



Smithsonian Environmental
Research Center

ON THE EDGE

News from the Smithsonian Environmental Research Center

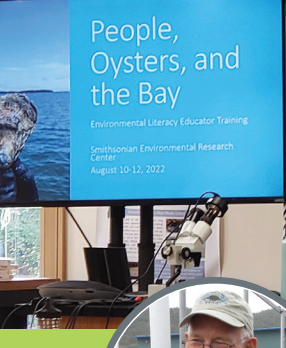
Spring 2023



SERC's Place-Based Teacher Training

ALSO INSIDE:

- New Estimate of Blue Carbon Storage in Belize's Mangroves
- Reflections From Retiring SERC Scientist Dr. Cindy Gilmour
- Meet the Reed Center's New "Tank Team"



DIRECTOR'S LETTER:

Raising Environmental Literacy In Our Backyards

Every spring, we adjust our driving patterns on the SERC campus to watch out for amphibians crossing the roads. As the ground thaws, salamanders, frogs and toads emerge to mate and lay eggs in our ponds and vernal pools. Amphibians are suffering major declines and extinctions around the globe, and we want to ensure populations of the 17 species here can reach their full reproductive potential.

Our scientists have their own “spring emergence” as they launch into a new field season. In the Mathias Laboratory, the once-quiet halls of winter now echo with the squeak of waders, the creak of trolleys filled with samples, and the hustle and bustle of technicians, interns, and principal investigators. It’s time to count the fish migrating up stream and to get the sensor arrays and experimental chambers in position. Down the Dock Road at the Reed Center, our education staff and volunteers welcome back school groups. Hundreds of students learn about Earth’s amazing ecosystems, some of whom have never seen a live turtle, held a net or waded in a river. They get wet, collect samples and discover (often for the first time) what it’s like to be a scientist.



High school teachers conducting a DNA extraction on applesauce using everyday materials. (Credit: Anna Mehlhorn/SERC)

However, unlike our local flora and fauna, our education department does not lie dormant in winter. In the colder months, Karen McDonald and her team continue to bring Smithsonian science into classrooms around the country by giving virtual lectures and conducting teacher development training. Virtual outreach has expanded our reach from the Chesapeake to California and beyond. Now, more children than ever learn about SERC research and incorporate it into their own experiences.

SERC is fortunate to work with donors, foundations and community leaders who share our commitment to education. Through that donor commitment, we’ve had programs that place teachers from around the D.C. region alongside environmental scientists in labs and in the field, putting them at the center of the action.

Our newest initiative is called EnLET. Short for “Environmental Literacy Educator Training” EnLET brings educators from across Chesapeake Bay to SERC for hands-on workshops, where they interact with scientists and other stakeholders. In the feature story of this issue, education postdoc Anna Davis offers an inside look at the EnLET program. These teachers go on to develop new curricula and lesson plans that become part of the broader Smithsonian Learning Lab to reach millions of children.

That is the power of Smithsonian. These professional development programs are at the heart of our educational mission, which goes back decades.

We launched our earliest professional development program—our undergraduate intern program—over 50 years ago, in 1970. SERC’s internship program was one of the first in the country for hands-on experience that is now *de rigueur* for progress to a research career. Today, we welcome roughly 60 paid interns per year to our campus (as well as some working virtually), over 5,000 students and teachers, and over 12,000 visitors. We reach thousands more every year through our Earth Optimism Lecture Series, our citizen science programs, dedicated docents and volunteers, and this newsletter.

All these programs boil down to one mission: raising environmental literacy. By working with teachers and students alike, we can promote good environmental habits and teach a new generation about Earth stewardship. And for so many, environmental stewardship ultimately comes down to *place*. People care about their homes, their backyards, what they see and what they know.

Which brings me back to the amphibians. It may seem like a small thing, having SERC staff use alternate routes to protect frogs and salamanders at a critical point in their lives. But this is what place-based education looks like in practice. By raising awareness of the unseen denizens of our campus, we can ensure they remain to chirp, burrow and eat flies for another year.

