CHESAPEAKE
BAY JOURNAL
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Welcome to your new home

A Chesapeake logperch is gently lowered into Chiques Creek, a Susquehanna River tributary in Lancaster County, PA. Ichthyologists raised 1,500 fingerlings from 28 caught in the spring as part of a reintroduction effort to keep the fish off the endangered species list. (Dave Harp) *See article on page 15.*

Striped bass decline spurs new look at mycobacteria

≈ Chronic wasting disease infects most of the striped bass in the Chesapeake

By Karl Blankenship

When Wolfgang Vogelbein peered at striped bass sores through a microscope 22 years ago, he knew he was looking at something very different than what was grabbing headlines at the time.

Pfiesteria piscicida — the so-called "cell from hell" — was being blamed for fish kills in Maryland and making people sick.

But what Vogelbein saw through his lens wasn't the result of a harmful algae toxin. It was a nasty bacterial infection, creating ugly sores on the outside of fish and lesions on the inside.

The infections were caused by mycobacteria, a type of bacteria that are widespread in the environment, but not typically associated with problems in wild fish. Suddenly, though, it was turning up in large numbers of the Chesapeake Bay's most prized finfish.

"I thought I would be spending the rest of my career working on myco," recalled

MYCOBACTERIA CONTINUES ON PAGE 22

Fox Island and its 'magical' classroom on stilts near their final act

≈ Education center inspired waves of future Bay advocates, but can no longer stem tide of rising water

By Jeremy Cox

This is the way the Fox Island Environmental Education Center ends: not with a gale or wrecking ball, but with the slow inevitability of wind and waves.

After four decades of hosting students and teachers, the spartan, barracks-style building that stands on stilts in the middle of the Chesapeake Bay is closing its doors at the end of this season, likely in early December.

The Chesapeake Bay Foundation, which purchased the low-lying Virginia archipelago and its lone structure in 1975, is bidding a reluctant farewell to the facility. The cause, according to the conservation and advocacy group, is rising water that has swallowed about 70% of Fox's land mass over the last half-century.

"It's a really hard thing for us," said Tom Ackerman, the foundation's vice president of education. "Fox Island is the heart of our program. In some ways, it's the heart of the organization. So, losing it is pretty tough."

According to William Cronin's book, *The Disappearing Islands of the Chesapeake*, the island group totaled 357 acres in 1895. By the book's publication in 2005, it was down to 67 acres. A GIS survey conducted this year by the foundation showed a mere 34 acres remaining.

ISLAND CONTINUES ON PAGE 24

Water laps at the Chesapeake Bay Foundation's education center on Fox Island. Rising sea level has led to a decision to close the facility. (Jeremy Cox)

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Editor's Note

Climate change increasingly lurks in shadows of Bay's ills

Virginia's Fox Island is pretty much gone, and rising waters are forcing the Chesapeake Bay Foundation to shut its education center there as 90% of the island's land mass has been lost since the late 1880s.

Meanwhile, scientists estimate that the number of birds inhabiting our meadows, forests, wetlands and backyards has declined by 25% in the last half century. One reason is the altering of habitats, including coastal marshes around the Bay, which is causing a number of species, such as the black rail, to decline.

Mycobacteria infections in the Bay's striped bass are likely to further worsen as Chesapeake waters warm. While much about the disease remains a mystery, it seems to be exacerbated by warm conditions.

None of these stories, which you'll find in this issue, are directly about climate change, but they are all about problems made worse by a warming climate.

Sea level is rising faster than ever, habitats are changing and water temperatures are climbing.

This collection of articles didn't happen by design, but by happenstance. In reading them, it struck me how — while climate change is far from the only issue facing the Bay region — it is one that increasingly touches all others.

In our recent reader survey, climate change was one of the issues most flagged by readers as needing more attention. We also heard from a number of readers who viewed climate as a political issue.

But while policy solutions might spur political debate, the fact that the climate is changing at an increasingly rapid rate — and has to be dealt with by community leaders at all levels — is increasingly obvious.

While many factors in the Bay region contribute to sea level rise, including land subsidence, the global rise in sea level is driving its acceleration in recent decades.

Our leaders have to account for that change. And our actions can still determine how much change will happen in the future. For instance, a Maryland sea level rise report issued late last year concluded that if we begin controlling greenhouse gas emissions now, sea level rise by the end of the century could be limited to 2 feet this century. (That's still twice the rate of the last century.) If emissions keep increasing, sea level could rise by an estimated 3 feet or more.

Like development, climate change is a pervasive issue altering the Bay and its watershed every day. Whether we are more successful in dealing with it, globally, as we have been in dealing with development, regionally, remains to be seen.

— Karl Blankenship

Correction

A piece of farm equipment was misidentified in the photo that ran with the article in the October issue of the *Bay Journal*. It should have said that the Plain Sect farmer was riding a side delivery rake to windrow his hay crop inorder to bale or use a hay loader. Hay-making generally does not contribute to pollution.

The *Bay Journal* regrets the error.

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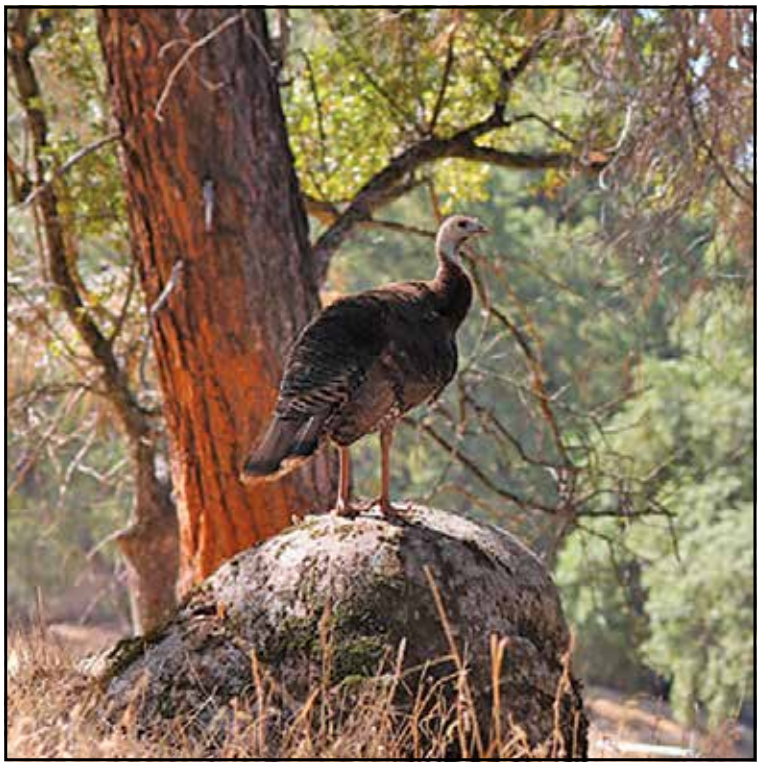

Clockwise from left:

A turkey hen surveys the terrain. To learn about Thanksgiving's iconic bird, see article on the back page. (Marji Beach CC BY-NC-ND 2.0)

The shell on the right is a real oyster shell. The the left shell is artificial and was grown using a process known as biofabrication. See article on page 11. (Dave Harp)

Forrest Pritchard, a farmer in Virginia's Shenandoah Valley, adapted his farm to survive economic challenges. See article on page 10. (Char Newswanger)

WHAT'S INSIDE

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Scientists raise alarm as North American bird populations plummet

≈ Climate change, loss of habitat particularly devastating for coastal, meadow and forest species

By Ad Crable

It's hard to imagine a world without birds chirping outside in the morning or during a stroll in the woods. But a new study has found that birds are in serious decline across North America, including in the Chesapeake Bay region.

There are nearly 3 billion fewer birds in North America than there were in 1970 — a 29% decline during a single human lifetime, according to the study published in October by the journal *Science*. The study was done by eight scientists with government and private bird research organizations in the United States and Canada.

Populations of even the most common species that people see at backyard bird feeders or outside have plummeted — think cardinals, titmice, wrens, goldfinches, house finches, sparrows and blue jays, to name just a few.

The decline of one of the most ubiquitous kinds of wildlife may be the strongest evidence yet that Earth's ecosystems are in trouble. The study warned that birds, which are widely monitored, are prime signals of environmental health. Birds are important pollinators and seed dispersers, and they keep insect populations in check. They also drive a considerable economic industry from birdwatchers who feed them and chase them around the country.

The increase in spring heat waves threatens the nestlings of the prothonotary warbler. Meanwhile, development continues to eat away at its habitat. (Dave Harp)

The factors that are driving down bird populations are accelerating, and the study warns that, unless those threats are addressed, some species will be in danger of collapse.

"It's alarming. It makes me feel like we are trashing the planet and we need to do things in a better way," said David Curson, director of bird conservation at Audubon Maryland/DC. "I've seen these trends for quite a few years. This study just kind of brings it all together and lays it out for the public to see that we have really damaged our environment."

David Curson, director of bird conservation at Audubon Maryland/DC, said that he's observed the avian decline for some time and that it's time for people to start "to do things in a better way." (Dave Harp)

One of the study's authors, Michael J. Parr, who also is president of the American Bird Conservancy, said the numbers show "the global wildlife crisis has arrived in our backyards." A *National Geographic* writer called the bird plummet "a state of quiet freefall."

The study's researchers pored over 50 years of annual bird surveys — many by citizen scientists — as well as government counts and radar data from weather satellites that have been used to track swarms of migrating birds at night.

A bird bander holds a black rail. As recently as 1990, the eastern black rail was a common bird found in marshes along the Bay. Now, the U.S. Fish and Wildlife Service, citing the inundation of nests from more frequent storms and increasingly high tides, has proposed listing the bird as threatened. (Woody Woodrow / USFWS)

The study found that the Baltimore oriole, so important to baseball fans in Maryland, has dipped by about one-third since 1970.

Among those suffering the most alarming declines are birds that depend on shoreline and marsh habitat, including those that are emblematic of the Chesapeake Bay.

These shorebirds and wading birds around the Bay are currently not threatened but are on the Maryland Department of Natural Resources' list of birds most in need of conservation: great egret, glossy ibis, brown pelican, laughing gull, least tern and spotted sandpiper.

Together, shorebirds are down by 17 million, or 37%, across North America. Red-winged blackbirds, found around almost any wet spot in Bay country, are down by 439 million.

Most of the bird problems along the Bay are due to climate change, said Bryan Watts, director of the Center for Conservation Biology at the College of William and Mary and Virginia Commonwealth University.

Rises in water levels from a warming planet are burying vital habitat at the water's edge, he said. "When you look out on the marshes, it looks fairly similar to what it did, but it's no surprise when you look at the small numbers [of birds] because they can't produce any young due to inundation."

Case in point: the eastern black rail, as recently as 1990, was a common bird found in marshes along the Bay. Now, the U.S. Fish and Wildlife Service, citing more frequent inundation of nests from more frequent storms and increasingly high tides, has proposed listing the bird as threatened. A final decision was expected in October.

The largest drop in North American bird populations is among grassland species such as meadowlarks, whip-poor-wills and horned larks. American sparrows, once a common sight in yards, had the largest single falloff in population, at 717 million, or 53%.

The disappearance of grassland birds makes Curson especially sad. "They're charismatic birds with beautiful songs that used to be a feature of people's childhood in the landscape in Maryland and elsewhere."

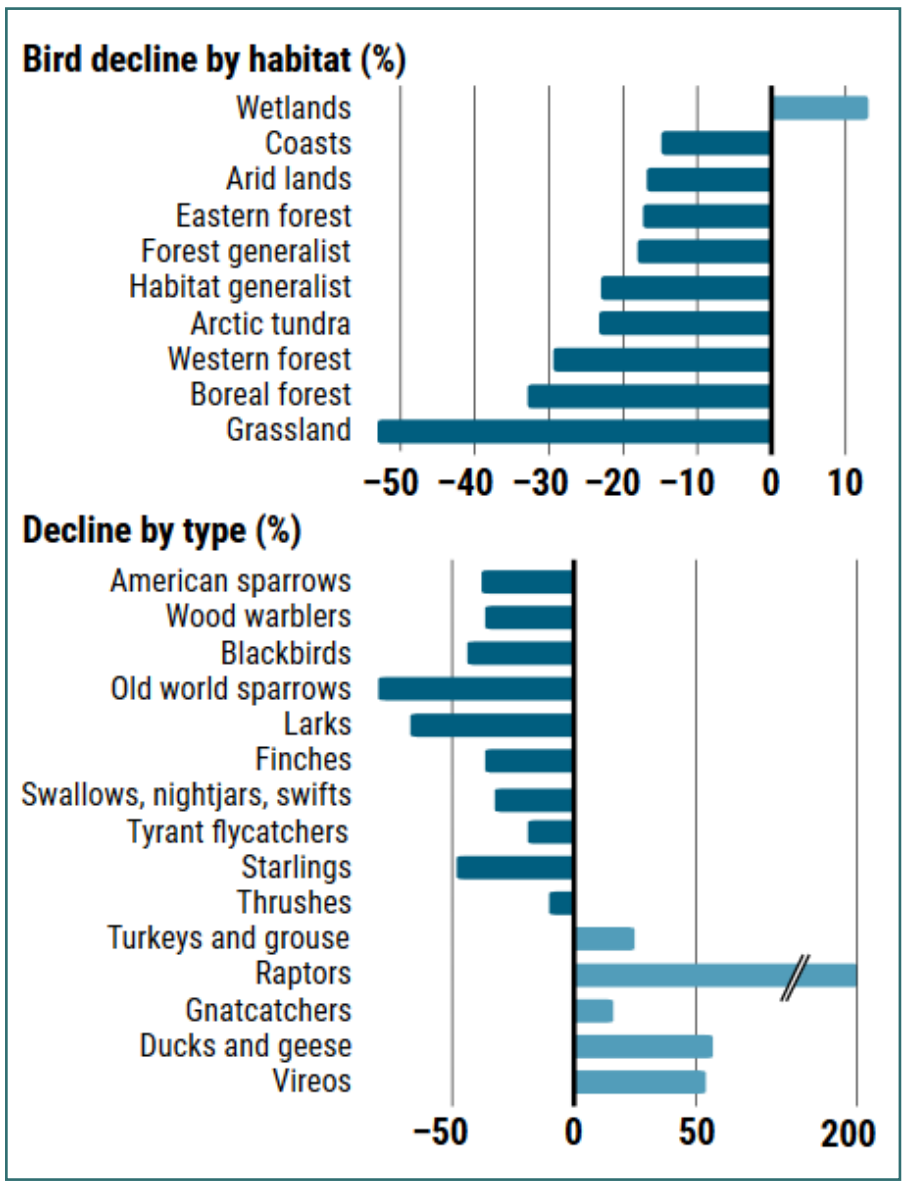
Not all birds showed declines. Raptors, wild turkeys and waterfowl such as geese and ducks showed large gains.

BIRDS CONTINUES ON PAGE 5

This 2004 photo shows a colony of royal tern on Shanks Island, between Tangier and Smith islands in the Chesapeake. Because the tern nests on low-lying sandy islands, its young are threatened by the high tides and rising sea levels associated with climate change as well as loss of habitat from shoreline development. (Dave Harp)

Birds from page 4

Raptors are protected and waterfowl and turkeys each have dedicated conservation programs, largely paid by hunters, to preserve their habitats. In the Bay region, ospreys, eagles and other birds of prey have actually increased because they have been targeted by multiyear restoration programs.



(From "Tallying the Losses." Reprinted with permission from AAAS K. Rosenberg et al., Science, adapted by N. Desai / Science)

The results of the study have grabbed headlines, but the researchers did not delve into the reasons for the striking declines. Other scientists and bird experts, though, have a ready list of reasons.

Chief among them is the loss or degradation of bird habitat. Development, forest fragmentation from energy extraction and changes in farming practices all contribute to loss of the habitat that birds need for eating, shelter and migration.

The study noted that all of the main habitats that birds depend on, from grassland to forests to coastal areas, are disappearing.

"Fragmented habitats, like you see in suburbia, make many birds more susceptible to predation — especially nest and egg predators — parasites, disease and changes in climate," said Aaron Haines, an associate professor of conservation biology at Millersville University in Pennsylvania.

"There has been fairly dramatic urban expansion [during the study's 50-year period] in the Bay region," Watts said. "In urban areas, the predator density from cats and raccoons is just too high."

Plenty of other stressors also are converging to dent bird populations, experts said.

Among them: feral and pet cats that roam outside, climate change that disrupts migration patterns, window strikes, lighted building strikes, cell tower and wind turbine mortality, West Nile virus and pesticides that both kill birds directly and the insects they need for food.

"It's like death from one thousand cuts. It's many reasons," Watts said.

What can be done?

Many experts advocate for people to make their yards more bird friendly by planting flowers, shrubs and trees that feed and shelter birds. After all, lawns make up about 40 million acres across the United States.

Trees that produce berries, such as hawthorn, dogwood, crabapple, holly and winterberry, are especially helpful. Two websites that offer tips for improving backyard habitat are the National Audubon Society (audubon.org) and National Wildlife Federation (nwf.org).

While Curson endorses individual steps to help birds, he thinks it will take collective activism by the public to push lawmakers and local government officials to adopt policies that help birds. He especially wants to see a reduction in the use of pesticides and a decrease in greenhouse gases that cause climate change.

"This is a political problem, and this needs advocacy," he said.

Dan Ardia, who has studied birds at Franklin & Marshall College in Pennsylvania, said, "The most frustrating aspect to me is that many of these impacts can be minimized if there was public will, especially as it relates to cats and to reducing evening lighting in buildings."

One current focus of conservationists is to get Congress to pass the Recovering America's Wildlife Act, which would dedicate $1.4 billion annually to states for the conservation of declining wildlife populations, including birds.

Researchers involved with the study noted that the restoration successes of waterfowl, eagles, ospreys and other species show that wildlife can be brought back with legislation and conservation action.

The possibility of a near-birdless landscape shakes the soul of Bruce Carl, a birdwatcher in Akron, PA. "To walk along a trail in the woods and have it be consistently silent no matter where you would go would be very disappointing," he said.

"I just can't imagine a time when this would be possible. Hoping that day never comes."

Forest conservation bill draws controversy in MD county

≈ Anne Arundel council waters down bill that would that would make it more difficult to cut down trees for development

By Timothy B. Wheeler

Battle lines have been drawn in one of Maryland's most populous counties over preserving more of its forest land from development, in a debate that could be a test case for the rest of the state.

Responding to public outcry over the clearing of trees for houses, offices and stores, Anne Arundel County Executive Steuart Pittman is pushing to tighten the county's protections for existing woodlands beyond what the state requires.

Legislation Pittman introduced in early September enjoys strong support from environmental organizations, civic groups and many residents. A bipartisan poll done recently for the Arundel Rivers Federation reported that more than three out of four voters contacted favored the forest conservation legislation, while fewer than 1 one in 10 opposed it.

But the bill has encountered fierce opposition from builders and business groups, who said the measure is so stringent it could make housing less affordable and stifle the local economy.

County officials say action is needed because Anne Arundel has lost 2,775 acres of forest since 2010, or about 300 acres a year, which they say is a greater loss than all of the surrounding counties combined. Opponents contend other data show the situation is not that bad, but state figures still tally losses of around 200 acres a year.

"By any measure, we are losing forest in this county, and that means we are harming water quality," said Alison Prost, Maryland director of the Chesapeake Bay Foundation, which supports the bill.

Anne Arundel's current forest conservation law, which mirrors state requirements, hasn't stemmed the decline. Developers are often able to clear much of a wooded site without having to replant a single tree. And even when developers are required to replace some of what they cut, they often opt to pay a fee instead, which officials say doesn't actually cover the cost of replanting.

Pittman, who pledged during his election campaign last year to curb "reckless development," put forward a bill that would:

- Lower "conservation thresholds" that specify how much land a developer may clear without having to replant or pay a fee
- Protect the largest and most ecologically important woodlands, including tracts of 50 acres or more that are deep enough to harbor forest-dwelling birds or that border streams
- Increase tree planting requirements
- Raise up to sixfold the fees that developers must pay when they don't replant

Trees were cleared on this site in Severna Park in Anne Arundel County, MD, to prepare for development. Local officials report that the county has lost 2,775 acres of forest since 2010, or about 300 acres a year, which they say is a greater loss than all of the surrounding counties combined. (Dave Harp)

"This is not anything radical," Pittman told about 200 supporters at an Oct. 7 rally held in advance of a public hearing before the county council on his legislation.

The seven-member council heard from a parade of 75 speakers during the 3.5-hour hearing, who argued for and against the bill. Environmental and community activists, along with concerned residents, warned that the quality of the county's air, water and everyday life are in jeopardy as forests shrink.

They called for prompt action to halt the loss of trees and woodlands in the county, with a few citing scientific studies on the role forests play in curbing pollution and fighting climate change. A couple even quoted Joyce Kilmer's classic poem, *Trees*, and the famous children's environmental tale by Dr. Seuss, *The Lorax*. They urged the council not to weaken the measure and to consider making it stronger.

"Forests are the sponges of the land that keep stormwater from polluting the waterways," said South Riverkeeper Jesse Iliff before the hearing. "Especially in Anne Arundel County," he added, "where we don't have large-scale agriculture or heavy industry, stormwater is the number one problem for our rivers and creeks. Anything we can do to slow it down and soak it up is going to reap dividends to water quality."

"The evidence is the declining health of all of our rivers," Iliff said. He noted that report cards on the Chesapeake Bay's health have given sub-par grades to all six of the Bay tributaries in the county.

Business and real estate industry representatives, though, warned of dire consequences if the bill passes as written. They contended it would virtually shut down development, costing thousands of jobs, aggravating a shortage of affordable housing and depriving the county of tax revenue.

"This is not a forest conservation bill. This is an anti-development bill," declared Angelica Bailey, vice president of the Maryland Building Industry Association.

The county is already facing a housing crunch, industry representatives say. Limiting how much land can be cleared in areas the county has designated for growth will push it elsewhere, they contend — to rural areas and out of the county altogether.

Such leapfrog development and sprawl would undermine the state's efforts to restore the Chesapeake Bay and reduce emissions of climate-warming greenhouse gases, they said. More dispersed housing would require more driving, stream-killing pavement and fossil fuel consumption.

The debate echoes one that has played out without resolution for three years now at the state level, where environmental groups have failed to persuade the General Assembly to strengthen the state's 28-year-old forest conservation law.

Activists are hoping action in Anne Arundel could inspire other Maryland localities to follow suit. Howard County Executive Calvin Ball has announced he's introducing legislation to strengthen that county's forest conservation law, increasing replanting requirements, raising fees and tightening variances.

On Oct. 21, the Anne Arundel council approved more than a dozen amendments to the administration's bill, most of which would ease but not entirely roll back the forest protections Pittman had proposed.

Among the changes approved, the council scaled back the proposed tightening of tree-clearing thresholds, beyond which developers would be required to replant.

"We are the first county in the state to raise conservation thresholds" beyond what state law requires, said Allison Pickard, the council vice chair. She said the smaller increases approved were as much as the council majority felt comfortable making without more information on how the new requirements would affect overall growth patterns. She suggested the council might revisit the requirements after completing a review of the county's long-range development plan.

The council majority also voted to exempt redevelopment of already built-up areas from the tougher standards.

In addition, they reduced the fee increases developers and landowners would have to pay in lieu of replanting trees themselves. Pittman had proposed a sixfold boost to the fee, with the higher rates reflecting what his aides said is the value of the ecological services that forests provide in clean air, water, habitat and cooling.

The council dialed the fee hikes back by half or more. They did agree, though, to more than triple the fee for clearing land in violation of the forest conservation law, from 80 cents per square foot of cleared trees to $3 per square foot.

"These are huge increases," said councilmember Nathan Volke, one of those voting to scale back the original bill. He said the amended fees would still be on par with the highest fees charged by any other locality in the state.

But councilmember Lisa Rodvien argued that they need to be much higher to deter developers from remov-

Forest continues on page 7

Forest from page 6

ing trees without replanting any. The city of Annapolis, she noted, charges $10 per square foot in such cases.

Rodvien, one of only two dissenters to most softening of the bill, proposed a series of amendments to make it stronger instead. She argued that what the county really needs — and what most of the public wants — is a firm policy that there be no more net loss of forest.

"They're sick of seeing trees cut down," she said.

But Nathan Pruski, the council chair, countered that he couldn't go along with a no-net-loss forest conservation policy until the county had upgraded transportation, increased affordable housing and achieved denser development along public transit lines. All of Rodvien's strengthening amendments failed.

Matt Johnston, the county's environmental policy director, called the council action "a big step forward," though he noted that the amended provisions are not as strong as the administration had proposed.

"We just don't think this gets us to where we want it to be," he said.

Tom Ballentine, vice president for policy for the Maryland chapter of the commercial real estate industry association, said he appreciated the council making changes to ensure growth can occur where the county has planned it.

