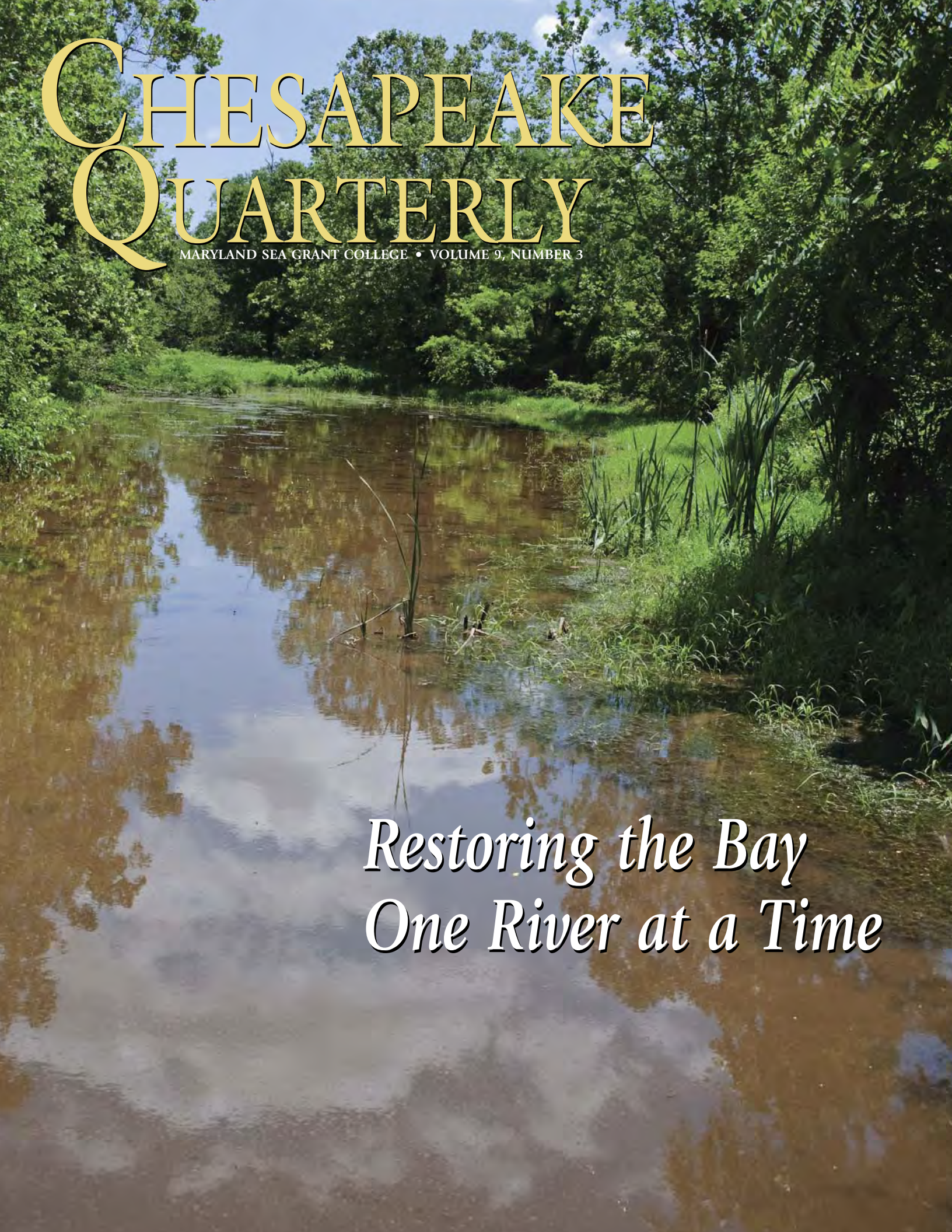

Chesapeake Quarterly

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Restoring the Bay One River at a Time

contents

CHESAPEAKE QUARTERLY

September 2010

Chesapeake Quarterly explores scientific, environmental, and cultural issues relevant to the Chesapeake Bay and its watershed.

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Cover photo: *Thick and murky, the headwaters of the Corsica River drain nutrient-laden water dowstream to the mainstem Bay. Suspended sediment clouds the water along with single-celled algae thriving on a feast of excess nitrogen.* ***Opposite page:*** *Using an age-old method for measuring water clarity — the Secchi disk — Maryland Sea Grant journalism intern Matthew Ellis gets a lesson from Corsica River Conservancy volunteer Sandy Simpson (bottom). Despite the Corsica River's shallow depth, 90 percent of the river bottom receives no light at all. A stretch of Corsica River shoreline (top).* PHOTOGRAPHS BY ERICA GOLDMAN.

Telling the

The Corsica is a little river that's seen a lot of love. Since 2005, an infusion of public funds helped set in motion unprecedented levels of engagement in restoration. Diverse sectors, including citizens, agencies, nongovernmental organizations, and local governments have rallied around the river. They've upgraded sewage, septic, and stormwater systems. They've planted thousands of acres of cover crops, and hundreds of rain gardens — monumental efforts to improve degraded water quality in this tiny 6½-mile subwatershed of the Chester River on Maryland's Eastern Shore.

This summer, along with Maryland Sea Grant journalism intern Matthew Ellis, I had the chance to meet some of the Corsica's champions. They showed us the sheer scale of restoration efforts undertaken in the watershed. I asked a lot of questions and Matt captured these local heroes on video.

Our first guide was John McCoy, who helped to coordinate the pilot restoration project from the beginning through his role at the Maryland Department of Natural Resources. He showed us the demonstration rain garden at the Centreville Public Library and dozens of other rain gardens put in by residents of the over-55 community at Symphony Village, proof-positive that good practices can be contagious. He brought us to new stormwater retention cells, where the town of Centreville has constructed a three-quarter-acre wooded wetland that helps to filter runoff. He pointed out surgical scars in the roadway, where new sewer lines connect to an upgraded sewage treatment facility. Later, we followed McCoy out to Bloomfield Farm, a property owned by the county on the edge of town, where he showed us restored wet-

Corsica's Story

lands, meadows, forest buffers, and cover crops.

We had other tour guides too. Sandy Simpson and other volunteers from the Corsica River Conservancy showed us the sampling protocol for water quality testing, an ongoing monitoring effort to track the health of the waterway. On a volunteer basis, they've sampled the water every Wednesday, all summer long — for the past six years.

We learned a lot about cover crops. Dave Mister and Katie Starr from the Maryland Department of Agriculture and the Queen Anne's County Soil Conservation District talked with us at length about the Maryland Winter Cover Crop program, an essential piece of the nutrient reduction puzzle. They took us to meet Buck Morris, a farmer who's been planting cover crops for more than a decade.

The commitment of many individuals to their local environment and their efforts to improve the Corsica have created a lasting infrastructure for restoration in the watershed. But has all of this effort improved water quality in the river? That's what we wanted to find out.

