit: Scott Ehardt)

Japanese barberry (Credit: Hladac)

Japanese barberry and water spinach photos licensed under the Creative Commons license https://creativecommons.org/licenses/by-sa/4.0/deed.en.
Background: Giant hogweed (Credit: Lendskaip)

INTERN SPOTLIGHT

ANNA PEDERSEN
and the Power of Science Illustration

BY ANNA DAVIS, SERC education postdoctoral fellow

Though the Smithsonian Institution is home to both mind-bending art and groundbreaking science, these two disciplines all too often appear as opposites. The myth that scientists are dominated by their "analytical left brain" and artists are dominated by their "creative right brain" creates a false dichotomy. However, art is an increasingly important way to communicate complex scientific ideas.

This spring, SERC sponsored its first science illustration internship and experienced the power of bridging the gap between art and science. Anna Pedersen joined SERC for an 11-week internship, thanks to generous funding from the Maxwell/Hanrahan Foundation. Her intern project centered on creating a beautiful and original painting that helps communicate SERC science.

Pedersen's background in both scientific studies and illustration poised her well for this task. She pursued her undergraduate degree in conservation at the University of California, Berkeley. Following college, Pedersen leaned into her artistic side, earning a master's certificate in science illustration from California State University, Monterey Bay.

Working at SERC offered her a new canvas, as she prepared to depict the underwater animals of Chesapeake Bay.

"Being from California, I wasn't entirely familiar with many of them before coming out here," she said. "It was amazing to get to surround myself and learn about all of these species."

During her internship, Pedersen worked with Matt Ogburn, senior scientist for SERC's Fisheries Conservation Lab, and Alison Cawood, director of public engagement at SERC.

Pedersen benefited from working closely with the Fisheries Conservation Lab. She regularly went into the field to observe the different species she would feature in her final product, a painting of life in Chesapeake oyster reefs. It was an important part of her artistic process to ensure that the depictions of the animals were accurate.

"If I ever had questions about fish anatomy or identification, there was always someone to ask and get feedback on what I was working on," she said. "It was a really invaluable and unique aspect of this internship."

Her final piece was a 14"x26" gouache painting that shows the many organisms of the Chesapeake that rely on oyster reefs for food and habitat. The painting creatively demonstrates how reef-dwelling organisms change from the less salty tributaries of the Chesapeake Bay down to its mouth near the Atlantic Ocean.

Anna Pedersen's painting of the organisms that live in Chesapeake oyster reefs. The left side represents oyster reefs in less salty parts of the Bay. The species change with increasing salinity towards the right of the painting. (Credit: Anna Pedersen/SERC)

While the original painting now hangs in SERC's Mathias Lab, a digitized version will help expand its use in public engagement. Plans are underway to create online interactive resources and printed posters featuring Anna's artwork, to share with educators and students. In addition, we used some of her preliminary sketches to create a coloring and activity book, featuring crabs, fish and other oyster reef residents. Even the youngest SERC visitors will be able to learn from Pedersen's work.

The science illustration internship offered a mutually beneficial experience for both Pedersen and SERC. We hope to continue sponsoring science illustration interns at SERC in the future, and further explore the powerful intersection of science and art.

If you're interested in exploring more of Anna Pedersen's artwork, visit her website at www.saltyearthstudios.com

Above, L-R: Anna Pedersen beside her framed painting in SERC's Mathias Lab. (Credit: Kristen Goodhue/SERC); Anna Pedersen working diligently on her painting of Chesapeake Bay oyster reefs. (Credit: Anna Davis/SERC); Anna Pedersen's painting desk, with an early version of her work. (Credit: Anna Pedersen/SERC)

DONOR SPOTLIGHT

AMY KLEIN

BY BRIAN MAGNESS

Amy Klein, of Menlo Park, California, has always considered herself an educator at heart. She started her career path as a teacher before moving into financial planning, where she built her own successful firm. But even then, she found time to teach a Zoom class on English idioms to the spouses of international grad students at nearby Stanford University.

One day, while listening to a Smithsonian Sidedoor podcast about the decline of global bird populations, she decided to prioritize support for scientific research on habitats and restoring ecosystems.

"I thought the emphasis on bringing more environmental teaching materials to educators was very important, particularly those serving less affluent communities," Klein said. "I am a fervent believer that we need to begin teaching our children about climate change so that they can have a solid basis for understanding what is happening in the physical world and what they might do to help bring about positive changes."