- ANSON “TUCK” HINES, SERC DIRECTOR

Top Photos L-R: SERC postdoc Dr. Anna Davis leads an educator workshop on Chesapeake Bay oysters. (Credit: Karen McDonald/SERC); Workshop participants sort through oyster shells to learn about the many organisms that call oyster reefs home. (Credit: Vanessa Holloway-Chambers/SERC)

Cover Photo: SERC postdoc Dr. Anna Davis discusses oyster anatomy during an educator workshop on oysters in the Chesapeake Bay. The workshop is part of a new educator professional development program at SERC. (Credit: Dr. Alison Cawood/SERC)

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RESEARCH DISCOVERIES

TO BEAT INVASIVE *PHRAGMITES*, LOOK AT ITS NEIGHBORS

BY KRISTEN GOODHUE

There's still time to defeat *Phragmites australis*, an invasive reed running rampant throughout U.S. wetlands. But it takes long-term commitment, and it can't be done everywhere.

In the latest study, ecologists from SERC, the University of Florida, and Utah State University attempted to beat back *Phragmites* at eight sites in Maryland. After three years of suppression, and two additional years of monitoring, they found the biggest key to success lay in the sites' surroundings. Sites with diverse native plant communities nearby were more likely to see a high cover of native plants return after *Phragmites* treatment.



However, the authors emphasize that one-and-done treatments aren't enough. Targeting sites with fewer, smaller *Phragmites* patches can also yield big payoffs, as these sites could ultimately become refuges for native plants.

LINK TO STUDY: <https://esajournals.onlinelibrary.wiley.com/doi/pdf/10.1002/ecs2.4392>

Lead author Christine Rohal of the University of Florida in a patch of Phragmites. (Credit: David England, Farmington Bay Wildlife Management Area)



A patch of Phragmites grows along the Patapsco River. (Credit: Dennis Whigham)

THE COMPLICATED CASE OF WETLANDS AND CLIMATE CHANGE

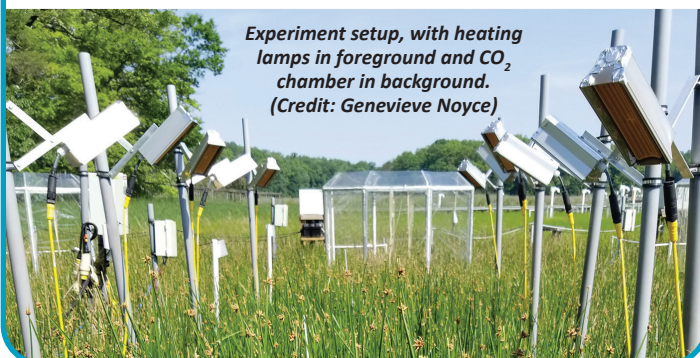
BY DR. ANNA DAVIS

Coastal wetlands are critical ecosystems that are threatened by rising sea level. Wetlands can escape rising waters by increasing their elevation through soil accumulation. But, how other complicating factors – namely warming and elevated carbon dioxide – play into this is less well understood.

A new four-year study led by researchers with SERC's Global Change Research Wetland (GCRew) sheds some light on how climate change factors affect the vulnerability of coastal wetlands to sea level rise. Researchers found that the combined effects of increased temperature and carbon dioxide seem to limit the wetland's ability to build its elevation. However, these conditions also decreased the emission of methane – a greenhouse gas naturally released from wetlands.

These results indicate that features of the wetland plants appear to affect the vulnerability of wetlands to climate threats and point to important avenues for further research.

LINK TO STUDY :
<https://www.nature.com/articles/s41561-022-01070-6>



Experiment setup, with heating lamps in foreground and CO₂ chamber in background. (Credit: Genevieve Noyce)

BLUE CARBON STORAGE IN BELIZE'S MANGROVES

BY DR. ANNA DAVIS



Ninon Martinez and Alwyn Mahung of the University of Belize Environmental Research Institute take a sediment core on Frenchman Caye. (Credit: Hannah Morrisette)

Mangrove ecosystems have an amazing capacity to store carbon long-term. Having accurate estimates of how much carbon they store – otherwise known as blue carbon, the carbon associated with marine and coastal ecosystems – is critically important to understanding the role of mangroves in combatting climate change.

