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The Magothy River saw an “explosion” of dark false mussels in its creeks this summer after an influx of rain made the water fresh enough to support the tiny mussels on floating cages and docks. The last time these mussels flourished in 2004, Paul Spadaro, president of the Magothy River Association, said they made the water as “clear as gin.” (Dave Harp)

Freshwater bivalves flexing their muscles as water filterers

☞ Mussels, once mostly ignored, are now being touted for their ability to clean streams much like oysters do for the Bay.

By WHITNEY PIPKIN

Oysters are in many ways the restoration darlings of the Chesapeake Bay cleanup effort. Touted for multiple benefits — as edible, water-filtering moneymakers — oysters attract both enthusiasm and funding to promote their recovery.

But the popularity of oysters often overshadows the water-cleansing role of other filter feeders such as mussels. A growing group of mussel advocates think it’s high time that the bivalves share the spotlight as clean-water workhorses that can carry the message farther upstream.

Projects to propagate mussels and restore them to waterways where they once thrived are cropping up in parts of Virginia, Maryland, Delaware and Pennsylvania as researchers working on them in various states begin to join efforts. The goal is to return some of the diversity once found in these waterways — mussel by mussel — so they can filter, feed, clean and otherwise serve the local ecosystem.

In late July, the Chesapeake Bay Foundation convened a meeting in at

Virginia Commonwealth University’s Rice Center on the James River, just south of Richmond, with more than two-dozen scientists and water quality advocates who are interested in seeing mussels expand their reach in the watershed. The day included a tour of a local mussel hatchery.

Costly MD oyster project pays off in pollution reductions, study finds. See article on page 19.

Joe Wood, the foundation’s Virginia scientist, sees mussels as a valuable tool for engaging new audiences in restoration work, particularly those who live far from the Bay and don’t feel connected to it.

“Mussels are a mascot they can rally around that relates to local water quality,” he said. “They’re also just really cool.”

Freshwater mussels come in all shapes and sizes, with nicknames that indicate their unique forms or textures, such as snuffbox, spectacle-case, pimple-back and pistol-grip.

Most live in rivers or streams, some others in lakes and ponds, but all rely on a current of water to provide phytoplankton and bacteria

MUSSELS CONTINUES ON PAGE 17

Chesapeake cleanup may lose race to 2025 goal, but presses on

≈ ‘Pollution diet’ is credited for spurring programs, but not enough action so far

By KARL BLANKENSHIP

As the Chesapeake Bay region enters what was supposed to be the final stretch of a decades-long effort to clean up the nation’s largest estuary, it — once again — faces a cleanup goal it appears likely to be missed.

Progress has been made — and Bay water quality has improved — but the region is significantly off track to meet its 2025 cleanup goals. In fact, updated

THE BAY’S POLLUTION DIET: IS IT WORKING?

pollution control targets approved by the state-federal Bay Program in July show that the shortfall is greater than previously thought.

That wasn’t supposed to happen after the U.S. Environmental Protection Agency adopted a new, more regulatory cleanup plan eight years ago.

Not only did the new “pollution diet” include oversight provisions that were supposed to keep cleanup efforts on track, work was supposed to be

front-loaded so that 60 percent of the needed actions would be implemented by the end of 2017 and put the region on a glide path to meet the 2025 goal.

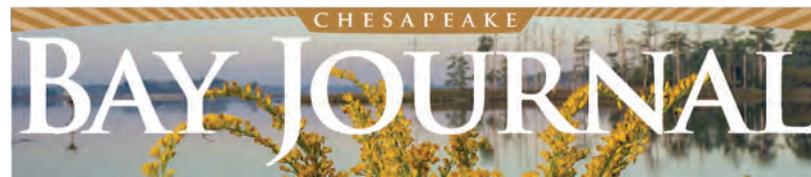
While the region did meet goals for two targeted pollutants, phosphorus and sediment, it achieved only 30 percent of the goal for nitrogen, which has long been the most difficult to control and is the most harmful pollutant in much of the Bay.

More worrisome is that the new

cleanup program doesn’t seem to have accelerated the rate of nitrogen reduction. Since 2010, the amount of nitrogen reaching the Bay has decreased at an average annual rate of 2.6 million pounds — or less than 1 percent per year — according to figures from computer models used by the state-federal Bay Program.

That’s essentially the same pace as the previous 25 years — and a rate at which it would take another quarter century to meet the Bay’s clean water

TMDL CONTINUES ON PAGE 27



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Editor's Note

Slow but steady may not be enough to win race to save Bay



If there is one way to describe the Chesapeake Bay cleanup, it might be "slow, but steady."

The Bay region has made progress toward reducing the amount of nutrients entering the Chesapeake since efforts

started in the late 1980s, and these actions are seen in monitoring, modeling and in resource response — like the recovery of underwater grass beds.

That progress has come in the face of tremendous growth. The watershed's population has increased from about 13 million to 18 million people; approximately 1.9 million acres of land have been developed; and, especially in recent years, farming has intensified.

So in that context, is the Bay's most recent "pollution diet" working? I interviewed a variety of state and federal officials, environmentalists and other stakeholders, and their answers were interesting, if nuanced. On one hand, the cleanup effort has failed to accelerate those much-needed nutrient reductions. In fact, the recent pace of nitrogen reductions is almost identical to the pace during the previous 25 years.

Stepping up progress will become increasingly difficult. Wastewater treatment plant upgrades, which account for the bulk of the nitrogen reductions since the pollution diet was enacted in 2010, have nearly maxed out. That means nearly all of the remaining reductions must come from stormwater and agriculture.

On the other hand, the pollution diet has resulted in ramped-up programs to address

those sources in recent years, and it is possible the pace of reductions will increase. But, with no further reductions from wastewater plants, it will require a huge increase in the rate of stormwater and agricultural reductions just to maintain the current rate of progress, much less accelerate it. It will take more funding, staffing and, potentially, regulations.

Is "slow, but steady" good enough? Maybe, especially if the Bay continues to show progress. But I was surprised at how many people thought that the region, out of frustration, could plummet into lawsuits over the slow rate of action and the strong probability that the 2025 cleanup goal will be missed.

During my interviews, I also found widespread agreement that the region needs to think differently in the future, that doing more of the same things isn't likely to work. More efforts need to go into reducing nutrient inputs — not just cleaning up after the fact — and exploring new technologies. Maybe we need even more focus on things like water-filtering mussels and oysters, that will, over time, help with the effort — and build a healthier ecosystem in the process.

Ultimately, the challenges facing the Bay don't end in 2025, whether the goal is met by then or not. There will be more people who need to be fed, and need places to live and work. And climate change will only make the job tougher. If the pollution diet builds a healthy Bay — one that shows it has indeed become healthy enough to bounce back from events like this year's torrent of rain and nutrients — it may well be deemed a success over time.

— **Karl Blankenship**



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Correction

An article in the September 2018 *Bay Journal* about Montgomery County's struggles with reducing stormwater pollution incorrectly reported the status of Maryland's water quality trading regulations. They were finalized in July. The *Bay Journal* regrets the error.

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Clockwise, from left:

Derek Warnecke of Blacksburg, VA, left, and Brad Fulcher of Amherst County, VA, pause while hiking on a hot September morning on an outcropping known as the Devil's Marbleyard in the George Washington and Jefferson National Forest. See article on page 36. (Jeremy Cox)

Ariana Sutton-Grier of The Nature Conservancy discusses research on Maryland's Deal Island looking at how natural features may shield the shoreline from erosion and storm surges. See article on page 22. (Dave Harp)

This little fish in the darter family, the Chesapeake logperch, was found to be its own species a few years ago. It recently turned up in a Lancaster County, PA, waterway. See article on page 25. (Rob Criswell)

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RiverSmart: BayScapes, rain garden performance tied to maintenance

BY LAURA TODD

On a chilly Saturday morning in March, a group of District of Columbia homeowners huddled around a backyard bonfire, eager for the approaching spring season. In addition to the warmer weather, many in the group also shared their excitement for the resurgence of native landscaping gardens planted in their yards.

They swapped stories of their participation in the RiverSmart Homes Program, which facilitated the installation of a rain garden or “BayScope” (native plant garden) on each of their properties. While some of their gardens were installed in recent weeks or years, others were early adopters of the program when installations began in 2009. At the garden party, a professional landscape designer, courtesy of Shorb Landscaping, Inc., answered the group’s maintenance questions and told them about a pilot program that would provide assistance in maintaining their gardens.

The growing need for maintenance services was emphasized by a RiverSmart Rain Garden Performance Study done by Urban Ecosystem Restorations, Inc. in partnership with the University of Maryland’s School of Landscape Architecture, the Landscape Architecture Foundation and the District of Columbia’s Department of Energy and Environment.

The study, which focused on 28 RiverSmart rain gardens in the District of Columbia, found evidence of some maintenance concerns. A handful of participating properties’ rain gardens were damaged, intentionally or unintentionally, as the result of a change in occupants or when a contractor hired to cut the lawn also mowed the rain garden.

More often, the study found that invasive plants had begun to establish themselves in the gardens, or plant communities had become unbalanced. In some cases, damage was done by homeowners who “loved their gardens” too much, as demonstrated by copious amounts of mulch, overwatering or overly aggressive “weeding” in which native plants were removed. It became clear that additional education and maintenance assistance for homeowners was needed to protect the city’s public investment in these gardens.

The Alliance for the Chesapeake Bay developed the Pilot RiverSmart 3-Tiered Maintenance Program to address some of the issues identified in the Rain Garden Performance Study by helping property owners to maintain their installations.

The pilot maintenance program was



Homeowners gather to learn how to maintain their native landscaping at a workshop sponsored by the Alliance for the Chesapeake Bay. (Jamie Alberti / Alliance for the Chesapeake Bay)



designed for flexibility: Homeowners can choose:

≈ Tier 1: They do the maintenance themselves and submit questions by email or phone about the best way to care for their garden.

≈ Tier 2: They can request a site visit, and for a fixed fee, receive on-site advice and direct, hands-on maintenance training.

≈ Tier 3: They can hire a contractor, at a pre-negotiated rate, to do routine maintenance or repair work on their garden.

Tier 1 offers suggestions and advice on how to address general maintenance issues cost-effectively, given the owner’s preferences and garden type. Property owners may elect to complete the suggested maintenance on their own or use a Tier 2 or Tier 3 service from the maintenance program.

In a partnership with the Alliance, Rachel Toker is one of the RiverSmart representatives who provides Tier 1 consultations for participating homeowners.

Meanwhile, Urban Ecosystem Restorations, Inc., an urban land trust working in the Greater DC area, focuses on preserving or creating

landscapes that perform ecosystem services over extended periods of time. It works to ensure that RiverSmart rain gardens and Bayscapes function at optimal levels for stormwater management, air quality improvement and biodiversity support.

“Most urban residents are not familiar with rain gardens or how they work — nor are they familiar with native plant behaviors and patterns — but once they know what they need to pay attention to and what they don’t, it gets much easier for everyone to ensure the health and functionality of these gardens in the long-term,” Toker explained.

Jamie Alberti, a senior program manager with the Alliance who coordinates the RiverSmart Homes Landscaping grant, designed the program as a part of the grant to better assist homeowners with their maintenance needs.

Looking to the future of the program, Alberti sees a great opportunity to grow the Tier 1 level of services that the program offers. Homeowners can call in or email questions about maintenance, and will get an answer from a RiverSmart representative. She plans to roll out additional resources in the near future. “Maintenance awareness will start through our new homeowner landscaping guide to get homeowners thinking about long-term maintenance

before their gardens are even installed,” Alberti said. “We will continue to build our online resources (available at allianceforthebay.org/maintenance) to serve as reference material for homeowners, as well as continue to offer the one-on-one opportunity for questions through our phone/email Tier 1 service.”

The RiverSmart Homes Program is creating more maintenance resources for all of its best management practices that go beyond landscaping practices such as rain gardens and BayScapes to include rain barrels, shade trees, impervious surface removal and permeable pavement.

In September, the District Department of Energy and Environment launched a website, riversmarthomes.org, where users can learn more about the program, see examples of past projects and read relevant articles.

The website has an entire section dedicated to maintenance where visitors can view care sheets, find information about invasive and native plants, watch short videos on a variety of maintenance practices and more. Soon, maintenance videos will be available for all of the best management practices that RiverSmart Homes installs.

More than 4,000 homes in the District have at least one RiverSmart Homes stormwater best management practice installed. With urban best management practice installations, monitoring must be coupled with maintenance to maximize stormwater retention benefits. Having invested significant funds, time and energy into the installation of these projects, maintenance is a vital piece of the puzzle to ensure long-term environmental benefits.

The installations will impact the Anacostia and Potomac rivers and Rock Creek — not today or tomorrow — but in the years and decades to come.

Laura Todd is the RiverSmart Program coordinator for the Alliance for the Chesapeake Bay’s DC Office.

Abnormally wet summer will challenge latest gains in Chesapeake's health

≈ Record streamflow threatens to impact Bay's fish and underwater grasses.

BY TIMOTHY B. WHEELER

Summer ended much as it began across the Chesapeake Bay watershed, drenched in rain that swelled rivers and streams. The abnormal run of chronically wet weather that continued into late September posed further challenges for maintaining recent gains in the Bay's health.

Freshwater flows into the Bay in August were the highest recorded for that month by a wide margin, the U.S. Geological Survey reported. And although Hurricane Florence didn't bring nearly as much rain to the Bay watershed in September as it dumped on the Carolinas, it produced enough to make Conowingo Dam open some of its floodgates yet again.

"The effects of Florence will be relatively short-lived to the Bay," predicted Scott Phillips, USGS Chesapeake Bay coordinator, as the storm approached. But he said the above-normal river flows that persisted from late spring through summer could have longer-term impacts on underwater grasses, the Bay's water quality and fish populations.



Freshwater flows into the Bay soared to a record high in August, and September brought floods and more high flows before, during and after Hurricane Florence. (David Harp)

Even before Florence hit, much of the mid-Atlantic region was experiencing the wettest year on record, or nearly so, according to the National Oceanic and Atmospheric Administration, with much of the watershed receiving two to three

times the normal amount of rainfall from May through July. Maryland saw record levels of precipitation through that period, while Pennsylvania had its wettest July since recordkeeping began 124 years ago.

cubic feet per second across the watershed. This year, the mean August flow reached 133,000 cubic feet per second, according to provisional USGS data.

River flows ran higher than normal across the Bay watershed from late spring through summer. A series of downpours in late July produced a peak flow at Conowingo Dam on the lower Susquehanna River of 375,000 cubic feet per second.

Things got only a little better the rest of the summer. Normal August streamflow entering the Bay ranges between 19,300 and 39,900

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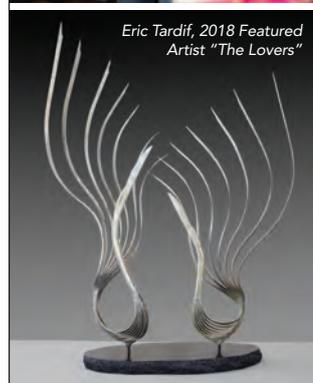
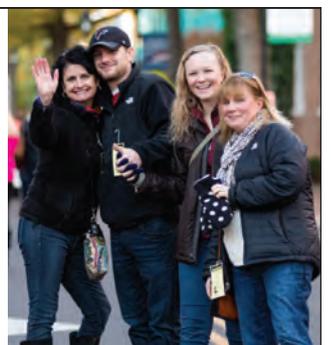
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Removal of Bloede Dam on the Patapsco begins with a bang

≈ Herring, shad, eels to benefit from demolition of long-dormant MD hydro facility

BY TIMOTHY B. WHEELER

After years of planning and preparation, the demolition of Bloede Dam finally began in September, with explosives blowing a hole in the long-dormant hydroelectric facility blocking the Patapsco River west of Baltimore.

Kiewit, the Nebraska-based contractor handling the removal of the state-owned dam, had been waiting in early September for the river's rain-swollen flow to subside before triggering the blast to make it easier for heavy equipment to work in the channel.

But Hurricane Florence's imminent East Coast landfall prompted a decision to get on with it, according to Amy Kober, spokeswoman for the

nonprofit conservation group American Rivers. The yearlong preparatory work for the dam's demolition already had suffered disruption and delay earlier this year because of severe flash flooding on Memorial Day weekend. Though the tropical storm came ashore in the Carolinas, there were fears its track could bring more heavy rain and potentially disruptive flooding to central Maryland.

Bloede's removal has been talked about and studied for more than a decade. It has limited the access of spawning fish to the lower 9 miles of the Patapsco since it was completed in 1907. Originally built to supply electricity to the nearby communities of Catonsville and Ellicott City, the dam became superfluous before long and ceased generating power in the 1930s. But it has continued to prevent fish

WET FROM PAGE 5

Then, as summer drew to its damp conclusion, a weakened Florence soaked the Susquehanna watershed, driving river flow at the dam back up to around 200,000 cfs on Sept. 20. The dam opened 10 of its floodgates that day to spill the rising water downriver into the Bay.

Though river flows this year haven't reached the peaks brought by past tropical storms or spring thaws, managers opened the dam's floodgates 87 times by Sept. 24, more than any year since 2006, said Deena O'Brien, spokeswoman for Exelon Corp., which operates the hydroelectric facility at the dam.

The high flows washed sediment and nutrients from lands across the watershed into a Bay already suffering from an excess of both pollutants.

As a result, oxygen levels in the Bay's waters have fluctuated through the summer. The Maryland Department of Natural Resources reported that hypoxic, or low-oxygen conditions, were worse than average in June. Conditions improved in July, in large part because windy storms had turned the water over, mixing oxygen back in. But in August, the DNR reported, the extent of low-oxygen water — where fish, crabs and shellfish struggle to survive — had dropped to near normal levels.

Even without the oxygen problems, the surfeit of freshwater into the Bay likely affected the survival of oysters and clams in upper portions of rivers, as well as the distribution of fish that favor either saltier or fresher waters.

The storms and resulting high flows also have brought waves of trash and debris into the Bay, littering shorelines and the water as well as posing navigation hazards for boats. After the late July storms, which yielded a bumper crop of debris in much of the Upper Bay, Maryland Gov. Larry Hogan wrote to Exelon asking for help in dealing with it.

Exelon officials have sued Maryland for requiring what it considers unreasonable conditions on its continued operation of the hydro facility, including keeping any



Exelon employees have removed 1,800 tons of floating debris at the dam so far this year, three times what they take out in a normal year. (Dave Harp)

"I know we're looking at what more we can do. [But] people need to take care of their trash."

— Exelon spokeswoman Lacey Dean

debris from passing over the dam. In a letter in response to Hogan, the company pointed out that the pollution and debris came from upriver in the Susquehanna's watershed.

Though debris is carried downriver when floodgates are open, much of it is trapped behind the dam, where it forms a vast raft of detritus. Plastic bottles, tires, foam coolers, soccer balls and even a few hot water heaters and propane tanks are mixed in among the tree branches and other floating wood.

Exelon employees have removed 1,800 tons of floating debris at the dam so far this year, three times what they take out in a normal year, according to Exelon spokeswoman Lacey Dean. The debris is sorted and as much as can be is recycled, said O'Brien, another Exelon spokeswoman.

"I know we're looking at what

more we can do," Dean said. But, she added, "People need to take care of their trash."

Beyond the unsightly litter, the repeated pulses of sediment and nutrients carried into the Bay by high flows this summer could spell trouble for underwater grass beds, one of the Chesapeake's most important habitats and a closely watched indicator of Bay health. Sediment blocks sunlight needed by the grasses growing on the bottom of the Bay and its tributaries, and high river flows can physically rip plants out of the soft bottom. Nutrients spur the growth of algae, which rob the water of oxygen when they die.

Grasses covered more than 100,000 acres of the bottom of the Bay and its tributaries in 2017, the highest level in decades.

Although the Bay's grass beds will

likely take a hit as a result of the summer storms, it "isn't going to be a complete washout," said Bob Orth, a researcher with the Virginia Institute of Marine Science who oversees the annual Baywide aerial survey of underwater grasses.

"We've been getting imagery after that big flow in July, and I've been shocked at what we've seen in terms of presence of grass that's hanging in there," he said.

Grass beds appear to be holding their own in Virginia's Rappahannock River and have actually expanded in the upper Chester River in Maryland, he said. They have expanded as well in the upper Patuxent River, Orth added, but a large bed off Solomons Island in the lower part of the river has disappeared.

In the James in Virginia and the Severn in Maryland, beds that existed last year appear to have persisted, though their size might be reduced, Orth said.

But the rain, clouds and turbid water have hampered the annual aerial survey, putting it

behind schedule. Areas with large beds, such as the Susquehanna Flats in the Upper Bay, have not yet been surveyed.

"The areas that we haven't flown are unfortunately important areas," Orth said.

The full impact, Orth cautioned, may not be known until next year. Some grasses need to build up energy during the sunny summer weather to overwinter and come back the next year. If they tap into their reserves because turbid water was blocking sunlight, it might impact their ability to survive and regenerate.

"The story is really going to unfold next year to see whether the plants were able to store reserves so that next spring they can come out of hibernation and do well," he said.

Bay Journal editor Karl Blankenship contributed to this article.

BLOEDE FROM PAGE 5

and eels from getting upriver while also posing a safety hazard. Situated in one of Maryland's more popular state parks, the dam has proven to be a dangerous attraction — there have been nine deaths from drowning there since the 1980s, according to the state Department of Natural Resources.

Bloede is the third large fish barrier on the Patapsco to be removed. Union Dam was taken out in 2010, followed by Simkins Dam in 2011. This \$17 million project, mostly underwritten with federal funds, will open up 65 miles upriver for the annual springtime spawning runs of migratory river herring and American shad, authorities said. It will also make even more of the watershed accessible to American eels.

The initial blast was planned to open up one end of the dam, drawing the river's flow through the breach so that heavy equipment could move into the channel and take out the rest of the reinforced concrete structure. Removal is expected to take several months, followed by the restoration of the portion of the riverbank that has been cleared and graded to provide access for heavy equipment. That area of Patapsco Valley State Park, closed to the public since last year, is expected to reopen in 2019.

The removal of Bloede Dam is likely to have short-term impact



Explosives breach the Bloede Dam on Maryland's Patapsco River in September, the beginning of a demolition process that will open upstream habitat to migrating fish and eels. (MD DNR)

on fish habitat in the lower Patapsco because it will release more than 300,000 cubic yards of sediment that have accumulated behind the dam. Analysis of the sediment buildup found it to be mostly sand and gravel, and less than a third silt, and without

significant toxic contaminants. The DNR has said that fishing success could decline for a year or two as sand and gravel wash downriver, but habitat is expected to recover afterward.

Dams are being breached throughout Maryland, Pennsylvania and Virginia to

restore long-lost spawning habitat for migratory fish. More than 1,200 stream miles have been opened in the last seven years, a nearly 50 percent increase in the number of stream miles opened to fish migration in the preceding 22 years, according to the Chesapeake Bay Program. That increase surpasses the goal set by the states and federal government to open 1,000 additional miles by 2025.

Much more work remains to be done to restore all historic spawning habitat. According to data compiled by The Nature Conservancy, there are an estimated 3,828 dams remaining across the Bay watershed, with each blocking more than 22 stream miles on average.

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PA coalition spells out key conservation issues before election

≈ Groups unite to send list of problems, policy solutions to gubernatorial candidates.

By DONNA MORELLI

Pennsylvania gubernatorial candidates have some explaining to do if they want the support of environmentally minded voters in November. Both Democratic Gov. Tom Wolf and his Republican challenger, Scott Wagner, are presumably in receipt of the *Pennsylvania Common Conservation Agenda* — a 20-page document identifying the state's most pressing environmental problems and suggesting policy solutions.

Authored by the advocacy group PennFuture in collaboration with 26 conservation organizations, the agenda is part of the “Green in 18” campaign — PennFuture's effort to bring environmental issues to the fore in the upcoming election.

“It is a very important time for PennFuture and our partners to raise issues to candidates in a public and supportive manner to see how they respond,” said the group's CEO, Jacquelyn Bonomo. “We need more investment in clean water, clean-energy jobs and [we need to] restore the funding that has been cut from state agencies dealing with environmental issues.”

“If you are elected governor,” the agenda's cover letter begins, “we expect that you will stand up for these rights, and we intend to work with you to protect and preserve the health of Pennsylvania's citizens and the environment that sustains them.”

The letter also reminds the candi-



The Susquehanna River flows by the Pennsylvania capitol in Harrisburg. (Dave Harp)

dates of the 1971 Environmental Rights Amendment to the state constitution, which establishes Pennsylvanians' right to “clean air, pure water, and the preservation of the natural, scenic, historic and esthetic values of the environment.” Public natural resources are common property, the amendment says, and it is the state government's

responsibility to “conserve and maintain them for the benefit of all the people.”

In a legal challenge last year, the amendment was upheld by the state Supreme Court.

Still, Pennsylvania has frequently been singled out by the U.S. Environmental Protection Agency for its failings — from poor air quality and unsafe drinking water to insufficient progress on Chesapeake Bay cleanup efforts.

“Pennsylvania has the third worst air quality in the United States,” PennFuture states in its executive summary of the agenda, and is

“among the states with the highest risks for lead-contaminated water. Nineteen thousand miles of our streams and rivers are unsafe for drinking, recreation, aquatic life, agriculture, or industrial use.”

Many of those problems have been worsened by several years of budget reductions, which have undercut the

missions of the state's Department of Environmental Protection and Department of Conservation and Natural Resources.

The conservation agenda addresses that issue, offering sobering statistics on budget cutbacks since the early 2000s. “Between [2003 and 2016] the Department of Environmental Protection saw a 40-percent budget reduction, dropping from a high of \$245.6 million to \$142.6 million,” the document points out. “As a result, the department retired more than 700 positions.”

Other key items on the agenda include a call for improving state agencies' ability to protect citizens from the “immense new threats” posed by the Marcellus shale natural gas (fracking) boom; a much stronger effort to prevent drinking water pollution; a push for a 21st century workforce through green jobs; a focus on environmental justice to protect poor communities from bearing the brunt of pollution problems; more investment in the state's Growing Greener program; and greater investments in clean energy.

National groups with a presence in Pennsylvania, such as the Audubon Society, Nature Conservancy and Sierra Club, have signed on in support of PennFuture's agenda, as have the Natural Resources Defense Council and the Environmental Defense Fund. To help keep these issues in the political conversation, PennFuture is also seeking citizens who are willing to ask agenda-related questions of the candidates in public forums.

PA power plant accused of illegal discharges into Susquehanna tributary

≈ Intent-to-sue notice alleges Brunner Island plant leaked chemicals from coal ash pond and landfill.

By DONNA MORELLI

A Pennsylvania power plant — accused of being one of the most polluting plants in the nation and the recipient of several fines for fish kills — is facing legal challenges once again. The Brunner Island power plant, located along the Susquehanna River just south of Harrisburg, may be the target of a lawsuit alleging that the plant is illegally discharging contaminants from coal ash into a Susquehanna tributary.

In August, four nonprofit environmental groups filed a notice of intent to sue Talen Energy, the plant's owner.

The Environmental Integrity Project, based in Washington DC, filed the notice on Aug. 29 on behalf of the Lower Susquehanna Riverkeeper

Association, Waterkeeper Alliance and PennEnvironment. Court papers assert that the discharges violate the federal Clean Water Act and Pennsylvania's Clean Streams Law. The notice includes Riverkeeper water quality data as well as an analysis of several years of company-collected results from monitoring wells on the property.

The notice contends that a coal ash pond and landfill on the island have been leaking contaminants into Black Gut Creek and groundwater for years.

Coal ash is a byproduct of burning coal for power. Though not considered a hazardous waste, it can contain chemicals and metals that pose health risks for people, as well as fish and wildlife. A “pond” is where the coal ash is mixed with water and stored; a landfill contains only dry ash.

Brunner generates 445,000 tons of coal ash annually, according to the notice.

Ted Evgeniadis, the Lower Susquehanna Riverkeeper, said he and other waterkeepers began building a case in February. In addition to citing contaminants found in the monitoring data, Evgeniadis said there is an outfall near the seeps that is not recorded on any permit from the state Department of Environmental Protection. Both the DEP and Talen Energy declined to comment for this article because of the potential litigation.

“Talen Energy knows what's going on,” Evgeniadis said. “What I saw was groundwater seeps directly discharging into the waters of Black Gut Creek. If you go back into the records, the seep that we found and where we recorded our samples is in direct proximity of seeps that were previously recorded years ago.”

According to Evgeniadis, water samples he collected from seeps on the creek have registered high levels of

arsenic as well as other pollutants such as boron, ammonia and lithium.

Coal ash contaminants drew attention in 2008 when 1.1 billion gallons of coal ash slurry breached a dam in Tennessee. Gray sludge covered nearly 300 acres of land, and flowed into the Emory and Clinch rivers, tributaries of the Tennessee River. The breach caused fish kills in the Tennessee River and destroyed 12 homes.

Another plant in Pennsylvania, also owned by Talen, spilled 100 million gallons of coal ash and water into the Delaware River in 2005. The company paid nearly \$1 million to the DEP for damages to natural resources, after a cleanup took place with a price tag of \$35 million.

Talen Energy came to an agreement with the Sierra Club earlier this year when that group also threatened

BRUNNER CONTINUES ON PAGE 9



Ted Evgeniadis, Lower Susquehanna Riverkeeper, stands in front of the Brunner Island Power Generation Plant on the Susquehanna River about 20 miles downstream of Harrisburg. Evgeniadis' group, along with others, has filed a notice of intent-to-sue its owner, Talen Energy, for alleged violations of the Clean Water Act and Pennsylvania's Clean Streams Law. (Tom Pelton / Environmental Integrity Project)

BRUNNER FROM PAGE 8

to sue the company for similar water pollution problems. The agreement in March was outlined in a consent order stating that the plant would stop burning coal and complete its transition to natural gas by 2029. In return, the Sierra Club agreed not to initiate or participate in any actions, discussions or processes related to Brunner's transition to natural gas.

