ASC

AQUATIC SCIENCES CHRONICLE

2024 ISSUE 1

Persistent Pollution PAGE 7

Researchers investigate the key to *E. coli* survival in Lake Michigan beach sand and water

ALSO IN THIS ISSUE

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Aquatic Sciences Chronicle

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The University of Wisconsin Water Resources Institute is one of 54 Water Resources Research Institutes nationwide authorized by the federal Water Resources Research Act and administered through the U.S. Geological Survey.

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STAY CONNECTED

ON THE COVER: Milwaukee's Bradford Beach. Image by Wisconsin Sea Grant

The St. Louis River. Image by Marie Zhuikov, Wisconsin Sea Grant

Recaps and ruminations on the "Unsalted" blog

By MOIRA HARRINGTON

Never salty and always informative in a nonformal manner is the Sea Grant "Unsalted" blog. Check it out at **seagrant.wisc.edu/blog** and read content that includes first-person recaps and ruminations. It's a way for the program to share news in a less structured manner than a typical news story delivers.

Zhuikov uses rice knockers to harvest wild rice in the St. Louis River. Image by Sharon Moen, Wisconsin Sea Grant

At least once a month, often more frequently, staff use this virtual space to provide a rundown of a past event. Typical offerings are those describing the popular River Talks public science café based in Superior. Or staff might share impressions and key takeaways from conferences, much as Science Communicator Marie Zhuikov did with her piece in early winter, "Lessons in Wild Ricing and Wild Rice Lake Restoration." She recounted seven things to know when harvesting rice, including this valuable tip: "Unprocessed wild rice features a long tail-like barb that can have uncomfortable consequences for unwary harvesters. It can sometimes get stuck in people's tear ducts, requiring careful extraction! If this happens to you, you'll be crying 'warrior tears.'"

At the end of 2023 and into early 2024, the space transformed into a hall of reflection as some of the Sea Grant team members looked back on their favorite projects from the prior 12 months. This included conducting a science workshop on a boat on Lake Michigan for a group of educators, per Adam Bechle, coastal engineer; a book club featuring Indigenous children's books from Senior Special Librarian Anne Moser; and Editor Elizabeth White's appreciation for an unsung publication, the biennial "Sea Grant Project and People Directory."

Student voices also shine here. On the blog, 2023 summer research scholars talked about their experiences with mentors and science.

The most popular blog post with readers during the 10-plus years it has been available is "That Time I Organized a Sea Lamprey Taste Test," **go.wisc.edu/f9gex2**. The title says it all, doesn't it? And no wonder people gravitate toward it.

Subscribe to the blog at **seagrant.wisc.edu/blog** so there's never the risk of missing sea lamprey recipes, wild rice harvesting tips and more. ■

Thoughts from Interim Director Christy Remucal

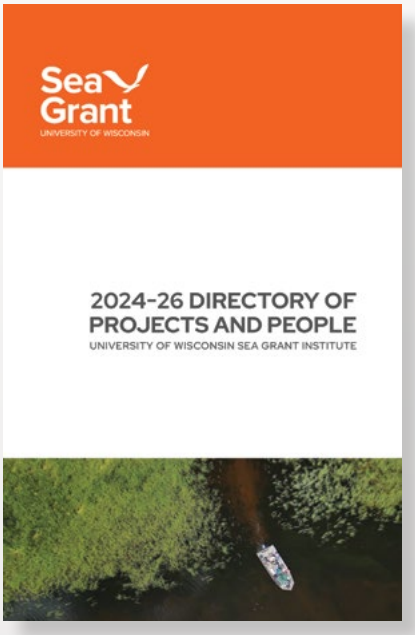
It is an honor to step into my new role as the interim director for the Aquatic Sciences Center at UW–Madison. I am a faculty member in the Department of Civil and Environmental Engineering and have spent the past 12 years at UW–Madison studying aquatic contaminants and other water quality issues in both natural and engineered aquatic systems.

As a researcher, I have benefited tremendously from the center in seeking funding for my own research, mentoring Freshwater@UW summer students and working with the communications team on many different projects. I see this role as an opportunity to give back to the water research community and to have an impact beyond my research group.

More importantly, I am passionate about research, education and outreach related to water quality issues. These activities are at the heart of the missions of both Wisconsin Sea Grant and the University of Wisconsin Water Resources Institute. I am proud to join an excellent team of professionals at the center who support freshwater research and outreach across the state of Wisconsin and beyond.

I appreciate that the center focuses on fundamental research questions that also address the needs of our residents, providing actionable research that can solve real problems related to water quality, aquaculture, fisheries, invasive species, coastal processes, social science and many others. Water is such a critical issue for people in Wisconsin and the importance of water provides a great opportunity for education and outreach; it is truly impressive to see the creativity of Aquatic Sciences Center staff and their partners in developing new ways to connect with our community. As we look forward to the remainder of 2024, I am eager to build on the past successes of the center and explore opportunities to further expand our efforts to address water-related issues across the state. ■

Remucal assumed interim directorship in fall 2023. She is the fourth leader of the Wisconsin Sea Grant College Program and the University of Wisconsin Water Resources Institute, programs that have both been operating in Wisconsin for more than 55 years. For a profile of Remucal, visit **go.wisc.edu/21c2r7**.