In a recent study, scientists from SERC worked collaboratively with communities in Belize to produce the first comprehensive estimate of blue carbon stored in the nation's mangroves. They found that Belize's mangroves hold 25.7

million metric tonnes of carbon. The highest carbon stock was present in taller, healthy mangrove ecosystems along rivers and offshore cayes.

The results emphasize both the importance of conducting local studies to accurately estimate carbon stocks, as well as the importance of engaging local stakeholders in the entire process.

LINK TO STUDY: <https://www.sciencedirect.com/science/article/abs/pii/S0048969723004448>

Educators participating in an EnLET workshop sort through oyster shells and learn about the ecological importance of oyster reefs. (Credit: Vanessa Holloway-Chambers/SERC)



USING 'PLACE' TO INCREASE Student Environmental Literacy

BY DR. ANNA DAVIS

It may have been a long time since you were a student. However, there are likely some educational experiences that have stuck with you long after you left formal education.

For me, I vividly remember learning about watersheds in elementary school. A group of environmental educators visited our class one morning to demonstrate how watersheds work. I watched as they added colorful 'pollutants' to rivers in a three-dimensional model of the Chesapeake Bay watershed. As we made it 'rain' with spray bottles, the pollutants flowed toward the low-lying Bay where they combined into a brown liquid. When I left the classroom, I was able to connect that the streams and rivers in the model were the same ones that I spent my summers playing in. And I understood that local actions had larger consequences downstream. It was a critical moment that began my interest in environmental science.

This educational experience was memorable because it related to my 'place' – an area with meaning.

Place can be something as small as your backyard or as large as the country you call home. More importantly, it tied to my *sense* of place – the meanings I assigned to my local area as a result of my experiences. For the Smithsonian Environmental Research Center's (SERC) education programs, place and sense of place are increasingly being used to help educators increase student understanding of and appreciation for the environment.

A NEED FOR ENVIRONMENTAL LITERACY

The Chesapeake Bay is an urbanized estuary that forms the backdrop for the research conducted at SERC. More than 18 million people reside in the Chesapeake Bay watershed, putting a huge environmental strain on the Bay ecosystem. Runoff from urban centers and agricultural activities has introduced pollutants into the water. Commercial fishing has removed key species from the food web. Globalization has led to the introduction of non-native species to coastal waters and ecosystems. Development has led to the destruction of natural environments. And impacts from climate change – such as sea level rise, rising temperatures, and increasing coastal storms – are intensifying the environmental strain.

Combatting these environmental issues requires an educated and motivated public. And educating K-12 students is an important way to engage a new generation in environmental stewardship.



Left photo: A high school teacher pipettes a sample into a molecular gel. She participated in a professional development workshop, designed to teach about methods important for environmental science. (Credit: Anna Mehlhorn/SERC)

Environmental literacy - the ability of individuals to understand the interconnectedness of people and the environment - is a key focus of K-12 science education. Environmental literacy is important because it supports the development of students' critical thinking skills and motivates them to be stewards of their local environment.

Place-based education is one approach teachers are using to increase student environmental literacy. Place-based education uses local communities and environments as a context for learning about a range of subjects, including language arts, mathematics, social studies, and, importantly, science. By immersing students in environments that are local and familiar, place-based education helps engage students in learning, leading to higher academic achievement. In addition, it can help to increase a student's sense of place, increasing their engagement with their local community.

PLACE-BASED EDUCATION AT SERC

The Chesapeake Bay Environmental Literacy Educator Training (EnLET) program began in spring 2022 with gracious funding from the Merrill Foundation. The EnLET program sponsors professional development trainings for classroom and non-classroom educators who teach throughout the Chesapeake Bay region. The workshops focus on environmental issues facing the Chesapeake Bay related to SERC research. In keeping with the place-based education focus, the workshops highlight the many ways the issues relate to the local ecology, economy, and culture of the region.