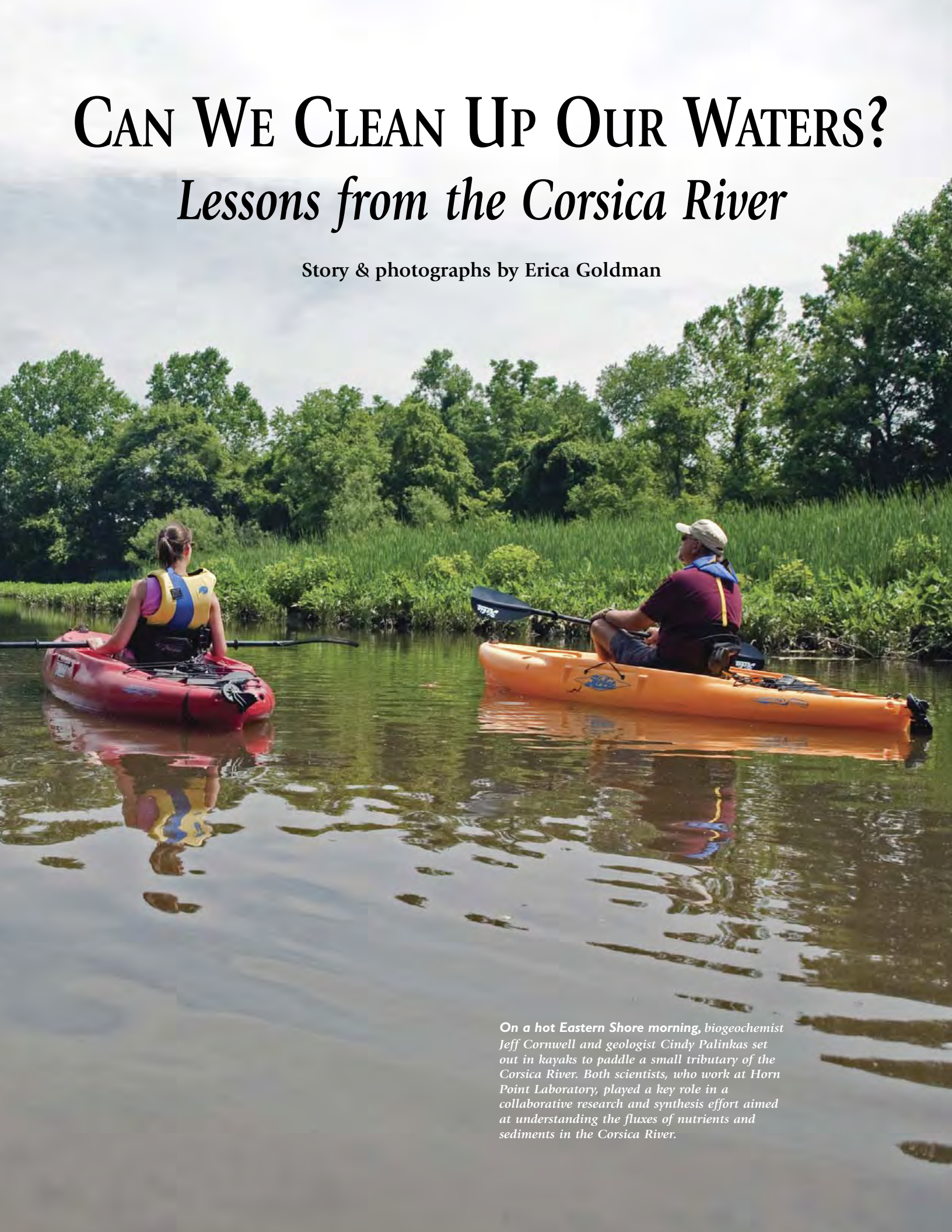
— *Erica Goldman*

For more on the restoration effort, watch Matthew Ellis's video, "The Corsica River: Taking on the Challenges of Restoration" at: www.chesapeakequarterly.net/V09N3/videos.

Can We Clean Up Our Waters?

Lessons from the Corsica River

Story & photographs by Erica Goldman



On a hot Eastern Shore morning, *biogeochemist Jeff Cornwell and geologist Cindy Palinkas set out in kayaks to paddle a small tributary of the Corsica River. Both scientists, who work at Horn Point Laboratory, played a key role in a collaborative research and synthesis effort aimed at understanding the fluxes of nutrients and sediments in the Corsica River.*

Murky water laps the pavement at the Centreville Public Landing, enveloping Jeff Cornwell's sandal-clad feet. He's ankle deep, putting three kayaks into Mill Stream, a tributary of the Corsica River on Maryland's Eastern Shore.

The same water is more than calf-deep on Cindy Palinkas — she seems small and slight in contrast to Cornwell's 6-foot, 7-inch frame. Palinkas climbs into a red kayak, next to Cornwell's yellow one, and pushes off with the side of her paddle. The two scientists strike out toward the center of the stream.

It's a pretty morning on the Eastern Shore — skin-prickling hot and sunny, humming with the buzz of summer insects. Only the slice of the kayak paddle breaking the surface disturbs this quiet creek.

Cornwell and Palinkas have taken a morning away from Horn Point Laboratory, part of the University of Maryland Center for Environmental Science (UMCES). The kayak trip provides a welcome break from the logistics and hectic pace of usual field trips, when they go out to take sediment cores and conduct shipboard experiments. Paddling the Corsica River offers the scientists a rare opportunity to step back and reflect on the river they've studied for several years — and on its future.

A few feet from shore, Cornwell drives his paddle down into the streambed, stirring up muddy bottom. The water's less than two feet deep here, so his paddle doesn't go far. Bubbles burble to the surface — like a pot of water that's just reached its boiling point.

"Methane gas," he says. For Cornwell, a biogeochemist, this is evidence there's little to no oxygen in these bottom sediments. He explains that certain sediment-dwelling microbes produce methane when oxygen is scarce — a clear sign that anoxic or hypoxic processes are at work.

And not a good sign for the Corsica River.

Cornwell and Palinkas maneuver their kayaks upstream. As the creek narrows, the water grows shallower, just deep enough to keep the kayaks afloat. But even in mere inches of water, the river bottom is barely visible. No underwater grasses grow here. Algae and suspended sediments cloud the water, turning it the color of coffee with cream.

An Unprecedented Effort

In 1998, the degraded condition of the Corsica River system earned it a Category 1 designation by the state of Maryland in its Clean Water Action Plan — placing it on the list with highest priority for restoration. What followed was one of the most intensive, highly targeted restoration efforts ever mounted in the Chesapeake Bay watershed.

The Maryland Department of Natural Resources (DNR) and the Maryland Department of the Environment (MDE) developed restoration strategies for 25 watersheds across Maryland. These plans — called Watershed Restoration Action Strategies — offered a roadmap for restoration that combined a number of intensive best management practices, such as sewer and septic upgrades, stormwater management, and cover crops. Based on the strong restoration plan put forth in the Corsica, the state of Maryland in 2005 selected this watershed to launch an all-out cleanup effort.

Then-governor Robert Ehrlich made the project a centerpiece of his environmental agenda. "The Corsica River Pilot Project is the first of its kind in the Bay watershed and can provide a blueprint for the future restoration of the Chesapeake Bay watershed," he proclaimed when kicking it off in the spring of 2005. "This multi-faceted effort will demonstrate that with a focused approach, combined resources, and a comprehensive strategy, we can potentially restore an entire river system."

A bold statement. And an ambitious experiment. The state of Maryland made a five-year commitment to the tune of $19.4 million. This effort would require a massive push from diverse sectors, with dozens of public, private, and environmental partners coming together around a common goal — to restore one 6½-mile stretch of river, a small sub-watershed of the Chester River. If successful, it would become a proof of concept that might be replicated around the Chesapeake watershed.

Five years later, the Corsica remains on Maryland's list of impaired waterways under the Clean Water Act — receiving failing marks for excessive sediments, nutrient over-enrichment, PCBs, fecal coliform bacteria, and impacts to biological communities. Local governments and state agencies remain deeply engaged, but citizen buy-in won't last forever.

"We're doing all of these things and I think we are cleaning the river," says Jim Malaro, the president of the Corsica River Conservancy. "The major obstacle is that it is hard to show improvement," he says. "And it's hard to generate enthusiasm if we don't see improvement in the river."