The plant added the capacity to burn natural gas in 2016 in addition to coal. Talen has indicated that the facility will continue burning coal at some level up until the 2029 deadline.

Some of the data collected on behalf of Sierra Club, such as engineering and hydrology studies, are being used as evidence in the current intent-to-sue documents.

"The Brunner Island plant is a poster child for the public health hazards posed by coal ash dumps across the country," said Mary Greene, deputy director of the Environmental Integrity Project. "It is also a compelling example of why power companies need to take responsibility and halt groundwater pollution."

Coal ash storage along the Virginia side of the Potomac River has also stirred recent controversy when

Dominion Power planned to close some of its ash ponds by draining them into a Potomac tributary. Dominion and other power plants were looking to close their storage ponds to comply with a 2015 federal rule — the first of its kind — to regulate discharges of coal residuals to ground and surface waters.

In response to the debate, Virginia legislators passed a bill this year that required companies with coal ash pits in the Chesapeake watershed to consider recycling their contents rather than allowing the ash to be permanently stored in place. The law stops short of requiring recycling, though.

Talen Energy Corp. and state or federal regulators have 60 days from the time of notice to address accusations, Evgeniadis said. Attorneys will file a lawsuit if the claims are not addressed at that time.

The U.S. Environmental Protection Agency imposed coal ash regulations under President Obama in 2015, the first year that the contaminants were regulated. The 2015 rules required companies to monitor and publicly report the contamination of groundwater by coal ash landfills and ponds. The Trump administration in July, though, issued proposed regulations to roll back the Obama era rules.

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Growing tension marks simultaneous uptick of clam dredging, Bay grasses

As soft shell clams rebound, their harvest leaves cloudy water in its wake.

By **WHITNEY PIPKIN**

The soft shell clam's meek return to Maryland waters is a bright spot on the Chesapeake Bay landscape. But an increase in the number of watermen going after them has renewed some fears that the nascent fishery could choke itself off before reaching its full potential.

Also called white clams, manos, longnecks and steamers, had all but disappeared from Bay waters, where they had been the source of a thriving fishery in the 1950s and '60s. After decades of little-to-no soft shells in most areas, the clams have rallied the last five years, particularly

increase in soft shells by the number of boats dredging in Eastern Bay, leaving plumes of stirred-up sediment suspended in their wake. But each time soft shells reappear, no one is sure how long they'll stick around before a combination of factors beat them back to modest numbers.

"At what point do we start to try to avoid that massive drop-off while also getting the ecological benefits of this soft-shell clam?" Bassett asked.

The up-and-down nature of the beleaguered clam population merits more study, Bassett said. She and others in the ShoreRivers consortium of riverkeepers would like to see the state conduct an environmental assessment of the soft shell clam population to consider how many can be sustainably harvested each year.

species. In a 2011 report, the Maryland Department of Natural Resources estimated that soft shell clams once constituted at least 35 percent of the state's large bivalve population, which includes oysters, razor clams and hard clams.

Razor and hard clams also are harvested by hydraulic dredge, though watermen are limited to where they can use the equipment that was introduced to Maryland in the early 1950s. The Maryland legislature banned hydraulic clam dredging in the state's Atlantic coastal bays near Ocean City in 2007, a contentious decision at the time that shuttered that region's clamming industry.

The technique used to harvest clams is called hydraulic dredging: a suction tube vacuums sediment onto a conveyer belt

from which watermen pick out the clams and release the rest back to the water. The process disturbs the bottom and can generate a sediment plume, both of which have the potential to harm the underwater grasses that are often located nearby. Grasses and clams grow in similar conditions and their habitats can overlap, although grasses typically grow in shallower areas than soft shell clams.

Dave Blazer, the DNR's fisher-

ies service director, said the change in the coastal bays came after the number of boats running small portions of the coastline for hard clams quadrupled over a short period, scouring grass beds in some areas. He said the circumstances in the mid-Bay are different — even in years when the number of boats going after soft shells skyrockets.

"There's a lot of space in the Bay, and clamming has been around for 60 or 70 years," Blazer said. "There's going to be isolated conflicts, but the Bay's a big area, and I think we can accommodate a lot of these activities."

The DNR completed a review of scientific studies on the environmental

impact of hydraulic dredging in 2001, and it details some of the differences between dredging off the coast versus in the Bay and its rivers (though most of the research focused on coastal bays). In both cases, "the direct impact of dredging in sea-grasses is catastrophic," the report states. The indirect effects of dredging, such as the plumes of sediment left behind and their impact on nearby grass beds, "are less clear."

Potential impacts on the aquatic ecosystem were nearly a moot point when there were hardly any clams to harvest. As recently as 2013 and 2014, according to DNR data, there were just eight watermen bringing in 278 bushels of soft shells in Maryland. But when that number rose to 31 boats harvesting 17,468 bushels of the clams two years later, river advocates began to take notice.

Over the same five-year period, the Bay's underwater grasses have expanded their reach at a record-breaking clip, flourishing under improved water conditions. Maryland law does not allow hydraulic dredges to be used in grass beds, but those rules could be more difficult to enforce if both grasses and soft shell clam harvests expand.

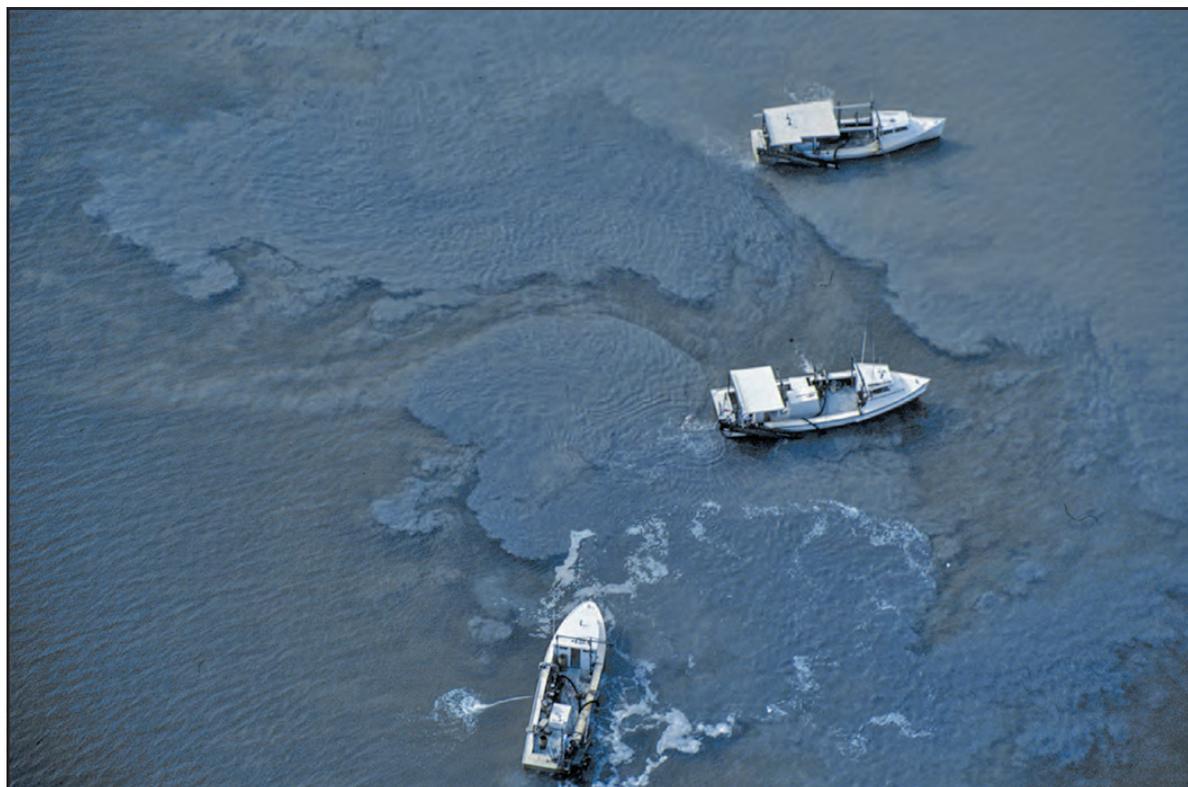
The ShoreRivers group is closely watching the grass beds that the DNR marks as off-limits to dredging to ensure that they match surveys of grass beds conducted by the Virginia Institute of Marine Science, alleging they have not aligned in the past.

Rebecca Golden, program manager for resource assessment services at the DNR, said that the department is discussing how a variety of human activities, including hydraulic dredging, interact with the grasses as their acreage grows. A workgroup at the state-federal Chesapeake Bay Program, for example, is looking at whether the laws regulating activities around grass beds are protective enough.

The DNR is required to mark off protection zones for the grass beds as they are mapped by aerial surveys. Areas that have grasses or have had them in the last three years are off-limits to hydraulic dredging, bottom dredging and harvest by shinnecock rake. They are also to be marked with landmarks and buoys.

Blazer said the agency is in the process of completing update of those protection zones for 2019, which will be posted publicly. The updates are included in the information packet that comes with a new clamming license, along with notices about shoreline setbacks or natural oyster beds that are also off-limits to the equipment.

The number of licenses doled out for soft shell clams has risen steadily the last five years as word of their comeback



During hydraulic dredging, a suction tube vacuums sediment onto a conveyer belt from which watermen pick out the clams and release the rest back to the water. The process disturbs the bottom and can generate a sediment plume, both of which have the potential to harm the underwater grasses that are often located nearby. (Tyler Campbell)

in Maryland's Eastern Shore rivers. And the number of clambers dredging for them has risen, too.

While watermen contend that poor water quality and bad weather have driven the shellfish's downfall in the past, some river advocates wonder whether the clamor to harvest them — without an overall assessment of the population — has contributed as well. And some are asking whether an increased harvest, which relies on dredging to extract clams from the bottom, could have local impacts on water quality and the Bay's underwater grasses.

Elle Bassett, the Miles-Wye Riverkeeper, said she can almost measure the

Watermen are permitted to harvest soft shells year-round, with a daily catch limit of 8 bushels in the summer and 15 in the winter — limits that haven't changed with fluctuations in the clam population. The clams have to be a minimum of 2 inches across. Virginia has yet to recover a viable population of soft shells or a market for them after the clam declined in the 1970s after Tropical Storm Agnes and the arrival of a parasite called *Perkinsus chesapeaki*, which went on to infect soft shells in Maryland in the 1990s.

Soft shells research waned with the industry decades ago, but scientists know that they filter water much like oysters and provide food for other

CLAMS FROM PAGE 10

spread, though only about half of the watermen who get a license end up reporting back with a harvest. The number of people who declared their intent to harvest soft shells rose from 85 in the 2015–16 season to 170 the next year, with about half reporting a harvest each year. The harvest numbers were not yet available for the 2017–18 season, but Blazer said that 179 declared an intent to harvest soft shells, and he expects about half did.

This season was shaping up to be a banner year for both Bay grasses and soft shell clams, which were once a food staple in the Bay but are now mostly sold to markets in New England. But heavy rain that started in July left the habitats where soft shells grow deluged with freshwater and sediment. The clams, which prefer higher salinity, had “gotten hammered” by the time the DNR went out for a survey later that month, Blazer said. During surveys, the grasses appeared to have suffered from the deluge as well.

“Our folks did not see that many [soft-shell] clams, and those they did find were stressed,” Blazer said, though there were small clams among them that could bounce back for future harvests. “We’re in the southern range of where these clams are [on the East Coast]. If the environmental conditions are right, they’ll be here in good numbers. But if it’s not,



James Thomas with a load of razor clams at Bryantown Landing on the Wye River. He, like others, moved on to harvesting razor clams, sold as crab bait, after finding few soft shells in late summer. (Dave Harp)

they’ll disappear for a couple of years.”

James Thomas, an Eastern Shore waterman, said that he, like many others, moved on to harvesting razor clams, sold as crab bait, in other parts of the Bay after finding few soft shells in late summer. But he doesn’t think dredging, which has been taking place in the Bay since midcentury, is contributing to the rise-and-fall cycle of soft shells.

“Mother Nature can do more in 30 minutes than we can do with a clam rig in five years,” said Thomas, 34.

He said that his great grandfather, Medford Thomas, was one of the pioneers of the state’s clamming business in the 1940s. His family continued the tradition through the boom years when hundreds, not dozens, of boats were dredging the Bay for soft shells, and through the bust

years when there were none to be found. “The soft shells made a comeback, but that was due to water quality,” Thomas said. “Fix the water quality and the Bay will fix itself.”

Thomas said that grass beds are something clammers would want to avoid even if there weren’t regulations requiring it, because the grasses clog the equipment and are cumbersome to remove. But some studies included in the DNR’s review found that, even when the dredge stays out of the beds, the plume of sediment they leave behind could have an impact. Silt and clay particles common in river bottoms can remain suspended in the water longer than sand, particularly when the harvest takes place in shallow areas.

The report found that little information was available about the broader impact of dredging on the habitats where clams live, but many of the impacts are mitigated by preventing the dredge from being used in grass beds.

Bassett said each of these factors should be considered in setting more precise parameters for the boom-and-bust fishery.

“It’s hard to do a stock assessment of [soft shells], but I’m not aware of any studies that have even tried,” Bassett said, noting that hard clams in the state’s coastal bays are regulated by a fishery management plan. “Every harvest we have in the Bay should be looked at: How does it benefit the economy and the ecology?”

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VA poultry groundwater fight escalates as crackdown looms

≈ Withdrawal permits designed to ensure aquifer's supply will meet demand.

By JEREMY COX

Large poultry farms on Virginia's Eastern Shore have been pumping groundwater from the region's fragile aquifer for years with no oversight from the state Department of Environmental Quality, which is charged with protecting drinking water supplies.

Now the agency is taking steps to regulate the withdrawals, issuing orders to 57 poultry operations. The orders approved by the State Water Control Board in September would allow those farms to continue tapping into the Shore's primary drinking water reservoir, consuming a total of nearly a half-billion gallons a year, until final permits are issued.

The orders set maximum monthly and yearly withdrawal limits for each of the facilities, but those thresholds are just a temporary measure, said Drew Hammond, who oversees the DEQ's water withdrawal permitting program. Each operation will still need to get a final permit, hinging on the results of a new state monitoring program that will establish its actual water consumption and on computer-modeling that will determine whether enough supply is available to meet demand.

"Any water withdrawal limits that may have been requested may be adjusted," Hammond said at a public hearing recently in Accomack County, home to all but one of the unpermitted farms.

Concerned neighbors and environmental advocates say they aren't out to shut down poultry farms. Many hope the ordeal will lead farmers and the Eastern Shore's two agribusiness giants, Tyson Foods and Perdue Farms, to reduce their dependence on the upper portion of the Yorktown-Eastover aquifer.

The U.S. Environmental Protection Agency has designated the Yorktown-Eastover as a "sole-source aquifer" because no other significant source of drinking water exists in the region.

"I don't think anyone wants to stop anything. We want them to go where there is water," said John Coker, a member of the Northampton County Board of Supervisors and chairman of the Eastern Shore's groundwater advisory committee. "This is not about poultry. This is about anyone who wants to withdraw water in the future."

The Eastern Shore water battle centers on a state law, enacted in 1992, that requires any entity wanting to consume at least 300,000 gallons of



Chickens take turns at the yellow automatic water dispensers at Eddie Kelley's farm in New Church, VA. (Dave Harp)

groundwater per month to get DEQ approval first. The law applies to users in two parts of the state: the Eastern Shore and a portion of the mainland east of Interstate 95.

But until recently, chicken operations hadn't been requesting permits, and no one at the DEQ was asking for them. Farmers had been registering

their wells with the local health department, but that information was not being relayed to the DEQ, officials said. (As a result of the current groundwater controversy, the two sides are now talking, they said.)

Eddie Kelley, who tends eight chicken houses in New Church just south of the Maryland border, wants to maintain his groundwater access now and in the future — after he retires in a few years and his son takes over. His consent order would allow him to use up to 3 million gallons of water per month, but he said that his actual usage is usually far less.

"The existing wells should be grandfathered, not have to apply for a permit

and then be subject to [the DEQ's] idea of how much water you should be able to withdraw," Kelley said. "To be threatened with my livelihood and my son's livelihood, it's scary."

At the heart of the dilemma lies an irony: The Eastern Shore is surrounded by water, with the Chesapeake Bay to the west and Atlantic Ocean to the east.

"The existing wells should be grandfathered, not have to apply for a permit and then be subject to [the DEQ's] idea of how much water you should be able to withdraw. To be threatened with my livelihood and my son's livelihood, it's scary."

— Poultry farmer Eddie Kelley

And rainfall is plentiful. But of the 44 inches of annual rain, only about a half-inch seeps into the Yorktown-Eastover aquifer, scientists have found. The rest winds up elsewhere — taken up by plants, evaporated into the atmosphere or washed off the land into the sea.

State water managers fear that wells may start going dry or saltwater will invade the groundwater. Over the last 20 years, water levels in some wells have dropped by an average of more than 20 feet, particularly in deeper portions of the aquifer, according to measurements taken by the U.S. Geological Survey at observation wells. While the salt concentration has been stable

in the upper Yorktown-Eastover aquifer, it is increasing at lower groundwater levels, according to the groundwater committee's materials.

If their permits are approved, poultry farms would be the most numerous category of large water users on Virginia's Eastern Shore, accounting for 57 of the 119 DEQ permittees. But their 1 million gallons a day of total permitted withdrawals would represent only about 10 percent of the amount set aside for that 119, according to Britt McMillan, a consultant working for the groundwater committee. The

other users include crop farmers, heavy industry and municipal water systems.

The overall amount being used appears sustainable for now, said Scott Kudlas, DEQ's director of water supply.

"We don't see evidence in our monitoring wells that alarm us," he said.

But McMillan has calculated that the current use from all wells — farms, chicken operations, heavy industry, private homes on well water — exceeds the aquifer's ability to recharge by 1 million gallons a day. Kudlas, for his part, argues that recharge rates and usage vary up and down the Eastern Shore, so a single number doesn't represent the whole picture.

Jay Ford, the Chesapeake Bay Foundation's Eastern Shore outreach coordinator, said the state's groundwater regulations are too weak to protect a resource as vulnerable as the Yorktown-Eastover aquifer. Permitted users can draw down the water level beneath their wells by as much as 80 percent without sanction.

"Drawing down the aquifer doesn't seem to be sustainable," Ford said.

He supports the groundwater committee's efforts to persuade policymakers and the agricultural industry to pump from a different reservoir — the Columbia aquifer, just beneath the land's surface — for some

WATER FROM PAGE 12

of their water needs. Currently, poultry operations use the Yorktown-Eastover aquifer to pipe in slightly less than half of the water they use for their chickens to drink and the rest for cooling the long, shedlike buildings that house them. Ford and other critics say farmers should use the Yorktown-Eastover, which has better quality drinking water, solely for watering their birds while tapping into the Columbia for cooling.

“If we don’t get the state to make this happen, I have lost confidence that we won’t have a major disaster at some point in the future,” said Elaine Meil, a groundwater committee member and executive director of the Accomack-Northampton Planning District Commission. She is pushing for the state to streamline the application process for using the Columbia.

The idea hasn’t caught on yet. None of the 42 final poultry farm permit applications analyzed by McMillan as of mid-August had proposed drilling into the Columbia.

Virginia’s water regulations require withdrawal applicants to use the “lowest quality water for the proposed activity.” But it’s up to the applicants, not the DEQ, to judge which water source best fits their needs, Kudlas said.



Eddie Kelley stands in one of eight chicken houses on his farm in New Church, VA. Perdue varies the flock sizes but this house contains approximately 21,000 two-week old chickens. (Dave Harp)

“We can’t upfront say, ‘You can only use the Columbia aquifer for cooling.’ They’re allowed to apply for the water they wish,” he said.

Poultry farmers repeatedly argue in permit applications that they shouldn’t be required to use the Columbia

aquifer because its water quality is substandard and it lacks a reliable supply.

Water monitoring results tell a different story, McMillan said. There’s no reason to believe the Columbia wouldn’t yield enough water, he told

the groundwater board recently.

As for the quality, he said, the two aquifers each present pros and cons. The Columbia contains more nitrates, which pose potential health hazards to humans, and it’s more susceptible to contamination because it lies just below the land surface. Meanwhile, the Yorktown-Eastover is saltier, making it more corrosive to cooling equipment parts. And, because it’s slower to recharge, the Yorktown-Eastover aquifer is more at risk for overpumping and saltwater infiltration.

Kelley, the New Church farmer, said some of the wells he uses have been in operation for decades without a quarrel from anyone, so he and many others were caught off guard by the state’s demand for permits.

His chicken houses are older than many of his fellow contractors’ facilities, putting him at a disadvantage in the industry’s “tournament system” of compensation, which bases a grower’s pay on how well it performs against similar operations. The last thing he needs is to have to spend thousands of dollars drilling new wells, he said.

“I live here, too. I’m not crazy,” said Kelley, a fourth-generation farmer. “I want to have water, too, just like everybody else. But unfortunately, my livelihood depends on the water.”

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VA pipeline construction to continue with 'aggressive' monitoring

≈ Water control board opts against revoking permits or tightening stream protection.

BY WHITNEY PIPKIN

Will existing environmental rules be enough to protect Virginia streams from the potentially damaging side effects of two pipeline projects? Citizens and environmental groups cry no, but the State Water Control Board says its hands are tied.

The seven-member board decided at a contentious Aug. 21 meeting to continue allowing two natural gas pipelines — the Mountain Valley Pipeline and Atlantic Coast Pipeline — to be constructed across the state, under additional oversight.

The governor-appointed board is charged with administering the state's water control laws and resolving special issues.

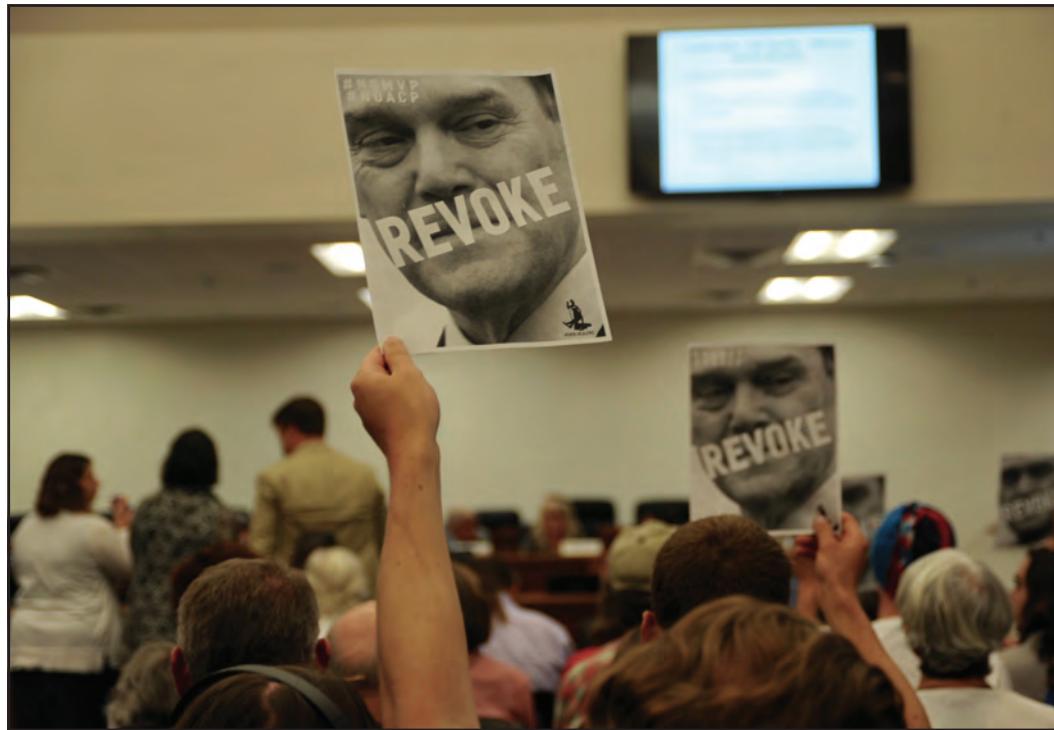
Both pipelines will carry natural gas, extracted from underground shale formations using a controversial technique called hydraulic fracturing or "fracking." Pipeline construction entails disrupting wetlands, crossing streams, removing trees and exposing bare soil, sometimes on steep slopes.

The Mountain Valley Pipeline travels a largely north-south route through West Virginia into Virginia's southwest corner, where work is already under way.

Construction has also begun on the Atlantic Coast Pipeline in West Virginia. From there, it will cut a southeastern path through Virginia, including parts of the Chesapeake Bay watershed, to North Carolina. According to the Southern Environmental Law Center, it will cross Virginia waterways nearly 1,000 times.

The State Water Control Board decided in April to open the pipeline projects they had conditionally approved to another public comment period, which garnered 13,000 comments by the August meeting. The board sought input on whether additional state permits should be required for each of the projects' stream crossings to ensure water quality is protected on top of the blanket permit required by the U.S. Army Corps of Engineers for crossing waterways.

Officials with the state Department of Environmental Quality have said that existing laws will protect water quality, and the board ultimately agreed. Its members debated suspending permits for both pipelines and enacting other measures that would require stream-by-stream analysis; ultimately, though, they pulled back in a unanimous vote and



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

directed the DEQ, which is tasked with monitoring hundreds of miles of pipeline construction, to make some changes in response to public concerns.

In a written statement, board members urged state regulators to be "aggressive" in their enforcement of existing laws intended to reduce erosion and sediment pollution during construction. They asked the DEQ to require more stringent erosion controls where needed to prevent sediment-laden runoff from washing off construction sites — as it has in several places along the path of the Mountain Valley Pipeline so far this summer.

"There is turbidity and sedimentation associated with this construction that is not acceptable, and enforcement action needs to be taken," board member Tim Hayes said to a crowd that made it clear they were looking for more. "I want that enforcement action to be as aggressive as it possibly can."

Citizens who live along the pipeline path where construction has begun insist those controls are not enough.

Several of the nearly 200 people that attended the August meeting held up photos that showed the damage they see the projects causing to streams and properties. Sent to the board in the weeks leading up to the meeting, the images showed streams filled with raw dirt and water-filtering berms overwhelmed by the high flows after heavy rain this summer.

"When you certified these pipelines

back in December 2017, is this the kind of harm you anticipated and envisioned?" Charmayne Staloff, associate attorney at the Southern Environmental Law Center, asked the board at the meeting. "The answer to that question has to be no."

In a statement, the Chesapeake Bay Foundation's Virginia assistant director, Peggy Sanner, called "the board's failure to take more meaningful action" disappointing.

"In just the first few months of construction, the Mountain Valley Pipeline has polluted rivers and streams with sediment, triggered mudslides and put drinking water sources at risk. The board's action will not prevent this damage from occurring on an even larger scale if construction on the Atlantic Coast Pipeline ramps up," the statement said.

The DEQ already had issued a stop work order and notices of violation to the Mountain Valley Pipeline after construction contributed sediment to nearby waterways in June and July. The Federal Energy Regulatory Commission also ordered the project to stop construction on a 3.6-mile segment in the Jefferson National Forest — and then along the entire project — until the construction sites could be stabilized.

Organizations, some of which are participating in legal challenges against the projects, also argued that — even if the sites were fully compliant with state law — the law doesn't go far enough to protect

water quality. They also expressed concerns that the DEQ may not have enough staff to adequately oversee the projects.

Before the meeting, several local groups opposing the Mountain Valley Pipeline, including Wild Virginia, circulated a letter clarifying that state law only requires the project to prevent erosion during the sort of storms it was designed to handle. In this case, DEQ officials explained at the meeting, the projects are only required to prevent erosion during a two-year, 24-hour storm event. If a stronger storm resulted in erosion, project managers would not necessarily be held responsible by those laws.

"If the storm exceeds the 'design storm,' a statistically derived rainfall amount engineers

use as a guideline in sizing pollution control measures, then DEQ apparently decides the polluter is not liable for its discharges or the water impacts they cause," the letter stated.

DEQ officials reiterated this rule during their three-hour presentation to the water control board, after which citizens had 30 minutes for public comments.

"Most of the rain events that we have seen to date are exceeding those two-year, 24-hour storm events," explained Ben Leach, team leader of the DEQ's office of stormwater management, to the guffaws of many in the audience.

Less than a week after the board's decision, Virginia's Advisory Council on Environmental Justice recommended that the state revoke the permits for both projects. The council raised questions about the projects' impact on human health and the environment, particularly in "predominantly poor, indigenous, brown and/or black communities."

Virginia Gov. Ralph Northam has maintained that the state's regulatory process is working as it should to protect air and water quality while allowing the projects to proceed. But the 15-member council urged him to reconsider that stance in a formal letter advising that water and air quality permits for the projects be suspended. The board was created by former Gov. Terry McAuliffe to make recommendations, but it has no authority over the regulatory process.

Pipeline proposals to test Delmarva's appetite for natural gas

≈ Opponents say pipelines could go through areas set aside for conservation and/or contaminate water; proponents say it would make region more economically competitive.