Anne Arundel County Executive Steuart Pittman addresses a forest conservation rally in Annapolis, on Oct. 7. (Timothy B. Wheeler)

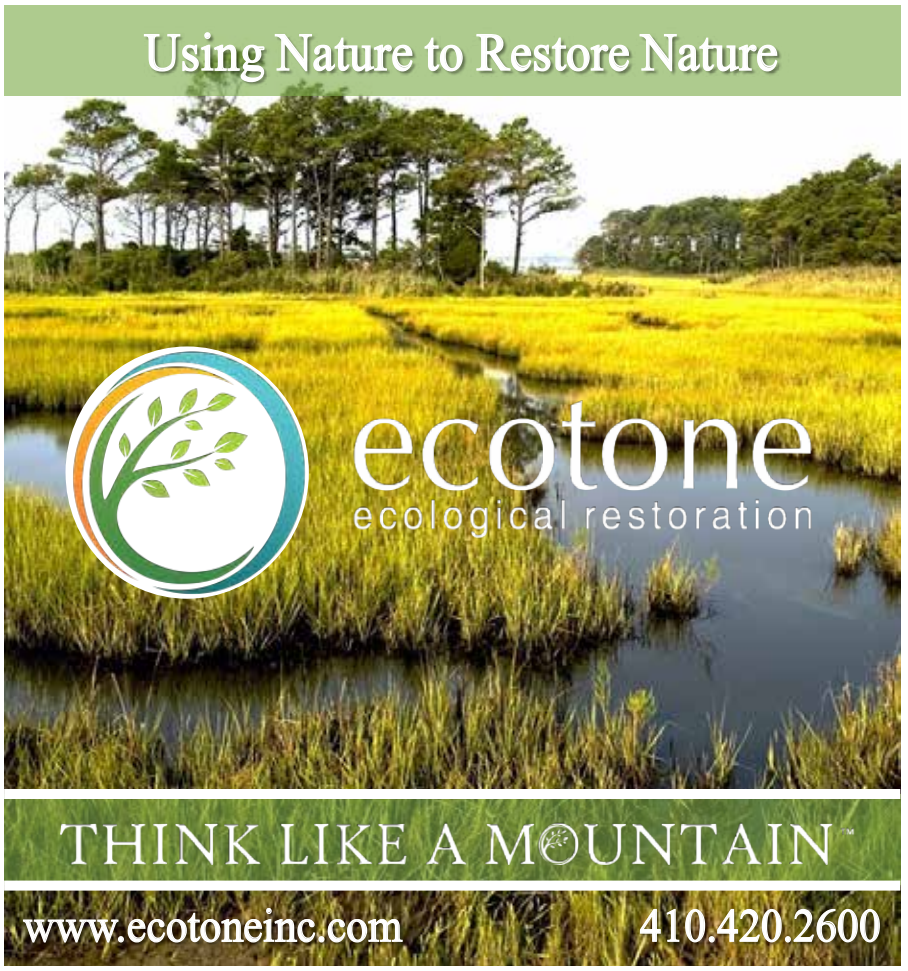
"There needs to be an ability for those areas to still be job and housing centers," he said. He said he needed to study the changes more to determine whether the industry could support it.

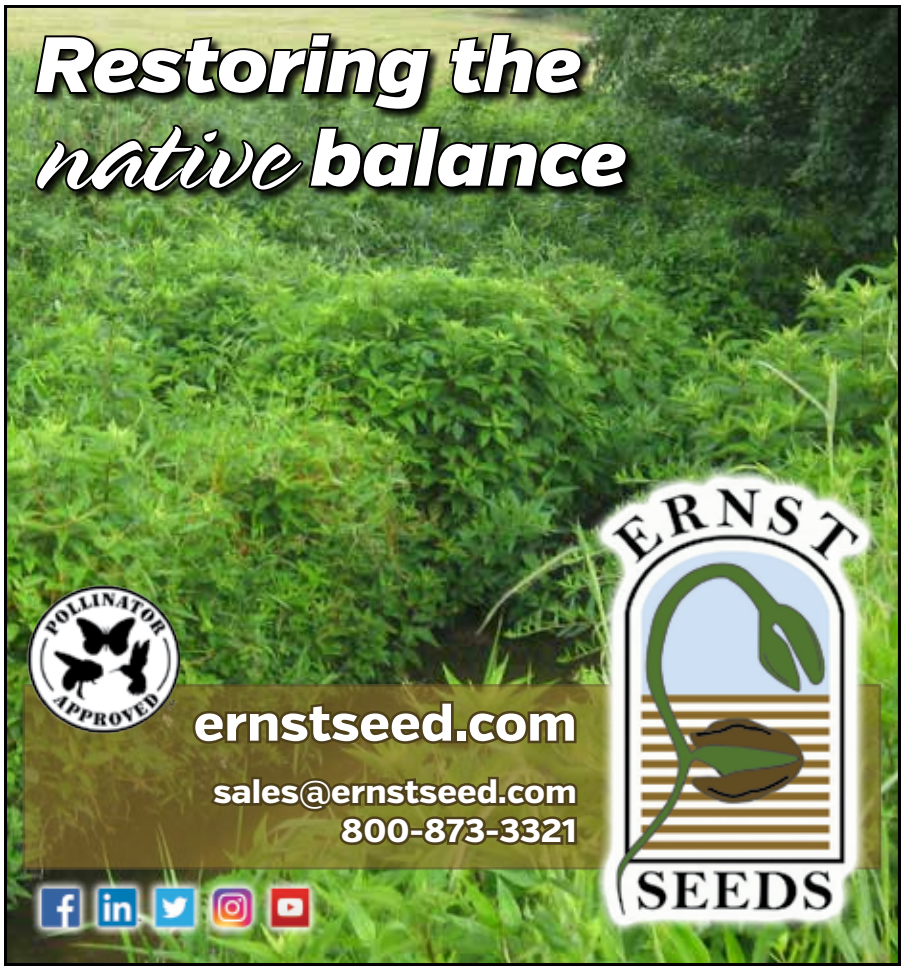
Ben Alexandro, water program director of the Maryland League of Conservation Voters, said the council changes made the legislation "much weaker." If passed now, he contended, the county would continue to experience significant forest loss.

Indeed, Chris Trumbauer, the county executive's senior policy adviser, pointed out that under the amendments, developers in some cases could still clear half of a large forested site without having to do anything in mitigation.

Even so, the administration has taken one step under the current law to reduce forest loss. Steve Kaii-Ziegler, the county's planning and zoning officer, said that his staff had stopped routinely granting modifications to the law's requirements whenever developers said it would be too hard to comply.

The revised forest conservation bill was scheduled for a public hearing at 7 p.m. Nov. 4 at the county office building in Annapolis, after which the council could vote it up or down or opt to amend it further.





Company gets paid when stream restoration work is proven effective

≈ Unusual financing approach has led to large-scale projects in northeastern MD

By Timothy B. Wheeler

Like two kids playing in the mud, a pair of excavators carved a new channel for an eroding stream on a farm in Cecil County, MD. One hulking machine picked up a tree trunk, pivoted and passed it across the gash in the ground. The other grabbed it and deposited it in the bank.

Across the Chesapeake watershed, degraded streams are getting similar facelifts in an attempt to curb the flow of nutrients and sediment fouling the troubled Bay.

What's unusual about the Cecil County stream work is its scale — and its financing.

While most restoration projects tackle up to a few thousand feet of stream at a time, nearly 10 miles of Little Elk Creek and Little Northeast Creek are undergoing extreme makeovers.

And unlike most such projects, the firm directing these is fronting the costs. Ecosystem Investment Partners, a Baltimore-based company, expects to be paid only when the jobs are done and proven effective at reducing pollution.

"If we don't deliver a working project, I don't get paid," said Nick Dilks, one of EIP's three managing partners.

EIP is a relative newcomer to the long-running Bay cleanup effort. Founded in 2006, the private company has worked elsewhere until lately, conducting 62 restoration projects in 11 states.

It has developed wetland and stream mitigation banks that encompass 87,000 acres and restored nearly 79 miles of streams. The firm and its partners restored degraded ecosystems, then sold "credits" for those improvements to developers and government agencies needing to offset the environmental impacts of new development or road building.

Until recently, Dilks said, there didn't seem to be much demand in the Bay watershed for the large-scale restoration work that EIP undertakes.

But these days, as watershed states and localities struggle to make the nutrient and sediment pollution reductions called for in the Bay's "pollution diet," they are looking for ways to stretch available funds. By putting together large projects, EIP promises to lower the per-pound cost of pollution reduction — and guarantee results.

"In the mitigation business," Dilks explained, "we're very used to and comfortable with building restoration projects with our capital and expertise. We're really trying to apply that to the Bay restoration."

Traditionally, state and local agencies have awarded grants or contracts to private restoration firms to fix eroding streams or create wetlands. The firms get paid a portion of the money upfront, then receive installments as the projects proceed.

Two excavators work together to carve a new, more stable channel for a tributary of Little Elk Creek in Cecil County, MD. The trunks of streamside trees that have to be removed to refashion the creek channel get used to help stabilize the banks, while their stumps and roots go back in the stream to provide habitat for fish and wildlife. (Dave Harp)

But EIP uses its own funds to scout, design and execute stream restoration projects. It does receive a small portion of its grant or contract funds once it obtains all necessary permits, but the final payment is made only after the construction work is complete and shown after five years to be performing as specified.

The company has finished four projects in Cecil County, in addition to the two under way. When all six are completed, EIP will have restored more than 15 miles of three different streams in that northeastern corner of Maryland at the head of the Chesapeake.

The four earlier projects, which in 2017 and 2018 restored about 5 miles of Principio Creek, were mainly underwritten with nearly $12.5 million in grants from the state's Chesapeake and Coastal Bays Trust Fund.

Until then, the state had been funding smaller restorations involving less than a mile of stream. Most were on public land, which ensured access. But the Principio Creek projects involved private land owned by four different families.

"It's a large investment for the state," acknowledged Gabe Cohee, director of restoration financing for the state Department of Natural Resources. But the "pay for success" arrangement with EIP made the commitment attractive.

"It reduced our risk," he said. "It gave us more confidence because we were paying at the end of the project" instead of paying quarterly installments or at multiple milestones along the way.

The combined size of the projects also brought economies of scale, Cohee said. For example, one stream project kept nitrogen pollution out of the Bay at a cost of about $700 per pound, he said, compared with the $2,000 per pound average for all projects DNR funds.

With the stabilization of the stream's eroding channel and the planting of about 80 acres of streamside buffer, Cohee estimated that the four projects would keep about 30,000 pounds of nitrogen and 2,700 pounds of phosphorus out of the water.

Cecil County chipped in a 10% match to the state grants for the Principio restoration, according to Kordell Wilen, the county's development plans review chief. In doing so, the county got credit toward its Bay cleanup obligations at a bargain price.

The client for the two projects under way is the State Highways Administration, which in 2018 agreed to pay EIP a combined $23 million for the work, slated for completion next year.

The EIP projects are among several the agency has undertaken around Maryland to help meet its regulatory obligations to compensate for polluted runoff from state highways. SHA spokesman Charlie Gischlar said the Little Elk project, covering more than 7 miles of the stream, is probably one of the biggest the agency has funded.

The Cecil Land Trust has had a major role in EIP's projects there. Bill Kilby, the trust's executive director, said he and Nick Dilks, then with the nonprofit Conservation Fund, worked together about 20 years ago to preserve Cecil County farmland under Maryland's Rural Legacy program. That experience helped forge their partnership to put together large-scale stream restoration projects.

Kilby, a former longtime dairy farmer, used his ties to the local agricultural community to recruit farmers willing to participate. It helped that EIP was willing to cover the full cost of the work and even pay landowners for setting aside the land needed to establish riparian buffers.

"We had to go out and convince all these farmers," he said. "They wanted to do it — most people would like to do it — but it's just so cost-prohibitive to do it on their own."

Still, it wasn't easy to line up often independent-minded farmers along a targeted stretch of stream, Kilby said. The Little Elk restoration project, for instance, required the consent of 11 contiguous landowners, according to Troy Anderson, EIP's assistant director for operations.

Some hesitated, he said, because they worried the stream work would disrupt their farming operations or leave the landscape scarred by heavy construction equipment. Kilby assured them their concerns would be addressed, and anything disturbed put back once the project is done.

"The farmers are trusting us to do the right thing," Kilby said. "I won't say we haven't done anything wrong. It's pretty invasive work." But the targeted streams have been so degraded by livestock incursions and other old farming practices, he said, that it's not enough to just plant trees along the banks.

To do the Cecil projects, EIP has brought in Appalachian Stream Restoration, a West Virginia-based firm it has worked with before.

"We've probably built over 200,000 linear feet of stream with this team," Anderson said.

Restoration involves re-sculpting and rebuilding streambeds to reduce erosion, but also to increase habitat for fish

PAYOFF CONTINUES ON PAGE 9

Payoff from page 8

and other wildlife. In some cases, they straighten an overly meandering stretch a bit; in others, they add hairpin-shaped oxbows to slow down high flows.

The work involves clearing the land and removing some streamside trees. But the contractor uses the felled trunks to shore up stream banks, and the uprooted stumps are inserted in places, roots pointing skyward, to provide habitat.

Doug James, Appalachian's site foreman, said the team works with farmers to minimize disruption. While looking over a sheep pasture where the next restoration would take place, he said they planned to work around a large tree under which the flock was seeking shelter from the sun.

"We want to be very careful and save everything that we can," he said.

When construction begins, the stream's water gets pumped through a pipe around the stretch of channel being reworked. When that's finished, the water's restored and tree seedlings, shrubs and grasses are planted along the banks.

Life returns before long to the channel. While pointing out results of some work in Cecil County, Anderson and Dave Urban, EIP's managing director for operations, turned over a rock in a stretch of stream restored in the spring and found insects clinging to it. In a stretch of Principio Creek finished last year, tiny fish darted through clear, rippling water.

Troy Anderson, left, and Dave Urban of EIP examine a rock taken from a Little Elk Creek tributary in Maryland, where restoration work was finished in the spring. They found little aquatic insects on the underside of the rock that were signs of a recovering ecosystem. (Dave Harp)

The land trust takes responsibility for maintaining the stream buffers after the projects are finished, with some funds provided by EIP for that purpose.

As an added environmental benefit, Kilby said, he's persuaded some farmers who agree to the stream restoration to put their whole farm in land preservation.

"It's the kind of people we're working with," he said. "They don't want to see sediment going into Chesapeake Bay. We can make it happen."

Don and Debbie Moore are among the landowners Kilby has enlisted for restoring Little Northeast Creek. They raise grain, hay and sheep on the 150-acre farm that has been in the Moore family for close to 75 years.

The Moores keep their sheep out of the creek. But decades ago, Don Moore explained, the farm was a dairy operation with no stream fencing. The erosion caused by those cattle getting in and out of the water remains.

Moore said he liked the idea of restoring the stream when Kilby first broached it two years ago. But he worried about the potential disturbance. His concerns were eased, he said, after learning from farmers involved in the earlier projects that they were satisfied with the results.

"We certainly want to be good stewards of the land," Moore said, "and our goal is to hopefully leave it better than when we got it."

To Kilby, it's a testament to the power of networking and of building community trust. "I can't imagine it getting done any other way."

It's not clear whether this is the start of a trend. The DNR's Cohee said that while a few other sizable stream restorations are under way, he doesn't foresee a lot of other companies being able or willing to front the costs of such projects. And there's a need to focus more on reclaiming smaller stretches of streams in urban areas, where the costs are higher.

EIP's Dilks, though, says he still sees opportunities to, as he put it, "do well and do good at the same time."

"I would foresee this happening in lots of other geographies," he said.

For farmers, Bay cleanup needs mix with fight for survival

≈ As economic pressures take toll, farmers looking to cost-share programs, new ventures

By Jeremy Cox

Eighteen dollars and 16 cents.

That's how much money Forrest Pritchard cleared in the mid-1990s after his first harvest. His farm in Virginia's fertile Shenandoah Valley produced five freight cars' worth of corn that year. But a drought sharply reduced his yield, and the Midwest was having a bumper crop.

The math was simply not in his favor.

So, Pritchard took matters into his own hands. He scrapped the commercial fertilizers and heavy machinery and stopped trying to compete against the global marketplace. Today, he sells pork, beef, lamb and eggs directly to consumers and restaurants — and looks back only to observe how far his farm has come.

"How can anyone make money at farming when we're growing the stuff with used $150,000 combines on soil that demands fossil-fuel nitrates to create a pound of product?" he asked.

His farm is one of more than 168,000 in the six states in the Chesapeake region: Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia.

In 1987, the multi-governmental Chesapeake Bay Program created its first specific pollution-reduction targets. Going forward, every industry would have to do its part to clean up the Bay. As the largest contributor of sediment and nutrient pollution to the Bay, agriculture would have to play a leading role.

But as Pritchard's plight shows, those efforts unfolded against a backdrop of economic turmoil that is rarely acknowledged outside Tractor Supply stores and farm bureau functions.

Those economic factors could play a significant role in the success of Bay cleanup efforts in coming years. All of the states in the Chesapeake watershed are counting on greatly accelerated efforts to control farm runoff to meet their 2025 nutrient reduction goals. But if farmers are struggling economically, many warn they would not have the ability to implement needed conservation measures.

The figures in this story primarily come from two sources: the U.S. Department of Agriculture's Census of Agriculture, which recently published its first update in five years, and reports compiled by the agency's Economic Research Service.

Because the statistics aren't tailored to the uneven geography of the Bay's 64,000-square-mile watershed, the *Bay Journal* has used numbers that reflect the conditions of each of its states in their entirety. Nonetheless, the figures paint a stark portrait of agricultural life in the late 1900s and early 2000s — a time of rapid change and fraying safety nets.

Forrest Pritchard, a farmer in Virginia's Shenandoah Valley, adapted his farm to survive economic challenges. Many farmers in the Bay region are asked to participate in conservation programs while struggling for financial survival. (Char Newswanger)

First, a quick history lesson: Thirty years ago, many farms were overleveraged and began failing when commodity prices plummeted. The sector's debt-to-asset ratio — the proportion of its assets financed by debt — peaked at 21% in 1986. The crisis led to a multibillion-dollar federal bailout of the farming industry.

Farms are generally more financially solvent today than they were in the late-1980s. But insolvency indicators are climbing again. This year, the USDA's Economic Research Service projects the debt-to-asset ratio to reach its highest level since the early days of the Great Recession in 2009.

"Over the last three years, we've seen farming decrease to an insolvent level on many of our farms," said Bill Kitsch, vice president and agricultural lending manager for Ephrata National Bank in Pennsylvania. "There's a tremendous amount of stress."

The bottom line

≈ In all states but one, farmers reaped more revenue in 2017 than in 1987 after adjusting for inflation. The gain was at least 13% in those states. The exception was West Virginia, where the typical farm raked in about 6% less than it did three decades earlier.

≈ Gross income may be on the rise, but net income — how much farmers actually take home — is another story. After subtracting expenses, roughly six out of seven farms in the Bay states make below the federal poverty level for a family of four, or $25,000 a year.

≈ Higher costs of machinery and equipment ate into farm profits. Nationally, the market value of farm products rose 35%, but machinery costs increased 50%. In four of the six watershed states, the typical farmer's paycheck didn't keep pace with such expenses.

≈ At first glance, Delaware looks like an outlier. Its average farm sold $636,000 in products in 2017, more than three times the value of its counterparts in any other watershed state. The state's windfall is linked to having more-lucrative specialty crops, such as watermelons, and the chicken industry's dominance.

Size & land value

≈ The typical Bay state farm is less than half the size of the national average: 178 acres vs. 441 acres. Smaller farms have greater difficulty weathering financial storms. Larger farms usually have more variable costs — labor and animal feed — from which to make cuts during lean times. With a higher ratio of fixed costs — such as real estate taxes and the mortgage — smaller farms don't have the same luxury.

≈ Since 1987, the average Bay state farm has shrunk by 11 acres. That represents a 6% loss of farmland. The national average was slightly more than 4%. Kitsch attributes the steeper decline in the mid-Atlantic to greater pressure from development.

≈ With less land available for tilling and raising livestock, the price of farmland has shot up in certain areas. In Maryland, the market value of an acre of farmland jumped from $4,900 in 1987 to $7,900 in 2017, adjusting for inflation. That's not necessarily a good thing for farmers, said Hans Schmidt, assistant secretary of the Maryland Department of Agriculture and owner of a 2,000-acre grain farm in Queen Anne's County. "You do recognize your own land value is going up," he said. "But that's only on paper. That's not equity you can use to pay your fertilizer bill, your seed bill or any of your inputs."

≈ In Pennsylvania, farmland values grew from $3,400 to $6,500 per acre over the same three decades. "Farmers have seen many of their neighbors sell the farm to make way for housing developments, shopping centers and warehouses," said Mark O'Neill, a spokesman for the Pennsylvania Farm Bureau. "Once a farm is sold off, it is gone forever."

Opportunities

≈ As urban areas encroach on farms, farmers have seized new marketing opportunities. Whether at roadside stands, farmers markets or by subscription, many operations now sell their crops and meat directly to consumers. Such sales more than doubled from 2012 to 2017 in the Bay states, reaching $577 million.

≈ Organic farming has offered many operations a path toward higher returns. Pennsylvania farms piled up $707 million in organic sales in 2017, representing ten-fold growth in the sector over five years. Maryland topped $30 million, tripling its returns over the same span.

The Chesapeake Bay watershed is home to some of the most progressive farming practices in the country because of the cleanup program, said the MDA's Schmidt. But farmers, he added, couldn't do it alone.

In Maryland, for example, regulations limit farmers to spreading manure as fertilizer at certain times of the year, when nutrients are less likely to wash into Bay tributaries. So, the state operates programs to help farmers finance the construction of storage sheds and transport the manure to fields that need it. Another program helps to pay for cover crops, plants grown to prevent soil and nutrients from running off the land. "If we didn't have these cost-share programs, our farmers would not be able to compete outside of the watershed," Schmidt said.

The future of farming in the Bay states, analysts say, will be linked to consumer demand. That means more direct-to-consumer sales, more organic conversions and greater emphasis on precision farming (using GPS systems to manage fields down almost to the foot).

For his part, Kitsch urges a note of caution. In the 1990s and 2000s, many farms sold off real estate or development rights to stay solvent. He worries that the latest generation of farmers will have less to fall back on when hard times inevitably come.

"We're on much shakier ground economically today than we were during the farm crisis of the '80s," Kitsch said. With the specter of oversupply once again looming over the marketplace, he said, "we're in the grinder cycle. It's really a question of who survives."

Can bacteria help restore the Chesapeake Bay's oysters?

≈ Researchers developing biocement to provide hard strata for oysters to grow on

By Jeremy Cox

Ryan Hoover teaches sculpture making at the Maryland Institute College of Art. So, why is he developing a product that could help oysters grow in the Chesapeake Bay?

"That's a fine question," he said, laughing.

The answer is that he prefers to make art that has a function. In this case, he's using new technology to build better artificial reefs for oysters — with an assist from nature itself.

The Chesapeake's oyster population is believed to be at approximately 1% of its historic abundance. Scientists say habitat loss is partly to blame. In many places, dredging has reduced oyster beds to thin, half-buried sheets of dead shells that offer little support for new generations of bivalves.

Restoring oyster reefs is one of the top goals of the multistate and federal Bay cleanup program. Oyster shells are widely believed to be the best perch for attracting and growing young oysters, but it's hard to find enough shells — dead or alive — to use for restoration. Fishery managers have substituted other materials, such as granite, with mixed success.

Ryan Hoover, an instructor at the Maryland Institute College of Art, is working on developing an artificial oyster substrate that mimics natural shell. The process involves using bacteria to grow a sandstone-like material. (Andrew Copeland)

Hoover is collaborating with the University Maryland Center for Environmental Science on developing a cementlike substance that, they hope, will provide growing strata for oysters and approach the productivity of natural reefs.

Well, UMCES is only one of his collaborators. The other is a common type of bacteria that doesn't cause disease and lives in the soil.

When mixed with nutrients, *Sporosarcina pasteurii* spits out calcium carbonate crystals, one of the main ingredients in oyster shells. Hoover and his team combine this mixture with sand. The crystals grow to fill the space between the grains, binding them together. The result is sandstonelike material known as biocement.

The project puts the team at the front lines of a field still in its infancy. Biofabrication, as it's called, harnesses biological organisms to make new products.

Hoover describes the process this way: In manufacturing, humans start with something nature has made, cut it up into smaller pieces and reassemble it into a product. One example: sawing a tree into boards and putting them together to form a chair. Biofabrication revolutionizes that process.

"What if we could take the tree cells and assemble those into the shape of a

Biocement continues on page 12

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Biocement from page 11

chair?" Hoover asked.

The field has made headlines for promising advancements in medicine, such as efforts to make organs with 3D printers.

Several universities and startups across the country have been racing in recent years to develop and manufacture products with biocement on a large scale.

Possible applications, backers said, include using it to harden important historic buildings, store carbon underground and make a grout that shores up soils in earthquake-prone areas. One of the uses closest to being realized involves a North Carolina company working with the U.S. Air Force to build aircraft runways in out-of-the-way places where traditional construction is unwieldy.

Hoover is no newcomer to biofabrication. He developed a biofabrication lab at MICA a few years ago, where he and students have developed a range of uses, from colorful petri dish art to vegan wool.