Once she learned about SERC, she began making generous annual gifts in support of our hands-on education programs.

"As a former teacher, I have always felt that getting students physically involved in their learning had a significant impact on their engagement," she said. "Field trips with hands-on experience can show a whole new world to students who have rarely had such exposure. Moreover, those hands-on experiences can lead to new career directions as well as greater academic aspirations."

This year, Klein's gift is supporting a SERC-led program that brings together educators from Smithsonian Affiliate organizations around the country to engage high school students in local climate action projects. As part of the program, the educators will attend a workshop at SERC in August. This will allow SERC to emphasize the importance of place-based education and local context to audiences from coast to coast.

Amy Klein on a recent trip to Kauai, Hawai'i. (Courtesy of Amy Klein)

VOLUNTEER SPOTLIGHT

MARIA ALEJANDRA CEBALLOS Returns After 30 Years

BY LAILA HURD

Maria Alejandra Ceballos, a volunteer with the Chesapeake Water Watch project, has returned to the Smithsonian Environmental Research Center (SERC) after 30 years. In 1993, Ceballos was a summer intern at SERC with Pat Neale, a scientist with the Photobiology and Solar Radiation Lab.

As an intern, Ceballos did "ground truthing," which confirms whether satellite readings match readings from the ground. Today, Chesapeake Water Watch volunteers do similar work with a smartphone app called HydroColor. But in the 90's, the technology was very different.

"She made the measurements on what was called the sun photometer," Neale said–or a little brown box with two buttons. "The instrument was constructed by the Smithsonian because there weren't a lot of commercial instruments available at that time."

Ceballos remembers the patience required to use it.

"We would use data from the satellite that came on a floppy disk," she said. "Then we would have to download it on the computer. . . There were a lot of steps that today you don't have to do."

The Chesapeake Water Watch project fits Ceballos' image of accessible science, as she can use HydroColor near her home in southern Maryland on local tributaries.

Left: Maria Ceballos uses a sun photometer during her 1993 internship. Right: 30 years later, Ceballos uses the Calitoo photometer, an updated version of the same device. (Credit: Jenny Jones and Pat Neale)

"I believe in volunteering wholeheartedly, and have been doing it since I was in my early teens through adulthood," Ceballos said. "I find rebranding it as citizen or community science really empowers the volunteer as an integral part of the team."

Outside of Chesapeake Water Watch, Ceballos has participated in various projects, such as tracking terrapin populations near the Bay and venturing out to the Bering Sea to collect water and mud samples for her lab.

"These projects highlight that volunteers can make a difference on a local and global scale, and that finding ways to participate allows one to value both our Earth and science tangibly," she said.

Left: Sun photometer from 1993. Built by the Smithsonian, Ceballos used this instrument to measure atmospheric clarity and UV light during her internship. (Credit: Jenny Jones); Background: View of the Rhode River from the SERC dock in 1993. (Credit: Maria Ceballos)

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Fall Events

Earth Optimism Webinars

Hosted on Zoom. Sign up at www.serc.si.edu/events/evening-lectures

The Mysterious Migrations of Cownose Rays

with Dr. Matt Ogburn, Smithsonian Environmental Research Center

Tuesday, Sept. 19 • 7pm ET

Cownose ray. (Credit: Jay Fleming/Smithsonian)

Capstone Lecture: What's For Dinner? Reconnecting Our Food With Our Climate

with Dr. Jessica Fanzo, Columbia Climate School

Tuesday, Oct. 24 • 7pm ET

Dr. Jessica Fanzo (Credit: Derek White)

ZOMBIE DASH

Sunday, Oct. 29 • 10am ET

This Halloween weekend, grab your running shoes and favorite post-apocalypse T-shirt for SERC's first ever zombie dash! Choose from a zombie-infested 5k or a zombie-free 1k, with post-run trick-or-treating for kids. Costumes optional...just don't forget to bring your brain. Special thanks to The Brick Companies for sponsoring the event!

Sign up at www.serc.si.edu

Photos: Meng Lu

the brick companies

The Smithsonian Environmental Research Center is recognized by the IRS as a 501(c)3 nonprofit organization. Contributions to SERC may be tax-deductible.

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