By focusing efforts on training educators, the EnLET program has significant reach. We estimate that each participating classroom educator has the potential to share material with nearly 100 students annually. Participating non-classroom educators have the potential to interact with far greater individuals through their programming, allowing for even greater reach. Non-classroom educators provide informal education programs, and can include educators at aquariums, environmental centers, or museums. With approximately a dozen educators participating in each workshop, we have the potential to reach thousands of students throughout the three years of the program.

Workshops to date have focused primarily on the decline in oyster abundance in the Chesapeake Bay, building educator understanding of its local ecological, economic, and cultural implications. The workshops introduced educators to the issue, the science being conducted to address it, and some of the complicating factors in its resolution. The educators engaged in hands-on activities, local field trips, and interactions with oyster scientists and local stakeholders. Participating

teachers received structured datasets and corresponding activities that they could bring back to their classroom. Participants will also be creating classroom-tested activities based on the material that will be shared broadly through SERC's educational resources.



A local waterman talks to educators about the cultural importance of oysters to the Chesapeake Bay. (Credit: Celia Cackowski)

A key aspect of environmental literacy is helping students to understand the process of science, and the methods scientists use to answer questions in environmental science research. To address this, EnLET also offers workshops that help educators bring some key science methods into their classroom.

The first "EnLET Skills" workshop in January 2023 focused on understanding how environmental scientists use genetic methods. Participating teachers got hands-on experience with DNA extraction using everyday materials. They also got to practice gel electrophoresis – a key genetic laboratory technique – to answer questions about diseases infecting Chesapeake Bay oysters and other bivalves.

PLANS FOR 2023 AND BEYOND

Spring 2023 marks the beginning of the second year of the EnLET program at SERC, and we're setting our sights on new topics relevant to SERC research.

Workshops this year will focus on understanding the environmental and societal implications of invasive species in the Chesapeake Bay region, highlighting research in SERC's Coastal Disease Ecology and Marine Invasions laboratories. Other workshops will bring educators to ecosystems on the edge, highlighting research on human impacts on wetlands from SERC's Biogeochemistry and Global Change Ecology laboratories. We'll also continue to sponsor workshops that help educators understand some of the methods SERC researchers use to answer important questions in environmental science research.

As the program grows, so will our resources available for local educators. Our goal with the resources is to help educators throughout the region to create memorable, place-based educational experiences that will stick with their students long after they graduate. Ultimately, we hope to inspire the next generation to be environmentally literate stewards of the Chesapeake Bay.

Left photo: Workshop participants pose for a picture at the end of an informative and engaging three-day workshop on oysters of the Chesapeake Bay. (Credit: SERC)



I feel very fortunate to look back on 40+ years of mercury research and count some wins for the environment, some progress in understanding mercury biogeochemistry, and the friendship and collegiality of the research community.

Over the years in SERC's Microbial Ecology Lab, we've studied the process of mercury methylation. This is an oddball reaction in nature, where microorganisms convert inorganic mercury, which is relatively stable, into a compound called methylmercury, which is much more toxic and can build up in the tissues of animals like fish. We've studied this process to better understand, and hopefully reduce, methylmercury risk to people and wildlife.

We have been able to learn enough to make policy recommendations. One of our biggest policy wins was mercury emissions controls on power plants. The power industry argued that since soils have been contaminated with atmospheric mercury pollution since the start of the Industrial Revolution, current practices wouldn't have much impact on mercury levels in fish. The research community suspected otherwise, and we were right. Our discoveries contributed to federal air emissions regulations for mercury (and other pollutants like sulfuric acid). As a result, mercury deposition in much of the US has been reduced by more than a third and



Dr. Cindy Gilmour conducting mesocosm-based mercury research in Florida. (Credit: SERC)

continues to drop. We are also starting to see declines in mercury levels in fish across the US.

The biggest policy losses were probably in agriculture and mining. Sulfate is a by-product of both industries, released to local waterways. Although we and many others showed that the microbes that produce methylmercury are stimulated by sulfate, several attempts at regulations to reduce sulfate releases to waterways have failed. However, air emissions regulations are helping to reduce sulfate pollution in our surface waters.

It's been a bit depressing to shut down my lab after all these years. But as we dig through the accumulation of lab equipment and supplies, I've been thinking about all the students, postdoctoral researchers, and technicians who used all that stuff, and the great work they've done since passing through. I'm proud of all of them and glad to watch many of them continue to push mercury research and policy forward.