The lack of natural shells for restoring reefs has been an ongoing challenge in the Chesapeake. In Maryland, efforts to dredge buried shell have been greeted by criticism from anglers and environmentalists, who say the practice destroys valuable fish habitat. Restaurants and seafood businesses have partnered to conserve and reuse shells. But the total returned to the Bay hasn't been nearly enough to offset the shells lost to harvest and ensure a ready supply for restoration sites.

Fishery managers have turned to shell alternatives, such as concrete, granite and even porcelain toilets. But young oysters, known as spat or larvae, generally have had greater trouble latching onto the artificial materials. They also tend to grow at a slower rate.

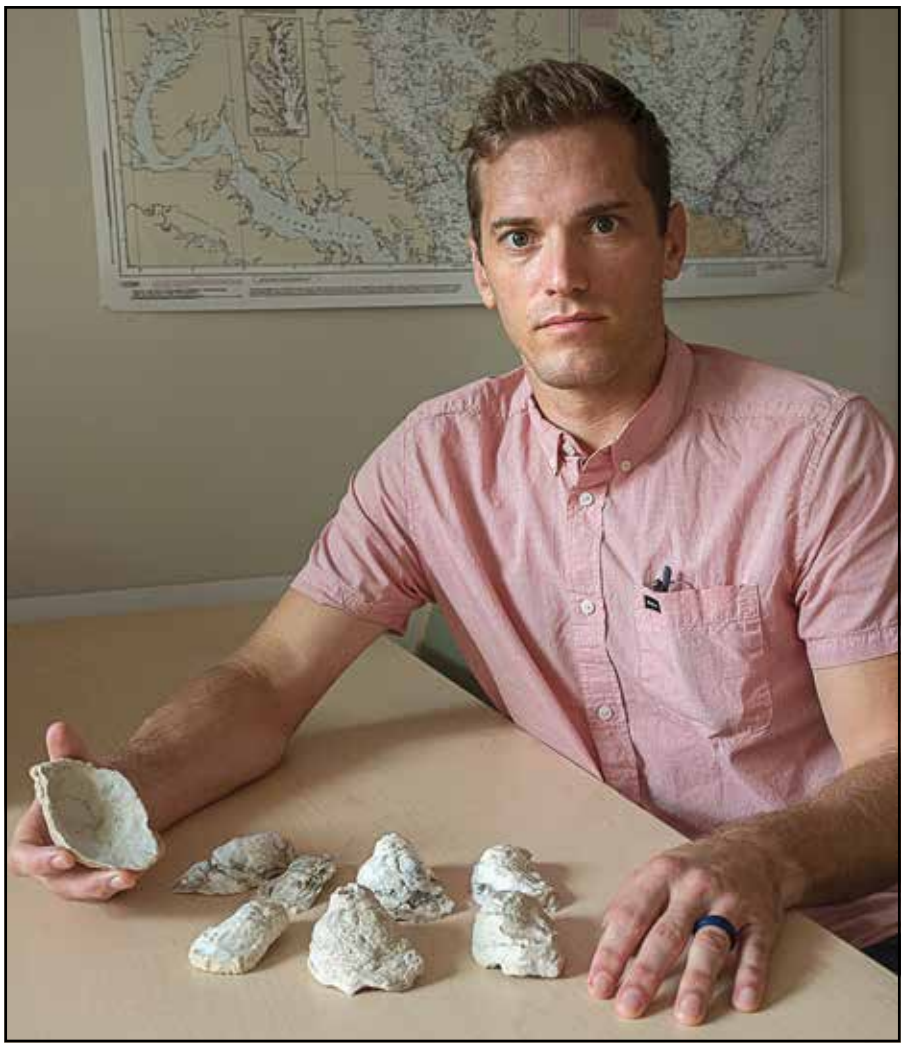
Because biocement consists of some of the same ingredients as natural shell, Matthew Gray, Hoover's partner at UMCES, thinks spat will be more apt to settle on it and grow compared with other artificial alternatives.

"Larvae are particular about what they want to settle on," said Gray, an oyster researcher at the center's Horn Point Laboratory near Cambridge.

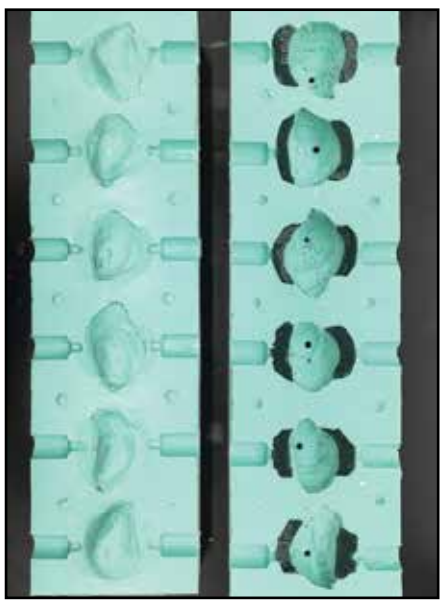
Since biocement eventually dissolves when exposed to water, Gray and Hoover hope it proves more palatable to watermen and boaters, who have voiced concerns for years that concrete and other types of artificial reefs posing permanent navigational hazards.

"Nobody is really excited about dumping a bunch of concrete in the Bay," Hoover said. "It's essentially there forever."

It's also important to consider the environmental impacts of concrete production, he said. Worldwide, manufacturing concrete generates about 8% of all carbon dioxide emissions, studies show.



Matthew Gray, an oyster researcher at the University of Maryland Center for Environmental Science's Horn Point Lab, shows the artificial oyster shells he has grown using a process known as biofabrication. (David Harp)
Below, what looks like an ice cube tray mold is actually the cast for biofabricating oyster shells using calcium and a bacteria. (Andrew Copeland)



Biocement doesn't have that problem, Hoover added.

Hoover said his interest in biofabrication grew out of taking a class at the Baltimore Underground Science Space, a nonprofit makerspace for synthetic biology. An UMCES graduate student sat in on a biofrabrication lecture by Hoover and later introduced him to Gray.

"When I talked to Ryan he was like, 'Oh, I think I could make oyster shells, if that would be useful,'" Gray recalled.

They started working together in January 2018, at first trying to reproduce a whole oyster shell in biocement form. Hoover initially forged the proper oblong shape of an oyster with a 3D printer, but it lacked the subtle ridges and other surface details of an authentic bivalve. So, they switched to growing the material in silicone-rubber molds. It takes anywhere from four days to 1 ½ weeks for the bacteria-sand mixture to grow to full size, Hoover said, adding that he hopes to find efficiencies to accelerate the process.

Then, it was Gray's turn to test their creation with live larvae in a lab. The results were promising. More baby oysters attached themselves to natural shells than on the biocement, but his work showed that biocement was significantly more successful than the third material, granite. He counted just 15 larvae on granite versus nearly 200 on biocement.

Why the difference? Gray speculates that the presence of carbonate in the biocement and natural shells may be a cue to young oysters that they've found a suitable place to settle. The carbonate also may affect the water chemistry, giving oysters a better chance at success.

Gray and Hoover aren't alone in putting bacteria to work to create oyster reefs.

Biomason, the company with the Air Force runway contract, applied last year for a patent on a technology in which the *S. pasteurii* bacteria transform fabric, such as burlap, into a hard strata for the bivalves. The method allows the strata to be formed into virtually any desired shape before it hardens, according to patent documents.

As for the Maryland project, several questions remain unanswered. What is the best way to grow and shape the biocement? What factors influence the larvae attachment to the material? How does it perform in the real world? And how much will it cost to make?

Molding biocement to mimic individual oysters may not be the best method going forward, Gray said. To provide more surface area for the floating larvae to find, he envisions forming it into veneers that attach to "oyster castles," the artificial reefs typically made from individual blocks of recycle shell and concrete. An entirely biocement oyster castle could be time-consuming to make and potentially costly.

He would like to get environmental bang for the buck by collecting the nutrients needed for the carbonate creation from sewage treatment plants.

But that's well into the future. For now, Gray and Hoover are trying to gather funding. They have applied for $140,000 from Maryland Sea Grant, which would cover two years of research. They expect to hear whether they received it this fall.

Their application included a letter of support from the Chesapeake Bay Foundation. Biocement offers a flexible design that could make it suitable for restoration at both public harvest grounds and at sanctuaries undergoing restoration, said Allison Colden, the group's Maryland fisheries scientist.

"We believe the study would provide 'proof of concept' for an approach that would address one of the biggest limiting factors to oyster recovery in Chesapeake Bay and could improve our own restoration program," she said in the letter.

In a way, biocement and other types of synthetic biology represent a shift in thinking about humanity's relationship with nature, Hoover said. Most of recorded history has seen an "extractive relationship" between the two, but it could become more symbiotic in the future.

"What if we collaborate with these bacteria to restore these oysters?" he asked. "It's sort of a multi-genus collaboration here."

New Bay grant projects range from stream buffers to soil health

≈ Many of the efforts are aimed at decreasing nutrient runoff from farms

By Jeremy Cox

One of the largest grant-making initiatives dedicated to the Chesapeake Bay cleanup has announced it is doling out nearly $13 million this year.

The U.S. Environmental Protection Agency and National Fish and Wildlife Foundation said Oct. 10 that the funding will be divided among 47 projects spread across the Bay region. The amounts range from $1 million to Virginia Tech for improving agricultural soil health to $38,629 to test buffer alternatives on poultry house properties in Delaware.

The federal agency and the conservation grantmaker jointly oversee the Chesapeake Bay Stewardship Fund, which has awarded more than 1,200 grants totaling $158 million since its inception in 1999. Those investments brought in an additional $238 million in matching funds.

This year's $12.7 million outlay is being matched by $21 million from local sources, officials say.

"These grants will help local communities and conservation partners restore and protect rivers and streams, improving water quality and the ecological health of the Bay," said Jeff Trandahl, the foundation's executive director.

The National Fish and Wildlife Foundation announced nearly $13 million in new grants at Our Lady of Mount Carmel School in Essex, MD. The school received a grant in 2017, which supported the construction of rain gardens and the planting of native trees, shrubs and perennials on its campus. (Will Parson/Chesapeake Bay Program)

Funding has been set aside for projects in all six states in the Bay watershed as well as the District of Columbia. The projects will be led by environmental groups, local governments, conservation districts, faith-based organizations and educational institutions.

Many of the projects aim to reduce the amount of nutrients and sediment that wash into waterways that flow into the Bay. Because farms are a leading source of nutrient and sediment pollution, much of the funding flows their way.

This year's largest project in terms of combined support from the Stewardship Fund and local financing is the Alliance for the Shenandoah Valley's $4.7 million effort to expand conservation practices on farmland. The group hopes to recruit 90 more farmers into the program while extending 106 miles of fencing to keep livestock out of streams and planting 490 acres of vegetated streamside buffers.

A nearly $2 million Penn State project has similar goals in the lower Susquehanna River watershed. The initiative plans to create 75 acres of forested streamside buffers and 7,500 feet of stream restoration while improving soil health on 1,360 acres of farmland. The focus is on Lancaster, Lebanon and Dauphin counties.

The Maryland Department of Agriculture also received $2.4 million for a program that aims to educate 150 producers, create an advisory committee for the state's Healthy Soils Program and establish baseline soil health measures.

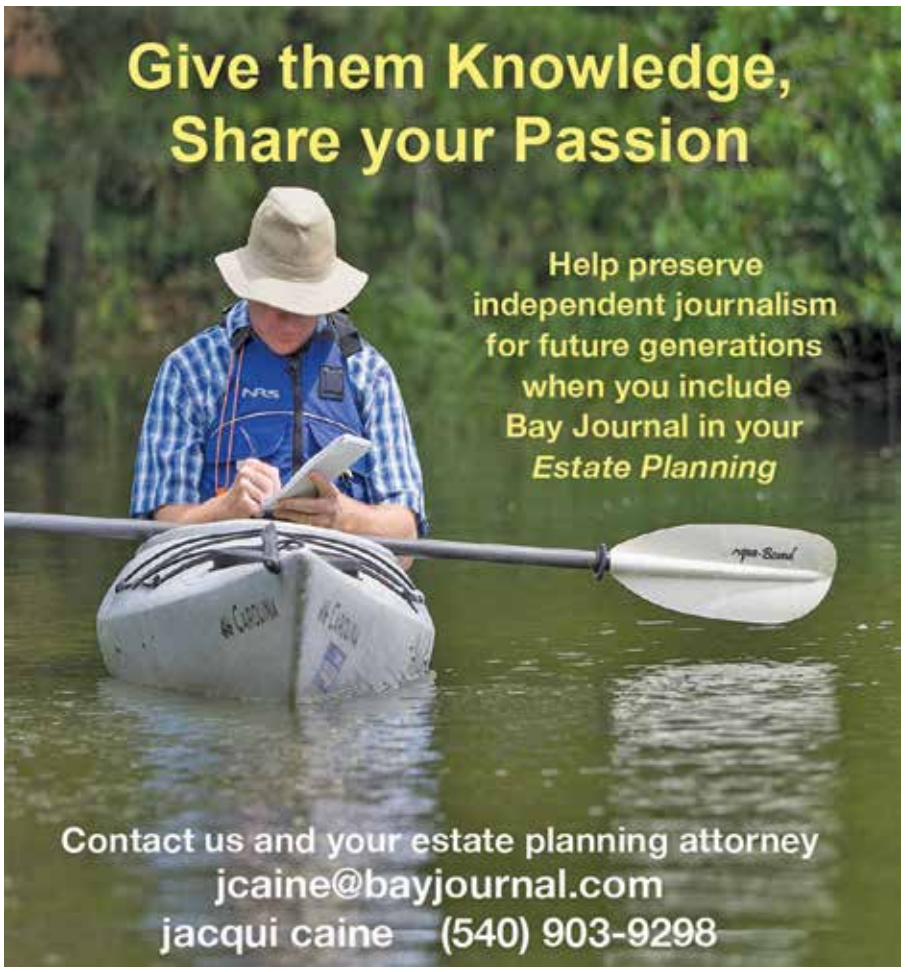
Some of the recipients have smaller geographic footprints in mind. Blue Water Baltimore, for example, plans to allocate $312,000 toward overhauling the parking lot at the People's Community Lutheran Church. The project includes constructing a rain garden, planting trees and treating the lot's surface to reduce stormwater runoff.

The District's lone project will involve using soil amendments to reduce ground compaction and improve soil health on opens lands. The project's price tag is $400,000.

Improving brook trout habitat is the subject of three Trout Unlimited projects, including $455,000 for the Potomac River in West Virginia, $300,000 for the North River watershed in Virginia and $525,000 for Western Maryland watersheds.

The funding doesn't leave out oysters. Projects getting support include a Chesapeake Bay Foundation plan to create a 2.5-acre oyster reef in the Western Branch of the Lynnhaven River in Norfolk, VA, and a Lynnhaven River Now effort to restore 3 acres of reefs in the river's eastern and western branches.

Additional support for the grants is provided by the U.S. Department of Agriculture's Natural Resources Conservation Service, U.S. Forest Service, U.S. Fish and Wildlife Service and the Altria Group Restoring America's Resources partnership.



Can a few hundred mussels become millions in the Anacostia?

≈ Effort to seed more native mussels in river continues to grow

By Whitney Pipkin

Last fall, Jorge Bogantes Montero of the Anacostia Watershed Society helped to transfer tiny, hatchery-raised mussels into protective baskets in the Anacostia River. At the time, Montero said, he "didn't have any expectations" that they would survive. But, under the careful watch of the watershed group and local schoolchildren who helped monitor their growth, nearly 92% of them did.

Now, the pilot project that started with 9,000 quarter-size mussels placed in a river no one was sure could sustain them has graduated to a much bigger one. In late September, the surviving mussels — some of which grew as much as 2 inches over the last year — were disseminated to several other locations in the river, from the marshes around Kingman Island to the faster-flowing waters near Yards Park.

Projects to circulate mussels through more of the Chesapeake Bay's freshwater systems have been picking up steam as more people recognize the bivalves' powerful water-filtering capacity. Although most of the species used for restoration projects won't show up on a local menu, they function like the Bay's beloved oysters by providing food and filtration to local ecosystems.

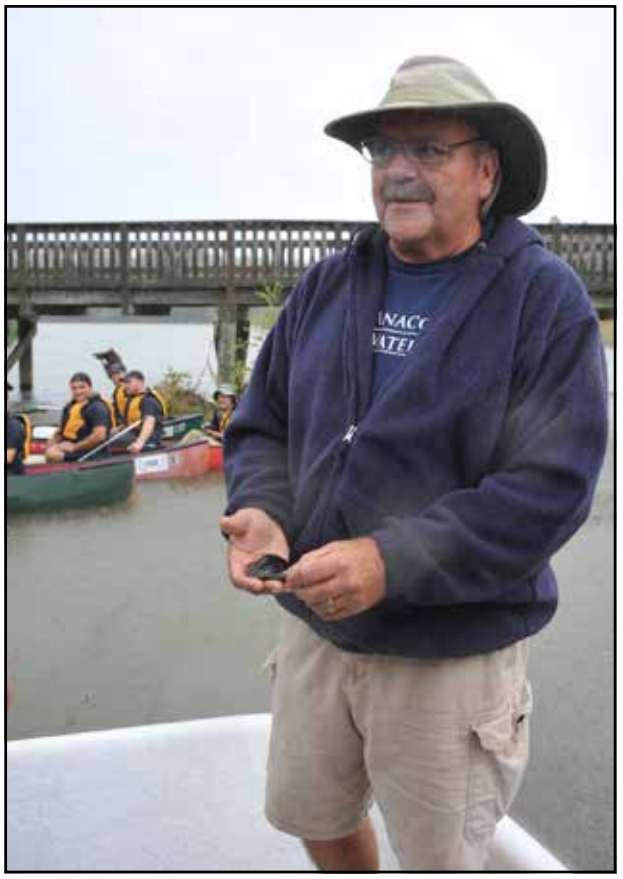
"Mussels filter the water. They take nutrients and bacteria and sediment out," said Jim Foster, president and CEO of the Anacostia Watershed Society. "We see this as an opportunity to help naturally clean up the river."

Researchers know of eight mussel species that are native to the Anacostia. So far, they've had success promulgating three of them: Alewife floaters — which grew the fastest this past year — Eastern pondmussels and Eastern lampmussels.

Montero, a natural resources specialist with the watershed society, estimates the mussels already filtered more than 32 million gallons of water in their first year and said that more reaches of the river stand to benefit from their presence.

In August, the District of Columbia's Department of Energy & Environment gave the organization a $400,000 grant to distribute another 35,000 mussels in the river and involve 400 District students in the process. DC Water also is contributing to the project.

"Let me say that cleaning up an urban river like the Anacostia River takes a lot of hands, a lot of partnerships," Tommy Wells, director of DOEE, said on a boat near Kenilworth Marsh, where a few hundred mussels were released that day despite a steady rain. "You can just look out on the river today and see that this is a river worth turning back into an asset for the people who live here — and for the generations to come."



Jim Foster, president and CEO of the Anacostia Watershed Society, prepares to toss a pair of mussels into the Anacostia River near Kingman Marsh. (Whitney Pipkin)

Volunteers, above, prepare to release hundreds of mussels that grew in baskets in the Anacostia River over the last year under a project led by the Anacostia Watershed Society.
Numeric labels were superglued to the shells of mussels that were spread in portions of the Anacostia on a rainy Sept. 30 morning. The labels will help researchers identify mussels they promulgated during future surveys. (Photos / Whitney Pipkin)

Mussels were far from the minds of advocates determined to improve the health of the Anacostia River until Montero started finding them in and around grass beds that his organization was helping to restore in 2015. The next year, a biologist from Maryland's Department of Natural Resources helped them conduct a survey for mussels. They found a couple of dozen, enough to form a baseline of the river's health and sow the seeds of a new project.

A collection at the Smithsonian Institution suggests how much of the river's mussel population has been lost. On display are the shells of mussels that were once abundant in a stretch of the river near Benning Road around the turn of the 20th century and into the 1950s. Last year's pilot project was a first stab at reintroducing some of those species, and it seemed to work.

"In the back of our minds, we were expecting more mortality — because it's the Anacostia River — but that wasn't the case," said Montero, who reported that just 8% of the mussels died in the first year. "The food available in the water column is great, apparently. They're not dying but growing."

Montero has worked closely on the project with fish biologist Rachel Mair from the Harrison Lake National Fish Hatchery, located along the James River south of Richmond. The facility and others like it are spawning the next generation of mussel researchers and hundreds of thousands of mussels for rivers like the James and Anacostia.

The hatchery produces thousands of baby mussels each year and grows them until they're more likely to survive in the wild. All three species in the Anacostia project rely on a host fish to complete their life cycle, so the propagation process is delicate.

With the DOEE funding, the watershed group plans to add two more species to the mix: the Eastern floater and Eastern elliptio. The latter seems to rely on the American eel to reproduce, and the hatchery is experimenting with in vitro fertilization techniques to promulgate it.

The Virginia hatchery grows the mussels by collecting females that already have larvae in their gills. The staff then extracts the larvae with a needle (to mimic a fish rubbing against it) or allows the mussel to release them. Placed into tanks with their host fish, the larvae will attach to the fish before dropping off two to four weeks later to continue feeding and growing in a series of tanks.

Now that the Anacostia mussels have grown successfully in their protective baskets at eight sites along the river, the organization will test their ability to survive in wetlands and on the river bottom. Volunteers on Sept. 30 tossed hundreds of the adolescent mussels into semi-protected portions of Kenilworth Marsh, where Montero said wild mussels have been found before, "so we know it's good habitat."

By the end of October, Montero said, about 8,700 mussels would be spread to new locations in the river.

Sites were chosen to avoid areas where dredging might take place in the future as part of the ongoing work to remove the toxic legacy that industry left along the river bottom. The District intends to release by the end of the year a plan for initial steps to clean up contaminated sediment.

Foster said his organization is interested in the mussels' ability to remove not only nutrient pollution but also contaminants such PCBs and microplastics from the water column.

If a few thousand mussels can help clean millions of gallons of Anacostia water, he said, imagine what a few million could do.

Rare Chesapeake logperch get first release into Susquehanna stream

≈ Scientists hope the restocking effort will help the struggling species avoid becoming endangered

By Ad Crable

Just a few miles from where they were first discovered in 1842, about 100 globally rare Chesapeake logperch, raised in captivity, were released with great fanfare Sept. 27 into a tributary of the Susquehanna River in Lancaster County, PA.

A phalanx of government officials and members of conservation groups, all holding cameras, stood by in waders and rolled-up pants as the 1.5-inch fingerlings were eased into the sun-dappled riffles from oxygenated plastic bags and sent on their way.

The day before, biologists had taken steps to give the fish their best chance of survival: They gently electro-shocked the water to raise other fish to the surface and captured 15 species that might compete with — or eat — the new releases. The species of concern were relocated to the mainstem of the river, said Doug Fischer, a biologist with the Pennsylvania Fish and Boat Commission.

It was a milestone just one year into a four-year project to reintroduce the tiny member of the perch family to a handful of Susquehanna tributaries in southern Pennsylvania. The hope is to keep the fish off the federal endangered species list.

So far, the project is going swimmingly. From 28 fish captured in March from three Pennsylvania streams just north of the Maryland line, about 1,500 fingerlings were raised in propagation tanks in Tennessee and at Penn State University, along with sand and pebbles from their home streams.

About 800 of them were stocked over two days in September into Chiques Creek, just a few miles from where botanist Samuel S. Haldeman discovered the logperch species in 1842. The fish disappeared from the creek long ago, probably the result of a combination of dams, which block their spawning runs, and pollution.

Haldeman reported his findings and described the fish's zebralike dark bars to the nation's nascent scientific community. But the fish were mistakenly lumped in with other logperch darters. Then, in 2008, DNA testing proved that Haldeman's fish was a separate species that only lived in the mainstem of the lower Susquehanna in Maryland and Pennsylvania and its tributaries, as well as the lower Potomac River drainage in Virginia. As such, it earned a new name: the Chesapeake logperch.

Doug Fischer of the Pennsylvania Fish and Boat Commission holds a container of fingerling Chesapeake logperch shortly before their release into Chiques Creek, a Susquehanna River tributary. (Dave Harp)

Biologists, government officials and members of conservation groups were on hand for the logperch reintroduction, part of an effort to keep the fish off the federal endangered species list. (Dave Harp)

None have been found in the Potomac Basin since 1938. But they were found in recent years in a handful of Susquehanna tributaries in Pennsylvania and Maryland.

The discovery set off a save-the-Chesapeake logperch effort with partners that include the state fishery agencies in Pennsylvania and Maryland, U.S. Fish and Wildlife Service, Pennsylvania Biological Survey, Pennsylvania Wild Resource Conservation Fund, Susquehanna River Basin Commission and others.

Adult logperch captured from three Lancaster County streams were sent to a rearing facility in Knoxville, TN, run by Conservation Fisheries, Inc., a nonprofit dedicated to propagating nongame fish, many of them imperiled species. The fish reproduced better than anyone had hoped. Later, the young were transported to Penn State to fatten up and be close to stocking sites.

This fall, project managers have begun returning Chesapeake logperch to native streams from which they had long vanished. The fish were tested to make sure they were not carrying any diseases or parasites.

Releases will be into small tributaries instead of the river because scientists said they believed the fish could find each other more easily there than in large rivers.

