Smithsonian Environmental Research Center

ON THE EDGE

News from the Smithsonian Environmental Research Center

Spring / Summer 2024

Putting Blue Carbon on the Map, With the Coastal Carbon Atlas

ALSO INSIDE:

- "Oyster Cam" Volunteers Track Restorations With Underwater Videos
- The Gaping Holes in America's Ocean Protections—and How We Can Fix Them
- Meet Dennis Whigham, Smithsonian Distinguished Career Medal Recipient

Chromis reef fish and staghorn coral, Palmyra National Atoll. (Credit: USFWS)

DIRECTOR'S LETTER:

Open Science and Putting Communities First

"We have to fix the 'who' of conservation. And when we bring more people in the room, it's going to change the 'how.'"

This January, I heard those words while at the Smithsonian and NOAA's Summit on Ocean Biodiversity. A man named Angelo Villagomez had the floor, addressing a crowd of roughly a hundred scientists, policymakers, community leaders and entrepreneurs. A senior fellow at the Center for American Progress, Villagomez is also a member of the Chamorro people from the Mariana Islands.

Villagomez joined several speakers from communities working on the front lines of climate change. The lieutenant governor of Guam, an urban wildlife biologist in Baltimore and an Alaskan Iñupiat shaping Arctic policy with the White House also shared their stories.

The summit was a call to action, a summons to find new solutions to protect our oceans and coastlines.

You may have heard of "30 by 30"—an ambitious goal to conserve 30% of the world's land and ocean by 2030. The U.S. already has 26% of its territorial waters under some kind of protection. But that figure fails to tell the full story. As you can read on page 6, our nation's marine protected areas are almost exclusively (over 95%) in one giant area of the tropical Pacific. Thousands of species and many vital ecosystems are left out.

However, by identifying the gaps, our scientists also discovered keys to moving forward: We need to prioritize critical habitats, especially for marine mammals and birds. It's also time to rethink what protection can mean, by allowing more room for community and indigenous-led efforts.

This February I was inspired by another story from Honduras, of a community in Estero Prieto. When their fish were suffocating in habitats crowded by invasive water lettuce, they rallied to restore their wetland. To date, they have cleared out half the invasive plants and replanted nearly 18,000 mangroves. Two SERC scientists, Steve Canty and Hannah Morrissette, joined their efforts. But the drive, direction and critical on-the-ground knowledge came from the community.

Angelo Villagomez (left) speaks at the Summit on Ocean Biodiversity Jan. 23 (Credit: Norwood Photography)

Elias Alamina, a University of Belize student, does mangrove research on a joint project with SERC's Marine Conservation Lab. (Credit: Hannah Morrissette/SERC)

Two team members from the Centro de Estudios Marinos in Honduras, which helped the Estero Prieto community with mangrove planting, process a sediment core. (Credit: Hannah Morrissette/SERC)

Actions like these are the future of conservation, and they are key to life on a sustainable planet. At SERC, we have a long history of working alongside local communities in the Chesapeake and globally. Many leaders on the ground are very attuned to their local environments. They know what the needs are. The Smithsonian's role is to provide tools, data and, if necessary, training to help scale up their efforts.

That's why I'm so proud of this issue's feature story. After the historic Paris Agreement, nearly 200 nations are required to report how they will cut or offset their greenhouse gas emissions to fight climate change. SERC's new Coastal Carbon Library and Atlas are helping them tap into the power of local wetlands, by offering data on how much "blue carbon" their coastal wetlands can store.

It's an open-access library, with raw carbon data from nearly 15,000 sites worldwide—the largest, most comprehensive database of its kind. And it's freely available to everyone. The discoveries communities can make with this data, especially by pairing the data with satellites, are infinite—and entirely in their hands.

What happens at the Smithsonian does not stay at the Smithsonian. If you join our mission, you can be part of a more open world—opening data, minds and possibilities.

-ANSON "TUCK" HINES, SERC DIRECTOR

Cover photo: Jim Holmquist, leader of SERC's new Coastal Carbon Library and Atlas, collects elevation measurements at the SERC Global Change Research Wetland. (Credit: Lisa Beers)

UNDERWATER 'OYSTER CAM' PROJECT
Draws Volunteers to Oyster Restorations

BY KRISTEN GOODHUE

In Maryland, two things mark the return of spring more than any other: boating and blue crab season. Oyster season—a cold-weather enterprise—closes March 31. But this year, like last year, dozens of volunteers are taking their boats to local oyster reefs—not to harvest them, but to check the health of Maryland's oyster restorations.

