

Gone with the waves: Storms, rising waters threaten pieces of past

Archaeologists scramble to recover, study artifacts before they wash away from Chesapeake shorelines

By WHITNEY PIPKIN

Climate change and erosion are taking steady punches at shorelines in the Chesapeake Bay region, slashing away soil and threatening the structures that stand on it. But resources buried within the land are at risk, too. Archaeologists in Maryland and Virginia are racing to recover artifacts from Bay area shorelines before they are gone for good.

The archaeologists worry that centuries of the history they're hunting can disappear with the next big storm. And, more often, places rich with records of the region's American Indian and colonial past are slipping away one inch at a time, lost to the gradual but quickening impact of erosion and rising seas.

It's no coincidence that many of the region's most precious archaeological sites are also located precariously on the shores of rivers, creeks and the sprawling Bay. That, said archaeologist Martin Gallivan, is where people have always liked living.

"Throughout human history, the water's edge has been an inviting place to settle," said Gallivan, a professor at the College of William & Mary whose work focuses on Powhatan sites on the James and York rivers. "Specifically for native history in Tidewater Virginia, the water's edge is the location of a majority of significant sites."

One of the places at risk is the first permanent English settlement in North America at Jamestown, VA, where site managers now factor in elevation and water levels when considering where to work next on a site that is increasingly inundated with water. Also threatened throughout the region are countless shell middens — long-buried heaps of discarded oyster shells and other items, some thousands of years old, full of clues about how the region's early residents lived.



U.S. Fish & Wildlife Service biologist Fred Pinkney tosses a fish trap into the Anacostia River as technician Tanner Stoker holds the boat steady. (Dave Harp)

Toxics, long-ignored, once again on cleanup radar

After being on back burner behind nutrients and sediment, PCBs are getting more attention.

By TIMOTHY B. WHEELER

Fred Pinkney went fishing this fall on the Anacostia River, but fish weren't the real quarry.

One drippy morning in October, Pinkney and his helper, Tanner Stoker, seined the shallows off a sandbar near Bladensburg, MD. Then they boated downriver into the District of Columbia and put wire mesh traps in a cove near the site of a demolished Pepco power plant. They baited the traps with open tins of salmon-flavored cat food.

Pinkney, a senior biologist with the U.S. Fish & Wildlife Service, wanted the small denizens of the aquatic world that anglers would ignore, including finger-size mummichogs and banded killifish, which spend their lives in one area of the river.

But his chief target were the toxic chemicals that may have built up in

the bodies of these fish during their lives in the Anacostia River. And so Pinkney's catch was sacrificed to science — sent to a laboratory for tissue analysis.

Pinkney is specifically tracking levels of polychlorinated biphenyls, or PCBs, present in the tissue of the small forage fish. PCBs — a family of chemicals once widely used in industry and commerce — were banned in 1979 because they caused

PCBS CONTINUES ON PAGE 18

ARTIFACTS CONTINUES ON PAGE 16



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Correction

The mussel photo that appeared on page 17 of the October 2018 issue of the *Bay Journal* should have been credited to Whitney Pipkin. The *Bay Journal* regrets the error.

Editor's Note

Thank you to all who responded to our reader survey



the survey we mailed to readers last summer is "Wow!" I am still stunned by the overwhelming 1number of results (which are still trickling in).

The word that most

sums up the results of

Approximately 3,500 of you responded — way more than we expected. We're still going through the results, but one thing is clear: Readers overwhelmingly are happy with the *Bay Journal*.

Many, in fact, said that they pass their copy on to friends or colleagues. Hundreds asked us to send sample copies to friends (we're in the process of doing that). And many asked us to increase distribution in areas where they live — "they all disappear each month," one reader said of bundles delivered to her local library.

One of the top reasons people said they read the *Bay Journal* is that it provides a watershedwide perspective on issues. "I like the way that you cover why a multi-state effort is necessary to keep the Bay healthy," one wrote.

The overwhelming majority of readers said they take some sort of action based on what they read in the *Bay Journal* — or that it inspires them to go outside and enjoy the region's natural bounty. "It reminds or informs me about natural resources I should make a point of seeing and enjoying," one said.

Interestingly, we got replies from all over the country. Many people who have moved away said the paper helps them stay connected to Bay issues. One reader told us that although she now lives in the Midwest, the *Bay Journal* helps her children learn about the Chesapeake. A few said they wished a similar paper was published where they live.

Wherever they reside, readers told us they appreciate that articles are based on facts and science. "It is not 'fake' news!" several wrote.

While people like the *Bay Journal*, they also suggested some tweaks. For instance, we clearly heard a call to bolster our Virginia coverage, particularly in the Richmond-Hampton Roads corridor. A lot of people would like to see us add a history column, and a number said they would like to see more coverage of headwater areas and climate change issues.

Some found areas they thought we could improve. A number of respondents thought agricultural coverage was too negative. That is, admittedly, a balancing act. We certainly try to have a mix of stories that capture the complexities of farming in the Bay region, and the difficulty of trying to produce more food while simultaneously trying to reduce runoff — a challenging issue here, and globally.

Nearly half of the readers said they would be interested in attending a *Bay Journal* event, so we may schedule some things next year that allow readers and our staff to get together. That will give us — and you — a chance to talk about these issues in greater detail.

We'll continue analyzing the information and passing on what we glean. Meanwhile, thanks to all those who shared their thoughts.

State:

- Karl Blankenship

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Clockwise, from left Passengers on the Western Maryland Scenic Railroad will find themselves riding parallel to the Great Allegheny Passage, a hiking and biking trail between Pittsburgh and Washington, DC. See article on page 22. (Western MD Scenic Railroad)

Steve Strano, left, a biologist with the U.S. Department of Agriculture's Natural Resources Conservation Service, and Brian Jennings, a U.S. Fish and Wildlife Service biologist, walk along a breach completed in 2016 on the Pocomoke River. The depression allows the river's water to spill over its banks more frequently into its floodplain. See article on page 6. (Dave Harp)

Josh Frye, a West Virginia farmer, takes a whiff of the biochar he made recently. The charcoal-like product consists of cooked poultry manure and even smells like a fresh bag of Kingsford charcoal. It can serve many purposes, from improving soil health to sponging up nutrients from stormwater runoff. See article on page 14. (Jeremy Cox)



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Foresters' conflicted love for red maple highlights its various roles

By CRAIG HIGHFIELD

Over the many years that I have been interacting with our region's forest practitioners and enthusiasts, I have observed that many of us harbor a profound and deep emotional relationship to particular tree species.

These emotions run the gamut from effusive adoration to downright animosity. Some species are almost unanimous in the passions that they invoke; from the pleasing attributes of the stately white oak to the displeasing attributes of the noxious tree-ofheaven. Some species are subtler, and our sentiments are derived by how we personally value specific qualities.

Sweetgum is a good example. If you are a birder, you may love to see this tree prevail on your land because it can be an important avian food source; providing seeds during fall and winter and attracting many species of butterflies and moths during the spring and summer. Sweetgum does not provide a quality food source for most game species, so a sweetgum-dominated landscape may cause ire to landowners looking to attract game. Sweetgum's brilliant autumn foliage is aesthetically pleasing for folks but at the same time its nefariously spiked seedpods are potential hazards to partially clad feet.

We are complex organisms, so our emotions about a species may not be so fixed. Black locust...anyone? How about American beech?

The tree that I seem to have the most complicated relationship with is the ubiquitous red maple (*Acer rubrum*). Red maple, by far, is the most abundant and widely distributed tree species in eastern North America with a native range from Newfoundland to Florida. In our Chesapeake region, according to U.S. Forest Service Forest Inventory Analysis data, it is three times more abundant than the second most numerous species, loblolly pine.

You probably don't need FIA data to tell you that red maple grows almost everywhere. You can find it growing along dry ridges of our mountains all the way down to the poorly drained edges of our tidal wetlands and throughout our urban and suburban areas. It is a super generalist in its resources needs and therefore can be found in a variety of soil types, climates and elevations.

Red maple, despite its abundance today, is estimated to only have made up 5 percent of the forest area in North America when Europeans first arrived. Although still widely distributed geographically at that time, they were mainly found in riparian areas, thus earning the name swamp maple by



The red maple grows quickly and is a great species to plant when one needs to get trees established quickly. (Mike Land)



early settlers.

Red maple has increased exponentially on the landscape for a variety of reasons beyond its ability to tolerate a wide range of site conditions and climates. They can produce flowers in as little as four years and are prolific seeders, often producing bumper crops every two years. These seeds, which are produced early in the spring, germinate soon after hitting the ground, and new seedlings take advantage of a longer growing season.

Both natural and anthropogenic disturbances over the years have created gaps in our forests and given red maple an opportunity to spread into new sites. Suppressing fire from the landscape, too, has aided the success of red maple establishment and proliferation, especially in our oak-dominated forests. The thinner barked maples are highly susceptible to even low-grade surface fire.

Red maple's proliferation throughout Eastern forests is changing the ecology of our forests now and for the foreseeable future and displacing tree species that often have a higher ecological and economic value. I am not trying put all of this ecological discord on the red maple. We humans are, obviously, the cause of the drastic changes to our forests (development, high grading, invasive species, air pollution, deer, etc.). Therefore, I remain conflicted about my perceptions of red maple, the tree.

To be honest, it is an awesome tree with attributes we all can value. Red maple is one of the first deciduous trees to break dormancy during winter. Think about the long winter we endured this year and what a joy it was to see the crimson buds of the red maple swelling early in a canopy of gray stupor.

Red maple flowers are set soon after bud break and typically before it unfurls its leaves. Although these flowers are generally wind-pollinated, they provide a vital early food source for various pollinators like bees.

Red maple trees are also tapped for maple syrup production. Sugar maple, obviously, is the gold standard in maple syrup production because of the higher sugar content in its sap, but the red maple ultimately supplements the amount of syrup being produced each year. It may play a more prominent role in the industry as species shift and sugar maple becomes less abundant in our region.

Red maple is a viable wood product as well. Although its value pales in comparison to other hardwoods in our region like oaks and black cherry, red maple is readily harvested as sawtimber and pulpwood and used to make such things as furniture and cabinets. Maple, including red, is a tone wood and is often used by North American luthiers in the production of guitars and other fine, stringed instruments.

With its ability to thrive on various sites, red maple is a valuable tree to incorporate in forest restoration and riparian buffer plantings.

There will probably be several people reading this who are wondering why on Earth would I want to plant more red maple when I just emphasized that their numbers are already exploding. I know — great question. Remember, I am conflicted here. We do incorporate a high diversity of trees in our plantings, especially oaks. Sometimes on certain sites we just need to get trees established quickly to reduce competition and, as mentioned earlier, red maple is really good at doing that. It is reassuring to see trees growing out of 5-foot shelters after just one growing season.

This has been my arboreal confession concerning a common and valued tree in our Chesapeake forests. We all know trees provide us all with benefits, but our woodlands are not static and will change whether we plan for it or not. The science of silviculture and its forestry practices were developed out of our need to sustain our woodlands, propagate them and enhance the myriad values they provide. It is important (and fun) to learn about the attributes of trees. You may discover appreciations or connections you never realized you had.

Craig Highfield is director of Chesapeake Forests for the Alliance for the Chesapeake Bay.

States seek to fix environmental wrongs with rights amendments

MD, NY bills based on PA's constitution, which includes right to clean air, pure water.

By Donna Morelli

Pennsylvania residents have something their neighboring states lack: an amendment in their state constitution declaring their right to clean air and pure water. A movement is under way to pass similar legislation in Maryland and New York.

In Maryland, a fledgling coalition of religious, health and environmental leaders stand behind Sen. Bobby Zirkin, D-Baltimore County, who introduced legislation for an amendment called the Right to Healthy Environment and Communities, in March. No action has been taken on the bill so far, save for a hearing in the senate's Education, Health and Environmental Affairs Committee.

In New York, advocates working with residents of Hoosick Falls, the village of 3,000 who, unknowingly, had been drinking contaminated tap water for decades, vow to lobby for another introduction of environmental rights legislation after a 2017 attempt died in committee.

Maya K. van Rossum, leader of the Delaware Riverkeeper Network and author of the book, *The Green Amendment*, said that such amendments are needed because they put the right to a healthy environment on par with the



Delaware Riverkeeper Maya van Rossum speaks to the New York State Bar Association about Pennsylvania's Environmental Rights Amendment of 1971. (DE Riverkeeper Network)

right to vote or practice religion.

"We already have legislation that is not protecting our air, our environment," she said. "There are about three dozen states that talk about the environment in their constitutions, but that is not a green amendment. It's just good public policy and a lot of pretty words."

About two dozen states have some language in their constitution, but they lack the punch of Pennsylvania's, van Rossum said, because they are not included in the state's Bill of Rights, like those in Pennsylvania and Montana.

Pennsylvania's environmental rights amendment was passed in 1971 but, until

recently, it proved pretty toothless, defanged by a 1973 Commonwealth Court ruling that applied a circuitous logic to its meaning. Then, in 2013, nine municipalities and van Rossum used the amendment to win a case in the Pennsylvania Supreme Court that affirmed the right of communities to define where fracking may or may not occur within their boundaries. The case created a precedent for using the amendment as a legal argument. The Pennsylvania Environmental Defense Foundation did so again in

2017, when the state Supreme Court ruled that Pennsylvania could only use revenue from oil and gas leases in state forests for conservation projects and not for plugging a hole in the general fund.

The success of these two cases, based on the environmental rights amendment, spread far in legal, political and environmental circles. The idea is catching on, van Rossum said. "I've been talking to people from Florida, Oregon and Massachusetts ... When I speak about it, the room is electric. People get very excited."

When drafting the amendment, she said, it's important to use strong, clear language and place it within the state's

Bill of Rights. She added that Maryland's bill has both the language and placement needed to be effective.

At a hearing on Maryland's proposed amendment, van Rossum and religious leaders from Baltimore and the surrounding areas spoke in favor of it. Kobe Little, the political action chairman for the Maryland NAACP Conference, also testified at the hearing. "I've been testifying for a number of hearings for bills in the House and the Senate that claw at parts of what this legislation would make happen automatically," Little said. "It almost seems like common sense that if we have the right to the pursuit of happiness that we'd have the right to clean air and clean water — and an environment free of the willful degradation by people who seek to place profit over people. This will protect all Marylanders, and especially the most vulnerable Marylanders.'

The effort in New York began in late 2016 when van Rossum got a call from Peter Iwanowicz, executive director of the Environmental Advocates of New York. The state assembly proposed the legislation in late 2017 and passed it with a vote of 113 to 26, Iwanowicz said, but it died in the senate.

"The clock starts all over again," Iwanowicz said. "If the question was presented to the voters, we probably would have seen an overwhelming yes vote."

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Pocomoke River 'replumbing' to ditch 20th-century ag channels

≈ Breaches will help to restore floodplain and reduce pollution entering Chesapeake without reducing cropland.

By JEREMY COX

As far as local farmers were concerned during the early 1900s, the sluggish and meandering Pocomoke River was a threat to their way of life.

"The flat farmland in this area must be drained by ditches which empty into the Pocomoke River," a newspaper announcement proclaimed at the time. "After hard rains the water backed up into the drainage ditches, and fields were sodden for days, making the ground barren and unprofitable as farmland."

In 1939, 200 workers with the Civilian Conservation Corps began converting the upper end of the river on Maryland's Eastern Shore from sinuous to straight. By the time the work was done eight years later, the waterway's 18-mile course toward the Chesapeake Bay had been shortened by 4 miles, and a makeshift levee frowned down from both sides of its banks.

But success for the 1940s farmers triggered problems for the Pocomoke's ecosystem. Now, an effort that has been decades in the making is trying to undo the damage.

Backhoes and bulldozers are carving more than 100 breaches in the levees along a 9-mile stretch of the river just south of Route 50 near the Wicomico-Worcester county line. Then, they're rolling into the surrounding farmland, plugging scores of ditches that were dug to ferry stormwater away as quickly as possible.

A coalition of state and federal agencies has been collaborating with The Nature Conservancy on the Pocomoke River restoration since 2015. Work is expected to be completed by the end of the year on the current phase of the project, which extends from Porters Crossing Road north to U.S. Route 50. In the coming years, the group plans to restore the segment stretching from that point north to the Delaware state line.

The nearly \$4 million project, funded by government and nonprofit sources, is designed to slow the water down, officials said. The breaches will allow the river to spill more often onto 4,000 acres of its historic floodplain, diverting tons of nutrients and sediment that would otherwise gush downstream and enter the Chesapeake Bay.

"It's a key location where we can make significant water quality improvements," said Amy Jacobs, agricultural program director for The Nature Conservancy in Maryland and Washington, DC. "Anything we do in



Steve Strano, left, a biologist with the U.S. Department of Agriculture's Natural Resources Conservation Service, and Brian Jennings, a U.S. Fish and Wildlife Service biologist, walk along a breach completed in 2016 on the Pocomoke River. The depression allows the river's water to spill over its banks more frequently into its floodplain. (Dave Harp)

the Pocomoke, we're going to see a pretty important impact in the Chesapeake Bay."

The Chesapeake has been overloaded with sediment and nutrients for decades, leading to a federally driven cleanup campaign with a 2025 deadline. The nutrients spawn algae blooms that



A bald cypress emerges from a 2016 breach. (Dave Harp)

create oxygen-starved "dead zones" that are nearly devoid of life. And, excess sediment turns the water cloudy, blocking the sunlight to underwater grasses, which are important habitat for young fish and blue crabs.

The Pocomoke River rises in southern Delaware from the Great Cypress Swamp, home to some of the northernmost stands of bald cypress trees in the country. From there, its black-tinged waters travel about 70 miles to the south, then southwest, emptying into the Chesapeake near the Maryland-Virginia border.

About one-third of the river's watershed consists of agricultural fields. Scientists determined that nutrients from that cropland were at least partially to blame for an outbreak of *Pfiesteria piscicida* on the lower part of the river in the late 1990s, when the microscopic organisms was blamed for killing countless fish and devastating the local seafood industry.

The outbreak prompted a raft of state legislation aimed at curbing nutrient pollution on farms and in cities. Little was done afterward to improve the Pocomoke River itself until the conservancy stepped in to restore its floodplain.

As for the impact to drainage the raison d'être of the Pocomoke's channelization — properties abutting the project area should see no difference once the work is done, said Steve Strano, a Marylandbased biologist with the U.S. Department of Agriculture's Natural Resources Conservation Service. All of the areas that will once again serve as an active flood plain are wooded; no cropland should was taken out of production, he said.

"You have hundreds of acres on each side of the river that are there for use [for capturing floodwater], but they're not being flooded," Strano said. The NRCS is one of the project's leaders.

Instead of shunting the water down the channelized river as quickly as possible, the new system will collect some of the flow in its floodplain. That brings an added benefit, Strano said. With less water gush-

ing down the river in high doses, there should be less flooding downstream.

A flood gauge near the northern terminus of the current project area tells the story. Strano's research shows the Pocomoke rose at least 6 inches above the level of its floodplain 4.3 times a year from 1997–2016. But since that flow was hemmed in by levees, the river typically only escaped its channel about once a year.

In that regard, the river's channelization was a smashing success. The Pocomoke River Swamp was once considered an "almost impenetrable wilderness" akin to the vast Dismal Swamp of Virginia and North Carolina, according to a pre-channelization description. The channel reduced the floodplain's width by half — and in some parts, two-thirds — of its original size. By the 21st century, much of the upper portion of the river was flanked by a floodplain measuring little more than 1,000 feet, the U.S. Geological Survey found.

While the change gave neighboring farmers a wider berth for planting crops, it robbed the Chesapeake Bay of one of nature's most potent filters. When the river's water would spill into the floodplain, it stayed put for several days, if not weeks, Strano said. That was time enough for much of the float-

POCOMOKE FROM PAGE 6

ing sediment to settle onto the land and for wetlands plants and trees to soak up excess nutrients.

The Pocomoke's wetlands also are a resting spot for migrating birds, ducks and other waterfowl, so enhancing that habitat became another goal for the restoration effort. The flocks can grow so dense above the river corridor that they register as clouds on weather radar equipment, said Rich Mason, a wildlife biologist with the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office in Annapolis.

"As these flood plains cleanse water and you get cleaner water flowing downstream, that will benefit submerged aquatic grass in the ecosystem," Mason said. "Those grasses are important for the ducks, so it's sort of all connected. Sometimes, we look at things with tunnel vision, but it's going to have broader benefits downstream."

The restoration partners are striving to return the river to its natural course to the extent financially and logistically possible.

The biggest hurdle: Nearly twothirds of the land needed for the initial phase of restoration was in private hands, Strano said. So, The Nature Conservancy negotiated with landowners to voluntarily provide easements. The property owners



Brian Jennings, left, and Steve Strano check on a recently dug breach along the upper reaches of Maryland's Pocomoke River. Officials hope the breaches will allow sediment and nutrients to be filtered from stormwater before reaching the Chesapeake Bay. (Dave Harp)

could receive about \$2,000 per acre for permanent easements under the NRCS's Wetlands Reserve Program or \$250 per acre for 10-year agreements with the Conservancy.

Many of the landowners in the rural area have used their riverfront properties in the past for hunting, and they can continue to do so under the easements, Jacobs said. Another obstacle was the scale of the work itself. From the start, the conservancy and its partners decided against leveling the entire 28-mile system of levees.

"In an ideal situation, we would take all the dirt piles and remove all of it and get it all out of there," Jacobs said. "But economically, that isn't feasible. So, we're creating as large of a breach as we can to open up these floodplains."

Each of the breaches stretches along 100 feet of shoreline and measure anywhere from 2–5 feet below the height of the adjoining levee.

Strano and Brian Jennings, an Annapolis-based Fish and Wildlife biologist, recently visited a breach off Whiton Crossing Road on an overcast but steamy morning.

About 100 yards to the west, the old Pocomoke River trickled beneath a road culvert and curved its way through the forest. It is one of several stretches where the old riverbed remains; elsewhere, it has been obliterated by the channel. But back to the east, where Strano and Jennings had pulled off the road in their pickup trucks, the channel was straight all of the way to the horizon.