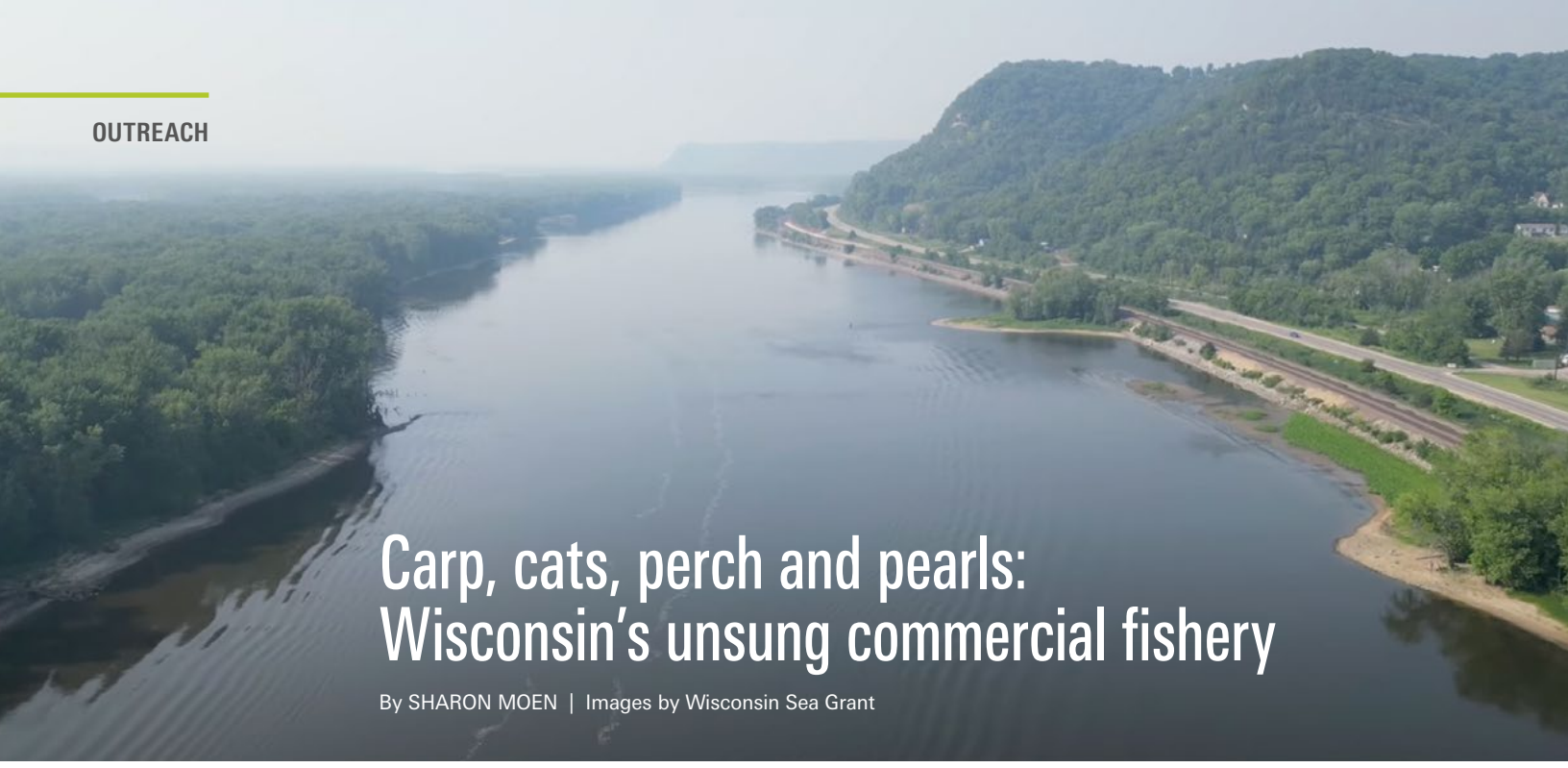


AVAILABLE FOR FREE DOWNLOAD

2024-26 Directory of Projects and People

In a letter to readers of the 2024-26 Sea Grant Project and People Directory, Christy Remucal, interim director, talks about the spark of discovery that fuels every scientific exploration. Capture that spark by downloading the new publication and read about the work that will be undertaken by researchers across Wisconsin.

Visit **go.wisc.edu/y79eer**, or to obtain a printed copy, contact Moira Harrington at **moira@aqua.wisc.edu**.



Carp, cats, perch and pearls: Wisconsin's unsung commercial fishery

By SHARON MOEN | Images by Wisconsin Sea Grant

Above: The Mississippi River provides an average harvest of 3,000 tons of fish to commercial fishing companies per year.

Wisconsin Sea Grant exists because the state's boundaries include parts of lakes Superior and Michigan, which are viewed as inland seas by the U.S. government. Commercial fishing for food happens in these waters and Sea Grant works to help these fisheries succeed. However, there is another Wisconsin boundary where commercial fishing for food occurs – the one defined by the Mississippi River. This lesser-known fishery is also within Wisconsin Sea Grant's statewide purview.

Commercial fishers of *misi-ziibi* (the Ojibwe word for Great River, the Mississippi) harvest an average of 3,000 tons of fish annually. This harvest makes up approximately 2% of the total inland catch in North America. Of the 119 species of fish swimming in the Upper Mississippi River, Wisconsin commercial fishers are permitted to harvest members of eight families of rough fish. *Rough fish* is a catch-all term for edible, nonsports species. Wisconsin commercial fishers can also harvest two types of turtles from the Mississippi.

During the summer of 2023, Wisconsin Sea Grant staff and summer scholars visited Mississippi River commercial fishermen to better understand their businesses and the fishery and to discuss ideas for amplifying seafood production across the state.

Read on to learn what surprised the Sea Grant team and how Sea Grant is working to address a challenge shared by Mississippi River commercial fishers and their Great Lakes counterparts.

Surprise #1 – Common carp are truly common
Surprise #2 – Cats can be huge
Surprise #3 – Sheepshead can be sold as perch
Surprise #4 – Freshwater pearls and clam shells were big business

Each surprise is explained in full on our website, along with source data for the facts included in this article. **go.wisc.edu/7w6852**

LISTEN TO THE PODCAST

The Fish Dish
Episode 13
Michael Valley, Mississippi River Fisherman and Catfish Fillets With Lime
go.wisc.edu/935b77

A common conundrum: Where's the workforce?

Commercial fishing on the Upper Mississippi peaked in the mid-1960s when the industry produced more than 6,000 tons of fish and generated about $9 million. Since that heyday, the number of commercial fishers plying the Wisconsin waters of the Mississippi has declined to a mere handful. Many are over 50 years old and thinking of retiring. At least one is 80.

Jeff Ritter, owner of Ritter Fish

"There's room for up-and-coming fishermen," said Jeff Ritter, owner of the wholesale business Ritter Fish. "If you have a good work ethic and stick your nose to the grindstone, I think you can make a good living at it."

Mike Valley, owner of Valley Fish and Cheese

Mike Valley, owner of Valley Fish and Cheese, said he fishes five days a week when he has help, but when Sea Grant visited, he was fishing two. "We have no problem selling our fish. The problem is making (that is, processing) it, finding enough time and the help. That's the No. 1 problem, you know? I can only clean 400 to 800 pounds in a day, so that's what I catch. I could set nets and catch two or 3,000, no problem."

Fish in the Valley Fish and Cheese smokehouse. Owner Mike Valley cuts all of the fuel for his all-wood smoker himself.

Fisheries managers agree that the Upper Mississippi River commercial fishery is stable and could support larger harvests. The gear needed is unsophisticated: gill nets, trammel nets, hoop nets and trot lines. And it is common for people to participate in the commercial fishery to supplement other incomes.

Youngsters who, like Ritter, have a penchant for playing in the mud, chasing turtles and catching bluegills, or like Valley, who simply loves being on a boat at dawn, have a career opportunity as a commercial fisher worth considering.

Both Ritter and Valley say that commercial fishing is in their blood. "It has been in my blood since I was a little boy," said Ritter. "The Mississippi River is God's country, that's for sure. If I'm not working, I'm playing on it. I just fish."

