2021 issue 1

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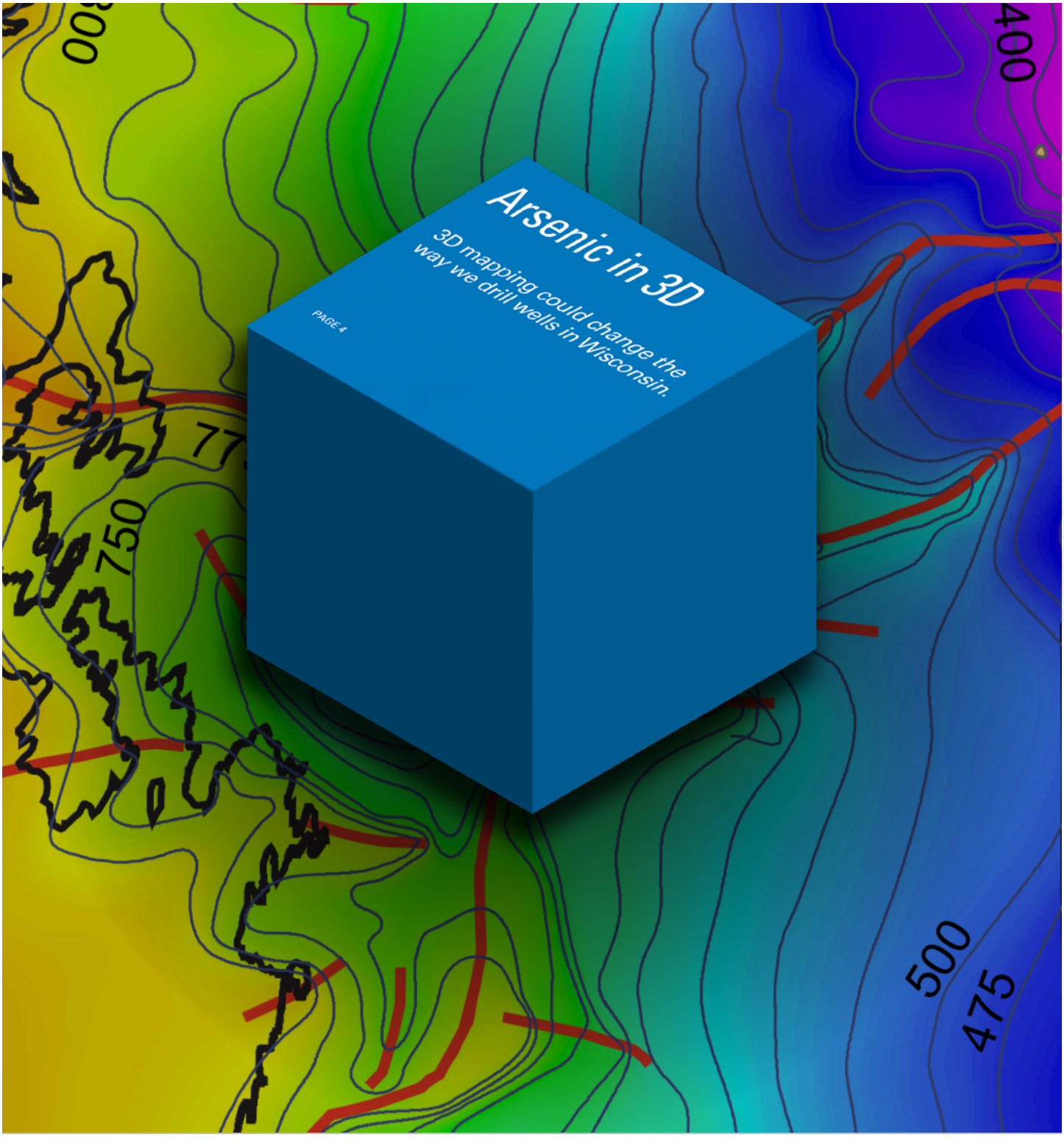
AQUATIC SCIENCES CHRONICLE



UNIVERSITY OF WISCONSIN SEA GRANT INSTITUTE | UNIVERSITY OF WISCONSIN WATER RESOURCES INSTITUTE

Aquatic Sciences Chronicle

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The University of Wisconsin Sea Grant Institute is part of a national network of 34 university-based programs funded through the National Sea Grant College Program, National Oceanic & Atmospheric Administration, U.S. Department of Commerce, and through matching contributions from participating states and the private sector.

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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Bonnie Willison /Wisconsin Sea Grant

Ciscoes Past and Present Offer Clues to Future

youtu.be/SaVib4GDg8M

In a new video, Sea Grant illuminates the varied coregonines, commonly known as cisco, which have pulsed through Great Lakes waters for 12,000 years. Now, due to human influences, the fork-tailed fish are diminished in number and range, and display less diverse forms. They are the subject of a research project by a team at the University of Wisconsin-Madison.

"The ciscoes were some of the most numerous and populous fish in the Great Lakes," said Ben Martin, Ph.D. student working with lead researcher Jake Vander Zanden, who is the chair and director of the Center for Limnology.

To learn the future of the species, Vander Zanden is looking toward the past — exploring the fish found in dozens and dozens of jars housed at the University of Wisconsin Zoological Museum on the Madison campus.

"We go to these museum specimens. We take a tiny tissue sample. We take these chemical measurements, and we make these inferences about the diet and feeding of these species," Vander Zanden said.

These fish that have been lifeless for 100 years will now breathe new life into an understanding of that past food web. Beyond analysis based on archived fish, many from a collection at the University of Michigan in addition to the UW-Madison ones, Martin is assessing modern-day cisco physical diversity.

Sea Grant Videographer Bonnie Willison was happy to play a part in that understanding. "I was very intrigued by the problem of studying fish that don't exist in the lakes anymore."

Martin and Vander Zanden stressed the value of collaboration on this project and expressed appreciation for colleagues at the U.S. Geological Survey, Great Lakes Fisheries Commission, University of Wyoming and U.S. Fish and Wildlife Service. — MH

Every Person Is a Decision Maker

RETIRED WATER QUALITY SPECIALIST VICKY HARRIS REFLECTS ON 50 YEARS WITH SEA GRANT

Vicky Harris has always loved biology — at least since 5th grade — and she's an eternal optimist. Now retired from her position as Wisconsin Sea Grant's water quality specialist in Green Bay, Harris reflects on her 50-year on-again off-again relationship with Sea Grant, and ponders the fate of the entire planet.