They tromped a little ways along the shoreline to a breach dug in 2016. As agreed to by the restoration partners, no maintenance had been performed in the interim.

Strano and Jennings found a lush, green meadow of wool grass and soft rush. But they were most excited to spot tree seedlings. Most were no more than a few feet high, but there they were — oaks, willows, bald cypress.

"This is what I envisioned would happen," Strano said.

Nature, it seems, is coming back. It just needed time and a flood of support from humans.



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Fones Cliffs: One parcel might be conserved, another faces legal challenges

≈ One tract is headed for wildlife refuge instead of condominiums while VA attorney general sues over unpermitted tree-cutting on neighboring site.

BY WHITNEY PIPKIN

The future of a pair of properties that both seemed destined for development along the Rappahannock River's Fones Cliffs diverged last month.

Terrell Bowers, the owner of a 250acre parcel who has oscillated for more than a decade between preserving and developing the property, finally placed it under contract with The Conservation Fund in October. If plans go smoothly, the land eventually will be preserved as part of a national wildlife refuge.

Meanwhile, the Virginia attorney general is suing the owners of an adjacent 1,000-acre property over environmental damages resulting from the unpermitted clearing of more than 12 acres at the end of 2017. The property's owner, Virginia True Corp., intends to capitalize on cliffside views by building a luxury golf resort and homes on the site.

Attorney General Mark Herring said in a statement on Oct. 10 that he will seek the maximum allowable penalties for "significant and repeated environmental violations" at the Virginia True property, which could run up to \$32,500 per day for each violation.

Conservation organizations have spent more than a decade trying to protect land along the 4-mile stretch of cliffs, which has remained largely undeveloped for 400 years. The land along the cliffs hosts a high concentration of eagles and is significant to the Rappahannock Tribe, which received federal recognition in 2018 and had a historic presence along Fones Cliffs. The cliffs were the site of an encounter in 1608 between the Rappahannock people and English explorers led by Capt. John Smith.

The Rappahannock Tribe's Chief Anne Richardson wrote in a recent letter to the editor in the *Fredericksburg Free-Lance Star* that the tribe wants to see all of the land along Fones Cliffs preserved.

She wrote that the land "is sacred to the tribe as it was once our home and today is home to the bald eagle, a symbol of our spirituality."

A Richmond County board rezoned the pair of properties in 2012 and 2015 to allow for increased density as requested by the property owners.

A Richmond County board rezoned the pair of properties in 2012 and 2015 to allow for increased density as requested by the property owners.

Those watching the projects were encouraged to see the state taking strong



The Virginia Attorney General is suing the owners of a 1,000-acre Fones Cliff property over environmental damages resulting from the unpermitted clearing of more than 12 acres at the end of 2017. (Chesapeake Conservancy)

action against violations along the already erosion-prone cliffs. They also seem more hopeful now that at least the Bowers property is on its way to becoming a publicly accessible wildlife refuge rather than a private enclave of homes.

"The fact that it's finally under contract is the culmination of a lot of effort by a lot of people," said Joe McCauley, who began working with Bowers while at the U.S. Fish and Wildlife Service before joining the effort as a fellow at the Chesapeake Conservancy. "I hope ... that we can find a way to work with the other Fones landowners to really conserve the whole feature."

Bowers said in an early October press release that "an incredible twist of fate" led him to pivot toward conservation and away from development, including a pending attempt to construct 10-story condominiums on the river's edge.

Heather Richards, The Conservation Fund's Virginia director and program manager, confirmed that the Bowers property is under contract, with a closing date tentatively scheduled for December. But she remained cautious, because these purchases are subject to acquiring federal funding.

"It's not done until it's closed," she said, but "it is under contract, and we do expect to close by the end of this year."

The Conservation Fund plans to sell the property to the U.S. Fish and Wildlife Service so it can be added to the more than 9,000-acre Rappahannock River Valley National Wildlife Refuge, Richards confirmed.

Virginia True

The Bowers conservation announcement came a few days after the case involving Virginia True was referred to the attorney general's office for potential legal action.

The owners of the property cleared more than a dozen acres of trees along the cliffs late last fall. The firm's Virginia-based lawyer at the time claimed that he wasn't aware of the need for certain permits before beginning the work. But individuals who had opposed the development and its promises to complete an "environmentally sensitive project" said the missteps made their fears about the project's impacts come to fruition.

In the spring, heavy rain contributed to erosion on the newly cleared land and was linked to a landslide in late May on the edge of the Virginia True property.

By that time, the company had already received two notices of violation and would receive a third from the state Department of Environmental Quality for lacking the proper permits while prepping the land for development. A consent order issued by state regulators and signed by Virginia True's executive vice president, Howard Kleinhendler, at the end of May details violations at the site that resulted in a \$42,000 fine. The order also required the company to submit weekly reports to the DEQ on their progress toward stabilizing erosion at the site and implementing a stormwater management plan.

Jeff Howeth, a professional engineer based in Tappahannock, VA, hired by Virginia True to get the site back into compliance, said he has been submitting weekly reports to the agency and was surprised by the decision to refer the case to the attorney general. The DEQ has the option to refer serious environmental violations to the Virginia attorney general or the U.S. attorney on a case-by-case basis.

Howeth said in late September that heavy rain throughout the summer made the work more difficult but that the cleared land was growing grass and mostly stabilized.

"We've done — barring bad weather, which has been pretty horrendous — everything they've asked us to do along the way," Howeth said. Howeth said Virginia

Howeth said Virginia True could go back to the county as early as November

to seek approval for changes to the development, which currently focuses on single-family homes and a lodge surrounding a golf course. The company is considering building luxury condominiums instead "to lessen the footprint" of the project.

Advocates that oppose development of the Virginia True property have kept a close eye on construction and lobbied state regulators to take any violations seriously. They applauded the attorney general's decision to sue the property owner over what Herring called in a statement "significant and repeated environmental violations."

The suit, filed in Richmond County Circuit Court, alleges 17 counts of illegal actions by Virginia True at Fones Cliffs.

"Today's news from the attorney general's office makes me hopeful that we won't have to say, 'If only we had tried a little harder to stop the damage,"" wrote Kathleen C. Harrigan, executive director of Friends of the Rappahannock, in a statement the day the filing was announced.

About face

Next door to Virginia True, Bowers seemed in recent years to be inching away from preservation and toward developing his property beyond his own partially constructed home, the only one that exists on the site. Bowers, who resides in South Caro-

lina, began building the house after he

FONES FROM PAGE 8

bought the riverside property as a weekend getaway for his family in 2002. But he stopped construction when he began getting offers from both developers and conservation groups amid a white-hot real estate market in the early 2000s.

McCauley said conservation groups have appraised his property three times over the years, but none of the offers made to Bowers were accepted. In 2015, Richmond County officials granted Bowers' request to rezone the property to allow for a 45-home "conservation community" on the property. Bowers also has entertained offers from Virginia True, looking to add his land to their project.

During the *Bay Journal*'s visit to the Bowers property earlier this year, Bowers said he would be ready to make a deal soon.

"I guess at this point, I want to sell and move on," said Bowers, who said he felt ostracized by residents who opposed his project during the rezoning process. "My druthers would be for it to be conserved, but I am not an anti-development person. I'm sensitive to the environment, but I don't think putting 22 houses on this cliff is going to destroy the river or the Chesapeake Bay."

What changed his mind? Bowers wrote that a series of unexpected events — including Hurricane Florence and a nearly stranded wife — contributed to the decision.



This is the view of the Rappahannock and Fones Cliff from the 250-acre parcel Terrell Bowers has agreed to sell for conservation purposes. (Wbitney Pipkin)

Bowers was scheduled to go before the Richmond County Planning Commission on Sept. 10 to present his conceptual plan for rezoning his "Rappahannock Cliffs" development to allow four 10-story condominiums along the cliffs instead of single-family homes.

A few days before the meeting, The Conservation Fund made a proposal to purchase his property for an undisclosed sum. Then, he got a call from his wife in South Carolina. She was trying to get out of the expected path of Hurricane Florence, scheduled to bear down on the region that weekend, and her car had broken down.

"I could either stay put and go to the planning commission and head home Tuesday, or rescue the damsel in distress," Bowers wrote.

He headed to South Carolina and, over the weekend, decided with his wife, Deane, to accept The Conservation Fund's offer. Deane Bowers, an environmental folk artist, has wanted the see the property conserved for years, Bowers said.

"She helped me see that even though the number was considerably less than what Virginia True had it contracted for last year, it was close enough." He wrote. "In the big scheme of things, it was the right thing to do."

Conservation groups that have lobbied for more than a decade to see portions of Fones Cliffs preserved lauded the freshly minted deal.

"It's welcome news that a 250acre section of Fones Cliffs could be preserved, given that a neighboring 1,000-acre parcel continues to be under threat from development violations by a different owner," wrote Rebecca Tomazin, Virginia executive director of the Chesapeake Bay Foundation, in a statement. "We're glad that Terrell Bowers has agreed to sell a portion of the cliffs for conservation and hope for a smooth transfer by the end of the year."

For now, McCauley said he is pleased that Bowers has signed on the dotted line and hopes that the property will become a public place where visitors can connect with both nature and the past.

"This spot," he said, "looks very much the same as it did 400 years ago. And that should be an inspiration to us to work together to make other places that vibrant and accessible for people."



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To save farmland in Cumberland County, PA, officials look to Lancaster

Private land trust could reach out to those not accepted by government program.

By Donna Morelli

Farmland preservation has become an increasing priority in Cumberland County, PA, where residential and commercial development — especially for large warehouses — is putting steady pressure on what's left of the rural landscape. The drive to pick up the pace of farmland preservation has led to a budding partnership between the Cumberland County Department of Planning and the neighboring county's Lancaster Farmland Trust to see if the nonprofit organization might extend its work into Cumberland County.

"There is definitely a need," said Jeff Swinehart, deputy director of the trust. "We heard from the community that the warehouse development is a concern of some farmers. They are worried about the growth pressures and what happens to these lands around intersections and exits as they convert to industrial and commercial uses."

Protecting more farmland in Cumberland County could also be good for the Susquehanna River and Chesapeake Bay because environmental stewardship practices can be required as part of the preservation agreement.

Cumberland County is located directly across the Susquehanna River from Harrisburg. According to the data center at Penn State University, it's been the fastest growing county in Pennsylvania for two years. Its commissioners attribute the growth to a high median income and low taxes, the attractions of approximately 55,000 acres of state parks and forests and a setting that includes approximately 154,000 acres of farmland.

The county's rich limestone soil hosts productive farms, most of which are cradled between the Yellow Breeches and Conodoguinet creeks on relatively flat, well-drained land. Plain Sect farms, including Amish and Mennonite, are common in the western part of the county. The state Department of Agriculture reports that one out of six jobs in the county is in agriculture or a business that supports it.

So far, approximately 19,000 acres of farmland have been preserved by a statecounty program, funded by both sources and coordinated locally by the Cumberland County Agricultural Land Preservation Board. The program buys the development rights to the farm at an average price of \$2,500 per acre, and the landowner signs a conservation agreement — a legal document attached to the land's deed stating that the property must be used solely for agriculture in perpetuity.

But farms have to meet stringent crite-



Jeffery Swinehart, (left) deputy director of the Lancaster County Farmland Trust, talks to Jeff Graybill of Penn State Extension. The land trust is considering an expansion of its farmland preservation work to Cumberland County. (Dave Harp)

ria to qualify for the program: Applicants are ranked by soil type, acreage and proximity to other preserved farms. The county accepts about five to eight farms from an average of 25 applications each year.

Stephanie Williams, county coordinator for the program, said that extra help may be needed.

"We wanted to see how we could preserve more farmland by means that work outside of the state program," Williams said. "There are farms in the county that don't rank well in the state program and there are farmers, particularly in the Plain Sect community, with a desire to preserve their farms but who are not comfortable working within a government program."

Private land trusts are funded through grants and private donations, and they can be more flexible in deciding which farms they accept into their program. So farms that didn't make it into the state-county program could be candidates for an easement with a land trust.

The county approached the Lancaster Farmland Trust because of its recognized success in protecting farmland, including agreements with the Plain Sect. The trust was founded in 1980 from a similar need to expand the efforts of the Lancaster County Agricultural Preservation Board. Since then, the organization has conserved 29,000 acres of farmland.

Armed with a \$50,000 grant from the National Fish and Wildlife Foundation, the trust is exploring opportunities in Cumberland County by meeting with landowners and businesses, as well as municipal and county officials. They are looking to measure both potential financial support and the agricultural community's interest in working with a private land trust.

The trust expects to finish its study in early 2019. Based on its findings, the trust will then determine whether it can justify expanding services into Cumberland County, about an hour's drive from its headquarters.

"We are excited about the possibility," Swinehart said. "We have really started ramping up our outreach. We are looking at where the opportunities are to raise dollars and to identify the highly visible leaders in the agricultural community."

So far, Swinehart said, the response has been positive. He spoke to farmers who prefer to work with a private group rather than a government agency and was surprised when one enthusiastic farmer was ready to donate an easement. Most of the county's 33 municipalities are on board. County residents as a whole have also expressed support for farmland preservation. A 2017 survey showed that 67 percent of residents ranked farmland protection as "extremely important." The survey was completed by nearly 3,000 people as part of an update to the county's comprehensive plan.

Residents are especially concerned with the boom in large warehouse construction that has been transforming the landscape for years. Located within a few hours' drive of five ports and bisected by Interstates 81 and 76, the county has become a transportation hub for commercial goods.

This is especially true in the western part of the county, where open farmland makes for efficient construction sites. There, Amazon's warehouse alone covers 18 acres. It was built in 2010 just outside the county seat of Carlisle.

Citizens have expressed anger at the continued construction of warehouses along Interstate 81, dubbing the large structures "monster" warehouses, posting yard signs and arranging protests.

Conservation debates also heated up over the county's recent proposal to use eminent domain to take a privately owned, 116-acre historic farmstead — which has been protected since 1986 through an easement with a private land trust

— to construct a school. Crowds filled the school district's meetings in opposition. The county indicated that it would withdraw its plans after the state legislature passed a bill in June that made it harder for public entities to use eminent domain on preserved properties.

Along with addressing citizen concerns, protecting farmland can benefit the environment. That's because the preservation agreement can require the use of conservation

can require the use of conservation practices that promote water quality in local creeks, the Susquehanna River and downstream in the Chesapeake Bay. Farms preserved with state funds, for example, must have a current conservation plan — a road map to needed improvements on the farm to protect soil and water quality. Cumberland County takes that one step further by requiring plans that detail manure management and erosion control.

Agriculture is the top contributor of nutrient and sediment pollution to the Chesapeake. According to the Pennsylvania Department of Environmental Protection, Cumberland County is one of five south-central counties that together contribute about 25 percent of the state's nutrient pollution load to the Bay. The others are Lebanon, Centre, Bedford and Franklin.

"When we're helping the farmer, we're also helping our waterways and the Chesapeake Bay," said Kirk Stoner, director of the county planning department, where the farmland protection program is located. "If they are going to use public dollars to preserve their farms, they also need to be good stewards of the land and water on that farm."

Owners of preserved farmland can also get priority consideration for funds that help put conservation practices in the ground. The state Department of Agriculture's Farmland Preservation Bureau recently signed a five-year \$6.3 million cooperative agreement with the U.S. Environmental Protection Agency to help pay for agricultural practices on preserved farms in six southcentral Pennsylvania counties, including Cumberland.

Tangier Island prepares for long-awaited jetty construction

✤ Project will keep channel open and protect harbor but won't help much to offset sea level rise.

By JEREMY COX

Tangier Island is getting some state and federal help in its long-running battle against the Bay's punishing waves. But officials said that it won't be much help with a larger problem: sea level rise.

The U.S. Army Corps of Engineers and Virginia Marine Resources Commission announced in late September an agreement to construct a nearly 500-footlong stone jetty just off the island's western shore.

The \$2.6 million project is designed to keep the community's navigational channel open and protect its commercial harbor from waves and future storm surges, said Virginia Secretary of Natural Resources Matthew Strickler.

"They've got some significant challenges with their harbor from a safety perspective, and there's some shoaling with sediment getting in," he said. "It's not protected from some of the winds, so the jetty will be a buffer for that and improve access."

The agreement paves the way for design work and construction to begin later this year and be completed in 2019, officials said. The federal government is shouldering 80 percent of the cost; the



Rising seas, land subsidence and erosion have claimed approximately two-thirds of the Tangier Island system's land mass since 1850. (Dave Harp)

state is picking up the rest.

Tangier Island's economy is closely tied to the water. Its shores are lined with docks, deadrise work boats and "shedding houses," shacks used for processing soft crabs.

"A clear and open navigation channel is key for public safety and for the local economy, which counts the Chesapeake Bay and tourism among its central assets," Gov. Ralph Northam said in a statement.

The project dates to 1994, when Congress authorized the Army Corps to study the potential for a jetty. A lack of funding and the need for further studies led to repeated delays.

In the meantime, the low-lying island has more recently played a role in the national debate over climate change. Tangier's 400 residents live along three ridges on an island measuring 5 miles long and 1.5 miles wide with no access to the mainland except by boat or air.

Rising seas, land subsidence and erosion have claimed approximately two-thirds of the island system's land mass since 1850, according to a 2015

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Army Corps study.

Many of Tangier's residents — with roots going back multiple generations on the island — are deeply skeptical of climate change science and blame erosion for its shrinking size. After a CNN report about the island last year, President Trump, who has often called climate change a "hoax," phoned the town's mayor, James "Ooker" Eskridge, and told him he had nothing to worry about.

The jetty is set to start at the southwestern tip of Uppards Island, a formerly inhabited island just north of Tangier, and extend south into the navigational channel, officials said. Although it will protect the channel, the barrier isn't expected to provide any relief to the land from sea level rise, Strickler said.

The sea is rising in the Bay at a rate of three-quarters of a foot every 50 years and accelerating, according to the 2015 Army Corps study. It predicted that Goose Island, one of Tangier's three main islands, will be underwater by 2050, and all will become inundated by 2106.

The jetty project, though, "gives our island and residents, young and old, renewed hope that we can save our homes and our way of life," Eskridge said in a statement. "This is the way that good government should work. This is a great example of true partnership between state and federal governments."

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Bay scientists: Stream restoration benefits not clear cut

States and local governments are investing millions of dollars in restoration but the science is still evolving.

By JEREMY COX

Erik Michelsen stopped his countyissued white Jeep Cherokee on the side of the road in a leafy neighborhood south of Annapolis, then plodded down into a ravine. He followed a trail through a tunnel of oak trees and rare Atlantic white cedars. The air was heavy with the scent of dew. At the bottom, Michelsen emerged in a picturesque scene: a babbling stream slightly too wide to leap across that was strewn with rocks, ranging in size from golf balls to microwaves.

If it seemed too natural to be natural, it was. In 2005, the state of Maryland and Anne Arundel County collaborated on a nearly \$1 million project that transformed two failing stormwater ponds into "Wilelinor Stream," named after the adjoining subdivision. Bulldozers reshaped the land, workers sowed underwater grass beds and dump trucks hauled in tons of sandstone boulders and river rock.

"It's essentially creating systems that slow the water down through the valley, stack the water up, provide an opportunity for it to be processed and slowly released down to tidewater at Church Creek and the South River," said Michelsen, administrator for Anne Arundel's watershed protection and restoration program.

Facing a 2025 deadline to clean up the Chesapeake Bay, officials in urban and suburban areas are spending millions of dollars on stream restoration projects. The six states in the estuary's watershed, along with the District of Columbia, have told the U.S. Environmental Protection Agency that they plan to restore a total of 655 miles of streams. The projects operate on a theory that converting upstream waters from stormwater superhighways to slow lanes would decrease erosion and encourage more water to soak into the ground, reducing the amount of nutrients and sediment heading into the Bay. Now, there is a growing scientific consensus that stream restoration isn't improving water quality and aquatic habitats as much as was once hoped in a highly urbanized area.

"It's not a waste of money," said Solange Filoso, a biogeochemist with the University of Maryland Center for Environmental Science. "But the return on investment is not as high as we thought it would be."

Filoso has been monitoring the Wilelinor and several other reconstructed streams for about a decade. At first, she was confident she would see significant improvement in water quality. What she found was much more modest: an average reduction of 5–15 percent in nitrogen and



Erik Michelsen, head of Anne Arundel County's watershed restoration program, stands near the base of a restored stream that flows into the South River. (Jeremy Cox)

40 percent in sediment.

Some stream restoration projects curb more pollution and others less, given the variations in construction methods and local topography, Filoso said. But she and other researchers studying projects across the mid-Atlantic have collected enough evidence to suggest that stream restoration alone can't solve the region's runoff problem. "We are trying to solve a big problem ... with a solution that isn't sufficient," Filoso said. "The solution being implemented doesn't match the magnitude of the problem."

Since 2010, when the EPA and Bay states agreed to their most rigorous restoration plan to date, the amount of nitrogen running off urban areas into the Chesapeake has increased from 39.7 million pounds a year to 41.3 million pounds, according to the federal agency's latest computer models. This is despite an overall 11 percent reduction in nitrogen from all sources, fueled largely by cuts to pollution from farms and wastewater treatment plants.

Nitrogen triggers algae blooms that cloud Bay waters, causing underwater grass beds to die back and rob the water of oxygen as they die, creating "dead zones" nearly devoid of fish and crabs. Efforts to reduce nitrogen fell short of the Bay cleanup midpoint reduction goal, registering a 30 percent decrease instead of 60 percent.

Proponents of stream restoration say that its benefits haven't fully come to light because the practice remains in its infancy.

"I would tell you ecological restoration is not yet a science," said Keith Underwood, an Annapolis-based contractor who was one of the region's pioneers in the field, starting his first projects in the mid-1990s. "It's still very much in the era of an art." Joe Arrowsmith, water resources engineer with Straughan Environmental in Columbia, MD, said it's time for the field to evolve. "We have reached our base goals, and now it's time to reach higher goals," Arrowsmith said.