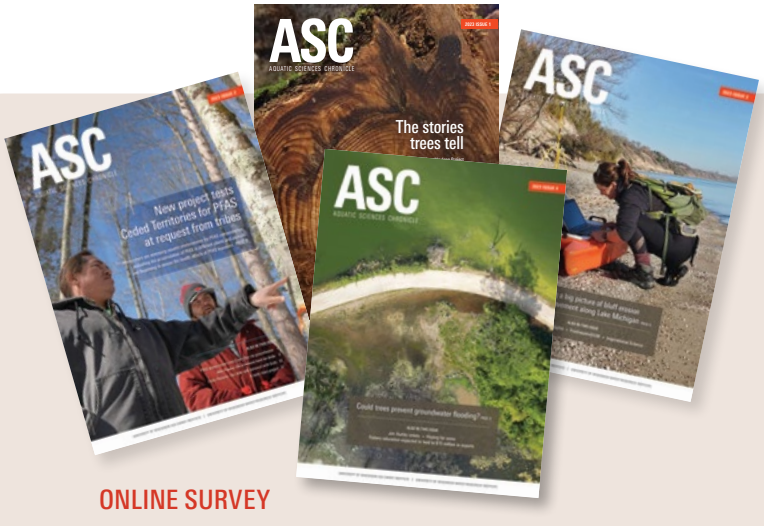
A new fisher will reap the benefits of a less polluted river but also one that is being increasingly used for recreation, including party boats and sports fishing events. Climate change will continue to challenge the commercial fishing industry with variable water levels, flash floods, droughts, heat waves and sedimentation caused by erosion. Invasive species will continue to add to the complications.

Sea Grant's visits with commercial fishers are generating momentum for future workforce development programs. Additionally, the exchange of information with business and rural communities is helping to build a more resilient food-fish industry and supporting the Wisconsin Idea that education should influence people's lives beyond the boundaries of the classroom. ■

WATCH THE VIDEO

A word from Mike Valley, Mississippi River commercial fisherman | Prairie du Chien

Mike Valley, fourth-generation commercial fisher, talks about his shop in Prairie du Chien, Wisconsin. **go.wisc.edu/43yp15**



ONLINE SURVEY

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Please let us know how we can improve the "Chronicle" by filling out a short online survey. **go.wisc.edu/kg6s6b**

Groundwater on the rocks

WRI-funded research will map naturally occurring contaminants in public wells across Wisconsin

By JENNA MERTZ

Pumped from the vast layers of bedrock beneath our feet, groundwater is the source of drinking water for two-thirds of people living in Wisconsin. According to geochemist Matt Ginder-Vogel, what's in that water is largely influenced by what's in the rock.

"Groundwater is not a lake underneath the ground. It's water that's in tiny pore spaces in the rock," said Ginder-Vogel, an associate professor in the UW–Madison Department of Civil and Environmental Engineering. "So, it really interacts with the rocks around it."

Under the right conditions, this interaction can cause naturally occurring or "geogenic" contaminants — like radium, arsenic, uranium and manganese — to leach from bedrock into groundwater.

Matt Ginder-Vogel is researching geogenic contaminants in public wells across Wisconsin.

> Just where geogenic contamination is occurring in the state and how are the questions Ginder-Vogel and his team of graduate students are hoping to answer in new research funded by the University of Wisconsin Water Resources Institute.

Savannah Finley

Juliet Ramey-Lariviere

Savannah Finley and Juliet Ramey-Lariviere are both graduate students working on the project. They're digging through drinking water quality data from the Wisconsin Department of Natural Resources to identify municipal wells with high levels of contaminants. The goal is to provide a snapshot of geogenic contamination across the state so that folks know what's in their water.

"We want to give a health progress report of our overall aquifer and say — here's what we have. Here are the contaminants that we're looking at," said Finley.

She and Ramey-Lariviere are working on a map that will show contaminant hotspots and the underlying bedrock in those locations to determine if there is a relationship between the two.

"The hope is, once we have this data, to lay it all out on top of one another and look at the different bedrock formations and hopefully try to tie in the bedrock formation with the different contaminants that we're seeing," said Finley.

The team is focused on public wells in the Midwestern Cambrian Ordovician Aquifer System, a horseshoe-shaped region that roughly occupies the southern two-thirds of Wisconsin. Once wells are identified, they'll collect both water and rock samples and begin experiments in the lab, which will reveal the amount of contamination leaching from the samples and how fast it's occurring.

"We'll be taking rock sections and grinding them up and looking to see what comes off the rocks," said Ginder-Vogel. "You expose them to water and see what partitions into the water. Then you can manipulate the conditions of water to release other contaminants."

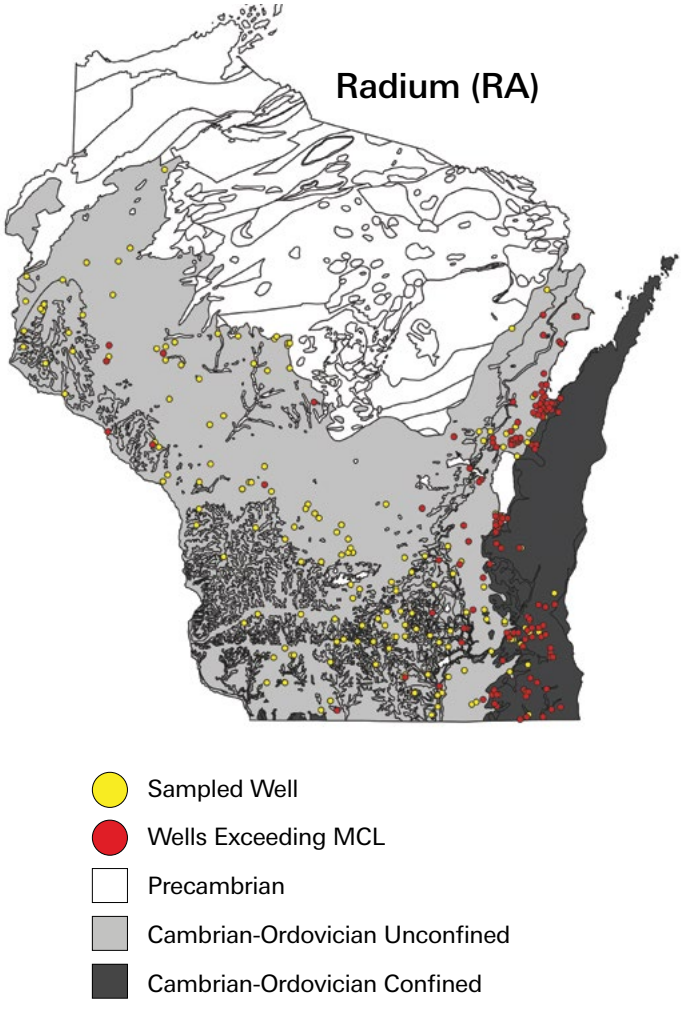
The team will then use these findings to create a model that identifies hotspots around the state prone to geogenic contamination. Ginder-Vogel hopes the model will raise awareness of the problem even if water utilities aren't currently experiencing issues. Concentrations of naturally occurring contaminants can change over time. Take, for example, the city of Waukesha.

"[Waukesha] didn't always have troubles with radium. But when they started pumping more groundwater — and the Chicago suburbs were also pumping more groundwater and were changing the flow path of the water — [Waukesha] started to have more and more trouble with radium," said Ginder-Vogel

"Once you've seen that, you can't help but ask, is it happening with other things, other naturally occurring contaminants like arsenic?"