It's part of a new participatory science project at SERC called "Oyster Cam." The project trains watershed organizations and their volunteers to deploy underwater cameras, collecting videos of oyster reefs across the state.

Maryland has been working to restore its oysters since the early 2000s. Once so plentiful their reefs almost touched the water's surface, overharvesting and disease have whittled the Chesapeake's oysters down to 1 to 2% of historic levels. Over the last decade, the state has planted nearly 7 billion baby oysters in Chesapeake rivers. The largest sanctuary, in Harris Creek, is roughly the size of the National Mall.

However, creating oyster restorations is only half the picture. Regular check-ups to see how the reefs are doing are equally important. And that, explained Anna Davis, can be expensive and time consuming.

"It requires folks who are essentially skilled divers to go down onto these reefs to collect oysters," she said.

Davis, a SERC postdoc, runs the Oyster Cam project with SERC's Fisheries Conservation Lab. Their biologists devised a less pricey method in 2021 that involved lowering a GoPro camera into the water—allowing them to cover five or six times more sites than a diver could in the same time period.

Captain Zack Kelleher, Sassafras Riverkeeper, deploys a camera rig on the Tred Avon River. (Credit: ShoreRivers)

The lab's head, Matt Ogburn, had the idea to share the technique with river organizations. Davis organized volunteer trainings and helped coordinate sites volunteers would visit.

During the first year, funded by the Chesapeake Bay Trust, Oyster Cam worked with four Maryland river stewardship organizations: Severn River Association, ShoreRivers, Arundel Rivers Federation and Advocates for Herring Bay.

"We're heavily involved in oyster restoration in the Severn River," said Tom Guay, program officer with the Severn River Association. "Anything that could help us understand the oysters and their predicament, whether they're doing well or not, we're always going to be interested in that."

The association hopes to grow 1.3 billion mature oysters in the Severn. "It's an ambitious target," Guay said, "but we've been having success. And so far, most of the spat on shell we plant are surviving their first year on the reefs." They began partnering with Operation Build-A-Reef Program in 2018 and have planted 25 million baby oysters every year since, missing only one year during the pandemic.

On Maryland's Eastern Shore, Choptank Riverkeeper Matt Pluta works on oyster restorations with the ShoreRivers organization. ShoreRivers has recruited dozens of volunteers to grow oysters off their own docks, as part of the Maryland Grow Oysters program. ShoreRivers then plants those oysters in 10 restoration sites along the Eastern Shore. But while some restoration reefs have existed for nearly a decade, Oyster Cam offered many volunteers the first chance to see the fruits of their work.

"Up until now, we haven't been able to show folks what their efforts have resulted in," Pluta said. "This was a great community engagement and volunteer appreciation to say, you're work isn't going unnoticed."

Now in year two, Oyster Cam has added three states to its Eastern oyster work: Virginia, New York and Florida. They're also helping SERC's San Francisco biologists track the imperiled Olympia oyster, California's only native oyster. The expansion is thanks to funding from the Smithsonian's Life on a Sustainable Planet Initiative.

Once the surveys are done, volunteers send their footage to SERC. SERC then uploads still images from the videos to Zooniverse, an online platform for volunteer science projects. Davis hopes to bring Oyster Cam to classrooms soon. With a little more pilot testing, K-12 students could analyze oyster reef images and give them health scores. Next-generation oysters, meet next-generation scientists.

Top photo: Oyster restoration in Maryland's Harris Creek. (Credit: SERC Fisheries Conservation Lab); Bottom Photos L-R: Grace Weeks (left) and Emi McGeady (right) survey for oysters at the U.S. Naval Academy bridge. (Credit: Tom Guay); Oyster reef in Eastern Bay, a tributary on Maryland's Eastern Shore. (Credit: Maura Bollinger); Choptank Riverkeeper Matt Pluta kayaks along Maryland's Bolingbroke Creek. (Credit: Dave Harp)

Coastal wetland in Parker River National Wildlife Refuge, Massachusetts. (Credit: U.S. Fish and Wildlife Service)

How Much Can Wetlands Fight Climate Change? A New Carbon Atlas Has The Answers.