With such a big investment and such a small return, more people are asking the tough question: What will it take — and how long will it take — to clean up the Corsica River?

What Can Data Tell Us?

The Corsica restoration effort began in 2005 with best management practices and monitoring. With a new focus on implementing best management practices on the ground, state and federal officials knew they would need to track water quality conditions very closely to find out whether their efforts were working.

All of a sudden, people were "running about the seascape and landscape of the Corsica making measurements," says Walter Boynton, an estuarine scientist from the UMCES Chesapeake Biological Laboratory. Volunteers from the Corsica River Conservancy were taking weekly samples from five stations in the river for water quality analysis. In a collaborative effort between DNR, the U.S. Geological Survey, and MDE, the agencies placed automated flow gauges just above where tidal influence begins in all three major streams that feed the Corsica. Together these gauges receive drainage from about 70 percent of the watershed, an unusually

large fraction of a watershed to measure directly, says Boynton.

What they got were data. A lot of it.

To put it in perspective, just one of these automated sensor systems records dissolved oxygen and other variables every 15 minutes between March and October, generating a whopping 210,000 data points for each site, every year.

Agency representatives quickly realized that by themselves these large data sets don't provide meaningful information for management. So in 2006, the Maryland Department of Natural Resources tapped Boynton, who has studied the Chesapeake Bay for more than 30 years, to pull together a team of scientific collaborators for an intensive synthesis effort that DNR would largely fund. The resource managers, led by Resource Assessment Service director Bruce Michael and Corsica project coordinator John McCoy, issued Boynton a tough challenge. They asked him to use these vast data sets to create a nutrient budget, to predict whether the proposed restoration activities could reduce these loads if fully implemented.

They wanted a forecast: if nutrient loads came down, how would the Corsica River respond?

Nutrient Overload

Boynton began by recruiting a top-flight group. He worked most closely with UMCES scientists Michael Kemp and Jeremy Testa, who have strong expertise in estuarine processes. He went to experts on stormwater from agencies and local governments and to experts on agriculture and cover crops from the Wye Center for Agro-ecology, especially Russ Brinsfield and Ken Staver. He also recognized the need to sample and account for certain processes not captured by ongoing measurements. For that, he turned to biogeochemist Jeff Cornwell to predict rates of denitrification and nitrogen burial in the Corsica River, both processes that can permanently remove nitrogen from the system. He looked to Cindy Palinkas to provide information about the overall sediment budget of the Corsica, to help understand the contribution of processes like shoreline erosion to the nutrient budget.

Researcher Walter Boynton *aboard the* R/V Rachel Carson. *Boynton pulled together a team of scientific experts to help assess the effect restoration efforts might have on the Corsica watershed.*

Boynton quips, "When the going gets tough, the smart collaborate."

By the spring of 2010, the scientific team was able to summarize their findings for DNR. Not surprisingly, their synthesis report found that nutrients from agriculture (so-called diffuse sources) make up the lion's share of the load entering the Corsica system — some 84 percent of the nitrogen and 74 percent of the phosphorus. The watershed's 25,298 acres are dominated by agricultural land uses — mostly corn and soybean farms that feed the Eastern Shore's poultry operations. Stormwater comes in a distant second, accounting for 10 percent of the nitrogen and 25 percent of the phosphorus (see Total Nitrogen Flux graph, p. 7).

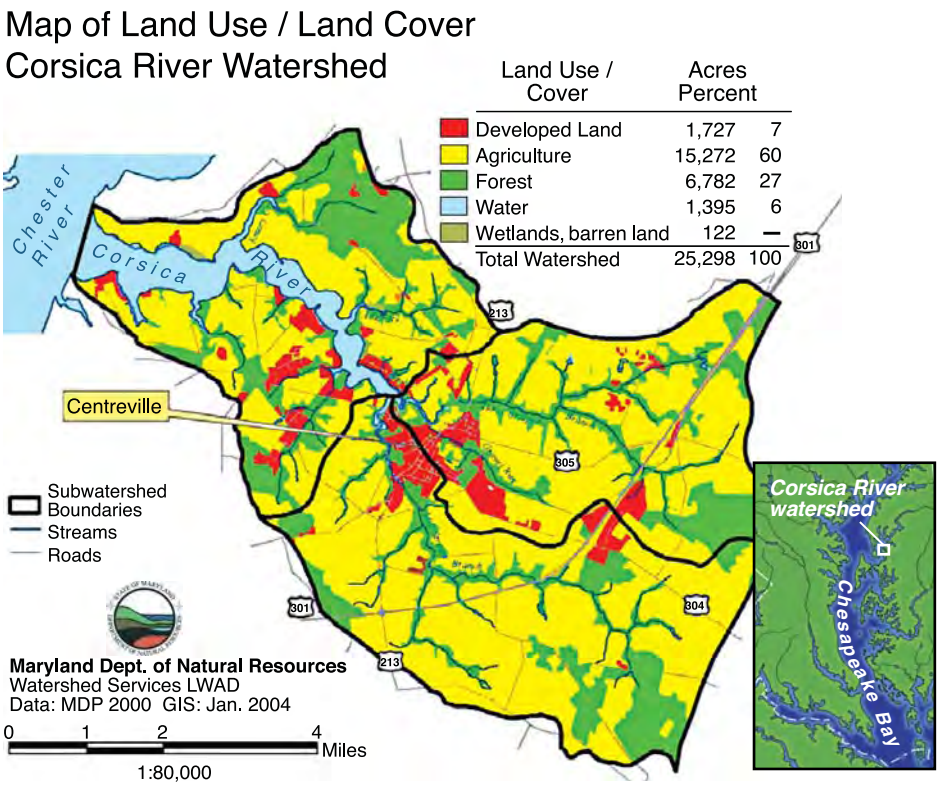
High nitrogen loads mean turbid water and algae blooms, says Boynton. Through further statistical analyses, the team demonstrated a strong relationship between the amount of nitrogen that reaches the system in the spring and the amount of chlorophyll-α (a proxy for algae) that shows up in summer. Algal blooms in turn reduce water clarity, letting very little light reach the bottom, despite the river's uniformly shallow depths. Currently, only 10 percent of the river bottom receives sufficient light to support even "potential" communities of underwater grasses, Boynton explains.

The team's study also confirms a strong connection between summer chlorophyll-α concentrations (algae) and low oxygen conditions (hypoxia). To generate this statistical relationship, they analyzed data from multi-probe sensor systems that recorded variables such as dissolved oxygen, chlorophyll, and turbidity at three different sites every 15 minutes between March and October of each year.

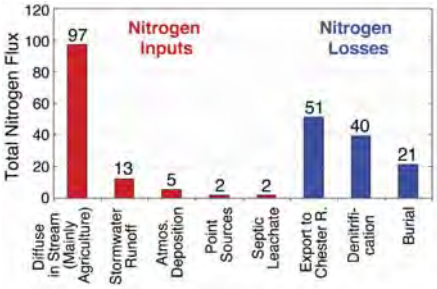
That high nutrient concentrations lead to poor water clarity and hypoxic conditions is not surprising. This is a story that's been repeated from tributary to tributary all over the Chesapeake watershed. But the connection between springtime nitrogen and summertime chlorophyll does carry a surprising twist. The relationship between nitrogen loading and chlorophyll-α is what scientists call "non-linear" (see Benefits of Reduced Nitrogen Load graph, p. 7). In this case that non-linear connection means that small declines in nitrogen loading might lead to large declines in algae blooms.