Ginder-Vogel said increased water use is what's driving the changing concentrations. Pumping more water pulls groundwater through the aquifer in different ways and allows water to interact with bedrock it hadn't before, picking up new contaminants.

> "People who think about groundwater often think about it being this unchanging pool beneath the ground, but with all the water that we use and the way we move water around right now, there's the possibility for lots of change," he said.



A map of Wisconsin showing wells tested for radium and those with drinking water that exceeds the maximum contaminant level (MCL) standard set by the EPA. Wells exceeding MCL are concentrated in eastern Wisconsin. Map provided by Savannah Finley and Juliet Ramey-Lariviere

Unfortunately for water utilities dealing with high levels of geogenic contaminants, the solution isn't an easy or cheap one. Geogenic contaminants don't biodegrade or go away. "They're metals," said Ginder-Vogel. "You can't destroy them and remediate them. You can only move them from one place to another."

One solution is to install treatment systems that remove contaminants from drinking water. It's an expensive option, however, and small municipalities may not have the resources to support such an endeavor. Water utilities may also choose to rebuild a well in such a way that it avoids rock formations with high amounts of contaminants.

Ginder-Vogel's hope is that the team's research helps municipalities develop a plan before geogenic contamination becomes a problem. While they can't change the bedrock, they can be strategic about how they pump water.

Said Ginder-Vogel, "We're trying to be smart about our water resources." ■

2024-26 Sea Grant research projects get underway

By MOIRA HARRINGTON

For Jennifer Hauxwell, Sea Grant's director of research, two opposing things are true: it's good *and* unfortunate there is a wealth of freshwater research talent in Wisconsin.

As of Feb. 1, when 11 new research projects in the 2024-26 cycle officially kicked off, it's the good part that wins out in this equation. There remains the slightest hint of regret, though, that so many high-quality and almost-sure-to-be-impactful projects remained on the table because the more than $2.8 million for two years of funding simply didn't stretch far enough to include them in the portfolio.

"On Wisconsin's campuses, there are numerous innovative researchers," Hauxwell said. "We released a call for Sea Grant funding in fall 2022. From then until now, I've been lucky to have interacted with creative investigators with creative ideas to address coastal and Great Lakes opportunities and challenges. I'm of course pleased we could fund who we have and, naturally, dismayed that we couldn't support others."

What is in the portfolio touches on themes that guide Sea Grant's work. Those are fostering healthy coastal ecosystems, building and sustaining a strong fishery and aquaculture industry, and ensuring resilient communities and economies. Layered into this year's projects were also special callouts to address emerging contaminants like per- and polyfluoroalkyl substances (PFAS); building a more diverse, equitable and just society; and addressing the urgency of climate change.

Researchers from three Universities of Wisconsin campuses — La Crosse, Madison and Milwaukee — are involved in the work. Other participating organizations are the Wisconsin Historical Society, Great Lakes Indian Fish and Wildlife Commission, Mole Lake Sokaogon Chippewa Community, town of Campbell and Wisconsin departments of Health Services and Natural Resources. Along the way, it is anticipated that the projects will provide training and employment for more than 25 students.

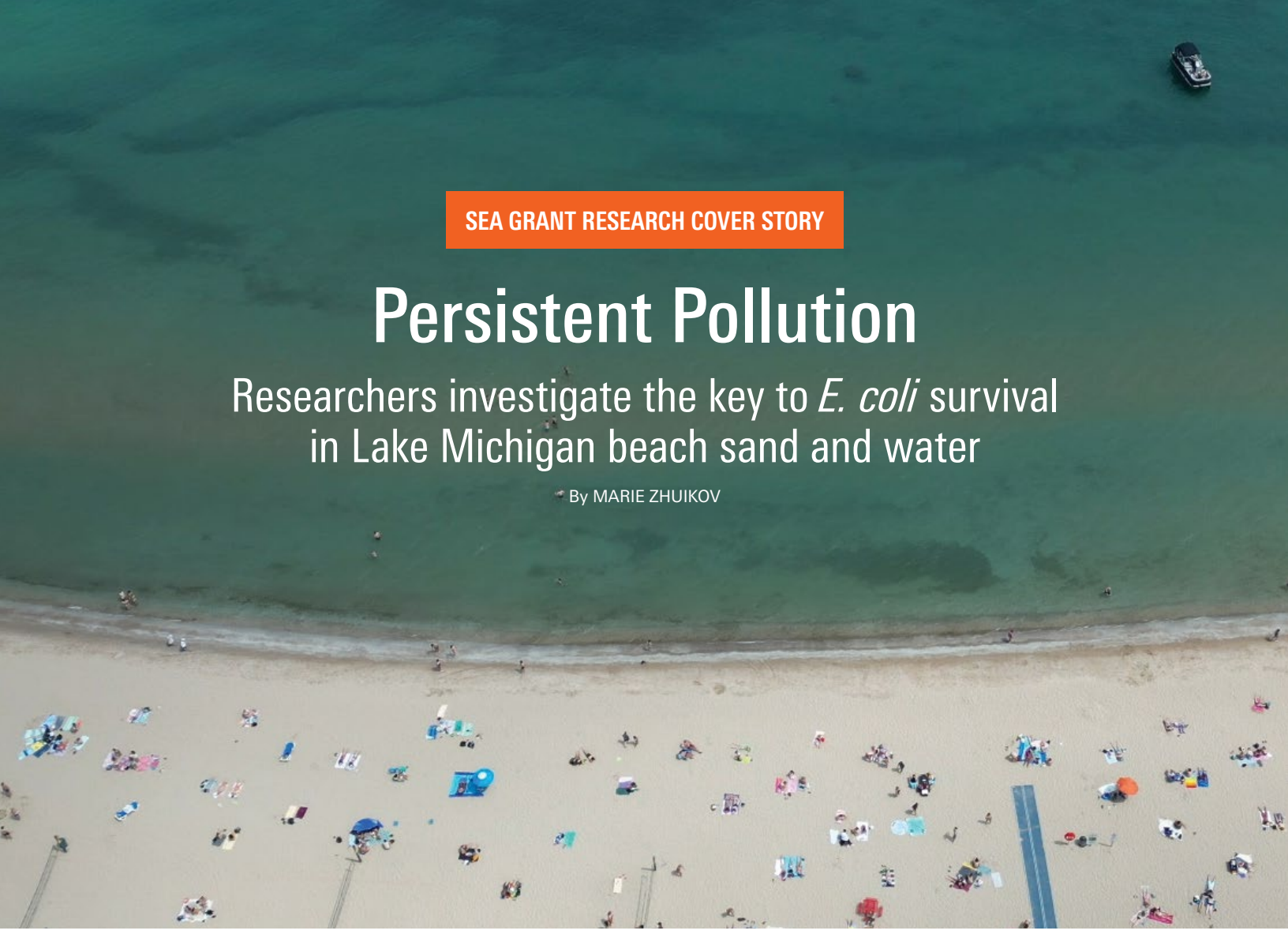
Hauxwell also noted it's rewarding to see that more than half of the projects are being led by investigators who have not previously secured Sea Grant research dollars. It's a welcome development to bring in fresh talent. ■

SEA GRANT RESEARCH COVER STORY

Persistent Pollution

Researchers investigate the key to *E. coli* survival in Lake Michigan beach sand and water

By MARIE ZHUIKOV



Sandra McLellan, professor in the School of Freshwater Sciences at the University of Wisconsin-Milwaukee.

