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Aquatic Sciences Chronicle

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

INSIDE:



Around the Country With Sea Grant



Milwaukee Superbugs



New Sea Grant Projects

WATER RESOURCES RESEARCH



WRI researchers evaluate the effects of municipal wells on Dane County's groundwater

Using Our Wells Well

Given the tens of millions of gallons of water that are pumped from municipal wells in southern Wisconsin's Dane County each and every day, it would be awfully naïve to believe that there's been no long-term effects on the deep aquifers that provide the groundwater.

And sure enough, there have been long-term effects — significant effects. In fact, Wisconsin hydrogeologists have verified that all that pumping has actually reversed the directional flow of groundwater: Water once flowed from aquifers into rivers and lakes, now it moves the other way.

"The lakes are now losing water (albeit relatively small volumes relative to the size of the lakes) to the groundwater system," said Jean Bahr, a professor of hydrogeology with the University of Wisconsin-Madison.

But flow isn't the only thing that may have been altered by long-term municipal well pumping — the groundwater chemistry itself may have been affected, including the possibility of elevated levels of metal

Municipal well pumping has changed the flow of groundwater, potentially changing the levels of metal contaminants in drinking water.

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Aquatic Sciences Chronicle

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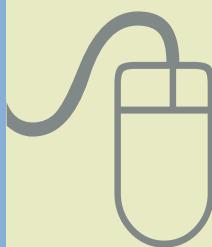


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FEATURED VIDEO

The Value of Sea Grant to the Country

Readers of this publication are well versed in recent accomplishments of the Wisconsin Sea Grant Institute, but what has Sea Grant recently accomplished on a national scale?

The 50-year anniversary of the National Sea Grant College Program in 2016 has occasioned a new video highlighting recent achievements of the country's 33 Sea Grant programs. It's only seven minutes long, so it paints with a broad brush.



Louisiana Sea Grant

"Across the country, Sea Grant has done so much in 50 years. In seven minutes, we could only examine a few of the major initiatives of a very complex, highly productive program," said John Karl, Wisconsin Sea Grant videographer and producer of the video.

Even so, the list remains impressive — ensuring a safe and sustainable seafood supply; fostering a successful aquaculture industry; helping coastal communities plan for and respond to hurricanes, flooding and oil spills; protecting the public from harmful algal blooms; spurring offshore wind farms; and protecting and restoring aquatic habitat.

And there's even more — promoting environmental literacy for all ages, developing our workforce, and providing fellowships and financial support to thousands of students and recent graduates.

It all began in 1963, when South African native Athelstan Spilhaus proposed the establishment of Sea Grant colleges at a meeting of the American Fisheries Society in 1963 as a parallel to the successful land-grant colleges, which he claimed was "one of the best investments this nation ever made. The same kind of imagination and foresight should be applied to the exploration of the sea."

Rhode Island Sen. Claiborne Pell championed the idea, and it quickly gained traction in Congress. Three short years later, the Sea Grant Colleges and Program Act was passed. U.S. Sen. Sheldon Whitehouse of Rhode Island said Sea Grant is "always there," unlike individual university projects or state-funded work, which may come and go. He said Sea Grant is essential to solving many of the issues facing our coasts.

A national advisory committee contributed to the video. It included staff from the Sea Grant programs of Mississippi-Alabama, Louisiana, Maine, Hawaii, Maryland, Rhode Island and Connecticut. Darcy Wilkins, temporarily based at Louisiana Sea Grant, is an assistant producer, and Stephen Wittman, former Wisconsin Sea Grant assistant director for communications, is the scriptwriter.



MILWAUKEE WATERWAYS

Antibiotic Resistant Hotspot

Water and sediment in the three rivers that converge in Milwaukee and the city harbor contain antibiotic-resistant bacteria in greater amounts than in bacteria isolated from the city's hospitals, a Wisconsin Sea Grant researcher and her colleagues have found. The researchers are concerned these environmental "hotspots" for drug-resistant bacteria could harm human health by increasing the incidence of bacterial resistance in medical centers, and they urge people not to use antimicrobial products in their homes.

Krassimira Hristova, assistant professor in Marquette University's Biological Sciences Department, and her colleagues published their findings in "Frontiers in Microbiology." They took both water and sediment samples from the Milwaukee Harbor and the Kinnickinnic, Menomonee and Milwaukee rivers, growing *E. coli* bacteria from the samples in the lab and screening them for resistance to 17 kinds of antibiotics.

The research team had undertaken the study to learn more about the relationship between antibiotic resistance in clinical settings and the environment, and about what genetic mechanisms code for this resistance.

"Fewer and fewer antibiotics are still viable options for treating even common infections," said Hristova. "We wanted to look at the environmental factors that could contribute to this."

Drug resistance was most prevalent for the widely used antibiotics erythromycin, sulfamethoxazole, aztreonam and ampicillin. Resistance occurred in 72 to 88 percent of the bacteria isolated from the samples. Chloramphenicol proved the least prevalent drug for antibiotic resistance, observed in less than 7 percent of the isolates.