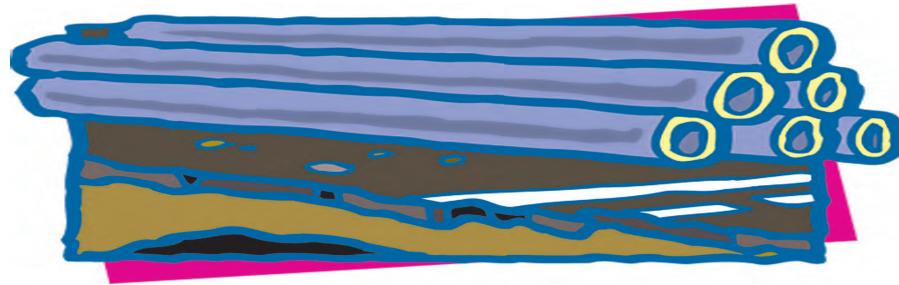
BY JEREMY COX

The Chesapeake Bay's Eastern Shore is shaping up to be the next battleground over the expansion of natural gas pipelines in the Bay region.

Two firms are competing to construct miles of new pipeline through Eastern Shore counties in Maryland and Virginia, projects they say are needed to meet the region's growing energy demands and boost reliability of service.

But environmental groups say that construction of the pipelines would potentially contaminate the many rivers in their paths and bisect lands set aside for preservation.

"There are so many other ways we can look at creating energy in renewable resources, so it doesn't make sense to build infrastructure for outdated technology that will continue to harm our resources," said Betsy Nicholas, executive director of Waterkeepers Chesapeake.



"It doesn't make sense to build infrastructure for outdated technology that will continue to harm our resources."

— Betsy Nicholas, executive director of Waterkeepers Chesapeake.

Critics also worry that the projects will increase the country's dependence on natural gas derived from hydraulic fracturing operations, also called "fracking," in Pennsylvania and elsewhere.

No natural gas is produced on the Delmarva Peninsula, so both firms plan to connect their lines to existing interstate pipelines — one in northeast Maryland, the other in southeast Pennsylvania.

"Anything that supports the fracking industry will increase climate change and keep us from transitioning

to renewable sources of energy," said Christy Dembrowski, a member of No Eastern Shore Pipeline, a group that opposes one of the pipelines.

Last year, Maryland became the second state in the nation to ban fracking, following New York, over public health and environmental concerns. But the state continues to allow the construction of new pipes to transport gas from places where fracking is permitted. Such was the case earlier this year when Gov. Larry Hogan's administration decided not to subject a proposed pipeline beneath the

Potomac River in western Maryland to higher environmental scrutiny. Details on the Delmarva projects are scant because neither company has submitted a permit application to state and federal authorities.

The Baltimore-based private equity firm H4 Capital Partners wants to construct 180 miles of pipeline between Rising Sun, MD, and Accomack County, VA. A sketch on its website shows a squiggly blue line traversing Maryland's Eastern Shore near the Delaware border and then winding to the west of Salisbury and into Virginia.

Eastern Shore Natural Gas, which has operated pipelines on the peninsula for nearly six decades, is looking to expand its existing 455-mile pipeline network as far south as Northampton County, VA, the southern neighbor of Accomack. Its current pipeline extends south from Delaware, terminating near Salisbury.

A map on the Chesapeake Utilities subsidiary's website indicates expansion options with several dotted lines splintering off into Maryland's Eastern Shore counties from the pipeline's main north-south artery in

DELMARVA CONTINUES ON PAGE 16

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DELMARVA FROM PAGE 15

Delaware.

The H4 project has attracted the most attention so far.

Through its subsidiary, Delmarva Pipeline Co., the firm conducted an “open season” from August to October last year, seeking commitments from potential industrial users. But little about the \$1.3 billion pipeline will be known publicly until the company turns to approval from regulators.

The lack of information is frustrating, said Assateague Coastkeeper Kathy Phillips.

“I think everybody right now is just sitting with this cocktail napkin drawing of where it’s supposed to go,” she said, adding that she is most concerned with a portion of the line that seems to pass through the Pocomoke State Forest in Maryland. “We’d like to see where it’s going, and we’d like to see the right of way easements that will be going alongside of it.”

Jerry Sanders, one of H4’s partners, said the company plans to file an application this fall with the Federal Energy Regulatory Commission, which oversees interstate energy transportation projects. “Like all pipeline projects we will go through an extensive comprehensive local, state and federal review,” he said.

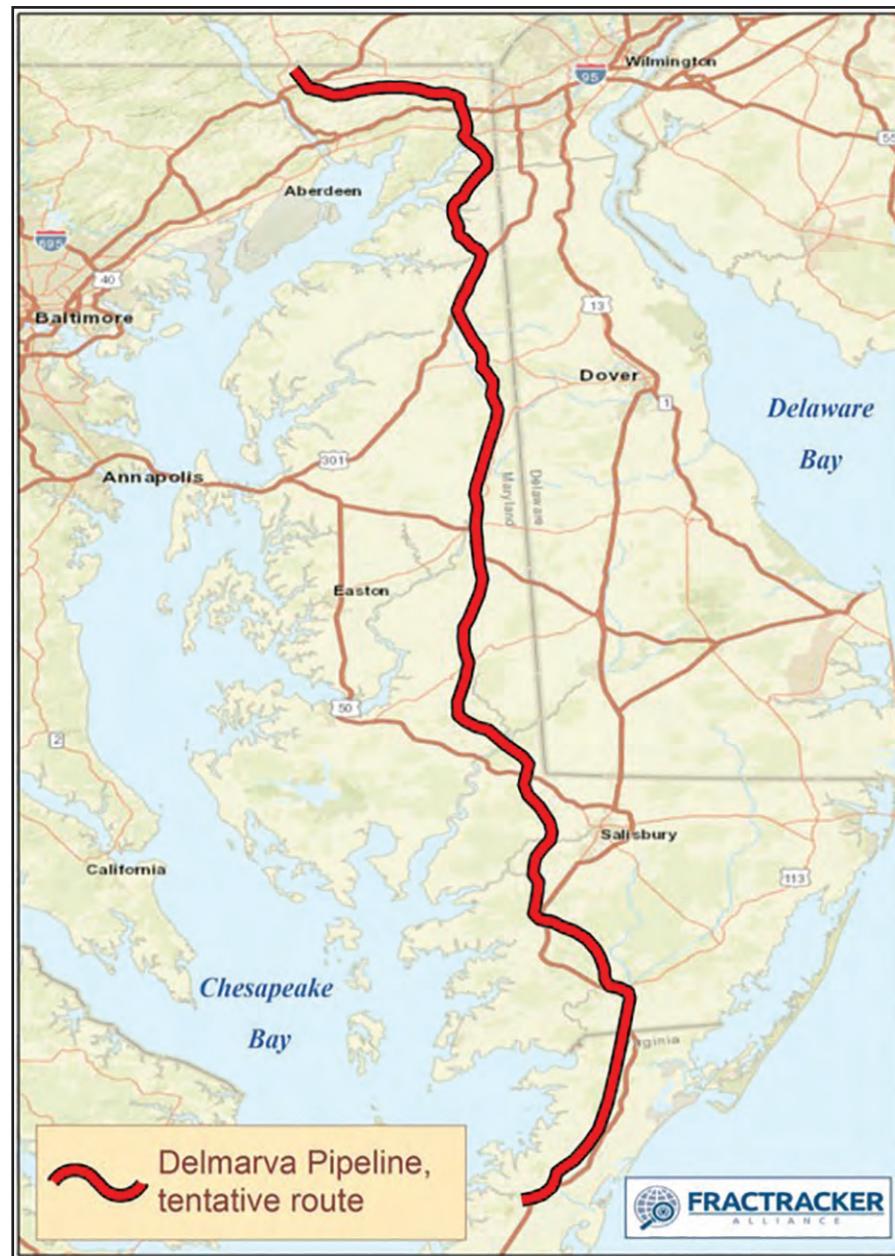
The pipeline will travel across existing utility corridors and other infrastructure for “most of its route,” according to its website. Sanders said that after construction is completed in 2021 or 2022, the line will jolt the rural region’s economy.

“Our pipeline is a backbone energy infrastructure project that opens up the potential for gas service in all Maryland counties not currently serviced by gas,” he said. “Response to our open season last year ... showed substantial customer need along our pipeline route.”

Somerset County officials and business leaders have been pressing for natural gas service for several years. The county, which is the poorest in Maryland, has lost potential business opportunities because it has no pipelines, according to economic development officials there.

He vowed that the company will take measures to prevent contaminating the environment during construction. It will employ directional drilling to install pipes beneath major rivers, ensuring no sediment — one of the leading causes of the Chesapeake’s degradation — is disturbed.

“Using a remote-controlled drill, we go through the soil well under the water body and then pull the pipeline through without any risk of water contact or stirring up sentiment,” Sanders said. “In fact, from the water



(Source: Delmarva Pipeline Company / Map: Fractracker Alliance)

you would never know the pipeline is being installed. For smaller stream crossings, we will follow state and federal laws that ensure water quality protection.”

Eastern Shore Natural Gas said in a written statement that because its project has yet to be defined, no specific details are available. But “as a provider of natural gas, one of the most environmentally friendly fuels, ESNG takes its responsibility to the environment very seriously and adheres to responsible business practices that benefit the environment,” it said.

Natural gas line construction has taken off in recent years as hydraulic fracturing has opened new markets to shale gas production. That has driven supply up and prices down.

Where pipelines have been proposed, controversy has often followed. In the Chesapeake Bay’s watershed states, several pipeline projects have come under fire from

opponents who say the lines extend the economic lives of drilling operations that put drinking water supplies at risk and exacerbate climate change.

On the Delmarva Peninsula, opposition is slowly gaining traction.

The No Eastern Shore Pipeline group has amassed more than 500 Facebook followers and collected about 4,000 signatures on an online petition protesting the H4 project. As of the end of August, members had conducted six information sessions across the peninsula.

Dembrowski accuses H4 of “environmental classism.”

“The people on the Shore are not the most wealthy, for the most part,” she said. “There are two reasons [H4 executives] think they can put it on the Shore. They think people won’t fight back, and there’s open land.”

Dembrowski said her organization isn’t opposing the Eastern Shore Natural Gas project because it

represents an extension of an existing pipeline.

Sanders said his company’s efforts will make the region more competitive economically. Its industries face higher energy costs than places with ready access to natural gas, leaving them at a disadvantage, he said.

The pipeline would pave the way for the construction of the peninsula’s second power plant. Spectrum Energy has proposed a \$700 million, 600 megawatt plant in Denton that would convert H4’s gas into electricity for the power grid.

“If we don’t build [the power plant], there won’t be a pipeline,” said Mark Gilliss, co-founder of the North Carolina-based company. “For them to put in a pipeline that big, they need someone to pay for it. The other users are pretty small next to us.”

The plant will be among the most efficient in the world, he said, releasing concentrations of nitrogen oxide, a main ingredient in smog, of no more than about 2 parts per billion. “If I put an ambient meter in downtown Annapolis, I would have a higher NOx reading than I would at the stack of the turbine,” Gilliss said.

He hopes the plant will be operational by 2023.

Denton Mayor Abby McNinch said she has contacted other communities that are home to similar power-generating facilities to learn more about the impacts they create. Spectrum has purchased property for the plant, but it hasn’t filed a zoning application yet.

“I’m going to continue with the rest of the town to do our research,” McNinch said. “I have my own personal concerns, but as a public official, I have to remain objective.”

Supporters of natural gas point to its relatively low emissions. Compared to coal, natural gas releases about half the amount of carbon dioxide when combusted in modern power plants, according to the Union of Concerned Scientists. But critics pan it for being largely composed of methane, an even more potent greenhouse gas if it leaks into the atmosphere.

The Delmarva pipeline, if built, would be the first that H4 has developed. But the company has constructed an industrial-scale solar energy project and, from that experience, learned that the country’s future energy grid will depend on a variety of sources, Sanders said.

“We all support moving toward a renewable future, and we have done and continue to do our part developing renewable projects,” Sanders said. “But clean and low-cost natural gas will help us get to that future and is critical for the Eastern Shore’s economic development of today.”

MUSSELS FROM PAGE 1

that they filter-feed from the water. Some species can live to be more than 100 years old.

They also have a complex life cycle that makes them difficult — but not impossible — to reproduce in hatcheries. Most need a fish to act as a host as they start their life: The larvae find shelter and grow in fish gills until they can navigate the waters on their own. Some mussels create lures to draw in their preferred host, and some clamp onto the fish with traplike mouths. If the fish species preferred by a certain mussel disappears, the mussel does, too.

“That’s what gets folks hooked on mussels,” said Brian Watson, a mussel biologist for the Virginia Department of Game and Inland Fisheries, at the James River meeting. “They’re highly diverse. There are species that live in streams no wider than this podium.”

Other parts of the country, such as the Tennessee River system and Delaware Bay, have seen the fruit that comes from investing in mussel propagation and research. Meanwhile, mussels have often fallen below the radar of Chesapeake Bay restoration efforts.

That may be because freshwater mussels, unlike oysters or some saltwater mussels, don’t end up on human plates. Research and restoration funding is harder to come by, even though three-quarters of freshwater mussel species are considered to be at some level of impairment. The money often comes in an off-and-on fashion from mitigation payments for environmental disasters and permit renewals, and partners in the Chesapeake Bay restoration effort community have not focused their resources on mussels. That may be changing.

Clinch inspiration

Many of the mussel advocates who gathered along the James River in July first interacted with the mollusks outside of the Chesapeake Bay watershed — in the Clinch River, which rises in the southwest corner of Virginia



Bryce Maynard, a biological science technician at the Harrison Lake National Fish Hatchery south of Richmond, shows visitors the tiny numeric label that is carved into mussel shells with a laser for future tracking. (Dave Harp)

and flows into Tennessee. The Clinch River is home to most of Virginia’s 81 mussel species, more than a third of which are endangered. The diversity of mussels found there has made the river a hotspot for research nationally.

Richard Neves, a professor emeritus at Virginia Tech University, studied mussels there for 30 years, obtaining grants to create the university’s Freshwater Mollusk Conservation Center and mentoring more than 50 other scientists. Fish biologist Rachel Mair was one of them.

Mair helps to run the Harrison Lake National Fish Hatchery, located along the James River south of Richmond, which is spawning the next generation of mussel researchers and hundreds of thousands of mussels for rivers like the James.

“If you don’t think mussels are cool, then get a snorkel and stick your head in the Clinch River,” Mair said. “If you don’t think that’s amazing, there’s no

hope for you.”

The Harrison Lake facility, built in the 1930s to support recreational fisheries, now has the capacity to grow tens of millions of mussels. Over the last decade, the facility transitioned from a focus on migratory fish species such as American shad to also growing tiny glochidia, the name for larval-stage mussels, into young mollusks.

When Dominion’s Bremo Power Station renewed its water discharge permit, the hatchery got more than a half-million dollars from the deal after a threatened mussel was found to be impacted by its discharge. When DuPont had to pay \$42 million to settle a case over mercury contamination of the South River, the hatchery got \$4 million. The coal ash spill in the Dan River in 2014 brought in additional funds to help replenish mussel species that might have been lost.

“It’s things like that that we have to, unfortunately, rely on for the work that

we do,” Watson said.

Still, Mair considers the hatchery, which employs five people, “fortunate” to be among the most well-staffed mussel facilities. And, their work is finally paying off.

The hatchery team used to release tiny mussels into portions of the James watershed and hope for the best. Now, the staff has the technology to grow them “almost indefinitely” at the facility to a large enough size that they have much better survival rates in the wild.

The center propagates the mussels by collecting female mussels that already have larvae in their gills, which the staff either extracts with a needle (to mimic a fish rubbing against it) or allows the mussel to release. 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. The lab is also working on in vitro fertilization for mussel species whose host fish is not known.

“We’ve come a long way,” Mair said. “In 2005, even getting a picture of the mussels we were releasing was hard, they were so small. In 2017, with some species, we’re really able to move the needle. We’re finally getting to the point where we can pick restoration sites, plan numbers, tag and go monitor them later. It’s taken 20-plus years.”

Mussel power

At the hatchery, in a squat building paid for by the Bremo mitigation funds, biological science technician Bryce Maynard demonstrated methods used to tag and track the progress of mussels grown here before being launched into wild waters. He flipped

MUSSELS CONTINUES ON PAGE 18

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the switch on a laser engraver that can carve numbers into several rows of mussels at a time, leaving a burnt-hair smell in the air and marking thousands of mussels a day for future tracking.

Among the hatchery mussels are rare species such as the James spiny-mussel, which was once abundant in the James River upstream of Richmond but disappeared from most of its range by the late 1980s. The hatchery-raised spiny-mussels are marked with tags sealed in place with dental cement. The tags can be located later with a beeping detector but are costlier than other tracking methods.

Every mussel that finds its way into the watershed and survives could help filter about 10 liters of water per day, said Danielle Kreeger, senior science director at the Partnership for the Delaware Estuary, where she's become an advocate for the potential of what she calls the #mighty-mussel.

"Pound for pound, freshwater mussels are not slouches," she said, debunking myths that the slower-growing animals are not as good at filtering water as other bivalves. "To me, every mussel is precious, and we need to protect them."

Kreeger, in the coming months, will be completing a review of studies on the ability of such bivalves to enhance water quality, which she hopes will shore up the amount of data available about mussels' benefits.

She said the findings on how much water they filter can vary based on species, location and feed, but that it's



Once mussels grown at the Harrison Lake hatchery reach a certain size, they are transferred to floating buckets in the lake where they continue to grow before being released to waterways like the James River. (Dave Harp)

important to gather the right data from the outset.

Even as that data is being verified, some organizations are already working to propagate mussels in their local streams, confident that the benefits will make the effort worthwhile.

After a survey a few years ago found eight species of native freshwater mussels in the Anacostia River, the Anacostia Watershed Society started an effort to boost those numbers in the District of Columbia and Maryland. Partnering with the Harrison Lake hatchery and the Maryland Department of Natural Resources, in late summer the nonprofit installed floating baskets in the center of the river filled with mussel species called alewife floaters and Eastern pond-mussels to see how they will fare after a year in

the tidal Anacostia. The group also will work with 250 students from local classrooms to raise mussels in 10-gallon tanks for learning opportunities throughout the winter.

"People don't know anything about mussels," said Jorge Bogantes Montero, a natural resources specialist with the Anacostia Watershed Society, who has developed his own hashtag for the project: #musselpower. "We have to educate them that we don't have oysters here, but we do have [mussels]."

Officials from Maryland's DNR also are working to restore Eastern elliptio mussels to portions of the Patuxent River where they once flourished, transferring them from a creek in Harford County, MD, where they are well established.

Both fresh and saltwater mussels maintain a natural presence in the Bay, too, though their numbers have dwindled in recent decades. That's one reason why members of the Magothy River Association were thrilled to see an "explosion" of dark false mussels in the river's creeks this summer after an influx of rain that made the water fresh enough to support those growing near the surface in floating cages and docks.

The association's president, Paul Spadaro, said that they could almost predict the native species would have a heyday this year, after seeing a similarly rainy season foster their growth in 2004. That year, the mussels did so much to clean the water that Spadaro and his neighbors joked it had become "as clear as gin."

A freshwater future

Clearer water is just one of the "ecosystem services" mussels provide that researchers like Delaware's Kreeger are trying to promote. At the Virginia meeting, Kreeger laid out a vision for a robust culture of mussel propagation that could improve miles of streams — and the possibility of funding a hatchery in Pennsylvania that would provide the bivalves to both the Delaware and Chesapeake estuaries.

"To me, this is absolutely the future," she said, noting how mussel farms in Europe are generating nutrient-reducing credits that developers can purchase. "How quickly we get there, we'll have to see."

Kreeger said that more research is needed to verify the scientific community's assumptions about mussels and how different species perform in various environments. That effort could help mussel propagation become a practice that is not only good for the Bay and river water quality, but one that could be measured.

Wood, the Bay Foundation scientist, wondered whether expanding the presence of mussels could become a goal for each of the Chesapeake's tributaries. Could states eventually get credit for the water-filtering mussel banks they're protecting or creating? What if native mussels could be added to more stream restoration projects?

The Chesapeake Bay Program already credits states for some of the nutrient-reducing work achieved by oyster aquaculture and restoration, but it took years for a panel to collect the scientific evidence to support it.

For Wood and others, the "mussel meeting" built momentum around an issue they'd followed for years. Some said the bivalves are also doing important work as a motivator.

"I've become convinced," Wood said, "that freshwater mussels can get people excited."

The Harrison Lake facility, built in the 1930s to support recreational fisheries, has the capacity to grow tens of millions of mussels. Over the last decade, the facility transitioned from a focus on migratory fish species, such as American shad, to also growing tiny glochidia, (the name for larval-stage mussels), into young mollusks. (Dave Harp)



Costly MD oyster project pays off in pollution reductions, study finds

≈ \$28 million spent rebuilding reefs in Harris Creek said to be removing 100,000 pounds of nitrogen annually.

By TIMOTHY B. WHEELER

The massive — and massively expensive — oyster restoration project in Maryland's Harris Creek is yielding some pretty big pollution reductions, according to a new report.

Using a computer model to calculate the project's water-quality impacts, researchers from the Virginia Institute of Marine Science and the University of Maryland Center for Environmental Science estimate that Harris Creek's restored reefs are removing about 100,000 pounds of nitrogen annually that otherwise would have been added to the Bay's pollution woes.

"We're taking a lot of pollution out of the Bay through these oysters," said Mark Bryer, Chesapeake Bay program director for The Nature Conservancy, which funded the report along with the Oyster Recovery Partnership. "And, presuming these oysters continue to do well over time, they'll continue to provide that benefit."

Despite the big nitrogen number, the reefs are producing only a modest improvement in water quality in the creek, a tidal tributary of the Choptank River on the Eastern Shore. That's because pollution is washing into the creek from the Bay almost as fast as the reefs can filter it. But this report shows the value of doing more such large-scale reef projects, Bryer said.

Over the last seven years, federal and state agencies have planted nearly 2.5 billion hatchery-spawned spat, or baby oysters, on 350 acres of restored reefs in the creek. Advocates say such large-scale undertakings are the best hope for reviving the Chesapeake's depleted oyster population, which has dwindled to 1 or 2 percent of historic levels through decades of overharvesting, disease and pollution.

Watermen and their political supporters, though, criticize the project's cost — which has grown to \$28.3 million — and question its outcome.

"How can you prove it's been successful?" asked Ron Fithian, a Kent County commissioner and former waterman, at a recent meeting of the Maryland Department of Natural Resources Oyster Advisory Commission. "After 7 years, you can't determine if Harris Creek was worth [the] expenditure."

The restored reefs are in a sanctuary off-limits to harvest, and surveys in recent years have shown that the oysters there are thriving. It's



Nearly 2.5 billion hatchery-spawned oysters have been planted since 2012 over 351 acres of restored reefs in Harris Creek — an area roughly the size of the National Mall in Washington, DC. Some reefs were restored using quarried granite, while others were built with mixed shell, mostly clams. The cost to date, including a second round of oyster plantings to cover thin spots on the reefs, is \$28.3 million. (U.S. Army Corps of Engineers)

too early to tell, though, if the reefs are self-sustaining, let alone seeding neighboring waters with juvenile oysters.

But scientists and restoration advocates say the reefs already provide

other ecological benefits, including habitat for fish, crabs and other marine life. The oysters also filter pollutants from the water, and the report by VIMS and UMCES researchers quantifies the water quality impacts for

farms, streets and lawns; in treated and untreated sewage; and in fallout from power plant emissions and vehicle exhaust.

Nitrogen feeds algae blooms, which in turn consume dissolved oxygen in the water as the algae die and decay. Fish, crabs and shellfish struggle to survive in the resulting oxygen-starved "dead zones."

Reducing nitrogen loads is a goal of the Bay's "pollution diet," formally called the Chesapeake Bay Total Maximum Daily Load, that the U.S. Environmental Protection Agency established for the Bay in 2010.

Oysters take in nitrogen as they consume algae and other bits of organic matter in the water. Some of the nitrogen in the algae is used by the oyster to grow its tissue and its shell, while the rest gets excreted and winds up in the sediment around the reef. There, in a complex chemical process known as denitrification, bacteria convert it into nitrogen gas, a form no longer able to feed algae blooms.

But measuring the oysters' filtration in open water like Harris Creek is a huge and tricky undertaking because it's not a controlled environment. So, researchers Lisa Kellogg and Mark Brush from VIMS and Jeff Cornwell from UMCES collaborated on a computer model that could handle the

the first time.

"One of the reasons for this study is to start to illuminate the benefits that may go unseen from a project like this," said The Nature Conservancy's Bryer.

An oyster can filter up to 50 gallons of water a day, so restoration advocates see projects like the one in Harris Creek as natural wastewater treatment plants.

Nitrogen is one of the main pollutants that oysters filter out of the water. It enters the Bay in stormwater runoff that contains fertilizer or animal waste from



This clump of hatchery-produced oysters was recovered from a restored Harris Creek reef during a monitoring survey in 2015. A model developed by Virginia and Maryland researchers estimates that the creek's restored reefs are capable of removing about 1 million pounds of nitrogen from the Chesapeake Bay over a decade. (Emily French / Oyster Recovery Partnership)

HARRIS FROM PAGE 19

complex calculation of all the variables involved in assessing what the reefs are doing to remove nutrients.

“The idea ... is basically that the sampling we’re doing is too expensive for any management agency to really undertake on their own,” explained Kellogg, a senior research scientist at VIMS in Gloucester Point, VA. Through the model, she said, she and her colleagues hope to provide a tool that natural resource agencies could use to gauge the ecological benefits of this and other reef restoration projects.

Initially developed in 2014, while the Harris Creek reefs were still being restored, the model has since been enhanced and updated. With funding from the National Oceanic and Atmospheric Administration, the scientists gathered more recent information about the creek’s water quality and the number of oysters planted there. Using that data, the model indicates that the restored reefs can filter all the water in Harris Creek — nearly 10 billion gallons — in less than 10 days during the warm summer months, when oysters are actively filtering.

The oyster population in Harris Creek grew from an estimated 4.5 million bivalves before the restoration project to about 134 million afterward, the report notes. As with wild oyster reproduction, many of the hatchery-spawned spat perished — eaten by predators, killed by disease or outcompeted and starved of food by the other shellfish crowded around them. But if the remaining oysters continue to thrive, the reefs could remove a total of 1 million pounds

“It’s not cheap, but if we want to have clean water and abundant fisheries in the Chesapeake Bay, you have to pay for that.”

— Mark Bryer

Chesapeake Bay program director for The Nature Conservancy

of nitrogen over the next decade, according to the model calculations.

And oysters aren’t the only ones removing nutrients from the water. The model figures that more than 40 percent of the nitrogen removal in the creek is being done by other filter-feeding marine animals that have found a home on the restored reefs — such as mussels and sea squirts (small bulbous creatures with little siphons), pilings, jetties and other hard surfaces in shallow waters.

Though the restored reefs could potentially remove all of the nitrogen getting into Harris Creek from its tiny watershed — a little less than 10 square miles in a mostly rural landscape — it’s only reducing the overall amount of nitrogen coming into the creek by about 5 percent. That’s because the vast majority of nutrients come in from the Bay, and the pollution being removed is promptly replaced as tides flush more Bay water into the tributary.

Even so, the scientists say it’s significant that the reefs are dealing with pollution from beyond the creek watershed.

“It’s a needle in the haystack

when it comes to [cleaning up] the Chesapeake,” acknowledged Brush, an associate professor of marine science at VIMS. But to reach the Baywide cleanup goal, he added, “every little bit helps.”

While the Harris Creek project’s expense has been controversial, prompting Maryland officials to consider a much smaller-scale effort planned for the St. Mary’s River, the report indicates that restored reefs have value to the Bay cleanup. Based on the construction cost to date, the nitrogen removed by the Harris Creek reefs cost roughly \$300 per pound. That’s significantly more than what it costs per pound for most farm runoff control measures, but far less than it costs to capture nitrogen running off city or suburban streets, where storm drain retrofits can cost thousands of dollars per pound of pollution captured.

“Obviously, this is not an inexpensive experiment, but I think the project looks pretty good from what we see right now in terms of water quality,” said Cornwell, a research professor at UMCES Horn Point laboratory in Cambridge.

Brush, who had the lead role in crafting the model, said it’s designed

to assess water-quality impacts of any reef project. The researchers hope to test that by applying it next to the Lynnhaven River in Virginia, recently selected for a 56-acre restoration project. Kellogg said that the Lynnhaven, near the mouth of the Bay, is far saltier than Harris Creek, and the population of filter-feeding creatures is somewhat different. Both factors could influence the rate of nitrogen removal.

“The real value is going to be down the line, when you apply models like this to more and more places,” Cornwell said.

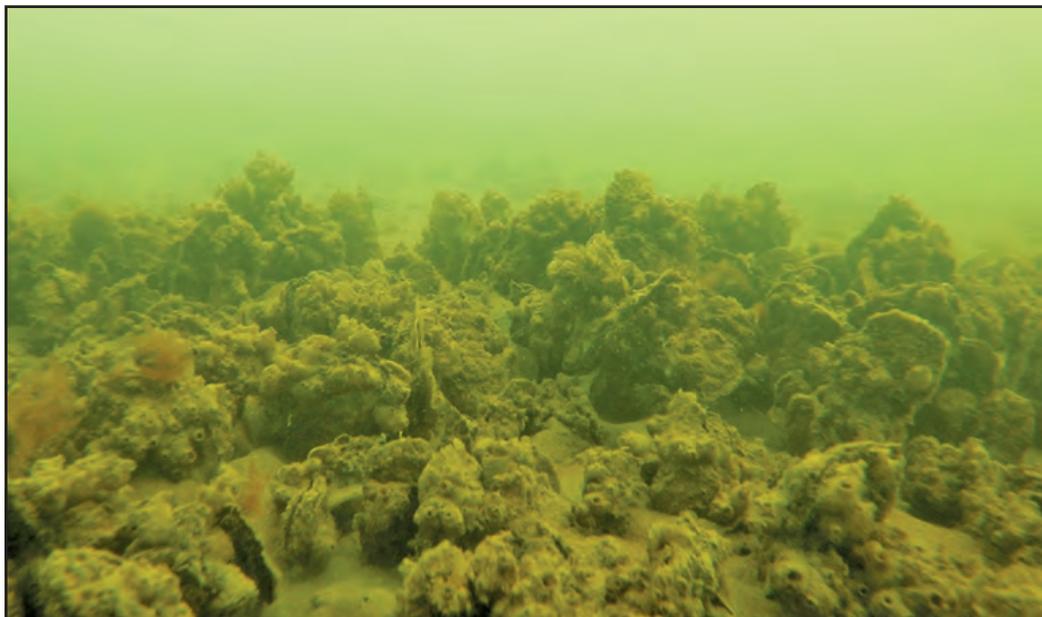
The report was welcomed by Stephanie Westby, oyster restoration coordinator for the National Oceanic and Atmospheric Administration Chesapeake Bay Office, which provided funding to Kellogg and Cornwell to collect data from Harris Creek that was used in the model.