Restored streams only get better with time, proponents say, as the scars of construction heal and nature reasserts itself. But one improvement is obvious almost immediately: Water travels through the channels more slowly. That leads to less streambank erosion and less sediment being transported downstream. Phosphorus, another problem nutrient, clings to sediment. So it ends up staying put rather than being flushed into the Chesapeake.

But there can be downsides, scientists caution. For instance, portions of restored streams can turn into "dead zones" themselves, Filoso said.

One of the main methods that contractors use to slow floodwater is creating a chain of pools separated by rock weirs; they're embedded in a slope so that one trickles into the next. In warm weather, decaying plants trapped in the slowmoving water can use up its oxygen.

When water turns anoxic, or lacking in oxygen, it can flip that lingering phosphorus from a positive story to a negative one. A chemical reaction unglues the nutrient from the sediment, transforming it into a fertilizer for algae blooms, Filoso said.

"All the restorations have trade-offs," she added.

There is disagreement over whether the re-engineered streams are providing better habitat for insects, frogs and other wildlife. Studying more than a dozen stream sites in Maryland, EPA researchers Rebecca Cope and Greg Pond found that restored streams weren't improving aquatic life and, in some cases, were leading to less diversity. All that could be found in some were worms and maggots, Pond said.

Again, the issue seems to be the low amount of oxygen in some restored streams, he said. "The thing with dissolved oxygen is it's a kill switch. You get below 2 milligrams [per liter], you get a lot of death with macroinvertebrates that may have colonized," Pond said during a recent conference call with the Chesapeake Bay Program stream health panel.

Underwood was listening, growing frustrated. In an interview later, he called it unfair for scientists to evaluate all restored streams with the same criteria when great variations exist among them. Truly "restored" streams, known in the industry as regenerative stormwater conveyances, or RSCs, re-establish hydrologic connections between channels, their floodplains and the groundwater, he said.

"You saw that our detractors were calling a lot of things RSC that were not RSC," Underwood said. In one case, he added, "they were studying bugs at the outfall pipe from the Annapolis Mall."

Ground zero for the debate is Maryland's highly developed Western Shore. Three out of every five miles of streams recommended for restoration across the Chesapeake's six-state watershed are in Maryland cities and towns.

As he drove to another stream restoration site a couple of miles away from Wilelinor Stream, Michelsen explained why the technology has caught on there. Anne Arundel's landscape, he said, unites two disparate features: loose, sandy soils and a Piedmont-like terrain. During heavy rains, that combination often leads to torrents of erosion that have scoured small streams and detached them from natural floodplains.

He stepped over the curb at the edge of a half-empty park-and-ride lot and tromped a few dozen yards to where a grassy margin fell away into a gently sloping wetland. In 2016, the State Highway Administration rehabilitated the channel, which flows into Broad Creek.

Just about everything about the original headwaters channel was unnatural, including its very existence; it was carved by gushing waters turned loose by a dam break in the 1980s, Michelsen said. By the 21st century, the uncontrolled water had scoured a channel as deep as 6 feet.

The entire restoration area measures a handful of acres and is responsible for the drainage of a watershed spread across 250 acres – roughly half of it consisting of impervious cover, such as parking lots, highways and buildings.

Still, the wetland seemed to teem with life. On Michelsen's approach, a snowy egret and green heron took flight. Pointing out the birds, he said that their presence suggests the wetland is prob-

Wilelinor Stream was restored in 2015 after a pair of neighborhood ponds began to fail south of Annapolis. Workers added rocks and plants to the streambed hoping to slow down water flows during strong storms. (Jeremy Cox)



PROJECTS FROM PAGE 12

ably full of insects as well.

Michelsen, another participant in the panel phone call, took the criticisms in stride. "I think the field is still so young, every project is sort of its own experiment."

Anne Arundel is home to dozens of stream restoration projects, dating back more than 15 years, and officials there and elsewhere in Maryland appear undeterred by their middling results. Gov. Larry Hogan's administration recently awarded \$22 million to 18 projects designed to improve the health of waterways. At least 14 involve restoring urban streams or using similar techniques to capture and store stormwater.

To government officials, stream restoration is a relatively simple, inexpensive solution to a complex problem, said Mike Lovegreen, stream team leader with the Upper Susquehanna Coalition in New York. In contrast, reconstructing drainage systems at the source of the problem — usually in decades-old developments on private land — is a much larger and more complicated fix, involving logistical problems, disruption of neighborhoods and a lot more money.

"It's not a real popular sale," said Lovegreen, who is also a member of the Bay Program's stream health panel.

On one hand, it makes sense to concentrate restoration efforts on headwaters streams because they collect stormwater from such vast areas, Filoso said. On the other, the premise relies on extracting a herculean amount of water-quality improvement from a relatively small project footprint. For that reason, she refers to the re-engineered wetlands as "watertreatment plants."

"Usually they restore a 100 or 200 meters of stream length," Filoso said. "It's a very small reach to take care of all the problems with pollution that are accumulating in the watershed."

She recommends that states and local governments invest more in a holistic approach that includes replacing impervious surfaces with those that enable water seepage, and installing rain gardens to filter stormwater at its sources.

One of the best hopes for answering questions about stream restoration lies with Muddy Creek, a tributary of the Rhode River in Edgewater, which is also in Anne Arundel County. It is one of the only sites where scientists studied a channel before the work crews arrived and after they left — a key to sorting out what impacts can be ascribed to restoration.

Workers used sand and wood chips to raise the streambed, which had fallen 12 feet below the surrounding land. They installed small berms across the width of the channel at certain points to check the flow of water. Where once there was a deep ditch, water can now overflow the banks into a surrounding marsh.

The \$1 million project caused a "profound change" to the ecosystem, said Tom Jordan, a senior scientist with the Smithsonian Environmental Research Center. He collected data on Muddy Creek's water quality for one year before and two years after the restoration.

Almost immediately, he noticed an influx of wood ducks, salamanders and frogs. The water table rose, making the bank inhospitable to tulip poplars, and they soon died. But his water samples showed the stream performing as promised in some ways, particularly in its ability to sponge up phosphorus. Nitrogen levels were down by only "marginal" levels.

The restoration had another unexpected effect — and not for the better. Portions of the stream have turned a rusty color, a symptom of iron leaching out of the rehydrated soil around it. The iron oxidizes when it comes in contact with the air at the water's surface. The bacteria that feed on the iron deplete the oxygen in the water.

For Jordan, Maryland's experiences with stream restoration present a larger question: Should streams suffer so that the Bay may live?

"It's some kind of urban runoff treatment system, and it doesn't seem right," he said. "It seems like we should design urban development to protect the streams and not the other way around."

Striped bass reproduction above average in MD, VA

Upward trend over the last few years bodes well for popular fish's future.

By KARL BLANKENSHIP

This year's heavy rainfall did not seem to hurt spawning striped bass, as scientists in both Maryland and Virginia reported that reproduction for the prized fish was bit above average.

It was the second straight year when the closely watched striped bass index was above average in Maryland. It was also the sixth straight year when reproduction was at, or above, average in Virginia.

Though striped bass migrate along the Atlantic Coast, about three-quarters of them spawn in Maryland waterways, and the success of reproduction there — or lack thereof —has historically been a predictor of future coastwide abundance.

"Consecutive years of healthy reproduction are a great sign for the future of this iconic species," said David Blazer, the Maryland Department of Natural Resources' director of fishing and boating services.

The DNR reported its 2018 youngof-year index — based on the number of juvenile fish captured during summer seine net surveys — was 14.8, a bit above the 65-year average of 11.8. It has been above average for three of the last four years.

A similar survey conducted by the Virginia Institute of Marine Science recorded a mean value of 10.72 fish per seine haul in that state's major rivers. That was a bit above the historic average of 7.77 fish per seine haul and similar to indices observed during the previous five years.

Reproductive success can vary widely from year-to-year because of weather and other factors. Mary Fabrizio, the VIMS scientist who oversees the Virginia survey, said the fact that indices



Seine survey chief scientist Brian Gallagher counts juvenile striped bass and other organisms following a seine haul on the James River. (© D. Malmquist/VIMS)

have been near average in recent years suggests that the abundance of juvenile striped bass has been stable.

Striped bass play an important role as a top predator in the Chesapeake Bay ecosystem and are a valuable recreational and commercial species. The population in the Bay hit historic lows in the late 1970s, prompting a fishing moratorium in the mid-to-late 1980s. It has since recovered, but remains closely monitored.

The Maryland index represents the average number of fish less than 1 year old captured in 132 samples collected at 22 survey sites in four major spawning areas — the Choptank, Potomac and Nanticoke rivers, and the Upper Bay.

DNR biologists have been conducting the survey since 1954.

Meanwhile, the Virginia survey samples 18 sites in the Rappahannock, York and James river watersheds and has been conducted since 1967.

Juvenile fish "recruited" into the population this year will be large enough for anglers to catch in three to five years.



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Biochar could be the hot new thing in addressing Bay's poultry litter

➢ Baked manure better for environment and bottom line but lacks industry standards.

By JEREMY COX

West Virginia farmer Josh Frye raises chickens for a meat processor and sells most of their manure to nearby crop growers for use as fertilizer. But what he does with the rest of the manure could help tackle two big environmental problems: cutting back nutrient pollution in the Chesapeake Bay and reducing carbon emissions that accelerate global warming.

A bus-size contraption next to Frye's three chicken houses bakes mounds of chicken litter — the mixture of manure, feathers and bedding materials that cover the houses' floors — at temperatures up to 1,300 degrees. The result is biochar, a black powdery substance that Frye said can serve many purposes, from improving soil health to sponging up nutrients from stormwater runoff.

"Why can't you take a pollutant out of the Chesapeake watershed and use it for a benefit?" asked Frye, whose farm is perched just inside the western edge of the Bay's drainage area, near Wardensville, WV, and the Cacapon River.

A NASA scientist has dubbed biochar an "environmental superstar." Al Gore has called the carbon-rich substance "one of the most exciting new strategies" for reducing greenhouse gas emissions.

What's more, making biochar can be lucrative, bringing in up to \$2,000 per ton rather than the \$10 per ton they get for raw poultry litter, Frye said.

So why is Frye one of the relatively few poultry farmers making and selling biochar in the Chesapeake's 64,000-square-mile watershed — or elsewhere, for that matter? The answer, biochar companies say, boils down to a lack of industry standards and the stubborn persistence of a marketplace that is either unaware of biochar's potential benefits or skeptical of them.

"Everything eventually ends up having its own operational value — what they're willing to pay for a material," said Tom Miles, an Oregon-based biomass energy consultant and board member with the International Biochar Initiative, which promotes the technology. "That just hasn't happened yet for biochar."

Something old, something new

Biochar is rooted in a natural process; it can be produced in a forest fire. But the earliest known humanmade biochar dates back hundreds of years to Amazon Indians, said Johannes Lehmann, a soil scientist at Cornell University.

When he and other researchers released their findings about the "black soil" in the early 2000s, it kindled a wildfire of scientific and entrepreneurial interest in the substance. What often gets lost in the telling of that moment, Lehmann said, is that no one could say for sure whether the Indians had produced the biochar intentionally or were just burning debris.

"To say we're rediscovering an ancient wisdom from the Amazon is a nice story, but I'm not sure we will ever be able to say that conclusively 100 percent," he said.

Today, more than 100 U.S. companies produce biochar, according to International Biochar Initiative surveys. About 45,000 tons are made each year, and almost all of it is derived from wood waste, Miles said. Sawmills in the South cook sawdust in large gasifiers to produce biochar and methane, which they use to heat the kilns that dry their lumber. In the West, urban landscaping debris is fed into biomass boilers that generate electricity and biochar.

In the mid-Atlantic, biochar usage has spread little beyond the academic world. But advocates say the technology is on the verge of breaking into the mainstream.

Millions of chickens are produced each year in the Chesapeake watershed, particularly on the Delmarva Peninsula. Farmers use the chicken manure to fertilize crops on nearby fields, but the rate of application is sometimes higher than crops can absorb. The excess nutrients wash into the Bay, fueling algae blooms that lead to oxygen-starved "dead zones" all but devoid of marine life.

Despite improved science and management strategies, agriculture, in general, remains the Bay's largest single source of nutrients.

Enter biochar. Lehmann said raw manure contains about 2–3 percent phosphorus, one of the nutrients fouling the Bay. Converting manure to biochar boosts the phosphorus content to about 15 percent, putting it on par with commercial-grade fertilizers. Farmers wouldn't have to apply nearly as much of it and could target only the spots that most need the nutrient, Lehmann said.

Scientists also have found that biochar can grip onto nitrate in the soil a leading theory is that it's negatively charged surface attracts the positively charged nutrients — and prevent it from leaching into nearby waters.

The charred material also is porous, which helps it absorb and retain stormwater. A budding industry is mixing biochar into "bioreactors," which act like large water filters at the edges of farm fields and urban spaces. Not only does biochar hold onto the water longer, it also soaks up its nutrients.

The nonprofit Ridges to Reefs is working with a grain farmer on Maryland's Eastern Shore to test the use of biochar as a nutrient sponge. The bioreactor used in that project consists of a 100-foot-by-30-foot patch of wood chips and biochar buried along a drainage ditch.

Josh Frye installed this gasifier on his West Virginia chicken farm about a decade ago, becoming a pioneer in the production of biochar in the Chesapeake Bay watershed. The gasifier bakes poultry litter, producing the carbonrich biochar, which can be used as a soil amendment. (Jeremv Cox)

Installed nearly two years ago, it looks like just another patch of grass. But according to Ridges to Reef's preconstruction estimates, the bioreactor should be removing up to 90 percent of the nitrates and 60 percent of the phosphorus from the stormwater that passes through it.

The group collected water samples over the summer at the Talbot County farm, and the results should be available in the coming months, said Julie Chang, a restoration ecologist with Ridges to Reefs, which is based in Sykesville, MD.

"It's not going to be the silver bullet," she said. But because bioreactors can be installed without reducing a farm's cropland acreage, Chang added, "theoretically there shouldn't be an issue to implementing it everywhere."

Char troubles

Miles, the biochar industry consultant, is an optimist. But even he concedes that the economic deck remains stacked against biochar.

"You could turn the clock back 30 years and be describing the composting industry," he said. "A big difference is with compost, [a company can] get paid to convert the residue to a product and with biochar, no one's paying you."

With compost, municipalities pay a "tipping fee" to the facilities that convert the material into energy, Miles said.

The nascent biochar industry has also been challenged by an identity



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crisis. Biochar can be derived from a host of organic source materials, including: wood, coffee husks, coconut shells, cow manure and poultry litter.

As a result, different recipes bearing the same "biochar" label may yield widely divergent amounts of carbon and nutrients. For example, carbon makes up about 70–80 percent of wood-based biochar but only 10–34 percent of poultry litter-based char.

"When you're buying Cheerios, you're buying Cheerios," said Joe Berg, a restoration ecologist with Biohabitats, a Baltimore-based conservation planning and ecological restoration firm. "When you're buying biochar, you don't want to be buying six different types of biochar. If there are six, they need to be labeled."

If the labeling problem could be fixed, biochar companies would still face another hurdle: overcoming scientific uncertainty about biochar's ability to lock carbon in the ground. In recent years, soil scientists have been feverishly working to provide scholarly perspectives on boosters' claims. A search of the term "biochar" in a major electronic academic database shows nearly 3,500 results over the last five years compared with just shy of 700 the previous 10 years.

Some studies have suggested that biochar can keep carbon from being released into the atmosphere for thousands of years. Normally, when plants decay, carbon dioxide is emitted into the air. Biochar, however, converts carbon into a more-stable form that decays over millennia instead of months, researchers say.

That has led advocates to push for a marketplace in which biocharproducing companies sell "credits" to industries that release carbon to offset those releases.

But those hopes were dealt a huge blow in 2015 when the American Carbon Registry, a nonprofit that sets carbon-trading standards, declined to endorse the International Biochar Initiative's protocol for biochar credits. The scientific literature "did not provide sufficient evidence of the stability of soil carbon sequestration" in treated farm fields, the registry's reviewers said.

The trade group is unlikely to take up the effort again anytime soon, Miles said.

A lack of scientific consensus also led to a bleak assessment of biochar in a 2011 U.S. Government Accountability Office report on potential climate engineering technologies. On a "technology readiness level" scale of 1 to 9, biochar received a 2, owing to a lack of plans for large-scale implementation and Josh Frye stands inside the fabric-covered hoop building where he stores poultry manure from his farm until he's ready to cook it inside his gasifier, turning it into carbon-rich biochar. (Jeremy Cox)



When poultry manure is "cooked" at temperatures reaching as high as 800 degrees, the result is carbon-rich biochar, which resembles smashed charcoal. It can serve many purposes, from improving soil health to sponging up nutrients from stormwater runoff. (Jeremy Cox)

uncertainty over its ability to trap carbon.

'Why isn't this happening now?'

At a recent biochar conference in Wilmington, DE, a speaker asked a room filled with dozens of industry members and scientists to raise their hands if they were involved in turning animal manure into biochar. A lone hand shot up into the air from the far end of the front row.

A few weeks later and 200 miles to the west, Josh Frye extended the same hand to show off the powdery evidence.

"The way to tell if your carbon is good is if it wipes off easy," Frye said as he ran his blackened hands together.

Frye never expected to become a biochar pioneer. He is the latest of several generations of farmers in his family and raises 800,000 chickens a year in three long, metal buildings on their old homestead nestled in a mountain valley.

Winters are long and cold in this part of Appalachia, and his heating costs just kept rising. In 2007, he heard about a technology that promised to help keep more money in his pocket. Like the big power plants out West, he could use poultry litter to generate energy.

With the help of state and federal agricultural grants, Frye had a

\$600,000 gasifier assembled next to his chicken houses in 2007. It sprouts a conveyor belt on one side, supports a ladder in the rear and has a cavernous oven in the middle.

The gasifier doesn't incinerate the poultry litter. Rather, it heats the litter at high temperatures in a lowoxygen environment to trigger a process called pyrolysis. There is virtually no smoke or smell.

"The material, when it's in [there], it looks like the end of a cigarette butt. It's not fire, it's smoldering," Frye said.

Because of a design flaw, Frye's hopes of heating his chicken houses with the gasifier never fully

materialized. Only one of the houses was ever hooked into the system. But the biochar output exceeded his wildest expectations. Frye can produce 1,000 pounds of biochar per hour, and he stores the material in tarp-covered mounds until he can find a buyer.

He sells the biochar primarily to golf courses, which mix it with soil to improve turf growth, and scientists, who use it in their research. But his profits are limited by the lack of a larger market.

"I can't take these groups out to wine and dine them to get them to try my product," Frye said.

A coalition of agricultural extension agents and wood industry leaders, known as the Mid-Atlantic Biochar Working Group, is trying to help producers like Frye overcome such hurdles. It helped him, for example, acquire \$10,000 from a West Virginia economic development organization a couple years ago to repair some of his gasifier's failing parts.

One of the coalition's goals is to create a regional processing facility, where several chicken farmers can have their litter turned into biochar, said Tina Metzer, executive director of the Eastern West Virginia Community and Technical College's business startup arm and an organizer with the biochar working group.

She still recalls her reaction when Frye first gave her a tour of his farm, its unusual piece of machinery and even more unusual product.

"We were like Josh — 'It's a nobrainer. Why isn't it happening now?"" Metzer said.

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A survey conducted by Virginia's Longwood University found that 28 out of 313 historic sites on the commonwealth's shorelines would likely be gone within 50 years. Remnants of settlements, cemeteries or shell deposits in erosion-prone areas such as the Bay's Eastern Shore or on private property could be especially hard to access before they disappear.

"These sites are washing away every day, and there's only so much money going around to save them," said Stephanie Sperling, an archaeologist with Maryland-National Capital Park and Planning Commission's natural and historical resources division.

Until last year, Sperling spent a decade working as a consultant for Maryland's Anne Arundel County, which received an influx of federal and state funding for shoreline archaeology after 2012's Hurricane Sandy. A two-year study in the county, which has about 500 miles of shoreline, showed that a quarter of its 1,600 archaeological sites could be lost in the coming years — and kicked off an invigorated season of excavation.

About 80 percent of the endangered sites are related to past Indian communities. Others are the locations of watermen's homes. Colonial era towns and plantations, and Bay beach resorts that bustled with visitors in the late 1800s through the mid-1900s.

The Lost Towns Project, a nonprofit composed of scholars and organizations interested in uncovering the region's past, provided additional funding to excavate five of the sites, "to get what we could before it went away," Sperling said.

Archaeologists say that funding to excavate sites - even those predicted to wash away soon — can be difficult to come by because there are so many projects vying for limited dollars. Maryland and Virginia have each set aside state funds for preservation efforts, but the last flurry of federal funding came to this region through recovery grants after Hurricane Sandy.

The Anne Arundel initiative took shape when that the state was dedicating funds to infrastructure being threatened by climate change, and archaeologists were at the table discussing the impacts. Maryland has a historic preservation specialist who monitors forecast changes and advises local governments on how to prioritize projects.

The increase of superstorms has continued to stir conversations about the impact of weather on infrastructure and cultural resources.

"Now," Sperling said, "it's normal to talk about this. It's a topic of conversation at every [archaeology] conference, because we're losing so many sites.'

Shifting sands can reveal new archaeological opportunities, even as others are being washed away.



Archaeologists David K. Hazzard and Michael J. Madden work along the water to sift through potential findings on the shores at Savage Neck on Virginia's Eastern Shore. (Provided by Mike Barber)



Located in south-central Virginia, Longwood University completed a survey last year for the Virginia Department of Historic Resources to assess the impact of changing shorelines on cultural resources in four counties. When asked why their far-from-the-shore university was a good fit for the project, Longwood professor of anthropology Brian Bates said, half-joking, "We actually expect to be beachfront in 100 years, so we're just thinking ahead."

Archaeology undergraduate students at the university used predictive software to overlay future shoreline changes on Maryland's Eastern Shore, are longburied heaps of discarded oyster shells and other items, some thousands of years old. that contain clues about the region's early human residents. (Dave Harp)

onto maps of historic sites in the state. The results could help researchers prioritize which locations they tackle first in a landscape where many could be at risk of washing away every year.

Bates said students found the work "utterly relevant," because it showed them how urgent the art of archaeological discovery can be.