Also, by releasing the young logperch in Chiques Creek, scientists hope that the fish will imprint on the creek and return in another two years or so when they are ready to spawn. To find out, the little logperch are fitted with color-coded tags so they can be identified later as part of the group released into Chiques.

"I'm very excited about it," said Jay Stauffer, a professor of ichthyology at Penn State University. "We have every reason to believe they will reproduce and this project will be a success." Stauffer first caught Chesapeake logperch as a teen doing volunteer work in 1969. At the time, he had no idea he was handling a rare fish and would later be involved in the effort to bring them back.

The team will be working for another three years to propagate logperch and reintroduce them into perhaps three more home waters devoid of the species. To begin a new round of propagation, they have already captured about 50 adult logperch in a different Lancaster County stream and in another stream across the Susquehanna in York County.

They'll also be monitoring the activities of released fish.

One sign of success will be finding the released, tagged fish later swimming as adults in the Susquehanna. That will be an elusive search, but scientists will use scuba divers, underwater drones and low dosage electric nets to aid their quest.

VA wants to boost its environmental agency, but will it get the money?

≈ Report suggests state will need to more than merely restore cut DEQ's lost resources

By Whitney Pipkin

Ralph Northam campaigned for Virginia's highest office on his Chesapeake Bay roots, and he seemed to be making good on those promises when he made reforming the state's environmental agency his sixth order of business last year.

A new report details what the state's Department of Environmental Quality needs to fulfill its mission, though it will face some financial hurdles to be enacted. Overseen by Secretary of Natural Resources Matthew Strickler, the report suggests that restoring the agency's budget and staff. Since 2001, DEQ's general fund appropriations have been reduced by $46 million, and 74 positions have been lost.

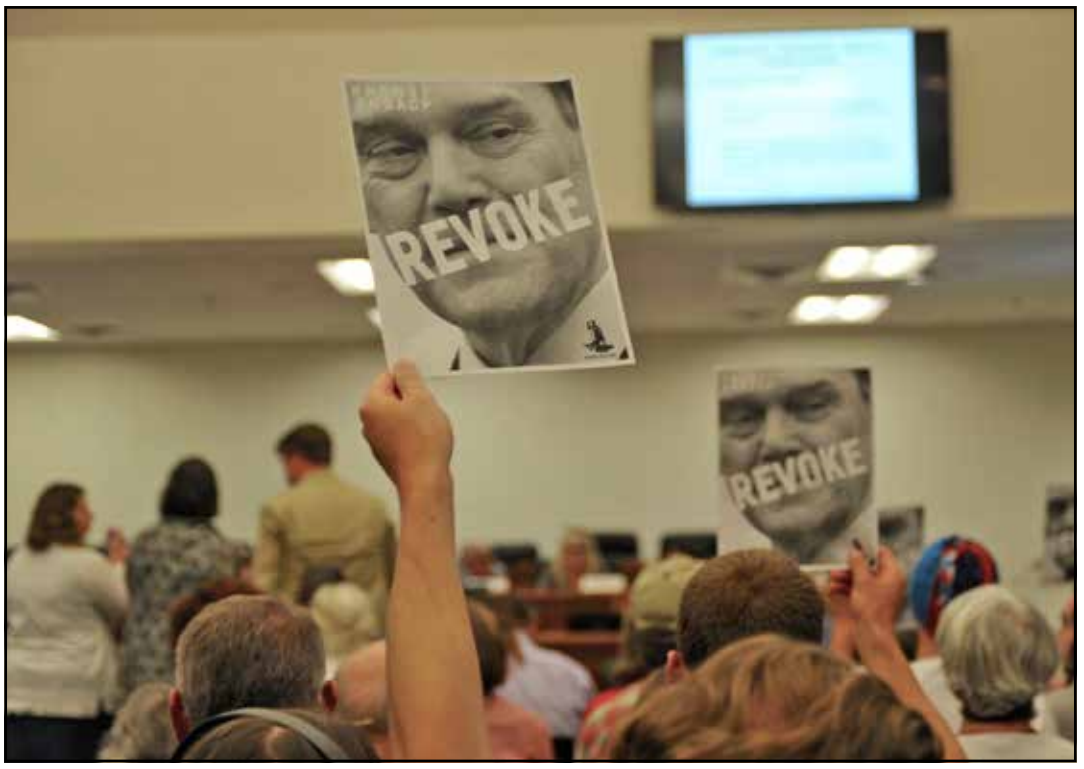
The 14-page report states that its recommendations "will require identifying additional resources and authorities for the agency." The need for both money and additional authority — likely to be reiterated in Northam's proposed budget due in mid-December — will be subject to the general assembly's approval in early 2020.

"I think this report really comes down to funding," said Mary Rafferty, executive director of the Virginia Conservation Network, which partners with more than 100 environmental organizations in the state.

Leading up to the governor's order, a 2017 report had revealed that Virginia ranked near the bottom among states for the percentage of its annual budget dedicated to protecting and enhancing natural resources. Northam said in 2018 that he wanted to nearly quadruple the state's natural resources budget, which includes the environmental agency, from less than 1% of the general fund to at least 2%.

A decrease in regular contributions from the state's general fund is not the only problem. Permit fees and penalties, which are often set in state code, have not been raised in recent years despite the increasingly complex tasks and growing workload that DEQ must process for development projects. The report suggests both factors be revisited and legislation be passed that would allow permit fees and penalties to keep up with inflation and cover the costs incurred by the agency needing to take enforcement action.

Virginia*forever*, an organization encompassing both business leaders and environmental organizations, didn't balk at the report's recommendations. Instead, the group agreed with the need for more natural resources



Citizens attending a meeting of Virginia's State Water Control Board in August 2018 waved signs asking for pipeline permits to be revoked. (Whitney Pipkin)

funding in its five-year funding plan for the state, released in July. Jeremy Slayton, a spokesman for Dominion Energy, a utility company whose energy-generating facilities are regulated by DEQ, agreed with the organization's conclusion that "additional agency funding is necessary."

The general assembly didn't follow the recommendations of the group's last plan, but this is the first year the group has specifically asked for increased funding for agencies like DEQ.

"There is widespread recognition that the agencies have been starved and can't accomplish what they need to do," said Peggy Sanner, the Chesapeake Bay Foundation's Virginia assistant director and senior attorney and a member of the group.

> *"Without additional resources," the report states, "the additional progress envisioned by [the governor's order] will not be possible."*

Last year, the governor got less than 35% of a $2.5-million "immediate" infusion that he requested for DEQ, including funds to support permitting and monitoring and to upgrade the agency's website.

"Without additional resources," the report states, "the additional progress envisioned by [the governor's order] will not be possible."

In recent years, DEQ has been the subject of increased public scrutiny over its approval of permits for two major natural gas pipeline projects crossing the state. At public meetings about the pipeline permits, residents who lived near construction expressed dismay at a perceived lack of oversight while agency officials said they did not have the staff to fully monitor the project while it was under way.

Both of the pipeline projects are currently on hold as the courts consider challenges to key federal permits.

Strickler pointed to two projects that were referred to the Virginia Attorney General for litigation last year as evidence of DEQ's willingness to use more enforcement action against environmental violators.

"DEQ has to walk a fine line if they're going to go after someone who's an egregious violator," Strickler said. "If they put a big penalty on the table, the other party might not consent… the [Attorney General's] Office has a lot more tools in their toolbox to hold people accountable under the law."

Attorney General Mark Herring ended up suing the Mountain Valley Pipeline project, which DEQ referred to his office, after the project racked up hundreds of sediment control violations. DEQ referred similar water quality violations to the Attorney General's Office over an unpermitted clearing at Fones Cliffs on the Rappahannock River, which resulted in steep fines. The company behind that project has since filed for bankruptcy.

CBF's Sanner said she had hoped the report would go a bit further to "articulate the protocol" for when the agency would turn cases over to the attorney general for enforcement. For now, Strickler said the relationship between the two parties has worked well and is one that "will continue to grow into the future."

Evaluating the impacts of federal rollbacks to environmental laws — and whether state programs would need to step into the gap — was one of three main tasks the governor asked the report to address. He also asked the report to identify any critical or time-sensitive updates to regulations and to work with stakeholders to understand how the agency could improve its communications with the public, particularly with underserved and lower-income residents.

For Rafferty, the report's assessment of state laws in the context of federal rollbacks was one of its most important elements.

"Right now, given where the rollbacks are happening at the Trump administration, it is really good to see the Northam administration step up and want to be a backstop to some of the worst rollbacks we've ever seen," she said.

The state already has enacted coal ash disposal requirements that are stricter than the federal requirements, for example, and the General Assembly is likely to again consider linking up with other states in their efforts to reduce carbon pollution by joining the Regional Greenhouse Gas Initiative. An off-year election in November also could change the makeup of the General Assembly just before Northam releases his budget proposal in December.

The report, Rafferty said, "is an incredibly important step in this process, but it still is just a report. It needs funding and resources in order to get some of these important initiatives off the ground."

Supreme Court will hear Atlantic Coast Pipeline case

≈ Lower court ruled Forest Service did not have authority to grant permit for pipeline to cross Appalachian Trail

By Whitney Pipkin

The U.S. Supreme Court said in early October that it plans to revisit a lower court's ruling that forced Virginia's largest electric utility to halt construction on a $7.5 billion natural gas pipeline in the southwest corner of the Chesapeake Bay watershed.

The project's backer, Dominion Energy, petitioned the court to consider the case after the Fourth Circuit Court of Appeals in late 2018 vacated a permit from the U.S. Forest Service. The permit would have allowed pipeline construction to cross the Appalachian Trail and 21 miles of national forest lands. It is one of seven federal permits related to the project vacated by the courts, resulting in a construction stoppage dating to late 2018.

"The Supreme Court's acceptance of our petition is a very encouraging sign and provides a clear path forward to resolve this important issue," Dominion spokesman Aaron Ruby said. "The law and the facts are on our side, and we're supported by a broad coalition of stakeholders."

A Virginia-based group of environmental and historic preservation groups represented by the Charlottesville-based Southern Environmental Law Center opposes the permit. A lawyer from SELC said the groups would continue to defend the lower court's decision.

Greg Buppert, an SELC attorney, said the Supreme Court's decision to take up the case "does not mean that Dominion has won this issue." He continued, "At this point, five years into this project, Dominion still doesn't know the route for its pipeline."

Environmental groups have questioned the government's decision to grant Dominion permission to lay the pipeline across federal lands, streams and habitats known to be frequented by endangered species. Judges have sent several permits back to the federal agencies that issued them, asking them to revisit their criteria and, in some cases, consider an alternative to the proposed route.

The Atlantic Coast Pipeline in West Virginia in 2018. Construction on the pipeline has been halted since December as judges have revoked or questioned key federal permits for the project. The fate of one permit will be decided by the U.S. Supreme Court. (Pipeline Compliance Surveillance Initiative)

In July, the same Fourth Circuit Court of Appeals overturned a U.S. Fish and Wildlife Service permit that allowed the Atlantic Coast Pipeline to impact endangered species. At the time, Dominion predicted that the revocation would not impact the project's cost nor its timeline for completion by 2021.

Environmental advocates argue that several federal permits were initially issued in haste under political pressure from Dominion E`nergy, leaving them vulnerable to legal challenges. In a 50-page opinion accompanying the endangered species permit decision, the court seemed to agree.

"In fast-tracking its decisions, the agency appears to have lost sight of its mandate under the [Endangered Species Act]: 'to protect and conserve endangered and threatened species and their habitats,' " Chief Judge Roger L. Gregory wrote in the opinion.

Dominion officials contend the project is necessary, pointing to growing demand for natural gas-based energy along the proposed pipeline's route. They are confident, too, of their case before the Supreme Court, which hinges on whether the Forest Service has the authority to issue a permit for the pipeline to be built beneath the Appalachian National Scenic Trail with the help of horizontal drilling technology that would keep construction away from the trail itself.

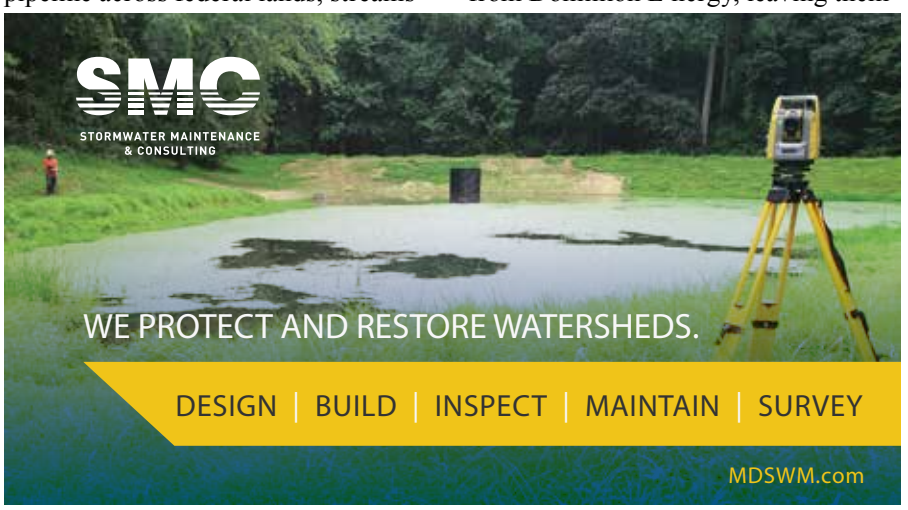
"More than 50 other pipelines cross underneath the Appalachian Trail without disturbing its public use," Dominion's statement said, adding that the pipeline would be installed more than 600 feet below the trail's surface and more than a half-mile from each side of the trail. "The public interest requires a clear process for the issuance and renewal of permits for such pipelines, and other essential infrastructure."

The Supreme Court has not yet scheduled when it will hear the case, but attorneys said the hearing would likely take place in the spring of 2020 with a decision some time that summer.

The 605-mile-long natural gas pipeline is one of two contentious pipeline projects under way in parts of West Virginia and Virginia. Virginia's Attorney General Mark Herring and the state Department of Environmental Quality sued the other project, the Mountain Valley Pipeline, in late 2018 over more than 300 environmental violations, mostly related to improper erosion control and stormwater management after construction began during a soggy year.

The Supreme Court declined to hear a different pipeline case over the use of a "quick take" type of eminent domain by backers of the Mountain Valley Pipeline. Landowners in the path of that 300-mile-long pipeline through West Virginia and Virginia contended that the project should not have been able to begin construction on their properties without first paying them "just compensation," but the high court will not review their case.

Both projects' paths cut across forested, sometimes steep, terrain and crossed streams in Virginia more than 1,000 times, reports noted.



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Is air cleaner on other side of the block? Museum, residents to test theory

≈ Richmond institution, city volunteers to monitor air pollution in urban neighborhoods

By Whitney Pipkin

Summer temperatures in Richmond can be 16 degrees hotter in a downtown ward than in a wealthy, tree-lined neighborhood five miles away. But the citizen scientists who found that out in 2017 now hope to answer a new question: Does the quality of air that citizens breathe also depend on their ZIP codes?

The project, led by the Science Museum of Virginia in Richmond, aims to again harness the data-collection efforts of volunteers to paint a more accurate picture of the air around them and the ways urban development and climate change could be altering it.

"It's amazing how much you can learn from a data set that the people who live in [the area] generate," said Jeremy Hoffman, chief scientist at the museum.

And there is still a lot to learn about air quality in the city.

The Virginia Department of Environmental Quality has been measuring ozone pollution outside of Richmond at one of 40 stations in the state since the early 1970s. But those stations, which once focused on industrial pollutants outside the city, are far away from the capital's urban core, where air quality can vary widely.

And while industrial pollution controls have lowered harmful emissions in some areas, a movement of residents into the city could be increasing air pollution elsewhere. Studies have shown that the factors that make parts of the city hotter — such as more paved surfaces, more cars and fewer trees — can worsen air quality, too.

"You can't surmise that it's the same on every single block," Hoffman said. "I think that's where our study will be useful: identifying places where people are disproportionately exposed to air pollution, so we can make informed decisions."

The data about city heat and air quality will eventually be projected as a map-based display on a large wall inside the museum as part of a new exhibit. And — if the use of the museum's urban heat island data is any indication — it will also be used to inform decision makers and help reduce temperatures and air pollution in the city's hotspots.

So far, the heat data has spawned a volunteer group called Throwing Shade RVA, run by Groundwork RVA, which plants trees and designs shade structures to lower the temperature in densely urban areas. The data from both the heat and air quality projects also will play a role in the city's climate resilience plan, RVAgreen 2050, which strives to reduce inequitable impacts.

Jeremy Hoffman, chief scientist at the Science Museum of Virginia in Richmond, said, "It's amazing how much you can learn from a data set that the people who live in [the area] generate." (Whitney Pipkin)

Alicia Zatcoff, Richmond's sustainability manager, said she's glad to see another project "that enables residents who are most affected by climate change impacts to participate in citizen science projects."

A $250,000 grant from the federal Institute of Museum and Library Services will make the air-testing project possible, putting 30 air sensors into volunteers' hands and installing another 30 around the city. Data collection will begin in the spring and results will be disseminated throughout the three-year project. The money also will support the data-projection exhibit and fund a full-time staffer to spearhead the monitoring work.

Museum officials say the funds will help them continue to interpret the impact of a warming climate on Richmond residents.

"Our personal health is intimately linked to the health of the environment," said the museum's chief wonder officer Richard Conti. He added that the funds help the museum "explore the backyard impacts of global climate change" and help residents "build more resilient communities."

Hoffman, who came to the museum in 2016 from Oregon, got the idea to measure temperatures in Richmond from a professor of urban studies and planning at Portland State University, Vivek Shandas. The professor's data collection in the West Coast city has shown a correlation between lower-income neighborhoods and higher temperatures. The urban heat island, he found, was more like several islands where temperature could differ from block to block.

But, working at a museum whose mission is to connect people to science, Hoffman wasn't interested in conducting the study entirely by himself. The museum worked with Groundwork RVA, a nonprofit that engages young people in environmental issues, to enlist nearly 40 citizen scientists in the effort.

"The results of that study have kind of elevated the museum's place in the city's discourse about the environment," Hoffman said, "because we enabled residents of the city to discover something for themselves that was also useful to the city."

Baltimore and the District of Columbia conducted their own heat studies in 2018, and 10 more cities followed suit this summer with the help of grants from the National Oceanic and Atmospheric Administration.

The air quality monitoring will take place in neighborhoods close to the museum. "We thought, 'Why not start in our backyard?'" explained Jennifer Guild, the museum's manager of communications.

The surrounding area includes a range of neighborhoods that represent some of the block-by-block diversity across Richmond. Across Broad Street, which passes the front of the museum, is the city's sought-after Fan District neighborhood, with shaded streets and historic homes that sold for an average of $456,000 in September, according to Redfin, a real estate brokerage.

And just northwest of the museum is Scott's Addition, an industrial-turned-urban enclave that has added 3,500 residents over the last seven years, according to its business association. The average house there sold for $280,000 last month, according to Redfin. Redeveloped to include additional housing and more than a dozen breweries, the *Richmond Times-Dispatch* called the neighborhood a "magnet" for millennials.

But all of those low-lying buildings and brick-and-asphalt surfaces make this neighborhood one of the city's hottest. Other studies indicate those same factors could make the air quality worse there, but Hoffman says he's keeping an "open mind."

"My favorite way to frame studies like ours is under the idea that there's no difference between one place and another," he said. "If we walk into it thinking Scott's Addition is going to have poorer air quality than everywhere else, then we're not really testing something. We're seeking something."

The stationary sensors the museum will be using can record various sizes of particulate matter in the air, from ash and soot to dust and pollen. The handheld sensors go a bit further by also recording the presence of volatile organic compounds. That includes nitrogen dioxide, a precursor to ozone that doesn't always turn into ozone — and, therefore, wouldn't be detected by some tests.

But nitrogen dioxide has increasingly been linked to environmental health hazards, such as airway inflammation and reduced lung function, according to the American Lung Association. Poor air quality, overall, can exacerbate allergy symptoms and asthma, inhibit lung function and contribute to diseases such as bronchitis.

Some of the particulates that are a concern for public health can also be a concern for local water quality when they fall onto paved surfaces and are washed into the nearest stream.

"It's all kind of tied together," Hoffman said. "So by understanding air quality, you can actually do a lot to better understand the health of the whole environmental system."

To aid cleanup effort, study looks at how toxic PFAS move through soil

≈ Found in everything from plastic to fire-fighting foam, complex chemicals linked to multiple health risks

By Timothy B. Wheeler

Brian Shedd has been spending time this year in a musty old brick building on Baltimore's waterfront, where he's hoping to unlock the secrets of a troublesome family of toxic chemicals contaminating water supplies across the United States.

Shedd, a geologist with the U.S. Army Corps of Engineers Baltimore District, set up a laboratory in the 19th century structure, which once served as a guardhouse and ordnance storehouse on the grounds of Fort McHenry, the historic harbor fortress that played a starring role in the War of 1812.

There, in a small compound just outside the walls of the national historic monument, the Corps' Baltimore District docks a small fleet of vessels used to survey shipping channels and clean up floating debris, among other tasks.

For Shedd, it offered a great location for studying per– and poly-fluoroalkyl substances, known as PFAS. That's because it was built long before the 1950s, when the chemicals began being manufactured for use in a host of consumer and industrial products. But, because PFAS have turned up practically everywhere — including in drinking water, foods and people's bodies — they tested the room and all materials brought in to be sure they were free of contamination.

Brian Shedd, a geologist with the Baltimore District of the U.S. Army Corps of Engineers, checks a pump used to control the flow of water through the aquifer mockup set up at a lab in an old guardhouse and ordnance storehouse by Fort McHenry on Baltimore's harbor. The scale model, used to test the flow of contaminants through soil and groundwater, is a shallow tank filled with clean, sandy soil from an Army installation in New York, with a grid of monitoring wells inserted to track and sample liquids as they move through it. (Timothy B. Wheeler)

PFAS have been particularly problematic for the U.S. Defense Department, because the chemicals are in the fire-fighting foam that's been used for decades by the armed services. Many of the more than 600 sites nationwide — including at least 18 in the Chesapeake Bay watershed — where PFAS compounds have been detected in groundwater are on or near military bases.

Exposure to PFAS may affect fetal and child development, including changes in growth, learning and behavior, according to the U.S. Agency for Toxic Substances and Disease Registry. They may also lower fertility and interfere with natural hormones, raise cholesterol, affect the immune system and even increase cancer risk.

At the request of dozens of members of Congress, the Pentagon's inspector general has agreed to review the military's history of PFAS use, how it handled the risks of exposing service members and their families and what is being done now to assess and resolve the contamination. That report could be ready by early next year.

Though the Pentagon has taken steps to reduce its use in recent years, the PFAS-laden "aqueous film-forming foam" had long been sprayed liberally during training exercises or while suppressing actual blazes.

Shedd, working in collaboration with researchers from the U.S. Geological Survey and University of Maryland, Baltimore County, is trying to better understand how PFAS compounds move through and linger in the soil once they soak into the ground. The hope, he explained, is to help the military, industry and affected communities figure out how to contain and clean up the contamination, which so far is resisting easy solutions.

"I think there's a lot of opportunities here for us to refine the process of investigation and remediation," Shedd said.

The DOD Strategic Environmental Research and Development program is supporting the study with a grant of nearly $200,000. It's just one piece of a wide-ranging research effort by military and civilian experts to learn as much as possible, as quickly as possible, about the many PFAS chemicals in use — estimated at anywhere from 3,000 to 5,000 — which do not all act alike.

Many of the PFAS chemicals are resistant to water and oil – which is what made them ideal for suppressing fuel fires at military bases and airfields. Nevertheless, they've migrated via groundwater from sites where foam was sprayed and soaked into the ground.

"The PFAS compounds are very complex, and understanding their behavior in the environment is also very complex," Shedd said. "It's very difficult to unpack all that complexity."

Shedd said he hopes this research can get a handle on how the contaminants interact with the soil and groundwater — how quickly they move and how much lingers.

Inside the old building, he built a scale model of an aquifer in a tank measuring roughly 8 x 6 feet. He filled it with sandy soil from Fort Drum, an Army installation in New York, which was tested to be free of contamination. Then he pumped water through it to simulate the movement of groundwater in the environment. To track the subsurface flow, he installed a grid of tiny monitoring wells throughout the tank.

Shedd first tested his model aquifer by injecting a water-soluble tracer chemical to see where and how quickly it spread through the tank. Then he injected a mixture of PFAS compounds.

He then installed a system to sample the mock groundwater as it moved through the tank, pumping it to a set of tubes, one for each monitoring well. The collected liquid samples went to be analyzed at the laboratory of Lee Blaney, associate professor and environmental engineer at the University of Maryland, Baltimore County.

Blaney, who specializes in studying contaminants, is set up to analyze PFAS to the specifications of the federal government. He uses two sophisticated instruments to identify and measure the ingredients of complex chemical mixtures down to minute levels.

PFAS compounds are "very hard to work with," Blaney said. Because they're generally present at very low levels in water samples, he noted, "A little bit of contamination can throw off measurements."