Dr. Cindy Gilmour recently retired from SERC after 18 years of serving as the principal investigator of the Microbial Ecology Lab. Prior to coming to SERC, Cindy was a researcher at The Academy of Natural Sciences Estuarine Research Center.

Retirement Reflections FROM A SERC SCIENTIST

BY DR. CINDY GILMOUR

FELLOW SPOTLIGHT:.....LEONE YISRAEL BY DR. KATRINA LOHAN

Meet Leone Yisrael, a current Smithsonian predoctoral fellow who is pursuing a PhD in Biological Oceanography at Johns Hopkins University. Leone received her B.S. in Marine Biology from Louisiana State University and a M.S. in Ocean Sciences from the University of California, Santa Cruz. She was recently awarded a Competitive Graduate Research Fellowship from Maryland Sea Grant.



Above: SERC predoctoral fellow Leone Yisrael processes samples for her Ph.D. research. Leone is studying the interaction of microbes and aquatic organisms in the Chesapeake Bay. (Credit: SERC)

For her Ph.D. research, Leone is working in the Coastal Disease Ecology Lab at SERC examining the potential of marine invertebrates as habitats for the microbes responsible for key biogeochemical processes. Using genetic methods to examine microbial genes, she is assessing the potential for aquatic animals to use these microbes to increase their resilience to climate stressors.

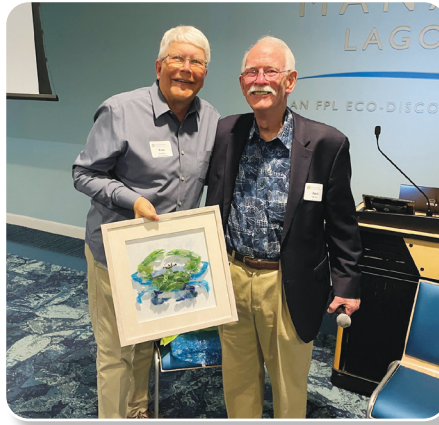
She is examining the gill and gut microbiomes from four species in Chesapeake Bay: the dark false mussel (*Mytilopsis leucophaetata*), the eastern oyster (*Crassostrea virginica*), the blue crab (*Callinectes sapidus*), and the Atlantic brief squid (*Loliginula brevis*). While dark mussels are invasive in the Chesapeake Bay, eastern oysters and blue crabs are both ecologically and commercially important. The Atlantic brief squid is often used as bait and has shown an unexplained 50-fold increase in abundance in fishery surveys since 2018.

Currently in the second year of her Ph.D. program, Leone is already processing hundreds of animal tissues for genetic analyses. The results of which will generate the most comprehensive assessment to date of aquatic invertebrate microbiomes in the Chesapeake Bay, providing information about the identity and function of those microbes. As coastal waters are projected to continue experiencing rapidly changing conditions, the ability of these animals to both serve as microhabitats for and benefit from microbial biogeochemical processes may be the key to their resilience and continued survival.

DONOR SPOTLIGHT:

TOM LINDLEY An Advisory Board Member's Legacy

BY BRIAN MAGNESS



Tom Lindley has been a regular donor and invaluable friend of SERC since joining its Advisory Board in 2007. As one of the nation's top environmental attorneys, Lindley was a partner at Perkins Coie LLP, where he chaired their Environmental, Energy & Resources (EER) practice. In that role, Lindley led nearly 100 EER attorneys in offices stretching from Anchorage, Alaska, to Washington, D.C. In 2015, his practice was selected as the environmental law practice of the year by U.S. News & World Report.

"As an attorney focusing on environmental issues, I was accustomed to every party in every dispute hiring its own environmental consultant to support that party's position," Lindley recalls. "SERC instead is a world-class source of unbiased scientific research, and its Advisory Board is a team of very educated and thoughtful volunteers who help keep bias away. I wanted to be a part of that wonderful world."