“We’ve long believed that the ultimate goal is not just to restore oysters, but to restore the ecosystem service function as well,” she said. “We’re very interested in anything that starts to quantify what that ecosystem service impact is.”

Bryer cautioned that building oyster reefs is no substitute for tackling pollution where it’s occurring, but he said that the study shows the value of restoring the Bay’s lost “natural infrastructure.”

“I think it should have a really great impact on how the state thinks about its restoration moving forward,” Bryer said.

“It’s not cheap,” he added, but “if we want to have clean water and abundant fisheries in the Chesapeake Bay, you have to pay for that.”



Oysters growing on a restored stone reef in Harris Creek are covered with bulbous sea squirts, small marine animals that grow in clumps on reefs, pilings, jetties and other hard surfaces in shallow waters. Like oysters, they are filter feeders. The model developed by Virginia and Maryland researchers found that sea squirts and mussels growing on the restored reefs accounted for about 40 percent of the nutrient removal taking place. (National Oceanic and Atmospheric Administration)



Pink macroalgae grows amid oysters planted on a restored shell reef in Harris Creek, as shown in this image from an underwater video. (National Oceanic and Atmospheric Administration)

MD changes plans, picks Manokin River for oyster restoration

≈ DNR says surveys found earlier choice, Breton Bay, unsuitable; community, watermen disappointed

By JEREMY COX &
TIMOTHY B. WHEELER

Maryland is switching the focus of its oyster restoration efforts to a river on the Chesapeake Bay's Eastern Shore known for its relative abundance of bivalves from a Western Shore waterway where they're said to be lacking.

The state Department of Natural Resources on Sept. 5 announced the Manokin River as its new candidate for large-scale restoration, saying that recent surveys of Breton Bay's muddy and sandy bottom found no oysters, dead or alive. Low amounts of oxygen in the water and a lack of suitable bottom habitat cast further doubt on the prospects for successful restoration, officials said.

"Following an in-depth review and scientific study of Breton Bay, the department had to shift its focus to another tributary that would fulfill the state's commitment to large-scale oyster restoration," DNR Secretary Mark Belton said. "We believe that the Manokin River — an area situated to provide for natural, robust and self-sustaining oyster recruitment and reproduction — provides the best possible site for large-scale restoration success."

The DNR had picked Breton Bay and the upper St. Mary's River for restoration in December from a field of 12 candidates. Both are Potomac River tributaries in St. Mary's County, across the Chesapeake from three waterways already undergoing restoration — Harris Creek and the Tred Avon and Little Choptank rivers.

At the time Belton announced Breton Bay's selection, some scientists and environmentalists raised questions about whether restoration would be feasible there. They noted that there had been little evidence of natural oyster reproduction in Breton Bay in recent years and suggested that rebuilding shellfish habitat could be costly and unlikely to succeed.

Belton said that the DNR will move forward with the Manokin in Somerset County, pending approval from the National Oceanic and Atmospheric Administration and the U.S. Army Corps of Engineers, the federal agencies partnering with the state in oyster restoration efforts.

As part of the federal-state Bay restoration effort, Maryland and Virginia each have pledged to rebuild oyster habitat and populations in five of their tributaries by 2025. Maryland has completed one — Harris Creek — with work ongoing in the Tred Avon and Little Choptank rivers. The Little Choptank restoration is state-funded, while the Tred Avon is mainly a federal effort.



Grass blows in a breeze off Manokin River at Raccoon Point. The Bay tributary in Somerset County, MD, was recently selected as an oyster restoration site. (Jeremy Cox)

The Army Corps left oyster restoration funding out of its work plan this fiscal year, which ends Oct. 1. That has led to delays in completing the Tred Avon project.

Environmentalists gave a qualified endorsement of the state's switch to the Manokin, while the head of the state watermen's association and a local advocate for Breton Bay expressed disappointment. The Chesapeake Bay Foundation, for its part, has long pushed for restoring oysters in the Manokin.

"With up to 800 acres that could be restored, it has the potential to significantly enhance both the Bay's oyster population and the benefits that oysters provide," said Alison Prost, the foundation's Maryland executive director.

The river flows from headwaters near Princess Anne into the Chesapeake Bay on the northern end of Tangier Sound. After it was made a sanctuary and closed to harvesting in 2010, the Manokin's oyster population reached its highest level in 20 years in 2015, and the number of diseased specimens dropped by more than half, according to the foundation.

But Prost said she worries that because the state doesn't plan to use federal funding — DNR officials didn't provide a cost estimate — the restored reef could be reopened to commercial harvest in the future. The group is calling on Gov. Larry Hogan to place the waters off-limits to future harvesting.

In originally selecting Breton Bay, the DNR secretary had said he hoped the federal government would fund restoration work there. DNR spokesman Gregg Bortz said in an email that department

officials believe that "federal funds would be unnecessary (and unwarranted) in the Manokin as the tributary may be able to achieve oyster restoration goals and targets ... with minimal investment from the state." The DNR selected the upper St. Mary's River for restoration for the same reason.

Robert T. Brown, Sr., president of the Maryland Watermen's Association and a St. Mary's County resident, said he didn't understand how the state could conclude oysters can't grow in Breton Bay. He noted that he raises oysters on a patch of leased Potomac River bottom just outside Breton Bay's mouth.

"I'm very disappointed that they're not trying to help a place that really needs help," he said.

Elizabeth Curtz, a leader of a watershed group pushing to improve Breton Bay, said she suspected that the DNR decision was driven by cost and the perception that restoration of the Western Shore tributary would have required what she called a "full-fledged investment." She called the state's switch a lost opportunity, noting community efforts are under way there now.

"There are live oysters in Breton Bay and lots of local folks working to increase their numbers," she said. An initial planting of oysters grown under a DNR program enlisting waterfront landowners "survived the summer surprisingly well," she said, and a second round of raising oysters at private docks for planting later in Breton is set to begin.

Fred Millhiser, another member of the watershed group, acknowledged that restoring oysters in Breton Bay would be

a long shot, when compared with other Chesapeake Bay tributaries. But he argued it was worth a try, given Breton's history as a productive shellfish area. Home to a dozen oyster shucking houses more than a century ago, they're all gone now.

Before the recent DNR surveys, state biologists had only made annual checks of a single oyster bar in the Breton Bay, where in 2016 they found the bivalve population only slightly above average, with "low and intermittent" reproduction.

Millhiser said he'd like to see the latest DNR survey results to understand the state's rationale.

"Why'd you pick it in the first place," he asked, "and what did you see that's so strong, relatively quick, to change it?"

In 2016, the DNR's annual fall survey of oyster bars reported finding four baby oysters, or spat, per bushel of shell dredged up on one bar sampled in the Breton Bay sanctuary. That's more than twice the long-term average density of spat found there over the last 32 years. For comparison, the survey found a mean of 175 spat per bushel in the Manokin River sanctuary, with as many as 372 spat per bushel on one bar sampled.

Chris Judy, the DNR shellfish director, said his staff used patent tongs this summer to survey Breton Bay for its suitability as a restoration site. While a dredge dragged across the bottom may pick up a few oysters or shells, the motor-powered tongs take grab samples, which reflect the density of oysters and shell in a given spot.

The DNR survey crew found no oysters in the 237 samples it took around Breton Bay, Judy said. Shell habitat on which oysters could readily grow was "very sparse," he added, with no shells recovered at 70 percent of the sites. Only four places yielded a liter or more of surface shell.

Del. Charles Otto, a Republican who represents Somerset County, said he had mixed feelings about the state's decision. It was a "tragedy" for commercial watermen when the DNR designated the Manokin a sanctuary, he said, because the county's waters are some of the most productive for oyster harvests.

"I've always been concerned with them doing the Manokin," Otto said. "We always have our questions, not knowing the details."

Otto said his biggest concern is keeping the Manokin open to navigation. He pointed to the project in Harris Creek, where improperly installed granite reefs damaged boats and snagged crabbing gear. DNR officials said the Manokin restoration will focus on deeper waters to avoid navigational hazards.

Will dunes project be Deal Islanders' line in sand against flooding?

≈ Researchers studying how natural features reduce erosion or offset rising sea level.

By **TIMOTHY B. WHEELER**

The sand dunes that used to line the western shoreline of Deal Island are almost all gone. So are the trees that stood behind them on this low-lying patch of land jutting into Tangier Sound on Maryland's Eastern Shore. All that remains now are stumps poking up out of the waves, which wash over a narrow, sandy beach and up into a grassy marsh stretching far inland.

"See the tree in the water?" asked SueKay Ford, pointing to a barren snag just offshore. "That used to be standing on the shoreline," she said, when she moved to the neighborhood 14 years ago. "It used to have an eagle's nest."

Before many more years have passed, homes for humans on Deal Island could be jeopardized as well. Erosion, storm surges and even fair-weather flooding are chronic or repeat threats. The impacts extend far inland on this stretch of the island's shore where there's a "ghost forest" of dead trees, killed because their roots have become too wet to survive.

With 7,000 miles of shoreline, Maryland is particularly susceptible to the impacts of sea level rise, storms and flooding, and the western shore of Deal is particularly vulnerable because of its exposure to the wind and waves of the Bay. State officials and scientists are teaming up now, though, in an



Juan Garzon of George Mason University and Ariana Sutton-Grier of The Nature Conservancy check a water level monitor attached to a stake on the beach on Deal Island. Behind Garzon, stumps of trees poke out of the water – they were once on dry land. (Dave Harp)

effort to help this community of about 400 people that is already losing ground to those threats.

The Maryland Department of Natural Resources is planning to restore the lost dunes along a 1,200-foot stretch of Deal's western shoreline. Construction is expected

to start in the summer of 2019, according to Nicole Carlozo, resiliency planner in the DNR's Chesapeake and Coastal Service. The dune restoration is one of 12 projects approved for funding by the state Board of Public Works in 2017 and earlier this year to demonstrate coastal resiliency

measures that communities can take. Meanwhile, researchers from George Mason University in Virginia are trying to get a handle on how the marsh at Deal Island, and possibly other features along its shoreline, may

DEAL CONTINUES ON PAGE 23



Storms and erosion have taken their toll on this beach on the western shore of Deal Island. As the Bay's water has encroached, trees have died; some are no more than stumps in the water now. (Dave Harp)



Juan Garzon and Ali Rezaie, doctoral students in coastal engineering at George Mason University, search the shallows for a submerged wave sensor they had planted on the bottom weeks earlier. (Dave Harp)

DEAL FROM PAGE 22

be reducing the erosive power of the Bay's waves. Their findings could help the state design its dune restoration project and other measures intended to reduce erosion or prevent flooding.

"We know that previous research showed that [habitat, particularly forest and wetlands] reduces flood impact by reducing wave levels during a storm," said Ali Rezaie, one of the doctoral students working on the project, during a visit to Deal Island this summer. "But to use nature as a form of flood protection — to engineer something — we need to quantify, we need to design it."

Earlier this year, Rezaie and his research partner, Juan Garzon, installed small, battery-powered wave and flow sensors in the shallows, on the beach and in the marsh. They returned in July to retrieve the data those sensors had been collecting. In addition, they brought along an acoustic Doppler current profiler, which they can deploy in the water to measure the currents and water velocity from the bottom to the surface.

On land, they have been chronicling the vegetation growing back from the beach, counting the number of marsh grass stems in a standard plot and measuring their height and thickness through the growing season.

The George Mason research is underwritten by \$30,000 in grants from The Nature Conservancy, which has been working to better understand the resiliency of Maryland's wetlands to climate change. Ariana Sutton-Grier, director of science for the Conservancy's Maryland and District of Columbia chapter, joined the researchers for their Deal Island visit.

"The goal of the project is to better understand how different features in the landscape are helping to attenuate or slow down wave energy, and as a result, helping to prevent erosion and flooding risk," Sutton-Grier said. She said the study is particularly useful because there hasn't been much research on natural wave attenuation.

"What they'll do with their measurements," Sutton-Grier explained, "is actually model how much wave energy is coming in and how much it decreases as it goes through the various natural components."

In a 2013 report for the Maryland Climate Commission, scientists predicted that sea level rise, combined with gradual land subsidence, could raise waters in the Chesapeake Bay by as much as 2.1 feet by 2050. By the end of the century, they projected the increase could be 3.7 feet or higher. Much of Deal Island is just 3 feet



Ali Rezaie, doctoral researcher at George Mason University, checks on a water-level sensor staked out in the marsh back from the beach. Dead trees in the background show the effects of the inland encroachment of brackish water from the Bay. (Dave Harp)



Juan Garzon, a doctoral student in coastal engineering at George Mason University, holds an acoustic Doppler current profiler, which is deployed in the shallows to measure currents or water velocity from the bottom to the surface. (Dave Harp)

above sea level now.

But a hurricane-driven storm surge could cause flooding that high or higher much sooner, putting hundreds of Deal Island residents' homes at risk. Tropical Storm Isabel in 2003 produced a surge in excess of 7 feet in parts of the Bay.

the shore on the island and elsewhere prevent marshes from providing that protection.

The Nature Conservancy funding helped to pay for the sensors the George Mason researchers have deployed and for the time they have spent making the three-hour trek from the university's campus in Fairfax County, VA. The team has already taken some measurements farther south along Virginia's shore but, in consultation with Sutton-Grier, they also selected Deal to study because wave action appeared pronounced there. The beach faces a long fetch of open water, which enhances the tendency for winds to whip up waves.

From earlier research that he's done with other colleagues, Rezaie said, he's learned that Maryland's coastal wetlands have helped to prevent anywhere from \$55 million to \$454 million in property damage from hurricanes and tropical storms. The amount of prevented damage goes up with the strength of the storm, according to the research, which means that wetlands may become increasingly valuable if, as some scientists predict, climate change brings more intense storms.

The George Mason researchers' analysis, which they hope to publish next year, may help make the case for preserving or restoring coastal wetlands. The study may also provide tips to environmental engineers charged with designing flood-prevention projects that use elements of nature.

The research on Deal Island's shoreline is of great local interest, Sutton-Grier said. Residents fear that, with the dunes gone, erosion could take out the marsh next and remove the community's remaining natural buffer against waves.

"So," she added, "the community is quite concerned about the fact that additional erosion may actually lead to increased flooding of their neighborhoods and on their roads."

Many residents in rural areas of the Shore say that erosion, not sea level rise, causes their flooding problems, but Ford — who's running for a seat on the Somerset County Board of Commissioners — says it's clearly more than that.

"The waters are rising," she said, adding that she'd like to see the county enhance and better maintain its network of roadside ditches to help counter the water's incursions.

Some roads on Deal Island already flood, Sutton-Grier noted. Restoring the dunes won't change that — nor stop the rise of Bay waters.

"There's still going to be flooding," she said. But, she added, "It'll give the community more time."

A 2016 study done by The Nature Conservancy and the DNR pointed out that coastal habitats, such as forest and wetlands, can reduce flooding and erosion. Marshes are particularly important around Tangier Sound, where Deal Island is located, but the bulkheads and riprap that line much of

Migration study: Cownose rays could be vulnerable to localized depletion

≈ Underwater microphones followed movements of tagged rays from the Bay to Florida.

BY TIMOTHY B. WHEELER

Human snowbirds aren't the only ones to flock to Florida's sunny shores when the weather gets chilly. New research shows that the Chesapeake Bay's cownose rays spend their winters off Cape Canaveral with other East Coast rays before returning to the Bay each spring to bear their young and mate.

The research, published Aug. 23 in the *Marine Ecology Progress Series*, sheds fresh light on the migration patterns of the kite-shaped creatures, which are beloved by nature lovers but reviled by oyster farmers and many watermen because they feed on shellfish.

The study's authors say their findings suggest that cownose rays, so named because of their cowlike snouts, could be depleted in a given area by fishing or other human activity if care is not taken. Maryland is currently the only East Coast state that has any limits on either the recreational or commercial harvest of cownose rays, with a temporary moratorium imposed last year on bowfishing tournaments that kill hundreds at a time.

"What we know about the migration behavior from this study suggests we do need to be cautious in the management approach," said Matthew Ogburn, an ecologist with the Smithsonian Environmental Research Center in Edgewater, MD, and the lead author of the paper. "It's a species that, if overfished, would potentially take a generation to recover."

From 2014 through 2016, scientists from the Smithsonian lab in Maryland, the Virginia Institute of Marine Sciences and Savannah State University tagged 42 rays that had been caught by commercial fishermen. Most came from Virginia, with five in Maryland and two in Georgia.

Researchers implanted tiny acoustic transmitters in the rays before releasing them. They tracked the tagged rays' movements via a network of hydrophones, or underwater microphones, that have been deployed in the Bay and along the East Coast. Those devices picked up the unique "ping" each ray's transmitter emitted. Of the total tagged, 28 rays were picked up by the telemetry network for more than 90 days, which was long enough to learn about their migratory behavior.

Another study published last year by VIMS researchers, which used a different tagging technology, identified the near-shore Atlantic waters of



SERC biologist Rob Aguilar prepares a cownose ray for tagging. Though scientists had to insert the tags out of the water, they kept the rays' gills submerged so they could breathe normally. (Smithsonian Environmental Research Center)

central Florida as a winter gathering place for rays. But the newly published research is the first to track their full annual migration cycle. It suggests that most if not all return to the same estuary — and even tributary — where they had been captured.

Though native to the Chesapeake, cownose rays' life history has been little understood until recently. Brown to olive-green in appearance on top with whitish bellies and long, whiplike tails, they are found along the East Coast and in the Gulf of Mexico, though those populations appear to be separate. They come into the Bay in May, and the females give birth in June or July to one or occasionally two pups. They then mate with male rays, which leave the Bay in July. The females stay through summer, departing by October.

All of the rays tagged for this study in Maryland, Virginia and Georgia spent the winter along Florida's Atlantic coast between Cape Canaveral and the St. Lucie Inlet. Ogburn said it's not clear why rays from all along the East Coast congregate there, but

researchers did note that some Atlantic shark species also overwinter there.

Tagged males spent the late summer foraging along the East Coast as far north as Long Island Sound, researchers said. Most stayed in relatively shallow coastal waters, but some did venture farther offshore. All joined the females on the fall migration to Florida.

Researchers have yet to pin down whether rays return to the same waters where they were born, as the studies so far have only tagged adults and followed them for just a couple of years at most.

The data so far are very

limited but suggestive. Only five tagged rays yielded location data for two summers in a row; of those, three from Virginia and one from Georgia returned to where they'd been tagged. The fifth spent both summers in the Chesapeake, but in different states.

Scientists are now turning their attention to studying immature rays, which remain mostly a mystery. Last summer, they tagged 20 in the Potomac River that had been born earlier that year.

"We're waiting now to see where they go," Ogburn said. The hydrophones that pick up their tag signals only get checked two to four times a year, but the initial data retrieved so far indicate they headed south last fall.

Cownose rays tend to travel in schools and can grow large, reaching a wingspan of 3 feet and weighing up to 50 pounds. They feed mostly on soft-shelled clams, but also go after hard clams and oysters when available.

Watermen contend there has been an explosion of rays in the Chesapeake, but Ogburn said that the population, if it increased, has done so gradually.

Female rays take seven to eight years to reach maturity and generally have only one pup a year.

Oyster farmers, though, say they have suffered significant losses to foraging schools of rays. Rays have also been blamed for tearing up underwater grass beds and depleting wild oyster populations, a claim rebutted two years ago by another study linking those declines to oyster diseases and overfishing. Even so, Virginia has tried — without much success — to promote the development of a commercial fishery for rays as a way of curbing their population.

Recreational bowfishing tournaments in Maryland and Virginia have targeted rays for several years, with as many as an estimated 600 killed in a single contest, including female rays still carrying their young. The tournaments have stirred a public outcry, fueled by graphic videos showing rays being killed. In response, Maryland lawmakers in 2017 passed a two-year moratorium on such contests, ordering the Department of Natural Resources to develop a management plan for the species.

The DNR convened a workgroup in February to discuss management options for cownose rays. It hasn't met since, but the DNR staff laid out plans then to develop a management plan by the fall and finalize it by December to meet the requirements of the law. It isn't clear what limits the DNR would impose. Animal rights activists and others have called for a permanent ban on ray bowfishing tournaments, but organizers and participants in such events defend them and insist the state shouldn't give in to "emotionalism."

Ogburn and the researchers said that fishery managers should be cautious about allowing fishing for rays. If research bears out that rays form distinctive localized populations, he said, there is a risk that intense harvesting or other human activity could deplete that group and whatever makes it different from the other rays. And if that happens, it may take a long time, if ever, for their numbers to rebound.

While cownose rays can impact commercial fisheries and aquaculture operations by consuming shellfish and can uproot some Bay grass beds, Ogburn suggested they may also play a constructive ecological role that's not clearly understood yet. Their disturbance of bottom sediments, for instance, may help increase the diversity of bottom-dwelling organisms.

"They're big enough and active enough. They must be important in what's going on down there," Ogburn said.

Restored stream lures trout and threatened logperch

≈ Presence of rare fish reveals that good habitat still exists in Lancaster County, PA.

By DONNA MORELLI

A small fish that once lived in freshwater streams throughout the Chesapeake Bay watershed got a lucky break in a Pennsylvania creek this year. When Donegal Trout Unlimited restored the Lancaster County creek to protect trout and other sport fish, the rarely seen Chesapeake logperch showed up for the party.

“We build it and they come,” said Greg Wilson, a longtime member of Donegal Trout Unlimited. “When they electrofished the creek after restoration, there were lots of trout and lots of logperch.”

A few months after planting the last tree on the restored banks of Peters Creek, a second electrofishing trip — which samples fish populations by stunning them with a mild electric charge — turned up about nine of the little olive fish with orange bands. Prior to the restoration, sampling produced no logperch at all.

The Chesapeake logperch, with an average length of just 4 inches, once swam in the streams of Pennsylvania, Maryland, Virginia and the District of Columbia, including a few direct tributaries to the Bay. Now, the logperch is listed as threatened in Maryland and Pennsylvania and is being evaluated for national protection under the U.S. Endangered Species Act.

Chesapeake logperch disappeared from the Potomac River basin by the 1930s. Their range in the Susquehanna watershed has decreased but persisted. According to the U.S. Fish and Wildlife Service, they were once found in the river as far north as Columbia, PA, but since 1842 they haven't been found upriver of the Conowingo Pond, a reservoir formed between the Holtwood and Conowingo dams. Most of the logperch found in both Pennsylvania and Maryland are in the lower reaches of streams that empty into the Conowingo Pond.

A Fish and Wildlife report cites water pollution and loss of habitat as reasons for the decline. Sediment is particularly harmful to logperch habitat. Using its conical nose, the fish roots around stones on stream bottoms to jostle out a meal of invertebrates. Silt that settles into the cobble smothers the small living spaces of the logperch's food. The species also faces threats from an increasing number of voracious, invasive species: the northern snakehead and flathead catfish.

“We would like to develop a conservation strategy for this fish,



The logperch is listed as threatened in Maryland and Pennsylvania and is being evaluated for national protection under the U.S. Endangered Species Act. (Rob Criswell)

expand its range and strengthen the population in the hopes that it doesn't have to be listed as an endangered species,” said Jennifer Bukowski, a fisheries biologist with the Fish and Wildlife Service in State College, PA. “The Chesapeake logperch falls into a category of species being considered for listing but for which there is little information on status and threats.”

The irony of finding the fish in Lancaster County's sediment-laden streams isn't lost on Bukowski or her colleagues. They are the same streams targeted for Bay cleanup efforts because of the county's disproportionate contribution to the state's nutrient load to the Chesapeake Bay. Even so, a small number of streams still contain sections with clean water and cobblestone bottoms that attract logperch.

Techniques employed along those streams for reducing water pollution — such as fencing livestock out of streams and installing practices on farms to stem the flow of sediment and manure — also improve habitat for both logperch and trout.

“What's good for the logperch is good for the trout,” said U.S. Fish and Wildlife Service biologist Adam Smith, who has worked on stream restorations in Lancaster County since the 1990s. “They like clean water, no

sediment and cover, the same as trout.”

Listing the logperch under the U.S. Endangered Species Act would place restrictions on disturbing streams, even for restoration purposes.

But its listing is far from assured. There are more than 300 species of plants and animals being considered for protection under the act that are awaiting decisions by 2023. The lengthy process starts with filing a petition to suggest the species be listed. The next step is to gather data to defend the petition.

Bukowski said a few studies “are in the works” and that the Fish and Wildlife Service is conserving logperch habitat with the hope that additional protection won't be needed. The agency is poised to restore more stream habitat in Lancaster County with partners like the state's Fish and Boat Commission, Trout Unlimited and the county's Conservation District.

The U.S. Fish and Wildlife Service and Conservation District recently finished a large restoration project in the Octoraro watershed, where Amish farmer L. Michael Kaufman asked for help to stabilize the eroding banks of a stream.

“When we first got there, there was not much habitat,” Smith said. “The stream had lots of sediment from lack of pasture management. But when we

explained to Mr. Kauffman about the logperch, he said, ‘hey, I can do better than this.’ Private landowners are key if we are to restore habitat for the Chesapeake logperch.”

The joint project restored 3,900-linear feet of streambank by regrading it to a level similar to the surrounding land and creating a natural floodplain. Logs and stones were used to create pools and riffles, which oxygenate the water and emulate natural stream flow. Mud sills, long log structures along the edges of the stream bed, were installed to provide cover for fish and reinforce the banks. Native trees, shrubs and grasses have been planted along the banks to filter runoff and help hold soil in place during storms.

The Fish and Wildlife Service is partnering with Donegal Trout Unlimited on more of these projects, including one on Fishing Creek in southern Lancaster County.

The Fishing Creek project was originally focused on improving trout habitat, but Smith said that it will be reviewed for ways to make a comfortable niche in the ecosystem for the logperch.

“Implementation so far has been good for the trout and the logperch,” Smith said. “But if we had to choose, we would give the logperch some priority.”

Conservationist looks back on a Shenandoah that nearly vanished

≈ Highway that drove away natural playground set woman on path to protect what was left.

BY JEREMY COX

Faye Crawford Cooper didn't lose her childhood all at once. But she knows how it started.

She grew up on a farm in Virginia's Shenandoah Valley, catching turtles, chasing snakes, scooping up tadpoles by the handful, overturning rocks to spot skinks and scouring the countryside for signs of deer.

Then came word that a new highway was slated to blaze its way down the middle of her family's 140 acres of rolling terrain. After that portion of Interstate 81 opened in 1963, life in and around the farm was never the same, Crawford Cooper recalled.

Workers dug a new channel to steer stormwater off the road. The wetlands dried up. The turtles vanished. The deer scattered. The hum of cicadas was replaced by the roar of semi-trucks and sedans.

"Everything changed in terms of the natural setting of the farm," she said. "I didn't realize how much of an effect it had on me until later on when I changed careers."

As seen through the lens of Crawford Cooper's experience, the interstate both shattered the valley's wild past and drove away the defense of its remaining pieces. Drawing inspiration from the valley of her memory, Crawford Cooper devoted most of her adulthood toward preserving the rural places that remained.

In 1990, as the march of subdivisions and strip malls looked almost inevitable, Crawford Cooper co-founded the Valley Conservation Council. The group quickly found itself at the head of a movement that eventually established conservation easements across approximately 155,000 acres — an area so large that, if assembled in one slab, it would be larger than Chicago.

A conservation easement is an arrangement in which property owners voluntarily donate or sell most, if not all, of the rights to build homes or businesses on their land. The ground remains legally theirs, though, and they can continue to raise crops, livestock or timber on it.

Crawford Cooper's efforts have shaped the valley as much as any force in recent decades, said Natasha Skelton, the council's executive director.

"She's put her signature on the landscape of the greater Shenandoah Valley," Skelton said.

Crawford Cooper, 65, has managed to remain a voice for the wilderness without becoming a voice in the wilderness, allies say. One of the biggest highlights on her resume was receiving the Gerald



Faye Crawford Cooper stands in front of the home where she grew up in Burketown, VA. She has helped connect scores of landowners in the greater Shenandoah Valley with conservation easements that protect land from development. This property is one of them. (Jeremy Cox)

P. McCarthy Award for Leadership in Environmental Conflict Resolution from the University of Virginia's Institute for Environmental Negotiation in 2011.

"We don't fight too much," said Crawford Cooper as she sat on the porch of a restaurant overlooking a pasture she hopes to someday see under an easement. "We didn't take an adversarial approach to local governments. We wanted to be viewed as a resource and not a thorn in their sides."

Crawford Cooper said preserving open space is vital to the Shenandoah Valley's economy and character.

The valley stretches along a northeast-southwest angle for nearly 200 miles but is only 30 miles wide at its maximum. It is often called Virginia's "farm basket," a basket that contains four of the state's top five agriculture-producing counties.