Gyaneshwar Prasad, professor in the School of Freshwater Sciences at the University of Wisconsin-Milwaukee.

Ah, a summer day at the beach: cool water, warm sand and a beverage at hand. Wisconsin's 180 public beaches are some of the state's most-valued assets. They provide recreational opportunities, economic benefits for coastal communities and enhance the quality of life for residents.

Keeping those beaches safe for people to use is a continuing process. Beach managers use levels of *Escherichia coli (E. coli)*, a bacterium from fecal pollution in water, to know when to keep beaches open or closed. It's far from a perfect indicator, however. *E. coli* can come from many sources, not all of it harmful to humans, and it can persist in the environment sometimes for weeks after it was introduced. In fact, sand can contain more *E. coli* than water. This can make a beach manager's job complicated.

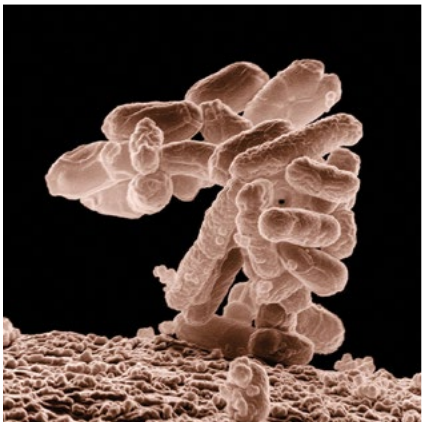
Sea Grant-funded researchers Sandra McLellan and Gyaneshwar Prasad, both with the University of Wisconsin-Milwaukee, are building on previous research to find ways to decomplicate beach managers' lives by determining what factors could limit long-term survival of *E. coli* on beaches.

McLellan, a professor in the School of Freshwater Sciences, explained the pros and cons of *E. coli* as an indicator.

"It's a great indicator because it's so easy for people to culture in the lab. It's easy to count. Where it's not a good indicator is it really doesn't tell you anything about the source of what's there. You don't know where to direct your management strategies. Should I be chasing away the birds or should I be looking for a leaking sewage pipe nearby? And then to top it off, the other downside is the *E. coli* survives outside of a host. There's prolonged survival in the sand and maybe even growth if enough nutrients are available," McLellan said.

Once outside a human or animal gut, *E. coli* usually only lives a couple of days. But under certain circumstances, it can live for weeks or even indefinitely in sand.

With graduate student Sophia Ward's help, McLellan and Prasad are studying sand and water at six Lake Michigan beaches: two in Kenosha County, two in Manitowoc County and two in Milwaukee County.



Top left: Mariella Boudreau collected samples over summer 2023 as an undergraduate researcher on Sophia Ward's project. Image by Daniel Wroblewski

Top right: Microcosms containing *E. coli* samples were buried in sand for six weeks at several beaches in a related project by McLellan. Image by Natalie Rumball

Left: Low-temperature electron micrograph of a cluster of *E. coli* bacteria, magnified 10,000 times. Image by the Agricultural Research Service of the United States Department of Agriculture

Right: Sand. Image by Wisconsin Sea Grant

Opposite: Bradford Beach, Milwaukee's largest public beach, became the country's first fully accessible beach in 2020. Image by Wisconsin Sea Grant

McLellan thinks this array of beaches will provide good representation of what goes on around the Lake Michigan shoreline.

They are also testing for levels of nutrients such as carbon, nitrogen, phosphorus and iron. In addition, they are conducting laboratory experiments to "starve" long-lived *E. coli* of these nutrients to see what drives their survival.

For the lab experiments, *E. coli* is mixed with sand and packed into small microcosms (miniature environments). McLellan describes them as four-inch diameter PVC pipes cut into four-inch sections. "We bury them in a bed of sand and keep them nice and moist. This helps us mimic what happens at the beach. The water can pass through, but the *E. coli* can't escape from those little microcosms."

The *E. coli* contain an extra piece of DNA that has a green fluorescent protein engineered in such a way that when the cell is starved, it lights up. The researchers then feed them with water containing varying amounts carbon, nitrogen, phosphorus and iron. They remove the microcosms periodically and count the *E. coli* to see how many have survived and see if any display the fluorescent-green markers of starvation.

From preliminary experiments, McLellan suspects carbon might be the most important factor that allows *E. coli* to persist. In beach environments, carbon is often provided by decaying plant life, especially leaves and the nuisance algae, Cladophora.

Once this limiting factor is confirmed, McLellan and her team will develop a scorecard for the potential of long-term *E. coli* reservoirs for each beach. "By scoring how easily or how much *E. coli* is growing in the sand at these beaches, it can help beach managers direct their attention to what might be some probable sources at their beaches," McLellan said. They are also taking nutrient levels into account.

"The scorecard is developing. I think once we understand the dynamic range of what these beaches look like, then we'll have a better idea of what the scorecard will actually look like," she added. The information will also be useful to the Wisconsin Department of Natural Resources, which heads the Wisconsin beach monitoring program. ■

WATCH THE VIDEO

Freshwater Research Helps Keep Beaches Safe

Video by Daniel Wroblewski, University of Wisconsin-Milwaukee, School of Freshwater Sciences

go.wisc.edu/b4btd2

Water librarian wins WLA award

By MOIRA HARRINGTON

In October, Anne Moser accepted the 2023 Wisconsin Library Association (WLA) President's Volunteer Award.

> "I am truly humbled to receive this award from the Wisconsin Library Association, and I share it with all the other dedicated librarians that contribute their time and passion to making WLA such a great organization," Moser said.

Moser is the senior special librarian for the Wisconsin Water Library (**waterlibrary.aqua.wisc.edu**) supported by Sea Grant and the Water Resources Institute. The Water Library holds a collection of more than 30,000 materials related to rivers, lakes, oceans and groundwater.

In addition, Moser engages in extensive outreach activities with a focus on science, technology, engineering, art and math as a librarian as well as the Sea Grant education coordinator.

In announcing the award, the WLA referred to Moser as "well known and well-loved among public librarians all around Wisconsin, and their patrons, for the cheerful, fun and educational programs she presents on STEM and water-related topics." This reflects her tireless travels across the state to bring programming to places as far-flung as the northwestern community of Deer Park (population 249), to Beloit in southern Wisconsin, then east to cities and towns along Lake Michigan.

For her part, Moser credits the organization that is honoring her: "As a solo librarian, I have relied on WLA and other professional organizations for support, mentorship and friendship during my career. I encourage all new professionals to get involved!"