Harris' relationship with Sea Grant started with a college class in oceanography taught by Professor John Pezzetta at the University of Wisconsin-Green Bay. She had transferred from UW-Madison as a premed student after the student protests against the Vietnam War had closed the UW campus and the Sterling Hall bombing raised doubts about the next semester. Pezzetta had Sea Grant-funded research on the sediments surrounding two nuclear power plant water intakes near Two Rivers and Kewaunee and needed a research assistant to collect samples and analyze them back in the lab. Harris enjoyed the experience and continued to work with Pezzetta as he moved on to another project studying sediments around the coal-fired power plant in Green Bay. As a graduate student, she worked with the U.S. Fish and Wildlife Service studying Green Bay waterfowl and macroinvertebrate populations and reviewing wetland permits.

In 1978, Sea Grant created a position for a field agent in Green Bay, and Harris was ready.

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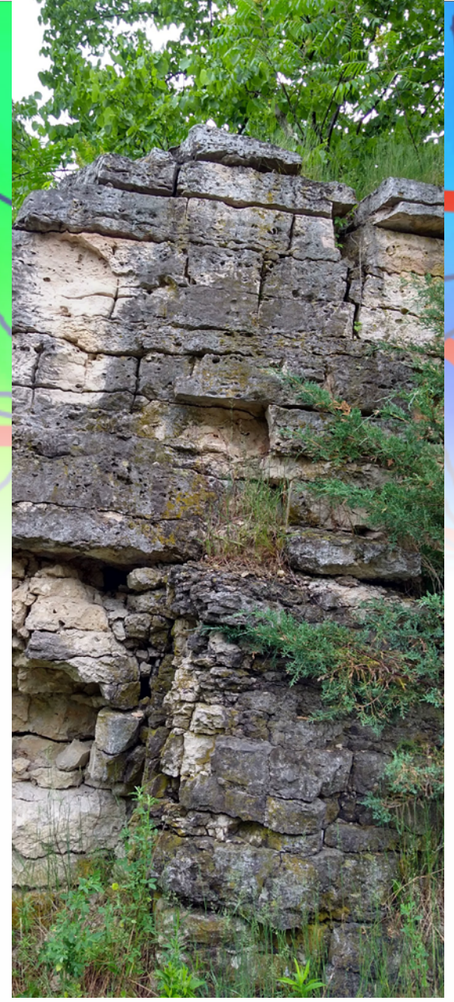
Narayan Mahon

Harris front and center of the Cat Island Restoration project in 2012.



Arsenic in 3-D

RESEARCHERS ASSESS RISK FOR EASTERN WISCONSIN GROUNDWATER WELLS

This map, and the one on the cover, illustrates the location of the Paleozoic folds — in red — superimposed over an aeromagnetic anomaly map, which reflects Precambrian geology.

Low levels of arsenic have been detected in nearly half of the wells in Fond du Lac and Dodge counties in east central Wisconsin.

Arsenic is a naturally occurring toxin. It's been found in every county in Wisconsin and is released from both bedrock and glacial sources. Long-term exposure to high levels of arsenic in drinking water is known to increase risks of skin, bladder, lung, liver, colon and kidney cancer. Arsenic gets dissolved into well water when the rock minerals are exposed to oxygen. This can happen when air in a well shaft breaks down minerals such as sulfides, or even from microbe communities within the shaft (or borehole), which can change water chemistry enough to release arsenic from other sources.

A research project funded by the University of Wisconsin Water Resources Institute is attempting to understand why arsenic is an issue in wells in Fond du Lac and Dodge counties and improve the probability of identifying where arsenic is likely to be a problem for new wells drilled in those counties.

Geologist Eric Stewart is leading the team from the Wisconsin Geological and Natural History Survey that is conducting the one-year project, which began in 2020. They are using 3-D mapping to detect subtle folds in the bedrock surface that could contribute to the chemical reactions that release arsenic into groundwater. They already have some findings.

"What we've been learning is that it's a switch in the bedrock host of arsenic from sulfide minerals to iron hydroxide minerals," said Stewart. "The fractured rock associated with the folds are creating conditions where the rocks are oxidizing a bit deeper beneath the bedrock surface. Now you have arsenic adsorbed on the surfaces of iron hydroxides rather than within sulfides and that might contribute to an increased probability of it being released."

Stewart said past studies have suggested microbial life inside well boreholes may create conditions that make the iron hydroxides unstable, which releases the arsenic. Another variable is the difference between the well casing depth and the depth of the bedrock.

"If the well is open to the top of the bedrock surface, those rocks tend to be more oxidized than deeper down. So, you'd be drawing more water from oxidized rock. If you case the well really deep and the difference is large — if you case it 300 feet down from the bedrock surface, then the rocks probably aren't going to be oxidized. Both the fracturing from folding and how the well's constructed seem to be influencing whether the well is drawing water from oxidized rock, and that influences the probability of arsenic being released," Stewart said.

Results of the mapping project could be used to help determine good places for new wells in the two counties.

"The model can provide probabilities for detecting arsenic over our cutoff value, which is 2 micrograms per liter," Stewart said. "Its probabilities are based on location, local geology and well construction practices. That's the kind of information we could provide to well-drillers." —MEZ

Left to right: Geologist Eric Stewart.

Large vertical fractures tend to form in the vicinity of mapped bedrock folds. In Dodge and Fond du Lac counties, researchers think these large vertical fractures cause deeper oxidation fronts to develop, which changes the arsenic detection probability.

An outcrop example of Silurian dolostone from eastern Dodge County.

Core photo showing abundant sulfide mineralization in the Elk Mound Group in Dodge County.

wisconsinwaterlibrary

Spring Outside

As we anticipate Wisconsin's spring thaw, the outdoors and our watery places beckon. For both kids and adults there is a strong urge to get outside and play. This urge also inspires narratives from writers out exploring our world on foot, in canoes, on bicycles, in their backyards, from their tents and sometimes from conversations with strangers they meet along the way.