As a member of SERC's Advisory Board, Lindley was instrumental in its formation and recruitment of new members. His wise counsel helped Director Tuck Hines through many challenging situations and charted a path for SERC's future success. In February 2023, Lindley stepped down from the SERC Advisory Board, but not before making one more valuable contribution—a planned gift that will come to SERC in the future.

"While I make small donations each year, my wife and I want to help secure the future of this great, unbiased research organization. However, because my wife and I both have serious health issues, we cannot risk giving away a significant amount when we might unexpectedly need it for healthcare," Lindley said. "By using a planned gift to give a share of our estate to SERC, my wife and I can support SERC fully without concerns."

Above: Tom Lindley (left) and SERC Director Tuck Hines (right). (Credit: Brian Magness/SERC)

VOLUNTEER SPOTLIGHT

REED CENTER'S TANK TEAM

BY EMILY BORGER



Beaks and fins and claws, oh my!

Volunteers are central to most of the work that happens at the Reed Education Center, and caring for the animals in all of the fish tanks is no exception. Recently, we've added a brand new group of volunteers to help us care for our aquaria and ambassador animals. We call them our "Tank Team."

The Tank Team volunteers chop food, weigh terrapins, scrub tanks, and rinse filters every week. And the animals have been loving it! Having the volunteers take on these tasks allows the education staff to devote more of their time to developing and running programs for students and teachers, and it ensures that we are able to provide visitors with a beneath-the-surface view of what lives right off of the SERC dock.

The Reed Center was closed through much of the winter as we underwent some construction. However, the Reed Center reopened to the public as of April 2023. So, be sure to come visit our beautiful tanks and happy creatures. Thank you very much to Mark Baskeyfield, Mary Edwards, Lynne and Alan Traher, and Richard Hohn for your continued support of our live animals and tanks!



Photos L-R: Dash, one of SERC's two resident diamondback terrapins, enjoys a swim in his tank. Dash is one of the many animals being cared for by the Tank Team. (Credit: Karen McDonald/SERC); Tank Team Member Mary Edwards measures vitamins for SERC's resident terrapins Dinky and Dash. (Credit: Karen McDonald/SERC)



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Upcoming Events: 2023 Virtual Earth Optimism Lectures

SERC's evening lectures run every third Tuesday of the month at 7pm ET, January through October. All of our lectures are recorded, and live closed captions are available. Learn more and view recordings of past talks at <https://serc.si.edu/visit/eveninglectures>.



Dr. Linsey Haram
(Credit: Stephen Page)

PLASTICENE SEAS – WHAT LIFE ON FLOATING PLASTIC MEANS FOR OUR OCEAN

Tuesday, May 16 • 7pm ET

Speaker: Dr. Linsey Haram, U.S.

Department of Agriculture

Millions of tons of plastic pollution enter the ocean each year. This global influx of plastic has devastating effects on marine life, including entanglement and

plastic ingestion. In this talk, marine biologist Dr. Linsey Haram will reveal another unexpected consequence of rampant plastic pollution: the creation of artificial, floating habitat for coastal marine life in the open ocean. Dr. Haram will describe how her team studies life on these floating plastics in the North Pacific Subtropical Gyre (also known as the "Great Pacific Garbage Patch"), and the surprising results they've found to date. These discoveries raise many challenging questions about the future of our oceans in the context of the global plastic pollution crisis.



Dr. Adrienne Crosier
(Credit: Karen Meeks)

BREEDING THE UNBREEDABLE: ASSISTED REPRODUCTION IN THE CHEETAH

Tuesday, June 20 • 7pm ET

Speaker: Dr. Adrienne Crosier

The fastest land animal is quickly running out of time. As cheetah populations in the wild continue to decline, our zoo populations are becoming even more critical to the future of the species.

In our June Earth Optimism webinar, learn about the difficulties of managing and reproducing these cats with Dr.

Adrienne Crosier, a cheetah biologist with the Smithsonian's National Zoo and Conservation Biology Institute. Adrienne will also offer an inside look at some of the cutting-edge techniques scientists are using to improve genetics and cheetah cub reproduction in zoo facilities.



A cheetah and her cubs.
(Credit: Dr. Adrienne Crosier)

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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ON THE EDGE

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