Moser herself supports new professionals through her work. Every year, she hosts a student from the University of Wisconsin–Madison. In turn, she draws out skills from those students, including their contributions to one of Moser's favorite projects — Maadagindan! Start Reading! (**go.wisc.edu/maadagindan**) It's a book club about children's literature written by Native authors, focused on Ojibwe culture and the Great Lakes. Educators, librarians and parents — in fact, all — are welcome to attend and discuss the book and learn from an invited honored Indigenous guest during these monthly virtual meetings. The club is a collaboration with the Great Lakes Indian Fish and Wildlife Commission and supported by a grant from the Great Lakes Restoration Initiative.

The WLA cited Moser's skill at linking science and art. She brought exhibits of student underwater photography to libraries. Working with the Thelma Sadoff Center for the Arts in Fond du Lac to celebrate the culture surrounding lake sturgeon, Moser led the effort to install "Ancient Survivors." She partnered with the Chazen Museum of Art in Madison on programming to raise awareness about marine debris and plastic pollution.

Moser is a member of the Association of Wisconsin Special Libraries, a division of WLA, and is currently serving as past chair of the group. She has also served on the WLA Board of Directors and chaired the board's professional development committee. ■

WISCONSIN WATER LIBRARY

New Year, New Books

One of the greatest pleasures of working in a library is opening up boxes filled with new books for the collection. This is just a smattering of new titles the library received in late 2023. Be sure to open up a browser and search the UW Libraries catalog to see more. **library.wisc.edu**

Anyone in Wisconsin can borrow these books. Just email askwater@aqua.wisc.edu.

The Chicago River: A Natural and Unnatural History by Libby Hill. Carbondale, Ill: Southern Illinois University Press, 2019.

Exploring Science Through Young Adult Literature, edited by Paula Greathouse, Melanie Hundley and Stephanie Wendt. Lanham, Md.: Rowman & Littlefield; 2023.

Ganawenindiwag: Working With Plant Relatives to Heal and Protect Gichigami Shorelines by the Great Lakes Indian Fish & Wildlife Commission, et al. [n.p.: GLIFWC, n.d.] Also available for download: **glifwc.org/climatechange/ganawenindiwag**.

Lessons From Turtle Island: Native Curriculum in Early Childhood Classrooms by Guy W. Jones. St. Paul, Minn.: Redleaf Press, 2002.

Uncovering Great Lakes Shipwrecks by Kathryn Wesgate. New York: Enslow Publishing, 2023.

Wastewater-Based Disease Surveillance for Public Health Action by U.S. National Academies of Sciences, Engineering, and Medicine (U.S.). Committee on Community Wastewater-based Infectious Disease Surveillance. Washington, D.C.:National Academies Press, 2023.

Water: How We Can Protect Our Freshwater by Catherine Barr. Somerville, Mass.: Candlewick Press, 2023.

Water Beings: From Nature Worship to the Environmental Crisis by Veronica Strang. London: Reaktion Books Ltd., 2023.

Plastics learning kit educates and enthralls

By MARIE ZHUIKOV

When Anne Moser began her librarian career in Seattle in the early 1990s, one of her first experiences was a tour of the city's wastewater treatment plant.

"It made a big impression on me, watching their operations and what great, amazing miracles can happen there. Wastewater enters the plant, is treated and is clean enough to discharge into Puget Sound. Creating this kit feels like I've come full circle in my career," Moser said.

Wisconsin Sea Grant's senior special librarian and education coordinator has now learned enough about wastewater treatment to create "Plastic Panic" (**go.wisc.edu/plasticpanic**), a grab-and-go teaching kit that formal and nonformal educators can use to teach about plastic pollution in the Great Lakes, specifically, microplastics.

Unlike larger plastic containers and pieces, microplastics (particles 5 millimeters and smaller) are too small for wastewater treatment plants to filter. What goes into the plant comes right back out into the environment. Fish and other animals can mistake microplastics for food. A belly full of plastic can make them feel full without providing any nutrients. In addition, heavy metals and other pollutants tend to stick to plastics. These can harm animals that eat the plastic, and the pollutants can work their way up the food chain this way.

The kit got its start after a plastic awareness-raising exhibition at the University of Wisconsin–Madison's Chazen Museum of Art in 2019 called "Plastic Entanglements" (**go.wisc.edu/1451sz**). That led to a prototype learning kit, which was updated in 2023. Information in "Plastic Panic" is based on research by Derek Ho, biological systems engineering Ph.D. student under Troy Runge, UW–Madison. Artwork is by Chelsea Mamott, Wisconsin Energy Institute digital media specialist.

Although the curriculum is designed for fourth- to fifth-graders, Moser said the kit has wide appeal.

"When we presented it at the Chazen, we saw it caught visitors' attention — from the littlest learners, maybe four or five years old, all the way up to the parents and grandparents. The tabletop's eye-catching, so many people came over to look at it. We also learned that many people don't know much about what happens to the wastewater leaving their house. The activity demystifies this weird building that treats wastewater," Moser said.

Colorful artwork and colorful plastics engage and teach

"We have included a sample jar that has different types and sizes of plastics," Moser said. "You get different densities, different weights, so they can experience the way plastic behaves in water. Some of it sinks, some of it floats, some stays in the middle. You get to filter and sanitize the sample, then look at what is ultimately discharged into our water bodies. So, it's kind of high-level thinking that kids get to enjoy without even realizing it."

Moser said the kit is "grab-and-go" for educators. "It comes with a guide that has clear instructions so they will be able to present the activity right out of the box." It also provides questions to ask students, background information for educators and worksheets for classroom use. "So, hopefully, they can just grab it and do it."

Content is aligned with Sea Grant's Great Lakes Literacy Principles but not yet aligned to specific state educational standards.

With the help of Great Lakes Restoration Initiative funding, 23 kits were produced by Sea Grant's Center for Great Lakes Literacy and distributed to Sea Grant programs around the Great Lakes Basin. Five are available free of charge in Wisconsin, and the kit is shipped via UPS. ■

Above: The Plastic Panic Kit is a colorful way to teach about the impacts of Great Lakes plastic pollution. Image by Chris Hynes Photography

Below: A young scientist works through the water treatment process. Image by Eric Baillie

Bottom left: The kit contains everything educators need for the activity in one container and fits on a standard tabletop. Image by Chris Hynes Photography

To order "Plastic Panic," visit the website at **go.wisc.edu/plasticpanic**.

Keillor Fellow, reviewing resilience of coastal wetlands

By MOIRA HARRINGTON

Mike Smale is assessing 38 wetlands in the Wisconsin part of the Lake Superior watershed to see what vulnerable plant and animal species are present.

If Mike Smale were king of the world for a day, he might just decree that all city buses in Madison, Wisconsin, be outfitted with front racks to hold kayaks, in addition to bikes they hold now. That way, a person could stow their kayak, climb onto the bus, ride to a nearby body of water, remove the kayak and have a paddle. This would be the convergence of two things Smale is passionate about – embracing mass transit to reduce emissions and enjoying water.