"Climate change is something our students grew up hearing about, but it's not something the average undergrad is able to do something about," said Bates, who's also executive director of Longwood's Institute of Archaeology.

Virginia archaeologist Mike Barber of the state Department of Historic Resources said the data from Longwood's work revealed 25 sites on Virginia's Eastern Shore alone that will wash away in the next 25 years. The next step is to identify how far those sites extend inland and which are the most significant. Barber explained that an archaeological site is more significant if its artifacts can still be discovered in an environment that's largely undisturbed.

'What we want to know is whether the material is undisturbed the way the natives or colonials or whomever left it," he said. "If we find a pile of bricks on a beach, that doesn't tell anything. But if we find that they are part of a well that's still intact on land, we can determine more about the site.'

That means that, in some cases, sites that have already experienced significant deterioration might not be as important as those that are still untouched but at risk of eroding a few years from now. Barber said his department is looking for other groups to conduct additional research and, in the meantime, chipping away at sites the state has deemed a priority.

Virginia is one of a few states that has a "threatened sites fund" established by the General Assembly in 1985, that provides about \$50,000 a year for pressing archaeological work.

The amount of money has fluctuated and has been higher on occasion, but we're very happy to get what we get," Barber said. "We use it as judiciously as we can."

Historic research on the fingerlike sliver of land that is Virginia's portion of the Eastern Shore has been a priority for decades, at least since archaeologist Darrin Lowry completed sweeping surveys of resources there around 2000 for the state. Some of the sites and artifacts are thought to date to the Paleo-Indian era, when the people first migrated to North and South America, and could be as old as 17,000 years.

"That whole area extended to the edge of the continental shelf when there was no Chesapeake Bay," Barber said. The Eastern Shore "would be the last land mass left from that time period."

"There are resources that are going to be disappearing, and we need to save those now," he said.

At a site on the shore called Savage Neck, near Eastville in Virginia's Northampton County, researchers and volunteers discovered a midden full of oyster shells, ceramics and some stone artifacts dating back to between AD 300 and 700. At Church Neck, also in Northampton County, crews "managed to salvage a portion" of a thin shell midden that dates back to a time near 3,000 BC when its residents appeared to move around more frequently.

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In other places, archaeological work on the shorelines is showing how much history has already been lost to time and tide.

Kirsti Uunila, historic preservation planner for Calvert County, MD, said recent underwater topography studies show how much has been lost at the site of a historic town near the mouth of Battle Creek. First established as the county seat of Calverton, and also known as "Battle Town" or "Calvert Towne," it was the second colonial town in Maryland. The studies revealed that 130 feet of its historic footprint — and the remains of significant buildings — are now underwater.

Some of the work was conducted with the help of the Maryland Historical Trust's underwater archaeologist, Susan Langley, who dives beneath the water's surface to see pieces of the past that have already gone under.

"At some point, where we're working now will be lost as well. That's the urgency," said Uunila, who estimates the site has lost about 15 feet of ground since she began observing it about 20 years ago. "I've documented some of the features eroding out of the bank as they go, but I know there are many more."

A few years ago, the county began cataloguing its historic resources, noting which are at risk of disappearing and which are worth attempting to save. Uunila said the work revealed that a 2-foot coastal flood — less than what portions of North Carolina saw under Hurricane Florence in September — would damage 44 archaeological sites in the county. But, Uunila said, water doesn't often rise evenly on the shore like it would in a bath tub, and a significant storm surge could impact closer to 100 archaeological sites.



"It's complicated, so I try not to say, We're going to lose so many." But it's certainly enough to say there's an issue here," she said.

Many Calvert County sites, including the historic county seat, are located on private property. Crews looking to excavate them must not only find the funding but also secure permission from landowners — who often discover buried artifacts as an eroding shoreline reveals them.

"Calvert County," Uunila said,

"is kind of like a wet sock hanging between the Patuxtent River and the Bay, and every wrinkle in that sock is a creek. It's what's made it a great place to live for 12,000 years."

Those who now live along the county's creeks were recently invited to a program on shoreline erosion where they were asked to keep an eye out for historic resources. Attendance was good, but probably not enough to save as many pieces of the county's



Workers screen through carefully excavated soil to search for artifacts along a rapidly eroding shoreline in southern Anne Arundel County, MD. Known by archaeologists as the Aldridge site, the Bayfront land probably served as a seasonal base camp for Native people between 1250 BC and AD 50. Thick shell middens have been discovered on site. (Anne Arundel County Cultural Resources Division and the Lost Towns Project)

past as archaeologists would like. Sperling said she's had a similar experience in Anne Arundel County and in her current work as she tries to spread the word among residents on an increasingly populated shore.

"Making people aware of the fact that so much is at stake," Sperling said, "that the erosion and sea level rise and storm surge that people see on their piers and in their yards impacts history, too — that's important to get across."



Rising waters made excavating the Aldridge site, located along Herring Bay in Anne Arundel County, MD, a challenge. At least 200 feet of shoreline have been washed away in the last 48 years. Archaeologists worked directly along the water's edge and in excavation pits that sometimes filled with water. (Anne Arundel County Cultural Resources Division & the Lost Towns Project)

birth defects and cancer in laboratory animals and were suspected of causing cancer and other health problems in humans. Their widespread use was also linked to the decimation of eagles, osprey and other large birds of prey around the Chesapeake Bay and elsewhere.

Though their concentrations in water have diminished some since then, PCBs remain among the most insidious and persistent threats in a toxic mix of chemicals that continues to contaminate the Bay and its tributaries — including mercury, pesticides, pharmaceuticals and metals.

Eighty percent of the Bay's tidal segments are either fully or partially impaired by toxic contaminants, according to the state-federal Chesapeake Bay Program that leads the restoration effort. PCBs figure prominently in those impairments. And PCB contamination is the basis for most of the watershed's fish consumption advisories.

Anglers are warned in many areas of Maryland, Virginia and the District to limit or avoid eating what they catch or feeding it to pregnant women and children. The warnings include the region's prized striped bass. And PCBs are even behind cautions in Maryland against consuming the yellow "mustard" (part of the digestive system) in steamed blue crabs.

State, federal and local officials working to restore the Chesapeake have long recognized the need to deal with toxic contaminants like PCBs because of their impacts on human health, fish and wildlife. They first pledged to reduce toxics in 1987 and have repeated that vow in each successive cleanup pact. After initially omitting any toxics commitment in drafting the 2014 Bay Watershed Agreement, officials ultimately called for states to ensure that waters are



PCBs may be present in waterways from past contamination, and they continue to wash into the water from land-based sources. PCBs don't dissolve easily, so most attach to bottom sediment, which can get washed downstream. Some work their way back out of the sediment and into the water. Fish ingest PCBs by feeding on the river bottom and through their gills, with levels building up in their tissue over time. Those PCBs are passed on to people, birds and other animals that eat the impacted fish.

"free of effects of toxic contaminants on living resources and human health." And for the first time, they specifically proposed to reduce PCBs.

But even so, it's been a back-burner commitment compared to the overriding focus on reducing nutrient and sediment pollution. Toxic contaminants have struggled to gain traction, said Greg

Why PCBs persist

PCBs, a group of 209 manmade organic chemicals, were widely used beginning in the 1930s as insulators in electrical equipment, engine oil, caulk, paint and fluorescent lights, among other things.

By the time the United States banned their manufacture in 1979, nearly 1.5 billion pounds had been produced and disseminated nationwide. The same durability that made them useful in commerce and industry has allowed them to stick around and spread. Some equipment containing the compounds is still in use. And while the EPA did clamp down on the storage and disposal of remaining PCBs, many have leaked or been unwittingly dumped in sewers or unlined landfills. Used oil containing the chemicals was for a time even sprayed on some unpaved roads to control dust.

The manufacturing ban hasn't been airtight, either — PCBs are still an inadvertent byproduct in making the yellow paint used to mark highways and parking lots. Allen, a staffer at the U.S. Environmental Protection Agency who chairs the Bay Program's workgroup on the subject. "I have to really fight pretty hard to get commitments and visibility," he said.

Even most environmental groups, which in the past pressed to make toxics part of the Bay cleanup, have lately made relatively little noise about it.

Beth McGee, senior water quality scientist with the Chesapeake Bay Foundation, said CBF leaders decided to focus their efforts on dealing with nutrients and sediment, which they consider to be more systemic pollutants of the Bay.

"The risk of trying to do everything is you don't do anything very well," she said.

But attention may be shifting. Energy has begun to gather around tackling toxic contaminants in the Bay and its rivers, with greater efforts to track down sources of PCB contamination in the Anacostia, Baltimore's Back River and elsewhere. The U.S. Geological Survey has hosted two workshops on the issue since last year to share the latest science and reports on what other jurisdictions are doing. And Bay Program managers are looking into forming a "PCB consortium" that would share information among the states about how best to rid their waterways of these persistent contaminants.

Up the food chain, unseen

One reason toxics have drawn less attention, Allen explained, is that apart from some tumors and lesions found on fish in a few places like the Anacostia, they haven't triggered many obvious impacts lately on fish and wildlife. Toxics once hampered the reproduction of eagles and osprey, but those effects have dissipated. And aquatic concentrations are generally low — barely detectable in places which leads many to think they're not a big threat.

But what you can't see can still hurt you. Through a process called bioaccumulation, PCBs ingested by fish build up in their fatty tissues, reaching levels many times higher than what's found in water or river sediment. As bigger fish feed on smaller fish, the PCBs build up in them, too. The same thing happens as birds and animals — and people — eat the contaminated fish.

The PCBs people may acquire from eating contaminated fish aren't likely to cause immediate or acute health problems. But laboratory studies have found that the chronic exposure of animals to relatively low levels of PCBs can cause cancer, harm reproduction and development, and affect a variety of organs and biologic functions.

Some studies have found higher incidences of reproductive and development problems among people who've eaten contaminated fish. And studies of electrical component factory workers exposed to high levels of PCBs found higher incidences of cancers among them.

Within the Bay region, PCBs were once regarded as a localized problem around Baltimore, the District of Columbia and Hampton Roads, but they are now recognized as a widespread contaminant. They cling to soil, dust and sediment particles, so they've spread extensively through air and water. The result: They're practically everywhere — even in the Arctic, transported far from civilization by wind.

"I can take soil from any backyard and analyze it, [and] I'll find PCBs," said Upal Ghosh, professor of environmental engineering at the University of Maryland-Baltimore County, who's spent two decades researching ways to reduce aquatic contaminants.

Still, most government agencies and nonprofit groups in the Bay region have not prioritized cleaning up PCBs and other toxics.

"I'm not trying to downplay it, but

PCBS CONTINUES ON PAGE 19

in terms of big issues and bang for the buck — whether you just like a clear Bay or like oysters or rockfish — it wasn't the number 1, 2 or 3 big issue behind overfishing, behind habitat destruction or overabundance of nutrients," said Rich Batiuk, who retired earlier this year as associate director for science in the EPA Bay Program office in Annapolis.

"It's been partly that it's not an inyour-face issue," he added. "It's much more subtle ... and solutions are that much more difficult to do."

As a result, it's been up to the states to determine, river by river, creek by creek, which are impaired by which contaminant and what to do about it. For PCBs, states have produced a stack of reports setting pollution reduction targets. Some localities have even drawn up restoration plans, but relatively little has been done to get results. Officials say it's been tough finding out where the PCBs in sediment and fish came from, and tougher still to get rid of them.

"It sort of gets second or third shrift to [reducing] nutrients and sediment," said Erik Michelsen, head of watershed protection and restoration for Anne Arundel County, MD. "These nontraditional pollutants, frankly, haven't gotten the attention and are harder to address."

'Pollution diets' for PCBs

In the Chesapeake watershed, state and federal regulators have been at work for nearly two decades preparing local "total maximum daily loads," or pollution reduction plans, for the various waterways impaired with PCBs. Like the Baywide TMDL — or pollution diet - for reducing nutrients and sediment, these plans rely on a combination of sampling and computer modeling to estimate the amount of PCBs getting into sediment and water. They then set a limit intended to make it safe to eat fish caught from that area. The reductions required to reach that limit are quite ambitious, exceeding 90 percent in some cases.

Virginia has drawn up TMDLs covering PCB contamination in its tributaries of the Potomac River and a few other waterways, including the Shenandoah. Others are in the works for the tidal portions of the James and Elizabeth rivers. Mountain Run, a small tributary of the Rappahannock flowing through Culpeper, is also on the to-do list.

"The whole thing's been a learning process," said Mark Richards, an environmental scientist with Virginia's Department of Environmental Quality. "It's really taken a lot of effort to get where we are today.... We didn't have any idea, really, what we were getting



Mandar Bokare, a graduate research assistant at the University of Maryland-Baltimore County, retrieves a passive sampler put in Back River this summer to measure PCB levels in the water. Local officials hope the sampling will help them track down and remediate sources of the contaminants getting into the Bay tributary. (Dave Harp)

into or the complexities associated with these TMDLs."

Lee Currey, water and science director for the Maryland Department of the Environment, said that the state's regulators have been working in earnest on PCB TMDLs since the late 1990s, but performing the water-quality monitoring needed to assess contamination has been laborious, and the science behind identifying and dealing with impairments has been evolving.

"It takes a very little bit to actually impair a water body," he said. When Maryland regulators began the TMDLwriting process, "we just didn't know the level of impact."

Maryland has developed 27 TMDLs so far, the most in the watershed. But the plans take time, and state regulators say they have 21 more to do to cover all of the state's impaired waters – including analyzing the lower Susquehanna River sediments above Conowingo Dam. They say they plan to finish all of them in the next 10 years.

In Pennsylvania, all 490 miles of the Susquehanna and its tributaries are impaired with PCBs, said Gary Walters, an environmental program manager in the state's Department of Environmental Protection. The state has written a TMDL covering an 83-mile stretch of the river in the middle of the state — the only one completed for PCBs so far.

Plans are needed to deal with the impairments in the rest of the river, but the DEP lacks the resources and expertise to undertake something that large and complex, said Bill Brown, the department's manager overseeing TMDL development. The DEP does plan, in the near future, to require PCB source tracking in 22 municipalities along the river segment covered by the one TMDL, he said.

"It isn't that we're not interested in it or not willing to focus on it," Walters said. "We are, but there are other issues we need to keep our eye on that are more pressing in the watershed [such as] sediment and nutrients." The state is lagging badly in meeting its sediment and nutrient reduction goals under the Baywide TMDL, which has a deadline of 2025. There are no deadlines in the cleanup agreement for dealing with toxics.

In places with PCB reduction goals, the localities bordering impaired waterways are often left figuring out how to clean them up. Most haven't gotten much beyond the first step: trying to figure out where the PCBs are coming from.

First, they have to find them — no easy matter. Concentrations in water are often so low as to be undetectable using traditional tests. A more sensitive method can pick up ultra-low levels, but it costs hundreds of dollars more per sample.

Extra-sensitive analysis is important because the water quality criterion for PCBs set by the EPA is 64 parts per quadrillion. That's the proverbial needle in a haystack, akin to taking a little more than 60 hairs from all the hair of all the people in the world. Miniscule though that seems, the EPA has determined that this limit is necessary to keep the lifetime risk of getting cancer from eating PCB-contaminated fish at no more than 1 in a million.

Better sampling / better solutions

Some of the PCB-tracking efforts are benefitting from a new sampling method, which proponents say promises to reliably measure PCBs at extremely low levels. It involves placing treated squares of polyethylene in the water for weeks at a time, tied to a stake or anchored with a piece of concrete. The plastic absorbs PCBs from the water and, once retrieved, the chemicals are extracted and analyzed.

UMBC's Upal Ghosh, who has been using this "passive" sampling to map PCB levels in the Anacostia and Baltimore's Back River, said the traditional method of analyzing water samples can yield varying results, as contamination fluctuates with weather and other factors. Passive sampling provides a good measure of PCBs in water that may be coming out of the bottom sediment, as well as gauging the concentrations that a fish might ingest through its gills.

Baltimore County officials are working with Ghosh's laboratory to search for possible sources of the PCBs in Back River's sediment and water.

"By checking in the water column where the [PCB] concentration is highest, we can track back upstream to see where it may be coming from," said Wesley Schmidt, a natural resources specialist with the county's Department of Environmental Protection and Sustainability. Schmidt said testing so far has identified one area with slightly elevated levels, but no source has been identified.

Trevor Needham, a UMBC graduate student, found that Baltimore city's wastewater treatment plant on Back River is a surprisingly large PCB conduit, receiving about 180 grams of PCBs daily from the sewage piped into the plant.

City officials think they know where at least some of those PCBs could be coming from. While they don't readily dissolve in water, PCBs attach themselves to fat molecules — and fats, oils and grease flushed down sinks over the years have built up in the sewer lines. Last year, workers found a congealed "fatberg" clogging a century-old pipe. Baltimore is planning to clean and line its pipe network as part of a longrunning effort to curb sewage overflows, and officials hope the effort will yield PCB reductions as well.

Complicated challenges

Meanwhile, the Back River treatment plant is removing most of the PCBs from the sewage, though about 5 grams get discharged daily into the river, the study found. Most of the PCBs removed wind up in the "biosolids," or sludge collected during the wastewater during treatment.

Some of that sludge gets pelletized and burned in a cement factory, while the rest winds up spread on farmland as fertilizer and compost, according to Jeff Raymond, spokesman for the city's Department of Public Works. The levels of contaminants in it are "well below the limits set by the regulators," he said.

But those limits may not be adequate for keeping PCBs out of fish. State rules for spreading sludge on farm fields and other land are intended to guard against the polluted runoff of nutrients to nearby streams. But MDE's Currey said the UMBC study showing PCBs in biosolids used for fertilizer may warrant reviewing those safeguards to ensure they're adequate.

Many officials hope that measures they're already taking to reduce nutrient and sediment runoff will vield some collateral PCB reductions. But UMBC's Ghosh suggests it may be more effective to track down and go after PCB "hot spots."



small amount of PCBs

out of stormwater practices,

why don't we spend a little

additional time investigating

where the hot spots are?"

A couple of years ago, Anne Arundel County, MD, submitted a cleanup plan for Curtis Bay and Creek, just off Baltimore Harbor, with a number of industrial sites in the watershed. The plan called for curtailing PCBs by installing stormwater management practices, paired with regular street sweeping and storm drain clean-outs.

But the projected price tag ranged from \$23 million

to \$34 million. Michelsen, Anne Arundel's watershed restoration chief, said he's since asked state regulators for more time to consider whether there might be other sources of PCBs that would be easier to remove and cost less

"Rather than launch full-

fledged into a strategy of trying to scrape a small amount of PCBs out of stormwater practices," he said, "why don't we spend a little additional time investigating where the hot spots are?" He noted that earlier this year, the Coast Guard reported uncovering a previously unknown cache of construction debris and toxic chemicals, including PCBs, in its Curtis Bay shipyard.

The Anacostia: Help wanted The Anacostia, which flows from

suburban Maryland into the District before meeting the Potomac, may pose one of the most complex challenges for cleanup. Besides

harboring PCBs, *"Rather than launch full-fledged"* the river's sediment is into a strategy of trying to scrape a tainted with a variety of pollutants harmful to humans and wildlife, including lead, pesticides and polycyclic aromatic Erik Michelsen hvdrocarbons Head of watershed protection & restoration (PAHs), a Anne Arundel County, MD byproduct of burning fossil

fuels, wood and garbage that is also linked to cancer.

Gretchen Mikeska, Anacostia restoration coordinator for the District's Department of Energy and Environment, said the city expects to settle on cleanup goals soon. But success will depend on working with partners, including the National Park Service, which owns the river bottom and parkland along the lower river.

The cleanup will also require help from upriver in Maryland, where the bulk of the Anacostia's watershed lies. Studies by Ghosh's laboratory have tentatively identified three of the river's nine tributaries, most notably Lower Beaverdam Creek in Prince George's County, as significant sources of PCBs.

Unless land-based sources of PCBs can be identified, the options for dealing with PCB contamination in the river bed are fairly limited, Mikeska said. They are: excavate contaminated sediments and haul them away for incineration or disposal in a safe landfill; bury them under a cap of relatively clean sediment; try to treat the PCBs where they are; or "wait for things to get better."

By collecting stay-at-home minnows this fall from 15 different spots along the river as well as in the Potomac, the Fish & Wildlife Service's Pinkney hopes to help the District pin down sources of PCBs that can be cleaned up.

"The good news is the river's not as contaminated as we thought," said Jim Foster, president and CEO of the Anacostia Watershed Society, which has pressed for a toxics cleanup there. PCB levels in the river are a fraction of what's been measured in other, more industrialized rivers, like New York's Hudson. And there's been a marked decline since the 1990s in skin and liver tumors found in brown bullhead catfish in the Anacostia, according to Pinkney. While those are caused by PAHs, research indicates that PCBs may contribute to their growth and spread.

Mikeska said she believes stream restorations that the District has undertaken for other reasons have helped. But much more is needed.

"The long-term goal is to have no fish advisories," she said. Given the uncertainties and complexities involved, she said, "It's almost impossible to say when that would be the case."

It might not have to take decades. UMBC's Ghosh and a colleague, microbiologist Kevin Sowers in UMBC's Department of Marine Biotechnology, have teamed up to develop a pair of methods for treating and immobilizing the PCBs, which could speed up the process.

Ghosh has developed a form of activated carbon, called SediMite, that has successfully "locked up" PCBs in wetlands and sediments. When spread on the bottom, the carbon captures PCBs in bottom sediment that otherwise might dissolve back

into the water.

Sowers has come up with a companion treatment, using naturally occurring bacteria to accelerate the breakdown of PCBs in aquatic settings. By infusing tainted sediment with bacteria mass-produced in bioreactors, Sowers said he's been able to significantly reduce PCB levels in months. His first tests used bacteria from Baltimore Harbor, he said, but he's since found an even more-potent strain in Charleston, SC.

Working with Ghosh, he's treated activated carbon pellets with the bacteria to ensure they'll stay in place, so that PCBs are not only immobilized but degraded more rapidly than would occur otherwise.