For that reason, rigorous precautions have to be taken to avoid cross-contamination of the water samples. When working with PFAS, labs must avoid using plastic beakers, tubing, vials and other often-standard equipment that might have anti-stick coatings that contain PFAS. Researchers must triple-wash their clothing and avoid wearing any PFAS-treated stain– or water-repellent fabrics. No sticky notes allowed — they may harbor PFAS. They shouldn't apply sunscreen or insect repellent for the same reason, and eating in the lab is prohibited, because food wrappers may also contain PFAS.

The analysis of the samples takes time. Shedd said he hopes to have results later this fall. But as he was running the first round of tests, he said researchers noticed that more of the PFAS molecules injected into the model aquifer stayed put in the tank than they'd expected. The next round of testing aimed to find out why.

The results may help clarify which PFAS compounds or mixtures stick to the soil and which ones move more readily in groundwater. Shedd said what he and colleagues learn will be shared publicly so it can inform future cleanup efforts.

"There's a lot of developing science relating to [individual chemicals]," Shedd said, "But in terms of complex mixtures, how all that works, that's not as well understood." And since these compounds rarely exist in isolation, he added, "That's part of the challenge the research community and environmental practitioners are up against right now."

Coalition to think beyond state borders to offset Conowingo flows

Group charged with finding new actions, sites and funding to reduce nutrient pollution

By Karl Blankenship

Here's one of the toughest jobs in the Chesapeake Bay cleanup:

- Write and enact a plan to eliminate millions of pounds of nutrient pollution washing into waterways.
- Do it without duplicating the pollution reduction plans that states will be using to meet their own goals, which typically contain the cheapest and potentially most effective options.
- Oh, and come up with a way to pay for it, too.

Surprisingly, people have signed up for this seemingly impossible job. A coalition of nonprofits is developing a plan to reduce nutrient pollution to the Upper Bay to offset the impact of the Conowingo Dam — and to pay for it.

They hope to identify highly effective ways to reduce agricultural and stormwater runoff, which carries nutrients into waterways, and use them in places not already being targeted by states for Bay cleanup efforts. They also aim to tap new funding sources, including the private sector, to help pay for the plan.

"It is certainly a challenge," said Byran Seipp, a watershed manager with the Center for Watershed Protection who is helping to coordinate the effort. "There is no doubt about that. It is something people have been wrestling with for quite a long time."

The 94-foot-high Conowingo Dam, located just 10 miles up the Susquehanna River from the Chesapeake, has been casting a shadow over Bay cleanup efforts for years. Scientists had long known that once its 14-mile-long reservoir was filled, it would no long trap pollutants and they would begin to flow downstream.

But that day of reckoning was thought to be far in the future — at least past the 2025 Bay cleanup goal. As a result, impacts from the filled reservoir were not factored in when the U.S. Environmental Protection Agency assigned nutrient reduction goals to states in 2010.

Recent studies, though, determined that the reservoir has filled and is spilling more nutrients — nitrogen and phosphorus — into the Chesapeake than previously thought.

Computer models estimate that an additional 6 million pounds of nitrogen and 260,000 pounds of phosphorus would need to be controlled to make up for the dam's lost trapping capacity. That would require roughly 15% more nutrient reductions beyond the stated 2025 cleanup goals — more than some states in the region have to accomplish individually.

With states already struggling to meet those goals, the state-federal Bay Program partnership last year decided to seek proposals from outside parties to develop a strategy to make up that gap.

A heron perches on a rock in the Susquehanna River, away from the turbulent flow from the Conowingo Dam. It is hoped that the newly formed Conowingo coalition will bring new insights that help tackle problems where progress has been elusive. (Dave Harp)

Proposals were collected earlier this year, and the EPA recently awarded grants totaling nearly $600,000 to the Center for Watershed Protection, Chesapeake Bay Trust and Chesapeake Conservancy to tackle the job. They, in turn, will enlist the support of nearly a dozen other nonprofits, university partners and private sector consultants.

They'll be working in partnership with a steering committee of state and federal representatives to coordinate the effort and ensure that their plan does not rely on practices states are counting on to meet their own cleanup goals.

The hope is that the Conowingo group will bring new insights that help tackle problems where progress has been elusive.

While the region has succeeded in reducing nutrient pollution from wastewater treatment plants, which can be addressed through regulation and technology, it has struggled to reduce nutrient-laden runoff from farms and developed lands. Progress remains far off the pace required to meet Bay water quality goals.

The Conowingo team will look to new high tech tools, new ideas and new financing strategies to accelerate progress.

"There is a real opportunity to create a sort of case study of how these states can come together to solve these basinwide issues in a cost-effective way," Seipp said.

One of the first tasks is determining, geographically, the best places for making additional nutrient reductions. While the dam is located on the Susquehanna, reductions from nearby areas of Maryland's Eastern and Western shores would have similar impacts on Bay water quality. The group is working with computer modelers to more precisely identify those areas.

The ability to explore that type of question is one reason that this plan will be unique. Unlike states, which are constrained to reducing nutrients within their borders, the Conowingo team can make reductions across jurisdictional borders.

Once those regions are identified, the team will use high-resolution satellite data and other tools to identify more precisely specific sites where runoff control practices will have the greatest benefit to water quality.

Many state and federal cost-share programs tend to rely on farmers signing up on their own to participate. By identifying specific sites, or groups of farms, they envision using more proactive outreach to targeted groups of farmers and other landowners, based on priority locations.

"It is not working an acre here and acre there," said Jeff Allenby, director of conservation technology with the Chesapeake Conservancy. "You can actually put together some significant initiatives that achieve larger results than they would if you were just working project by project."

The team also will explore barriers, whether financial, technical or cultural, to different nutrient reduction techniques. Some stream restorations, for example, meet resistance from landowners or local governments because the work requires more land than they are willing to make available or can acquire. The new tools can help identify opportunities for such projects that require less land.

Allenby said the group also might identify effective but underused manure treatment technologies to try to figure out how to boost their adoption.

Ultimately, though, the effort will require more money.

Some could come from Exelon, the utility that owns the dam. The state of Maryland wants Exelon to pay tens of millions of dollars a year as a condition of relicensing the facility, but Exelon has challenged that in court.

Regardless of that outcome, the Conowingo plan will require more money and creative ways to find it. A group of financial advisers will be recommending ideas, including private sector involvement.

One possibility is to view some agricultural efforts as infrastructure projects, and fund them through bonds. That would bring money to address problems more quickly, but allow those improvements to be paid off over time.

Also, the plan will likely involve the use of nutrient "trading," and other market-based tools that encourage private investors to install nutrient control practices for credits that can be sold to jurisdictions or businesses needing to offset pollution impacts in other places. And that needs to happen across state borders, said Dan Nees of the University of Maryland Center for Global Sustainability.

"Somehow, we have to agree that geopolitical boundaries are not going to work when it comes to finance," Nees said. "There needs to be an opportunity for revenue to flow back and forth where it has the greatest economic value, and that is through markets and water quality trading."

Such techniques have been talked about for years in the Bay region, but have never had widespread adoption. Because of its cross-border approach, Nees said the Conowingo plan is ideally suited to pilot such concepts.

"We've been talking about this for too long," Nees said. "We have to actually do it."

A draft strategy is expected by March, with a final plan in June.

There is one key difference between the Conowingo cleanup plan and those written by the states. The EPA can take action against the states if their plans fall short, because they are legally required to meet Bay water quality standards. There's no such legal requirement for the groups working on the Conowingo plan.

"We are working toward being able to devise a plan and have the funding to implement it and the tools to track it," Seipp said. "But if that doesn't happen, the people who ultimately hold the regulatory responsibility is the states."

This grilling oyster quiz is stuffed with bivalve brain teasers

Many people will be stuffing their stomachs with oyster dressing this Thanksgiving. Here is an oyster quiz to stuff your brain. *Answers are on page 37.*

1. According to the fossil record, how long have oysters been around?
A. About 120 million years
B. About 180 million years
C. About 240 million years
D. About 300 million years

2. When/where did someone first create a hydraulic system to support "oyster farming"?
A. Ancient China
B. Roman Empire
C. Medieval Europe
D. Mediterranean Renaissance

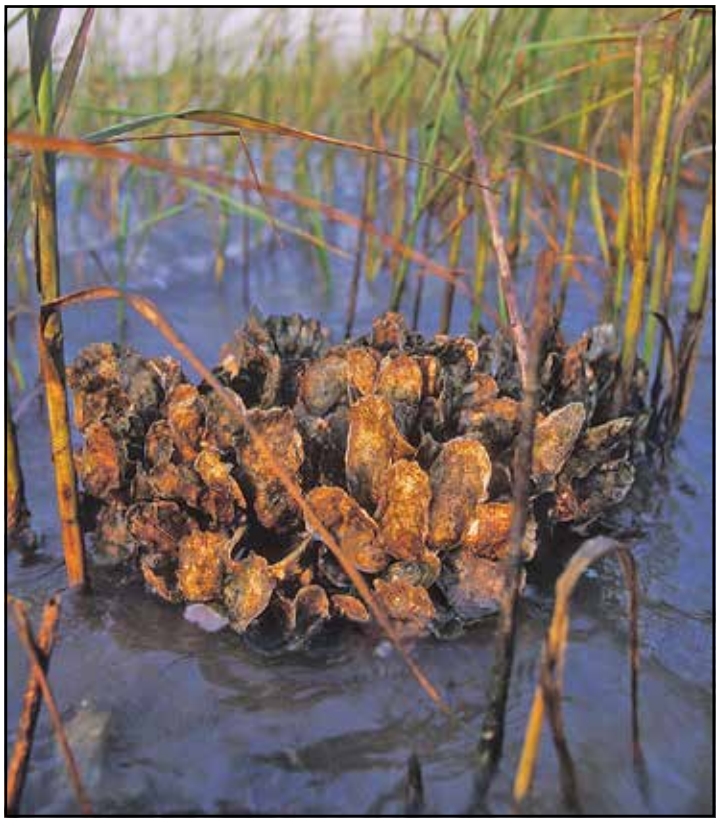
3. Capt. John Smith wrote in the early 1600s that Chesapeake oysters "lay as thick as stones." Due to overharvesting, habitat loss and pollution, their population has plummeted. Today's Bay oyster population is estimated to be what percent of the population in Smith's time?
A. 1%
B. 3%
C. 7%
D. 10%

4. An oyster can grow up to 14 inches in length. As a rule, an oyster grows how many inches in a year?
A. 1
B. 2
C. 3
D. 4

5. Oysters grow faster in:
A. High salinity water
C. Low salinity water
D. Fresh water
E. None of the above; they grow equally in all water.

6. As a rule, the top shell of a wild oyster is flatter while the bottom shell is more cupped. What factor most determines the shape of an oyster?
A. The salinity of the water
B. The mineral content of the water
C. The number of other oysters crowded around it
D. The water temperature

7. Not all oysters taste the same. What is/are the greatest factors in an oyster's flavor?
A. The oyster's species
B. The amount of salt, nutrients and acidity of the water where the oyster lives
C. The age and size of the oyster
D. The shape of the oyster



An oyster reef at low tide (Dave Harp)

8. Oysters are considered less tasty when they spawn. As a rule, when do they spawn?
A. Months with the letter "R" in them
B. Months without the letter "R" in them

9. Oysters suck in water, eat the phytoplankton it contains, then spit out the filtered water, cleaning the water around them. How many gallons of water can one oyster filter in a day?
A. 25
B. 50
C. 75
D. 100

10. Match these parts of an oyster with their description.

ADDUCTOR
CILIA
GILLS
MANTLE
PALPS

A. These are made of tiny hairs covered in mucus. The oyster pumps water and waterborne particles throughout this part. Then the mucus traps food particles.

B. This is the name for the tiny hairs that trap food when the oyster draws water.

C. This is the part of the oyster's mouth that sorts the particles in the mucus, keeping only the food and spitting out the rest.

D. This thin layer of tissue surrounds the oyster's body and plays a role in the development of its shell.

E. This is the muscle the oyster uses to keep its shell closed. When it is gone, it leaves a purple scar.

11. Oyster reefs can be a natural barrier against storm waves and sea level rise — reducing damage from storms by decreasing erosion and floods. How much wave energy can an oyster reef absorb?
A. Up to 32%
B. Up to 48%
C. Up to 67%
D. Up to 93%

12. Many oysters change their gender at least once in their life. Which of these is generally true?
A. Most oysters up to 1 year old are male, and most older oysters are female.
B. Most oysters up to 1 year old are female, and most older oysters are male.
C. Most oysters are male in cold months and female in warm months.
D. Most oysters are female in cold months and male in warm months.

— Kathleen A. Gaskell

Take this quiz to gather pearls of wisdom about oysters. *Answers are on page 37.*

1. The word "Chesapeake" comes from an Algonquian word thought to mean:
A. Great Shellfish Bay
B. Half Shell Heaven
C. Mother of Oysters
D. Bay of Oyster Reefs

2. Oysters are a bivalve mollusk, which means they have two hard shells made of calcium and carbon. Which of these is not a bivalve mollusk?
A. Barnacle
B. Cockle
C. Mussels
D. Scallops

3. Oyster reefs create habitat for many creatures. Which of these species are found on or near an oyster reef?
A. Anemone, barnacles, shrimp
B. Croaker, flounder, spot
C. Striped bass, menhaden, speckled trout
C. All of the above

4. The oystercatcher is known to smash oyster shells on a rock to get at the tasty creature inside. What kind of animal is an oystercatcher?
A. Bird
B. Crab
C. Mammal
D. Octopus

5. All oysters can create pearls by covering a piece of sand or other irritant in a smooth secretion to protect its soft tissues. Why don't we find pearls in Chesapeake oysters?
A. They are harvested before they form pearls.
B. They're there. We don't recognize them because Chesapeake oysters' secretion lacks the substance that creates the luster we associate with pearls.
C. Shuckers remove the pearls before serving oysters to the public.
D. The Atlantic Ocean and Chesapeake Bay lack the proper irritants to cause an oyster to form a pearl.

6. Oyster larvae prefer to attach to oyster shells to grow, but they will use other surfaces, too. Which of these have been used to create artificial oyster reefs?
A. Old toilets
B. Balls made with concrete and human cremains
C. Old subway cars
D. All of the above

7. Young oysters in the larvae stage start out mobile. Once they attach to a hard surface on which they will transform into adults, what are they called?
A. Shellies
B. Oystettes
C. Nacres
D. Spat

8. Before an oyster larvae attaches to a hard surface, it drops to the bottom and develops a light-sensitive eyespot and an appendage that helps it crawl toward a suitable surface. After it attaches, the appendage is absorbed back into the oyster. What is the name for this appendage?
A. Foot
B. Pedal
C. Slider
D. Velopper

9. What is an oyster shell without the animal inside called?
A. Box
B. Kaboom
C. Shelly
D. Slurpt

— Kathleen A. Gaskell

MYCOBACTERIA FROM PAGE 1

Vogelbein, a fish pathologist at the Virginia Institute of Marine Science.

It didn't turn out that way. Mycobacteria never snagged the attention — nor large-scale research funding — as did Pfiesteria. Nor was it associated with high-profile fish kills or considered a human health threat.

Decades later, Pfiesteria has largely vanished from discussion, and some scientists now question whether it was responsible for fish kills at all.

But the mycobacteria problem never went away — and has only gotten worse. The majority of the Bay's striped bass are infected and, by the time they are 5 years old, nearly all carry the disease. An unknown number are thought to die. "We think it is substantial," Vogelbein said.

Now, with the striped bass population in trouble, the Bay's mycobacteria problem may get another look. Striped bass numbers have been declining along the East Coast for a decade and a half, and a recent stock assessment for the Atlantic States Marine Fisheries Commission concluded that the population was being overfished.

The commission, made up of East Coast fishery managers, was poised at the end of October to impose new fishing restrictions in response.

But the assessment also raised questions about whether mycobacteria infections may be playing a bigger role in the decline than currently thought, citing studies that suggest even higher rates of mortality among striped bass from the Bay than assumed in the assessment. The study called for a better understanding of the impact the disease might be having in the Bay and coastwide, and flagged it as one of the highest research priorities.

If the disease is having a greater impact than previously thought, it could also mean any new fishing regulations would be less effective than hoped.

"There is likely an impact somewhere," said Mark Matsche, a fish health scientist with the Maryland Department of Natural Resources. "My question is, what is the severity of the impact to the population?"

An apparently healthy stripped bass, left, and a suspiciously unhealthy one will have their spleens removed and tested for mycobacteria. (Dave Harp)

A mysterious disease

Mycobacteriosis — and what it means for the Bay's most valuable recreational species — has perplexed scientists and fishery managers since it was first observed in 1997. It is a chronic wasting disease which, in aquaculture, usually results in death, but severe infections typically are not seen in wild fish populations.

Diseases affecting finfish are usually short-lived events, which sometimes result in dramatic fish kills and then disappear. In contrast, the mycobacteria infections in the Bay show no sign of relenting and are likely to take years to kill fish.

"We are not used to seeing this persistent, long-term epizootic which doesn't seem to go anywhere," Matsche said. "It is very, very different."

Further, the two types of mycobacteria causing problems in the Bay — *Mycobacterium shottsii* and *M. psuedoshottsii* — were previously unknown. They were only discovered when a researcher at VIMS accidentally left slides with tissue samples from striped bass in an incubator, and colonies of the bacteria began to grow.

No one knows why they seemed to have suddenly appeared and become a problem. In early years after the discovery, only 10–20% of striped bass in the Bay seemed to carry the infection. Today, the majority are infected, and surveys in Maryland and Virginia show that 80–90% of striped bass carry the disease by the time they are 5 years old.

Also unclear is why striped bass are so susceptible. Although the same two mycobacteria species sometimes turn up in other fish, they don't seem to have the same impact, even in closely related species like white perch.

Nor does the disease seem to be a problem outside the Bay. While there is some anecdotal evidence that infections are seen in other areas, they do not seem as widespread or severe as in the Bay, and it's unclear whether they are even the same mycobacteria species.

There is also some evidence that the disease may progress more slowly in adult fish after they leave the Chesapeake. That makes scientists suspect there may be some type of stress in the Bay that makes the condition worse — but it's unclear what that might be.

Efforts to answer such questions have lagged in recent years. Aside from some support after the initial discovery, research funding largely dried up. The striped bass population, after bottoming out in the 1980s, was thriving by the time mycobacteria infections were discovered.

"Things were so good with striped bass — management was in a great place, anglers were happy and the pressure wasn't there to deal with a crisis mode," said Robert Latour, a VIMS fisheries scientist. "It was, 'How do we enjoy this recovered fishery?' And there were many other fires for fisheries managers to put out."

Slow killer with uncertain impacts

The biggest unanswered question is the extent to which the infections are actually killing fish and impacting the striped bass population.

The disease progresses slowly, with the condition of the fish deteriorating over time. Scientists believe many of the infected fish die, but how many and how quickly are difficult to determine.

"We are not seeing thousands of fish washing up on the shoreline," said David Gauthier of Old Dominion University. "They are probably dropping out of the population a few at a time and getting eaten by crabs, so it is not highly visible. So trying to measure how much mortality there is on a population basis is really difficult."

An intensive study years ago on the Rappahannock River, in which striped bass were tagged, recaptured and examined over a period of years, concluded the mortality rate of infected fish was double that of uninfected fish.

Still, that's not the full story. It's unclear whether the disease shaves a few months, or many years, off the lifespan of an infected striped bass. If it survives long enough to reproduce, the impact of the disease on the overall population might be minimal.

On the other hand, a number of sublethal impacts could also be important. For instance, studies show that infected females tend to mature earlier and are smaller than uninfected fish. Because smaller fish produce fewer eggs than larger ones, the reproductive capacity of the population might be reduced.

Trying to figure out what that means for the overall striped bass population is further complicated because most do not spend their entire lives in the Chesapeake. They are spawned in the Bay, and the young live there for several years. Eventually, most move to the ocean until returning to spawn, though some males never leave the Bay at all.

And while the Chesapeake is thought to be the largest component of the overall coastal population — and the focal point of the disease — it's unknown just how much of the coastal stock they constitute. It's also unknown how many males stay in the Bay and how many leave.

"We feel like it is a problem within the Bay for the time that the resident population is here, but sort of casting that into the broader, full coastwide population is a little more murky because of these missing pieces of information," said VIMS' Latour.

Modeling the population

The model used in the Atlantic States Marine Fisheries Commission assessment to estimate the size of the striped bass stock lumps the entire population together. If striped bass from the Chesapeake Bay are dying at a faster rate than fish elsewhere, it has no way to precisely account for the difference.

As a result, increased mortality caused by mycobacteria is not directly factored into the stock assessment. Estimates of "natural mortality" — fish that die because of all non-fishing activities — have been adjusted over time for the entire coast, but it's not known whether they fully capture the

MYCOBACTERIA CONTINUES ON PAGE 23

Mycobacteria from page 22

impact of the disease.

Complicating the problem is that those estimates are based partly on tagging studies. Each year, biologists along the coast place tags on striped bass, asking that they be returned when those fish are caught, often years later. That helps biologists estimate the ultimate fate of fish.

But return rates for tagged fish have declined since the striped bass population crisis ended decades ago. It's not totally clear how much of that decline is caused by the loss of fish to disease and how much is from public apathy.

"We don't know how many of the fish that disappear are dying naturally, and how much is because they are caught and people are seeing them again, but just aren't telling us," said Katie Drew, the stock assessment team leader with the ASFMC.

She said the assessment's overall estimates of total striped bass mortality are probably correct because it matches what is observed in the overall population trend. But it's possible that the population model underestimates natural mortality and overestimates fishing mortality.

In either case, she said, the remedy is the same — reduce fishing pressure — because managers have no control over the disease. But if disease is responsible for a larger portion of overall mortality than assumed, and fishing causes a smaller portion, efforts to reduce the catch may have less of an impact than hoped.

"You will see some benefit in reducing fishing mortality for sure," Drew said. "But if natural mortality is a much bigger component of total mortality than we think, it won't be as big of an effect."

The commission might get better estimates in the future. It wants to move away from a stock assessment model that lumps the entire striped bass population together and toward one that separates the population by regions —allowing them to better estimate disease-related impacts on fish spawned in the Bay.

A rockfish awaits a necropsy. Its spleen will tell whether it has been infested with mycobacteria. (Dave Harp)

Trying to answer questions

In the wake of the recent stock assessment, scientists are working to fine-tune what they think they can say about the disease's impact on striped bass.

"I think people are really eager to get to the bottom of this and to try to better understand what might be causing this particular epizootic in the Bay," said Genevieve Nesslage a fisheries scientist with the University of Maryland Center for Environmental Science.

Nesslage is working with a graduate student to use disease data that the state collects each year, along with environmental and other information, to build a computer model that examines potential population-level impacts of disease-related mortality in the Bay. They also want to try to identify environmental triggers that may worsen its impact on infected fish.

Likewise, Vogelbein, Gauthier and Latour are working to analyze many hundreds of samples from striped bass collected over the last decade that have been preserved but never examined because of a lack of funding. The hope is that a larger, richer set of data will help paint a clearer picture of what's happening — at least in the Chesapeake.

Because most "deaths" are seen in computer models rather than the real world, that improved understanding will help modelers better predict disease impacts, and mortality, on the population and gain confidence in their results.

"Models are only as good as the data that go into them," Vogelbein noted.

Scientists generally believe that some stress factors are playing a significant role in making the disease impact worse.

Variables such as increased temperatures, large oxygen-starved dead zones — even increased particulates in the water — have been suggested as factors that speed the decline of infected fish. Some think changes in striped bass diet, related to changes in menhaden abundance, might have reduced their health and made them less resistant to disease.

The renewed focus might shed light on those issues.

While the disease progresses over time, that progression isn't always steady. Matsche said that some recaptured fish show relatively little change after several years, but some are considerably worse after a single season. "There are a lot of variables at play here that we don't fully understand," he said.

If those factors could be understood — and alleviated — it might open another door for management to help the fish.

Does a dead zone equal dead fish?

One prime suspect is the Bay's poor water quality. During the hot summer, striped bass seek refuge in deeper, cooler water. But if the Bay's oxygen-starved dead zone makes those areas off limits, it pushes the fish into warmer water that is more stressful — and may make them more vulnerable to disease progression.

A laboratory study several years ago by scientists at VIMS showed that when infected fish were exposed to both low dissolved oxygen and higher temperatures, they appeared fatigued and were likely less able to elude predators or pursue prey fish to eat.

Jim Gartland, an assistant research scientist at VIMS, has observed this in the wild as well. Gartland, who helps conduct a fish survey along the entire length of the Bay each year, said striped bass in midsummer heat appear especially stressed near areas of low oxygen water.

"When you are in the dead zone area, you will see them just easing along the surface sometimes," Gartland said. "And striped bass usually don't do that."

If such a correlation between environmental conditions and disease exists, it could offer both hope — and peril — for striped bass.

While there may be little that can be done about the disease itself, such work could suggest that some actions — such as accelerating nutrient reduction efforts aimed at eliminating the dead zone — might reduce disease impact on striped bass.

On the other hand, Bay water temperatures are already warming, and if that trend continues, it could stress striped bass even more and make oxygen conditions worse.

"This level of a significant pathogen in a population is kind of ominous," Gauthier said. "It is possible they are holding their own against it right now, but what is going to happen? They are already sort of at the edge of their thermal limit down here. What is going to happen in the future if the environment keeps changing?"