"I'm kind of a nerd in that way (supporting eco-friendly trains and buses) on top of being a water nerd," Smale said.

While filling the role of the J. Philip Keillor Great Lakes — Wisconsin Sea Grant Fellow focused on climate change and coastal wetlands, Smale may not really don the royal mantle and order what's affixed to buses, but he can embrace his love of water. He took on the 18-month fellowship based at the Wisconsin Department of Natural Resources (DNR) in Madison in mid-June and has a dual-focused appointment.

First, he is tackling what he calls "oddball" tasks, such as collaborating with people in the DNR's Drinking Water and Groundwater Program, attending conferences and assisting with Sea Grant's review process to determine a biennial research package. His second focus is assessing how climate change is affecting 38 wetlands in the Wisconsin portion of the Lake Superior watershed.

Smale said, "We are coming up with methods for a framework to evaluate the climate sensitivity of these wetlands. That involves finding out what data is available, working with experts to establish those methods, and how that framework could be representative of true climate sensitivity. And then some mapping (of the wetlands)." The end point will be a scoring table for the sites.

Smale is looking through the lens of four shifts expected to affect wetlands under a changing climate as identified by the 2021 Wisconsin Initiative on Climate Change Report: **wicci.wisc.edu/2021-assessment-report/**

- Warmer temperatures
- Increased precipitation
- Lake level fluctuations
- Increased lake wind and wave action

Those shifts are being incorporated into a whole-picture analysis of a wetland. Smale elaborated, "Based on communities that are present (in a wetland), we can estimate which wetlands are more or less likely to shift — which wetlands are going to change the most. We're starting with vegetation, and we are going to move into looking at the climate sensitivity of fish habitat and birds, and also culturally important beings."

With that data in hand, Smale and his team will next determine how those components or communities will translate, or not translate, into adaptive capacity. He said, "We're asking, 'How well could these wetlands, even though they're sensitive, how well could they cope with the change in climate?'"

Smale's work can also inform assessments throughout the Great Lakes Basin because one source of data is the Coastal Wetland Monitoring Data Program, which includes insights about the region's fish, frog, bird, macroinvertebrate and vegetation populations, along with water quality. The program is based at Central Michigan University and is supported by contributions from binational governmental agencies, universities and a private business.

"We're building the framework (in Wisconsin) to, at a very minimum, work with that dataset so it could be extrapolated to all the Great Lakes. We're finding ways where we could include state data or from other sources to fill out gaps or make it a little bit more robust, more applicable, but other states could also use this data, tweak it to their own framework using their own data sources," said Smale.

Speaking of tweaks, Smale said he's so far encountered one in his own fellowship. "When I first started this position, it really seemed like I jumped into Sophie's (his predecessor in the fellowship, Sophie LaFond Hudson) work. I thought 'Oh, wow, this is halfway done. What am I going to be doing?'"

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Keillor Fellow helps Great Lakes communities plan for coastal hazards

By JENNA MERTZ

Helena Tiedmann's interest in the Great Lakes began with a new city and a book. Tiedmann, who grew up on a small family farm in Connecticut, moved to Milwaukee after graduating from Beloit College with a degree in environmental geology and political science. It was there she became enamored with the big lake in her backyard.

"I just really fell in love with Lake Michigan and loved being there," said Tiedmann. "It was during that time that I read 'The Death and Life of the Great Lakes' by Dan Egan, and that opened my eyes to what an incredible and complicated history this resource has."

Now the J. Philip Keillor Wisconsin Coastal Management — Wisconsin Sea Grant Fellow, Tiedmann, who has a Ph.D. in civil engineering, works at the intersection of science and policy to help Great Lakes communities build their resilience to coastal hazards like bluff erosion, flooding and changing water levels. Her main project is updating the "Coastal Processes Manual" — a publication about the risk that storms and other coastal hazards pose to shoreline communities. **go.wisc.edu/4d66rr**

"I'm taking the lead on one of the remaining chapters, which is about resilience planning and strategies," she said. "I'm really excited because that's right in my wheelhouse."

Tiedmann's background is in water systems, specifically how they respond to natural disasters or unexpected crises. She experienced two of them while a graduate student at the University of Texas at Austin: the COVID-19 pandemic and Winter Storm Uri, which resulted in deadly power blackouts during some of the coldest temperatures the region has ever seen.

Tiedmann ended up studying both events. Her master's thesis explored how water systems responded to the pandemic, and her dissertation, Winter Storm Uri. While Texas doesn't have Great Lakes, she's finding that what she learned during her graduate work can be applied to coastal environments in Wisconsin.

"A big part of my work that can be transferred here is looking at building resilience through a multidimensional approach," she said. That means evaluating problems and solutions through multiple lenses and taking both infrastructure and economic, environmental, governance and social systems into account.

The fellowship is also giving Tiedmann an opportunity to work outside her wheelhouse and learn new things, like the "nitty, gritty details of coastal processes."

"I've been really, really enjoying it because it's a new set of problems to learn about," she said.

One example is low water levels in the Great Lakes, which present a unique set of challenges.

"When the water levels are low, we often collectively forget that they will likely come back up again. So, there can be a temptation to build closer to the water," which can cause future problems, said Tiedmann. Low water levels can also accelerate rotting of wooden docks and expose drinking water intakes.

If she has a question, Tiedmann can turn to an experienced team of mentors that includes Kate Angel and Todd Breiby of the Wisconsin Coastal Management Program and Wisconsin Sea Grant's Coastal Engineering Outreach Specialist Adam Bechle. Bechle himself is a former Keillor fellow, as are two of Tiedmann's colleagues in the coastal management office — Lydia Salus and Hannah Paulson.

"We have kind of like, a Keillor club," laughs Tiedmann. The small-but-mighty coastal planning community is one reason she feels energized about her work.

"Seeing what a vibrant, tight-knit community of people there [is] working to make life along the Great Lakes better — that's super exciting to me." ■

Helena Tiedmann is taking the lead on a chapter on resilience planning and strategies in the upcoming revised edition of the "Coastal Processes Manual."

Tiedmann holds up a topographical map and discusses bluff erosion at Schafer Beach in Superior, Wisconsin. Image by Wisconsin Sea Grant

Variable fellowship brings learning and results for all involved

By MOIRA HARRINGTON

Sarah Gravlee, 2023 Water Science Policy Fellow, has been working with the Department of Health Services on a variety of water-related issues.

In the roughly 10 months she has been the 2023 Water Science Policy Fellow, Sarah Gravlee's throughline has been science, in many forms. It's been her head-down task to complete a literature review of the hurdles facing public water systems. Gravlee's been checking for lead water-service lines to a location where someone has applied for day care certification. She's been fielding phone calls from people across Wisconsin with questions about contaminants in their private wells. There was also the meth house.