The Coastal Carbon Atlas and Library map how wetlands store carbon around the world — and put open data to work for the environment.

BY KRISTEN GOODHUE

When Superstorm Sandy reached New York on Oct. 29, 2012, it pummeled the coastline with 80 mile-per-hour winds, flooding streets and subway tunnels. Leaving over $70 billion of destruction across its entire path, Sandy ranks among the costliest natural disasters in U.S. history. But in the northeastern U.S., coastal wetlands prevented an estimated $625 million in damage.

The world needs wetlands to protect us from climate change, and not only in the form of extreme weather. Coastal wetlands are champions at storing carbon in their soils—231 metric tons per hectare on average, according to one estimate.

"Wetlands are pulling a lot of weight for the given amount of area that they take up on the planet," said Jaxine Wolfe, a research technician with the Smithsonian Environmental Research Center (SERC).

"The conservation of wetlands, while it might have global effects, also has the most localized benefits," said fellow data technician Henry Betts, citing examples like sustaining fisheries and recreation. "Keeping them healthy and growing can benefit people directly in their everyday lives."

Wolfe and Betts work on a team illuminating the unique powers of wetlands. Last December, the team unveiled an online database centered on how wetlands store carbon worldwide: The Coastal Carbon Atlas and Library. It contains nearly 15,000 soil cores from every continent except Antarctica. Like a true public library, the data is free for everyone. And it's revolutionizing our ability to make predictions about wetlands and climate change.

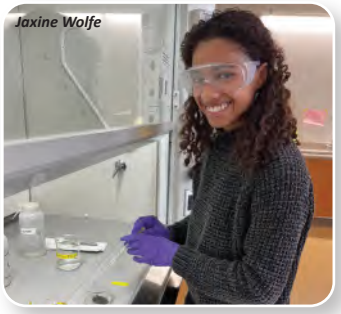
CARBON MEAL KITS

The team's leader is wetland ecologist Jim Holmquist. Holmquist spearheaded the effort at SERC four years ago.

The timing couldn't have been more critical. Under the Paris Agreement, nations must outline exactly how they will slash or offset greenhouse gas emissions. Many nations are relying on wetlands to shoulder part of the load. But no two wetlands are identical. Without country-specific data, governments are often left groping with regional or even global averages.

"Certain countries right now could be greatly overestimating or greatly underestimating the amount of carbon in their soils, simply because they're using a single average," Holmquist said.

Wetlands along the Kobuk River, Alaska. (Credit: Neal Herbert, National Park Service)



Jaxine Wolfe

Rose Cheney (left) and Henry Betts

Left: Jaxine Wolfe prepares an acid test to determine the presence of inorganic carbon in soil samples from Sierra Leone. Right: Rose Cheney (left) and Henry Betts grind soil samples from Sierra Leone in SERC's Biogeochemistry Lab. (Credit: Kristen Goodhue/SERC)

That's where the true worth of the atlas and library lies. All data are raw, original values, freeing scientists to do any calculations they like without wondering where the numbers came from. Holmquist views it as supplying raw ingredients for researchers to create whatever recipes their communities need.

"This is a meal kit service rather than a restaurant," he explained.

However, it's not enough to know how much carbon wetlands store now. To plan for a changing climate, we also need to know how much they will store in the future. Holmquist and others are studying how much faster—or slower—different places accumulate carbon.

"A lot of these places, we project coastal wetlands will collapse in response to sea level rise, and these stocks will be big carbon bombs," Holmquist said.

Mangrove wetland in Belize, a nation that has contributed over 100 soil cores to the Coastal Carbon Library. (Credit: Jonathan Lefcheck)

DISRUPTING THE BLUE CARBON MARKET

Meanwhile, the market has begun catching up to wetlands' value for people and economies. Maryland, where SERC and the Coastal Carbon Library are based, is pioneering new ways to make wetland conservation profitable.

"Blue carbon"—the name for the precious carbon wetlands store—is among many benefits often overlooked, according to Elliott Campbell of the Maryland Department of Natural Resources.

"The economy is not directly putting a value on it, because it doesn't exist within a traditional market," he said.

Campbell drew on the Coastal Carbon Library when preparing a blue carbon study for the state, looking at how much carbon Maryland could save by restoring wetlands.