Along Wisconsin's Ice Age Trail By Bart Smith. Madison, Wis.: University of Wisconsin Press, 2008.

Crossing the Driftless: A Canoe Trip through a Midwestern Landscape By Lynne Smith Diebel and illustrated by Robert Diebel. Madison, Wis.: Terrace Books, an imprint of the University of Wisconsin Press, 2015.

Chippewa: Biography of a Wisconsin Waterway By Richard D. Cornell. Madison, Wis.: Wisconsin Historical Society Press, 2017.

The Great Lakes at Ten Miles an Hour: One Cyclist's Journey Along the Shores of the Inland Seas By Thomas C. Shevory. Minneapolis: University of Minnesota Press, 2017.

Great Lakes Journey: A New Look at America's Freshwater Coast By William Ashworth. Detroit: Wayne State University Press, 2000.

The Mississippi: A Visual Biography By Quinta Scott. Columbia: University of Missouri Press, 2010.

Naked in the Stream: Isle Royale Stories By Vic Foerster. Traverse City, Mich.: Arbutus Press, 2010.

A 1,000-Mile Great Lakes Walk: One Woman's Trek Along the Shorelines of all Five Great Lakes By Loreen Niewenhuis. Milwaukee: Crickhollow Books, 2013.

Walking Home Ground: In the Footsteps of Muir, Leopold, and Derleth By Robert L. Root. Madison, Wis.: Wisconsin Historical Society Press, 2017.

Please visit the Wisconsin Water Library's blog to see more titles on this topic. go.wisc.edu/m5d755

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

Science Signaling Service

Over a two-year period, Sea Grant staff serves coastal stakeholders in one-on-one circumscribed ways — perhaps providing advice on how to protect property from Lake Superior waters or sharing ways to enhance production at an aquaculture business.

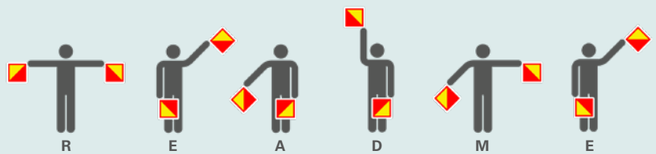
There are also more long-term and in-depth projects like an effort to address coastal erosion near the Kenosha Dunes Natural Area where Titus Seilheimer, fisheries specialist, and Coastal Engineer Adam Bechle are teaming up with numerous academic and state agency partners to install underwater sills in Lake Michigan that will break up wave action on the shore while also providing fish habitat.

Or there are the Sea Grant contributions to the restoration and ongoing maintenance of the Cat Island chain of restored lands. The three islands are being rebuilt using dredged material from the shipping lanes of Green Bay. The new land provides nesting sites for birds and homes for other aquatic and amphibian species.

It can be a big job to capture 730 days' worth of outreach work, like the preceding examples, in a compelling manner. Yael Gen, designer, found a way. She led the creative presentation of the work in a brand-new 2018-20 Sea Grant Biennial Report.

Gen said, "In the past, we would commission a photographer to create images based on a theme. But because of the pandemic, that couldn't happen. Assistant Director for Communications Moira Harrington came up with the idea of using signal flags, and after a few minutes of researching the flags, I could visualize the entire report in my head. All I had to do was get it down on 'paper.'"

That "paper" is available online and hard copies can also be provided at no charge upon request. — MH



Narayan Mahon

Emma Wiermaa of Wisconsin Sea Grant and the University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility (NADF) was one of the presenters at Great Lakes Aquaculture Day. She is pictured with NADF Assistant Director and Research Program Manager Greg Fischer.

Great Lakes Aquaculture Day

The first Sea Grant Great Lakes Aquaculture Day was held online last fall, showcasing the region's potential for fish and seafood production and including a culinary competition. If you missed it, you can watch the recorded event online.

The day featured a variety of interactive panel discussions and presentations on aquaculture, targeting a variety of audiences, from beginning and current farmers to consumers interested in learning more about preparing and cooking seafood.

The event was hosted by the Sea Grant Great Lakes Aquaculture Collaborative, a project of Sea Grant programs across the region — including Wisconsin Sea Grant — that are working to share resources and promote best practices in the aquaculture industry.

Wisconsin Sea Grant outreach specialists Emma Wiermaa — who holds a joint position with the University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility in Bayfield, where she is based — and Titus Seilheimer, Wisconsin Sea Grant's fisheries specialist, participated in the event.

The day concluded with a cooking demonstration featuring Chef Jeff Igel of the Wisconsin Technical College System, followed by a competition between three culinary students from the Great Lakes region. Each student was required to use a key ingredient and local aquaculture products in his or her dish.

Seilheimer said, "The most fun part of the day was when Elliot Nelson (Michigan Sea Grant Extension Educator) and I were emcees for a virtual Iron Chef-style cooking contest. Although that sounds strange, it actually worked really well."

As the fastest-growing sector of agriculture worldwide, aquaculture now accounts for more than 50% of world seafood production, surpassing that from wild-caught fisheries. However, aquaculture growth in the U.S. has been stagnant, and seafood supply from U.S.-based, wild-caught fisheries is not enough to meet nationwide demand. One result of that is a $14 billion seafood trade deficit.

The U.S. aquaculture industry has potential for growth, particularly in the Great Lakes region, where abundant inland freshwater resources have enabled a handful of state-based aquaculture operations to employ a local workforce and produce sustainable, healthy and tasty fish.

Seilheimer said the event was a team effort including Elliot Nelson and Lauren Jescovitch (Michigan Sea Grant), Emma Wiermaa, Amy Schrank (Minnesota Sea Grant), and himself, with essential help from Cindy Hudson and Geneva Langeland from the Michigan Sea Grant communications team. — JAS

OUTREACH

A Change of Plan

Sea Grant updated its strategic plan in late 2020 and is now operating on a blueprint for action that will extend into 2023.

The document builds on one originally created for 2018-21 that has been added to under National Sea Grant College Program guidance to include an additional two years, and it will encompass changing conditions brought about by the coronavirus global pandemic that has altered service delivery and working conditions; a long overdue examination of social justice issues and an assessment of the program's approaches and actions in the areas of justice, equity, diversity and inclusion; and a severely shaken economic system, which is affecting the vitality of coastal communities and industries in Wisconsin and throughout the Great Lakes basin.