"I joined one of our toxicologists in the field a few months ago," Gravlee said. "We went to a home where someone used to smoke meth. We tested it to ensure it was safe for children to resume living there. It passed with flying colors. Well, not flying colors. There was a negligible amount of residue detected. We used a test similar to a PCR test (a DNA polymerase chain reaction test). We wiped windowsills down and mixed these samples with a chemical solution. The solution was dropped on a tester that uses color indication to quantify the meth levels."

Gravlee's two-year fellowship is supported by the Wisconsin Department of Health Services (DHS) and the University of Wisconsin Water Resources Institute (WRI). Her indisputably wide range of tasks is precisely the intention of the sponsoring organizations.

Jennifer Hauxwell, WRI associate director and a co-mentor for Gravlee, noted the initial call for applicants stated that the fellow would capitalize on many opportunities to help communities facing hazardous conditions.

The mentor team is rounded out by Roy Irving and Sarah Yang at DHS and Environmental Health Capacity Evaluator Jacquie Cronin, also at DHS. This fellowship/co-mentoring model, Hauxwell said, serves the interests of all three participants — the university, agency and fellow.

The university, through WRI, contributes to workforce development — training the next generation of scientists to do community-engaged science. Then, "Agencies make progress on a water challenge for the people of Wisconsin and attract talent for a project, and potentially longer-term positions." Hauxwell continued, "Fellows apply technical skills to real-world problems, learn how to engage partners and communities and are invited to step outside of a comfort zone."

For Gravlee's part, she's ticking the boxes Hauxwell described. "I like working at the intersection between water and public health. I've enjoyed fielding questions from the public about water contaminants, sitting in on meetings about newly identified water contamination, and assisting in projects focused on reducing Wisconsin's environmental health hazards. I've learned a lot about how DHS functions and collaborates with its partners, including the DNR, DATCP (Department of Agriculture, Trade and Consumer Protection), UW–Madison Extension and local health departments."

She also offered: "I know the DHS fellowship is a little different than other fellowships that are focused on a singular project. I love that I have a variety of tasks, so every day is different. DHS has been great about providing professional development opportunities and involving me in work that is in line with my interests."

As for longer-term positions that could result from a fellowship, Gravlee isn't yet sure of her future direction. "I never pictured myself working in public health before this fellowship, but I think it's been a good fit. I could see myself continuing environmental health work or transitioning to work focused specifically on contaminated water resources."

In the meantime, she's soaking up the experience and providing solid contributions to, for example, implementing a wide-ranging Centers for Disease Control and Prevention grant on building environmental health capacity. According to the DHS, 83% of community water systems in the state serve small populations, 3,330 or fewer people. Through a mini-grant program on which Gravlee works, local public health departments and tribal health agencies are getting assistance to address health hazards such as high nitrate levels, flooding and contaminants.

Based on that grant, Gravlee has been preparing for a conference presentation in March. It will focus on her and Cronin's environmental health capacity support for local health departments investigating and resolving water-related issues. The pair is refining a presentation they previously delivered at a statewide conference in fall 2023. ■

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Smale said through the fellowship he has "learned that I like these actionable positions where you're doing something that is having a visible effect on people's lives."

Keillor Fellow, reviewing resilience of coastal wetlands

As he dug deeper, though, Smale realized he should adjust LaFond Hudson's work in the aquatic invasive species (AIS) category — to view AIS as an indicator of stress in a wetland not as a community on par with, say, the state of fish and frogs. For example, if nonnative cattails are present, the wetland is near a tipping point toward a monoculture that should be reflected in an individual wetland's resiliency score.

Adjusting that part of the framework "felt like I was regressing back in the project," he said. "Here, I thought I was halfway done and actually I'm back working on the basics of the project. But after talking it through with Cherie Hagen, who's my supervisor at the DNR, she's like, 'Oh no, this is exactly what you should be doing. You're building it up more. You're incorporating exactly the feedback you're supposed to.'"

In light of this, Smale said, "I guess I was surprised at how much more influence I would have on this project and also kind of the depth that we are working on."

In addition to the DNR's Hagen, the Lake Superior basin supervisor in the Office of Great Waters, Smale is also mentored by Madeline Magee, monitoring and beach coordinator in that same DNR office; Sea Grant's Associate Director Jennifer Hauxwell; and Titus Seilheimer, Sea Grant's fisheries outreach specialist. ■

Lights, camera, awards

By MOIRA HARRINGTON

In late fall, Bonnie Willison, who produces videos and podcast series for both Sea Grant and the University of Wisconsin Water Resources Institute (WRI), won awards for two videos.

The first production award went to "What Accelerates Harmful Algal Blooms in the Great Lakes," spotlighting research being done at the University of Wisconsin-Milwaukee and funded by Sea Grant. The second was one of only two judge's choice awards in the competition. It went to "Testing Maple Sap, Fish and Wild Rice for PFAS," funded through a national competition of the National Water Resources Institutes and administered through WRI.

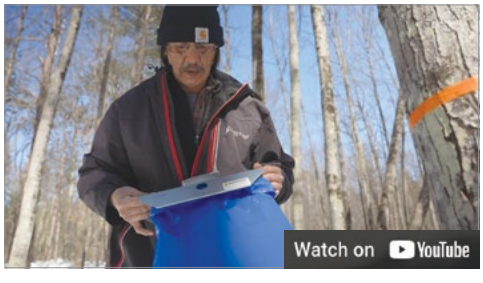
The judge, a video professional based in Philadelphia, said, "This video inspires curiosity, learning and action in our communities. The project is impressively high quality for a one-person production. The story is meaningful, the footage is compelling and the strategic decisions in post (production) strengthen it, including utilizing music and SFX (sound effects). Little details in this project immerse viewers deeply into the story and place, and make it feel like a higher-tier production. The creator elevated the voice of Indigenous community members in the telling of this place-based story. To lead with thought like this is to set an example for all of us, regardless of our client or category. Great job!"

Willison said, "I am honored to be recognized for these two videos, and I'm proud of the work I create about Great Lakes science and stories."

The competition was sponsored by an organization called Madison Media Professionals. ■

WATCH THE VIDEOS

What Accelerates Harmful Algal Blooms in the Great Lakes?
go.wisc.edu/2y4qiu



Testing Maple Sap, Fish and Wild Rice for PFAS
go.wisc.edu/vjfwmc

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a joint newsletter from UW Sea Grant and Water Resources Institutes

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Support water research, outreach and education this spring.

The two-day campaign, which lasts precisely 1,848 minutes to honor the year of the university's founding, invites alumni, students and friends of the university to donate to the programs of their choice. This year, we hope you'll choose Wisconsin Sea Grant and the Water Resources Institute.

Wisconsin is a state rich with water, but those waters face many challenges. To find solutions, Wisconsin Sea Grant and the Water Resources Institute are funding research on water quality and emerging contaminants like PFAS, helping coastal communities plan around flooding and bluff erosion, and inspiring the next generation of water professionals through paid, hands-on internship and fellowship opportunities.

If you believe in our mission, we welcome you to participate. Your gift helps us continue our ambitious and impactful research, outreach and educational efforts that — in keeping with the Wisconsin Idea — benefit the state as a whole. ■

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