And just two years ago, Maryland passed the Conservation Finance Act of 2022. The law created a "pay for success" program, the first conservation law like it in the U.S. It encourages private investors to finance conservation projects like wetland restoration. After completion, the state repays investors based on tons of carbon stored or other measurable ecosystem services.

But the law only works with solid data, which the Coastal Carbon Library can help provide.

"If we don't have strong science supporting the market mechanism, then how do we know we really are paying for something that's real?" asked Rachel Lamb, senior climate advisor for the Maryland Department of the Environment. "Good science is critical."

REPRESENTATION MATTERS

At the time this article went to print, the Coastal Carbon Atlas had 14,972 soil cores around the globe. The team is constantly seeking to add more, to fill in gaps. The initial version released in December 2023 had just under 10,000 cores. Roughly half the data came from the U.S. alone. The team has updated it twice since then. Now, only a third of the data are from U.S. soils.

"We definitely don't have enough data on tropical or Arctic marshes," said Tania Maxwell of Austria's International Institute for Applied Systems Analysis. Maxwell assembled data from over 2,000 sites, many outside North America, during a University of Cambridge fellowship. Those data joined the library and atlas in the most recent update on March 29.

Including more data from developing nations is another high priority. Wolfe spent the past year conducting trainings in Ghana and Costa Rica, while fellow SERC technician Rose Cheney gathered data from South Africa. Though many scientists are interested in sharing data, the barriers can be legion: time, skills, language, whether another government owns the data and concern about credit.

At its heart, the database is built on trust, Wolfe said. She and Cheney emphasize consistently that the original authors get credit for any data they share. Anyone who uses the data likewise must credit them.

"Even though this is hosted through and served through the Coastal Carbon Library and Atlas, this is still their work," Cheney said. "We just are trying to help them make it more accessible."

As the team prepares for the next release, the tropical representation gap is already closing, Holmquist said. In the meantime, he hopes governments of every level can use the data to incentivize wetland conservation.

"A lot of people think blue carbon, they think, oh, we can get carbon credits. Carbon's money," Holmquist said. "But I think of carbon as life. I think of it as a structural component of the ecosystem that we need to understand, to project how these things are going to survive."

The Coastal Carbon Library and Atlas are available at https://serc.si.edu/coastalcarbon/data

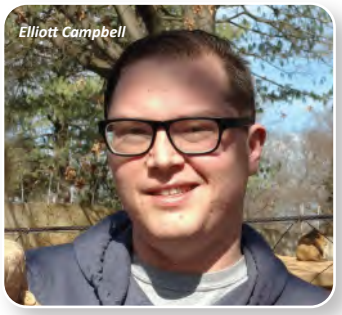


Photo credits L-R: Lauren Brown, Elliott Campbell, Stacey Lamb, and courtesy of Tania Maxwell.

New Study Reveals Gaping Holes in AMERICA'S OCEAN PROTECTION. Here's How We Can Fix Them.

BY KRISTEN GOODHUE

Thousands of species, and many vital habitats, have little to no coverage in America's marine protected areas, according to a study co-led by the Smithsonian Environmental Research Center (SERC).

Officially, 26% of U.S. waters fall under a marine protected area, or MPA. That's tantalizingly close to the "30% by 2030" conservation targets for land and water embraced by the global community and the Biden administration.

However, the figure masks some troubling inequities. Nearly all MPAs—a full 96%—are in the central Pacific. Other regions, especially Alaska and the Caribbean, have been left behind. Furthermore, a mere 3% of U.S. MPAs are considered "fully protected areas," where fishing and other destructive activities are completely prohibited.

"Few regions meet criteria to protect biodiversity in a way that would ensure health and resilience in marine ecosystems as a whole," said Emmett Duffy, a co-author and SERC senior scientist.

QUALITY OVER QUANTITY

The study, published in the journal One Earth, represents the first attempt to quantify biodiversity inside and outside all the country's marine protected areas. The authors sought to answer one crucial question: Are the United States' protected areas capturing the full diversity of species and habitats that call these waters home?

"It is especially important that we understand what biodiversity we are actually conserving in U.S. waters," said Sarah Gignoux-Wolfsohn, lead author and former SERC postdoc now at the University of Massachusetts Lowell.