Aside from farming, the region's hiking trails and Civil War sites generate nearly \$1.5 billion in annual tourism spending.

One motivation for preserving land that sometimes gets overlooked but is no less important, Crawford Cooper said, is ensuring the health of the Chesapeake Bay. No fewer than three major tributaries — the Shenandoah, James and Rappahannock rivers — spring forth from western Virginia.

"We're sitting in the headwaters of the Chesapeake Bay," she said.

Initially a teacher of emotionally disturbed children, Crawford Cooper took a job with the Nature Conservancy's office in Charlottesville in the 1980s. In her telling, she was compelled more by a

paycheck than the idea of conservation. But that soon changed. As the director of stewardship, she traveled regularly to some of the most pristine parts of Virginia, where the Conservancy managed its land preserves. She also learned how to make a nonprofit survive financially.

In 1989, after the first of their two sons was born, Crawford Cooper and her husband, Peter, decided to move to Staunton.

By then, the valley's population had swelled more than 50 percent from 1960–1990, climbing to nearly 350,000 people, according to U.S. Census figures. Most of that growth took place in the region's cities. Harrisonburg, home to James Madison University, saw its population double to 31,000.

"Zoning either didn't exist or was a dirty word," she said. "We were just seeing hundreds and thousands of acres being converted from open space to these other uses."

Crawford Cooper and other alarmed residents began strategizing over kitchen counters and coffee tables. A consensus soon jelled that there was no organization working to shield cropland, timber acreage and other open space from bulldozers.

"We were not anti-growth," Crawford Cooper said. "We were for good planning."

They established the Valley Conservation Council and, after a few years, Crawford Cooper was hired to direct it. The group financed reports underscoring the need for open space, lobbied local officials to write preservation into growth plans and persuaded dozens of private

landowners to sell the development rights on their properties.

Since 1990, the amount of land under conservation easements has jumped from 5,000 acres to more than 160,000 acres, Crawford Cooper said. "Now, I'm not going to claim they influenced every one of those acres, but I think [the council] has had a hand in that movement," she added.

Under her direction, the group also successfully encouraged some jurisdictions to create agricultural districts, which prevent multiple tracts of contiguous land from being heavily developed for up to 10 years. She

continued her easement work out of the Staunton office of the Virginia Outdoors Foundation and later guided conservation efforts as Virginia's representative to the Mid-Atlantic Highlands Action Program. Crawford Cooper rejoined the Valley Conservation Council for a second stint as executive director before leaving with an emeritus title to go into private practice a few years ago.

While much of the region is now protected from intense development, many of the threats facing the greater Shenandoah Valley remain.

A University of Virginia think tank projects the valley's population to surge by nearly another one-fifth by 2020, surpassing 630,000 people. Meanwhile, the Virginia Department of Transportation is studying ways to carry that additional traffic on an already congested I-81. One option being considered is widening the 325-mile stretch to six lanes at a cost of nearly \$3 billion.

For her part, Crawford Cooper plans to retire in January to spend more time traveling with her husband. But she isn't sure whether she will step away entirely from environmental causes.

She worries that today's children won't appreciate the outdoors as much as previous generations because of technology, such as video games and smartphones.

"The work is not all done," she said. "There's been some great success stories with land and water conservation. I'm proud to have been associated with some of that to make that happen. But there's still a lot to be done in terms of changes to the landscape."

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goals.

"It didn't create this monumental acceleration in implementation that we would have liked to have seen," said Beth McGee, senior water quality scientist with the Chesapeake Bay Foundation, though she added that progress would likely have been even less without the new cleanup plan.

The vast majority of nitrogen reductions have come from sources that are the easiest to control: wastewater treatment plants. Those plants have nearly all been upgraded, though, so most of the remaining nutrient reductions will have to come from the agricultural and stormwater sectors, where getting significant reductions has been difficult.

"In the next couple of years, progress is really going to start to slip unless there are some big changes in funding levels and improvements in programs," said Jeff Corbin, the EPA's former "Bay czar" who is now with an environmental restoration firm. "It gets harder and harder every day that we get closer to 2025."

Some, including Corbin, even worry that the 35-year-old state-federal Bay Program partnership could disintegrate into lawsuits that pit states against one another if progress continues to falter.

So as the region reaches what was supposed to be the halfway point to its ultimate cleanup goal, has the latest cleanup plan — the Chesapeake Bay Total Maximum Daily Load — worked?

A historic moment

In December 2010, the EPA called it a "historic moment" as it unveiled the Bay TMDL, which it had spent years crafting in collaboration with states in the watershed. Unlike earlier voluntary



Chicken litter is piled in a field. Across the Bay watershed, agriculture remains the largest source of nutrients and is responsible for about 48 percent of the nitrogen reaching the Bay. (Dave Harp)

commitments that failed to meet goals, the "pollution diet," as it became known, required states to write more detailed plans than ever before and to face potential consequences if they fell short.

Then-EPA Regional Administrator Shawn Garvin called it "by far the most comprehensive and rigorous road map to restoration we've ever had. Not just in the Chesapeake Bay, but nationally."

In fact, fearing the Bay TMDL would force more action by agricultural interests — and inspire similar plans elsewhere — the American Farm Bureau Federation immediately

sued to block it, an effort that failed in federal court.

The TMDL is not unique to the Bay. It is a federal requirement for any waterbody that falls short of water quality standards and is aimed at making rivers, lakes, streams and coastal waters fishable and swimmable. A TMDL sets the maximum amount of a pollutant that a waterway can receive and still meet those standards.

But the Bay TMDL was by far the largest — covering a 64,000-square-mile watershed — and the most complex ever written. It defined the maximum amount of water-fouling nitrogen, phosphorus and sediment that the Chesapeake could handle while meeting measurable goals to improve water clarity and largely eliminate oxygen-starved summer-time dead zones.

Those "maximum loads" were then allocated to states and major rivers. Mindful that past Bay cleanup efforts had missed earlier goals set for 2000 and 2010, the EPA required states to write detailed plans showing how their portion of the goals would be met. The state plans also set reduction goals for different sources of pollution, called sectors, such as wastewater, developed lands and agriculture, to provide better accountability.

To keep efforts on track, the EPA also required states to set interim two-year cleanup goals, which are evaluated by the agency. Collectively, the states were charged with implementing 60 percent of the

needed cleanup actions by the end of 2017, roughly halfway to the ultimate 2025 cleanup goal.

If states fell short, the agency could take a variety of actions, such as forcing even greater — and more costly — reductions from wastewater plants than states had planned; regulating smaller animal operations than normally covered by federal programs; withholding water grants; or other actions.

In theory, the threat of those consequences would spur states to create new programs, provide more funding or establish new regulations to rein in pollution. That was particularly important for agriculture, an area over which the EPA has limited regulatory oversight.

"This was markedly different from the majority of other TMDLs," said Jon Capacasa, who is now retired but oversaw the development of the TMDL as the former head of EPA Region III's water protection division. "We gave it a running chance at success by paying attention to detailed implementation strategies and the accountability framework that became part and parcel of the TMDL package."

Uneven progress

Questions remain about the ability of the TMDL to push the region to the finish line, though, as well as its effectiveness at getting needed pollution reductions from hard-to-control sources.

Since the pollution diet was adopted, Bay Program figures show

How far to go

Here are the average annual nitrogen reductions needed by 2025, categorized by state.

Pennsylvania: 34.14 million pounds
Maryland: 8.44 million pounds
New York: 2.78 million pounds
Virginia: 2.43 million pounds
Delaware: 1.9 million pounds
West Virginia: Accomplished
District of Columbia: Accomplished

These figures do not include reductions needed to offset the impacts of the filling of the Conowingo Dam reservoir, climate change, population growth and development between now and 2025, nor pending new water quality standards for chlorophyll *a* on the James River in Virginia.

Ramping up Efforts

2.5 million pounds
 Average annual nitrogen reduction Baywide from 1985 to 2010 when the TMDL went into effect

2.6 million pounds
 Average annual nitrogen reduction Baywide since 2010, when the TMDL went into effect

4.26 million pounds
 Average annual nitrogen reduction needed by Pennsylvania from now through 2025

1.75 million pounds
 Average annual rate of nitrogen reduction from jurisdictions other than Pennsylvania from now through 2025

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that 87 percent of the nitrogen reductions have come from upgrading wastewater treatment plants, which are subject to strict regulatory oversight, although they are not the largest source of nitrogen pollution.

Chris Pomeroy, an attorney with the firm AquaLaw, which has represented wastewater treatment plants on Bay issues over the years, said it's not surprising that entities with permits would bear the brunt of the cleanup effort early on.

"Generally speaking, it probably is working about the way you would expect," he said. Pomeroy added that the long-term regulatory certainty provided for dischargers by the TMDL fended off any potential litigation by wastewater treatment plant operators against the cleanup plan.

In fact, wastewater treatment plant operators in Virginia and Maryland even joined the EPA in defense of the TMDL when it was unsuccessfully challenged by farming interests and homebuilders. Wastewater plant opera-

"We are looking for a stable regulatory climate extending well into the future now that we have done our part."

Taken as a whole, the wastewater sector has already reached its 2025 goal, and their discharges will further decline in the next few years as upgrades at a handful of additional plants come online. Their overachievement will help cover some of the shortfalls in other sectors. But that benefit will only be temporary as the population they serve increases.

Virginia, for instance, overachieved its 2017 goals largely because discharges from its wastewater treatment plants were nearly cut in half. But, cautioned James Davis-Martin, Chesapeake Bay program manager with the Virginia Department of Environmental Quality, "Those loads are going to start climbing back up with continued growth through 2025."

Meanwhile, stormwater runoff in the state has increased, and the nitrogen load from agriculture has decreased only about 3.5 percent since the TMDL took effect. "This next

able nitrogen and phosphorus reduction goals. But meeting nutrient reduction goals — especially as the acreage of developed lands continues to increase — will be difficult.

Among the jurisdictions affected by the TMDL, only the District of Columbia, where a huge underground tunnel is now capturing and storing much of its stormwater, has seen a decrease in the amount of nitrogen runoff from developed lands.

Rich Batiuk, the recently retired associate director for science with the EPA Bay Program Office, said states are starting to make progress with stormwater, but "they are probably going to need another five to 10 years beyond 2025 to fully put their programs in place."

Even that may not fully meet water quality goals for the stormwater sector. About 40 percent of developed lands in the Bay watershed lie outside areas covered by stormwater permits and their regulatory requirements. "That is something that states have no idea how to get their hands around," Batiuk said.

agriculture has decreased 2.5 million pounds since 2009 — the baseline for measuring TMDL progress. That's about a quarter of one percent per year. And that reduction was driven in large part by the loss of farmland across the region.

In parts of the watershed, farm operations have intensified in recent years. Crop production is increasing and, in some cases, low-intensity lands, such as pastures, were converted to crop lands. Also, data collected by the Bay Program show that more fertilizer is going onto more fields than previously thought. In some areas, a growth in farm animal populations is generating more manure.

Put another way: In many areas of the watershed, nutrient control best management practices — or BMPs — have done little more than hold the line on active farmland since the TMDL was enacted. Existing programs would need to be greatly ramped up to achieve the needed goals of the pollution diet.

"It has not conquered the agricultural problem," said Roy Hoagland, who was a vice president at the Chesapeake Bay Foundation when the TMDL was being written. "And I don't think the TMDL alone ever could conquer the agricultural problem. I think we have an overall flaw in the Clean Water Act when it comes to agriculture."

A boost for programs

Nonetheless, Hoagland and many others involved with the cleanup effort say that the TMDL has not failed, even as they acknowledge that it is unlikely to achieve its goal on schedule. Without it, they say, the Bay's restoration would be even further off track.

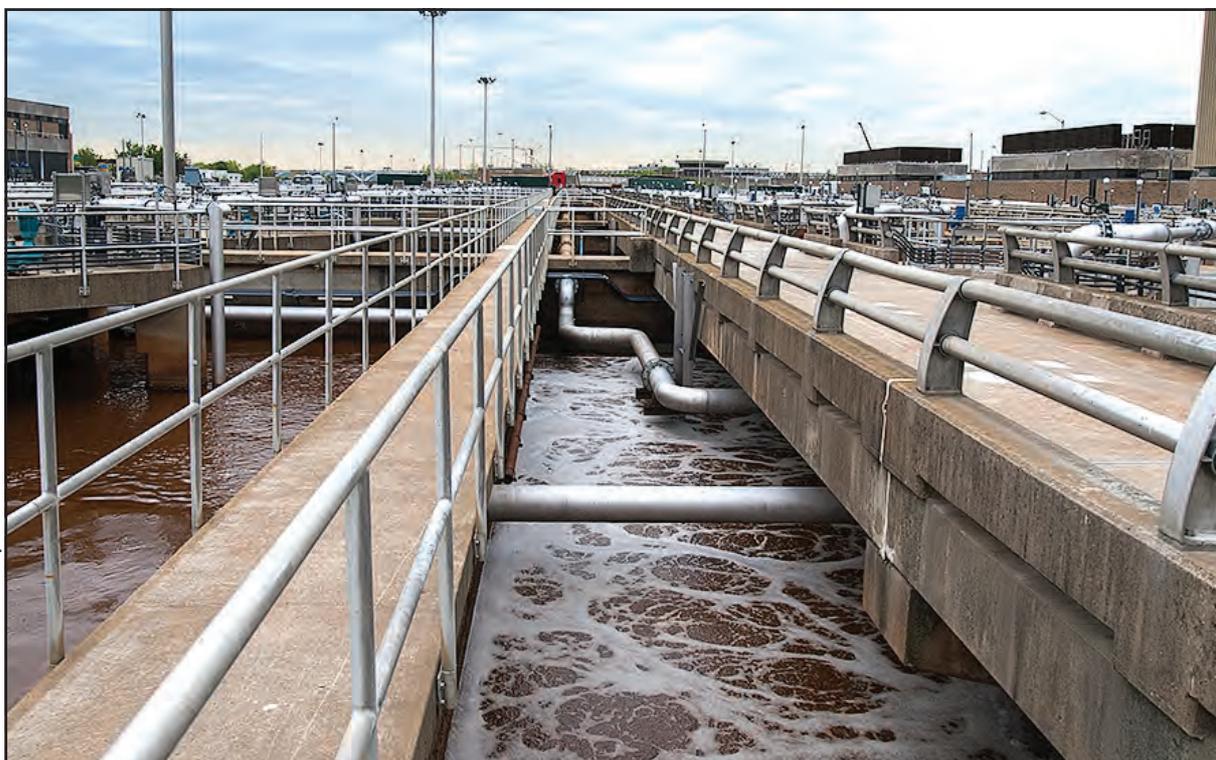
Leaders and advocates for the cleanup effort said the TMDL deserves credit for prompting policy changes throughout the region that could produce improved results in coming years. Many states, for instance, have ramped up their support for farmers and launched new programs, such as a state-funded stream bank fencing initiative in Virginia.

Some have enacted new rules or regulations. Maryland, for instance, has taken action to prevent farm animals from entering streams and enacted new rules to limit phosphorus applications on farmland.

Recognizing that agricultural efforts need to be ramped up, the Chesapeake Bay Executive Council — a panel that includes state governors and the EPA administrator — in August pledged to increase the amount of technical support available to help farmers install nutrient control practices.

Under the TMDL, states for the first time are starting to incorporate nutrient reduction goals into stormwater permits.

Upgrades at the Blue Plains Advanced Wastewater Treatment Plant, right, are responsible for most of the District of Columbia's reduction in nitrogen loads to the Chesapeake Bay.
(Dave Harp)



tors, in their filings, said the cleanup plan provided a "holistic watershed approach" that was needed to prevent excessive reliance on dischargers that would be "inequitable and insufficient" to restore water quality.

But their support could change, Pomeroy said, if other sectors don't do their share, and states seek another round of costly wastewater plant upgrades.

"I can assure you there would be no patience in the wastewater sector for any sort of, 'What have you done for us lately' approach," Pomeroy said.

period, even though we hit those 60 percent targets, is going to be very difficult for us," Davis-Martin said.

Difficulties ahead

Controlling nutrients from stormwater is a costly and evolving challenge, especially for older urban areas that were developed before stormwater controls became required in recent decades. Under the TMDL, permits for stormwater systems — which historically had been more focused on managing water flows — are starting to include quantifi-

Across the Bay watershed, agriculture remains the largest source of nutrients and is responsible for about 48 percent of the nitrogen reaching the Bay. Since the TMDL was established, many states have ramped up their oversight of agricultural programs and even provided additional funding.

At the same time, though, federal assistance for agricultural conservation practices has decreased after a Bay-specific funding program in the federal Farm Bill ended in 2014.

The net result is that nitrogen from

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As a result, many local governments are starting to charge stormwater fees to help meet Bay goals. And many places are testing new “green infrastructure” techniques to treat urban runoff that they hope will become more widely adopted in coming years.

In Pennsylvania, which has the greatest shortfall in nutrient reductions, the General Assembly is debating legislation that could charge large water users a fee that would be used to help fund the state's faltering cleanup efforts.

“People are no longer debating the need for reducing nitrogen, phosphorus and sediment,” Hoagland said. “One of the strongest things [the TMDL] has done is it has made water quality improvement in the Bay watershed, and the needs for these reductions, a routine consideration. It has helped drive conversations. It has helped drive changes.”

Now that the region has reached the midpoint to its 2025 goal, states are required to update their cleanup plans and describe how they intend to reach the remaining portion of their nutrient reduction obligations. As part of that process, the EPA is requiring states to develop more localized subgoals and better incorporate local officials in the planning process to help drive further progress.

“We are poised to do the right things if we go to the local scale,” Batiuk said.

More oversight needed?

At the same time, there is growing pressure for the EPA to more aggressively use its oversight to accelerate progress than it has thus far. Most point their fingers to Pennsylvania as the biggest laggard — measured in sheer pounds, it accounts for about half of the region's shortfall in nitrogen reductions, and was the only state to miss goals for phosphorus and sediment.

Like the region as a whole, Pennsylvania's nitrogen reductions have come almost entirely from wastewater treatment plant upgrades. Runoff from developed lands and 33,000 farms in its portion of the Bay watershed have both increased since the TMDL was enacted.

Past reports lay out a host of woes facing the state. It lacks the staffing to oversee its programs or enforce regulations, faces an overall shortage of funding for conservation programs, and has done a poor job of managing the federal grants it received to help the state address its problems.

But there are other problems as well. New York has also shown little overall progress with nitrogen and is the one place where wastewater discharges are increasing. Nor did Delaware or Maryland meet nitrogen goals. Stormwater runoff is increasing everywhere except



Nitrogen runoff from stormwater in developed areas increased from 37.92 million pounds in 2009 to 39.58 million pounds in 2017. (Dave Harp)

Trends: some good, some troubling

🌿 **Wastewater:** Nitrogen discharges from wastewater treatment plants decreased from 56.59 million pounds in 2009, the baseline for measuring pollution diet progress, to 36.58 million pounds in 2017. As a whole, the wastewater sector has already met its 2025 goals.

🌿 **Agriculture:** Nitrogen loads from agriculture in the Bay watershed decreased from 122.7 million pounds in 2009 to 120.1 million pounds in 2017 — a reduction of 2.6 million pounds, or 2.1 percent. But most of that stemmed from a 260,000-acre loss of farmland. From active farmland, the per-acre rate of nitrogen runoff remained largely unchanged and actually increased slightly, from 14.26 pounds to

14.4 pounds per acre (averaged across all types of farmland). As a result, the greater use of conservation practices essentially balanced out the increased use of fertilizer, a growing number of farm animals and in some cases, the transformation of low-runoff pasture land into higher-runoff crop land.

🌿 **Stormwater:** Nitrogen runoff from stormwater in developed areas increased from 37.92 million pounds in 2009 to 39.58 million pounds in 2017. The average per-acre runoff decreased slightly from 7.35 to 7.29 pounds during that period as regulatory oversight increased, but that reduction was more than cancelled out by a 275,000-acre increase in developed land.

the District of Columbia.

When the TMDL was enacted, the EPA had insisted that it would use its oversight to keep states — and sectors — on track. It reiterated that pledge in a June letter to the states, saying it would take “appropriate federal actions . . . if there is a lack of adequate progress” toward meeting 2025 goals.

So far, the agency has been reluctant to impose the consequences it had originally outlined in 2009, although it twice temporarily withheld grant funding from Pennsylvania to force it to take certain steps.

“EPA has a role under the TMDL now to take backstop actions, and it is going

to get harder and harder and harder to not take some sort of action unless some of the states that are lagging make progress, and some of the sectors that are lagging make progress,” said Corbin, the EPA's former Bay czar.

If that doesn't happen, he said, “my nightmare scenario is that states are going to end up challenging, legally or otherwise, the ones that aren't making progress.”

Earlier this year, some Maryland lawmakers already engaged in saber-rattling about taking Pennsylvania to court for lack of adequate progress. Maryland Gov. Larry Hogan has been increasingly critical in his comments about his state's

northern neighbor.

Maryland Environment Secretary Ben Grumbles, who chairs a Bay Program committee of senior state and federal agency officials, cautioned that “adding courts and litigation into the mix can be a challenge” but added that “the patience grows thinner as 2025 gets nearer. So there is a sense of urgency.”

“There is a point where the EPA has to provide less discretion and more backstop authority and accountability and step in and impose different types of consequences,” he said. “We need a strong and fair EPA to hold each state accountable — and keep our feet to the fire.”

Slow, but steady, progress

Ultimately, the success of the TMDL may be determined by patience. Reaching the 2025 goals is unlikely and would require a level of implementation — and funding — significantly beyond what is occurring, or has ever occurred, in the stormwater and agricultural sectors.

Reaching those goals got even harder in recent months, when the Bay Program updated its computer models to incorporate new science and better data and found that there was even less progress in those sectors than previously thought. Older models estimated that the region had achieved 36 percent of its nitrogen goal; the new models revised that down to 30 percent.

And those figures do not factor in the substantial reductions that will be needed to offset the impacts of climate change and the filling of the Conowingo Dam reservoir.

Climate change is projected to increase precipitation to the region and supercharge the impact of stormwater and agricultural runoff.

The Conowingo reservoir, now filled to capacity with a backlog of sediment, is sending more nutrients and sediments downstream instead of trapping them in the Susquehanna River. At recent rates of progress, it would take six years of work just to offset those factors.

That said, nitrogen pollution does continue to be on a downward trend — at least for the moment — despite increased development and a growing population. Phosphorus reductions are on track — though the Bay will never meet its water quality goals without dealing with nitrogen.

“Overall, the TMDL has done, and continues to do the job of driving progress forward,” Hoagland said. “It is a question of how fast it will move forward.”

“It's easy for us to say we haven't made our goals and we haven't achieved the reductions that we committed to,” he added. “On the other hand, you've made the reductions in spite of continuing healthy economic progress and the unavoidable increases in pollution that comes with that.”

New nutrient reduction goals reflect updated science, data, computer modeling

The state-federal Chesapeake Bay Program partnership recently revised its nutrient reduction goals for 2025 based on improved information, new science and updated computer modeling.

States are updating their cleanup plans to address the revised goals. These watershed implementation plans, drafts of which are due to the U.S. Environmental Protection Agency by April 12, 2019, are supposed to demonstrate that states have realistic plans to meet their new goals, as well as adequate programs, regulations and funding to get the job done. States are also supposed to engage local officials and organizations, as well as establish more localized planning goals in their plans.

Final plans are to be completed by Aug. 9, 2019.

The revised cleanup goals, or “planning targets,” stem from new computer models developed during the Bay Program’s “midpoint assessment” of the progress made since 2010 toward the 2025 cleanup goals outlined in the Chesapeake Bay Total Maximum Daily Load, or “pollution diet.” The TMDL defines the maximum amount of pollutants the Bay can receive and still attain water quality standards.

Overall, the new numbers show a more difficult path toward the 2025 goal than those produced by the previous models. While they continue to show that the region as a whole is on track to meet its phosphorus goals, it is further behind on its nitrogen goals.

The previous computer model found that the region had, through the end of last year, achieved 36 percent of the needed nitrogen reductions. The new model has found it is only 30 percent of the way to the target.

A variety of factors contribute to the changes. The new model uses a host of updated information, such as improved land cover data, new information about soil types and better information about nutrient movement through river systems.

The model also uses updated data about fertilizer sales, animal populations and the implementation and effectiveness of a wider range of nutrient-reducing “best management practices.”

Taken as a whole, the new analysis shows fewer nitrogen reductions from non-wastewater sources.

The model analysis further incorporates refined information about the importance of where nutrients are generated. Nutrient runoff that occurs closer to major rivers, for example, tends to have more influence than



Wetlands are included in the ‘Natural Land’ sector, which also includes forests, stream banks and other largely natural areas.

(Dave Harp)

A guide to understanding nutrient trends

The figures on the facing page show, in pounds, computer-estimated nutrient “loads” reaching the Chesapeake from each major “sector” — sources of nutrient pollution — in each state. The figures presented for each state reflect levels in 1985, the approximate year in which nutrient control efforts began; 2009 levels, which are the baseline for measuring efforts since the Chesapeake Bay Total Maximum Daily Load was established; estimated progress at the end of 2017; and the 2025 cleanup goals.

Load changes between 1985, 2009 and 2017 reflect the estimated impact of new urban and agricultural runoff control practices, upgrades to wastewater treatment plants and land use changes.

The sectors that generate nutrients are categorized as follows:

≈ **Agriculture**, which covers all forms of farming, including large concentrated animal feeding operations, croplands and low intensity pastures.

≈ **Developed Land**, which reflects runoff from all urban and suburban land, including areas covered under stormwater permits and areas where runoff is unregulated.

≈ **Wastewater**, which includes

discharges from treatment plants and sewer overflows, as well as any industries that discharge nutrients.

≈ **Septic**, which includes septic systems and other small, on-site treatment devices.

≈ **Natural Land**, which includes forests (including harvested areas), wetlands, stream banks and other largely natural areas. Many natural nutrient sources are largely uncontrollable.

As states develop new watershed implementation plans in the coming months, they will set new sector goals for 2025, which the EPA will use to track progress toward overall goals, as well as more local targets.

Additional Nutrient Sources

These figures do not include some significant nutrient sources which the Bay Program has also committed to address:

≈ **The impact of the filling of the Conowingo Dam reservoir on the Susquehanna River.**

This results in about 6 million additional pounds of nitrogen and about 260,000 additional pounds of phosphorus reaching the Chesapeake each year. States have committed to writing a joint plan to address that issue.

≈ **The impact of climate change.**

This results in about 9 million additional pounds of nitrogen and 385,000 pounds of phosphorus reaching the Bay each year. Those estimates are being reviewed, and states have committed to revising cleanup plans to address climate change in 2021.

≈ The impact of continued population growth and development.

Based on past trends, that could mean another 4 million pounds of nitrogen and 154,000 pounds of phosphorus entering the Bay by 2025.

≈ Additional pollution reductions may be needed on the James River in Virginia.

Right now, Virginia figures only include reductions for the James River that are needed to address Chesapeake Bay water quality. But scientists and state and federal officials are working to establish a revised standard for chlorophyll *a* (a measure of algae) that is needed to protect aquatic life in the tidal portion of the James River, which could require additional nutrient reductions.

Sediment goals will be set later but are presumed to be accomplished by phosphorus controls, which also control sediment.

runoff near smaller rivers because major rivers transport nutrients to the Bay more effectively.

Nutrient reductions from the Potomac River basin also have a somewhat greater impact on Bay health than was indicated by the previous model.

In addition, the relative impact of nitrogen is greater than phosphorus in the new modeling.

Overall, the new model findings had the greatest impact on Maryland. In the old model, the state needed to achieve 5.7 million additional pounds of nitrogen reductions to meet its

2025 goal; in the new model it has to achieve 8.4 million pounds of reductions.