UNIVERSITY OF WISCONSIN SEA GRANT COLLEGE PROGRAM
2018-23 Strategic Plan

The plan will also need to respond to accelerated climate change and to harness the momentum of a new federal administration that has made the issue a centerpiece of its agenda.

"The National Sea Grant College Program (Sea Grant) is committed to careful planning and rigorous evaluation at both the individual Sea Grant Program and national levels in order to ensure that Sea Grant has meaningful local, regional and national impacts," said Chelsea Berg, Wisconsin Sea Grant's program officer through the National Sea Grant College Program.

She continued, "Thoughtful strategic planning at the national and individual Sea Grant Program levels allows Sea Grant to continue to support efforts that are strategic and ambitious in addressing local, regional and national needs. Strategic plans are also the basis for evaluation, which is designed to evaluate the overall effectiveness of programs, provide feedback that may help improve program performance, and ensure the greatest benefit for the federal and state/local investments. Therefore, the importance of these strategic plans cannot be understated." —MH

PFAS on the Move

INVESTIGATING THE FATE OF PFAS IN GREEN BAY AND LAKE MICHIGAN


Bonnie Willison / Wisconsonn Sea Grant

In December, the Wisconsin PFAS Action Council (WisPAC) released a final report of statewide initiatives regarding per- and polyfluoroalkyl substances (PFAS) with Gov. Evers to the public. Representing the entire University of Wisconsin System, Christina Remucal, associate professor of civil and environmental engineering at the University of Wisconsin-Madison, is one member of the council composed of representatives from 17 state agencies. The council has been working on the PFAS Action Plan for over a year to identify priority actions in response to growing concerns about PFAS and the hazards this class of chemicals poses to human health. The council was put together in 2019 by the governor to ensure Wisconsinites have access to clean, safe drinking water.

Remucal brought her research experience with PFAS to the table, including her most recently funded Wisconsin Sea Grant project, where she is investigating the fate of PFAS in Green Bay and Lake Michigan sediments and water for two years.

"We often think of PFAS as a groundwater contaminant, but here we have an interesting scientific opportunity to learn about how these chemicals move in surface waters," Remucal said. Her research team is looking in and around the city of Marinette, which has a known PFAS contamination site, and also the bay of Green Bay. They plan to collect samples out on Lake Michigan this year.

Unlike other traditional environmental contaminants like PCBs, which tend to be found more in sediment, Remucal said PFAS dissolve easily in water and move about more freely. There are thousands of different kinds of PFAS, and their chemical structure determines where they're more likely to travel in the environment.

"The ones that are longer-chain compounds — the ones that are a little bigger — are more likely to be found in the sediment," Remucal said.

"The Tyco facility drainage ditch sites have a lot of PFAS in them, which we knew. The amounts that are ending up in the sediment vary a lot. We're finding more of the longer-chain compounds in the sediment than the shorter-chain compounds — more of the sulfinates and the carboxylates. It really depends on the chemistry," Remucal said.

> "We're finding more of the longer-chain compounds in the sediment than the shorter-chain compounds — more of the sulfinates and the carboxylates. It really depends on the chemistry."

One mystery her team is focusing on is why the amounts of PFAS measured in sediment in the field are different from what's been observed in the laboratory. "In the lab we always try to mimic the environment, but I think these compounds, because of their chemical properties, don't behave very well. That's why it's important to make those measurements in the field as well," Remucal said.

Remucal recently met with Wisconsin Department of Natural Resources staff members to share what her team has found so far, which is that PFAS concentrations in sediment vary widely.

The researchers are analyzing the sediments themselves to see if their composition might explain why the PFAS amounts vary.

Remucal finds all the public interest in PFAS and her research refreshing and in keeping with Sea Grant expectations to engage stakeholders in research. "It's challenging working with these chemicals and communicating about them because the chemistry is so complex, but it's been rewarding to have people so interested in what we are doing." — MEZ

PFAS, a group of over 5,000 chemical compounds that can contaminate water and soil are associated with negative health impacts. Above, a still photo from a video about Professor Christy Remucal's Sea Grant-funded research project focusing on PFAS in the Marinette area, the "ground zero" for PFAS contamination in Wisconsin.

Decision Maker

RETIRED WATER QUALITY SPECIALIST VICKY HARRIS REFLECTS ON 50 YEARS WITH SEA GRANT

Clockwise fom left: Harris at the Cat Island restoration site in Green Bay, at her retirement party in 2011, receiving one of the pens that Gov. Jim Doyle used when he signed the Great Lakes-St. Lawrence River Basin Water Resources Compact into law in 2008, and on vacation with husband Bud Harris.

« Continued from page 3

"Sea Grant really was a key factor in my choosing Great Lakes management as a career to begin with, so going to work for them was wonderful," she said. "The Green Bay field office was created by Sea Grant to develop an ecosystem-based research and outreach program for the bay, which was so polluted. I loved being part of developing a new ecosystem approach and learned so much from the researchers."

However, at the time Harris was most interested in being a field biologist studying birds and wetlands, and she felt that working for a regulatory organization — an agency that had "power" — would have the most impact. So she returned to the U.S. Fish and Wildlife Service in 1980 only to lose her job when Ronald Reagan was elected president and the new administration swept in with huge cuts to government agency budgets and staffing. From there she ended up working as the Northeast Wisconsin water resource planner and policy analyst at the Wisconsin Department of Natural Resources (DNR) — a position she would keep for about 17 years. It was during this time that she began her involvement with several of the key projects that define her career, projects that she is still involved with even after her retirement in 2011.

Two of these projects are the Green Bay and Fox River Remedial Action Plan (RAP) and the Cat Island Restoration project. The RAP was created in the 1980s by the DNR, and Harris served as the onsite coordinator. She enlisted the involvement of researchers and community stakeholders to address the issues of contaminated sediment, poor water quality and lost or altered habitat in Green Bay. The Cat Island project evolved from the RAP and involves rebuilding a chain of barrier islands in southern Green Bay using dredged material to provide habitat while also providing a beneficial use for the dredged material.