Thanks to this connection, the Corsica River estuary currently hovers near a potential "tipping point" for nitrogen loading, explains Boynton. And it's a tipping point in the right direction. Nutrient reduction efforts could really punch a lot of bang for the buck, he says. To put it in numbers, the data suggest that a 50 percent reduction in nitrogen loading to the system would produce a 70 percent decline in summer algae.

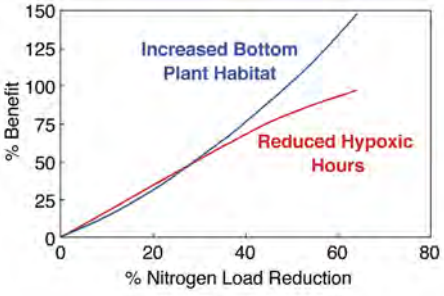
Crossing this threshold would push the Corsica River toward another one — — a tipping point that would cause a rapid increase in water clarity up to 75 percent. Here non-linearity becomes important again, explains Boynton. A relatively small change in water clarity (Secchi depth increase by about half a meter) is predicted to cause a sharp increase in the amount of river bottom

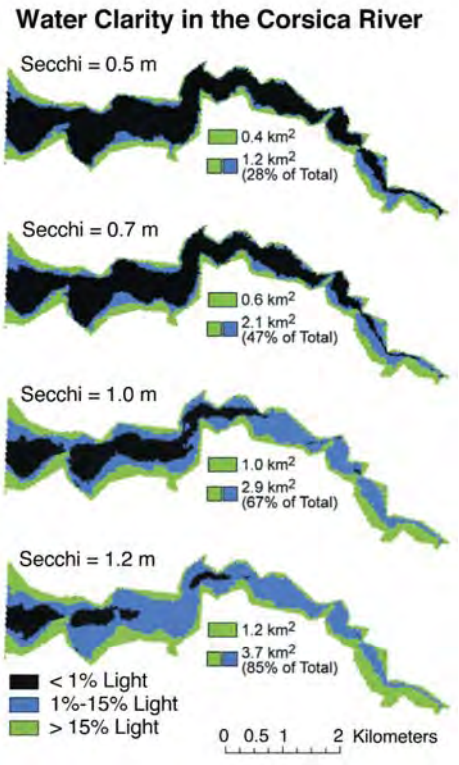


Agriculture for corn and soybeans *(shown on map in yellow), dominates the Corsica watershed, making up more than 60 percent of the land cover. Outside the town of Centreville, the population in the watershed is spread out, with developed land comprising a relatively small overall percentage.* MAP COURTESY OF THE MARYLAND DEPARTMENT OF NATURAL RESOURCES.



To create a nutrient budget for the *Corsica River, researchers evaluated nitrogen inputs and losses from all sources. They were not surprised to find that most of the nitrogen entering the watershed comes from agriculture.*





Scientific models predict that a 50 percent reduction in nitrogen loads *would increase water clarity enough to significantly boost bottom habitat for plants and decrease hypoxia (bottom left). Improving light penetration (measured by Secchi disk) from 0.7 meter to 1.2 meter, for example, would lead to a sharp increase in the amount of light reaching the bottom (maps at right).* GRAPHS AND MAPS (BOTTOM RIGHT) COURTESY OF WALTER BOYNTON.

that would receive enough light to support the growth of benthic algae and underwater grasses — critical for repairing degraded ecosystem functions in the Corsica River. Their predictions also suggest that a 50 percent reduction in nitrogen load and an associated chlorophyll-α decline would also reduce the amount of summer low oxygen by 80 percent, essentially eliminating the water quality problem.

These potential tipping points or thresholds for nitrogen loads, algal abundance, and water clarity are good news for the Corsica River says Boynton. But will nutrient loads decline enough to cause the river to "tip"?

Putting Science to Work

For citizens of the watershed, getting the Corsica River to the tipping point is serious business. The county government employs a watershed planner, Eva Kerchner, who oversees all of the stormwater retrofit projects. Since September 2009, she has managed the construction of a three-quarter-acre wooded wetland that drains 17 acres of the watershed within town boundaries. She's overseen the relocation of storm drains to intercept the drainage from impervious surfaces that were directly discharged into Gravel Run, one of the Corsica's small tributaries. She's also managed a retrofit project for 10 acres of drainage area to a coastal plain outfall, reconfiguring a pipe that dumped stormwater directly into the stream.

Along with multiple partners, the town of Centreville also has instituted a Green Business Certification, offering a voluntary program whereby businesses that follow a stringent set of best management practices can market their participation with a sticker displayed in their storefront window. To date, Centreville boasts 11 certified green businesses, restaurants, and office spaces — including big retail operators such as Acme and Food Lion.

Watching over these governmental projects is the non-governmental Corsica River Conservancy, some 670 members strong, working to build stake-

The Corsica River watershed boasts some 250 rain gardens — *an impressively high number for a watershed with only about 1600 families. Rain gardens help retain stormwater, preventing direct runoff into creeks. The over-55 community of Symphony Village has nearly 70 rain gardens (top), and the Centreville Public Library is home to a large demonstration rain garden (bottom left) with explanatory signage. Standing near the headwaters of Gravel Run, John McCoy, who helped coordinate the Corsica restoration effort for the Maryland Department of Natural Resources, checks on one of three automated water samplers.*

holder buy-in for the restoration process. Volunteer members coordinate weekly water quality sampling in the summer months, a process done with scientific rigor sufficient to be included with the Chesapeake Bay Program's water quality sampling data (see A Citizen Scientist, p. 10).

The Corsica River Conservancy also facilitates the installation of rain gardens in Centreville, acting as liaisons between the homeowner and contractor. They help administer a grant that provides $2,000 per homeowner to offset the installation and material costs. The practice of planting rain gardens seems to have spread like wildfire, says John McCoy, who has overseen the coordination of the Corsica River restoration

Continued on p. 11

View from the

Tall stands of corn arc high along the sides of the road, like walls of a slot canyon. Our car navigates the narrow passage until we reach a grassy clearing. Here Buck Morris waits alongside his black pickup truck, near the property line where his farm extends toward busy Route 213.

Overgrown grass reaches past Morris's knees. His big frame seems diminished in the high grass — grass that he planted but is not allowed to mow for another month or more. This grassy patch, a so-called vegetated buffer, still has its work to do, intercepting nutrient-laden runoff from Morris's fields. After a rain, the buffer slows the flow before it reaches the watery ditch in the forested area of his property, where pools of water become headwaters of the Corsica River.

A narrow grass channel extends all the way from the edge of Route 213 down toward the grassy field. This is a grass waterway, Morris explains, designed to stop road runoff that could erode the ditch and carve a channel that could carry nutrients to the headwater stream.

Morris says that he's put best management practices, like these grass buffers and waterways, on nearly all of the properties that he works, which tallies to ten, not including his own. And of course cover crops.

Cover crops, like waterways and grass buffers, work in a straightforward manner to help take up excess nutrients from the soil during the winter. But the questions raised by the economics of cover crops suggest that it's not so simple. Can farmers make money planting cover crops? Without significant federal and state subsidies, can planting cover crops provide farmers with a reliable source of financial profit?

Morris has been planting cover crops for more than 10 years, well before the beginning of the Corsica River restoration effort. Cover crops "mellow" the soil, he says, preventing it from packing down. "If we can do something to better our soil, we're going to do it, especially if it doesn't cost us a lot of money out of pocket," he says. "Plus, we're helping the environment too. It's a win-win situation for everyone."