After two decades of wondering, scientists hope a resurgence in interest will help shed light on those questions.

An enlarged spleen is a sign of a mycobacteria infestation in striped bass. By the time they are 5 years old, 80-90% of the Bay's striped bass carry the disease. (Dave Harp)

Lucidity Information Design, LLC

This map by K. Leaverton of the CBF staff shows the diminishing of Fox Island over 25 years. Data Sources: 1994 / U.S. Geological Survey & 2019 / ESRI World Imagery

ISLAND FROM PAGE 1

Fox Island was the first of what grew to four foundation-run island centers, where adults and children learn about the estuary's ecology during multi-day stays. The immersive experience drew tens of thousands of people to Fox over the years, the foundation estimates.

The nonprofit broke the news of Fox's impending closure on its website in early October. The announcement drew an outpouring of nostalgia-tinged grief on social media.

Emily Rhode first visited Fox Island as a middle school student in the early 1990s. She tweeted that the program taught her how to pick a crab, properly skin an eel and appreciate silence.

"I fell in love with the Bay that summer and, by doing that, I found my life's work," said Rhode, now a science writer and educator based in Durham, NC. "Fox Island will always hold a sacred place in my heart. And I'm so sad that future generations will be denied the privilege of getting to know it."

Ackerman said the foundation's decision is based on safety concerns. The program has been forced to rearrange itineraries at the last minute with increasing frequency in recent years because tides or winds imperiled the facility.

Sea level rise is accelerating around the world as warmer temperatures cause ocean water to expand and glaciers to melt. It's happening even faster in and around the Bay, possibly because of regional changes in ocean currents and wind patterns, as well as a phenomenon known as land subsidence — a sinking of the Earth's crust that dates back to the last Ice Age.

Sea level rise and erosion have erased several islands that once stood in the Bay. The last of the inhabited islands without a bridge to the mainland — Tangier Island in Virginia and Smith Island in Maryland — have been transformed in recent years into real-life laboratories for adapting to climate change.

Tangier's water tower is clearly visible from Fox Island's shores, and Smith lies just over the horizon to the north. Much of what remains on Fox Island stands less than 2 feet above the surrounding water. But, unlike Fox's neighbors, no one has come to its rescue.

"We don't see this problem getting any better," Ackerman said. "It's heading in one direction."

If humans had started reducing greenhouse gas emissions sooner, the education center might have been spared, Ackerman said. Since that didn't happen, he added, its closure illustrates the kinds of heartbreaking decisions that will have to be made about coastal infrastructure in the future.

Water is the throughline of the center's story.

Decades ago, the main island bore an uncanny resemblance, when viewed from above, to a fox in midstride. The name stuck even as large chunks of its body vanished beneath the waves. Maps still refer to it as Great Fox Island, but any illusions to grandeur went out with the tide long ago.

A group of investors constructed a hunting lodge on the island in 1929 but not on dry land. Instead, they perched it on pilings a little more than 2 or 3 feet above the Chesapeake's surface. A ringlet of small islands — the Fox archipelago — sheltered it from rough seas.

After the Chesapeake Bay Foundation acquired the building, it quickly proved to be an ideal setting for teaching young people and adults alike about the Bay's unique environment, said Cindy Adams Dunn, one of the nonprofit's educators in the early 1980s.

"The wind, the tides, the weather, the wildlife — it's just right there," she said.

The facility's quirks enforce a back-to-nature ethos, according to Dunn and other current and former foundation staff members.

Rooftop solar panels provide only enough electricity for a refrigerator, radio and handful of lights. There's a composting toilet. A propane tank delivers gas to the stove and oven. Water for cooking and bathing comes from a shallow well, but drinking water is hauled in from the mainland in giant jugs.

One of the place's memorable novelties was that energy for the water pump was generated by someone pumping the pedals on a stationary bike. (The bike is no longer linked to the pump, but it remains in the kitchen to anyone seeking some impromptu exercise.)

ISLAND CONTINUES ON PAGE 25

The Fox Island education center, left, shown in 2007. An unusually high tide swamps part of Fox Island in 2004. (Photos/ Chesapeake Bay Foundation)

Island from page 24

Cell phone service is weak but available. Staff members encourage participants, especially the young, to place their phones in a bin at the beginning of their stay and retrieve them at the end.

The island experience is otherwise off the grid.

"It's nice and quiet," said Larry Laird, a plainspoken Smith Island native who pilots students around on his 40-foot, jet-drive boat named the Walter Ridder. "A good place at night to see the stars."

Laird and a small crew of fellow foundation employees tied up the boat Oct. 13 at Crisfield on Maryland's Eastern Shore for one of the last educational outings to the island. A charter bus greeted them at the marina but only after creeping through saltwater standing as much as 2 feet deep on some of the town's roads, a result of so-called "sunny day" flooding.

Such floods are forecast to happen more often in low-lying places around the Bay as seas continue to rise this century, experts say.

Into the boat's lower hull went duffel bags, rolling suitcases, blankets, fishing rods and enough provisions to last the group three days and two nights. The passengers included 13 middle and high school students, their teacher and a few adult chaperones from Halifax Area School District, a small rural area in central Pennsylvania near the Susquehanna River — the Bay's largest tributary.

Lenka Platt, an 18-year-old senior, organized the trip through the student organization she founded, the Student Environmental Action Club. She hoped the excursion would inspire her classmates to take action in their corner of the watershed to protect the Bay.

"We're looking at the environment we want to save," Platt said, standing on a pier waiting for the call to board the boat. "I'm going to be one of the last students that gets to go. It's because of our human actions that it has to close."

With all aboard, Laird slipped the boat out of Somers Cove and into Pocomoke Sound. After 30 windblown minutes, a shoebox-shaped silhouette loomed into view: the education center.

But where was Fox Island? Surely, these few scraps of salt marsh and that lonesome stretch of sandy beach couldn't be it. But they were.

"The smaller it gets, the quicker it erodes," said Jeff Varnon, the last in the line of Fox's education program managers. "There's less of it to hold together. One storm from the right direction, and the center is gone."

After unloading their gear into the center's 11 bedrooms and catching a quick briefing in the clubhouse-like living room, the students got to work.

Varnon and another foundation educator, Lucas Scott, gathered the children onto a dock along with a giant stack of multi-colored crab traps. They handed each a dead fish, an oily specimen known as menhaden, and explained its dual role as a key Bay filter-feeder and cog in the crabbing industry. Then came the messy part: shredding the fish by hand (to release the oils) and tucking the pieces into a special pouch in the trap to serve as bait.

Emily Snyder (left), 15, hands a crab pot to her sister, Evelyn, 11, on the dock at Fox Island in October. Their classmate, Lenka Platt, 18, gets ready to keep the trap moving down the line. (Jeremy Cox)

Under a slate sky, Laird brought the students back out on the boat, where each took turns hurling traps into the water, an iconic Chesapeake pastime known as crab-potting. The next day, with any luck, there would be a crab feast.

Platt said she aspires to be a biologist working on the Bay. If that happens, she will join a long list of students whose Fox Island experiences helped propel them into academia, volunteering or government leadership roles.

"It's probably something that's motivated me in my upstream work," said Adams Dunn, now the head of the Pennsylvania Department of Conservation and Natural Resources.

Once this season winds down, the foundation plans to put the property up for sale. Programming will continue, Ackerman said, but it will take place at the nonprofit's Port Isobel Island facility near Tangier. It is refurbishing some buildings on the west side of the campus to accommodate those who would have once traveled to Fox on the opposite side of Tangier Sound.

For many who spent time at Fox Island over the years, what they will miss most isn't the building, the islands or anything tangible at all. It's something they call "Fox Island Magic."

"That's something you might hear a lot about if you speak to folks who have come out and stayed here," said Varnon, who has been stationed there for two years. "It's a unique experience that Fox Island has that's hard to find elsewhere even among our other island programs. There's something about Fox that connects you to the Bay so completely. You're immersed from the moment you step off the dock to the moment you leave."

The program has been living on borrowed time. The end nearly came in September 2003 when Hurricane Isabel tore off the west side of the building and punched away half of the flooring.

The foundation wasn't ready to let it go then. It fixed the damage, and classes resumed 11 months later.

A scrapbook lying on the center's coffee table tells the story of the rebirth, one photo at a time. The last page shows the building looking like new.

At the bottom of the page, there's a triumphant message scrawled in black marker: "Open for business … the MAGIC returns."

Jeff Varnon, Fox Island's education program manager, leads a group of Pennsylvania students in a lesson about crab traps on the dock at the education center in the middle of the Chesapeake Bay. (Jeremy Cox)

Benny Dorman, 12, a sixth-grader at Halifax Area School District in Pennsylvania, rips apart a dead menhaden to release the fish's oils in preparation for using it as bait in a crab trap. (Jeremy Cox)

Arlington Woods a living monument to forests of the past

Rows of gravestones cover most of the ground at Arlington National Cemetery in Virginia. The grounds also include more than 8,600 trees representing hundreds of species and varieties, with a 12-acre patch of old growth forest known as Arlington Woods.

Story & Photos
By Timothy B. Wheeler

Cemeteries are places of remembrance. Arlington National Cemetery is perhaps the most famous, the final resting place of more than 400,000 veterans of American conflicts and their spouses.

More than 3 million people visit each year to see the gravesites, row upon row over more than 600 rolling acres across the Potomac River from Washington, DC. Many are drawn to the eternal flame at John F. Kennedy's grave or to the majestic Tomb of the Unknown Soldier.

Virtually unnoticed among all of the headstones, there's a different kind of memorial. It's a 12-acre swath of trees tucked into a steep ravine downhill from Arlington House, the one-time home of the adopted grandson of the nation's first president.

Arlington Woods is a remarkably intact descendant of the ancient forest that once blanketed much of Northern Virginia. Leaving the manicured cemetery behind to stroll among the towering oaks and hickories is to take a journey back in time, to contemplate this landscape as it was for eons. In the intervals between the whoosh of jets flying in and out of nearby Reagan National Airport, the only sounds are the whisper of wind in the trees and rustling of leaves on the ground.

"A lot of this is nature's gift. It's irreplaceable," said plant ecologist Rod Simmons as he led a walking tour of the tract on a sunny Friday in October. The woodland is an old friend to Simmons, a member of the Virginia Native Plant Society, who seems to know every tree on the tract. He's studied them, written about them and worked to save them.

This is an "old growth" patch of forest, he said, because there's no record of it ever having been logged. He pointed out how closely the trunks were bunched, further evidence that the trees had not been planted or replanted by hand.

"You'll see a lot of trees that were here long before the Civil War," he promised.

Given the history of the land that is now Arlington cemetery, it's extraordinary that these woods have survived relatively unscathed through the centuries.

They were once part of an 1,100-acre estate owned by George Washington Parke Custis, grandson of George Washington's wife Martha from her first marriage. In the early 1800s, Custis built a Greek revival mansion atop the hill, clearing enough trees to afford a commanding view of the river and the fledgling nation's capital.

While the lowlands along the river were converted to crop fields and some other areas used for pasture, most of the estate remained densely wooded. On a visit in 1824, the Marquis de Lafayette, the French general who fought with Washington in the American Revolution, reportedly remarked to Mrs. Custis, ""Cherish these forest trees around your mansion...recollect how much easier it is to cut a tree than to make one grow.""

When the Custises died in the 1850s, their only child, Mary Anna, inherited the right to live there. Her husband was Robert E. Lee, then an up-and-coming U.S. Army officer, who took over management of the estate. But in 1861, as the Civil War loomed, he resigned his Army commission and went south to lead Confederate forces, never to return.

Federal troops seized and occupied the property in May 1861, clearing more trees on the hill around the mansion to provide artillery sites sight lines for defending DC. Two years later, the federal government established a community for freed slaves on the southern portion of the property, which continued until the end of the 1800s.

In 1864, as cemeteries in the capital filled up with war dead, the Army designated 200 acres of the old plantation as a new military burial ground. Lee's son briefly reclaimed the property in the early 1880s after winning a lawsuit claiming it had been illegally confiscated. But by then, thousands of slain Federal soldiers had been buried there, and he sold the land back to the government a few months later for $150,000.

The cemetery itself features more than 8,600 native and exotic trees of about 300 different species and variet-

Fallen tree limbs lay on a relatively open forest floor in Arlington Woods. Even in autumn, as leaves began to turn and drop, the canopy was thick enough to shade the ground.

At left, a large tree in Arlington Woods is among many there that tower over the forest and provide its thick canopy. Above, Rod Simmons leads a tour of Arlington Woods sponsored by the Landscape Designers' Group of Washington, DC. Simmons has studied the trees, written about them and worked to save them. "You'll see a lot of trees that were here long before the Civil War," he said.

ies, some champion size and some nearly 250 years old, predating the military burials there. In appreciation of the formal and informal gardens and groves throughout the cemetery grounds, they were designated as a Memorial Arboretum in 2014.

But Arlington Woods represent a different, informal sort of memorial to the forest ecosystem that once existed there.

It has survived at least one more recent threat. Arlington House and the surrounding grounds are owned by the National Park Service but, in 1995, the service transferred 12 acres of the woods to the Department of Defense. The Pentagon wanted more burial space because the cemetery was filling up.

Nature lovers in the area only learned of the impending loss of old-growth trees at the cemetery when *The Washington Post* exposed the deal, Simmons said.

Up in arms, he and other environmental and community advocates rallied to ensure the rest of the woods would be spared and remain in park service control.

To get to Arlington Woods, our tour group separated ourselves from the busloads of visitors arriving every few minutes and walked from the cemetery welcome center to the neoclassical memorial honoring women who served in the military.

From there, we followed Schley Drive until it became Sherman Drive. Just past its intersection with Lincoln Drive, the woods stretched out down the hill to the right.

Some of the trees nearest Sherman Drive had turned prematurely brown in October, which Simmons suggested could stem from extreme heat and a lack of moisture. Despite last year's heavy rains, many trees are stressed, making them more vulnerable to other threats, such as insects and disease.

At the edge of the woods, English ivy and other vines covered some trunks — the invasive bane of woody areas everywhere. Going deeper, though, the undergrowth disappeared as the light dimmed and the air cooled. The forest floor was relatively open, save for tree trunks toppled by wind and age in various states of decay. Leaves crunched and branches snapped underfoot.

Northern red oaks and chestnut oaks anchored the north-facing slope, with beech and tulips mixed in. Some seedlings poked up through the leaves carpeting the ground.

At the bottom of the hill, where the woods ended, there was a creek with just a trace of flow in it. It's the type of habitat that might harbor the extremely rare Appalachian springsnail, Simmons said, along with somewhat less rarified Eastern box turtles.

Farther along, the group came upon a small spring-fed stream trickling down the slope, evidently the source of the water at the base of the hill. Even in droughts, Simmons explained, springs like this don't run dry, providing water for plants and animals.

The forest canopy parted near there, allowing a minty patch of richweed to flourish in the light gap. Not far away, the group encountered a clear sign that despite a lack of wildlife encounters, they were not alone in the woods. A maple sapling had its bark stripped away, most likely by a male deer rubbing its head and antlers against it.

After more than an hour exploring the woods, the group worked its way up the hill, skirting a boulder-lined gully receiving stormwater runoff from the roads and buildings at the summit. We ended our tour at the back of Arlington House, which is closed to visitors until early next year as the mansion and outbuildings undergo a multimillion-dollar rehabilitation. There, visitors can find a sign with text and historical photos about Arlington Woods.

The tour Simmons led was a one-off event sponsored by the Landscape Designers' Group, a nonprofit corporation whose members are DC area designers, arborists, horticulturists and others. Having a knowledgeable guide enriched the experience, but visitors to Arlington can still wander the woods on their own and soak up some old-growth atmosphere.

Chunks of tree bark lie on the floor of Arlington Woods.

Arlington National Cemetery is in Arlington, VA, across the Potomac River from Washington, DC. It's open daily year-round, 8 a.m.- 5 p.m. from October through March and 8 a.m.- 7 p.m. April through September. Admission is free. The site is also accessible by Metro. For information and directions, call 877-907-8585 or visit arlingtoncemetery.mil.

For those who'd like a similarly curated stroll, Simmons and other DC area nature lovers will be leading a winter solstice walk on Dec. 22 on the Gold Mine tract at C&O Canal National Historic Park. Though not old growth, it's the largest Piedmont forest in Maryland. The walk, which is free and open to everyone, is expected to go from 10 a.m. – 4 p.m. It begins at the Great Falls Tavern Visitor Center, 11710 MacArthur Blvd., Potomac, MD. For information, visit vnps.org.

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Crab pots with their colorful "corks" sit along the roadside at the Dorchester County wharf in Crocheron, MD. (Dave Harp)

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Roy & Grace Newsome
Harrisburg, PA

A. J. O'Brien
Baltimore, MD

Mike O'Brien
Solomons, MD

Nelson Ohl
Folly Beach, SC

Philip Olson
Lanham, MD

John Ordeman
Gwynn Oak, MD

Robert & Elaine Peoples
San Ramon, CA

Mary Perkins
Glen Burnie, MD

Frances W. Porter
Newport News, VA

John Poutier
Yorktown, VA

Mark Pratt
Hampstead, MD

James Ragsdale
Leesburg, VA

James Rahochik
Hagerstown, MD

Angela Randall
Vienna, VA

Jennifer Randazzo
Callao, VA

Mary Reardon
Silver Spring, MD

William Rickards
Charleston, SC

Roger Rohrbaugh
Silver Spring, MD

Rudy Rohrbaugh
Dover, PA

Joseph Roussos
North Chesterfield, VA

David & Marion Royer
Newark, DE

Thomas M. Ruby
Baltimore, MD

Kay Saderholm
Hyde Park, NY

George Savage, Jr.
Cape Charles, VA

Ben & Dorothy Schaefer
Fairfax, VA

Jerry Schafer
Souderton, PA

Henry Schaffer
Perry Hall, MD

R. Schoone
Easton, PA

Jo Lynn Seibel
Ellicott City, MD

Mr. & Mrs. Richard Sharek
Indian Head, MD

Sarah Sinsabaugh
Richmond, VA

Gerald Snyder
Arnold, MD

Paul Solomon
New Freedom, PA

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Stuart S. Speaker
Takoma Park, MD

Joseph Stein II
Marriottsville, MD

Paula Sullivan
Alexandria, VA

Jule Szabo
Fairfax, VA

Judith Tanner
Mapleton Depot, PA

In memory
of Leslie A. White
from Sherrond Taylor
Norfolk, VA

S. I. Taylor
Woodstock, MD

Anthony Ulehla
Annapolis, MD

Jack W. Vellines
Norfolk, VA

Gary Visscher
Silver Spring, MD

Jack Vondercehr
Richmond, VA

Mary Vondrak
Glenn Dale, MD

John Voytko
Pittsburgh, PA

Stanley Watkins
Annapolis, MD

Frank Watson
Salisbury, MD

Jim Wightman
Blacksburg, VA

David A. Yannarell
Center Valley, PA

Ray York
Lexington, VA

James Ziegenfuss
Harrisburg, PA

Alicia A. Meenan
Virginia Beach, VA

Caeser Butkiewicz
Mount Carmel, PA

Richard Carroll
Easton, MD

James Florentine, Jr.
Westminster, MD

Neal Foster
Dutton, VA

Rosemary Francis
Wilmington, DE

Joe Gresko
Montpelier, VA

Michael J. Jacobs
Linthicum, MD

Mike Madden
Salem, VA

James J. McCann
Crownsville, MD

Eugene McMullen
Port Deposit, MD

Thomas O'Brien
Kingsville, MD

Perrie Prouty
Rockville, MD

Dave & Billie Roberts
Still Pond, MD

Jonathan Rogers
Lutherville, MD

Dan Rosen
Springfield Center, NY

Susan Rowe Grabb
Laneview, VA

Patricia M. Soltys
Hampton, VA

Myrl Stevens
Rock Hall, MD

The historic Galloway house heads down the Tred Avon River on a barge, soon to be located on a new plot along the Wye River. The house, built in the 1760s, was moved from its initial location near Easton, MD. (Dave Harp)

Lee Yohn
Mechanicsburg, PA

Susan Adams
Henrico, VA

Elaine Adams
Elverson, PA

Sue Allen
Columbia, MD

Carole George Andrews
Havre de Grace, MD

M. Anzalone
Parkville, MD

Jacqueline Baker
Silver Spring, MD

Tyler Bastian
Mount Airy, MD

Walter L. Baumann
Falls Church, VA

Todd H. Boone
Cumberland, MD

Gerald Booze
Delta, PA

Caro A. Brown
Chestertown, MD

M. Hanford Day
Silver Spring, MD

Nancy Diangelo
Chestertown, MD

Jim Dondero
Pittsgrove, NJ

Charles Dye
Williamsburg, VA

Judy Eliason
Millsboro, DE

Ted Fairbanks
Williamsburg, VA

Thomas Finderson
Carrollton, VA

Sally Foley
Baltimore, MD

Pat Golla
Catawissa, PA

Selwin Gray
Towson, MD

Gregory Greene
Blue Point, NY

Phillip Harrison
King George, VA

Lois Herrmann
Washington, DC

Tom Himpsl
Mountville, PA

Don Hyland
Pasadena, MD

Pete Irino
Forest Hill, MD

Yvon Jensen
Georgetown, TX

Steve Jones
Cambridge, MD

Linda Keefer
Barboursville, WV

L. Scott Kilmon
Royal Oak, MD

Stan Klapp
Marriottsville, MD

Michael T. Krisch
Snow Shoe, PA

H.R. Liverman
Mechanicsville, MD

Mike McNeill
Mooresville, NC

Donald Merryfield
St. Michaels, MD

Bob Murphy
Yorktown, VA

Todd Nickleson
Pasadena, MD

Bonnie Palmer
Sykesville, MD

William P. Pearce
Cecilton, MD

Joseph E. Pinhak
Havertown, PA

Sherry Potocek
Stevensville, PA

Joseph S. Ragona
Feeding Hills, MA

M.J. Russell
Midlothian, VA

Michael F. Ruth
Baltimore, MD

John Seiple
Mount Joy, PA

Kenneth Seldon
Richmond, VA

Kevin Sellner
Frederick, MD

Bruce Setzer
Nazareth, PA

Essie Burgess &
Susan A. Stevens
Rosedale, MD

Dick Swartz
Washington, DC

R. Taylor
Pasadena, MD

Francis Volante
King George, VA

Douglas & Teresa Ward
New Freedom, PA

Rick Williams
Calhoun, GA

Roy Yeager
Dover, PA

Raymond Yingling
Halethorpe, MD

William Young
Reading, PA

Christopher Zone
Scranton, PA

Ted Ashby
Staunton, VA

Dave Browne
Virginia Beach, VA

Claudia Degges
Heathsville, VA

Leroy W. Oates
Ellicott City, MD

Dennis Obermayer
Fairfax, VA

Marty Reefe
Libertytown, MD

Ed Reisman, Jr.
Camp Springs, MD

Heather Schwartz
Clarksville, MD

Chris Surowiec
Gwynedd, PA

Alan Sweatman
Havre de Grace, MD

Joseph Varano
Tabernacle, NJ

William Zeller
Bel Air, MD

Robert Meminger
Hanover, PA

David & Kathleen Brenneman
Mechanicsburg, PA

Lucy Ewing-Martin
Roseland, VA

Lori Irvin
Lancaster, PA

Mar La Wells
Norton, VA

Courtney Worrall
Hampton, VA

Cy Jones
Silver Spring, MD

Avi Friedman
Baltimore, MD

Armin Behr &
Jean Fourcroy-Behr
Bethesda, MD

William Nickel
Locustville, VA

RJS Environmental
Medford, NJ

Baker's Marine Service
Inman, SC

Roderick Barr
Columbia, MD

Alec N. Baugus
Ephrata, PA

Anna Book
Elizabethtown, PA

Michael Ciarlo
Timonium, MD

Maurice P. Lynch
Williamsburg, VA

Dean Meledones
Silver Spring, MD

Marria O'Malley Walsh
Pottsville, PA

Marsha Wilkins
Virginia Beach, VA

Robert Youmans
Edgewater, MD

Larry Books
Chase, MD

James & Jean Robinson
Oakton, VA

Jon Bauer
Rose Valley, PA

Norma Ciarlo
Parkton, MD

Steve Lukaczer
Washington, DC

The Neisess Family
Ellicott City, MD

Barbara Pitts
Grafton, VA

George & Nancy Plunkett
Richmond, VA

Bub Bachman
Columbia, PA

Judith Anne Patterson
Baltimore, MD

Catherine M. Urbanek
Silver Spring, MD

Elizabeth Kfoury
Baltimore, MD

Rick Parks
Newport News, VA

Richard Anderson
Baldwin, MD

Ronald & Kathleen Brown
Sykesville, MD

Theresa & Jim Frisbie
Colchester, IL

Brian Gramp
Springfield, VA

David Haller
Hagerstown, MD

James Kosmides
& Mignon Petrini
Annapolis, MD

Ray & Gerda Schmidt
Woodbridge, NJ

Shelly Sparks
Bel Air, MD

Charles Stephen Ward
Annapolis, MD

Mr. & Mrs. Robert M. Weekley
Lancaster, VA

Maureen Wilkerson
Bethesda, MD

Tom Zeender
Washington, DC

Catharine Tucker
Richmond, VA

Steve Lukaczer
Washington, DC

Richard Crews
Virginia Beach, VA

Elizabeth Hedges
Lovettsville, VA

Stephen C. Hiett
Woodbridge, VA

John Klunk
Dover, PA

Yvonne M. Turner
Hampton, VA

Bob Wirth
Sparrows Point, MD

Paul Farragut
Ellicott City, MD

Ed Reisman, Jr.
Camp Springs, MD

N. Vastardis
Malvern, PA

Forum

Commentary • Letters • Perspectives

We must save wildlife if we are ever going to save ourselves

By Kate Breimann

A diamondback terrapin emerges from the sand on Poplar Island off Talbot County, MD, in the Chesapeake Bay. (Dave Harp)

There's so much in Maryland that's worth standing up for. Our "America in Miniature" is home to a rich diversity of natural features and wildlife.