When a position finally opened up at Sea Grant again, Harris jumped at the chance.

"It's the best decision I've ever made in my career," she said.

Sea Grant is clearly not a regulatory agency, so what made Harris want to leave the position she initially thought would be the most influential?

She explained, "I think I learned over time that research — having the facts — is absolutely necessary. And it was my work with stakeholders during the development and implementation of the remedial action plan that showed that outreach was as important — that research and outreach together were in fact the key factors and not necessarily regulatory authority. Authority only goes so far."

Harris continues to work as a member of a couple of committees advising the RAP on its future activities.

"I've been a lifelong committee participant, I guess. I'm going from the coordinator to just one of the masses, and I still like it…I am committed to it. That, I would say, has been a real passion for me," she said.

She also remains active on the Cat Island project as a member of its advisory committee, which continues to meet regularly.

Continued Commitment

With Sea Grant, Harris also continues to keep a hand in. She serves as a member of the Committee on Outreach and Education that provides insights and guidance on communications, education and outreach initiatives of the program.

Yet another project that benefits from Harris' continued involvement is the Clean Marina Program, which she developed in conjunction with the Wisconsin Marine Association in 2009. The program is designed to reduce pollution from marinas into Wisconsin's waterways. To become certified, marinas agree to adopt a set of best management practices. Program staff conduct site visits to verify marina practices and provide training and technical support to managers.

After her retirement from Sea Grant, Harris continued to work with the Wisconsin Marine Association and current Sea Grant Water Quality Specialist Julia Noordyk for a few hours a week, but limited funding kept the program from expanding. Then in 2019 Noordyk secured a $200,000 grant from the Fund for Lake Michigan and hired Theresa Qualls as the Clean Marina Program Coordinator with an eye toward significant expansion in 2020. Unfortunately, COVID-19 is preventing travel and in-person work with the marinas, but new marinas are still joining the program. Harris is a member of the Clean Marina Technical Advisory Committee, and she remains very pleased with the project: "The marinas certainly appreciate it here in Wisconsin, and everyone sees it as a win-win program. For very little investment really it's very helpful for the marinas."

The Clean Marina project remains fluid, but the State of the Bay report stands tall as a comprehensive record in time about the state of Green Bay as an ecosystem. It's the third iteration of the report, and by far the most comprehensive, including data on water quality, fish and wildlife populations, aquatic invasive species, beach conditions and contaminants. Harris hired Theresa Qualls and together they spent years working on the report along with Vicky's husband, Hallett J. "Bud" Harris, emeritus professor of natural and applied sciences at UW-Green Bay. Bud authored the first two State of the Bay reports, but with guidance and editing from Vicky and Bud, Theresa did the hard work of pulling the expanded report together.

"Theresa is amazing at organizing and presenting data, and I'm so glad she is continuing her work with Sea Grant," Harris said.

Together the Harrises were crucial to Sea Grant's work in Green Bay for decades, with Bud Harris beginning his work in the late 1960s. In February, they received the Wisconsin Sea Grant Actionable Science Award as a team for their devotion to the cleanup of the Lower Fox River and Green Bay.

Looking into the future for Green Bay, Harris sees significant challenges — "I've always been an eternal optimist, but I tell you the past four years have been pretty hard to remain optimistic."

One of the biggest problems she's seeing is the continual rise in population, both worldwide and locally.

"We keep battling for the improvement of Green Bay and yet with all the progress that's been made in cutting back on factory discharges and sewage discharges and even the nonpoint source agricultural runoff, we're still not making headway because we have twice as many cows now in the watershed and twice as many people," she said.

Another problem that concerns Harris is the level of public trust placed in scientists, and even science itself. Starting with the issue of fossil fuels and climate change and continuing through other issues, there have been increasing challenges to the concept of unbiased scientists and even uncontested facts. In the complex world of environmental management, it's important to have mangers and stakeholders working together, and stakeholder support is crucial.

> "Scientists can only speak the truth through facts and then it's up to the decision makers. Of course, every person out there is a decision maker in terms of what they believe."

"People are reluctant to change their ways. If we take more actions to reduce our carbon emissions, we can perhaps over time back off from disaster. In the meantime climate change is causing serious damages to agriculture and species on the planet. Maybe the planet will recover in some way. It will be different," she continued.

But Harris is an optimist, and she believes in people: "I'd have to say that when it comes down to an individual citizen, the people that I talk with and the people that live in my community, I remain optimistic. When you really talk to people about what they believe in and what they value in their life, the environment is still important, clean water is important, clean air is important. They value our Great Lakes." — EAW

Fellow Palooza

FEATURING

DANA LAPIDES

BRYAN MAITLAND

PATRICK BLAUFUSS

NATHAN POLLESCH

WRI FELLOW DANA LAPIDES FINDS PATH TO HYDROLOGY THROUGH ORGANIC FARMS

For Dana Lapides, the road to a postdoctoral fellowship has wended through organic farms on two continents. Lapides began her post as a Water Resources Science-Policy Fellow at the University of Wisconsin Water Resources Institute (WRI) in early November. She completed her Ph.D. at the University of California in May, focusing on surface water hydrology.

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WRI FELLOW BRYAN MAITLAND LOOKS AT WHAT'S AHEAD FOR BROOK AND BROWN TROUT AMID WISCONSIN'S CHANGING HYDROLOGY

While it's not news to avid anglers, many Wisconsinites may be unaware that the Badger State has over 13,000 miles of cold-water streams that support many world-class fisheries for brook trout and brown trout.

Continued on page 15 >>

SG AQUACULTURE FELLOW PATRICK BLAUFUSS TO BOOST RESEARCH CAPACITY

Aquaculture, or fish farming, is a $21 million industry in Wisconsin. Wisconsin Sea Grant has a long history of nurturing the growth of aquaculture through research and public outreach. Coupled with Sea Grant efforts related to Great Lakes commercial fishing, these activities help Wisconsin producers offer consumers a sustainable, domestic alternative to imported fish and seafood.

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EPA FELLOW NATHAN POLLESCH USES MATH TO PREDICT TOXICITY FOR FISH AND OTHER WILDLIFE

A passion for mathematics, natural resources and community outreach led Nathan Pollesch to the U.S. Environmental Protection Agency (EPA) in Duluth, Minnesota. That's where he is working to develop an analytical model that can predict the effects of pesticides on wildlife populations.