Farmers in the Corsica watershed, according to Morris, think favorably of the cover crop program and other best management practices recommended by the Maryland Department of Agriculture. And he should know. He serves as chair of the board of Queen Anne's Soil Conservation District, running monthly meetings and contacting local representatives on particular issues.

"They [MDA] are listening to us when we make recommendations. This year, they changed the signup dates. They extended the window so that [cover crop signup] doesn't coincide with the wheat harvest." Farmers are

Farm: Putting Best Management to Practice

A narrow road wends through the farm *of George "Buck" Morris (top right). Morris plants grass waterways, buffers, and cover crops to keep nutrient-laden runoff out of this watery ditch (bottom right) on the edge of his property, which drains into the headwaters of the Corsica River.*

too busy at harvest time to get to the office to register their acreage enrollment.

Most farmers that Morris knows plant some sort of cover crop over the winter. That can be either a traditional cover crop or a commodity cover crop, a crop harvested for sale. To plant traditional cover crops farmers rely on incentives from the state — up to $95 per acre. They must plant these crops — commonly wheat, rye, or barley — by early November, after corn. The crops must remain unfertilized through the winter, so they can take up excess nutrients and stabilize the soil during the vulnerable period for runoff and seepage. After March 15, farmers can destroy them or cut them for livestock forage, but rules say that they cannot harvest them.

Commodity cover crops, which are sold in open market, bring farmers more modest incentives of $25-35 per acre but provide the chance to bring in more money. Under the commodity cover crop program, farmers still cannot apply fertilizer in the fall. But after March 1, they can add fertilizer to bring the crop to market size.

Why would the state offer incentives for winter commodity crops? According to MDA's Dave Mister, the payments help offset a potential loss in yield that farmers might see by not fertilizing in the fall. But the state's interest is to entice farmers to plant cover crops — not to bolster the income of farmers. "That was never the intent," says Mister. "The cost share for the cover crop program is to cover the cost of planting for nutrient reduction."

Though it varies year-to-year, the decrease in yield from using no fertilizer in the fall is often quite small, says Morris. "This past year [2009-2010], I don't think I lost any yield," says Morris. "They [MDA] are compensating enough to make up the difference."

Furthermore, if farmers don't plant a commodity cover crop, like wheat, under MDA's program, Morris explains, they'd probably plant the same crop anyway, but they'd put fertilizer on it to ensure that they could grow as much as possible.

As with any commodity, selling cover crops depends on the market.

Right now, wheat is the only small grain cover crop with any kind of market on the Eastern Shore, says Mister, and it's not a big one. Perdue buys wheat as filler for chicken feed, but compared with the demand for corn, the demand for wheat is quite low.

What about the market for other small grain cover crops? For a while, hull-less barley was being touted for biofuel production, Mister explains. "We thought that we were going to have biofuels here in Baltimore," he says. "But that never materialized."

Maybe not in Baltimore, but at the southern end of the Chesapeake Bay watershed, in Hopewell, Virginia, the first biofuel plant in the Bay watershed broke ground in May 2009. Osage BioEnergy has nearly completed construction of this barley-based biofuel plant, and it will soon be operational. With target ethanol production set at 65 million gallons per year, the company anticipates processing 30 million bushels of barley annually and generating $100 million in agricultural economic opportunity for local farmers and agriculture-related business.

A market for a small grain like barley could make the planting of cover crops a self-sustaining and profitable enterprise for farmers. Until then, cover crops will depend on government incentives.

Since agriculture accounts for the Bay watershed's largest load of nutrients, improving the health of the Chesapeake will depend on planting cover crops over many acres, year after year. This won't be easy, Morris says. "People are doing almost all they can do now."

For now, funding for the Maryland Agricultural Water Quality Cost-Share Program remains strong. This year, the state has made $15 million available to Maryland farmers. And for the 2010-2011 planting season, in the Corsica watershed and statewide, MDA reports record enrollment for the program. But how long can the state afford to pay for cover crops? What if subsidies for cover crops should dwindle?

Commodity crops like barley for biofuels might shift the cost from the state to private markets. Could we then pay for cover crops through our energy bills? Intriguing thought. For now, according to Mister and others, the immediate goal is to keep more nutrients out of the Bay. The rest may be up to the bigger forces of capitalism.

— E.G.

For more about using barley for biofuel, see Chesapeake Quarterly, *volume 8, number 1, www.chesapeakequarterly.net/V08N1.*

A Citizen Scientist on the Corsica River

The small boat rocks gently as Sandy Simpson fits a glass sample bottle into a metal buckle at the end of a long wooden pole. She unseals the cap and lifts the pole over the side of the boat as it idles along the widest part of the Corsica River. Leaning down, she swipes the bottle through the water, making sure that the sample comes from below the surface.

On the distant shore, student sailors wrestle with the rigging of small boats in the heavy air. It's hot when the boat's not moving, and the sun is strong. Simpson wears a cloth bandana to keep her hair off her face in the summer heat.

This week, on this boat, she's first mate, working with captain Ben Heilman and crew Jeff Smith, all of them volunteer water quality monitors from the Corsica River Conservancy (CRC). Every Wednesday, from May to October, a different set of citizen scientists heads out at 11:00 am sharp to sample the water. They follow a rigorous protocol, certified by the Maryland Department of Natural Resources, that allows their data to be included in the agency's Eyes on the Bay database (http://mddnr.chesapeakebay.net/eyesonthebay/index.cfm). To make these trips possible, different volunteers commit their personal boats to the outing each week. In six summers, the water quality monitors from the Corsica River Conservancy missed only one day — this was due to an instrument malfunction.

Simpson swings the collection bottle up to the surface and screws the cap back on, careful not to touch the inside of the rim. Any contamination might confound the measurements. Next, she drops overboard the probe of a device called a CTD meter, which measures conductivity, temperature, and depth. She submerges it just beneath the surface, waiting for the readings to stabilize.

Simpson calls out, "pH 8.35, temperature 29°C," and Heilman jots this down on the data record sheet.

Simpson has volunteered with the Corsica River Conservancy for four years, ever since she moved to the Eastern Shore. Like most members, she's a retiree — in her case, a retired nurse. But she's always identified herself as an environmentalist, ever since she majored in biology "eons ago."

Since then Simpson's lived in 16 different places — from northern Michigan to California, Arizona to New Jersey. Her ex-husband was in the military service, flying B52s in northern Michigan during the Cold War. In every place she's lived, she's sought out ways to connect with the environment.

"I've enjoyed just about every area that I've ever lived in. There's always something new to experience, both the culture and the environment," she says. "I think you need to pay attention. You need to learn about the area that you are in and how you can keep it safe."

When she moved to Centreville to be closer to family, volunteering with the Corsica River Conservancy felt like a natural fit. She's already been out once before this summer to collect water samples, and she'll probably go out at least once more. She also helps with the local rain garden program run by the Corsica River Conservancy and with outreach at Canard Elementary School. Reaching the kids really strikes a cord with Simpson. It is with the kids, she says, that environmentalism can have its deepest reach.

"The kids are the ones who are going to be making a change in the future," she says. "I've seen their awareness growing."

After Simpson finishes taking water samples and CTD measurements from all five stations, Captain Heilman turns the boat around. Simpson busies herself filling out forms and preparing the cooler that holds the water samples.

When she returns to shore, Simpson will drop the samples off at Centreville Health Department. From there, a courier will bring them to Baltimore to be analyzed for nutrient and bacteria levels at the state of Maryland Department of Health and Mental Hygiene.