The District of Columbia, which had already met its 2025 goals in the old model, continues to do so in the updated model. West Virginia has also met its goal

Chesapeake Bay Watershed Nutrient Trends and Goals

State/District	Sector	Nitrogen Loads in Pounds				Phosphorus Loads in Pounds			
		1985	2009	2017	2025 Target	1985	2009	2017	2025 Target
New York	Agriculture	10,357,285	7,328,276	6,601,411		404,233	187,396	171,451	
New York	Developed	1,540,050	1,942,730	2,001,316		64,970	73,448	73,032	
New York	Wastewater	3,319,407	1,955,512	2,437,084		363,036	214,472	139,308	
New York	Septic	161,079	177,207	176,314		0	0	0	
New York	Natural	3,294,822	3,102,523	3,101,558		358,247	261,955	248,580	
New York	All Sources	18,672,643	14,506,247	14,317,683	11,533,018	1,190,486	737,271	632,372	587,326
Pennsylvania	Agriculture	76,587,104	62,876,782	63,292,073		2,465,652	1,737,423	1,579,945	
Pennsylvania	Developed	11,240,175	14,760,447	15,374,611		314,632	431,691	435,714	
Pennsylvania	Wastewater	13,329,342	14,417,809	8,114,705		1,849,085	1,109,266	689,811	
Pennsylvania	Septic	1,526,442	1,870,763	1,941,243		0	0	0	
Pennsylvania	Natural	19,336,192	18,783,705	18,591,328		1,416,281	1,184,266	1,095,373	
Pennsylvania	All Sources	122,019,256	112,709,507	107,313,961	73,175,692	6,045,650	4,462,646	3,800,842	3,043,906
Maryland	Agriculture	34,272,099	22,978,436	22,376,859		1,890,831	701,705	645,859	
Maryland	Developed	6,590,782	9,009,369	9,351,599		604,031	685,732	673,835	
Maryland	Wastewater	32,218,029	14,396,666	11,306,504		2,639,701	784,040	512,229	
Maryland	Septic	2,123,636	3,046,890	3,090,474		123	651	664	
Maryland	Natural	8,867,000	8,081,054	8,098,301		2,287,295	1,875,517	1,832,490	
Maryland	All Sources	84,071,546	57,512,415	54,223,737	45,783,540	7,421,981	4,047,644	3,665,077	3,679,925
Virginia	Agriculture	24,955,425	20,407,591	19,726,462		2,431,704	1,618,795	1,568,470	
Virginia	Developed	6,692,618	10,143,140	10,805,130		740,817	1,241,267	1,328,617	
Virginia	Wastewater	37,619,836	22,529,974	12,742,822		7,708,829	1,780,191	947,346	
Virginia	Septic	1,333,419	1,970,591	2,117,300		1,243	1,243	1,243	
Virginia	Natural	13,692,855	13,049,459	12,763,352		2,664,922	2,348,565	2,276,485	
Virginia	All Sources	84,294,154	68,100,754	58,155,065	55,725,441	13,547,516	6,990,061	6,122,161	6,192,384
West Virginia	Agriculture	4,291,552	3,272,061	3,085,736		273,688	144,585	122,145	
West Virginia	Developed	716,200	1,232,259	1,206,985		32,724	73,029	59,684	
West Virginia	Wastewater	753,177	668,966	574,004		163,168	181,387	46,890	
West Virginia	Septic	205,134	323,607	330,193		7	7	59	
West Virginia	Natural	2,748,987	2,567,753	2,573,339		287,086	225,115	200,275	
West Virginia	All Sources	8,715,051	8,064,646	7,770,256	8,221,298	756,673	624,124	429,053	431,952
Delaware	Agriculture	5,820,611	5,809,903	5,019,938		127,907	63,776	44,094	
Delaware	Developed	416,380	656,874	681,992		16,063	24,947	25,667	
Delaware	Wastewater	74,224	53,175	43,225		3,590	3,334	7,228	
Delaware	Septic	101,275	172,847	179,905		201	201	201	
Delaware	Natural	563,064	557,802	532,471		73,097	47,465	40,879	
Delaware	All Sources	6,975,554	7,250,600	6,457,531	4,550,209	220,856	139,723	118,069	108,446
District of Columbia	Agriculture	0	0	0		0	0	0	
District of Columbia	Developed	164,429	173,099	163,142		13,515	14,959	13,089	
District of Columbia	Wastewater	6,289,206	2,567,723	1,358,842		71,933	53,253	59,270	
District of Columbia	Septic	406	194	173		0	0	0	
District of Columbia	Natural	26,114	23,776	22,479		4,161	4,060	3,820	
District of Columbia	All Sources	6,480,155	2,764,791	1,544,637	2,424,737	89,609	72,272	76,178	130,065
Chesapeake Bay Watershed TOTAL		331,228,358	270,908,960	249,782,870	201,413,934	29,272,771	17,073,741	14,843,751	14,174,003

(Chesapeake Bay Program Phase 6 Watershed Model)

Success of Chesapeake's restoration tied to PA, which lags far behind

≈ Some think the EPA should take action to pressure the state toward more aggressive pollution reduction programs.

By **KARL BLANKENSHIP**

Across the Chesapeake Bay watershed, controlling runoff from agriculture and stormwater has proven difficult for decades.

Nowhere is the problem greater than in Pennsylvania, which has more of both than any other state in the Bay region — and where efforts to control them are the farthest off track.

Whether that trajectory changes may ultimately determine whether the latest Bay cleanup plan — the Chesapeake Bay Total Maximum Daily Load, or “pollution diet” — is deemed a success.

“Pennsylvania is going to be the key,” said Nick DiPasquale, the recently retired director of the U.S. Environmental Protection Agency’s Bay Program Office. “They are going to need a lot of help.”

Based on the EPA’s 2017 assessment of the cleanup effort, Pennsylvania accounts for about half of the region’s shortfall in meeting its nitrogen reduction goal and is the only state that also missed its goals for reducing phosphorus and sediment.

Pennsylvania does not border the Chesapeake Bay but is intimately linked to its health. The Bay is, in geologic terms, the ancient bed of the Susquehanna River, which drains half of Pennsylvania, as well as a portion of New York and a bit of Maryland. (A small part of Pennsylvania is in the Potomac watershed.)

The Susquehanna supplies about half of the freshwater to the Bay — and more than two-fifths of the nitrogen pollution. Because the mouth of the river is at the head of the Bay, those nutrients tend to have an especially large impact on the Chesapeake’s health.

Pennsylvania produces more runoff from agriculture and stormwater than any other state in the Bay watershed. About 59 percent of its nitrogen load to the Bay comes from the runoff generated by 33,000 farms, according to Bay Program figures. Another 14 percent comes from runoff that originates on developed land, often from small communities sprinkled throughout the landscape. The amount of nitrogen from both of those sectors has increased in the state since the TMDL went into effect in 2010.

Still, Pennsylvania has reduced its overall nitrogen load to the Bay since 2010 — by about 4.8 percent — but the reduction has come almost entirely from upgrades at wastewater treatment



Pennsylvania produces more runoff from stormwater than any other state in the Bay watershed. (Dave Harp)

Pennsylvania's problematic situation

Pennsylvania was the source of 112.7 million pounds of nitrogen reaching the Bay in 2009, or 41.6 percent of the regionwide total. By 2017, the amount of nitrogen from Pennsylvania was reduced to 107.3 million pounds, but its share of the regionwide total had increased to 43 percent as other states did more to reduce their nitrogen loads.

Here's a look at Pennsylvania by the numbers:

≈ **5.4 million pounds:** Nitrogen reductions since 2009

≈ **18.3 million pounds:** Shortfall in needed nitrogen reductions through the end of 2017

≈ **34.1 million pounds:** Needed nitrogen reductions by 2025

≈ **6.3 million pounds:** Nitrogen reductions from wastewater treatment plants since 2009

≈ **416,000 pounds:** Nitrogen increases from agricultural lands since 2009

≈ **614,000 pounds:** Nitrogen increase from developed lands since 2009

plants. In Pennsylvania, though, those plants account for less than a 10th of the nitrogen that ultimately reaches the Bay, which leaves a huge amount of additional reductions needed from agriculture and developed lands.

Past EPA reviews have laid out a host of woes that got Pennsylvania into this situation. The state has lacked the ability and capacity to oversee its stormwater and agricultural programs or to enforce existing regulations.

Although Pennsylvania has the largest agricultural sector among the Bay states, it puts the least amount of state funding into conservation programs. It has even done a poor job of managing federal grants aimed at helping the state address its problems, the EPA has said.

To meet Bay cleanup goals,

Pennsylvania between now and 2025 would have to accomplish more than 70 percent of the remaining nitrogen reductions needed from the entire Bay watershed. And that doesn't account for additional reductions needed to offset the impacts of increased precipitation from climate change and the filling of the Conowingo Dam reservoir, both of which will deliver more nutrient pollution to the Bay, and both of which have disproportionately large impacts in Pennsylvania.

'Clearly behind' but committed

At an August meeting, Pennsylvania Environment Secretary Patrick McDonnell acknowledged to other cleanup leaders that the state was “clearly behind” but “committed to

developing a plan that gets us to 2025.”

McDonnell also said the state anticipates that 80 percent of its needed nutrient reductions will come from farms. That means that from now through 2025, their farmers would have to accomplish 11 times what was achieved by farms throughout the entire Bay watershed since 2010.

The number and relatively small size of many Pennsylvania farms makes the task even harder because working with so many individual farmers requires a huge amount of resources.

“If they accomplish a good third of what they have committed to do by the 2025 deadline, that would be huge,” said Rich Batiuk, the retired associate director for science with the EPA’s Bay Program Office. Batiuk had a leading role in crafting the TMDL and overseeing its implementation. He estimated that Pennsylvania will need to come up with \$100 million to \$200 million a year just to help farmers implement programs.

If keeping states on pace was one of the key goals of the TMDL, how did Pennsylvania get so far off track?

“The bottom line is that EPA has not fully exercised its options — and what is listed clearly for the partnership and the public — of tools that it has,” Batiuk said.

In a letter sent to states in 2009, the EPA outlined “consequences” that states might face if their efforts fell behind. It included actions such as requiring additional nutrient reductions from wastewater treatment plants, withholding clean water grants and directing how that money is spent. Another option is to draw more animal feedlots under its regulatory umbrella.

The EPA has twice temporarily withheld grant funding from Pennsylvania to prod it toward specific actions. But withholding money from a cash-strapped state isn't ideal.

“Some of the tools that EPA has, like withholding funds, doesn't really help them get the job done,” DiPasquale said.

The EPA does have the authority to require greater reductions at wastewater treatment plants and has warned Pennsylvania that it could do so. Although most of the state's largest wastewater treatment plants have been upgraded, they still allow higher nitrogen concentrations in their discharges than other states.

But Pennsylvania's wastewater contributions are so small that, even if all of those discharge pipes were corked, it would only get the state a quarter of the way to its goal and would

PA FROM PAGE 32

come at a high cost.

Local wastewater authorities already have spent \$1.4 billion to upgrade 191 treatment plants. Another round of upgrades could cost an additional \$2 billion to achieve even smaller results, said John Brosious, deputy director of the Pennsylvania Municipal Authorities Association.

“That has been a bone of contention with our [wastewater] sector. In the 13 years that we’ve been at this, we have done every single thing that has been asked of us, and more,” he said. “‘No good deed goes unpunished’ — we’ve had guys saying that.”

EPA’s reach is limited

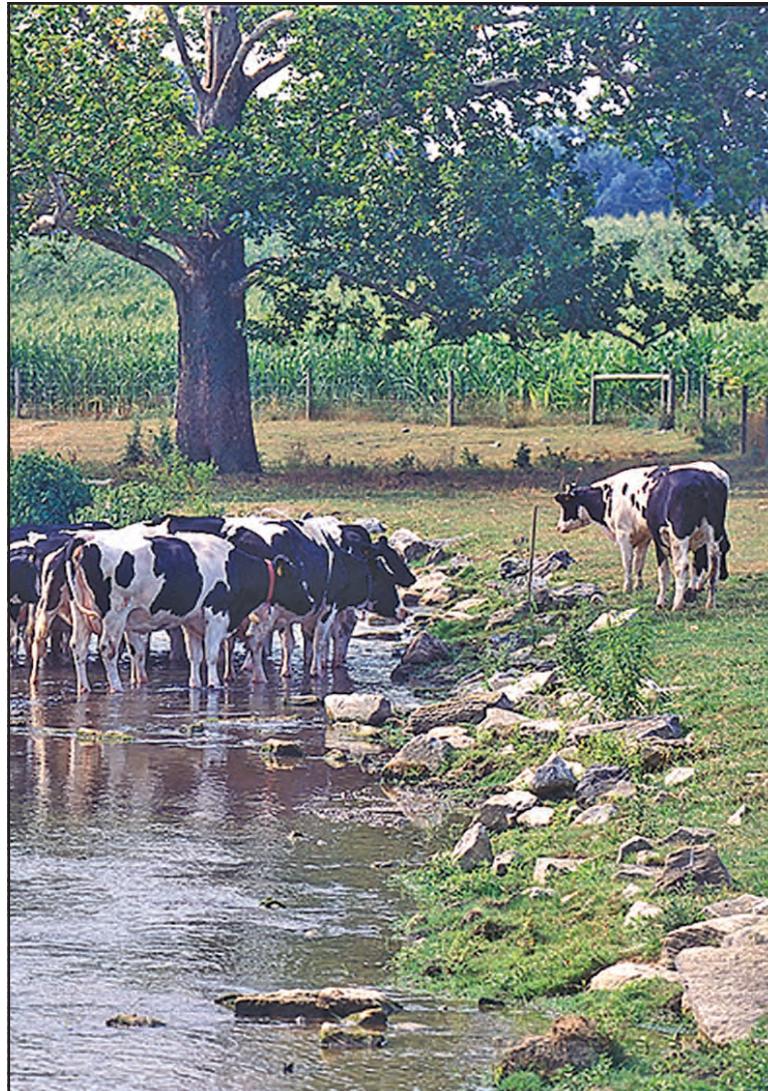
The EPA’s regulatory reach is limited too, particularly for agriculture. Typically, the EPA regulates dairy operations with 700 or more cows. But it can regulate smaller operations if they are contributing to a water problem, as the agency has warned it could do. Several years ago, though, the agency reviewed Pennsylvania’s Lancaster County and concluded it would have to regulate farms with as few as 50 cows to cover half of the dairy manure produced in the county — something it concluded was unworkable.

The enforcement framework in the Bay TMDL was patterned after the Clean Air Act in which the federal government sets overall standards, and states develop and implement the needed actions. If states fail to meet goals, they can lose federal highway funding — a huge amount of money. The consequences under the Bay TMDL, though, do not have the same degree of leverage.

“The options that we used were legal and available under the Clean Water Act, but we didn’t have the same advantages that the Clean Air Act did with substantial backstops,” said Jon Capacasa, the former head of EPA Region III’s water protection division, who wrote the 2009 letter to the states outlining the “consequences” the agency could take.

Still, some argue that the agency could take other actions, such as yanking grant funds from the state and giving them to a third party to implement on-the-ground cleanup programs, or further ramping up enforcement and oversight activities.

The threat of additional actions has had some impacts already. The state has dramatically ramped up its inspections of farms to make sure they have required manure and erosion management plans. It also has launched the most aggressive effort of any Bay state to develop new county-level



Pennsylvania produces more runoff from agriculture than any other state in the Bay watershed. (Dave Harp)

cleanup plans showing how the state could reach its 2025 cleanup goals. It is working to target problem areas to better focus its cleanup efforts.

The Pennsylvania General Assembly is also debating legislation that could charge large water users a fee that would be used to help fund the state’s faltering cleanup efforts.

Buy-in from farmers needed

John Bell, government affairs counsel with the Pennsylvania Farm Bureau, praised the state’s recent efforts to develop local plans, with input from farmers and others, which will more clearly lay out what needs to be done. Such extensive outreach didn’t happen with the state’s earlier cleanup plans, he said, and resulted in strategies that many thought were unrealistic. The latest effort, he said, is a process that can win buy-in from farmers, but he added “there still needs to be an element of patience” and that farmers need to be able to view it as realistic.

“I think the more important focus is devising a plan that Pennsylvania truly believes it can do, whether it be 2025 or 2030, or years beyond,” he said.

Bell also cautioned that “if this exer-

cise becomes one of ‘let’s pass more regulations and laws and ordinances’ that attempt to restrict practices and uses, that is going to be problematic.”

How much patience others have remains to be seen. Some think that if Pennsylvania’s shortfall is an obstacle to Bay recovery, it may spur a lawsuit either by another state or an environmental group as an attempt to force more aggressive actions.

“Certainly, it is not the first option that people want to exercise,” DiPasquale said. But, “that is a potential option down the road if Pennsylvania can’t get the job done.”

Batiuk also said he thought it likely that others would sue if the state isn’t showing more progress. But, he said, “I would hope that the states would put more pressure on EPA to take action versus they themselves feeling the need to do it.”

Maryland Environment Secretary Ben Grumbles, who chairs a committee of senior state and federal agency officials that helps guide Bay policy, said the EPA needs to not only play the role of umpire in assessing state progress, but take action.

“In order for it to be meaningful

and real, you do need evidence that EPA follows through on its consequences memo,” he said, adding that “you absolutely need as well, however, the development of different tools and funding sources.”

Not everyone thinks EPA actions need to be punitive, though. “Pressure is one thing,” Capacasa said. “I would speak to the power of affirmation.”

Capacasa said that while the EPA has a role in overseeing the TMDL’s implementation, the agency acting alone “is an imperfect solution” because its tools are limited.

“It is up to the Bay community as a whole to hold states and jurisdictions accountable for results,” he said. The EPA can do a better job working with states to get programs on track, he said, and the region as a whole can do more to share knowledge about programs that work — and how they can be improved.

“We can poke our fingers in their chest all we want,” agreed James Davis-Martin, the Chesapeake Bay program manager with the Virginia Department of Environmental Quality and co-chair of the Bay Program workgroup that helps evaluate cleanup actions. “It is not going to make more implementation happen on the ground. Helping them develop new programs and get them implemented in one year rather than three years, that is what is going to get more stuff on the ground.”

Martin said that while it was unlikely Virginia would ever send money to Pennsylvania to implement programs, it could possibly send staff to advise on areas where Virginia has made progress, and how those programs could be adapted to another state.

‘This could get ugly’

Determining how the EPA should exercise its oversight will likely become a bigger issue in coming years, as the region faces its significant shortfall in nitrogen control efforts. While Pennsylvania has the biggest hurdles, New York’s nitrogen numbers have decreased only slightly since the TMDL went into effect, and Maryland and Delaware both missed their nitrogen goals. Nearly all states face hurdles in getting, or keeping, their agriculture and stormwater sectors on track — where most remaining nitrogen reductions must come from.

“This could get ugly,” warned Jeff Corbin, one of the EPA’s former Bay experts who now works for a private environmental restoration firm. “We are starting to max out on the goodwill and the voluntary actions. Now we are getting into some really tough situations where we don’t have the money, we don’t have the regulatory authority, and what happens now?”

'In another decade or two, we'll see a different Chesapeake'

≈ Scientists seeing onset of 'tipping' point, where positive changes act as catalyst for new improvements.

BY KARL BLANKENSHIP

This December will mark the 35th anniversary of the original promise by regional leaders to work together to protect the water quality of the Chesapeake Bay — and the fish, crabs and other species that depend upon it.

More than three decades after it started, the cleanup effort still has a long way to go. In its latest water quality assessment, the state-federal Bay Program partnership found that just 40 percent of the Chesapeake's tidal waters met agreed-upon goals for clarity, dissolved oxygen and chlorophyll.

That's the best status report since the cleanup effort began, but still far from attaining water quality standards.

So how long will it take to get there?

"Decades," said Rich Batiuk, the retired associate director for science with the U.S. Environmental Protection Agency's Bay Program Office. "But I think, in another decade or two, we'll see a different Chesapeake out there."

Indeed, while it might take decades to meet Baywide water quality goals, people could see a substantially better Chesapeake much sooner — in fact, they are already seeing it. Last year, the Bay's underwater grass beds exceeded 100,000 acres, a level not reached in decades.

Their resurgence demonstrates results from decades of often slow but steady work. But reaching goals for water clarity and oxygen concentrations throughout the Bay will be difficult.

The most recent plan to deliver a clean Bay, the Chesapeake Bay Total Maximum Daily Load or "pollution diet," sets a 2025 cleanup deadline. But that doesn't mean the Bay would be "clean" by 2025. The 2025 deadline is for states to implement all of the actions needed to meet water quality standards.

Even if that happens on schedule, there would be substantial delays before the impact of all of those actions would be felt in the Chesapeake. It can take many years for some runoff control practices, like newly planted streamside forest buffers, to become fully effective. And much of the nutrient pollution that enters the Bay and its rivers first travels through slow-moving groundwater.

Management practices such as cover crops can reduce the amount of nitrogen



The improvement in the Chesapeake Bay's health demonstrates results from decades of often slow but steady work. (Dave Harp)

sinking into the groundwater, but it can take years to decades for the "old" groundwater — which predates the use of cover crops and other practices — to work its way out of the system.

During the years it takes for the full impact of those actions to be felt in the Bay, states will have to take even more pollution control actions to offset the impacts of population growth, new development and increasingly intense agricultural operations — just to hold the line on pollution.

Also, the 2025 cleanup deadline does not account for the substantial new efforts that will be needed to offset the filling of the Conowingo Dam reservoir on the Susquehanna River and increased precipitation from climate change — both of which deliver nutrients that were not accounted for when setting the current cleanup goals. At recent rates of nutrient reductions, additional efforts to offset those loads would take at least five more years. And then, as with current efforts, it would take additional time for their full impact to reach the Bay.

But there is good news. The nutrient reductions required by the TMDL were set to achieve water quality standards in the deepest areas of the Bay, where dissolved oxygen concentrations are lowest. But lesser amounts of nutrient reductions will trigger improvements sooner in many other areas, said Jon Capacasa, who is now retired

but oversaw the development of the Bay water quality standards as the former head of EPA Region III's water protection division.

"There is going to be a lot of change happening in the shallow reaches of the Bay, particularly where the habitat is most valuable, long before you return oxygen to the deep part of the Bay," Capacasa said.

That's already been seen with the recent expansion of underwater grass beds.

Another positive factor, scientists say, is that better water quality can kick-start other biological and chemical processes that lead to further improvements.

For instance, large underwater grass beds improve surrounding water quality, which in turn allows those beds to expand farther than might be predicted by nutrient reduction efforts alone. Scientists say that's already happening in places around the Bay, including the Susquehanna Flats, an area that was nearly barren two decades ago but is now covered with thousands of acres of lush underwater meadows.

Recent research has shown that nutrient reductions have also triggered chemical-processing changes in deep areas of the Bay, resulting in better oxygen conditions than were predicted. While much of the Bay remains blanketed by a hypoxic (low oxygen) dead zone, the amount of anoxic (no-oxygen) water has been gradually shrinking.

Some believe that slight improvements in water clarity will activate still more changes. As light hits the bottom, it can spur the growth of certain bottom-dwelling algae species that help bind sediment, preventing it from being churned up and clouding the water.

In short, they say, parts of the Bay are near a "tipping point" at which Mother Nature will help improve conditions.

"That is really exciting," said Beth McGee, senior water quality scientist with the Chesapeake Bay Foundation. "We know the Bay isn't going to be saved by 2025. But the big unknown is what we are seeing now — the notion of a tipping point. We are seeing improvements."

Scientists refer to that natural assistance as "positive feedback." It has the potential to act "like a turbocharger" for the ecosystem by producing greater — and perhaps faster — improvements, said Bill Dennison, vice president for science applications with the University of Maryland Center for Environmental Science.

"We certainly have got the trajectory in the right direction," he said. "That is the most important thing because that positive trajectory helps accelerate the feedback."

"But we can't backslide," he added. "We have to continue to make progress."



Bay Buddies
Standing Out!

Clockwise from top right: a vial of horseshoe crab's blood, the Delmarva fox squirrel and monarch butterflies. (Dave Harp)



"Look" at the animal, plant or mineral in each of these lists. Three share a common trait that the fourth does not. Can you figure out which one stands out from the rest, as well as what the other three have in common? Answers are on page 46.

1. Chicory flowers, horseshoe crab's blood, kyanite crystals, northern cardinal feathers
2. Dandelion petals, Delmarva fox squirrel, eastern tiger swallowtail, tip of a young copperhead's tail
3. Baltimore oriole, corn snake, monarch butterfly,

- marbled salamander
4. Calcite, ripe poison ivy berry, trout lily, wood from a holly
 5. Robin eggs, bullfrog, luna moth, serpentine
 6. Scarlet tanager, northern puffer, cooked blue crab shell, beebalm
 7. Tip of gray fox's tail, bear, cattle egret, dead man's fingers fungus
 8. Monkshood, amethyst, purple martin, raccoon
- Kathleen A. Gaskell



Odd-standing in their Crowd

For some, October is the month to dwell on the odd and unusual. In each list here, three of the items have at least one thing in common. You are asked to pick the odd man out. Answers and explanations are found on page 46.

1. Winnie Estelle, Dee of St. Mary's, Nathan of Dorchester, HM Krentz
2. Mile-a-minute, wavyleaf basketgrass, poison ivy, garlic mustard



3. Great Dane, Chesapeake Bay retriever, golden retriever, American foxhound, Newfoundland



4. Belted kingfisher, pileated woodpecker, tufted titmouse, black-capped chickadee

5. Comb jellyfish, dogwood flower, firefly, honey mushroom

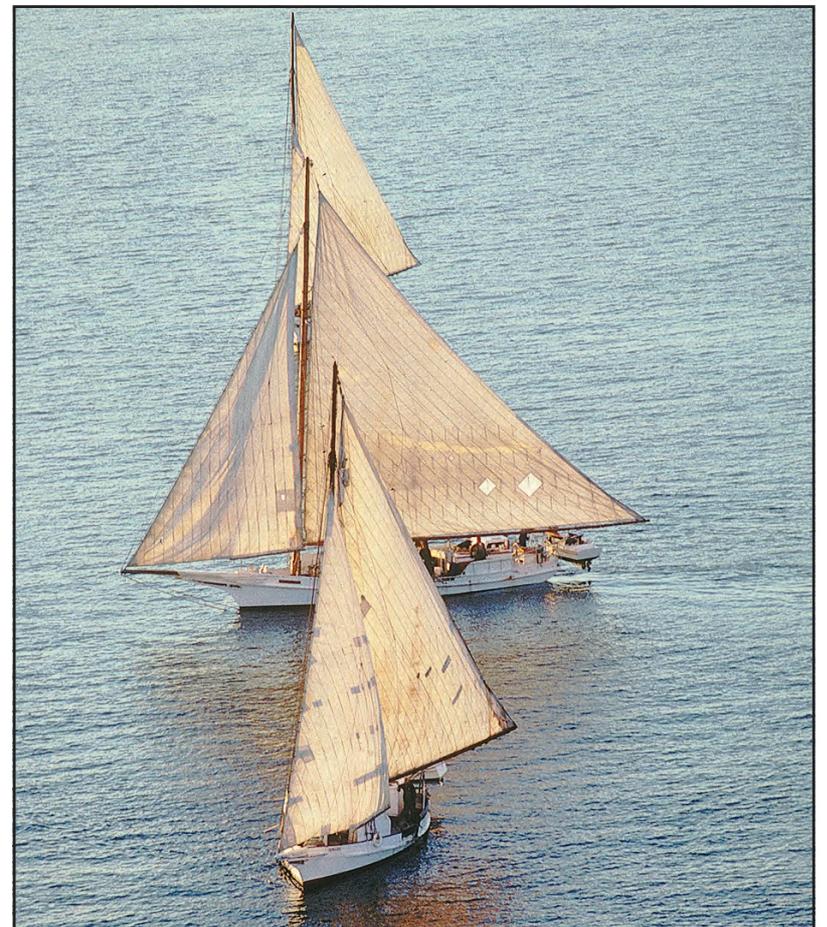
6. Copperhead, Eastern yellowjacket, rockfish, Atlantic oyster

7. White flounder, windowpane, hogchoker, mummichog

8. Monticello, Mount Vernon, Wheatland, Montpelier

— Kathleen A. Gaskell

Poison ivy, left, and three skipjacks. (Dave Harp)



Devil's Marbleyard tempts hikers with rocky challenge



Derek Warnecke of Blacksburg, VA, bottom, and Brad Fulcher of Amherst County, VA, climb the rock formation known as the Devil's Marbleyard inside the George Washington and Jefferson National Forest in western Virginia.

STORY & PHOTOS BY
JEREMY COX

After a mile of increasingly pitched hiking through a dense forest, a strange scene unfolded. Quartzite boulders, ranging in size from La-Z-Boy recliners to school buses, reared up, blazing away in the sun. The absence of green was matched only by the audacity of white and its kindred tints: alabaster, ash, gray.

The well-tended trail continued upward, following the rim of woods along the outcropping's flank. But I didn't come all this way to take the path of least resistance. I came to explore one of the East Coast's singular hiking experiences: the Devil's Marbleyard, a rock slide of epic proportions and views.

The boulder field lies along the 2.3-mile Belfast Trail inside the George Washington and Jefferson National Forest, about a 30-minute drive south of Lexington, VA. The out-and-back route is a haven among hikers, attracting dozens of elevation-seekers on a typical weekend day. But it's not nearly as popular as another outdoorsy destination I passed along the way: the Natural Bridge, a limestone arch that attracts 180,000 visitors a year.

It would be inaccurate to refer to the Marbleyard as "off the beaten path," though. The trek from the parking lot to its base measures about one mile, making it relatively accessible to hikers of varying abilities.

At about 9:30 a.m. on the Saturday before Labor Day, my car was the third in a gravel parking lot big enough to contain about six vehicles. By the time I returned nearly four hours later, the lot was full, and several cars were parked along the shoulder.

Hiking at elevation — any elevation — is a bit outside my comfort zone. To see a hill in my native Florida or my current residence on the Eastern Shore of Maryland, visit a landfill. So, I had little frame of reference for the challenge of scrambling to the top of this roughly 8-acre rock pile.

Such formations are relatively common farther north, where glaciers upended the landscape during the most recent Ice Age. But glaciers never ventured into the area that produced the Marbleyard.

Geologists, though, think it may have been frigid enough during that period — about 18,000–30,000 years ago — to create periglacial conditions. That's when seasonal thawing of snow generates runoff that seeps into cracks in rocks. When the water refreezes, it expands, potentially breaking large rocks into smaller ones over time. This process, known as frost wedging, is what may have produced the Marbleyard.

Similar rocky masses can be seen across this portion of the Appalachians, wrote Edgar Spencer, a Washington and Lee University geologist, noting that the Marbleyard's boulders "are huge, many are several meters across and much of the accumulation, especially near the top, has apparently not moved very far down slope."

This remote part of Rockbridge County is otherwise covered with chestnut oaks, Virginia pine and red maples. Its jagged, soaring landscape can seem like a million miles from the salt-tinged air of the Chesapeake Bay. But don't be fooled. Just beyond the Marbleyard's ridge flows the upper portion of the James River, Virginia's largest tributary to the Bay.

Up the rocks I climbed. Here are some things I learned along the way.

Camaraderie goes a long way. I had come alone — generally not the best idea for a challenging hike. To stay out of trouble, I wasn't planning on breaking too much of a sweat. But I can state unequivocally that I wouldn't have made it without the friendly support of two generous fellow hikers.