From sailing around Annapolis and enjoying the beaches of the Eastern Shore, to hiking the Appalachian Trail and visiting state parks, Marylanders are lucky to have so many opportunities to experience the best that nature has to offer.

The benefits of spending time in nature are familiar to us all, so it's no surprise that, time and time again, polls show that Americans are passionate about protecting our wild lands and our wildlife, regardless of political ideology.

But the job of defending our wild has never been harder than it is today.

A recent report found that worldwide, species and ecosystem diversity is declining faster than at any time in human history. Because of encroaching development, climate change and other impacts, the report estimates that extinction currently threatens 1 million species.

The report also points out that the loss of these species threatens humans ability to survive — our food, water and energy security, as well as our public health, are all threatened as we continue to lose biodiversity.

The Chesapeake Bay is a defining feature of Maryland and a national treasure. It is an inherent part of our culture, and is an important part of the state's history.

Home to bald eagles, blue crabs and about 3,600 other species of plants and animals, the Bay is one of the most productive estuaries in the world and is the largest estuary of its kind in the United States.

But even the Chesapeake is under threat — many of the species that visit or make their homes in the Bay are endangered or threatened, including the diamondback terrapin, Maryland darter and leatherback sea turtle.

Furthermore, we're seeing a decline in the presence of underwater grasses, which provide critical habitat and food to a variety of marine life, as well as add oxygen to the water and shield shorelines from erosion.

Many of the species that visit or make their homes in the Bay are endangered or threatened, including the diamondback terrapin, Maryland darter and leatherback sea turtle.

Despite those grave risks, the Trump administration recently announced a new rule that severely weakens the Endangered Species Act — one of our nation's bedrock environmental laws that protects wildlife and plants. Since President Richard Nixon signed the Endangered Species Act in 1973, it has prevented 99 percent of the species it protects from going extinct, and allowed hundreds of them to thrive.

The new rule punches holes in this critical safety net, putting our most vulnerable species at an even greater risk — as the *Bay Journal* pointed out in *Legal battle likely over Trump rules weakening endangered species protections* (July-August 2019), this rollback will have unignorable impacts on the vulnerable species of plants and animals that make their home in the Chesapeake.

A weakened Endangered Species Act will make it more difficult to save species in Maryland such as the Maryland darter and leatherback sea turtle, which are both recognized as endangered.

The weakened act will also make it easier for companies to develop pipelines and other industrial infrastructure inside wild places that are critical for endangered species' survival.

That isn't who we are. These aren't Maryland's values.

That's the message we must send to our federal legislators in Washington, DC. The ask is simple: Keep our animals from going extinct.

We are counting on our Congressional delegation to stand up for Maryland's wildlife by coming out in opposition to the Trump administration's rollback of the Endangered Species Act.

They should also work to strengthen the act and create new opportunities for species to thrive by supporting the Wildlife Corridors Conservation Act that both houses of Congress are considering.

As members of the Environment and Public Works Committee, Sens. Ben Cardin and Chris Van Hollen are well-positioned to fight for this important bill on behalf of Marylanders.

All of our state leaders can strengthen wildlife protections as well.

Now is the time to defend our wildlife, before it's gone.

Kate Breimann is an advocate for Environment Maryland.

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.

Forum

Commentary • Letters • Perspectives

Rachel Carson no stranger to the Chesapeake, its creatures

"...to see the running of the old eels and the young shad to the sea is to have knowledge of things that are as nearly eternal as any earthly life can be."

— R.L. Carson

By Tom Horton

Some of the finest nature writing about the Chesapeake Bay scarcely mentions the great estuary by name and studiously avoids naming specific places. Its author, for years, chose not to use her given name, Rachel, presuming readers would think "R. L. Carson" male and more credible.

I don't know why in her first book in 1941, *Under the Sea Wind*, the writer most famous for *Silent Spring* (1962) minimized the Chesapeake as the setting and inspiration for many of the delightful essays.

Perhaps it was to avoid pigeonholing her writing as "local" or "regional," the bane of nature writers whose nonfiction can be transcendent. Easier for localized fiction to pass for universal — Faulkner's Nobel Prize-winning novels about his tiny corner of Mississippi come to mind.

But Carson came to know the Chesapeake region and its birds and fishes well, starting in 1929, when she began work at Johns Hopkins on a masters in zoology and rented a house in Stemmers Run in eastern Baltimore County, a couple of miles from the Bay's edge.

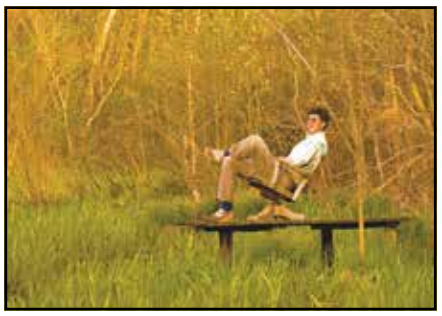
Dissecting and analyzing the urinary system in catfish earned her the degree, but she kept a tank of American eels in her laboratory in Gilman Hall on the Homewood campus.

She found the catadromous (running downstream to spawn) *Anguilla rostrata* fascinating. Indeed, the inexplicable impulse of adult eels, after living in Chesapeake streams and ponds and rivers for years or even decades, to suddenly seek the abyss of the Sargasso Sea to spawn and die at depths still unobserved by humans, remains almost as mysterious now as in Carson's day.

Anguilla's epic fall journey, and the equally improbable spring return of its offspring to every rivulet of a watershed they never knew, anchor the last third of *Under the Sea Wind* in beautifully detailed prose, weaving together the biological and the poetic as only Carson could.

Always strapped for money, the main breadwinner of her family, Carson for years refined her craft with more prosaic stuff. She wrote scripts for *Romance Under the Water,* a lengthy series of U.S. Bureau of Fisheries radio shows aimed at the public. For this she earned $6.50 a day.

Scientist and author Rachel Carson worked with Bob Hines, a wildlife artist with the U.S. Fish and Wildlife Service, while conducting research off the Atlantic coast in 1952. (USFWS)



Chesapeake Born

In 1936, "R. L." Carson sold the first of many articles on the Chesapeake to Mark Watson, editor of the *Baltimore Sunday Sun*. It was about the decline of the shad — from pollution, overfishing and development. I was writing the same sad story 42 years later for the *Sun* when fishing for shad in Maryland was closed, never to reopen.

She would go on to write (for $20 each) well-researched pieces on everything from mackerel to oysters, waterfowl and shorebirds to invasive species. Only when she submitted a piece about ticks did editor Watson reject it, fearing the piece would unduly alarm readers.

Also during the 1930s, she began working in the U.S. Bureau of Fisheries field station in Baltimore, a job that took her all over the Chesapeake, talking to watermen and biologists, who also keenly observed the region's bird life.

In 1937, Carson sold a larger essay, *The World of Waters*, to T*he Atlantic* magazine, an acclaimed piece that would lead to *Under the Sea Wind* four years later.

I don't want to imply that this classic, which earned its writer a paltry $689.17 in royalties before going out of print for years, was only about our Bay. Carson spent important field time elsewhere along the coast, from the Woods Hole laboratory in Massachusetts to North Carolina's sounds and sea islands.

But from the intricate life cycles of mackerel, to gripping accounts of osprey-eagle interactions, this book illuminates Chesapeake nature in the fullest sense.

I particularly love her opening chapter, *Flood Tide*, describing the unique feeding flights of *Rynchops niger*, the black skimmer — one of the loveliest sights to be had on calm summer evenings as the tide floods in along the merges of marsh and sand and water:

"...where water no deeper than a man's hand ran over gently ribbed bottom, Rynchops began to wheel and quarter.... [flying] with a curious lilting motion ... head bent sharply so that the long lower bill, shaped like a scissor blade, might cut the water.

"The blade plowed a miniature furrow over the placid sheet of the sound, setting up wavelets of its own and sending vibrations thudding down through the water to be received by the blennies and killifish that were roving the shallows. ... [T]he small fishes came nosing at the surface, curious and hungry. Rynchops, wheeling about, returned along the way he had come and snapped up three of the fishes."

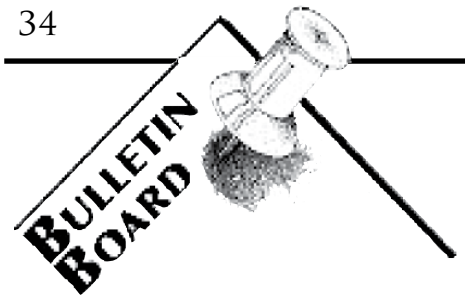
Every year, I gather my class at Salisbury University near a little pond that drains through a nondescript stream — a ditch really — that runs between parking lots and under trafficky MD Route 213 in downtown Centreville, on Maryland's upper Eastern Shore.

"There is a pond that lies under a hill ... two hundred miles from the sea," I begin reading from Carson's essay on the departure of the eels for Sargassan depths from all over the Bay watershed, and, indeed, from the entire Eastern Seaboard.

"When the cocks were crowing, saluting the third hour of the new day, Anguilla slipped into the channel spilling down to the stream below and followed the moving water."

Could this be the actual "bittern pond" of *Under the Sea Wind*? Close enough. Like Carson, who would write movingly of educating by conveying "the wonder of the world," I am inspired by the eels, who eternally connect this rude patch of Queen Anne's County to the vast abyss of the Bermuda Triangle, to living circuits, energized by bright, silver snakes every year since the continents split apart.

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.



VOLUNTEER OPPORTUNITIES

Paradise Creek Nature Park

Paradise Creek Nature Park in Portsmouth, VA, needs participants, ages 12 & older (12–16 w/adult), for volunteer service days 9–11 a.m. Nov. 23 & Dec. 7. Tasks include weeding, planting, cleaning, pruning and light maintenance. No experience is required. Bring work gloves and a water bottle if possible. Registration, info: paradisecreek.elizabethriver.org.

Manassas, VA, stream cleanup

The Prince William, VA, Soil and Water Conservation District is looking for volunteers to help with a stream cleanup 9 a.m. to noon Nov. 16 near the Costco in Manassas, VA, which is in the Bull Run watershed. Volunteers are encouraged to wear shoes (preferably boots) that can get dirty. Student service hours are available. Registration is required. Info: waterquality@pwswcd.org, 571-379-8213.

York County, PA, parks

Volunteer opportunities at York County (PA) Parks, include:

- *Exploration Forest:* The Nature Play Area at the Nixon Park Nature Center near Jacobus, needs to be monitored on a regular basis for hazards such as thorny plants or poison ivy. Info: Andrew at 717-428-1961.
- *Project FeederWatch:* 9 a.m.–4 p.m. Nov. 19, 20, 26 & 27 and Dec. 3, 4, 10, 11, 17 & 18. Nixon Park near Jacobus. Project FeederWatch is a citizen science program in which participants identify and count the number of bird species visiting the center's feeders from November through early April. The data is forwarded to the Cornell Laboratory of Ornithology and becomes part of a nationwide data set that tracks winter bird population trends. Beginners are welcome. Volunteers are asked to commit to one hour every other week. Info: Andrew at 717-428-1961.
- *Christmas Magic Food Stand & Nature Center Front Desk Greeters:* Nov. 29–Dec. 31. Rocky Ridge Park, York. Ages 14+ Help out at this fund-raising attraction featuring 600,000 LED lights, Info: NixonCountyPark@YorkCountyPA.gov.

Howard County Conservancy

The Howard County Conservancy is looking for volunteers to lead elementary and secondary school hikes. No experience is necessary. Volunteers can choose which hikes they would like to do. There is no minimum or maximum time requirement. Volunteers are also needed for various events. Info: Carole at 410-465-8877, volunteer@hcconservancy.org.

Cromwell Valley Park

Cromwell Valley Park in Parkville, MD, is looking for volunteers of all ages (12 & younger w/adult) for its *Habitat Restoration Team / Weed Warrior Day* 2–4 p.m. Nov. 23. Help to remove invasive species, install native ones and maintain habitat. Service hours are available. Meet at the Sherwood House parking lot. Registration is not required. Info: Ltmitchell4@comcast.net.

MD Volunteer Angler Survey

Anglers of all ages can become citizen scientists by helping the Maryland Department of Natural Resources collect scientific data through its *Volunteer Angler Survey.* Anglers record information from their catch such as species, location and size directly to the survey on their smartphone. Biologists use these data to develop, plan and implement management strategies. The artificial reef initiative, blue crab, freshwater fisheries, muskie, shad and striped bass programs have been upgraded to mobile-friendly methods. Participants are eligible to win quarterly prizes. Info: dnr.maryland.gov/Fisheries/Pages/survey/index.aspx.

CBL Visitor Center

Volunteers, 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.

Volunteer at CBEC

The Chesapeake Bay Environmental Center in Grasonville, MD, has volunteer openings for those who only want to drop in a few times a month as well as people who would like to help out on a more regular basis. Openings include: helping with educational programs; guiding kayak trips or hikes; staffing the front desk; maintaining trails, landscapes and the Pollinator Garden; feeding or handling captive birds of prey; maintaining birds' living quarters; participating in CBEC's team of wood duck box monitors; and other wildlife initiatives. Other opportunities include participating in fundraising events, website development, writing for newsletters and events, developing photo archives and supporting office staff. Volunteers donating more than 100 hours of service per year receive a complimentary one-year family membership to CBEC. Info: volunteercoordinator@bayrestoration.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 the Ruth Swann Park-Potomac Branch Library parking lot. Bring lunch. Info: 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. and return at 5 p.m. Carpool contact: 301-277-7111.

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 every 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.

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@pgparks.com, 301-442-5657.

Magruder Woods

Help Friends of Magruder Woods 9 a.m. to 1 p.m. the third Saturday in November, December and January remove invasive plants in the forested swamp in Hyattsville, MD. Meet at the farthest end of the parking lot. Info: Marc.Imlay@pgparks.com, 301-283-0808, (301-442-5657 the day of event); or Colleen Aistis at 301-985-5057.

Become a VA Master Naturalist

Virginia Master Naturalists are a corps of volunteers who help to manage and protect natural areas through plant and animal surveys, stream monitoring, trail rehabilitation and teaching in nature centers. Basic training covers ecology, geology, soils, native flora and fauna, and habitat management. Info: virginiamasternaturalist.org.

Adopt-a-Stream or Pond

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 in recognition of their efforts. For info, to adopt a stream or get a proposed site, visit waterquality@pwswcd.org. Groups can register their events at trashnetwork.fergusonfoundation.org.

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. to 12 p.m. Wednesdays. All ages (16 & younger w/adult) are welcome. Training, tools and water are provided. Registration is required. Info: 410-414-3400, landmanager@acltweb.org, acltweb.org.

Anita Leight Estuary Center

Anita C. Leight Estuary Center in Abingdon, MD, needs volunteers, ages 14 & older, for its *Invasinators*

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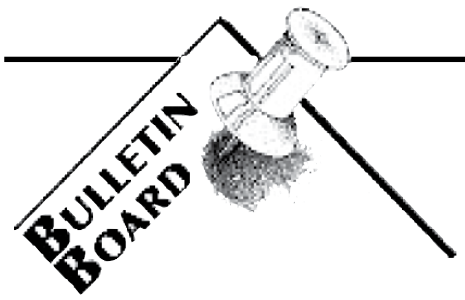

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Workday 2–4 p.m. Nov. 17, weather permitting. Help remove invasive species and install native plants around the center. Wear sturdy shoes, long sleeves and work gloves. Registration is required: 410-612-1688, 410-879-2000 x1688, otterpointcreek.org.

Creek Critters app

Audubon Naturalist's *Creek Critters* app lets people check their local streams' health through finding and identifying small organisms that live in freshwater, then generating 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 partnerships or host a Creek Critters event: cleanstreams@anshome.org.

Resources

Boating safety instruction

Boating safety classes are required for operators of recreational boats in Virginia, Maryland and the District of Columbia, as well as most other states. Those who missed the Coast Guard Auxiliary courses have online alternatives:

- *Virginians:* boat-ed.com/virginia
- *Marylanders:* boatus.org/maryland
- *DC residents & nonresidents:* boat-ed.com/districtofcolumbia
- *Comprehensive list of training options:* uscgboating.org/recreational-boaters/boating-safety-courses.php
- *Free boating safety tools & materials from the Coast Guard Auxiliary:* Info/Search engine: recreational boating safety outreach.

Bilingual educator resources

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

Wetlands Work website

The Chesapeake Bay Program's website, *Wetlands Work* (wetlandswork.org), helps to connect agricultural landowners with people and programs that can support wetland development and restoration on their land.

Stormwater class

The Alliance for the Chesapeake Bay has released the Municipal Online Stormwater Training Center's *Dig Once Course*. Developed by the Local Government Programs staff and the University of Maryland's Environmental Finance Center, the course provides ways that local leaders can integrate green infrastructure into community capital projects such as road construction, and school and park improvements. Interactive lessons, videos and knowledge checks in a user-friendly format provide communities with tools to better communicate about, build and enhance local stormwater programs. Info: mostcenter.org.

Watershed education capsules

Prince William (VA) 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/capsules.

Learn if your yard is Bay-Wise

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

Turf / lawn programs

For information on the Prince William (VA) Cooperative Extension's *12 Steps to a Greener Lawn / Building Environmental Sustainable Turf BEST Lawns* low-cost, research-based programs for lawn education, contact: 703-792-4037, bestlawns@pwcgov.org.

Floatable monitoring program

The Prince William Soil & Water Conservation District in Manassas, VA, needs volunteers to help assess and trace trash in streams in 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.

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 on marine ecosystems through hands-on citizen science, education and community outreach. Info/search engine: marine debris monitoring toolkit for educators.

Baltimore Biodiversity Toolkit

To help meet the need for high-quality and accessible green space in Baltimore for native plants, animals and people, the *Baltimore Biodiversity Toolkit* identifies ambassador animals that represent habitat types within, and historic to a community. It facilitates sharing resources for supporting specific wildlife needs; monitoring and the collection of citizen science data; and developing a culture of conservation and stewardship. The Toolkit contains 20 ambassador wildlife species representing four habitats. These animals require a variety of conditions that are present in high-quality environments for human, plant and animal health. Its multi-platform format helps partners prioritize community greening projects based on representative species, citizen science data and spatial analysis that includes social, economic and ecological indicators. Info: fws.gov.

Wildlife education trunks

The Maryland Department of Natural Resources is offering a variety of wildlife education trunks 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 such as 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 supplies, books, furs, replica tracks, videos and other hands-on items. Trunks 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 first-come, first-served basis for up to two weeks. Info/search engine: Wildlife Education Trunks.

Test for chemicals in water

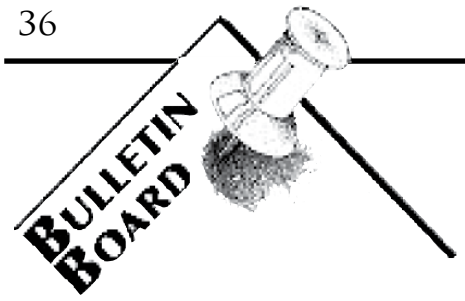
Prince William County, VA, and the state's Department of Environmental Quality need volunteers to join their Chemical Water Quality Monitoring Teams, who collect chemical data from local streams. DEQ will teach volunteers the techniques to collect and read the data. Monitoring sites are accessible for easy data collection. Info: waterquality@pwswcd.org.

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 2020 issue.

Please e-mail news about upcoming events to this address: kgaskell@bayjournal.com.

Bulletin continues on page 36



BULLETIN FROM PAGE 35

FORUMS / WORKSHOPS

MD water monitoring forum

The Maryland Water Monitoring Council's 25th annual conference, *Where We've Been, Where We're Going,* takes place 7:30 a.m.–4:30 p.m. Dec. 6 at the Maritime Conference Center in Linthicum. The event's plenary session is a presentation by former Chesapeake Bay Program Director Nick DiPasquale. Concurrent breakout sessions will include *Invasive Species, Remote Sensing and the Bay, Stream Restoration Monitoring, Working with Big Data, Harmful Algal Blooms, Litter Education, Trends in Stream Health* and other topics. The event also includes posters, exhibitor tables, an all-you-can-eat buffet lunch and post-meeting social. The cost, which varies, depends on the level of one's participation. There is a discount for those who register before Nov. 18. For conference details, registration and abstract submission info: Search engine Maryland water monitoring conference.

EVENTS / PROGRAMS

Natural History Society of MD

The Natural History Society of Maryland invites the public to *Big Game Record Keeping: Past, Present and Future* at 3–5 p.m. Nov. 24 in Overlea, MD. Learn about the national game registry, a measuring system that tracks the success of new conservation policies. Attendees are invited to bring in their specimens for an official measure. Fee: $20. Info: bstrong@marylandnature.org.

VA film fest accepting entries

The 10th RVA Environmental Film Festival is accepting entries from around the state for the 2020 Virginia Environmental Film Contest. Submissions are due by Dec. 31. The festival showcases films that raise awareness of environmental issues relative to all residents of Earth. Selected entries will be screened Feb. 9 at the Byrd Theater in Richmond. Admission to the festival is free and open to the public. Prizes, including the $1,000 grand prize, will be awarded that day. Info: facebook.com/pg/rvaenvironmentalfilmfestival/posts.

Chesapeake Bay Maritime Museum

The Chesapeake Bay Maritime Museum in St. Michaels, MD, invites woodworkers to sign up for its *Open Boat Shop,* 5:30–8:30 p.m. Nov. 14 & Dec. 12. Novice woodworkers can bring a small woodworking project or ideas for a future project to receive guidance from an experienced shipwright and woodworker, along with assistance with CBMM's machinery and tools. Participants must be 16 or older unless accompanied by an adult. Fee: $35 per session. Preregistration required: cbmm.org/shipyardprograms.

Oregon Ridge Nature Center

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

- *Shoots & Letters:* 10–11 a.m. Nov. 14 (*Hibernation*) & Nov. 21 (*Deer*). Ages 3+ Outdoor adventures, activities. Fee: $2/child. No registration required.
- *Campfire Cooking:* 1–3 p.m. Nov. 16 & 17. Ages 8+ Hike to find kindling, learn about fire safety, build a campfire, make campfire treats. Fee: $8.
- *Council Speaker Series / Monarch Butterflies:* 7–8:30 p.m. Nov. 18. Adults. Master Gardener Pam Spencer has studied, raised and tagged monarchs for the annual migration to their forest sanctuaries in Mexico. Her discussion will focus on creating lush habitats for pollinators, which include both host plants and nectar sources that bloom all season long. The program also discusses theories on why monarchs are at risk and ways to help them. Free, donations appreciated. No registration required.
- *Habitat Hunt:* 1–3 p.m. Nov. 23 & 24. Ages 5+ Hikers will look for clues hidden in the park that lead to a sweet surprise. Fee: $5.
- *Turkey Tales:* 1–2 p.m. Nov. 30. Ages 5+ Turkey tales & craft. Meet a live turkey. Fee: $2.

Ages 15 & younger must be accompanied by an adult. All programs require advance registration unless otherwise noted: info@OregonRidgeNatureCenter.org, 410-887-1815. Include everyone's name and ages of children. Payment must be made within one week of registration. Events take place rain or shine. Programs are for individuals and immediate families. Groups are welcome to schedule programs by calling 410-887-1815. For disability-related accommodations, call 410-887-1815, 401-887-5370 or 410-887-5319 (TTD/Deaf).

Paradise Creek Nature Park

Paradise Creek Nature Park in Portsmouth, VA, invites the public to these programs:

- *Holiday Wreath Workshop:* 10 a.m.–12 p.m. Nov. 23. Ages 18+ Decorate a wreath using cedar, pine & holly branches; pinecones, magnolia leaves, lemons, pears and oyster shells. All materials, supplies are included. Fee: $40.
- *Family Nature Walks:* 12–1 p.m. Nov. 23 & Dec. 7. All ages. (children w/adults) Learn about native plants and animals. Look for signs of wildlife. Free.
- *Herb Collecting & Drying Workshop:* 10–11 a.m. Nov. 16. All ages (children w/adults) Walk in the herb garden to learn which are best-suited for drying and how to harvest and safely dry them. Free.

Registration is required for all programs. Info: paradisecreek.elizabethriver.org.