The wind picks up as the boat accelerates. Simpson works quickly but calmly. For the samples to be valid she has to drop them off by 1:00 pm. It's already close to noon.

The volunteers speed toward shore.

— *E.G.*

At the first of five sampling stations, *Sandy Simpson, a Corsica River Conservancy volunteer, prepares a collection bottle. Conservancy volunteers offer boats and dock access for monitoring trips (top). Today's trip departed from the dock of Myron Richardson, who coordinates the water quality monitoring program (middle). Simpson and other volunteers follow a data collection protocol certified by the Maryland Department of Natural Resources (bottom).*

Thanks to the Corsica River Restoration *Pilot Project, the town of Centreville (left) is home to sewer, septic, and stormwater upgrades, along with hundreds of rain gardens. On the outskirts of town, Bloomfield Farm (above), a property owned by Queen Anne's County, has become a demonstration site for wetland and meadow restoration, as well as forest buffers and cover crops.*

Corsica River Lessons, *from p. 8*

effort since the beginning for Maryland DNR. The town of Centreville now boasts nearly 250 rain gardens, with dozens more in the planning stages.

Outside of town, the Corsica River Conservancy and Maryland DNR have undertaken extensive wetland restoration and planting of forested buffers in places like Bloomfield Farm — a large property owned by the county on the outskirts of town. The group also oversees the Maryland Grows Oysters project for the watershed, which has put 140 cages in the water for oyster aquaculture.

These efforts have clearly improved the local environment and bolstered on-ground capacity for restoration. But frankly, it would be surprising if citizens could see an improvement in the river at this point. Aside from the upgrade to the sewage treatment plant, which brought about an initial 7 to 8 percent decline in nitrogen, nutrient loads have not yet decreased by even a measurable amount, says McCoy.

"The [synthesis] report is spot on as far as what needs to be done," he says. "We haven't achieved this yet, but it confirms and reaffirms what we need to do. I don't think people really appreciate how much work needs to get done to really improve water quality."

So what will it will it take to reduce nutrient loads in the Corsica? That is the million-dollar question.

Cover Crop Challenge

In the drive to reach a positive tipping point for the Corsica, the greatest roadblock facing the watershed is nutrient runoff. "If we can't get a handle on agricultural pollution, we won't get anywhere," says the Corsica River Conservancy's Malaro. "All of the other things that we are doing pale in comparison."

But solving the problem related to nutrient pollution from agriculture presents huge challenges. Crops like corn and soybeans depend on nitrogen-based fertilizers for rapid growth. As long as these crops drive the economy of the Eastern Shore, high nutrient loads will be on the ground.

When the summer growth season ends, these annual crops die back. At this point, active uptake of water and nitrogen (in the form of nitrate) cease, though soil processes that release nitrate will continue as long as soil temperatures are warm.

Fall and winter become vulnerable seasons for nutrient pollution. Freely available nitrate in the soil can flow directly into nearby ditches and creeks when it rains, ultimately making its way into the river. Winter rain and snowmelt also seep downward through surface soils toward the groundwater — carrying with them any nitrate that was left in the root zone. Nitrogen that reaches the groundwater can be trapped in the system for up to 10 years, according to a study by the U.S. Geological Survey.

Planting cover crops ranks as the best way to reclaim the nitrogen and phosphorus applied to farm fields. "We get the biggest bang for the buck with the cover crop program," says Dave Mister, who's served as the Eastern Shore area supervisor for the Maryland Department of Agriculture for nearly 23 years. And not just for the Corsica, but for the entire state of Maryland.

Cover crops can keep nutrients from leaving the farm, explains Mister. If planted early enough, these crops — small grains such as rye or barley or winter wheat planted without fertilizers immediately after harvesting corn or other row crops — also help take up nitrate in the root zone before it leaches into groundwater.

In the Corsica watershed, total crop acres approach 11,000 acres. Under the restoration scenario, the goal acreage for cover crops is 6,000 acres, or roughly 60 percent.

This is high, says Mister. On a year-to-year basis, he doesn't think that 60 percent is an attainable goal. "Weather is a big factor," he says. "Last fall was just horrendous. We're lucky to have gotten the cover crops that we did get planted."

"I would like to see a 30-35 percent goal. "I think this is reasonable for farmers to accommodate in this watershed, but this is probably not enough from a nutrient reduction standpoint."

Though incentives help, planting and managing additional cover crop acreage is hard work for farmers. "This is where we

National Resources Conservation Service

At the county office for the USDA Soil Conservation District, *area supervisor Dave Mister and soil conservation planner Katie Starr look over a map showing farms in the Corsica watershed (left). In the fall, farmers plant cover crops, like barley (right), to prevent excess nutrients from polluting local streams and seeping into groundwater.*

struggle," says Mister. "Farmers understand that cover crops will help the Bay, but it all comes down to how much one individual can do."

This year, MDA has made some strategic changes to the cover crop program statewide to boost acreage enrollment. For the first time, the agency removed the acreage cap, which previously set a limit on how many acres an individual farmer could plant. While the intent of the cap had been to ensure that incentive payments were distributed equitably, Mister suspected that the cap was holding back individual farmers from planting their maximum possible cover crop acreage. In addition, MDA extended the window for cover crop signup — increasing the period from one week to three.

The Maryland Department of Agriculture also stepped up outreach to farmers for the cover crop program in the Corsica watershed. The agency advertised in the newspaper and placed huge signs up at the field mills, so farmers would see them when they were hauling in wheat to sell. Katie Starr, the soil conservation planner for the Queen Anne's County Soil Conservation District, sent letters and contacted each farmer in the watershed by phone to explain the program — some multiple times. She offered to come out to the farm to sign anyone up if they were too busy to make it into the Soil Conservation District office, since the signup period fell during the window for wheat harvest. Buck Morris, a farmer who works land for ten different landlords in the watershed, took her up on the offer (see View From the Farm, p. 8). She enrolled him in the cover crop program while riding with him on his combine.

MDA's efforts seem to be working. Whether due to the change in acreage cap or intensified outreach, cover crop enrollment has hit a peak this year, both in the Corsica and throughout the state. For 2010-2011, the Corsica watershed has enrolled more than 9,000 acres in the program, for the first time both meeting and exceeding the 60 percent target. Compared with last year, more than twice as many farmers enrolled more than double the previously enlisted acreage. Statewide, MDA approved a record 502,323 acres of cover crops, requested by 1,688 farmers.

The Gift of Time

Cover crops, stormwater management, sewage treatment and septic upgrades, wetland restoration, riparian buffers. The Corsica watershed has made considerable progress toward getting these best management practices in the ground. In doing so, they've created a solid foundation of local capacity for restoration and deep community engagement. No doubt that these efforts have improved the local environment in real and tangible ways. But will these efforts ultimately translate to an improvement in water quality?

"People look to Corsica for how to accomplish things and for lessons learned," says McCoy, who recently left his coordinating role with DNR to take a job as watershed planner with the Columbia Association in Howard County. "How much work it will take is one of the lessons learned."

Hard work and time. This seems to be the verdict on what it will take to restore the Corsica River. In preparing the synthesis report, Boynton reviewed the calculations in his statistical models with agriculture experts. The calculations suggest that the watershed still needs to do a lot of cover cropping — early planting, year in and year out, to really achieve reductions in nutrient loads. It will take time, he says. Nitrogen that seeps into the ground can reside in groundwater for more than a decade. Once enough cover crops are in the ground, one could still expect a lag time of anywhere from five to eight years for nutrient loads to actually decline.