"It's the best of both worlds," Sowers said. Where natural degradation could take decades, seeding contaminated sediments with large quantities of the bacteria can break down 80–85 percent of the PCBs, he said, while the rest remain bound up in the activated carbon, unable to dissolve into the water.

The scientists' use of bacteria-laden activated carbon has proven effective at treating PCB-contaminated sediments in relatively small, confined ecosystems such as ponds, lakes and wetlands. It hasn't been tried on a broader scale, particularly in more dynamic water bodies affected by currents or tidal sloshes.

"The challenge is, if you can get money to clean up hot spots, will it help fish?" Ghosh said.

The answer, if you look at the Delaware River basin, appears to be yes.

Progress in Delaware Beginning around 2000, the Delaware River Basin Commission launched a campaign to address toxic

microbiologist Kevin Sowers stands with the bioreactor in his laboratory that he's used to mass-propagate PCB-eating bacteria. He's seeded *SediMite pellets* with the naturally occurring bacteria and successfully reduced contaminant levels in ponds and wetlands much more quickly than would otherwise happen. (Dave Harp)

contaminants. It persuaded major wastewater plants and industries to test their discharges for PCBs. They used the more sensitive, expensive test to spot PCBs and found that the top 10 dischargers accounted for 90 percent of all of the contaminants getting into the river from point-source outfalls; runoff was the second biggest source.

Greg Cavallo, a senior geologist with the commission who worked on the effort, said factories and treatment plants undertook a variety of actions to get PCBs out of their waste stream, including cleaning and removing PCB-laden sediment from discharge pipes and storm drains. They also revisited past cleanup sites, because the PCB levels that were acceptable for those projects may not be keeping the contaminants out of the water.

"Everybody did something different," he said, but it involved "a lot of detail. We sweated it out."

The results so far have been impressive. Between 2005 and 2016, the flow of PCBs into the river from the top 10 dischargers declined 76 percent, Cavallo said.

As a result of declining contamination levels in fish tissues, warnings about eating fish from the river eased somewhat.

More is needed, Cavallo said, but the Delaware basin's experience attests to the value of taking concerted action, with the commission as the conductor.

"It's more difficult to implement something like this across all jurisdictions without someone taking the lead," he said. "When there was a meeting, there was one voice, one goal. That helped in getting the message across."

Action in the Bay region With the hope of spurring a similar stepped-up effort in the Chesapeake watershed, state officials have



"The challenge is, if you can get money to clean up hot spots, will it help fish?" asks Upal Ghosh, environmental engineering professor at the University of Maryland-Baltimore County. He displays activated carbon pellets designed to lock up PCB contaminants in bottom sediment so they don't get into the water, where fish can take them in through their gills. (Timothy B. Wheeler)

authorized the EPA's Chesapeake Bay Program staff over the next year to explore the feasibility of forming a "PCB consortium." It would not have any authority over states, but would share information and promote the best methods for identifying and remediating sources of the chemicals.

The EPA's Greg Allen said the consortium would be "bringing everybody together to say, 'how can we work together to address the problem as efficiently as we can?""

The consortium idea, though, is on the back burner for the next several months, at least. State officials specified that the feasibility study wait until they finish updating nutrient and sediment pollution reduction plans, due in April.

Nonetheless, Allen and others say it's time to get serious about tackling PCBs and other toxic contaminants.

"Can we do just nutrients and have a restored Bay? Absolutely not," Allen said. A cancer survivor himself, he expresses a certain passion about it.

"The residents and visitors of this watershed every day have the potential to be consuming these toxic pollutants that in the case of PCBs add to our carcinogenic risk," he added. "That's happening every day, all across this watershed. We shouldn't be tolerant of that."



Western Maryland railroad turns on charm at every bend



Passengers prepare to board the Western Maryland Scenic Railroad, which travels between the town of Cumberland, located along the Potomac River, and a station in Frostburg, about an hour's ride to the west. The Great Allegheny Passage, a hiking-biking trail between Pittsburgh and Washington, DC, parallels the route, and cyclists can take their bikes on the train. (Western MD Scenic Railroad)

Story & Photos by T. F. Sayles I've always been fascinated by the influence of topography on where humans have decided to set up camp over the millennia.

Here in the Chesapeake Bay region, as recently as a few centuries ago, settlements in coastal areas were all about water: The best place to live was along a navigable river or creek, so that canoes and rafts and boats and ships could bring you stuff and people, or take away stuff and people.

Farther west in the Appalachian Mountains, though, waterborne transportation is less workable. The rocky rivers, creeks and streams that lead to the Bay have helped shape the land, but the placement of communities — and travel between them — has historically depended more on gaps and passes and hollows and valleys.

Take, for example, the trip from Cumberland to Frostburg in Western Maryland. In fact, take a *train* from Cumberland to Frostburg — on the Western Maryland Scenic Railroad — and you'll see exactly what I'm talking about. Sure, you can draw a straight east-west line on the map from one town to the other, but out here, where the hills and ridges lie on the landscape like wrinkled sheets, there are precious few straight lines available to the traveler. Unless you're prepared to hike over half a dozen steep ridges, the only way to go is north and around or south and around.

The south-and-around route is via the modern highway — taking Interstate-68 (US 40) out of Cumberland, through the hollow below La Vale, across the valley that gives La Vale its name, then through the Braddock Run gap between the steep ridges west of Frostburg.

The Western Maryland Scenic Railroad, in contrast, goes north and around, chugging out of Cumberland along Wills Creek, a tributary of the North Branch of the Potomac River that carves a dramatic gap through the ridge just west of town. This is called the Narrows — or, if you're inclined to match nature's drama, the Gateway to

the West. A mile or so north of the Narrows, near Corriganville, the track hairpins twice before settling into a more or less westerly-then-southerly route, roughly parallel to Maryland Route 36 and Jennings Run the rest of the way to Frostburg.

I boarded the Frostburg Flyer with about 50 other passengers on a fall morning at the Cumberland station. Ranging in frequency from two to six days a week, depending on the season, the Flyer departs at 11:30 a.m. for the roughly hourlong trip to Frostburg.

Our tour guide, speaking to us over the train's PA system, was an entertainingly chatty gentleman named Bruce Pfeifer — authentically clad in a shirt and tie, denim overalls and a pinstriped railroad cap.

As we approached the first hairpin turn, Pfeifer told us to be on the lookout for the so-called Bone Cave. A minute later it appeared — about 20 feet from the tracks at the foot of a rock wall, a craggy human-sized hole desultorily closed off by a rusty chain-link gate. Railroad workers discovered the cave a century ago, Pfeifer said, and it turned out to contain some truly remarkable Pleistocene-era fossils, including that of the long-extinct saber-toothed cat. Reconstructed skeletons from the cave have been on exhibit at the Smithsonian Institution since 1974, he said, as part the National Museum of Natural History's exhibit of ice age mammals.

Shortly after the second horseshoe bend, called Helmstetter's Curve, a little boy about 5 years old, with exquisitely shiny black hair, popped up over the seatback in front of me, looked at me for few seconds, then looked out the window and asked, "Why do we keep turning? Are we going back?"

I wasn't sure if he was asking me or his father, who was in the window seat next to him. When the father said nothing — or nothing I could hear — I said, "You mean the train? Why does the train keep turning?" He nodded. I said, "Um, well..." Then the father said, "No, buddy, we're not going back yet. We just have to go around a lot of mountains."

That was a good answer. Mine was going to be, "Because it has to follow the tracks, and the tracks turn a lot." But dad's reply was *way* better; it spoke to the landscape. And it seemed to satisfy the boy, whose name was Taylor, I learned in a later conversation about bears. (They're



Excursions on the Western Maryland Scenic Railroad are a popular way to enjoy fall colors along mountain towns and Potomac River headwaters. Be sure to reserve your seat in in advance. (Western MD Scenic Railroad)

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A conductor chats with guests on a holiday ride on the Western Maryland Scenic Railroad. A variety of dining options and different themed tours are available throughout most of the year. (Western MD Scenic Railroad)

out there, he told me, but, according to his dad, "They're way back in the woods and won't bother anyone.")

After Helmstetter's Curve, where farm fields sprawl on both sides of the track, we dove back into the woods for about 2.5 miles — passing through a nearly 1,000-foot tunnel along the way. When we emerged from the woods near the town of Barrelville, roughly the halfway mark to Frostburg, Pfeifer pointed out a long procession of wind turbines on a mountain ridge off to the northwest. They seemed enormous, even though they were actually 3.5 miles away, across the state line in Somerset County, PA.

After another dip and hairpin curve through Woodcock Hollow, we came within 1,000 feet of the town of Mount Savage, though the thick woods obscured any view of the town itself. There's a certain irony to that, because Mount Savage is why the railroad is here in the first place. By the 1840s the town had become a little industrial beehive, with coal mining, clay mining, three iron furnaces, a thriving brick works (which operates to this day) and a locomotive manufacturer.

Hence the need for what was called the Mount Savage Railway when it opened 1845 — built for the primary purpose of carrying the town's products and raw materials to Cumberland. From there, they could go anywhere, by rail, C&O Canal or National Pike.

Several decades later the line became part of the Western Maryland Railway, which at its peak ran clear across the state and into West Virginia and Pennsylvania. That company lasted into the 1970s, by which time it had all but vanished in a series of rail line mergers — Chessie, C&O, B&O and finally CSX. Then, in 1988, came the Western Maryland Scenic Railroad, which has operated the Cumberland-to-Frostburg excursion ever since.

This stretch of right-of-way also accommodates more than trains. Just as I had begun to wonder why we were seeing so many hikers and bicyclists along the tracks, Pfeifer answered the question. For most of its 16 miles, the railbed doubles as the Great Allegheny Passage — the 150-mile trail that, combined with the 185-mile C&O Canal trail, makes it possible to walk or pedal from Washington, DC, to Pittsburgh.

A couple of miles past Mount Savage, we came at last to the tidy Frostburg Depot. With a one-hour layover there, we had some options. After watching the train's lumbering black engine spin around on a huge turntable just beyond the depot (That was a must-see, Pfeifer said, and he was right.), we could stay there and visit the Thrasher Carriage Museum, just behind the depot —which should have been open, according to its sign, but wasn't — or grab a bite and a beer at the Trail Inn Café, right next to the turntable. Or we could explore Frostburg's Main Street, part of the historic National Pike, which is just up the hill about two city blocks away. Those would be two very vertical city blocks, mind you, by way of a giant multitiered wooden staircase and an uphill path along Depot Terrace. I chose the latter option, exploring a quarter mile or so of Main Street before heading back to the depot for the return trip.

For the time being, the railroad's mixed-vintage passenger cars are hauled by a 1960s diesel engine — assisted, when the number of cars and



A train on the Western Maryland Scenic Railroad travels through the snow-covered landscape of Allegany County. (Western MD Scenic Railroad)

passengers calls for it, by a recently acquired second diesel. But for most of the Western Maryland Scenic Railroad's 30 years, the star of the show had been its century-old steam locomotive, No. 734, nicknamed Mountain Thunder. Built in 1916 for a Michigan railroad, Mountain Thunder was acquired in 1991, when the excursion tours were brand new, and served the line for nearly 25 years. In April 2016, the engine had to be pulled out of service for a federally required rebuild and inspection a process that can take years.

Another vintage steam engine has been in the wings since 2014, and it's a doozy — C&O Railroad locomotive No. 1309, called Maryland Thunder. This huge two-engine behemoth, built in 1949, was the last commercial steam locomotive made for a U.S. railroad. The Western Maryland Scenic Railroad purchased it in 2014 from Baltimore's B&O Railroad Museum, where it had been on display since the early 1970s.

The plan was to have Maryland Thunder up and running by early 2017, but it needed a lot more work (meaning a lot more time and a lot more money) than first estimated. The latest cost projection puts the total rehab at \$1.8 million, and the expected completion date is "some time in 2019."

So, for now, the two not-so-glamorous diesel engines will have to do the work — carrying around 30,000 passengers a year, weaving through hills and hollows and horseshoe bends from Cumberland to Frostburg and back again, demonstrating to all that out here, where the land was long ago shaped by winding, gravitydriven water, there are precious few straight lines.

Hills and hollows and horseshoe bends

The Western Maryland Scenic Railroad's regular Cumberlandto-Frostburg excursions run from March through December. The schedule varies by season, from two to six trips per week.

For children, the Winterland Express, featuring Santa and elves, runs four times every weekend between Thanksgiving and Christmas.

For adults, generally two Saturday evenings per month in season, there's an evening murder mystery excursion, including dinner. Ticket prices range from \$30/child and \$46/adult (standard coach, no meal) to \$99 or more, depending on special themes, events and dinner options. Cyclists can take their bikes on the train for a small additional fee.

For information, visit wmsr.com or call 800-TRAIN50 (800-872-4650).

'Dig a little deeper' at the Norfolk Botanical Garden



Colorful blooms grace the foreground of a view from a footbridge in the Norfolk Botanical Garden. (Dave Harp)

Story by Jeremy Cox

At Norfolk Botanical Garden, everything is just so. Horticulturalists deadhead roses in the summer to ensure visitors encounter a perfume-filled, technicolor display in the fall. Azaleas are arrayed for maximum visual pop in the spring.

Even the wildflower meadow is meticulously combed for undesirable upstarts.

This oasis of beauty is perched on a 175-acre peninsula in Virginia, less than 3 miles from the Chesapeake Bay. But what statements can such a manicured place make about the nature of this southernmost loop of the Bay's watershed?

Quite a few, I found on a recent expedition among the garden's leafy trails and dizzying variety of flora. But first, the experience needed to be reframed.

The Botanical Garden, which is celebrating its 80th anniversary this year, features plant and tree species from around world, ranging from scheffleras from China to flameberry shrubs from Argentina. It's all a bit much and, for the most part, not representative of what's to be found around the rim of the Bay.

As I whirled from one colorful exhibit to the next, I found myself awed by the magnitude of human effort and imagination so clearly heaped upon this landscape. Try not to be moved by the 336 different flowering trees in the arboretum; the formal rose garden, brimming with more than 3,000 plants; the traditional Japanese garden seemingly transplanted from across the Pacific.

I also couldn't help feeling a bit lost. Part of me wondered whether I was still in southeastern Virginia or some Walt Disney version of it.

My malaise broke after I talked to Theresa Augustin, the director of environmental engagement and outreach. Her advice: "Dig a little deeper."

"Sometimes, this is a person's only exposure to nature these very designed and manicured gardens," said Augustin, who has worked at the facility for 18 years. If you look below the surface, "you'll see pollinators are working there, the birds are eating the bugs. Our job is to showcase plants but to do that in a very responsible way."

To be sure, not every one of the garden's plants fit snugly into the Bay's ecology. But many do. Its 60 gardens include the wildflower meadow, an forest stocked with many indigenous tree species, a 2-acre butterfly garden, a fern glade and a Virginia native garden that explores four types of plant communities.

As I pondered Augustin's point, I was reminded of a concept from the wine industry: terroir. It is the "French concept of place reflected in the glass," as one *Wine Spectator* editor put it. Terroir emphasizes that a wine is shaped not only by the grapes it is made from but also by the place where those grapes are grown. The soil, elevation, sun exposure, climate and other factors make the products of one winemaker unlike any other.

And while there are dozens of botanical gardens in the United States, none is quite like the Norfolk Botanical Gardens. The Norfolk garden distills the breathtaking range of life that can sprout from the soil in the southern Bay's watershed.

Augustin is cognizant of the Norfolk garden's special geographical setting.

"We're kind of the northernmost range for a lot southern plants and the southernmost range for a lot of northern plants," she said.

That lends to the grounds a tremendous variety of flowers, trees and shrubs that may be able to grow in separate places but rarely all in the same place. More than 250,000 plants call the gardens their home, not counting those grown in seasonal displays.

Some make for strange bedfellows. Crotons, which thrive as far south as the tip of Florida, wind up sharing the same grounds as maidenhair ferns, which would wilt in Florida but do nicely as far north as Ontario.

Given that flexibility, it may be surprising to learn that the botanical garden was originally developed largely with



A bee pollinates a coreopsis flower in a butterfly garden at the Norfolk Botanical Garden. (Dave Harp)

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just one type of plant in mind. Thomas P. Thompson, Norfolk's city manager from 1935–38, was impressed by the drawing power of the azalea gardens in Charleston, SC, and was convinced that his city could do the same. So, with the aid of the Depression era Works Progress Administration, the city launched an azalea garden project in 1938.

Much of the hard toil fell to a group of more than 200 African American women whose efforts are memorialized by a statue in the WPA Memorial Garden, depicting a woman sinking a shovel into the earth. By March of 1939, they had planted 4,000 azaleas, 2,000 rhododendrons, several thousand miscellaneous shrubs and trees and 100 bushels of daffodils on what had until recently been an unforgiving swamp.

Over the years, the gardens continued to grow, and their stewardship



The Norfolk Botanical Garden includes forests and ferns (left), as well as wildflowers, azaleas, a Japenese garden and more. Above, a statue honors the African American women who planted thousands of azaleas to launch the garden in the 1930s. (Left/Dave Harp, Above/Tom Houser, Norfolk Botanical Garden)

was turned over to a nonprofit that today oversees a \$6.5 million annual budget (although the city still owns the land).

Highlights include a vista festooned with eleven, 7-foot-tall marble statues of notable artists created by sculptor Moses Ezekiel; a 2-mile walk through a holiday light display (Nov. 9–Dec. 15 this year); a caroriented million-bulb light display (Dec. 16–31 this year); a children's garden featuring a large splashpad; and a cavernous butterfly house that flutters to life in the summer and early fall.

In recent years, the Botanical Garden has begun adopting more sustainable practices, Augustin said. In 2015, for example, staff stopped mowing the grass in the flowering arboretum, providing a wildflower meadow for butterflies and other pollinators. The café no longer sells single-use disposable plastics. There's more to a garden, after all, than its visual attributes, Augustin said.

"That's more how we think now. What is the function of the garden? [The Botanical Garden's leaders] want it to be attractive but be a little deeper so that these plants are supportive of the local ecosystem," she said.

The Norfolk Botanical Garden is located at 6700 Azalea Garden Road in Norfolk. The garden is open from 9 a.m.-7 p.m. April 1-Oct. 15; 9 a.m.-5 p.m., beginning Oct. 16. The garden is closed Thanksgiving, Christmas and New Year's Day. Admission is \$12/ adults; \$10/seniors and military; and \$10/children ages 3-17. Entrance is free for ages 2 and younger.

A tram operates year-round. Boat tours are available at a cost of \$6 for adults. The 45-minute tours follow the facility's internal canals and go out onto Lake Whitehurst. Walking routes travel 15 miles of paved trails and mulch-covered paths.



Chesapeake Bay Maritime Museum, St. Michaels, MD for schedule and tickets: chesapeakefilmfestival.com



Lafayette River oyster reefs reach habitat restoration milestone

✗ Waterway, once one of dirtiest in VA, is now first to count toward state's goal in Bay agreement.

By JEREMY COX

Once among the Chesapeake Bay's filthiest tributaries, the Lafayette River has become the first Virginia waterway to have its oyster habitat declared fully restored.

"We've done it. Feel proud," Marjorie Mayfield Jackson, executive director of the Elizabeth River Project, told a cheering crowd during an October ceremony celebrating the milestone. The Lafayette flows into the Elizabeth River, which empties into the Chesapeake Bay near its mouth at the Atlantic Ocean.

The effort, led by her group and the Chesapeake Bay Foundation, "pretty much re-invented oyster restoration," Jackson said, as it constructed 12 new reefs over eight years. Workers created 32 acres of habitat that, when combined with "historic reefs" discovered while the project was in progress, satisfied the campaign's 80-acre goal set by scientists.

The Lafayette is the first waterway in Virginia to count toward the 2014 Chesapeake Bay Agreement, which calls for oyster reefs to be restored in five tributaries in Maryland and five in Virginia by 2025. Each state has now completed one.

Still to go in Virginia: the Lynnhaven River, the Piankatank River, the Lower York River and Great Wicomico River. (Rieger said his group and partners also aim to forge ahead with restoration work already begun on the Eastern Branch of the Elizabeth River, even though it's not been officially selected as one of the state's five targeted rivers, and thus won't likely be in line to receive significant government funding.)

The Lafayette project's architects said its impact will reverberate beyond the river's 14-square-mile watershed. Their methods and materials evolved over time, transforming the river, which lies entirely inside the city of Norfolk, into a testing ground for oyster restoration, they said.

Funding for the multimillion dollar restoration came from multiple sources, including the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency and National Fish and Wildlife Foundation, among others.

Oysters act like filters, removing nutrients that fuel harmful algae blooms and sediment that block sunlight from underwater grass beds. The reefs where oysters grow help to shield shorelines from erosion while providing habitat for fish, crabs and other marine life.

Early monitoring results suggest the effort is already paying dividends, scientists said. Biological surveys on the river are showing greater diversity of aquatic life, including at least 25 different species



John Small of Small's Smokehouse and Oyster Bar steams oysters from the York River during the Lafayette River celebration. (Dave Harp)

of fish, such as sea horses, red drum, striped bass and speckled trout, according to the Bay Foundation.

The restoration added 70 million baby oysters, or spat, to the river bottom. Regular surveys show they are thriving, exceeding the density goal of 50 oysters per square meter along several of the reefs, officials said. At the Granby Street bridge, for instance, a total of 118 oysters per square meter were counted last year.

The turnaround has impressed many observers.

"I put a challenge down to all of the cities and towns along the Chesapeake Bay — if you can do this in Norfolk, VA, you can do this anywhere," said Andria McClellan, a member of the Norfolk City Council and the Chesapeake Bay Program's Local Government Advisory Committee.

The environmental odds have long been stacked against the Lafayette River. About 40 percent of Norfolk's population lives inside its watershed, leaving little room for natural buffers to absorb and filter stormwater.

During the early 20th century, pipes carried raw sewage directly into the river. More than a century of shipbuilding and other industrial activities fouled the bottom sediments with polychlorinated biphenyls. Exposure to PCBs has been linked to liver damage. cancer and other health problems, leading to a national ban in 1979.

The oyster industry was shut down on the river in the 1920s because of its sewage and polluted stormwater runoff.