Of the nearly 30,000 species known in U.S. ocean waters, the study estimates only three-fourths appear in any marine protected area at all. However, the scientists suspect even this is an overestimate. Since marine protected areas are popular study sites, it's easy for species found only *outside* protected waters to escape notice. The study also counted a species as "present" in a protected area even if only one specimen appeared—hardly enough for a viable population.

The authors also looked at criteria like size, connectivity and inclusion of important feeding or spawning habitats.

Large marine mammals, like whales and dolphins, were of special concern. Less than 10% of the important areas they rely on for food or breeding received official protection. Seabirds fared better, with nearly 60% of their important areas protected.

On average, coral reefs—Earth's most famous biodiversity hotspots—are better protected than other habitats. However, corals in the Caribbean are severely underrepresented, and deep, cold-water corals have almost no protection at all. Mangroves and seagrasses, by contrast, received comparatively good coverage.

A NEW BLUEPRINT: WHAT COUNTS AS PROTECTION?

The study offers a wave of suggestions for improving marine protection. "Stepping-stone MPAs" could create vital connections to help species move between protected zones. The study also calls for protecting more critical areas for marine mammals and birds, and prioritizing deep-water corals.

Perhaps one of the most powerful opportunities involves embracing less traditional protections.

Community-led and tribal-led efforts can offer real conservation benefits, even if their goals are different from traditional MPAs. These fall under the category of OECMs, or "Other Effective Area-Based Conservation Measures." Examples include sacred sites, shipwrecks, locally managed fishing zones closed seasonally or zones open only for small-scale or indigenous fishers.

While OECMs may not be as strong as formal MPAs, they can be longer lasting and better enforced thanks to community buy-in. Right now, the U.S. does not have a formal designation for OECMs. However, according to the authors, such recognition could improve the country's ocean conservation.

Finally, the authors emphasized that genuine protection requires regular, long-term monitoring. This can ensure marine protected areas are still doing what we need them to in a rapidly changing world.

LINK TO STUDY:

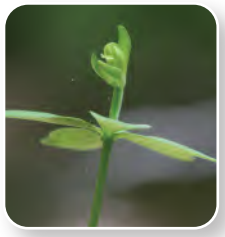
https://www.sciencedirect.com/science/article/pii/S2590332223005985?via%3Dihub

Center, top to bottom: Marine mammals like this humpback whale were among the species least protected by U.S. marine protected areas, because many of their feeding and spawning areas lack coverage. (Credit: Personnel of NOAA Ship RAINIER); Kelp shelter a school of sardines in California's Channel Islands National Marine Sanctuary. (Credit: Robert Schwemmer, NOAA National Marine Sanctuaries); Coral reef at the Palmyra Atoll National Wildlife Refuge, one of the U.S. marine sanctuaries in the tropical Pacific. (Credit: U.S. Fish and Wildlife Service); Snails on seagrass, a vital habitat that receives relatively good protection in U.S. waters. (Credit: NOAA)

THANKS & ACCOLADES

DENNIS WHIGHAM Joins Smithsonian's First Distinguished Career Service Medal Recipients

BY KRISTEN GOODHUE



Senior botanist Dennis Whigham spent his career studying what others might miss: The unassuming alder tree. The underappreciated wetland. The threatened orchid so small and green, it nearly blends in with the forest. In the process, he built collaborations to understand and protect some of the rarest, most vital pieces of life on Earth.

This March, after 46 years heading the Plant Ecology Lab, Whigham received the Smithsonian's Distinguished Career Service Medal. He is among the first Smithsonian staff to receive it, the first year the Smithsonian has offered it.

Whigham joined the Smithsonian Environmental Research Center (SERC) in 1977.

"He is one of the five founding research scientists at SERC, beginning when SERC first operated out of an abandoned dairy barn and used FEMA trailers for laboratories," said SERC director Tuck Hines, who nominated Whigham for the award.

Just one year after he arrived, Whigham co-edited a book that became the "textbook bible" for college courses on freshwater wetlands, a field that was just emerging at that time. Wetland research eventually took him to Alaska's Kenai Lowlands. While there, he helped build an interdisciplinary team that uncovered how small headwater streams and their alder trees support millions of juvenile salmon. Their research eventually led to regulations to protect wetlands and headwater streams.