Continued on page 17 >>

FELLOWPALOOZA

Dana Lapides Water Resources Science-Policy Fellow

« Continued from page 12

Lapides' original intent in heading to the Berkeley campus was to study atmospheric science. After beginning her studies, however, she realized that field was not the right fit for her. She knew something else would suit her better as she sought to take her undergraduate background in math in a more applied direction.

While in California, she began volunteering on a campus-owned community farm, and that led to two summers on a farm in Portugal, where a farmer with a computer science background sparked Lapides' interest in rainwater harvesting.

"He was really thoughtful about how he did everything," said Lapides of Guy Miklos, owner of the farm Quinta do Barbeito. This introduction to rainwater harvesting drew Lapides to hydrology and sustainable water management. At last, she'd found her professional calling.

For her WRI fellowship, Lapides' main charge, as she summarized it, "is to help develop a decision support tool for the screening of applications for high-capacity wells in Wisconsin. I'm thinking a lot about how to conservatively estimate how much stream depletion will be caused by a well, so that we can separate out applications into those that are definitely not going to impact stream ecology, and those that may negatively impact stream ecology and require site-specific review."

Working Collaboratively for Sustainable Water

Her work will intersect with another postdoctoral fellow, Bryan Maitland, who holds a joint appointment between WRI and the Wisconsin Department of Natural Resources Fisheries Management Program. "I expect to be working a lot with Bryan on identifying ecological thresholds," Lapides said.

Due to the COVID-19 pandemic, Lapides is working remotely from Canada, but she hopes to move to Wisconsin at a later date. Wisconsin's status as a water-rich state was part of what drew her to the WRI fellowship, she noted.

Lapides hails from Pennsylvania and received her bachelor's degree there before heading to California for graduate school. "Because

I didn't have a water resources background until my Ph.D., my understanding of hydrology and hydrological systems is mainly shaped by California. Going into my postdoc, I was interested in learning about a different region with really different hydrology — a more water-rich system — to broaden my understanding. Wisconsin, in particular, is a very wet state and has more groundwater interacting with surface water, and that was another component I'm interested in investigating more."

Lapides expects to spend two years in the fellowship program. As for long-term goals, she's mulling options between government agency work and academia. For now, she said, "I'm excited to have my work be directly applicable and important to management decisions." —JAS

^ **Lapides at Quinta do Barbeito farm in Portugal.**

> **Maitland shows off his first fish caught in Wisconsin — a common shiner from the Blue River near Dodgeville, where he was fishing for trout.**

Bryan Maitland Wisconsin Water Science-Policy Fellow

« Continued from page 12

Coldwater streams are flowing waters with maximum summer temperatures under 72 degrees Fahrenheit. Trout living in these streams not only play an important role in ecosystems but also represent significant economic value to the state. For example, according to research done by retired University of Wisconsin-La Crosse Professor Donna Anderson, trout fishing in Wisconsin's Driftless Area had an economic impact of $1.6 billion in 2015.

But these brook and brown trout face challenges. Two leading ones are climate change (and the resulting shifts in precipitation patterns and flood frequency) and high-capacity wells in the state, as those wells draw groundwater that might otherwise replenish streams.

Here to better understand these challenges — and ultimately help natural resource managers make decisions related to trout populations — is Bryan Maitland, a new Wisconsin Water Science-Policy Fellow whose position is jointly supported by the University of Wisconsin Water Resources Institute (WRI) and the Bureau of Fisheries Management at the Wisconsin Department of Natural Resources (DNR).

Maitland, who recently completed his doctorate in ecology at the University of Wyoming in Laramie, began his fellowship in September. He also holds a master's degree in conservation biology from the University of Alberta in Canada. The fellowship is a one-year commitment with a possibility for a second year.

During this time, he'll focus on building computer models that illuminate how long-term changes in hydrology across the state are affecting trout populations. "The flip side of this," he said, "is the conservation and management side, translating it into some type of decision support tool that decision-makers can use to inform policy in the state."

As Maitland elaborated, climate change has brought shifting precipitation patterns that have altered Wisconsin's hydrology.

Alex Latzka

Increased precipitation — and particularly the frequency of intense precipitation events — has triggered floods in rivers and streams statewide. Depending on their timing and severity, these floods can threaten the emergence of trout fry or the survival of juvenile trout.

For example, a big winter flood can "scour out these little trout eggs that are growing under the stream in the substrate" that time of year, said Maitland. As a result, that year class of fish could be wiped out since eggs will not hatch in the spring. "That age-zero year class is really important for long-term trout population dynamics, because if you don't have a good age-zero cohort, you can have very depressed populations in the stream for multiple years after that," he noted.

At the same time, some high-capacity wells have the potential to deplete groundwater levels, thereby reducing input into nearby streams.

"The reason we have 13,000 miles of streams is because we have really good groundwater here in Wisconsin and good input into streams, which helps keep these streams colder in the summer and a little warmer in winter," said Maitland, which creates a favorable environment for brook and brown trout.

Modeling Long-term Change

Maitland's modeling work will pull together these two large-scale factors, and their interplay, to see how trout populations have been influenced over the past 26 years. Fish data collected from 1994 to 2020 are being used to inform the computer models to investigate how stream flow, precipitation and water temperature drive trout population numbers. Looking to the future, Maitland and collaborators will examine how increases or decreases in stream flow are likely to affect trout populations, with an eye to guiding a management framework for things like high-capacity well permits.

While economic considerations like the value of Wisconsin's recreational trout fishery are outside the scope of his work, this effort could set the stage for other researchers to pursue this topic.

Maitland is an angler himself, which explains part of the appeal of this topic for him. Yet another draw is the chance to work with an array of other fellows and with permanent staff at the DNR. His collaborators at the DNR include former WRI fellow Alex Latzka, now a fisheries systems biologist there, and Lori Tate, section chief at the Fisheries Management Bureau and a member of Wisconsin Sea Grant's Advisory Board. His efforts will intersect with that of other current fellows like Carolyn Voter and Dana Lapides.