"A lot of people thought restoration was hopeless," said Jackie Shannon, the Chesapeake Bay Foundation's Virginia oyster restoration program manager. "It still has a stigma around here." The Virginia

Marine Resources Commission banned harvesting oysters from the restored reefs in the Lafayette a few years ago, but the agency could allow aquaculture in the future if the water quality continues to improve, Shannon said.

Dozens of people plied the water on that sunny October day aboard a rainbow of canoes, kayaks and stand-up paddleboards. At the signal — a few short horn blasts from the Bay Foundation's workboat, the Baywatcher — the crowd poured a cascade of oyster spats into the river.

The 2,500 spats settled on a 5-acre reef a few dozen yards from the lush shoreline at the Hermitage Museum and Gardens. Afterward, the group of residents, politicians, scientists and nonprofit professionals gathered on the museum's grounds for an oyster roast and locally brewed beer.

One after another, speakers praised the river's neighbors for their support. The Elizabeth River Project has recruited thousands of homeowners, for example, into its River Star Homes program. Participants agree to protect the river on their properties by taking steps such as reducing lawn fertilization and bagging pet waste. Many have planted "oyster gardens" in the waters beyond their lawns to create more habitat.

Michael Berg, who lives about a block from the Lafayette tributary Haven Creek, was an early registrant. The retired schoolteacher has collected oyster shells from restaurants, designed a floating wetlands prototype and poured scores of concrete blocks to create starter reefs.

"I like doing the physical work, and it's exciting work," said Berg, 73. "The truth of the matter is I'm a wannabe biologist."

Oyster restoration efforts in the Lafayette River date back to 1998, when the Rotary Club of Norfolk funded the construction of two reefs. But it didn't kick into high gear until 2009, when the Bay Foundation and Elizabeth River Project teamed up to develop a broad restoration plan.

A survey of the river showed 140 acres of sandy bottom suitable for planting oysters, Shannon said. Their target was to restore half of that total, but the scientists added another 10 acres to the goal — for a total of 80 acres — to provide a cushion.

Ironically, the river's contamination provided a near-ideal setting for an oyster comeback, said Joe Rieger, deputy director of restoration for the Elizabeth River Project.

"No one was harvesting oysters, so it was naturally protected," he said.

That set the stage for a pleasant surprise: In 2014, researchers with the Virginia Institute of Marine Science and Christopher Newport University found 48 acres of relict reefs teeming with oysters. If not for the discovery, the Lafayette's restoration would have continued for another decade, scientists say.

As the work progressed, the river became a kind of living laboratory, Rieger said. Facing a shortage of recycled shells, the groups turned to granite and later crushed concrete to serve as shellfish homes.

They also began laying the rocky material in strips along the river bottom instead of unbroken mounds. That gives young oysters more surface area on which to attach themselves, he said. And it allowed the groups to claim credit for more restored acreage while using less substrate.

Shannon, with the Chesapeake Bay Foundation, said she and other scientists are now moving on to the next phase in the restoration: monitoring. Over the next six years, they will determine whether the new reefs continue to thrive.

"We're not going to walk away and let this good work slip through our fingers," she said.

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A late summer carpet of native sunflowers at Blackwater National Wildlife Refuge on Maryland's Eastern Shore reminds onlookers that autumn is near. (Dave Harp)

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A great egret works the grassy edge of Parson's Creek, just off the Little Choptank River in Masrayland. (Dave Harp)

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FORUM COMMENTARY • LETTERS • PERSPECTIVES

State pollution-permitting must be reformed to adapt to climate change

By David Flores

Recent extreme weather — Hurricanes Harvey and Florence — caused widespread toxic contamination of floodwaters after low-lying chemical plants, coal ash storage facilities and hog waste lagoons were inundated.

Such storm-driven chemical disasters demonstrate that state water pollution permitting programs are overdue for reforms that account for stronger and more intense hurricanes and heavy rainfall events, sea level rise and extreme heat.

As the District of Columbia and the states in the Chesapeake Bay watershed prepare their final watershed implementation plans for cleaning up the Bay, two important lessons should be clear from the recent disasters: First, climate change will greatly complicate Bay cleanup efforts and must therefore be factored into planning. Second, the state regulation of pollution sources can and should be a critical component of the plan.

The potential pollution implications of climate change are many and varied for the Bay watershed:

Where sunny-day flooding now occurs on a weekly basis in parts of DC, Maryland and Virginia, accelerating sea levels will cause nuisance flooding on a near-daily basis in the next 20–30 years.

Sea level rise also raises the prospect that seawater will intrude into coastal groundwater, inundating and degrading drinking water wells, septic tanks and underground chemical or hazardous waste storage facilities.

Sea level rise will also shrink tidal wetlands, weakening these natural filters' ability to help capture pollution. The most recent Bay pollution modeling suggests that present-day climate impacts, including increased rainfall and more intense storms, are responsible for higher levels of inorganic nitrogen, as well as hotter water temperatures that render pollution reductions less effective at preventing dead zones.

➢ Prolonged, extreme heat from climate change is problematic, too, as heat waves can cause blackouts that disrupt pollution control practices, and high temperatures can degrade above-ground storage tanks.

Without further study, it's difficult to determine the extent to which more frequent and heavier rainfall already disrupts pollution control practices at regulated facilities — from the local gas station to major sewer infrastructure — and, as a result, just how much



This scene is from aptly named Water Street, along the Choptank River in Cambridge, MD. Such flooding is occurring more often around the watershed. (Dave Harp)

additional pollution has resulted from climate change. But it's clear that regulators cannot continue to rely on historic rainfall data and expect the same results from outdated control practices.

As Bay jurisdictions develop plans to integrate climate resilience into their pollution permitting systems, it's also important that they keep in mind the overwhelming social dimension to this problem: Climate-driven chemical disasters and environmental pollution may amplify the harm to the vulnerable populations and communities that are already disproportionately exposed to both industrial pollution and the impacts of climate change.

Low-income communities, surrounded by urban industrial facilities that emit toxic dust and air pollution, or industrial agricultural operations that emit toxic ammonia into the air and toxic nitrate pollution into surface and groundwater, are often the same communities plagued by flooding, storm surge and extreme heat.

Vulnerable populations — children, seniors, among them — are more susceptible to environmental pollution and climate impacts, and they are more likely to be immobile during disaster. State policy makers also need to address disaster policy to ensure that when pollution or a disaster does occur, vulnerable communities will have the means to minimize their exposure.

Fortunately, not all of the news is bad. Many Bay jurisdictions have made progress in addressing adaptation and resilience to climate change broadly. New York State, for example, has tackled the threat of climate-driven pollution head on. Environmental organizations pushed New York to pass the Community Risk and Resiliency Act in 2014. Among other requirements, the law requires state agencies to develop regulatory standards for sea level rise projections and requires pollution permit applicants and regulators to consider present and future exposure to sea level rise, storm surges and river flooding. These requirements only took effect less than two years ago, so critical questions about their effectiveness are still unanswered.

There are a number of other steps that jurisdictions can undertake today to help minimize the costs of climate impacts on the Bay and pollution-permitting in the future. They include:

Bay jurisdictions should examine opportunities to apply existing legal authority to adapt pollution-permitting to climate impacts as part of their commitment to address climate change in their upcoming watershed implementation plans. Merely adapting restoration practices will fall far short of what is needed to account for the impact of climate change on the Bay cleanup. Bay jurisdictions can also establish a longer-term task force staffed by regulators, elected officials, and community stakeholders — to continue exploring opportunities for climate resilience policy reforms by amending state pollution regulations in a manner that also aligns with existing commissions focused on the Chesapeake Bay, environmental justice and climate change.

Searching Bay jurisdictions should dedicate resources to identify and study climatevulnerable pollution permittees and the communities potentially exposed to climate-driven pollution, then commit resources to assess the environmental and social benefits of any adopted policy reforms, including state funding decisions for investments in infrastructure and growth planning.

Seforms in regulatory transparency will serve communities exposed to potential climate-driven chemical disasters. State regulators should meaningfully comply with existing regulatory frameworks, including the Emergency Planning and Community Right-to-Know Act, which requires public disclosure about neighborhood chemical risks. Moreover, regulators should use this information to target inspection and enforcement resources to vulnerable communities and those with greater exposure to climate-induced pollution.

➢ Policy makers must engage industry and others in the process of investigating policy reforms and discrete actions that can be taken at facilities to address vulnerabilities to flooding and other climate impacts and that require sufficient resources for regulators. The Massachusetts' Office of Technical Assistance has produced a remarkable model for this type of work.

Additionally, without sacrificing ambitious near-term action, the public and private sectors need to collaborate and develop long-term, enforceable plans to move or modify problematic facilities.

Billions of dollars are at stake measured by the value of our natural resources and the health of our communities, as well as the magnitude of past and present investments in pollution control and a clean and healthy Chesapeake Bay. We must break away from business as usual and reform our public safeguards to account for the accelerating impacts and cascading harm of a changing climate.

David Flores is a policy analyst at the Center for Progressive Reform.

FORUM COMMENTARY • LETTERS • PERSPECTIVES

What on Earth led to the failure of environmental ethics?

By Tom Horton

Surveying the current wreckage of federal environmental policies, I've wondered: Close to half a century out from the first Earth Day — April 1970 how could such a dramatic reversal even be possible?

Across the board, clean air and water regulation is being aggressively rolled back, commitments to public lands undercut, credible science linking environmental responsibility to human and planetary health rejected out of hand.

Where is the massive public objection to this unprecedented assault?

Could it be we still lack an environmental ethic, a value system strong enough to make the madness unthinkable? Could that be, despite all of our environmental education, the passage of major air and water and chemical laws, the establishment of the U.S. Environmental Protection Agency and its counterparts in virtually every state, and despite the maturing of ecological science that proves how humans and the rest of nature are interconnected?

William Rees raises that sad possibility in a compelling piece, *Are Humans Unsustainable by Nature*? Rees is a scientist and co-inventor of the "ecological footprint" analysis that shows we'd need several Earths if everyone consumed like Americans. He says that being opportunistic, oriented to the short term, to the quick gain, to seizing all available resources — all this served humans quite well as an evolutionary strategy (so far).

The University of British Columbia professor further argues that to support these genetic predispositions we have concocted "cultural genes," or memes like the myth of endless, limitless growth, applied to everything from population politics to housing developments.

Indeed, mainstream economics uncritically embraces the no-limits myth, discounting natural systems — the Earth, in other words — as a constraint on human ingenuity and enterprise.

In contrast, environmentalism at its core is about heeding limits; and while limits on growth, consumption, stuffing the atmosphere with CO_2 (carbon dioxide) and saturating coastal waters with nutrient runoff ultimately may be liberating (as in, we get to keep the Bay, the planet, etc.), politicians running on a platform of "limits" are too easily dismissed as against progress.

I was set to keep on in this vein, to cite critiques of the environmental movement since Earth Day 1970 for having cast its



Posting at Gwynns Falls in Baltimore is a sign that environmentalism still has a way to go to protect nation's waters. (Dave Harp)



net too narrowly, focusing on wilderness too much and social justice not enough for betting we could sustain the planet by working within our corporate-capitalist system. But does our breakdown of environmental resistance really lie in citizens' failure to develop a strong enough ethic? Not so fast, some say.

Environmentalists have gotten used to mainly playing defense, said Gerald Winegrad, former Maryland state senator and one of the environmental stalwarts of my generation. And that needs to change; [we] need to think Civil Rights movement, anti-Vietnam protests, marches, sit-ins, civil disobedience, super-PACS. "Mimic the NRA," he said, referring to the political potency of the gun group.

Another view: Modern history can be seen as pendulum swinging between the powers of the state and those of corporate interests. This is according to Michael Lewis, my environmental historian colleague at Salisbury University.

The great rise of environmentalism in the decade around the first Earth Day coincided with a major swing toward strong government. It also came at a time of comparative economic prosperity, when "jobs versus regulations" lacked the power to divide us.

Environmental awareness has never been higher, Lewis noted. That's not the same as an ethic, but still, "there's a lot of dry wood sitting around in the environmental forest [waiting] for something to spark it," he said.

Our democracy itself emerged hand in hand with the exploitation of natural resources and other peoples (think slaves and Native Americans). It remains an

Letters to the Editor

Keep covering Fones Cliffs

I would like to thank the *Bay Journal* for continued, in-depth coverage of the damages and violations at Fones Cliffs along Virginia's Rappahannock River. It is clear that many citizens across the Chesapeake landscape are concerned about what happens at this very special place rich in history and where eagles soar.

Fones Cliffs is a majestic place. This 4-mile formation of forested cliffs reaches heights of 80–100 feet and is composed of diatomaceous earth formed millions of years ago. This is the ancestral territory of the Rappahannock Tribe. It is also designated as a globally significant Important Bird Area for both resident and migratory bald eagles and other migratory birds.

As your loyal readers know, in mid-October, Virginia Attorney General Mark R. Herring and the Virginia Department of Environmental Qualopen question, Lewis said, how democracy will cope with an age of limits that we are still so reluctant to acknowledge.

Indeed, representative democracy is not very representative right now, in the view of Will Baker, who has led the Chesapeake Bay Foundation for decades. His early inspirations and mentors were Republicans like William Ruckelshaus and Russell Train, the first two EPA administrators. (It was also a Republican, Arthur Sherwood, who co-founded the Bay Foundation in 1967).

But with few exceptions, the majority of Republicans in both houses of Congress are simply unwilling to challenge President Trump's environmental rollbacks and rejection of sound science, Baker said.

That, Baker said, does not reflect the majority wishes of citizens of all political persuasions, "any more than most East Germans wanted the Berlin Wall."

But it's the lobbyists, the big money, the computerized gerrymandering of political districts that is running things these days, he said. His words: "Democracy isn't really achieving its ideals."

Maybe it does come down an ethical failure after all, or a moral vacuum. And maybe it's centered in Washington, DC.

Tom Horton has written about the Chesapeake Bay for more than 40 years, including eight books. He lives in Salisbury, where he is also a professor of Environmental Studies at Salisbury University.

ity announced the filing of a lawsuit against the would-be developers for significant and repeated environmental violations.

While damage to archeological resources is irreparable, the habitat can be repaired, especially if the property can be permanently protected. Regardless, trees can and should be replanted on the illegally cleared area. Under a conservation scenario, archeological resources would also be protected.

We are pleased that Gov. Ralph Northam's administration is taking this environmental and cultural loss seriously. We remain hopeful that we can permanently protect the cliffs for current and future generations. Thank you to the thousands of people who have voiced their support for Fones Cliffs.

> Joe McCauley Chesapeake Fellow Chesapeake Conservancy

FORUM COMMENTARY • LETTERS • PERSPECTIVES

Chesapeake Bay Program fueled by science, driven by partnership

By JOAN SMEDINGHOFF

For 35 years, the Chesapeake Bay Program has been the collaborating force behind Bay restoration.

This December marks 35 years since the signing of the 1983 Chesapeake Bay Agreement. This agreement set up the Chesapeake Bay Program and started the monitoring network that has been at its center for more than three decades. The Bay Program has changed as we've learned more about the Bay watershed, but the fundamentals have stayed the same: We are fueled by science and driven by partnership.

Sticking to these values, the Bay Program has been able to stay on the right track. By convening different groups and working together, the partnership has hit milestones that were unimaginable at the beginning.

The original signers of the Chesapeake Bay Agreement initiated the program when they saw the results of a Congress-commissioned multiyear study. The Bay was in poor health, and excess nutrients were to blame.

But the results went beyond science. Maryland and Virginia were losing a lot of money because the crab and oyster fisheries were impacted. Tourism decreased because people didn't find the Bay swimmable.

"I can tell you that when I started almost 34 years ago, I would've never thought that we would have made the progress that we have," said Rich Batiuk, the Chesapeake Bay Program's recently retired associate director for science, analysis and implementation.

"When I came, we had 12 million people. We now have 18 million people,' Batiuk noted. "You would have had to reduce the footprint just to hold steady, and you could have claimed success. We've not only done that, but we're turning it the other direction. The system's coming back."

Last year, we saw the largest amount of underwater grass acreage in the Bay in our three decades of collecting data-an estimated 104,843 acres. This surpassed our 2017 restoration target and, along with being the fifth consecutive year of acreage growth, is the first time in modern history that grasses in the Bay have exceeded 100,000 acres. It represents the biggest resurgence of underwater grasses recorded, not only in the Chesapeake Bay, but in the entire world

Bay Program partners also completed oyster restoration on two tributaries:



Harris Creek in Maryland and the Lafayette River in Virginia. Now home to 351 acres of oyster reefs, Harris Creek represents the largest oyster restoration project in the world.

A relay race

Although much of our progress has been seen in recent years, the groundwork for these successes was laid a long time ago

"This not a marathon but a relay race," said Carin Bisland, associate director for partnerships and accountability at the Chesapeake Bay Program.

At its inception in 1983, the Bay Program was founded on coordinated science and monitoring. The governors of Maryland, Pennsylvania and Virginia and the mayor of the District of Columbia met with the administrator of the U.S. Environmental Protection Agency and the chair of the Chesapeake Bay Commission, an advisory group that represents the state legislatures, to sign the first Chesapeake Bay Agreement. In this groundbreaking document, the signatories agreed to work together toward a healthy Chesapeake.

This first agreement brought together these different entities, established a coordinating Chesapeake Bay Program office in Annapolis and set up a monitoring partnership that exists to this day.

"At that point, we were actually

are increasingly helping to gather data. Here, former South Riverkeeper Diana Muller, left, checks data being uploaded from a hydrolab probe in the South River, MD. Volunteers Paula Frohring and Andrew Muller assist. Frohring measures wind, humiditv and air temperature, which Andrew Muller records. (Dave Harp)



Around the Watershed

building up what is now entering into its fourth decade: the partnership's monitoring program," Batiuk said. "The states and DC were working with us to set up what is now about 160 stations in their 34th year of collecting water quality data across the entire Chesapeake Bay.'

Through the Chesapeake Bay Monitoring Program, the partnership established consistent standards for water monitoring in the states of Maryland, Pennsylvania and Virginia and the District of Columbia.

While this may seem obvious now, Bisland said, it was unheard of at the time for states to use the same monitoring protocols, and this innovation set up the partnership for success. Not only did it make it possible to compare progress among the four jurisdictions, but it also began the process of building trust across the partnership.

This trust allowed the Bay Program to apportion pollution responsibly across the jurisdictions based on one model that everyone agreed to. By the time 1987 rolled around, the partnership was ready to work toward its first numeric goal rather than setting up programs with only vague goals of reducing pollution.

"We had this growing partnership agreeing to numerical goals about what we wanted to try to do," Batiuk said. "It set the basis for actually dividing up those goals among the four jurisdictions that were currently at the table."

The Bay Program partners signed the 1987 Chesapeake Bay Agreement committing to an ecosystem approach to restoration, with the stated goal of reducing 40 percent of nutrients entering the Bay.

While ambitious, this was the first time the partnership committed to a measurable goal and an ecosystem approach. It was the first agreement in which the partnership committed to take specific voluntary action to reduce pollution, restore fisheries and habitat and increase stewardship of the Bay and its rivers.

In 1992, through amendments to the 1987 agreement, the partnership officially acknowledged that, to bring back the Bay, they had to focus more than just on the Bay itself and its most impaired waterways. They began to create plans to reduce pollution in all of the Bay's waterways, called tributary strategies.

Uniquely Chesapeake

By the end of the 1990s, the partnership had gathered close to two decades' worth of data about the watershed. They also had worked together for more than 10 years at reducing pollution, restoring habitat and improving fisheries management, but they were running into a problem that made this difficult.

Under the Clean Water Act, the states and DC had to take certain actions to improve waterways that are impaired. But in the partnership's voluntary Chesapeake Bay Agreement, they had agreed to reduce nutrient and sediment pollution. This meant that they had regulatory responsibility to improve their impaired waters to meet water quality standards, and a different set of voluntary responsibilities to the Bay Program to reduce nutrient and sediment pollution by 40 percent.

On top of the fact that there were two different approaches to meet, the water quality standards in the Bay were, in some instances, inconsistent across state

Forum

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lines. In addition, scientists didn't think the regulatory standards were reflective of what was known about the biology of the Bay, and, for deeper waters in some areas, might not be possible to ever achieve.

Armed with monitoring data and cooperation among the jurisdictions, the Bay Program worked with the EPA to reconcile these two programs — the regulatory and the voluntary — to create one program that would be better suited for the Chesapeake Bay.

The Bay Program achieved this through the signing of another agreement, Chesapeake 2000. This agreement had more numeric goals — including wetland acres, miles of fish passage and an increased number of oysters — but most importantly, it called for the development of consistent standards built from the unique scientific understanding of the Bay. This allowed the jurisdictions to develop coordinated water quality standards that, once approved by the EPA, they could work toward for improving their impaired waterways.

This early work would make it possible, in 2010, to set up the Chesapeake Bay Total Maximum Daily Load. The Bay Program had an agreed-upon model, decades of monitoring data, statespecific but coordinated water quality standards and a trusting partnership. With those in place, the Bay Program would be able to put the nation's largest TMDL in place that would be suited for the Bay, not based on generic or inconsistent standards.

An adapting partnership

While the original agreement was signed by representatives from Maryland, Pennsylvania, Virginia, the District of Columbia, EPA and the Chesapeake Bay Commission in the 1990s, it became clear that the Bay could not be restored without the involvement of its headwater states.

Even though Maryland and Virginia have direct connections to the Bay, the watershed extends up to New York and out to Delaware and West Virginia. With the knowledge that they all have an impact on the Bay, those three states signed on to the most recent agreement in 2014.

Batiuk reflected on the benefits that the new partners bring to the Bay Program. "We found that they brought their own experiences working with farmers or working with localities, working with their folks in cities and townships and boroughs. By bringing them to the

Commentary • Letters • Perspectives



Widgeon grass grew near the bulkhead in Tylerton, on Smith Island in 2018. Last year saw the largest acreage of underwater grasses in the Bay in three decades of collecting data. (Dave Harp)

table, it just expanded our sense of what might work and what might not work in different places."