Endangered orchids likewise found a home in Whigham's lab. North America contains over 200 native orchid species, many threatened or endangered. Whigham's team, including long-term collaborator Melissa McCormick, made groundbreaking discoveries on what orchids need, especially the microscopic fungi that help them germinate and grow. In 2012 Whigham helped found the North American Orchid Conservation Center, a continent-wide coalition to assure native orchid survival.

Internationally, Whigham worked with Japanese colleagues to ensure two important ecosystems slated for development were conserved. One, the Tadami Biosphere Reserve, is now a UNESCO World Heritage Site. In the Netherlands, he served at Utrecht University as one of the country's first two landscape ecology professors, leading field-based courses for European students at SERC.

"The extent and diversity of Whigham's research and interests is amazing....His leadership, productivity and guidance has been a tremendous influence in making SERC into a truly impactful center of national and international regard," said Hines.

Left: The small-whorled pogonia* (Isotria medeoloides)*, the "rarest orchid east of the Mississippi," one of many threatened and endangered orchids Whigham helped conserve. (Credit: SERC); Right: Dennis Whigham in the Kenai Lowlands of Alaska. (Credit: Kelsie Moore)

DONOR SPOTLIGHT

WILLIAM H. DONNER FOUNDATION and the Quest to Protect Mangroves

BY COLE JOHNSON

In Central America, Belize is spearheading efforts to protect and restore its mangrove ecosystems. The William H. Donner Foundation is helping keep momentum strong, by supporting the Smithsonian's on-the-ground work with scientists and students in Belize for the past four years.

Mangroves play a crucial role in coastal protection and carbon sequestration. Belize's mangroves alone store nearly 26 million metric tons of carbon. The decline of mangrove cays, particularly ones birds use as rookeries, threatens the region's biodiversity and carbon storage.

The project the foundation currently supports aims to shed light on the causes of this decline and spearhead effective conservation strategies. It is part of a broader commitment to support the research of Steve Canty, a mangrove scientist at the Smithsonian Environmental Research Center (SERC). Canty's Marine Conservation Lab seeks to understand and protect mangroves across Central America and the Caribbean.

"Our continued support for Steve Canty's work reflects our deep commitment to environmental sustainability," said Anita Winsor, president of the William H. Donner Foundation. "This project in Belize is just one of many that we believe can make a significant difference in preserving the vital mangrove ecosystems in this region."

Three University of Belize undergraduate students — Indali Cawich-Duran, Elias Alamina and Tony Lizama—each lead a segment of the research. The introduction of new field, laboratory and data skills builds out their experience, highlighting the initiative's dedication to cultivating the next generation of environmental scientists. The project takes a comprehensive approach to studying mangroves and the impacts of bird rookeries, including biomass assessments, sediment cores, remote sensing and biodiversity analyses using environmental DNA.

"The Donner Foundation's commitment to our mangrove research projects has been a game-changer," Canty said. "Their support has enabled us to explore new frontiers in conservation science and has been a driving force behind our efforts to protect these vital ecosystems."

Top, left to right: Indali Cawich-Duran, Elias Alamina and Tony Lizama, students from the University of Belize working on the project. Right: Hannah Morrissette, a postdoctoral fellow in Steve Canty's lab, poses for a selfie with team members in Belize. (Credit: Hannah Morrissette)

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Upcoming Events

Life on a Sustainable Planet Evening Webinars

How a Return to Tribal Management is Restoring Landscapes

TUESDAY, MAY 21 • 7PM ET
with Cody Desautel, Executive Director, Confederated Tribes of the Colville Reservation

North Twin Lake in the Colville Reservation. (Credit: Mark Pouley, https://creativecommons.org/licenses/by-nc-nd/2.0/)

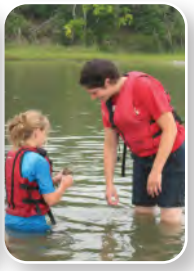
What a Warming World Means for Plants, Pests and Pollinators

TUESDAY, JUNE 18 • 7PM ET
with Michael Raupp, Professor Emeritus, University of Maryland

Great Spangled Fritillary. (Credit: Kristen Goodhue/SERC)

River Day

SATURDAY, JUNE 29 • 11AM-4PM
Join our scientists for a day on the waterfront, with hands-on activities for the whole family! No advance registration required for most activities. Co-organized by the Anne Arundel County Executive's Office.



(Credit: SERC)

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ON THE EDGE
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