With aggressive cover cropping, combined with continued upgrades to septic systems and stormwater treatment, models predict that a 50 percent target for nitrogen load reduction could be achieved. And the good news is that once nutrient loads do come down, recovery should be fairly rapid. The "tipping point" effect predicted by the team's study suggests that once the algae-clouded water begins to clear and light can reach the bottom, ecological processes should kick in to take the river the rest of the way.

But will funding and politics stay the course for the Corsica River? Boynton for one has his doubts. "If political officials lasted for the residence time of groundwater, maybe they'd support this," he said in a symposium talk in which he presented the report's findings.

And the Corsica River restoration pilot project raises a big question for the Bay as a whole. If it takes so much to bring back one 6½-mile stretch of river, what will it take to replicate such intensive efforts tributary-by-tributary over the whole Chesapeake Bay watershed?

This question comes at a time when the stakes are higher than ever. This sum-

For More Information

Corsica River Watershed Enhancement and Restoration Project
www.corsicariver.org/

Corsica River Conservancy
www.corsicariverconservancy.org/

Corsica River Watershed Restoration Action Strategies
www.dnr.state.md.us/watersheds/surf/proj/wras.html

Seminar by Walter Boynton on the scientific synthesis effort
http://vimeo.com/10633532

Cover Crops
Maryland Department of Agriculture
http://www.mda.state.md.us/resource_conservation/financial_assistance/cover_crop/index.php

Chesapeake Bay TMDL
Environmental Protection Agency
www.epa.gov/chesapeakebaytmdl/

Maryland Sea Grant: Watershed Protection and Restoration resources
www.mdsg.umd.edu/programs/extension/communities/watershed/

Thresholds and Tipping Points
Chesapeake Quarterly, vol. 3, no. 3
www.chesapeakequarterly.net/V03N3/main/

Nitrogen and Cover Crops
Chesapeake Quarterly, vol. 4, no. 1
www.chesapeakequarterly.net/V04N1/side5/

mer, the Environmental Protection Agency adopted nutrient and sediment goals that represent the maximum amounts of nitrogen, phosphorus, and sediment that can originate river-by-river from each state, so-called Total Maximum Daily Loads or TMDLs (see What Will It Take to Limit "Daily Loads"?, right). These will be legally binding requirements, a huge pressure on local jurisdictions watershedwide.

As Bay states move forward into the brave new world of TMDLs, the Corsica River carries an important message for the future. Restoration takes time, money, and a whole lot of hard work. The best science available predicts that the Corsica River can recover, and rebound quickly, once nutrient loads come down. But it will take a marathon, not a sprint, to achieve a tipping point for recovery in this watershed. The road to restoration will be a steep hill to climb.

— *goldman@mdsg.umd.edu*

What Will It Take to Limit "Daily Loads"?

Erica Goldman

In the crowded conference room at the Caroline County Health and Public Services Building in Denton, Maryland, Jennifer Dindinger takes questions from the audience in rapid-fire succession. The questions are coming from local officials, land-use planners, agency personnel, community activists, and environmental advocates. They've driven here from all over the Eastern Shore to get answers about what to expect from the new Baywide Total Maximum Daily Load (TMDL) process coming down the pike. They know that the Environmental Protection Agency is establishing load limits for nutrients and sediments for the Chesapeake Bay and its tidal tributaries — but they don't know how they're supposed to meet those limits.

Dindinger projects calm and assurance as she fields these inquiries, deflecting palpable anxiety from the crowd that fills the room. As Eastern Shore watershed restoration specialist for Maryland Sea Grant Extension, she's helping to explain the Watershed Implementation Planning (WIP) process — the nitty-gritty work required for developing a roadmap for nutrient management to achieve and maintain stringent load requirements for nitrogen, phosphorus, and sediment to meet Bay water quality standards.

Everyone in the room already grasps the basics of the federal TMDL. They understand that the Environmental Protection Agency is establishing load limits because of continued violations under the federal Clean Water Act and a watershedwide failure to meet the goals set forth in the Chesapeake 2000 Agreement. They may also know that the Chesapeake Bay TMDL will be the largest and most complex TMDL ever, involving interstate waters and effects on

Erica Goldman

It won't be business as usual, *explains Jennifer Dindinger, watershed restoration specialist for Maryland Sea Grant Extension. The Baywide Total Maximum Daily Load (TMDL) will require new levels of detailed planning and implementation to meet nutrient reduction goals. This is the message Dindinger sends to this audience at a public meeting on the Eastern Shore held to discuss new expectations. This fall, the Environmental Protection Agency will hold 18 such meetings to answer questions and hear public comment.*

water quality from the cumulative impact of more than 17 million people, 88,000 farms, 483 significant treatment plants, and thousands of smaller facilities.

What they don't know yet is exactly what they will be asked to do to meet the new requirements — and the devil will be in the details.

Faced with a short timeline for developing the Watershed Implementation Plans, the audience asks Dindinger a lot of questions. She shares the microphone with Catherine Shanks, the program manager for community and local government services for the Maryland Department of Natural Resources. Together they do their best to clarify and reassure.

Erica Goldman

To restore the Bay one river at a time, *TMDLs emphasize accountability and consequences for failure to meet load allocations. The Corsica River (above) has already grappled with many of the challenges of reducing nutrient loads, offering a model for "lessons learned" as the new TMDL process moves forward.*

The EPA issued a draft TMDL on July 1 that specified nutrient allocations for each jurisdiction. The states in turn will be required to submit final Watershed Implementation Plans by November 29, and that document will serve as a roadmap for achieving and maintaining those limits. By December 31, 2010, the EPA will issue the Baywide TMDL, with final allocations that will achieve water quality standards.

What differs from past efforts to reduce nutrients in the watershed is that the TMDL process spells out a procedure for accountability and consequences should the states and the District fail to meet load allocations. Instead of pursuing a distant deadline, the jurisdictions will be required to meet two-year milestones. The states and the District adopted the first set of milestones at the 2009 meeting of the Chesapeake Executive Council and will be required to meet them by December 31, 2011. In successive two-year increments, Bay jurisdictions will be required to put in place all pollution control measures necessary to restore the Bay by 2025.

Accountability will be essential to the TMDL process. The EPA is working with jurisdictions to develop an adaptive management approach that includes contingencies and consequences if a state or the District does not establish two-year milestones sufficient to reduce pollution loads on schedule or does not achieve its previous two-year milestone commitments.

Dindinger's position as a Maryland Sea Grant watershed restoration specialist is linked to the TMDL process. In 2009, the Maryland Department of Natural Resources teamed up with the University of Maryland Sea Grant Extension, the Environmental Finance Center, and the Chesapeake Bay Trust to create the Watershed Assistance Collaborative (WAC). Working through Sea Grant Extension and the collaborative, Dindinger serves as a liaison with local governments and watershed groups to help them secure funding from grant programs like the Chesapeake and Atlantic Coastal Bays Trust Fund to launch projects for improving water quality. She works closely with Amanda Rockler, the Sea Grant Extension watershed restoration specialist for Central Maryland and Jackie Takacs, who serves Southern Maryland, along with Sea Grant Extension coastal communities specialist Vicky Carrasco.

"I enjoy meeting with the people who run towns and counties, helping them write grants and implement restoration projects," says Dindinger who works to show how on-the-ground restoration fits into reducing nutrient loads. She will remain deeply engaged at this level. "This is one of the metrics that we will be ultimately measured by," she says.

As the Bay TMDL process ramps up, lessons from the Corsica River loom large. This pilot project functioned a lot like a TMDL. Throughout the Corsica watershed, homeowners, farmers, and others set about implementing intensive efforts to reduce nutrient loads, sector-by-sector. Water quality monitoring closely tracked these efforts. Funding and resources helped to ensure that restoration efforts moved forward. Still, nutrient loads have been slow to decline.