At the same time, they received benefits from being part of the Bay Program. "The monitoring system expanded to include stations in their parts of the watershed," he said. "They got to benefit from the tools that we built in terms of the science and the models. More recently, all seven jurisdictions got to have, for the first time in the United States, high-resolution, land cover data, wall to wall across their towns and cities and farmlands."

Because of this state-level involvement, the Bay Program has always been a partnership. Every partner is part of the decision making. At its highest level of management — the Executive Council — there are nine people in charge: the governors of Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia; the mayor of the District of Columbia; the administrator of the EPA; and the chair of the Chesapeake Bay Commission. Decisions are made based on consensus or unanimous approval.

Since the beginning, residents and local governments have played a special role in the Bay Program. The partnership developed two advisory committees to the Executive Council, one for residents and one for local governments, so the voices of these two large stakeholder groups were always front and center in the partnership. At the same time, the partnership developed an advisory committee for science to ensure the voices of the scientists were never lost.

The partnership has expanded to

include more federal involvement as well. The EPA has always acted as a representative for all federal agencies, but in 2010, President Obama signed an executive order calling on federal agencies to play a larger role in restoring the Bay.

"What the executive order really did was create an opportunity — and actually a demand — for our many federal partners to come to the table," remarked Jim Edward, acting director of the Chesapeake Bay Program, who led the implementation of the executive order for the partnership. "It brought the Department of Defense and the Corps of Engineers to the table, as well as the National Park Service and other agencies you may not think about."

Now, the Bay Program is learning how to adapt in a new way: management. As we learned through retrofitting the federal regulatory program, the Chesapeake Bay is a complex ecosystem with its own unique needs that we are only beginning to understand. The Bay Program partnership is set up to make decisions informed by the best available science, but these conditions can change, and we need to be flexible and understanding in a way that accommodates those changes.

Looking forward

The Bay Program has more than 30 years' worth of monitoring data, but that doesn't mean we know everything. This year's record rainfall could put a damper on the progress we've seen in the past few years, so we are closely watching to see how the ecosystem reacts to it. We're still monitoring to see what these impacts are, but thanks to our monitoring partnership, a network already exists, as well as ample data to compare it with.

We're looking into a new source of information: residents. Through the Citizens Monitoring Cooperative, a project of the Bay Program, volunteer monitoring groups can learn how to collect quality data from their local streams, providing useful data to the jurisdictions and Bay Program for areas that we don't have the capacity to monitor.

Along with collecting data, the partnership has stepped up its work to verify what pollution reduction measures, also known as best management practices, are in place. All of the states and DC have BMP verification processes that include initial inspection, follow-up checks and evaluation of performance.

This achievement helps state and local governments as well as the Bay Program know that restoration investments are maintained and sustainable. It also helps the Bay Program's modelers estimate how much pollution is prevented from entering waterways, which is then cross-checked with the monitoring data.

For 35 years, the Chesapeake Bay Program has been running a relay race, passing the baton of science and restoration as we innovate, learn and adapt. Join us on the next leg of the race at chesapeakebay.net.

Joan Smedinghoff is the web content specialist with the Chesapeake Bay Program.

LET US KNOW

The BAY JOURNAL welcomes letters pertaining to Chesapeake Bay issues. Letters should be no more than 400 words. Send letters to: Editor, BAY JOURNAL, 619 Oakwood Drive, Seven Valleys, PA 17360-9395. E-mail letters to: bayjournal@earthlink.net

Letter writers should include a phone number where they can be reached. Longer commentaries should be arranged in advance with the editor. Call: 717-428-2819.

Views expressed are those of the writers and do not necessarily reflect those of the BAY JOURNAL or Bay Journal Media.



VOLUNTEER OPPORTUNITIES

Count birds at Nixon Park

Nixon County Park near Jacobus, PA, needs volunteers for the Cornell Laboratory of Ornithology's Project FeederWatch, a citizen science program in which participants count the number and identify species of birds visiting feeders from November through early April. Volunteers commit to a one-hour time slot on Tuesday or Wednesday every other week. Data is forwarded to Cornell for its nationwide project that tracks winter bird population trends. Beginners are welcome. The park is ADA accessible. Info: Andrew at 717-428-1961.

Paradise Creek Nature Park

Paradise Creek Nature Park in Portsmouth, VA, needs people of all ages (12 & younger w/adult) to participate in its *Volunteer Service Days* 9–11 a.m. Nov. 10 and Dec. 8. Help to replace invasive plants with native species or maintain trails and recreation amenities. Wear closed-toe shoes and long pants. Bring sunscreen, insect repellent and a water bottle. Preregistration is required. Info: Ranger Kat Fish at 757-392-7132 or kfish@elizabethriver.org.

Tree plantings, free trees

Stream-Link Education is looking for volunteers to help plant trees at Waterside Community in Frederick, MD, 9–11 a.m. Nov. 10 & 17. Info: streamlinkeducation.org/plantings.

Stream-Link is also seeking new planting sites along streams and rivers, particularly on farm land. Those who own property along streams or rivers with inadequate vegetated buffer can contact Stream-Link to see if they could be eligible for free trees. Planting area must be a minimum of 5 acres and must meet other requirements. Info: 301-473-6844.

Woodbridge, VA, cleanup

The Prince William (VA) Soil and Water Conservation District needs volunteers for its *Woodbridge Community Big Cleanup Day* 9 a.m. to noon Nov. 17. Volunteers can join a cleanup group or lead an event. Sites include Jefferson, Marumsco and Veterans Memorial parks. Supplies and support will be provided. Info: waterquality@pwswcd.org.

CBL Visitor Center

Volunteer docents, ages 16 & older, are needed at the Chesapeake Biological Laboratory's Visitor Center on Solomons Island, MD. Volunteers must commit to a minimum of two, 3– to 4-hour shifts each month in the spring, summer and fall. Training sessions are required. Info: brzezins@umces.edu.

Anita Leight Estuary Center

Anita Leight Estuary Center in Abington, MD, needs volunteers, ages 14 & older, for an *Invasinators* workday 2:30–4:30 p.m. Nov. 17. Help to remove invasive plants and install native species. Learn why nonnative invasive plants threaten ecosystems, how to identify problem plants, and removal and restoration strategies. Wear sturdy shoes, long sleeves and work gloves. Info: 410-612-1688, 410-879-2000 x1688, otterpointcreek.org.

Adopt-a-Stream program

The Prince William Soil & Water Conservation District in Manassas, VA, wants to ensure that stream cleanup volunteers have all of the support and supplies they need for trash removal projects. Participating groups receive an Adopt-A-Stream sign from the PWC Public Works Department in recognition of their stewardship. To learn more, adopt a stream or get a proposed site, visit waterquality@pwswcd.org. Groups can also register their events at trashnetwork.fergusonfoundation.org.

Little Paint Branch Park

Help the Maryland-National Capital Park and Planning Commission remove invasive species 11 a.m. to 3 p.m. the last Saturday in November, December and January at Little Paint Branch Park in Beltsville. Learn about native plants. Sign in for a safety orientation. Gloves and tools are provided. Info: Marc Imlay at Marc.Imlay@pgparks.com, 301-442-5657.

Cromwell Valley Park

Cromwell Valley Park near Towson, MD, needs volunteers for *Habitat Restoration Team / Weed Warrior Days:* 2–4 p.m. Nov. 14, 17 & 28. All ages (12 & younger w/adult) are welcome. Remove invasive species, install native plants and maintain restored habitat. Service hours are available. Meet at Sherwood House parking lot. No registration is required. Info: Laurie Taylor-Mitchell at Itmitchell4@comcast.net.

Magruder Woods

Help Friends of Magruder Woods 9 a.m. to 1 p.m. the third Saturday

WORKDAY WISDOM

Make sure that when you participate in cleanup or invasive plant removal workdays to protect the Chesapeake Bay watershed and its resources that you also protect yourself. Organizers of almost évery workday strongly urge their volunteers to wear long pants, long-sleeved shirts, socks and closed-toe shoes (hiking or waterproof). This helps to minimize skin exposure to poison ivy and ticks, which might be found at the site. Light-colored clothing also makes it easier to spot ticks. Hats are strongly recommended. Although some events provide work gloves, not all do; ask when registering.

Events near water require closed-toe shoes and clothing that can get wet or muddy.

Always bring water. Sunscreen and an insect repellent designed to repel both deer ticks and mosquitoes help.

Lastly, most organizers ask that volunteers register ahead of time. Knowing how many people are going to show up ensures that they will have enough tools and supervisors. They can also give directions to the site or offer any suggestions for apparel or gear not mentioned here.

in November, December and January remove invasive plants in the forested swamp in Hyattsville, MD. Meet at farthest end of parking lot. Info: Marc Imlay at Marc. Imlay@pgparks.com, 301-283-0808, (301-442-5657 the day of event); or Colleen Aistis at 301-985-5057.

American Chestnut Land Trust

The American Chestnut Land Trust in Prince Frederick, MD, needs volunteers for invasive plant removal workdays 9–11 a.m. Thursdays and 10 a.m.–12 p.m. Wednesdays. All ages (16 & younger w/adult) are welcome. Training, tools and water are provided. Preregistration is required. Info: 410-414-3400, acltweb.org, landmanager@acltweb.org.

Ruth Swann Park

Help the Maryland Native Plant Society, Sierra Club and Chapman Forest Foundation 10 a.m. to 4 p.m. the second Saturday in November, December and January remove invasive plants at Ruth Swann Park in Bryans Road. Meet at Ruth Swann Park-Potomac Branch Library parking lot. Bring lunch. Info: Marc Imlay at ialm@erols.com, 301-283-0808, (301-442-5657 day of event). Carpoolers meet at the Sierra Club MD Chapter office at 9 a.m., return at 5 p.m. Carpool contact: Laurel Imlay at 301-277-7111.

Snap a stream selfie

Water quality in 80 percent of U.S. streams is unknown. Help to bridge the information gap by taking a selfie in one's backyard or nearby stream. Info: iwla.org/streamselfie.

VA Master Naturalist training

The Prince William County (VA) Master Naturalist Merrimac Farm Chapter needs volunteers interested in the stewardship of natural areas, trail and stream rehabilitation, and water quality monitoring. They can lead educational programs or assist scientists in plant and animal surveys. Training covers ecology, geology, soils, native flora & fauna and habitat management. The fee is \$200; a scholarship is available. Volunteers commit to 40 volunteer hours a year. Info: merrimacfarmvmn.weebly.com/.

Floatable monitoring program

The Prince William Soif & Water Conservation District in Manassas, VA, needs volunteers to help assess and trace trash in streams as part of an effort to reduce nonpoint source pollutants in urbanized and industrialized areas in relation to the County's Municipal Separate Storm Sewers (MS4) permit. Cleanup supplies are provided. Info: waterquality@pwswcd.org.

Resources

EPA citizen science report

An EPA advisory body recently submitted a report to agency leadership recommending that the U.S. Environmental Protection Agency proactively and fully integrate citizen science into its work, embrace it as a core tenet of environmental protection and use citizen science data directly. The full report can be found online. Google: EPA Needs a Comprehensive Vision and Strategy for Citizen Science.

Creek Critters App

The Audubon Naturalist's Creek *Critters App* empowers people to check on the health of their local streams by through finding and identifying the small organisms — or creatures — that live in freshwater streams, then generating stream health reports based on what they find. The free app can be downloaded from the App Store and Google Play. Info: anshome. org/creek-critters. To learn about



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partnerships or host a Creek Critters event, contact cleanstreams@anshome.org.

Watershed education capsules

Prince William Soil and Water Conservation District's watershed capsules, which teach students about the important functions of watersheds, are available, first-come, first served. Info: pwswcd.org/ educators, education@pwswcd.org.

Environmental education grants

EcoTech Grants offer up to \$2,500 to engage children in inquirybased, STEM-related projects that leverage technology and/or use nature-based design to address environmental problems in local communities. This cycle's application deadline is Jan. 15, 2019. Info: captainplanetfoundation.org/grants/ ecotech.

Park passes for 4th-graders

The Maryland Department of Natural Resources is partnering with the U.S. Department of the Interior's Every Kid in a Park program to provide fourth-grade children and their families free admission to national public lands and state parks. The Maryland Park Service will honor the federal passes, valid through Aug. 31, 2019, at all 75 state parks. The passes are also valid at 16 national parks, six national natural landmarks, five national wildlife refuges and two federal heritage areas in the state. The program's goal is to increase access to public lands and facilities for children at an impressionable age to ignite their interest and love for the outdoors. It also offers teachers resources for planning field trips, including free access for classes and eligibility for federal transportation funding. In addition, the DNR offers educational resources for teachers. The pass covers admission, but does not cover amenities and services, such as boat rentals, camping or staff-led tours. For details or to print a pass for this year, google Every Kid in a Park and follow the directions on the website.

Wildlife education trunks

The Maryland Department of Natural Resources is offering a variety of wildlife education trunks

Do You Have a Mid-January through Mid-March Event?

This is to remind organizations and centers with events or deadlines that take place between mid-January and mid-March that announcements for these items must reach the

Bay Journal office no later than Dec. 11 if they are to run in the combined January-February 2019 issue. Please e-mail news about upcoming events to this address: kgaskell@bayjournal.com.

for use by teachers, home-school educators, naturalists, scout leaders and other instructors. These free interdisciplinary tools are designed to interest students in local wildlife while building on disciplines like art, language arts, math, physical education, science and social studies. Each trunk contains an educator guide with background information, lesson plans and hands-on K–12 activities, as well as activity supplies, books, furs, replica tracks, videos and other hands-on items. Trunk subjects include aquatic invasive species, bats, black bears, furbearers, white-tailed deer and wild turkeys. Trunks are available at seven locations around the state and can be borrowed on a firstcome, first-served basis for up to two weeks. Info: Google Wildlife Education Trunks.

Learn if your yard is *Bay-Wise*

Master Gardeners in Prince George's County (MD) takes part in Bay-Wise, a program that offers free consultations on sound environmental practices for county residents' yards to help them to have their landscapes certified as Bay-Wise. The Master Gardeners look for healthy lawn maintenance, efficient watering and pest control, and native trees and plants that provide shelter and habitat for wildlife. They also suggest approaches to reduce pollution. Free Bay-Wise signs are given to homeowners who demonstrate sound practices. Homeowners can also evaluate their property online using the MD Yardstick, which tallies their pollution-reducing gardening and landscaping practices. To have a yard certified as Bay-Wise, though, homeowners need to have the Master Gardeners visit and evaluate their landscape. Contact: Esther Mitchell: estherm@umd.edu or visit extension.umd.edu/baywise/ program-certification. Click on "download the yardstick" to evaluate a landscape and/or vegetable garden.

Marine debris toolkit

The National Oceanic and Atmospheric Administration's Office of National Marine Sanctuaries and the NOAA Marine Debris Program

have developed a toolkit for students and educators in coastal and inland areas to learn about marine debris and monitor their local waterways. This toolkit is a collaborative effort to reduce the impact of trash on marine ecosystems through hands-on citizen science, education and community outreach. Info: Google marine debris monitoring toolkit for educators.

Bilingual educator resources

Bilingual lessons are available in English and Spanish for Interstate Commission on the Potomac River Basin educational programs. Info: potomacriver.org/resources/educator.

Turf / lawn programs

For information on the Prince William Soil & Water Conservation District's 12 Steps to a Greener Lawn / Building Environmental Sustainable Turf BEST Lawns programs, low-cost, research-based programs for lawn education, contact: 703-792-4037 or e-mail bestlawns@pwcgov.org.

Stormwater management info

Businesses and nonprofits interested in landscaping and turf management, stormwater pond management, wildlife concerns, recommendations for maintaining landscapes, protecting water quality and pollution prevention can call 703-792-6285 to schedule a free site visit.

VA water monitoring test kits

The Virginia Department of Environmental Quality is distributing a limited number of water monitoring kits to test for dissolved oxygen, pH, turbidity and temperature. These kits are available for free to schools and organizations that do not have water monitoring equipment. The DEQ requests that participants use these kits as part of the *EarthEcho* Water Challenge (formerly known as World Water Monitoring Challenge. See worldwatermonitoringday.org). Groups with their own monitoring equipment can also participate in the event. Teachers, or those who work with a large number of students, can request a free kit. Contact: Stuart Torbeck at charles.torbeck@deq. virginia.gov and provide a mailing address, the number of monitoring

locations and the total number of participants from the organization or school expected to participate in the EarthEcho Water Challenge. This information helps to determine how many kits a group needs. The Virginia Water Monitoring Council provided the kits for this effort.

Emerald ash borer program

The Virginia Department of Forestry's Emerald Ash Borer Cost-Share Program will help landowners and organizations (nonprofits, schools, homeowner associations, municipalities) treat ash trees to prevent their death by the emerald ash borer. Info: Meredith Bean at meredith.bean@ dof.virginia.gov, 434-220-9034. To learn about the invasive insect, visit emeraldashborer.info. To participate in free webinars, visit emeraldashborer.info/eabu.php.

Bay Backpack Provided by the Chesapeake Bay Program's Education Workgroup, the *Bay Backpack* is an online resource for educators with information about funding opportunities, field studies, curriculum guides and lesson plans related to the Chesapeake. Contact: baybackpack.com.

Baltimore biodiversity toolkit

The Baltimore Biodiversity Toolkit addresses the need for high-quality and accessible green space in the city, not only for native plants and animals, but for residents as well. It helps communities identify a suite of ambassador animals that represent habitat types within, and historic to, this area; shares practical resources for supporting specific wildlife needs; and monitors and encourages the collection of citizen science data; and develops a culture of conservation and stewardship. The toolkit highlights 20 ambassador wildlife species from four different habitats. These animals represent a variety of conditions that are present in high-quality environments for human, plant and animal health. The multi-platform toolkit is designed to help partners prioritize community greening projects based on representative species, citizen



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science data and spatial analysis that includes social, economic and ecological indicators. Info: fws.gov.

FORUMS / WORKSHOPS

MD water monitoring forum

The 24th Annual Maryland Water Monitoring Council Conference, Science, Stewardship and Citizen Involvement / Working Together for Clean Water, takes place 7:30 a.m. to 4:30 p.m. Dec. 7 at the Maritime Conference Center in North Linthicum. The conference includes a morning plenary session featuring presentations by Chesapeake Bay Foundation President Will Baker and Dominique Lueckenhoff, acting deputy director of the U.S. EPA Region 3 Water Protection Division; concurrent breakout sessions; posters; exhibitor tables; snacks; all-you-can-eat buffet lunch; and post-meeting social. Topics include: forests & water quality; urban ecology; promoting stewardship; environmental reporting; stream restoration monitoring; sewage infrastructure; citizen monitoring; and toxic contaminants. Contact: dnr.maryland.gov/streams/Pages/ MWMC/conference.aspx or Dan Boward at dan.boward@maryland.gov. The registration fees include lunch, breaks and conference materials.

Chesapeake Challenge Answers to **Take this otterly fun quiz!** on page 38. 1. Antarctica & Australia 2. B & C 3. B 4. A 5. D 6. A 7. An average adult male weighs around 25 pounds, an average female weighs around 18 pounds 8. River otters can run up to 18 mph and swim 12 mph 9. C 10. Right/4 Left/2 11. A

Bay Buddies Answers to Otter Adaptations on page 38. 1. Whiskers 2. Membrane 3. Hair 4. Nostils & Ears 5. Toes 6. Tail 7. Paws Boxed Word: Weasels The fees (before Nov. 20/after Nov. 20) are: non-presenter: \$70/\$80; Presenter: \$65/\$80; full-time students, nonprofit member or staff: \$40/\$60. Register online by noon Nov. 30. Walk-ins will not be accepted. Discounts for full-time students and members/staff of nonprofit organizations [501(c)(3)] are also available on a first-come, first-served basis.

EVENTS / PROGRAMS

Patuxent Research Refuge

Upcoming events at the Patuxent Research Refuge's National Wildlife Visitor Center [C] and North Tract [T] in Laurel, MD, include:

⊗Owl Eyes: 12:15–12:45 p.m. Nov. 10 & 17 [C] All ages. Learn about owls. No registration.

Bird Walk: 8–10 a.m. Nov. 14 & 28 [C] Ages 16+ Search for fall migrants in several habitats. Binoculars recommended.

≈ Nature Tots: Pigment of Patuxent: 10:30–11:15 a.m. Nov.
20 [C] Ages 3-4. Learn about the change of the season by examining color changes on the refuge.

■ Raptors Reign: 1–3 p.m. Nov. 24 [C] All ages. Licensed falconer Rodney Stotts shares the power of nature through discussions and up-close encounters with birds of prey. No registration.

Tiny Tots: 10:30–11:15 a.m. Nov. 25 & 26 [C] Ages 16–48 months w/parent participation. Interactive songs, stories, activities highlight the refuge's wildlife.

North Tract Bicycle Ride: 1–3:30 p.m. Nov. 25. Ages 10+ Learn how to reduce one's footprint, leave no trace on 12-mile ride. See local wildlife, plants, historical sites. Bring bike, energy bar/snack, water bottle, helmet. Ride is weather-dependent.

Except where noted, all programs are free (donations are appreciated; designed for individuals/families; and require preregistration. Contact: 301-497-5887. For disability-related accommodations, notify the refuge, giving as much notice as possible. Info: fws.gov/refuge/Patuxent.

Paradise Creek Nature Park

Upcoming events at Paradise Creek Nature Park in Portsmouth, VA, include:

Cuided Ranger Walks: 2–3 p.m. Nov. 10 & Dec. 8. All ages (11 & younger w/parent) Learn about native plants, wildlife & how to identify wildflowers. Free. Preregistration required. Contact: Kat Fish at 757-392-7132 or kfish@elizabethriver.org.

Brown Bag Lunches / Elizabeth River 101: 12−1 p.m. Nov. 7 (Elizabeth River's past); Nov. 14 (River's current condition) & Nov. 28 (Restoration under way). Preregistration required. Suggested donation: \$15. Info: elizabethriver.org, jrieger@elizabethriver.org.

South Field Day: 1-3 p.m. Nov. 12. All ages. Games, nature activities. Free. No registration.