Irvine Nature Center

Upcoming events at Irvine Nature Center in Owings Mills, MD, include:

- *Tales & Tails:* 10–11 a.m. every Friday. All ages. Story, songs, puppet show. Meet an animal. Free.
- *Eat, Drink & Learn / Awesome Bugs & Frosty Mugs:* 6:30–9 p.m. Nov. 21. Adults. Listen to "Bug Guy" Michael Raupp, professor of Entomology at the University of Maryland as he dives deep into the world of entomology. Dinner and drinks are provided. Fee: $60.
- *Day-off Camp / Forest Foragers:* 8:30 a.m.–4 p.m. Nov. 22. Ages 5–10. Participants take part in trail walks, nature games, crafts, stories and animal encounters. Children should wear nature-friendly clothing for outdoor activities and bring a lunch. Children will go outside even if snow is on the ground. Fee: $85. (Aftercare, 4–6 p.m. available for an extra fee.)
- *Drop-in Science Saturdays & Sundays:* 10 a.m.–12 p.m. Nov. 23 (*Native American Weaving*) & Dec. 7 (*Sunny Snowflakes*). All ages. Explore the natural world of science. Self-guided activities could include crafts and/or hands-on exhibits. Free.
- *Hoot's Feast-ival:* 1–3 p.m. Nov. 24. All ages. Join Hoot at Irvine's Native American Site for games, crafts and food. Learn about some of the foods from the first Thanksgiving that are grown in Irvine's garden. Fee: $10.
- *Holidays with Hoot:* 1– 3 p.m. Dec. 15. All ages. Make a gift, play winter-themed games and drink hot cocoa. Fee: $10.

Info on all programs: explorenature.org.

Patuxent Research Refuge

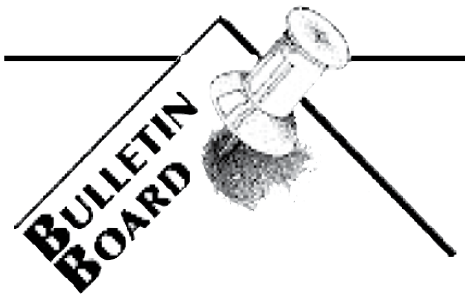
Upcoming programs at the Patuxent Research Refuge's North Tract [T] and National Wildlife Visitors Center [C] in Laurel, MD, include:

BULLETIN CONTINUES ON PAGE 37

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 13th of the month in which the item is published through the 13th of the next month. Deadlines run at 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**



Bulletin from page 36

≋ *Stars & Stories:* Possible dates: Nov. 12, 14, 15 or 16. [T] All ages. View the Andromeda Galaxy, Ring Nebula, Dumbbell Nebula through an 18-inch diameter telescope. Learn how light pollution affects wildlife, what to do to help preserve dark skies for future generations.

≋ *Family Fun / Furry Friends:* Drop-in any time between 10 a.m.–1 p.m. Nov. 15 & 16 [C] All ages. Learn about the refuge's mammals through activities, games, crafts for all ages. No registration.

≋ *Owl & Kestrel:* 12:15–12:45 p.m. Nov. 16, 23 & 30. [C] All ages. Learn about the acrobatic American kestrel and the stealthy eastern screech owl. No registration required.

≋ *Story Time:* 10:30–11:15 a.m. Nov. 18 [T] Ages 3–5. Nature-themed stories, crafts.

≋ *Agents of Discovery DC Explorer 2.0 Campaign Celebration:* 10:30 a.m.–12 p.m. Nov. 19 [C] All ages. Play the game on trails. No registration required.

≋ *Raptors Reign:* 10:45 a.m.–12:30 p.m. Nov. 19 [C] All ages. Licensed falconer Rodney Stotts will discuss and share close encounters with birds of prey. No registration required.

≋ *Bird Walk:* 8–10 a.m. Nov. 20 [C] Ages 16+ Search for fall migrants. Binoculars are recommended if participants have them.

≋ *Bicycle Ride:* 10 a.m.–12:30 p.m. Nov. 23 [T] All ages. Take in the natural area's wildlife, plants, historical sites on 12-mile guided tour. Bring a bike, snack, water bottle, helmet. Ride is weather-dependent.

≋ *Boy Scouts of America Environmental Science Merit Badge:* 12–4 p.m. Nov. 24 [T] Ages 10–17. Some pre/post work is also required to earn the badge.

All programs are free; donations are appreciated. Except where noted, events require registration. Programs are designed for individuals and/or families. Let the refuge know if there are any special needs that need to be accommodated. Info: 301-497-5887, fws.gov/refuge/Patuxent/visit/PublicPrograms.html.

York County, PA, Parks

≋ *Kids Nature Play:* Drop in any time from 8:30 a.m.–4:30 p.m. Nov. 15, 16, 22 & 23. Nixon Park near Jacobus. Dress-up, use puppets, touch and feel natural objects, take part in short scavenger hunts. Explore indoor play stations.

≋ *Christmas Magic / A Festival of Lights:* 6–9 p.m. Monday–Thursday; 5–9 p.m. Friday–Sunday Nov. 29–Dec. 31. Rocky Ridge Park, York. All ages. Half-mile ADA trail features 600,000 LED lights, animated scenes, enclosed pavilions with food, trains, entertainment. Online registration only. Fee: $10/adults; $9/ages 60+; $5/children; free/ages 3 & younger. Info (for this event only): parkevents.yorkcountypa.gov.

≋ *Birds of Prey Presentations:* 11 a.m. & 1 p.m. Nov. 30. Nixon Park near Jacobus. Meet live hawks, owls or falcons during this indoor program presented by local raptor rehabilitators. Learn how these birds of prey are adapted to hunting on the wing. Cameras are welcome. Free. Registration required: 717-428-1961.

≋ *Hanging of the Greens:* 6–8 p.m. Dec. 6. Rail Trail's Hanover Junction Train Station in North Codorus Township. Decorate the station's exterior. Hot beverages, cookies provided.

≋ *Natural Ornament Making:* Drop-in any time between 1–3:30 p.m. Dec. 8. Nixon Park near Jacobus. Make ornaments out of natural materials, glue and ribbon. Materials are provided.

≋ *Winter Wildlife Walk:* 2–3:30 p.m. Dec. 15, Nixon Park near Jacobus. Join a 1-mile wander to search for signs of wildlife activity.

Unless noted otherwise, events are free and do not require registration. Info: 717-428-1961.

Cromwell Valley Park

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

≋ *Scout Day:* 1–3 p.m. Nov. 16. Girl & Boy Scouts, ages 5–11 w/adult. Meet animals native to Maryland, go outside to explore their fall habitat. Participants receive a Cromwell Valley Park logo patch. No siblings! Fee: $5 per Scout.

≋ *Earth Oven Bread:* 1–2:30 p.m. Nov. 17. Ages 8+ Bake a no-knead loaf in a wood-fired earth oven. Fee: $6.

≋ *Let's Talk Turkey:* 1–2:30 p.m. Nov. 23. All ages. Meet and learn about wild turkeys. Fee: $4.

≋ *Black Friday Hike:* 7–8:30 p.m. Nov. 29. Ages 5+ Hike ends with s'mores around the campfire. Fee: $5.

≋ *Good Night Groundhog:* 1–3 p.m. Nov. 30. All ages. Learn about woodchucks/groundhogs, then hike to search for their burrows. Fee: $4.

Ages 12 & younger must be accompanied by an adult. Except where noted, programs are free and require registration. Info: 410-887-2503, cromwellvalleypark.org info@cromwellvalleypark.org. Online registration: cromwellvalleypark.campbrainregistration.com. For disability-related accommodations, call 410-887-5370 or 410-887-5319 (TTY), giving as much notice as possible.

Anita Leight Estuary Center

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

≋ *Kiddy Campfire:* 11 a.m.–12 p.m. Nov. 16. Ages 3–6. Meet at Pontoon Pier. Play games, sing songs, learn how to stay safe around a fire. Roasted treats provided. Fee: $3.

≋ *Fall Discovery Hike:* 1–2 p.m. Nov. 16. All ages. Observe seasonal changes. Fee: $2.

≋ *Trail Running Series:* 10–11 a.m. Nov. 17. Ages 10+ (16 & younger w/adult) All skill levels/paces welcome. 2-mile course is an out-and-back, single track. Free.

≋ *Drop-in Program / Meet a Critter:* 1 p.m. Nov. 17. All ages. Up-close animal encounter.

≋ *Beautiful Backyard Birds:* 10:30 a.m.–12 p.m. Nov. 23. Ages 6–12. Learn to identify birds at a feeder, make a seed feeder to take home. Fee: $3.

≋ *Owl Prowl:* 5–6:30 p.m. Nov. 23. Ages 8+ (16 & younger w/adult) Meet at Bosely Conservancy. Listen, look for owls. Fee: $5.

≋ *Owls of Maryland:* 2–3:30 p.m. Nov. 24. Ages 10+ Learn about the state's owls. Fee: $3.

≋ *Children's Garden Club:* 10:30–11:30 a.m. Nov. 30. Ages 5–8. Cook, create, explore while learning how a garden is connected to humans, the wild world. Fee: $5/child.

≋ *Tracks, Scat & Chews:* 2–3:30 p.m. Nov. 30. Ages 6+ Look for and interpret clues that animals leave behind: footprints, chew marks, droppings. Make track, scat models, then hit the trails to test your "reading" skills. Fee: $4.

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

Wild & Scenic Film Festival

The Alliance for the Chesapeake Bay invites the public to its *Wild & Scenic Film Festival* Jan. 23. The selection includes award-winning films about nature, community activism, adventure, conservation, water, energy and climate change, wildlife, environmental justice, agriculture, and Native American and indigenous cultures. Ticket prices vary between sites. Early bird prices end 11:59 p.m. Nov. 21. Tickets will be sold at the door if they haven't sold out. The schedule is:

≋ *Richmond:* Science Museum of Virginia. Doors open at 5:30 p.m. Film program runs 6:30–9:30 p.m.

≋ *Washington, DC:* The Miracle Theater. Doors open at 7 p.m. Film program runs 7:30–10 p.m.

≋ *Lititz, PA:* Penn Cinemas IMAX Theater. Doors open at 5:30 p.m. Film program runs 6–9 p.m.

≋ *Annapolis:* details not available at time of deadline.

Search engine: Alliance for the Chesapeake Bay wild and scenic film festival.

Chesapeake Challenge

Answers to

This grilling oyster quiz is stuffed with bivalve brain teasers

on page 21.

1. B 2. B 3. A 4. A 5. A 6. C 7. B 8. B 9. B 10: A. Gills B. Cilia C. Palps D. Mantle E. Adductor 11. D 12. A

Bay Buddies

Answers to Oysters on page 21.

1. A 2. A 3. C 4. A 5. B 6. D 7. D 8. A 9. A

(Dave Harp)

Correctional collaborative trains new generation of riparian buffer experts

By Ryan Davis

On a sweltering July afternoon, a handful of conservation professionals walked through a cornfield toward a stream in Huntingdon County, PA. While that alone would be commonplace, this cadre was accompanied by a group that was far from ordinary: 20 inmates at Huntingdon State Correctional Institution and their correctional officers.

They stopped a few times on the way to the tree line to examine the slit left in the soil from a no-till drill and look at the empty stream banks of a small tributary. They paused near bare spots where wet soil was hampering corn growth, before ducking into the shade of a mature forest.

The men had learned about water quality, the Chesapeake Bay and riparian forest buffers from a variety of guest speakers in the classroom. This was their chance to see how these pieces fit together in the field while they looked for macroinvertebrates in the shallow stream that runs directly into the Juniata River.

The inmates, who were hand-picked by Tina Hicks-Kern, corrections employment and vocational coordinator at Huntingdon SCI, are participants in a pilot program aimed at reducing recidivism while helping the state accomplish its conservation goals.

Under the fledgling Correctional Conservation Collaborative project, participants receive riparian forest buffer vocational training to help them re-enter the workforce with skills to help reduce nutrient and sediment pollution reaching waterways.

In Pennsylvania, where local, state and federal agencies, as well as scores of nongovernmental organizations, are working to reforest stream banks, we not only need to create buffer professionals — it's likely the state can't accomplish its goals without them.

Pennsylvania's task to reduce its share of pollutants reaching the Bay has always been immense, but with just a few years left until the 2025 Chesapeake Bay Total Maximum Daily Load deadline, the numbers are looming larger than ever. The target for new acres of riparian forest buffer establishment is 86,500 acres. For perspective, that's nearly twice the size of Washington, DC.

This goal is theoretically attainable, but if we are to get anywhere close, we are going to need dramatic accelerations in funding, momentum and practitioners. Those 17.3 million trees will not only need to be planted, but must be properly cared for, an issue that has plagued riparian reforestation for decades.

Participants in the Riparian Forest Buffer Vocational Training listen to the finer points of buffer maintenance from staff at the Mifflin County (PA) Conservation District and Alliance for the Chesapeake Bay (Shea Zwerver)

Most landowners do not have the equipment, time and expertise to complete the requisite tree establishment care duties, which boil down to managing vegetation in the buffer area, especially around each tree.

Contractors who offer this service are present, but are few and far between, largely because there has not been enough funding or buffer plantings to justify the investments in time and equipment. That is changing; riparian forest buffer planting has begun to surge again in Pennsylvania, and the maintenance of these sites in the most vulnerable first few years is now often supported with funding and technical assistance.

But there are still not enough contractors distributed across the watershed who can care for these young forests.

A similar reality faces urban forestry best management practices. Street trees get planted, but there may not be arborists around later to make sure that they are properly pruned and tended to.

In 2017, Shea Zwerver, community engagement coordinator for the Pennsylvania Department of Conservation and Natural Resources, launched a program to intervene. Melding her passion for the environment and social justice, Shea began building a curriculum to train arboriculture techniques to inmates at Rockview State Correctional Institution in Centre County. The participants took an arborist short course and learned skills like tree climbing and pruning, Upon release, a few of the graduates got jobs in the field.

This successful pilot program was the seed of what has grown into the Correctional Conservation Collaborative, intentionally abbreviated CCC as a nod to the Civilian Conservation Corps, which knitted environmental stewardship together with social welfare for unemployed young men during the Great Depression. Shea has since provided more than 343 hours of tree-related vocational instruction, reaching 172 inmates at two facilities and 10 programs. The Riparian Forest Buffer Vocational Training began in July.

Joining Shea in creating and coordinating the training are Teddi Stark, riparian forest buffer coordinator for the DCNR, and myself, the Pennsylvania Forest Program manager for the Alliance for the Chesapeake Bay. Together we developed a curriculum that introduces inmates to all things buffer in the classroom and in-depth field practice on all components of converting a treeless stream to one enclosed by a healthy forest.

More than a dozen guest experts have helped to teach not only technical skills, but also entrepreneurship, professionalism and business development. The participants will be well-qualified for positions in the buffer industry or other "green jobs," from landscaping to forest management.

In the event that they cannot find employment, participants will be equipped to pursue their own venture in buffer maintenance. They have enthusiastically taken this opportunity, and many are looking forward to working on forest buffers, even if just on the side, upon release.

The pilot class of the Riparian Forest Buffer Vocational Training concluded in mid-October with a graduation ceremony and a forest buffer planting of 400 trees on Huntingdon SCI property. The buffer was designed by class participants, who were busy preparing the site over the summer when they weren't helping to maintain local riparian forest buffers planted by the program's partners.

Many state correctional institutions own vast areas of land that was formerly cultivated by inmates but are now rented to local farmers. Like most agricultural property in the state, there are huge opportunities to plant riparian forest buffers on this state-owned land, which up until now hadn't really been considered as an avenue to accomplishing more streamside acres planted in trees.

This potential for chipping away at the state's riparian reforestation goals could help to fuel the growth of the Correctional Conservation Collaborative at more state facilities.

Hicks-Kern, who has worked at Huntingdon SCI for more than 30 years, sees immense potential in the collaborative for both the inmates and others across the state. "This program provides vocational training, but is also an opportunity for re-entrants to use their heads and their hands to do positive things. They see their worth and are given the opportunity to believe in themselves, while also helping others, she said. "This program gives them something to look forward to every session; it's a really good thing!"

The Riparian Forest Buffer Vocational Training, and indeed the Correctional Conservation Collaborative as a whole, is an example of the many innovative partnerships that are springing up around the Chesapeake Bay watershed.

A diverse group of partners with an array of objectives found common ground in working together to train a new generation of riparian forest buffer professionals. Once released, participants will be able to help Pennsylvania meet its massive riparian reforestation targets and water quality goals, and the new forests will give participants a second chance to lead a fulfilling life on the outside.

Ryan Davis is the Chesapeake Forests Program manager at the Alliance for the Chesapeake Bay.

Rough-legged hawk's rare visit to Gettysburg strikes a chord

By Mike Burke

The battlefield was silent. The split-rail fence rose peacefully atop the grassy hillside. The sky, once filled with smoke and the smell of gunpowder, was the brilliant blue only seen in winter.

I had last visited the Gettysburg National Military Park decades earlier. The hallowed ground was even more moving than I remembered.

Reports that a rough-legged hawk had been seen here offered the rationale for the visit. I had never seen one. I was glad we came.

We sighted the rough-legged hawk (*Buteo lagopus*), an uncommon winter visitor, as it stood peacefully atop a fence post. I pulled up the binoculars for a better look. Rough-legged hawks are large, almost as big as red-tails. They stand 20 inches tall and their broad wings can reach a span of 4.5 feet when fully extended.

Like many hawks, they come in both light and dark morphs. There is great variability in plumage color, from nearly all-black to a sparsely speckled and streaked version. This rough-leg was in the intermediate range, which is most common. Sexes are similar in color, although females are considerably heavier. They carry the same color feathering year-round.

A dark line extended back from the eye on the bird's light brown head. The cap was a bit darker and the horn-hued bill was surprisingly small. The neck and breast were mostly white, but the belly was nearly solid black. The back and wings were heavily streaked, with solid dark brown wing tips. Its body feathers reached down to its toes, giving the bird its eponymous name.

Rough-legs are visitors from the far North. They breed in Arctic regions across the globe.

They build large stick nests, along cliffs and rocky outcroppings, that take up to three weeks for both parents to assemble. The female will lay eggs as soon as construction is complete. She alone has a brood patch, so she must sit on the eggs almost continuously for a month until the eggs hatch.

Rodents are the chief food for rough-legs. They consume vast numbers of lemmings and voles in the Arctic. Adults need to consume four to six small rodents daily just to maintain their body weight. It is estimated that two nestlings will require 26 pounds of food during the 40-day period from hatching to fledging.

The male hunts constantly to gather enough food for himself, his mate and the hungry chicks. He also preys on hares, ground squirrels and birds. These hawks prefer game birds, especially ptarmigans. (The species name of rough-legged hawks is *lagopus*, which is the genus name of the three ptarmigan species.)

North American individuals are completely migratory. They depart their breeding grounds in August and September. Skipping over the boreal forest to their south, they winter in the lower 48 states (except for the South) and along the southernmost parts of Canada.

It is estimated that two rough-legged hawk nestlings will require 26 pounds of food during the 40-day period from hatching to fledging. (U.S. Fish and Wildlife Service)

Like many hawks, the rough-legged hawk comes in both light and dark morphs. There is great variability in plumage color, from nearly all-black to a sparsely speckled and streaked version. (Louis Agassiz / U.S. Fish and Wildlife Service)

These are birds of open landscapes. Their favored winter habitats mimic their nearly treeless breeding locations. They can most often be found in the great prairies stretching from Saskatchewan and Alberta in Canada to Oklahoma and Texas, but are especially partial to the Upper Midwest. Grasslands, farms, marshes and, yes, historic battlefields, host smaller numbers.

Rough-legs hunt by diving on their prey or pouncing from atop poles, posts and small trees. Hunting over fields and marshes, they resemble the common northern harrier.

Flying low and into the wind, they often hover briefly before their lethal dives. And like another common raptor, the kestrel, they seem to be able to see the ultraviolet spectrum. Doing so enables them to see urine trails of rodents, a major aid in locating prey.

Like many raptors, rough-legs are opportunistic predators. They will eat reptiles, amphibians and insects in addition to their favored prey. They also steal food from other birds such as gulls and will eat carrion, too.

As we continued watching the Gettysburg bird, it took off, flying low over a ridge in search of food. The flight gave us a chance to see two more of the bird's most distinctive field markings: its tail and "wrist." The broad tail opened wide, revealing white feathers with a subterminal band of black. The underwing showed white primaries tipped in black, heavily streaked inner wing feathers, and a bold, black carpal patch, where the wing bends slightly. The dark belly was also more evident in flight.

With the hawk gone, my mind immediately came back to the present. That's rare when I'm birding, especially after just seeing a new life bird. The high drama of our nation's huge political chasm was intruding on my thoughts yet again.

When Lincoln spoke here, the nation was torn apart in an even more stark and deadly way, I reflected. A century and a half ago he called upon the nation to rededicate itself to the noble work democracy demands. Those words seem as relevant to today's politics as they were so long ago.

Birds are never divorced from where we see them. That was uniquely true with the rough-legged hawk at Gettysburg. The bird brought me to that place, and the location's powerful history inspired me to recommit myself to the never-ending hard work of democracy.

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Let's talk turkey about Thanksgiving's most famous icon

BY KATHY RESHETILOFF

During November there is a tradition that links almost all Americans. And I am not talking about the U.S. holiday, Thanksgiving.

Instead, think back to the first time you drew a turkey (or showed a child how to draw one). It's the same process: Trace your fingers and palm on a piece of paper and fill it in with bright colors to conjure up this large bird with fanned-out feathers. This was your first wild turkey!

The wild turkey (*Meleagris gallopavo*), an upland game bird, is native to North America and found from southern Canada throughout the 48 contiguous states and Hawaii, and along the Sierra Madre Occidental mountain range to central Mexico.

The domestic turkey, a staple of Thanksgiving feasts, was derived from wild turkeys brought to Europe from Mexico. The common name, turkey, may be attributed to the fact that the bird were transported to England through Turkey — and was first called "turkey coq" before being shortened to just "turkey."

Wild turkeys are large birds, 36–44 inches in length. They are noted by their large, fan-shaped tails; long, pink or gray legs; short, rounded wings; and bare head and neck. Their body is covered with iridescent bronze feathers with black and white bars on their wings. In the East, the tip of the turkey's tail is brown.

The male turkey has a tuft of feathers called a beard on his chest and an upwardly curving spur on his lower legs. His breast feathers are tipped with black and he has a bluish-gray neck and a red fleshy lobe of skin that hangs from its neck or chin called a wattle. The male's bare head and neck is red, blue or white depending on the season

The female's breast feathers are tipped with brown, white or gray. She doesn't have spurs and she usually doesn't have a beard. She has a gray head and a feathered neck. Males are usually larger than females.

Wild turkeys get around mostly by walking, though they can also run and fly. When threatened, females tend to fly while males tend to run. At sundown, turkeys fly into the trees moving upward from limb to limb to a high roost spot. They usually roost in flocks.

Two tom turkeys strut their stuff. Males form all-male flocks outside of the breeding season. (Howard Ignatius / CC By-NC-ND 2.0)

Courting males gobble and strut with their tails fanned to attract females. Males breed with multiple mates and form all-male flocks outside of the breeding season, leaving the chick-rearing to the females.

Wild turkeys nest on the ground in dead leaves at the bases of trees, under brush or shrubs, or occasionally in open fields. They lay four to 17 eggs that incubate for 25–31 days. Chicks are precocial, meaning they are mobile and ready to leave the nest soon after hatching. The female will feed her chicks for a day or two, then the chicks are able to forage on their own. The chicks travel in a family group with their mother, often combining with other family groups to form large flocks of young turkeys accompanied by two or more adult females.

Wild turkeys are hunted by people and preyed on by coyotes, bobcats, raccoons, mountain lions, golden eagles and great horned owls. Nest predators include raccoons, opossums, striped skunks, foxes, woodchucks, snakes, birds and rodents.

When first encountered by colonists, wild turkeys ranged from Canada to Mexico and numbered in the millions. This was due to the plentiful habitat of hardwood and mixed conifer-hardwood forests; access to open areas such as fields and grasslands; and a wide variety of foods including mast (the nuts and fruits of trees or bushes that is eaten by wildlife), seeds, fruits and insects.

Between the excessive loss of habitat and hunting, their numbers dwindled in the late 19th and early 20th century. Game managers estimated that the entire U.S. population of wild turkeys was as low as 30,000 by the late 1930s.

In the late 1940s, people began to successfully transplant wild-caught turkeys into other areas with suitable habitat. These transplantations allowed wild turkeys to spread to all of the lower 48 states (plus Hawaii) and parts of southern Canada.

In 2014, Partners in Flight estimated a global breeding population of 7.8 million turkeys, with about 89 percent of those birds in the United States.

Populations have rebounded in part because of maturing forests. Landowners can manage land to provide for this bird's needs. Promoting the growth of mast-producing trees provides a vital food source especially during winter. Acorn crops can be cyclical, so it is important to promote a diversity of woodlands trees. Pine, hickory, birch, alder and American beech are great food sources for turkeys.

Small clearings near a woodlot provide crucial brooding habitat for young turkeys and are great foraging habitat for most of the year. Grassy, shrubby patches provide cover. Grassy areas may need to be mowed every few years to prevent the forest from encroaching. Creating a soft edge between field and the forest also provides better escape and cover for turkey. This can be done by planting early successional, mast-producing shrubs like viburnums, elderberry, sumac and blackberry.

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