I met Ben Fulcher and Derek Warnecke along the shaded Belfast Trail, which leads to and skirts the Marbleyard. Fulcher was sporting a University of Florida T-shirt. My alma mater. His, too. Connection made. Off we went.

Time and again, as I was heaving myself over yet an-



All is lush and green at the beginning of the Belfast Trail, where a wooden footbridge spans a small creek. The base of the Devil's Marbleyard is located about one mile from the start of the trail.



The Devil's Marbleyard is an 8-acre boulder field thought to have formed many thousands of years ago. The rocks are known to be hot to the touch on certain summer days.

other boulder, I would think about withdrawing to the relative ease of the Belfast path just a few dozen yards to my right. Then, I would look at Warnecke and Fulcher, plying on, and think again.

Hiking spawns relationships.

In his influential 2000 book, *Bowling Alone*, Harvard political scientist Robert Putnam decries the breakdown of social networks, pointing to plummeting membership in clubs and community organizations, such as bowling leagues. His critics argue that people may be still interacting, just differently. One example, I suggest, may be at the intersection of hiking and the internet.

Fulcher and Warnecke also had recently met. Warnecke, an electrical engineer just transplanted from Houston to Blacksburg, VA, had asked for trail suggestions near his new home using a hiking-themed hashtag on the photo-sharing social media app Instagram. Fulcher, an architect-turned-life coach, grew up one valley over from the Marbleyard and has hiked it several times, so he was quick to reply.

"I was just trying to come up with one [hike] that's good for pictures and an experience he probably hasn't had before," Fulcher said.

Connection made. Off they went.

Crawling over boulders is a slog. The first mile is deceptive. The trail is marked by blue blazes painted here

and there on trees at eye level. It gets progressively steeper, the rocks larger. But the going is rather similar to any mountain hike: demanding but not exhausting.

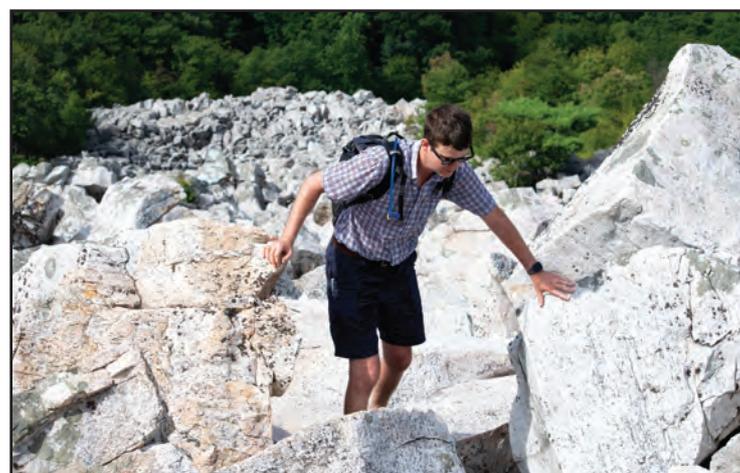
Then the tree canopy gives way to that unbroken mass of white rocks, ascending skyward. Given the undulating slope, there are at least two horizons hikers must cross to make it to the top. The Devil's Marbleyard simply defies being taken in at a glance, not at ground level anyway.

"This isn't a beginner's course," Fulcher told me somewhere around the second horizon.

Mark that down as information that would have been useful earlier. The upward climb often requires the work of all four limbs. Sometimes, I found myself having to deadlift my entire weight with my arms to get over an obstacle. By the top of the slide, I was panting and so drenched with sweat that my clothes felt heavy.

Overall, the hike climbs from 1,000 feet above sea level to more than 2,500 feet.

It's worthwhile. The experience conjures a series of unforgettable snapshots: the jagged pine boughs



Derek Warnecke of Blacksburg, VA, scrambles over a pair of boulders on his way to the top of the Marbleyard.

contrasted against a seemingly endless blue sky; the green clearings in the valley below; the splotches of dried lichen on the rocks, ready to spring to life in the next rainfall.

There is the achievement, too, of having surmounted so many obstacles — real-life,

knee-scraping obstacles that serve as good proxies for the metaphorical ones that pop up every day.

Keep nature natural. Is there anything as off-putting as climbing most of the way up a natural wonder only to find someone has tagged it with spray paint? Several rocks are sullied in this way at the Devil's Marbleyard.

That's one of the reasons why Josh Tao, a ranger with the nonprofit

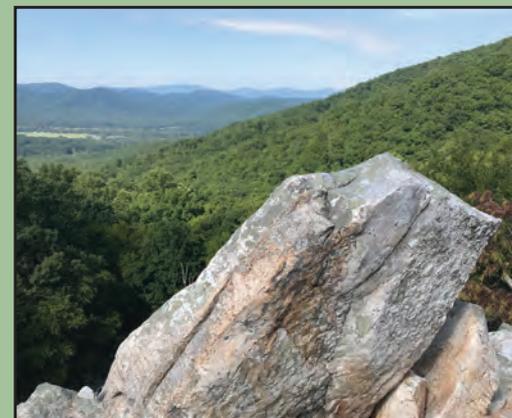
Southern Appalachian Wilderness Stewards, patrols these parts. We ran into him coming up the Belfast Trail after we rejoined it at the top of the rock scramble. The group, founded in 2010, serves as backup manpower for the U.S. Forest Service on public lands in Tennessee, North Carolina, South Carolina, Georgia and Virginia.

Tao said the Marbleyard is part of a federally designated wilderness area, placing it under the government's highest protection from development and other human impacts. For users, that means no motorized vehicles, chainsaws, drones or anything else that might distract from nature.

"The biggest thing is 'leave no trace,'" Tao said. "You can have hundreds of people in a place, and it would look the same" so long as they follow that precept.

Devil's Marbleyard Travel Trips

- ✦ Directions to Belfast Trailhead: From Interstate 81, take exit 180A to head south on U.S. Route 11. Turn left on Buck Hill Road (State Route 689). Turn right onto State Route 608 and turn quickly left onto Virginia 130. Turn left onto State Route 781. The parking area is on the left after about a mile.
- ✦ Trail difficulty: moderate to difficult. Scrambling over the boulders is optional and the most difficult challenge of all.
- ✦ Bring plenty of drinking water. I brought two 16.9-ounce bottles and wanted more.
- ✦ Wear sturdy shoes with good traction. I wore running shoes with slightly worn soles and fell twice on the steep trip back down the Belfast Trail.



A large boulder stands in the foreground of a typical panorama taken from about halfway up the Devil's Marbleyard outcropping.

FORUM

COMMENTARY • LETTERS • PERSPECTIVES

Time to put the pedal to the metal: Create bicycle-friendly cities

By TOM HORTON

My hope for America's future? With any luck it'll be a yawn.

Such a future begins with cities. About four in five of us already live in urban areas. Since the 1950s, U.S. cities with populations of more than a million people have increased from 12 to 53.

So cities, yes, but cities fit for people? The U.S. city of today is meant for cars, surely as the auto industry decades ago pushed laws to punish jaywalking — the term “jay” meaning a clueless bumpkin who dares impede motorists by walking outside the lines decreed by traffic engineers.

“Car habitat” accounts for about half to three quarters of the impervious cover — paved or otherwise hardened surfaces — in the urban-suburban landscapes around the Chesapeake Bay watershed, according to a study by the Center for Watershed Protection.

The focus of the study was water quality. It has been well-documented that impervious surfaces like highways, driveways and parking lots degrade streams and amplify the stormwater runoff that is a significant part of Bay pollution. But it was also telling about quality of life, nicely demonstrating what anyone who's tried to hike or bicycle in developed areas well knows. Cars rule.

Cities can serve their pedalers and walkers a lot better. And in metropolises from Europe to South America many already do, as richly documented in a new book, *Copenhagenize — The Definitive Guide to Global Bicycle Urbanism*, by Mikael Colville-Andersen.

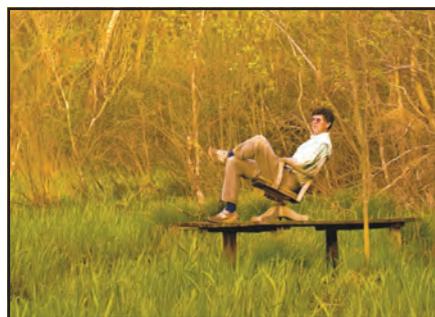
After the Arab oil embargoes of 1973–74 caused soaring fuel prices and gas rationing, nations like the Netherlands and Denmark, where Colville-Andersen lives, made commitments to favor bicycles over cars. In Copenhagen today, about 62 percent of people get to work or school by bicycle. Another 21 percent use mass transit, and the rest split evenly between driving and walking.

Last summer, I shared a beer with Dutch friends seated outside in the quiet, urban heart of Zwolle, their prosperous hometown of 124,000. It was quiet because cars are banned for more than a mile radius. Imagine that around the City Dock of Annapolis or your favorite urban spot.

“The bicycle is the most important and powerful tool in our urban toolbox for making cities better,” Colville-Andersen states. His city of 700,000 people, Copenhagen, has invested about a third



Copenhagen has invested about a third of a billion dollars in bicycle-friendly infrastructure in just the last decade. (Dave Harp)

**Chesapeake Born**

of a billion dollars in bicycle-friendly infrastructure in just the last decade. This ranges from major bike bridges and (soon) a “bike interstate” from the suburbs to trash cans cleverly angled so passing cyclists can toss a coffee cup as they pass or streetlight posts placed for bikers to lean on while waiting at intersections.

The proof of success? My favorite is a full-page, color picture in *Copenhagenize*. A young woman on a bicycle, dressed as if she's commuting to an office job, pedals through a busy (with bicycle) intersection — yawning. “If you don't see cyclists yawning in your city, then you're doing something wrong,” the author notes.

The bicycle is a marvelous people mover, propelling a rider on flat roads around three miles with an energy expenditure equivalent to the calories in a large apple (100). It is non-polluting, quiet,

The key is to design cities so that a bicycle is the quickest, easiest way to get from point A to point B.

good for your health and cheap.

None of the above, by the way, will get lots of people to give up cars for bicycling, the author explains. The key is to design cities so that a bicycle is the quickest, easiest way to get from point A to point B.

That's not as impossible as you might think, even with our current car dominance and greater distances between destinations. About half of Americans live within 5 miles of where they work, Colville-Andersen says.

In a chapter of the book called *Myth-busting*, he takes on all the reasons bicycle naysayers cite: too hilly, too cold, too hot, too sprawling, bicycle thieves.

Don't try to figure how everyone, everywhere can ride bikes all of the time, he says. Start with the low-hanging fruit, of which there's plenty. Start with shifting the lens to “believing anything not massive and enclosed and fossil-fueled is the future.” That includes putting more onus on the automobile for cyclist safety, rather than targeting whether they have proper lighting, high-visibility (dorky) clothing,

constant high alertness and helmets.

For example, if cars move at 20 mph, almost all bikers and walkers survive collisions or suffer no injury at all. At about 32 mph, though, the result is often injury or death (about 50–50). At 45 mph, you almost always die. In Sweden, Volvo has developed cars with protective exterior airbags.

U.S. cities don't have to invent bicycle-friendly design. Virtually all of that work has been done in Europe and Brazil, and it is eminently transferable. Colville-Andersen's firm has been doing such work worldwide for years, so he is no armchair enthusiast.

Yet he admits he is “not a cyclist in any sense of the word ... just a modern city dweller who just happens to use a bicycle to get around because it is safe and efficient.”

What he is saying is that the typical cyclist here in the United States, who dons Spandex and all manner of other special gear, who rides mainly to see how fast or far they can go, is *not* the future, or at least not the mainstream.

The future is people who just want to get to work, to school, to the store and back — quickly, safely and with yawning ease. Our cities of the future should offer nothing less.

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.

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Thanks to Bay Journal Fund contributors, we've increased our staff, expanded coverage, added pages and are better able to inform the public about issues affecting the Chesapeake and its watershed. Donations support the *Bay Journal* and other activities related to Bay Journal Media's mission to expand independent journalism that informs the public about environmental issues affecting the Chesapeake Bay and the mid-Atlantic region. This includes our Bay Journal News Service, which distributes articles and commentaries to newspapers throughout the region.

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What did the mallard duck tell the turtle? We're not sure either. (Dave Harp)

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Shoreline grasses and cumulus clouds frame an early fall landscape. (Photo / Dave Harp)

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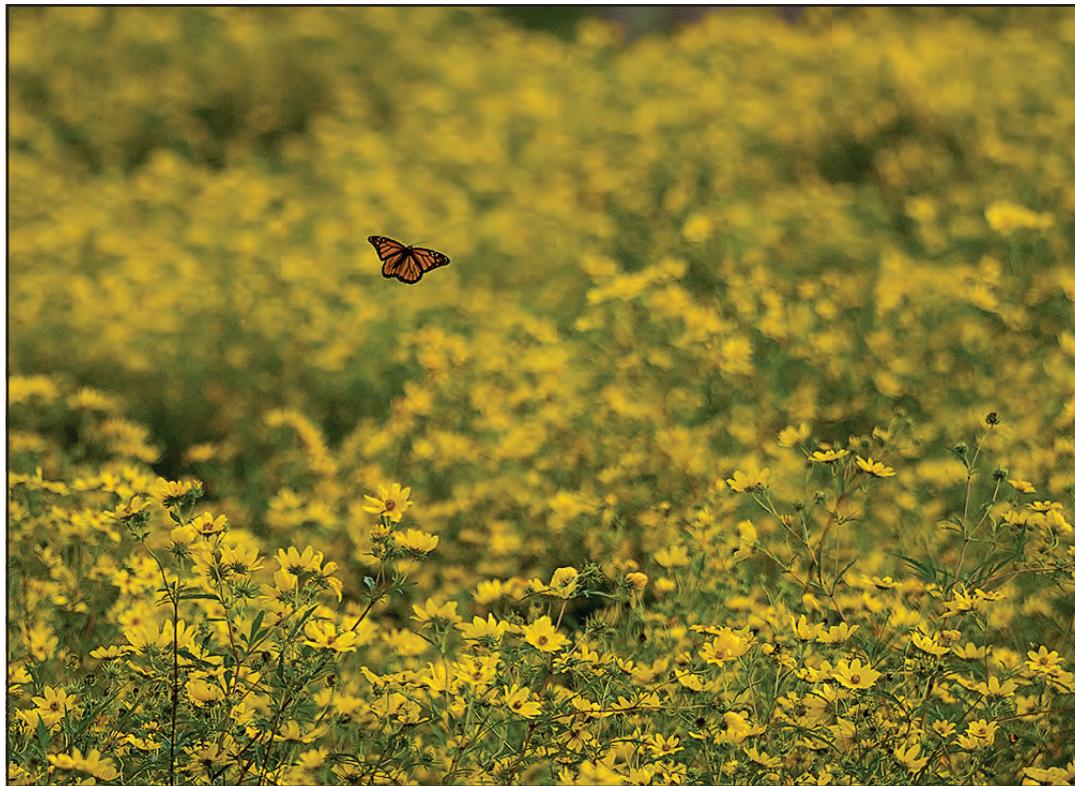
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A monarch butterfly collects nectar from a sea of tickseed sunflowers, fattening up for is migration to points south. (Dave Harp)

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VOLUNTEER OPPORTUNITIES

Upper Patuxent watershed

The Wildlife Achievement Chapter of the Izaak Walton League of America needs volunteers 9:30 a.m. to noon Oct. 27 (rain date 10/28) for its *Upper Patuxent Watershed Cleanup*. Help to prevent trash and debris from entering the river and the Triadelphia Reservoir. Gloves, trash bags, water and lunch are provided. Students can earn service learning hours if forms are brought for signature the day of the event. Preregistration is not required. Meet at the Chapter in Mt. Airy, MD. Info: Meo Curtis at meosotis58@verizon.net.

Watch birds at Nixon Park

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

Paradise Creek Nature Park

Paradise Creek Nature Park in Portsmouth, VA, needs people of all ages (12 & younger w/adult) to participate in its *Volunteer Service Days* 9–11 a.m. Oct. 20, Nov. 10 and Dec. 8. Help to replace invasive plants with native species or maintain trails and recreation amenities. Closed-toe shoes and long pants are advised. Bring sunscreen, insect repellent and a water bottle. Preregistration required. Info: Ranger Kat Fish at 757-392-7132 or kfish@elizabethriver.org.

Frederick, MD, tree plantings

Stream-Link Education is looking for volunteers to help plant trees at Waterside Community in Frederick, MD, 9–11 a.m. Nov. 3, 10 & 17. Info: streamlinkededucation.org/plantings.

Cabin Branch cleanup

The Lois Green-Sligo Chapter of the Isaac Walton League of America needs volunteers of all ages for its biannual *Save Our Streams* monitoring and cleanup of the Cabin Branch in

Gaithersburg, MD, 8:30–10:30 a.m. Oct. 27. Learn how to conduct a physical description of a stream and a stream velocity analysis, as well as perform stream chemistry tests. No registration. Meet at Lois Y Green Conservation Park parking lot. Info: William H. Roberts, Jr., at 301-977-3025, whadyntrob@gmail.com.

CBL Visitor Center

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

Bull Run stream cleanup

Help the Merrimac Farm Master Naturalists, Friends of the Square and Keep Prince William Beautiful 9 a.m. to 12 p.m. Oct. 13 as they clean up the stream behind the Manassas (VA) Costco that flows into Bull Run. Student community service hours are available. Light refreshments will be served. Wear shoes (boots preferable) that can get dirty. Preregistration required. Info: 571-379-8213, waterquality@pwsacd.org.

Adopt-a-Stream program

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

Anita Leight Estuary Center

Anita Leight Estuary Center in Abington, MD, needs volunteers, ages 14 & older, for *Invasiators* 2:30–4:30 p.m. Oct. 13. Help to remove invasive plants and plant native species. Learn why nonnative invasive plants threaten ecosystems, how to identify problem plants, and removal and restoration strategies. Wear sturdy shoes, long sleeves and work gloves. Info: 410-612-1688, 410-879-2000 x1688, otterpointcreek.org.

Occoquan River cleanup

Join Friends of the Occoquan for a *Fall Lower Occoquan River Cleanup* 9 a.m. to noon Oct. 13. Boaters are needed to assist at sites along waterways. Bring a refillable water bottle. Contact 703-624-7124. Here are the contacts for those who wish to register at a particular location:

☞ *Lake Ridge Marina in Lake Ridge*: Renate Vanegas, 703-674-6659.

☞ *Town of Occoquan*: Julie Little,

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.

703-491-2168.

☞ *Bull Run Marina in Clifton*: German Vanegas, 703-624-7124.

☞ *Fountain Head Park in Fairfax Station*: Sonia Monson, 703-581-5487.

☞ *Occoquan Regional Park in Lorton*: John Houser, 703-690-2121.

Woodbridge, VA, cleanup

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

Little Paint Branch Park

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

Cromwell Valley Park

Cromwell Valley Park near Towson, MD, needs volunteers for:

☞ *Habitat Restoration Team / Weed*

Warrior Days: 2–4 p.m. Oct. 13 & 20 and Nov. 7, 14, 17 & 28. All ages (12 & younger w/adult) Remove invasive species, plant natives and maintain restored habitat. Service hours are available. Meet at Sherwood House parking lot. No registration. Info: Laurie Taylor-Mitchell at ltmitchell4@comcast.net.

☞ *Drop in Gardening*: 9 a.m.–12 p.m. Oct. 27. Children's Garden. Individuals/families, ages 13+ Gloves, tools, water provided. Bring a hat, sunscreen. No registration. Info: 410-887-2503, info@cromwellvalleypark.org.

☞ *Project Feeder Watch Training*: 10:30–11:30 a.m. Nov. 8. Adults. Learn how to count birds for science. After the training, participants meet weekly at the Nature Center on Tuesdays or Thursdays for a one-hour shift from Nov. 13 to April 4. No registration.

Magruder Woods

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

American Chestnut Land Trust

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

Prince William Ploggers

Join the *Prince William (VA) Ploggers*, a volunteer corps of joggers who pick up litter. Contact: Lynda Kummelt at 571-285-3772; lkummelt@kpwb.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 October, November and December remove invasive plants at Ruth Swann Park in Bryans Road. Meet at Ruth Swann Park-Potomac Branch Library parking lot. Bring lunch. Info: Marc Imlay at ialm@erols.com, 301-283-0808, (301-442-5657 day of event). Carpoolers meet at the Sierra Club MD Chapter office at 9 a.m., return at 5 p.m. Carpool contact: Laurel Imlay at 301-277-7111.

Snap a stream selfie

Water quality in 80 percent of U.S. streams is unknown. Help to bridge the information gap by taking a selfie in



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one's backyard or nearby stream. Info: iwla.org/streamsselfie.

VA Master Naturalist training

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

Floatable monitoring program

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

RESOURCES

Park passes for 4th-graders

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

Wildlife education trunks

The Maryland Department of Natural Resources is offering a variety of wildlife education trunks for use by teachers, home-school educators, naturalists, scout leaders and other instructors. These free interdisciplinary tools are designed to interest students in local wildlife while building on disciplines like art, language arts, math, physical education, science and social studies. Each trunk contains an educator guide with background information, lesson plans and hands-on K-12 activities, as well as activity supplies, books, furs, replica tracks, videos and other hands-on items. 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: google Wildlife Education Trunks.

FORUMS / WORKSHOPS

Delmarva Soil Summit

The *Delmarva Soil Summit* takes place 9 a.m.–5:15 p.m. Nov. 1 at University of Maryland Eastern Shore in East Princess Anne, MD. The summit features local and regional experts addressing carbon sequestration, soil microbes, Delmarva soil types and their characteristics and other soil-related topics, as well as a farmer panel on challenges and successes in soil health management on farms across the Delmarva Peninsula. Summit tickets are \$45. A limited number of scholarships are available. The summit precedes the annual *UMES Small Farm Conference* Nov. 2-3 at the same venue. A bundled, discounted ticket package for the summit and conference is available. Info: niamh@futureharvestcasa.org.

EVENTS / PROGRAMS

Horn Point Lab open house

The theme of the University of Maryland Center for Environmental Science's Horn Point Laboratory's 17th annual open house 10 a.m. to 3 p.m. Oct. 13 is *Sustainable Solutions through Science*. Learn how research at the lab in Cambridge impacts the Bay and how marshes, oysters, sediment, tiny zooplankton and computer models help to restore and sustain the Chesapeake. Visitors can also go aboard UMCES research vessel Rachel Carson to explore new advances in aquaculture; tour the campus on a hayride; play in a digital sand box to create shorelines and model weather's impact around the Bay with laser imaging; watch an animation of oyster larvae moving from the reef where they spawned to a new, permanent home reef; match up a DNA sequence to microscopic creatures

NEW SUBMISSION GUIDELINES

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

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

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

☞ **November: October 11**
☞ **December: November 11**

important to the food chain; learn how much energy is being produced by a 10-acre solar field; observe sturgeon, a fish with ancestors dating to the Jurassic period; build a healthy marsh and learn about the partners in this effort; go on a scavenger hunt; and talk to graduate students about their environmental career goals. Children receive a free T-shirt. The event is free and takes place rain or shine. Info: umces.edu.

Climate change & PA forests

The Manada Conservancy invites the public to *Climate Change & Penn's Woods: What Does the Future Hold?* at 7 p.m. Oct. 23 at the Hershey Gardens Conservatory in Hershey, PA. This free presentation by Greg Czarnicki, climate change and research coordinator for the Pennsylvania Department of Conservation and Natural Resources, will look at the current and projected impacts of climate change on native species and forests, as well as the challenges and opportunities conservationists face in helping to ensure their survival. Registration required. Info: 717-566-4122, office@manada.org.

Eastern Shore Land Conservancy gala

The Eastern Shore Land Conservancy's annual gala, *Party to Preserve*, takes place 4-7 p.m. Oct. 27 at Chateau Bu-De Vineyard & Winery, Bohemia Manor Farm in Chesapeake City, MD. The farm is the historic property of 17th century Bohemian explorer, merchant and cartographer Augustine Herrman, who produced a map of the Chesapeake Bay and Delaware Bay in exchange for permission to establish the plantation. Live music, wine and locally sourced cuisine await guests, who may take advantage of a shuttle service with pickups and drop-offs in Easton and

Chestertown. Attendees will learn about the ESLC's new initiative, *Delmarva Oasis*, which seeks to protect 50 percent of the Delmarva Peninsula by 2030. Tickets are \$125. Info: eslc.org, 410-690-4603, x0, Julia Babbitt Williams at 410-690-4603 x171 or jabbitt@eslc.org.

Rain garden, Bayscape workshop

The Gunpowder Valley Conservancy's Clear Creeks Project is presenting a *Rain Garden & Bayscape Maintenance Workshop* 10 a.m.–12 p.m. Oct. 14 at the Baltimore County Game and Fish Protective Association in Parkville, MD. Learn how to identify common weeds, prepare garden beds for winter and perform other tasks to keep native plant gardens at peak performance. Preregistration required. Info: Amy Young at ayoung@gunpowdervc.org or gunpowdervalleyconservancy.org/clearcreeks.

Youth fishing rodeo

The MD DNR Fishing & Boating Services invites ages 3-15 to a free *Youth Fishing Rodeo* 10 a.m.–1 p.m. Oct. 27 at Baltimore's Patterson Park. Participants learn basic skills; develop an understanding of the environment and natural resources; and have an experience that fosters interest in conservation and fishing. Info: Bob Wall, Baltimore City Recreation and Parks, 410-245-0854.

Mount Harmon Plantation

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

☞ *Guided Native Tree Walk*: 1-2:30 p.m. Oct. 21. Fee: \$10. Preregistration required.

☞ *National Revolutionary War Festival*: 10 a.m.–4 p.m. Oct. 27 & 10 a.m.–3 p.m. Oct. 28. Revolutionary War



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re-enactment & colonial festival features British & Continental encampments tours; military demonstrations; colonial marketplace; hearth cooking; musket drill for children; colonial crafts & living history demonstrations; manor house tours; food & beverages. Admission: \$5. Ages 12 & younger are free. Info: info@mountharmon.org, mountharmon.org, 410-275-8819.

Garden Glow at Ladew

Ladew Gardens in Monkton, MD, invites the public to Garden Glow, 5–9 p.m. Oct. 20 (rain date 10/21). The celebration includes illuminated sculptures, hundreds of glowing jack o' lanterns, live music, and food & spirits as well as exhibits on nocturnal creatures. Before the event, the community is encouraged to participate by creating an illuminated sculpture or carving a pumpkin to be used in the display. Proceeds benefit Ladew's Environment Educational program. Tickets are: \$15/adults; \$13/students & seniors; \$6/ages 2–12. Info: LadewGardens.com, 410-557-9570.

Paradise Creek Nature Park

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

☞ *Guided Ranger Walks*: 2–3 p.m. Oct. 27, Nov. 10 & Dec. 8. All ages (11 & younger w/parent) Learn about native plants, wildlife & how to identify wildflowers. Free. Preregistration required. Contact: Kat Fish at 757-392-7132 or kfish@elizabethriver.org.

☞ *Princess at the Park*: 1–3 p.m. Oct. 20, Grades pre-K to 1st, w/adult. Listen to Princess Elizabeth, for whom the river was named in 1619, relate river adventures. Help create a piece of artwork to raise money for Elizabeth River Project, its education programs. Contact: Kat Fish at kfish@elizabethriver.org or 757-392-7132.

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

☞ *Youth Field Day*: 1–3 p.m. Nov. 12. All ages. Games, nature activities. Free. No registration.

Cromwell Valley Park

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

☞ *Paint a Pumpkin*: 1–2:30 p.m. Oct. 20. Ages 2+ Pick a pumpkin from the patch to decorate. Fee: \$5 per pumpkin.

☞ *Bucks, Deer & Antlers*: 1–3 p.m. Oct. 27. Ages 5+ Look for signs of deer; make a venison taco. Fee: \$5.

☞ *Night Out with Nature / Rumor or Fact? A Town Under Loch Raven Reservoir*: 7–9 p.m. Nov. 2. This event takes place at Sherwood House.

Adults. Cynthia Mann, a researcher and volunteer with the Historical Society of Baltimore County, will discuss Loch Raven Reservoir and the "lost" town of Warren. The program covers the 1800 until the time the town was eliminated to make way for the reservoir in the 1920s. Fee of \$10 includes dessert.

☞ *Earth Oven Bread*: 1–2:30 p.m. Nov. 4. Ages 8+ Make, bake no-knead bread in wood-fired earth oven. Fee: \$6.

☞ *Our Feathered Friends*: 1–3 p.m. Nov. 10. Ages 5+ Learn about the birds that will be migrating to Cromwell, make a bird feeder. Fee: \$4.

☞ *Native Americans of Maryland*: 1–3 p.m. Nov. 11 Ages 5+ Try out tools—bows, arrows, spears, rabbit sticks—used by Native Americans to fish, hunt, grow crops. Free.

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

Farm Sprouts

The Maryland Agricultural Resource Council invites children, up to age 5, to *Farm Sprouts* at the Baltimore County Ag-Center in Cockeysville. The program uses themes from children's books to explore a farm or nature topic through movement, stories and arts & crafts. Sessions are scheduled 9:45–10:45 a.m. or 11:30 a.m.–12:30 p.m. Oct. 21 (*Pumpkins*); Oct. 26 (*Pigs*); Nov. 9 (*Sheep*); Nov. 16 (*Turkeys*). The fee, for ages 9 months and older is \$8. Anyone who wants to attend the program but is unable because of financial constraints is asked to call MARC at 410-887-8973 to see if arrangements can be made. Bring a lunch to stay longer and explore the park. Registration required. Info: info@marylandagriculture.org, marylandagriculture.org/farm-sprouts-preschool.