"I think science and policy are team sports," said Maitland. "To join such a big group of researchers and managers working on these big-picture issues in Wisconsin is very exciting." —JAS

FELLOWSHIPALOOZA

Patrick Blaufuss Keillor Fellowship in Aquaculture

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A fresh chapter in this history is the Wisconsin Sea Grant Keillor Fellowship in Aquaculture, created in partnership with the University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility (NADF), where the position is based. The Bayfield facility is a national leader in aquaculture research.

The inaugural fellow, Patrick Blaufuss, began his two-year position in September. He holds a doctorate in animal physiology from the University of Idaho, where his research focused on nutrition and physiology in rainbow trout. He's also a graduate of North Dakota State University and Southern Illinois University, where he earned his bachelor's and master's degrees in zoology, respectively.

One of his greatest satisfactions, said Blaufuss, is seeing laboratory research provide useful results for fish farmers. "I'm excited to get experience with the aquaculture industry in the Great Lakes region… and to get more experience with commercial producers and the commercial setting, helping them refine what they do. Applying what we do in the lab out in the real world is very important," said Blaufuss.

One of his top priorities will be analyzing data from past and current NADF projects and preparing manuscripts for publication in scientific journals.

Said Greg Fischer, NADF assistant director and research program manager, "Having Patrick on board as our new Sea Grant fellow will directly impact getting our completed research projects analyzed and published in a timely manner, which allows us to share results with the aquaculture industry and scientific community more rapidly, and to move aquaculture forward with confidence."

Chris Hartleb, UW-Stevens Point professor of fisheries biology and NADF co-director, echoed those thoughts. "Pat's background and knowledge will assist us with completing past projects, restructuring current projects and expanding our ability to provide assistance to many aquaculturists with new projects."

Experienced in Aquaculture

Blaufuss' prior experience includes restoration aquaculture work with burbot in Idaho, where that species was almost extirpated from the Kootenai River watershed due to the operation of a dam that led to increased water temperatures (burbot need very cold water to spawn successfully). The recreational burbot fishery there had been closed since 1992. As part of the restoration work, Blaufuss served as a consultant to the Kootenai Tribe of Idaho, which runs a commercial-scale fish hatchery. Employing results from University of Idaho lab research, Blaufuss helped the tribe with its first season of burbot aquaculture. Subsequent years of restocking efforts by the Kootenai Tribe have succeeded in restoring burbot populations to a level that recreational fishing is once again possible for anglers.

Commented Blaufuss, "I came out there (to the tribal hatchery) regularly throughout their first season, since there are multiple steps in burbot culture, and you have to be aware of them." Burbot are extremely carnivorous, so cannibalization can be an issue, and they also have a longer larval rearing period than some other species. "It was very fulfilling to help them through each stage of the culture, and to see how our smaller-scale research data could be applied to a full-size commercial setting."

Currently, Blaufuss is writing a manuscript about previous NADF work on commercial diets for larval walleye and saugeye (a walleye-sauger hybrid that also occurs in the wild). "It's so important that producers know the best diet to feed these larval fish," he said. Wisconsin Sea Grant funded this research in its 2018-20 grant cycle.

He's also working on a nanobubble oxygenation project, a novel way of introducing oxygen into aquaculture systems. "We're looking at how it affects fish health, growth and other parameters," said Blaufuss. The National Sea Grant Office is supporting the nanobubble work; read more about it here. —JAS

Nathan Pollesch Environmental Protection Agency Fellow

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Pollesch is the latest fellow in a partnership project between the EPA's Great Lakes Toxicology and Ecology Division, the University of Wisconsin-Madison and its Aquatic Sciences Center. The goal of the three-year U.S. Environmental Protection Agency Human Health and the Environment Research Fellows program is to train the next generation of scientists in environmental and ecosystem health.

Pollesch's EPA mentor is Ecologist Matt Etterson. The duo has been working together already with a group of EPA ecological modelers who are spread across the country. Pollesch said the toxicity translator model he is working on is specific to fish.

"Dr. Etterson got the ball rolling by developing the first model, which is for birds and looks at nesting success related to pesticide exposure," Pollesch said. "Two others are under development that focus on invertebrates and amphibians."

Risk Assessment Tools

These models will be tools that risk assessors at the EPA and elsewhere can use to help inform their assessments of new chemicals and chemicals that are up for reregistration. For instance, for agricultural chemicals, "We can run scenarios. Using some other models developed by the EPA and elsewhere will give us a time series of a concentration of the chemical that we can expect in the environment. We can see how that concentration will fluctuate over the course of a year and then we can pair that with the integral projection model I'm developing. We'll be able to say, 'Given this exposure profile, we would expect this potential effect on the populations of whatever species we're looking at,'" Pollesch said.

Pollesch became interested in mathematics in college, thanks to some excellent professors. "A lot of people see math as this dry, robotic thing. It's a shame you don't learn until much later that it's really not. At a certain point, it's so far past memorization. That's when it gets really interesting," Pollesch said.

He was also interested in natural resource problems and decided to apply his math passion along that pathway. Pollesch earned his bachelor's degree from the University of Wisconsin-Stevens Point in mathematics. He continued to the University of Minnesota Duluth where he earned his master's in applied and computational mathematics. For his master's project, Pollesch developed a model to look at impacts of the Deepwater Horizon oil spill on the Gulf of Mexico. For his Ph.D., Pollesch studied mathematical ecology at the University of Tennessee. Then Etterson had an opening for a postdoc, and Pollesch jumped at the chance to use his mathematical training to help solve environmental problems. His EPA fellowship is offering the chance for him to continue his work with Etterson and other EPA researchers.