With the requirements of the Bay TMDL setting the bar higher than ever, specialists like Dindinger will prove essential. Acting as an on-the-ground conduit of information between the local level and state agencies, she offers an avenue for true two-way communication. She says, "I am a presence people can rely on."

Jack Greer Sets Sail

Michael W. Fincham

Jack Greer leaves Maryland Sea Grant with a plan. Shortly after the hurricane season ends and well before the winter gales begin, he'll weigh anchor on his 40-foot sloop and sail south out of the Chesapeake Bay, headed for the Lesser Antilles. He and his wife, Bobbie, will overwinter in the Caribbean, waiting for the weather to warm so they can head north then east across the Atlantic to Europe. It's a plan that calls for work: weeks to get the 40-footer ready to sail, weeks to repair what breaks under sail, then weeks to repair the repairs.

He leaves behind years of work, a network of colleagues and friends, and a 31-year career with Sea Grant that began with part-time work as a grad student and expanded to include jobs like science writer, publications editor, and Assistant Director for Communications and Public Affairs. He also served as Acting Director for Maryland Sea Grant, the founding director of the Environmental Finance Center (EFC), and became a key player in the kingdom of acronyms, serving with CEPP, EMECS and BBCAC (see Accolades, right).

A sailboat is an appropriate exit since it was a boatyard that first brought him to Sea Grant in June of 1979. Back then I was Communications Coordinator for the new Sea Grant program that Rita Colwell was heading up, and I needed help. We were trying to create publications and films that would tell the story of Bay science and how it could apply to the environmental issues facing the Chesapeake. As a Ph.D. student in English at the University of Maryland, Jack arrived in my office with writing samples and a resume and a strong recommendation from one of my friends in the English Department. The writing samples were mostly academic essays, not exactly proof he would soon write graceful prose about marine science. The best thing he had going was my friend's recommendation. She was smart and she knew smart when she saw it.

Skip Brown

***Jack Greer** sailing aboard his 40-foot sloop* Moon Rise.

Accolades Over the course of his career with Maryland Sea Grant, Jack Greer has been one of the most effective voices for bringing science to policy for the restoration of Chesapeake Bay, says Jonathan Kramer, Maryland Sea Grant Director. "Jack's role as facilitator and synthesizer has often been not only catalytic, but the glue that has held these groups together." Below are some of Jack's major efforts and awards.

Coastal and Environmental Policy Program (CEPP); director
Environmental Finance Center (EFC); founding director
1993 Environmental Management of Enclosed Coastal Seas (EMECS); organizer, facilitator
Governor's Chesapeake Bay Watershed Blue Ribbon Finance Panel; facilitator
Bi-State Blue Crab Advisory Committee; facilitator
Chesapeake Futures: Choices for the 21st Century; author and editor (with Don Boesch)

Awards The President's Award for Excellence in the Application of Science, from the University of Maryland Center for Environmental Science, 2005
APEX Awards for Magazine Writing, 2006, 2007, 2009, 2010
Individual Artist Award from the Maryland State Arts Council (for Fiction), 1999
Individual Artist Award from the Maryland State Arts Council (for Fiction), 2000
Baltimore Artscape Award (for Memoir), 2000

The second best thing he had going was a gap in his resume. It dutifully listed his patient academic progress: an English degree from the University of Virginia, two years teaching in the middle schools of Appomattox, Virginia, a Master's Degree from the University of Richmond, and several years in the Ph.D. program at the University of Maryland. But there was one break in this studious litany: a dropout year when he left grad school, buckled on a tool belt and went to work in a Bayside boat yard. That showed a connection with the Chesapeake, but better yet, it showed creativity and imagination that I seldom saw during my own spell in grad school. That was the connection that got him hired. Never trust a man or woman who never dreamed of dropping out.

Jack did more than dream about it. "I woke up one morning," he says, "and realized I'd been in a classroom since I was six years old." When he wasn't in the classroom, he was often on a river. He spent his childhood summers in Gloucester, Virginia riding down from Richmond and out through the arching woods to where the world suddenly opened wide at the York River. There he launched self-made boats and watched them sink, then inner tubes, then rowboats he'd have to bail out, then small sailboats that carried him out on the

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Greer Sets Sail, *from p. 15*

river. Years later when he wanted a break from grad school, he headed for a nearby river and went back to working on boats. It didn't look like a plan, but it turned into one.

Heading for a river opened the world again, leading him to Maryland Sea Grant and turning him into a writer and an expert on Bay policy issues. We put him to work for four years writing weekly *Bay Shore Reports* for newspapers, more than 200 short essays and columns about natural history and cultural history, about boating and fishing, watermen and scientists, the turning of the seasons, and the rising effort to revive a declining estuary. It was the education of an environmental writer and thinker. There were longer pieces for Sea Grant magazines and more responsibilities, especially when he became director of the communications program. That meant writing proposals, surviving site reviews, managing people, and juggling hundreds of administrative details and dozens of committees.

Everybody has a river not taken, usually several, and for Jack they were law and politics, interests that came alive again in his professional career. In high school he served in the student senate and in grad school he was first president of the English Graduate Organization (EGO). In the contentious world of Chesapeake Bay policy issues, he established a reputation as a respected facilitator, able to manage meetings focused on divisive issues and through his smarts, his patience, and his good humor lead competing groups toward common ground.

Those same traits, along with his writing talent, made him a great editor, not just with writers at Sea Grant (who can be prickly about changes in their prose) but with scientists and politicians who leaned on him to edit, rewrite or co-write major reports, including one on the financing of the Chesapeake Bay cleanup and another on future scenarios for the Bay's ecosystem. As one of those prickly Sea Grant writers, that is the talent I'll miss the most. Jack was the best editor I ever worked with — even though we often butted heads over levels of language, metaphors, dialogue, narrative hooks, nut grafs, turning points, even serial commas, as well as dozens of other issues that writers worry about in working out an article or finishing a film script. Every head butting helped the piece or the film and most of them left us laughing.

Among all those duties, the miracle he managed was this: the writer never disappeared beneath the burden. He finished his Ph.D., wrote articles and essays for Sea Grant, and created poetry and fiction — usually while holed up in a cabin in the hills of Virginia. Last year he published *Abraham's Bay*, a collection of dramatic sea stories created from a year-long sailing trip to the Caribbean.

He finally left the classroom, but Jack never left the university. The home base for every Sea Grant program around the country is a university, often the land-grant university, the institution that democratized higher education in America and spurred the application of science to agriculture, aquaculture, natural resources, and environmental studies.

Bay science, says Jack, has done much to clarify the causes of decline in the Chesapeake, but major questions remain, especially questions about how to reverse the decline. "I wish there was a clearer picture about what really needs to be done," he says, "a better way to fix the Bay without driving people out of business."

Rivers lead to oceans. After wintering in the Caribbean, Jack and Bobbie Greer will weigh anchor in late spring and head north to Bermuda, then east across the Atlantic. Barring bad winds and rogue waves, they'll reach landfall several weeks later in the Azores and drop anchor behind the breakwater at a town called Horta on the island of Faial. With its white stone houses and red tile rooftops and black sand beaches, Horta is a stop-over famous among sailors bound across the Atlantic. Both Greers will go to work repairing the boat and Jack will walk the docks gathering sea stories for another book. Then they'll light out for the Continent. With more sailing and more stories, more work of noble note may yet be done. That, at least, is the plan.