Oregon Ridge Nature Center

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

☞ *Bird Walks*: 8:30–10 a.m. Oct. 12, Nov. 9. Adults. Bring binoculars, wear hiking shoes. Free.

☞ *Scarebaby*: 10 a.m.–12 p.m. Oct. 13 & 14. All ages. Learn about scarecrows, then look for natural

decorations to build a small one to take home. Old clothes will be available, but feel free to bring some. Fee: \$6 per project (maximum 3 people / project).

☞ *Oregon Ridge Nature Center Council Speaker Series / 4,000 Years of Women in Science - The History of Women in Science, Technology & other Wonderful Stuff*: 7–8:30 p.m. Oct. 15. Adults. SETHANNE HOWARD, retired chief of the Nautical Almanac Office at the U.S. Naval Observatory is the presenter. Free, donations appreciated. No registration.

☞ *Shoots & Letters*: 10–11 a.m. Oct. 18 (*Animal Camouflage*); Oct. 25 (*Animals with Warning Colors*); Nov. 1 (*Poisonous vs. Venomous*); Nov. 8 (*Nocturnal Animals*). Ages 3+ Stories, crafts, adventures explore nature. Fee: \$2/child. No registration.

☞ *No Bones About It*: 1–3 p.m. Oct. 20. Ages 5+ Explore skulls alphabetically to solve the identity of a mystery skull. Fee: \$2.

☞ *Tricks & Treats*: 1–2:30 p.m. Oct. 27. All ages. Wear a costume for a half-mile stroll through the woods, meadow to learn about tricks that plants, animals have up their "leaves." Get a treat at each stop (bring a bag). Participants begin at 10-minute intervals and will get a start time at registration. Walk-in guests will only be accommodated if there is an empty slot. Fee: \$5/child.

☞ *Fall Foliage*: 1–3 p.m. Oct. 28. All ages. Learn why leaves change color, hike to collect leaves to create artwork using crayon-resist technique. Fee: \$4.

☞ *Bookworm Story Time*: 11–11:45 a.m. Nov. 2. Toddlers to age 6. Nature story w/activity (animal encounter, puppets or craft). Dress for brief outdoor experience. Free. No registration.

☞ *Mother Nature's Recycling*: 1–3 p.m. Nov. 3 & 4 Ages 8+ Learn how to turn kitchen scraps and yard waste into rich fertilizer during discussion of composting, its benefits, best practices. Make a shoebox-size vermicomposting (worm) bin to take home. Fee: \$5 per project (maximum 4 people / project)

☞ *In search of P.R. Mantis*: 1–3 p.m. Nov. 10 & 11. Ages 4+ Learn about praying mantises while searching for them and their egg cases in the meadow. Fee: \$2.

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

Patuxent Research Refuge

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

☞ *Bird Walk*: 8–10 a.m. Oct. 13 [C] All ages. Search for, identify birds on walk around Cash Lake. Bring water bottle, binoculars. No strollers. Event is weather-dependent.

☞ *Scouts BSA Merit Badge Classes*: 8–11:30 a.m. Oct. 13 (*Nature*) & Oct. 27 (*Plant Science*) [N] Ages 11–17. Work on Scouts BSA Merit Badges. Open to Boy, Venture scouts. Some homework required.

☞ *Owl Eyes*: 12:15–12:45 p.m. Oct. 13 & 27 [C] All ages. Learn about owls. No registration.

☞ *Bird Walk*: 8–10 a.m. Oct. 17 & 31 [C] Ages 16+ Search for fall migrants in several habitats. Binoculars recommended.

☞ *Family Fun / Wonderful Wolves*: 10 a.m.–1 p.m. Oct. 20 [C] All ages. Learn about wolves' important role in the ecosystem, why they should be respected, not feared. No registration. Drop-in program: Come & leave when you wish.

☞ *Live Wolf*: 10–11 a.m., 12:30–1:30 p.m. & 3–4 p.m. Oct. 20 [C] See a live wolf from Ironwood Wolves. Learn about wolves' family life, diet, myths. Learn why we should respect, not fear them. Tickets are \$10/ages 13 & older; \$5/ages 12 & younger. They must be bought online at LiveWolfatPatuxentResearchRefuge.eventbrite.com and will not be available at the door.

☞ *Bird Walk*: 8:15–10:15 a.m. Oct. 21 [N] All ages.

☞ *Night Hike*: 6:15–7:45 p.m. Oct. 21 [T] All ages. Looking for wildlife on a short walk.

☞ *Learn to Fish*: 10 a.m.–12 p.m. Oct. 23 [C] Ages 3–12. Staff-led fishing experience on Lake Redington. All fishing gear is provided.

☞ *North Tract Bicycle Ride*: 1–3:30 p.m. Oct. 28. Ages 10+ Learn how to reduce one's footprint, leave no trace on 12-mile ride. See local wildlife, plants, historical sites. Bring bike, energy bar/snack, water bottle, helmet. Ride is weather-dependent.

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

Eden Mill Nature Center

Upcoming events at Eden Mill Nature Center in Pylesville, MD,



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include:

☞ *Still Life Drawing*: 5:30–7:30 p.m. Oct. 16 (*Bones*); Nov. 13 (*Bees*) Teens, adults. All skill levels. Learn to view your surroundings with an artistic naturalist's eye. Draw from a choice of displays. Fee: \$9.

☞ *Preschool Nature Series*: 10–11:15 a.m. Oct. 23 (*Gourds Galore*); Oct. 30 (*Night Owls*); Nov. 6 (*Leaf Hunt*); Nov. 13 (*Camping Fun*) Ages 2–5 w/adult. Nature activities, story, craft, hike. Fee: \$10 per date.

☞ *Nature Storybook Art*: Three-session program meets 12:30–2:30 p.m. Nov. 7, 14 & 21. Ages 6–12. Parents do not attend. Participants learn about books, illustrators, art techniques. Fee: \$44.

Preregistration is required for all programs. Info: 410-836-3050, edenmillnaturecenter@gmail.com. Preregister on-line at goo.gl/forms/ixqAK8OC1nAvSrai2. Registration closes 24 hours in advance of programs. Weekend program registration closes at noon on the prior Friday.

Chesapeake Bay Maritime Museum

Upcoming programs at the Chesapeake Bay Maritime Museum in St. Michaels, MD, include:

☞ *AWW... SHUCKS Oyster Social*: 4–7 p.m. Oct. 13. Fund-raiser for the skipjack, Dee of St. Mary's, includes live music, beer and wine, heavy hors d'oeuvres from local restaurants. Tickets: \$75. Purchase online at calvertmarinemuseum.ticketforce.com. Info: Vanessa Gill at 410-326-2042 x18, Vanessa.Gill@calvertcountymd.gov.

☞ *Fall Speaker Series / Where is Watkins Point? Mapping Maryland's Southern Boundary*: 2–3:30 p.m. Oct. 17. Van Lennep Auditorium. Learn about the controversy surrounding Maryland's southern boundary with Edward Papenfuse, retired Maryland state archivist and commissioner of land patents. Fee: \$7.50. Preregistration encouraged. Info: cbmm.org/fallspeakerseries.

☞ *Fall Speaker Series / The Restoration of Poplar Island*: 5–6:30 p.m. Oct. 24. Van Lennep Auditorium. Rachael Gilde, an environmental specialist with the Maryland Environmental Service, will discuss how an island in the Chesapeake can go from 1,140 acres to less than 5 acres, then rebound back to 1,140

again. Fee: \$7.50. Preregistration encouraged. Info: cbmm.org/fallspeakerseries.

☞ *Building a 3D Town: GIS Mapping of Historic Easton & Chestertown*: 2–3:30 p.m. Nov. 1. Van Lennep Auditorium. GIS Program Director Erica McMaster will discuss how staff and students at the Washington College GIS Lab have used historic maps, census data, and old photos to create interactive 3D maps. Fee: \$7.50. Preregistration encouraged. Info: cbmm.org/fallspeakerseries.

☞ *Fall Speaker Series / Innovation in Conservation*: 2–3:30 p.m. Nov. 8. Van Lennep Auditorium. Chesapeake Conservancy President and CEO Joel Dunn will discuss how his organization has been leading the way in applying emerging mapping technologies to improve the effectiveness and efficiency of conservation and restoration practices throughout the Bay watershed. Fee: \$7.50. Preregistration encouraged. Info: cbmm.org/fallspeakerseries.

☞ *OysterFest*: 10 a.m.–4 p.m. Oct. 27. Special to this year's festival will be the 3 p.m. re-launch of the 1889 bugeye Edna E. Lockwood, whose nine-log hull has been restored by CBMM shipwrights and apprentices over the last two years. The event also includes river cruises aboard Winnie Estelle; an oyster stew competition, cooking presentations, Chesapeake Bay retriever and oystering demonstrations, oyster-slurping contest (1–3 p.m.). Family activities include Bay-themed games, scavenger hunt, a chance to build a take-home model boat for \$3. Food and beverages include wild and aquaculture oysters served steamed or raw, oyster fritters, crab cakes, fried shrimp, clam strips, pit beef and turkey, pulled pork, ice cream, funnel cakes, kettle corn, a specialty rum cocktail, oyster shooters. Guests will also be able to explore CBMM's exhibits. Admission is \$18/adults; \$15/seniors & students with ID; \$6/ages 6–17. No non-service dogs allowed during CBMM festivals. (Leashed dogs permitted during regular operating hours.) Proceeds support CBMM's education, restoration, exhibition programs. Info: cbmm.org/oysterfest.

York (PA) County Parks

Upcoming programs at York (PA) County parks include:

☞ *Hawk Watch*: 9 a.m.–12 p.m. Oct. 13, 20 & 27. Rocky Ridge Park, York. Meet at Oak Timbers Parking Lot, North Overlook. Practice identifying raptors in flight. Bring binoculars, field guides, lawn chairs. A limited number of loaner binoculars will be available. Drop-in program:

Come & leave when you wish.

☞ *Pumpkin Walk*: 6–9 p.m. Oct. 13 rain or shine. Heritage Rail Trail, Seven Valleys Parking Lot. Take a 0.6-mile, round-trip, walk on the Heritage Rail Trail decorated & lit with hand-carved pumpkins. Recommended donation: \$5/adult. All proceeds benefit the development of York County rail trails. Details at YorkCountyTrails.org or 717-428-0999.

☞ *River Overlook & Fall Colors Hike*: 9–11 a.m. Oct. 14. Apollo Park, Brogue. Meet at Shenk's Ferry Road Parking Area. Hilly, 1.5-mile hike includes vista overlooking Safe Harbor Dam. Wear hiking footwear.

☞ *Cider Fest*: 1:30–4:30 p.m. Oct. 14. Wallace-Cross Mill, Felton. Tour the mill, sample freshly prepared cider.

☞ *All About Plastics*: 2–4 p.m. Oct. 14. Nixon Park, near Jacobus. Hands-on activities will test, increase knowledge of plastics and how they impact the environment. Learn to recognize which plastics get recycled, how to use green alternatives, how to help save the ocean. Handouts will be available. Drop-in Program: Come & leave when you wish.

☞ *50th Anniversary Celebration Party!* 5–9 p.m. Oct. 18. Wyndham Garden, York. Fund-raiser includes hors d'oeuvres, dinner, silent auction. Richard Louv, author of *Last Child in the Woods*, will speak at the event. Purchase \$50 ticket at supportyourparks.org. Info: 717-840-7440 with questions or assistance buying tickets.

☞ *Fall Colors*: 2:30–4 p.m. Oct. 21. Nixon Park, near Jacobus. Learn about the park's 30+ tree species, the science behind fall colors during hike that includes uphill & downhill sections with some roots, rocks.

☞ *Native Lands County Park Hike / Exploration of a Historic Landscape*: 1:30–3 p.m. Oct. 27. Zimmerman Center, Wrightsville. Ages 12+ Hike to the site of the last Susquehannock Indian village. Learn about village's way of life, natural materials, foods of the native lifestyle. Good hiking shoes needed. Register at 717-428-1961.

☞ *How Animals Prepare for Winter*: 2:30–4 p.m. Oct. 28. Nixon Park, near Jacobus. Stroll explores how animals prepare for winter.

☞ *Native American Stories*: 1:30–3 p.m. Nov. 11. Nixon Park, near Jacobus. Ages 5+ Seneca Indian Jerry Dietz will tell traditional animal tales told only after the leaves fall from the trees.

Except where noted, all programs are free and do not require registration.

Anita Leight Estuary Center

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

☞ *Critter Dinner Time*: 10:30 a.m. Oct. 13. All ages. Learn about turtles, fish, snakes while watching them eat. Free. No registration.

☞ *Amazing Arachnids*: 2–3:30 p.m. Oct. 13. Ages 4+ Learn about native Maryland spiders, Take a short hike to look for them. Fee: \$3.

☞ *Days Cove Kayak*: 12:30–3:30 p.m. Oct. 14. Meet at Mariner Point Park. Ages 12+ Look for eagles, beavers, foliage along Gunpowder River. Fee: \$12.

☞ *Meet a Critter*: 2 p.m. Oct. 14. All ages. Check out a live animal, learn what makes it special. Free. No registration.

☞ *Halloween Hike & Campfire*: 6–9:30 p.m. Oct. 20. Participants must be able to handle slightly spooky 0.75-mile hike in woods at night. Meet real "scary" creatures up close, listen to their tales spun by Halloween characters on hike. Later, listen to music, roast marshmallows by a fire. Pay \$7 fee at door. Preregister in advance for half-hour time slot to begin hike. Allow an hour for hike & campfire.

☞ *Pumpkin Chunkin' Hike*: 10–11:30 a.m. Oct. 21. All ages. Hike Discovery Trail to examine what creatures have taken up residence in the jack-o-lanterns from the Halloween Hike. Biodegradable pumpkin chunkin' starts later! Free.

☞ *Tails & Tots*: 2 p.m. Oct. 21. Ages 0–6. Listen to a tale about an animal or a habitat. Story time may include meeting a live critter, a simple craft or acting out the story. Free. No registration.

☞ *Kayak Cruising on the Creek*: 10 a.m.–12:30 p.m. Oct. 25. Adults. Explore Otter Point Creek, upper Bush River. Fee: \$12.

☞ *Colors of the Creek Canoe*: 10–12:30 p.m. Oct. 27. Ages 8+ Paddle Otter Point Creek. Bring camera. Fee: \$12.

☞ *Haunted Pontoon Cruise*: 7–8:30 p.m. Oct. 27. Ages 8+ (younger than 16 w/adult) Listen to ghostly tales, ghostly folklore on upper Bush cruise. Fee: \$10.

☞ *Spooky Science*: 12:30–2 p.m. Oct. 28. Ages 5–10. Learn about real world monsters, make creepy concoctions. Be ready to get messy. Fee: \$5/child.

☞ *Skeleton Leaf Project*: 3–4:30 p.m. Oct. 28. Ages 8+ Fee: \$4/project. Take a short hike to collect natural supplies to combine with chemistry to create leaf skeletons to turn into artwork.

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

NATURALIST FROM PAGE 48

deep, soft feathers that funnel sound. Furthermore, the feathers over the ear, the auriculars, are modified to be loose and airy. An owl's entire face acts as an outer ear, with compact facial feathers funneling sound to the ears.

Owls have the largest eyes of all birds. Their eyes are so large that there is little room in their skulls for eye muscles. Thus, an owl turns its head, sometimes as much as 270 degrees, rather than moving its eyes, to follow an object.

Contrary to popular belief, owls have excellent vision in both daylight and at night. Their pupils are huge at night, letting in great quantities of light. In daytime, the pupils shrink to the size of a pinpoint. Their eyes are 10 times as light-sensitive as human eyes, due a concentration of light-sensitive rods in the retina.

Because they swallow their prey whole or nearly so, owls regurgitate indigestible parts like the bones, feathers or fur. They eject this matter in the form of a hard fur or feathered pellet. By dissecting pellets, scientists are able to determine just what types of animals an owl is eating. Even if they eat insects, the pellet will contain the hard exoskeletons.



Moths make up most of the endangered Virginia big-eared bat's insect diet. (USFWS)



A garden spider spends most of its time waiting for its prey to become trapped in its large, round web. (Andrew King / USFWS)

Probably the most familiar owl is the great horned owl, noted for its large yellow eyes and large ear tufts. Its call is a series of low hoots. The eastern screech owl is a small (8 inches long) eared owl with color varying from rust to gray. Its call is a long quivering whistle.

Of the earless owls, the barn owl is easily recognized by its light colors and heart-shaped face. Barn owls nest in barns, abandoned buildings and tree cavities. Its song is a long raspy screech.

The barred owl is recognized by a nine-hoot call that sounds like the phrase "who-cooks-for-you, who-cooks-for-you-all."

SPIDERS

As silly as it is, I have to admit that I am a bit of an arachnophobe. Over the years I've become accustomed to the small ones. I usually leave them alone. But the big ones, like the wolf spiders lurking in my compost bin, make my skin crawl.

Despite this irrational fear, most spiders are harmless to people and will not bite unless they are trapped or held.

As predators of many kinds

of insects, spiders are important in controlling many insect pests in gardens or homes

Spiders are not insects; they belong to a group called arachnids. Unlike insects, they have eight legs, and lack wings and antennae. Most spiders have eight eyes, and all have a pair of claw-like fangs through which venom can be ejected. The tip of the abdomen has silk-spinning glands.

Some make webs to trap prey. Others, such as wolf spiders, actively pursue their prey.

They feed on a wide range of prey, including insects and other spiders. They produce venom to poison their quarry. Because spiders can only ingest liquids, digestive fluids are either injected or regurgitated into their prey.

Different types and textures of silk may be used to construct snares or webs, egg sacs, draglines and ballooning threads. Some spiders use web snares to trap prey, and all species construct a silk sac to deposit eggs. Silk is secreted as a liquid that hardens on contact with air.

Spiders lay eggs in a silken egg sac, often ball-shaped and hidden in the web or carried by the female.

For a spider to grow, it must shed its skin (molt) usually four to 12 times.

Most local spiders will not bite unless handled or confined and are not dangerous. The exception is the black widow spider. The female is about a half-inch long, black with a bright red hourglass shape on the belly. This spider's bite is poisonous but it is more dangerous to children than adults. Should you believe you have been bitten by this spider, go to a doctor immediately for treatment.

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

Chesapeake Challenge

Answers to
Odd-standing in their Crowd
on page 35.

1. All are famous Chesapeake vessels. The Winnie Estelle is a buyboat; the others are skipjacks.

2. Poison ivy is the only native North American species; garlic mustard is from Europe; wavyleaf basketgrass and mile-a-minute are from Asia.

3. The Newfoundland is the official state dog of Oregon. The others are official dogs of Chesapeake Bay states: Great Dane [PA], Chesapeake Bay retriever [MD], golden retriever [DE], American foxhound [VA].

4. All but the black-capped chickadee have tufted crests on their head.

5. All but the dogwood flower are luminescent under the right conditions.

6. The Atlantic oyster is the only creature that isn't striped.

7. All of these species are flatfish except for the mummichog.

8. Of all of these presidential homes, Wheatland, in Lancaster, PA [James Buchanan] is the only one not located in Virginia: Monticello [Thomas Jefferson], Mount Vernon [George Washington], Montpelier [James Madison].

Bay Buddies

Answers to
Standing Out!
on page 35.

1. Northern cardinal feathers. The others are blue.

2. Delmarva fox squirrel. The others are yellow or mostly yellow.

3. Marbled salamander. The others are orange or mostly orange.

4. Trout lily. The others are white or mostly white.

5. Robin eggs. The others are green.

6. Northern puffer. The others are red.

7. Cattle egret. The others are black

8. Raccoon. The others are purple.

Joyful flight of the tree swallow is poetry in motion

By MIKE BURKE

Brilliant flashes of steel blue and white swirled and danced, careened and darted, twisted and dipped in a masterful display of aerial skills. The binoculars hung unused around my neck — these dazzling acrobats were best viewed with unaided eyes.

Simply put, tree swallows (*Tachycineta bicolor*) are joy in motion.

They were preying on a swarm of invisible insects just above the marsh grasses. We were at the Eastern Shore of Virginia National Wildlife Refuge on a gorgeous mid-October afternoon. Temperatures were in the 70s, the insects were plentiful and the swallows were feeding hungrily.

As their species name “bicolor” suggests, tree swallows on the wing look like two-toned aerialists, iridescent blue on top and bright white below. At rest, swallows reveal that their long wings are black. Closer inspection shows a black mask about the eyes and a small, flat black bill as well. Although males are generally brighter than females, which tend toward sooty gray, there is considerable overlap. Young birds lack the steel blue coloration entirely.

Tree swallows stand on tiny legs. Their tails are broad with just a hint of a central notch. These are small birds. Their wingspan is just a bit more than 4 inches and they weigh three-quarters of an ounce.

Although they are called tree swallows, a better name might be meadow swallows. As we witnessed, they favor open fields and marshes, especially ones bordering water where insect populations boom.

Trees do play an essential role in one aspect of their lives: nesting. These swallows build their nests in tree cavities, often old woodpecker holes. Since the advent of true suburbia 50 years ago, dead and dying trees (viewed as unsightly by lawn-obsessed homeowners) were cut down, eliminating innumerable nesting holes. Consequently, the population of tree swallows has plummeted by half since the 1960s.

Fortunately, tree swallows readily take to nest boxes. Throughout the United States and Canada, many modern homeowners and park managers have begun to turn the tide by erecting thousands of man-made bird boxes.

Tree swallows are migratory. Almost all of the Chesapeake region's tree swallows depart the region by late September. As they head south, they engage in great roosting spectacles every night. Groups of birds join other



The tree swallow, above, is one of the most studied bird species in North America. We know, for example, that as global temperatures rise, tree swallows nest nine days earlier in the spring than they did 50 years ago. (Tom Koerner / USFWS) Tree swallows readily take to nest boxes, below, which has helped to stem the decline in their population as the dead trees that provide their nesting cavities are increasingly being removed. (Donna Dewhurst / USFWS)



groups at dusk, merging into enormous flocks that can easily grow to the thousands. These swirling masses circle over a favored roosting spot, and with each pass, scores of swallows land and settle in for the night. These bird storms can take minutes to finally dissipate. It is a sight to behold.

The Eastern Shore NWR serves as a massive funnel for southbound avian migrants. It is usually the last place in the watershed to see tree swallows in the fall. A few hardy individuals will even stay all winter.

In the North American West, tree swallows winter from northern California down to Baja and then broadly throughout Mexico. In the East, they winter from the lower Delmarva to



Florida, across the Gulf, through Mexico and into Central America. Cuba is the only Caribbean island with a substantial population.

In spring, tree swallows head north to build nests across a massive area that spans central and northern North America — basically, any area with trees / open fields north of Arkansas. Tree swallows begin to arrive in the Chesapeake in early March. Ornitholo-

gists speculate that this early arrival is an adaptation to assure the birds a good chance to find nest holes.

Tree swallow are one of the most studied bird species in North America. We know, for example, that as global temperatures rise, tree swallows nest nine days earlier in the spring than they did 50 years ago.

To swallows, insects are food. If it has wings and is smaller than a bird, it is probably part of the swallow's diet: mayflies and caddisflies, dragonflies and damselflies, butterflies and moths, bees and wasps; the list goes on.

Tree swallows migrate earlier and stay later than many migratory birds because they are also able to digest plant foods when insects are scarce. In the fall and winter, they favor the berries of the *Myrcia* genus. These plants include bayberry, wax myrtle and about a dozen others. In early spring, they'll eat catkins and the like.

In the back of my mind I knew that this irreplaceable refuge was at great peril from rising sea level. Localized impacts are already evident. And I knew that many bird species are not as adaptable to climate change as tree swallows appear to be.

But at that moment, the swallows were dazzling, the marshes a glorious palette of fall colors, and the sun shining. There would be time for worry and, more important, action after I got home. This was a time for witnessing great beauty and recharging the heart. And the tree swallows were playing a starring role.

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

CHESAPEAKE
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Don't be tricked, it's a real treat to have these animals around

By KATHY RESHETILOFF

Halloween. It's probably your children's (and maybe your) favorite day of the year with candy, costumes, pumpkins, scary movies and ominous images.

Among the ghosts and witches associated with things that go bump in the night are iconic creatures that because of their nocturnal nature or creepy-crawly character have been connected to dark forces. But when we clear away the cobwebs, we see just how useful these animals really are.

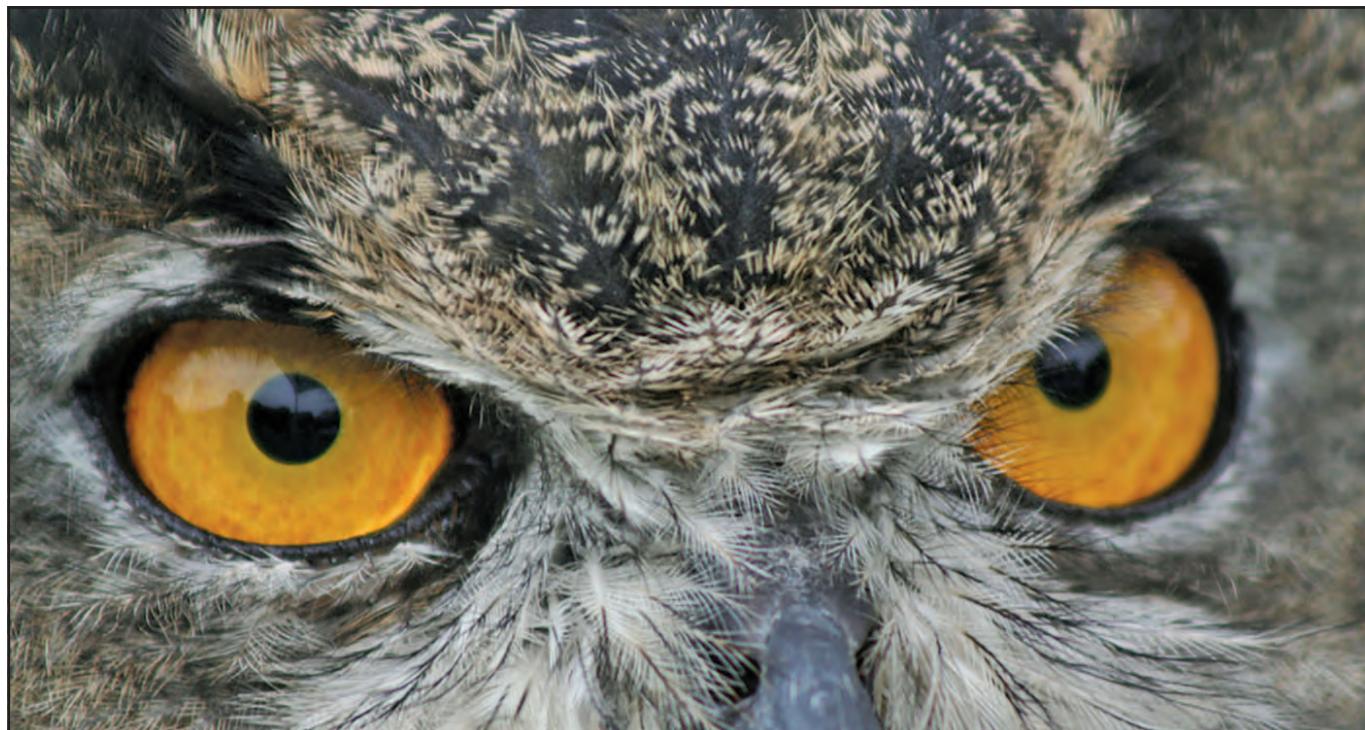
BATS

No other animal can be compared to the Earth's only flying mammal. Like all mammals, bats have hair, bear live young and feed on milk. But unlike other mammals, fingers in a bat's hand are elongated and connected by skin to form a wing.

Some bats pollinate plants, ensuring the production of fruits that support local economies, as well as diverse animal populations. Fruit-eating bats in the tropics disperse seeds that are critical to restoring rainforests. Bat droppings, known as guano, are valuable as a rich natural fertilizer.

Many bat species prey on insects, including some of the most damaging agricultural pests. As primary predators of night-flying insects, bats help to control many of our most annoying pests.

To hunt at night, bats have developed a very efficient system to help them detect other objects. They produce sounds at high frequencies, and by listening to the echoes of these sounds, bats are able to discern objects. This is



The great horned owl's eyes don't move in their sockets, thus, an owl turns its head, sometimes as much as 270 degrees, to follow an object. (Susan Rachlin / USFWS)

known as echolocation.

Tropical bats are active year-round, while those in temperate regions either hibernate or migrate during the winter.

Many bats hibernate in caves and move to trees and buildings during summer. Some bats reside in caves year-round but have different summer and winter roosts.

Disturbing bats in a maternity colony or while they are hibernating poses a major danger for many bat species. White-nose syndrome, named for the white fungus that sometimes appears on hibernating bats, is the latest peril. White-nose syndrome causes wintering bats to fly outside when they need to be hibernating.

Ongoing research to increase bat survival includes biological treatments, vaccines to boost resistance and molecular and genetic tools. For the latest news about white-nose syndrome, research efforts and response plans, visit whitenosesyndrome.org.

OWLS

With their nocturnal nature and ghostly calls, owls have been viewed as bad omens, messengers of misfortune or even death.



Indiana bats are only 1-2 inches long when full grown. (Andrew King / USFWS)



The reality is that owls are valuable predators. A single barn owl can eat more than a thousand mice in a year!

Owls stalk their prey without a sound. A modification in their feathers makes this possible. Their wings have downy fringes along the stiff flight feathers that muffle sound as an owl swoops in unnoticed.

Owls probably have the most acute hearing of any bird. They can hear sounds 10 times more faint than a person can detect. Several features make this possible. An owl has an extra large ear opening surrounded by

NATURALIST CONTINUES ON PAGE 46