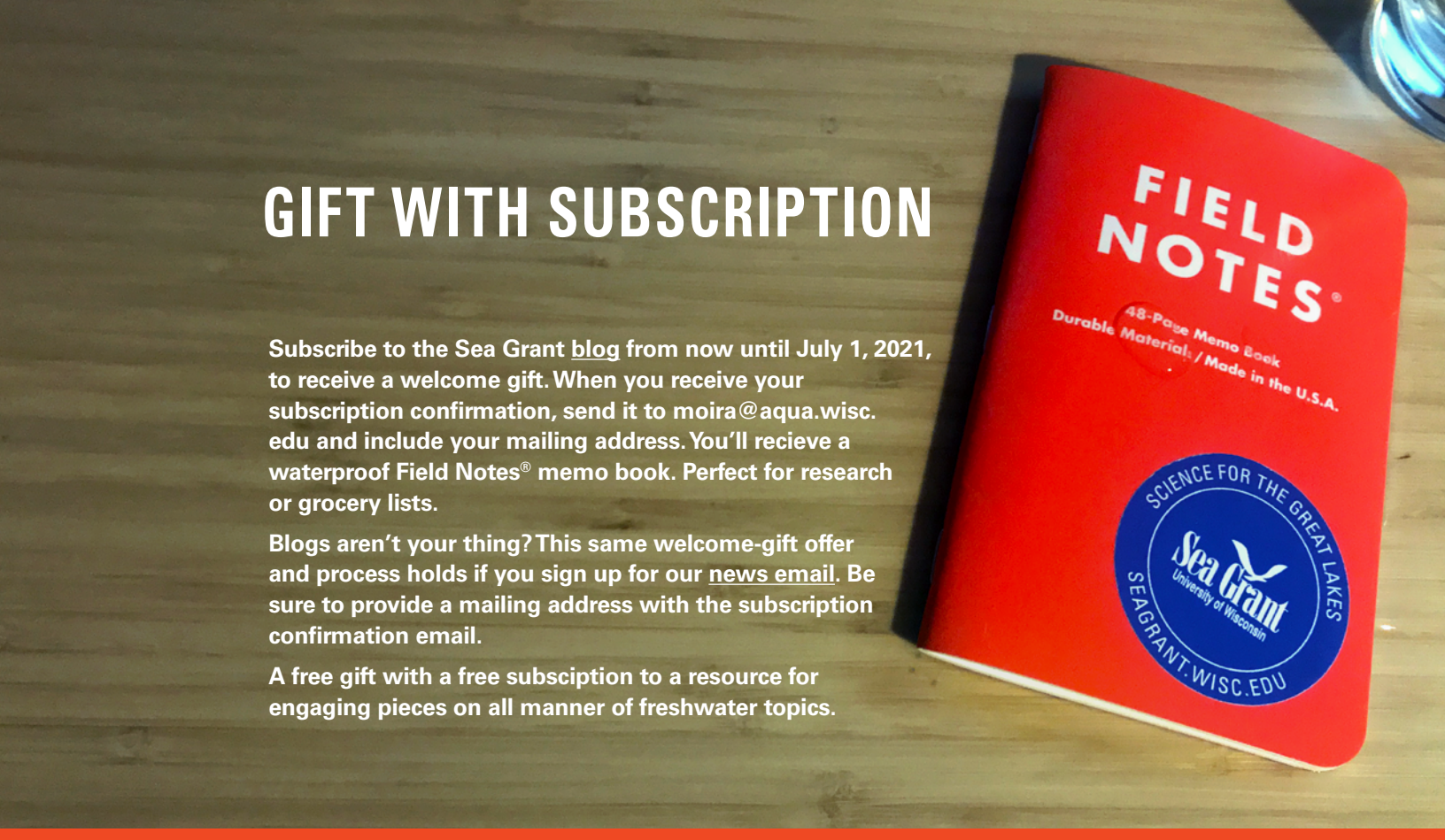
Soon after his arrival in 2016 at the EPA, Pollesch started a community outreach program centered on science. He is the lead organizer of a series of monthly science cafes that are ongoing. He said that experience also helped him gain the EPA fellowship.

"Outreach and the application of science had a strong emphasis in the fellowship application. That was especially exciting, given the work I've done with Café Scientifique. For those experiences as well as in my own research, I always try to communicate science and what I'm doing at a level that's appropriate for the people I'm talking to. Also, I have a strong interest in working on applied problems," Pollesch said.

"I think the reason I do research in the environmental field is because I feel strongly that environmental protection is one of the things that benefits the community the most. Protecting these shared resources is really important for everybody. The community-minded aspect probably influences why I spend time doing community outreach for science. I think there's a connection," Pollesch said.

Eventually, more trainees will be placed at the Duluth EPA Laboratory, ranging from undergraduate students, graduate students and postdoctoral fellows such as Pollesch. They will focus on four EPA priorities: systems toxicology, watersheds and water resources, ecosystem services and translational toxicology. —MEZ

GIFT WITH SUBSCRIPTION



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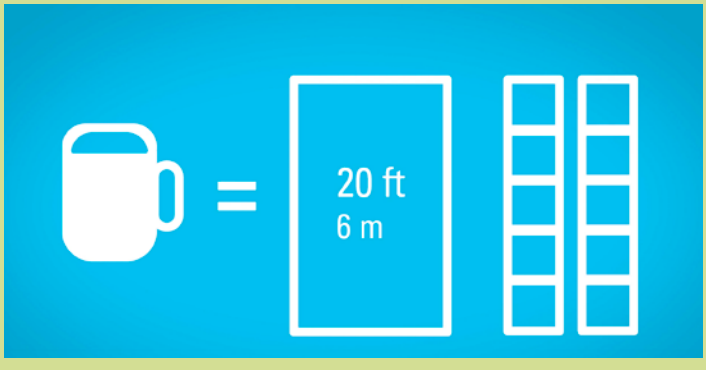

Bonnie Willison / Wisconsin Sea Grant

Don't Put Yourself on Ice

Winter in Wisconsin is winding down. But there is still ice to be found. Ice on ponds and lakes is nice. Ice on sidewalks or driveways is less nice and can certainly be dangerous. When clearing it away, here's a video reminder produced by Digital Storyteller Bonnie Willison to use salt sensibly to get needed safety while sparing those ponds and lakes excess salt. The core message: A little salt goes a long way. Watch this Winter Salting Guide.

Check Online for Calendar Updates

Due to the disruption caused by the spread of the coronavirus and public health guidelines to maintain social distancing, large public meetings focused on water science have been postponed or outright cancelled.

Check the websites of organizations you are interested in for updates regarding scheduling. For the latest on Sea Grant and University of Wisconsin Water Resources Institute functions and other news, visit seagrant.wisc.edu or wri.wisc.edu or follow our social media channels.