Strut: 11 a.m.− 12 p.m. & 2−3 p.m. Nov. 24. All ages. Walk off some of that Thanksgiving dinner! Take a brisk 2-mile walk on trails through the forest, wetlands. Learn about local fall flora, fauna along the way. Wear walking shoes, bring a water bottle. Free. No registration.

Winter Animal Adaptations: 2–3 p.m. Dec. 1. River Academy. All ages (12 & younger w/adult) Discover the adaptations that wildlife use to stay warm and protected. Free. Preregistration required. Contact Kat Fish at kfish@elizabethriver.org, 757-392-7132.

York (PA) County Parks

Upcoming programs at York (PA) County parks include:

Schristmas Magic - A Festival of *Lights:* 6–9 p.m. Monday–Thursday; 5-9 p.m. Friday, Saturday & Sunday*. Nov. 23-Dec. 31 (Closed Dec. 24 & 25) Rocky Ridge, York. Fund-raiser, is the largest holiday attraction in the area with more than 600,000 lights, animation, trains, holiday scenes, refreshment for sale. Two onsite wheelchairs are available on a first come-first serve basis. Fee: \$10/adults; \$9/ages 59+; \$7/ group of 12+ adults & seniors; \$5/ ages 4–12; free/ages 4 & younger. Personal checks, credit cards not accepted. There will be an ATM on the premises. Tickets can be purchased on site Monday-Thursday. *Admission on Fridays, Saturdays, Sundays is by timed tickets only, which can be purchased at yorkcountyparks.org. Reservations required, no walk-ins these nights. In the event of inclement weather, call 717-840-7443 for updates, closures.

Set Night at Christmas Magic:
6−9 p.m. Nov. 28/rain date: 11/29.
Bring your pet to have its photo taken with Santa Claus for a \$7 donation. See first item for event, admission details. Pets admitted free.

■ Birds of Prey Day: 11 a.m. & 1 p.m. Nov. 24. Nixon Park, near Jacobus. Meet live hawks, owls, or falcons during indoor program by local raptor rehabilitators. Learn how these birds are adapted to hunting on the wing. Cameras welcome. Register at 717-428-1961.

➢ Natural Ornament Workshop: 1−3:30 p.m. Dec. 2. Nixon Park, near Jacobus. Supplies provided. Drop-in, leave anytime. Preregister at

717-428-1961.

Hanging of the Greens: 6–8 p.m. Dec. 7. Rail Trail at Hanover Junction Train Station. After decorating the station's exterior, snack on hot beverages, cookies during a holiday-themed program.

Ø Winter Wildlife Hike: 2–3:30 p.m. Dec. 9. Nixon Park, near Jacobus. One-mile wander explores park habitats while searching for signs of winter activity.

Except where noted, all programs are free and do not require registration. Contact: 717-428-1961.

Farm Sprouts

The Maryland Agricultural Resource Council invites children, up to age 5, to Farm Sprouts at the Baltimore County Ag-Center in Cockeysville. The program uses themes from children's books to explore a farm or nature topic through movement, stories and arts & crafts. Sessions are scheduled 9:45-10:45 a.m. or 11:30 a.m.-12:30 p.m. Nov. 16 (Turkeys) and Dec. 7 *(Hibernation*). The fee, for ages 9 months and older, is \$8. Anyone who wants to attend the program but is unable because of financial constraints is asked to call MARC at 410-887-8973 to see if arrangements can be made. Bring a lunch to stay longer and explore the park. Preregistration required. Info: info@marylandagriculture.org, marylandagriculture.org/farmsprouts-preschool.

Oregon Ridge Nature Center

Upcoming events at Oregon Ridge Nature Center in Cockeysville, MD, include:

Shoots & Letters: 10−11 a.m. Nov. 15 (*Hibernation*) & Nov. 29 (*Deer*) Ages 3+ Stories, crafts, adventures. Fee: \$2/child. No registration.

■ Bookworm Story Time: 11–11:45 a.m. Dec. 7. Toddler to age 6. Nature story plus activity such as an animal encounter, puppets or craft. Dress for a brief outdoor experience. Free. No registration.

➡ Falling Behind: Nov. 17 & 18. All ages. Learn about winter birds, seed pods, animal signs on hike. Free.

■ Turkey Tales: Nov. 24 & 25. Ages 5+ Stories, crafts, live turkey. Fee: \$3.

Solution Status Sta



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changing the evolution of animals, plants. Light refreshments provided, feel free to bring a snack to share. Free.

All events take place, rain or shine. Ages 12 & younger must be accompanied by an adult. Preregistration is required or strongly encouraged, except where noted. Info: 410-887-1815, info@OregonRidgeNatureCenter.org. Payment must be made within five business days of registration. Programs are designed for individuals and families; groups can call the park to arrange a program. For disability-related accommodations, call 410-887-5370 or 410-887-5319 (TTD/Deaf), giving as much notice as possible.

Mount Harmon Plantation

Upcoming events at Mount Harmon Plantation in Earleville, MD, include:

➢ Photography Workshop / Nature & Architecture - Taking More Creative Photographs: 1–4 p.m. Nov. 17. Steve Gottlieb, photographer and author of several books on photography, will discuss composition, lens choice, natural light, camera position, selective focus, the effective use of foregrounds & backgrounds. Workshop includes field work. Fee: \$40. Preregistration required.

≋ Yuletide Festival: 11 a.m.–3 p.m. Dec. 1 & 2. Fund-raiser features holiday decorations inspired by Colonial Williamsburg, hearth cooking demonstrations, including gingerbread; wassail punch; mansion tours; children's holiday craft activities; Christmas marketplace; and a decorations & greens sale featuring plants from the plantation. Fee: \$10; ages 12 & younger are free. Proceeds benefit Mount Harmon Plantation. Info: mountharmon.org, info@ mountharmon.org, 410-275-8819.

Ladew Christmas Open House

Ladew Topiary Gardens in Monkton, MD, invites the public to its Annual Christmas Open House 9 a.m. to 4 p.m. Dec. 7 & 8. Visitors can tour the rooms of the circa 1747 Manor House, which have been decorated by local floral designers and garden clubs, as well as purchase hand-crafted items at the Greens Sale. Guests are treated to complimentary cider and cookies. Weather permitting, the 22-acre gardens will also be open for selfguided tours during the open house. Proceeds benefit Ladew's Manor House, 22-acre gardens, 60-acre Nature Walk, and Butterfly House. Admission is \$13/adults; \$10/seniors & students; \$4/ages 2–12. Purchase tickets at LadewGardens.com.

Cromwell Valley Park

Upcoming programs at Cromwell Valley Park's Willow Grove Nature Center near Towson, MD, include:

Black Friday Hike: 7–8:30 p.m. Nov. 23 Ages 5+ Hike ends with s'mores around a campfire. Fee: \$5.

■ Autumn Leaf Lantern: 1–2:30 p.m. Nov. 24. Ages 2–10. Take a short hike to gather leaves to craft a mason jar lantern. Fee: \$5.

Scood Night Groundhog: 1–3 p.m. Nov. 25. All ages. Learn about woodchucks. Hike to search for their burrow. Fee: \$4.

Ages 12 & younger must be accompanied by an adult. Except where noted, preregistration is required for all programs. Info: info@cromwellvalleypark.org, cromwellvalleypark.org, 410-887-2503. For disability-related accommodations, call 410-887-5370 or 410-887-5319 (TTY), giving as much notice as possible.

Anita Leight Estuary Center

Programs at the Anita C. Leight Estuary Center in Abingdon, MD, include:

Scratitude Hike: 8:30–10 a.m. Nov. 17. Adults. Research has shown that practicing gratitude increases happiness. Take a guided stroll through Leight Park's woods. Free.

■ Kitchen Chemistry: 10:30 a.m.–12 p.m. Nov. 17. Ages 5+ Delve into the world of chemistry using items found in a kitchen. Experiments explore the science of food & cooking. Fee: \$5.

Herp Hibernation: 1–2:30 p.m. Nov. 17. Ages 5+ Discover where reptiles, amphibians go for the winter. Up-close encounter with a snake, turtle. Check out wild herptile wetland areas. Free.

Where do the Wild Things Go? 12–1:30 p.m. Nov. 18. All ages. Learn where some animals go to escape winter's cold. Free.

≋ Tails & Tots: 2 p.m. Nov. 18. Ages 6 & younger. Listen to a story

New Submission Guidelines

The *Bay Journal* regrets it is not always able to print every notice it receives because of space limitations. Priority is given to events or programs that most closely relate to the preservation and appreciation of the Bay, its watershed and resources. Items published in *Bulletin Board* are posted on the online calendar; unpublished items are posted online if staffing permits. Guidelines:

Send notices to kgaskell@bayjournal.com. Items sent to other addresses are not always forwarded before the deadline.

Bulletin Board contains events that take place (or have registration deadlines) on or after the 11th of the month in which the item is published through the 11th of the next month. Deadlines run at

about an animal or a habitat. Event may include meeting a live animal, a craft or acting out the story. Free. No registration.

Solution So

Solution Series Fort Building Fun: 12:30–2 p.m. Nov. 24. Meet at Pontoon Pier. Ages 8+ Collect natural material to build a temporary fort. Learn how to make twine to lash materials together. Fee: \$3.

SOWI Prowl: 5–6:30 p.m., Nov. 24. Meet at Bosely Conservancy. Ages 8+ Listen for the call of these elusive creatures, maybe catch a glimpse of one. Fee: \$5.

Sunday Trail Running Series: 10–11 a.m. Nov. 25. Ages 13+ (15 & younger w/adult) All skill levels/paces welcome. Log miles while enjoying beautiful scenery with fellow nature enthusiasts. The course is an outand-back, single track, about 2 miles long. Free.

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pesticides altogether.

➢ Plant gardens filled with native, nectar-producing flowers for your area. Go to pollinator.org/guides.htm and type in your zip code. You'll get information about pollinators in your area plus a list of pollinator plants.

➢ Leave tree stumps, dead branches and rotting trees on your property, if least two months in advance. See below.

Submissions to *Bulletin Board* must be sent either as a Word or Pages document, or as simple text in the body of an e-mail. PDFs, newsletters or other formats may be considered if there is space and if information can be easily extracted.

Programs must contain all of the following information: a phone number (include the area code) or e-mail address of a contact person; the title, time (online calendar requires an end time as well as a start time), date and place of the event or program. Submissions must state if the program is free, requires a fee, has age requirements, has a registration deadline or welcomes drop-ins.
 December issue: November 11
 January-February issue: December 11

Ages 12 & younger must be accompanied by an adult. Events meet at the center and require preregistration unless otherwise noted. Payment is due at time of registration. Info: 410-612-1688, 410-879-2000 x1688, otterpointcreek.org.

Parkway's biodiversity program

The Friends of Dyke Marsh, Friends of Little Hunting Creek, the American Horticultural /Society, and the Four Mile Run Conservatory Foundation invites the public to hear National Park Service biologist Brent Steury discuss the George Washington Memorial Parkway's 11-year biodiversity inventory 7:30 p.m. Nov. 14 at the Huntley Meadows Park Visitor Center in Alexandria, VA. Steury will talk about documenting 5,563 species in the parkway's 4,580 acres from the rare plant communities of the Potomac Gorge to the birds of the Dyke Marsh Wildlife Preserve. The event is free. Those using a GPS device to find the center should enter 3701 Lockheed Blvd., Alexandria, VA. Info: fodm.org, 703-768-2525.

possible. They provide nests for some species of bees.

If you find a bee nest too close to your home, don't destroy it. Contact a local beekeeper or your state cooperative extension service for advice about removing the nest without harming the bees.

Kathy Reshetiloff is with the U.S. Fish and Wildlife Service's Chesapeake Bay Field Office in Annapolis.

Take this otterly fun quiz!

1. The river otter is one of 13 otter species found around the world. They are found on all but two continents. Which two?

2. Which two of these are names for young otters?

- Á. Cub
- B. Kitten
- C. Pup
- D. Ottling

3. North American river otters often come within a few feet of a human on land or a boat when they are swimming with their head above the water. Why is this?

A. They are one of the most curious mammals known.

B. Their eyes are adapted for sight underwater, making them nearsighted above the water.

C. They are notorious for begging for food, especially fish.

D. They are extremely social animals and associate with a variety of other animals.

4. River otters are in the *Mustelidae* family, which except for the sea otter, have anal scent glands that produce a strong secretion used to attract mates and mark territory. Which one of these is not a member of this animal family:

- A. Badger
- B. Beaver
- C. Fisher
- D. Wolverine

5. Otters are active year-round, and are able to withstand winter's cold temperatures because of their dense fur. What is the estimated density per square inch of an otter's pelt?

A. 460,000 hairs B. 360,000 hairs C. 260,000 hairs

D. 160,000 hairs

D. 160,000 nairs

6. On average, how long can an otter hold its breath underwater?

- A. 4–6 minutes
- B. 6–8 minutes
- C. 8–10 minutes
- D. 10–12 minutes

7. Which is larger? A male or a female otter?

8. As a rule, is a river otter faster on land or in the water?

9. The scent of otter poop has been described as relatively pleasant for animal scat. Each otter has its own unique aroma that helps other otters identify which individual



Pop goes the otter (a member of the mustelidae or weasel family). (Dave Harp)



left the pile. Otter scat has its own special name. What is it?

- A. Perfoop
- B. Scootch
- C. Spraint
- D. Tottle

10. One of the otter's lungs has twice as many lobes as the other.

This adaptation is thought to help the animal swim underwater. Which lung has four lobes? Which lung has two lobes?

11. Instead of creating its own home, a river otter may decide to move into the abandoned den or lair of an other animal, or even take it over. These animals include muskrats, beavers, foxes, badgers and rabbits. It might even move in with one of these animals, with each species living in an area not being used by the other. Which animal is it?

- A. Beaver
- B. Fox
- C. Muskrat
- D. Rabbit

— Kathleen A. Gaskell

(Answers are on page 36)



If you want to learn how the North American river otter's body is adapted to the animal's needs, you otter take this quiz. Each description is accompanied by its scrambled answer. Put the answer in the spaces provided. The boxes, when read from top to bottom, will spell out the common name for *Mustelidae*, the animal family that otters belong to. Answers are on page 36.



1. These are long and thick and help the otter find its prey in murky water.

2. This is a clear, filmlike "third eyelid" that protects an otter's eyes when it swims underwater with its eyes open.

3. This ranges in color from brown and black to gray and white. It is thick and waterproof, which helps an otter to maintain its temperature when swimming in cold water.

4. Both of these features close while the otter is underwater to prevent water from entering them.

5. These are fully webbed, which help to make the otter a powerful swimmer.

6. This thick, tapered feature makes up about a third of an otter's length. It is very muscular and moves in a wavelike motion that can propel the otter though the water in bursts of 12 miles per hour. It also provides stability and helps to steer while swimming.

7. These have a very delicate sense of touch, which helps the otter identify objects in the dark, as well as skillfully grasp or handle objects.

Downy woodpecker chips out its own niche in the avian world

By Mike Burke

Action at the bird feeders was continuous. Red-winged blackbirds had arrived, scattered across the backyard, eating spilled seeds and fighting for position on the suet feeder. Cardinals and chickadees were hungrily feeding on black oil sunflower seeds. A dozen mourning doves had staked out a prime location under the thistle feeder.

A single downy woodpecker (*Dryobates pubescens*) was shuttling back and forth between a redbud tree and one of the feeders filled with a mixture of nuts. The downy would take a bite, scoot 20 feet to the safety of the redbud, eat the nut and immediately head back for more.

Although there was just one woodpecker, seeing him at the feeder was no fluke. Downies are widespread and common. Their range includes all of the continental United States except for the extremely arid Southwest and north of the tree line in Alaska. In Canada, they are equally dispersed from the Maritime Provinces to British Columbia and as far north as trees can grow.

They are also tolerant of humans. One of the wonderful crowdsourced programs run by Cornell University's innovative Ornithology Lab is called Project FeederWatch. It collects data from thousands of participants who record the number and species of birds attracted to feeders in the winter. Five of the six North American regions analyzed in the FeederWatch effort reveal that downies are in the top 10 of species seen at feeders. In the Northeast Region, which includes most of the Chesapeake Bay watershed, downy woodpeckers were recorded at 92 percent of the yards enrolled in the program last year. Only chickadees and juncos showed up more often.

Downies are the smallest woodpecker in North America. At 6 inches, they are just a bit bigger than chickadees.

The downy's head features black and white stripes punctuated by a shortish black bill and mahogany eyes. They have feather tufts just above the bill that protect their eyes and nasal passages from wood chips as the birds peck away at trees. Males, like the one in our backyard, have distinctive red patches on their napes.

The body is black on top except for a large white streak down the back. The wing and outer tail feathers are spotted white. Downies are light colored underneath. The white parts get progressively duskier as one moves farther west and south.

As the name makes clear, woodpeckers need wood. Their diet consists



Downy woodpeckers are the smallest woodpeckers in North America. At 6 inches, they are just a bit bigger than chickadees. (Donna A. Dewhurst / U.S. Fish and Wildlife Service)

mostly of insects and other tiny animals.(About a quarter of their diet consists of nuts, berries and seeds, especially in winter when insects are scarce.) Downies use their sturdy bills to open small crevices in trees to get at insects in their tunnels under the bark. They use their long, sticky tongues to reach their prey.

Because dying and dead trees harbor the most insects, downy woodpecker populations tend to expand in areas ravaged by tree pests and diseases such as emerald ash borers, Dutch elm disease and gypsy moths.

The downy's adaptable bill — less chisel-like than those of other woodpeckers — can be used to prick open insect tunnels or as a tiny forceps to extract insect eggs. Part of the bill's utility is evident in the birds' tree excavations. They build nesting holes



every year as well as several smaller roosting cavities nearby.

Downies are at least seasonally monogamous. The pair works together drilling nest sites, and the cooperation continues through the brooding and feeding of chicks.

Nests typically contain four to six eggs laid on consecutive days. The chicks all hatch at once 12 days later. They fledge in a bit more than two weeks, although they will rely on their parents for food for weeks.

Downy woodpeckers look remarkably like hairy woodpeckers. Although downies are much smaller, the overall color pattern is identical. At a distance, size can be hard to judge. Birders have developed a handy field identification trick. The downy's bill is relatively short, extending forward about the same distance from the base of the bill to the back of the head. The hairy's bill is much longer than that. Other differences exist, but the bill length is the easiest identification method.

Although these two species have an uncanny resemblance, they aren't even of the same genus. Bird biology has been revolutionized in the last decade, powered by molecular analysis of mitochondrial DNA. We now know that downy woodpeckers are most closely related to two woodpeckers of the Southwest: the ladder-backed and Nuttall's. These three species are now classified as members of the Dryobates family.

Hairy, red-headed, pileated and others belong to the *Picoides* genus. (Field guides published before 2015 may still list the downy's old scientific name, *Picoides pubescens*.)

DNA analysis and Project FeederWatch are just two of recent major scientific advances in bird biology. Tracking technology, photo recognition, even global on-line birding apps are adding depth to our understanding of the avian world.

This rapidly growing reservoir of knowledge is impressive. But as I watched the downy in my backyard probe away at the feeder, these developments weren't foremost in my mind. To me, nothing is more impressive in the avian world than the singular life of a living bird.

Mike Burke, an amateur naturalist, lives in Cheverly, MD.

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Bee grateful this Thanksgiving for native pollinators

By KATHY RESHETILOFF

Many people do not realize that native bees have been pollinating the continent's flowering plants long before honey bees were brought from Europe.

As bees move from flower to flower collecting nectar, they also move pollen from flower to flower. Pollination occurs when pollen grains from a flower's male parts (anthers) are moved to the female part (stigma). Once on the stigma, the pollen grain grows a tube that runs down into the ovary, where fertilization occurs.

Bees, both honey bees and native bees, are crucial to the production of most fruits, nuts and berries on which people and wildlife depend.

Although honey bees are used extensively in agriculture, many plants still rely on native bees for pollination. Many of the common dishes we relish on Thanksgiving might not be on the table without native bees: apple pie, pumpkin pie, cranberries, the onions in stuffing, as well as many vegetables like carrots, sweet potatoes, squash, brussels sprouts, broccoli and green beans. Even the almonds for tasty casseroles would be missing.

For instance, the honey bee does not know how to pollinate tomato or eggplant flowers. And, it does very poorly compared with native bees when it comes to pollinating many native plants, including pumpkins, cherries, blueberries and cranberries.

Some native bees, like bumblebees, are generalists, and gather pollen from a wide variety of flowering plants. They use a method called buzz pollination, in which a bee attaches itself to a flower and rapidly vibrates its flight muscles. This causes the entire flower to vibrate and loosens the pollen so it flows out of the openings in the anthers.

Plants that rely on buzz pollination include tomatoes, cranberries, blueberries and eggplants. The bumblebee is also an important pollinator of some clovers, a forage crop for cattle.

Other native bees are specialists, requiring certain plant species. Squash bees, for example, are very efficient pollinators of melons and various squashes, including zucchini and pumpkin. These bees often nest underground beneath the



plants they will pollinate. So if you go to a local pumpkin patch around Halloween, it's likely that you are walking over nests full of developing young squash bees.

Blueberry bees and cactus bees are also specialists. Miner bees nest underground and are very good pollinators of apple species. Some bee species are only active for a few weeks during the growing season and depend on plants that flower at that same time.

Many pollinators — so important to our economy and lives — are in trouble. Honeybees, raised specifically to pollinate crops, are declining. Causes include parasitic mites, disease, pesticide poisoning, the encroachment of Africanized honey bees and a phenomenon, Colony Collapse Disorder (CCD), where they leave the hive in search of nectar and do not return.

The causes of decline in wild bee populations vary by species. Like the honey bee, the bumblebee has been hurt by the introduction of a nonnative parasite carried by bumblebees imported from Europe for greenhouse pollination.

Pesticides are also a threat. Many of the pesticides used on farms and backyard gardens are broad-spectrum varieties, meaning that not only are they toxic to plant pests, but bees and other beneficial insects as well.

The loss of habitats and native plants affects native bees and other insect pollinators including butterflies. To help conserve native bees and

other pollinators:

Reduce the use of pesticides. If you must use an insecticide, apply it in the evening when many pollinators are inactive. If possible, stop using