The researchers suspect that genes for antibiotic resistance are disseminated between the bacteria from clinical sources and the environment during the treatment process or when the clinical bacteria gets into surface waters through wastewater effluent. The bacteria end up living in the river and harbor sediment for long periods of time, increasing the likelihood for antibiotic-resistant gene exchange with other bacteria. The researchers are in the process of genetic studies to gain a clearer picture of how the transfer is

**Antibacterial
products contribute
to the creation of
superbugs resistant
to antibiotics.**

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A Great Place on a Great Lake — Milwaukee

Water has played a part in Milwaukee's history, economy, culture and recreation for years — not to mention the fact that it's vital for brewing beer. From management plans to histories to tourist guides, the Wisconsin Water Library has what you need for research, fun reading and travel.

HARD WATER: POLITICS AND WATER SUPPLY IN MILWAUKEE, 1870-1995

By Kate Foss-Mollan. West Lafayette, Ind.: Purdue University Press, 2001.

Examines formation, growth and change in the Water Department of Milwaukee from 1870-1995. It combines history, technology, politics and policy-making in an effort to understand how municipal decision-making processes determine technological determinations throughout the history of water works.

MARITIME MILWAUKEE

By the Wisconsin Marine Historical Society. Charleston, S.C.: Arcadia Publishing, 2011.

Explores the growth of Cream City's port and three riverfronts through a variety of photographs spanning the 1800s to the present thanks to the collections by the Port of Milwaukee, the Milwaukee Public Library and the Wisconsin Marine Historical Society.

MILWAUKEE AT WATER'S EDGE: RESOURCE GUIDE TO THE LIVELY SIDE

By Tom Pilarzyk. Boulder, Colo.: Trails Books, 2013.

A timely guide to top attractions and hidden treasures. Short, magazine-style chapters describe eight city sections along the waterfront and how they embody culture, diversity and vibrancy.

THE STATE OF THE MILWAUKEE RIVER BASIN

By the Wisconsin Department of Natural Resources. Madison, Wis.: Wisconsin DNR, 2001.

Provides an overview of land and water resource quality, identifies challenges and outlines actions the Wisconsin Department of Natural Resources and its many partners can take to protect and restore natural resources throughout the Milwaukee River Basin.

A WATER RESOURCES MANAGEMENT PLAN FOR THE MILWAUKEE HARBOR ESTUARY

By the Southeastern Wisconsin Regional Planning Commission. Waukesha, Wis.: The Commission, 1987.

A three-volume report that details the comprehensive study of the water pollution, flooding, storm damage and dredging problems of the Milwaukee Harbor estuary area and a plan to meet water use objectives in a cost-effective manner.

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

Wisconsin Sea Grant's former (and first) social scientist, Jane Harrison, departed for North Carolina Sea Grant last year. In a trade-off by chance, the program's new social scientist, Deidre Peroff, arrived here in February from North Carolina. Peroff worked as a social research assistant for the North Carolina Wildlife Resources Commission in Raleigh and brings a wealth of experience to her new job from across the U.S. and even internationally.

James Gill



Although she grew up near Kansas City, Kan., Peroff's academic roots are at the University of Wisconsin-Madison, where she earned a bachelor's degree in geography, people and the environment. After working in environmental education for several years in Mississippi and southern California,

Deidre Peroff

New Wisconsin Sea Grant Social Scientist

Peroff moved to Boston, where she worked as a research assistant for the Harvard University Forest. That experience sparked her interest in social science research, and her boss, noted conservationist Jim Levitt, encouraged Peroff to pursue a master's degree.

"I knew I wanted to focus on social science," Peroff said. "Most environmental problems are really people problems. You have to talk to people and assess their awareness of these problems. My experiences in different parts of the country have been eye-opening in terms of differences in how people think about natural resources, how they relate to them, and the concerns they have, or the lack of concerns or knowledge they have about environmental issues."

Peroff's continued academic success and interest in social science brought her to North Carolina State University where she is in the final stages of completing her Ph.D. in the department of parks, recreation and tourism management. Her dissertation focused on how locals' involvement in tourism-related small businesses can support livelihoods and environmental stewardship in underserved communities.

Along her path she has worked often with coastal communities. Peroff is looking forward to focusing more on water issues, and she's excited to get back to the Midwest.

"I'm looking forward to learning more about the different problems in the Great Lakes and how people use coastal resources," Peroff said. "I have a lot to learn but I have a lot to give, too."

Peroff started work this February at the Sea Grant office in the University of Wisconsin-Milwaukee's School of Freshwater Sciences.

She can be reached at dmperoff@aqua.wisc.edu. —MEZ



Moira Harrington/Wisconsin Sea Grant

The Lake Sturgeon Bowl

Where Numbers Other Than the Final Score Matter

In any competition, numbers matter — it's the final score that often captures people's attention. The 2016 Lake Sturgeon Bowl was no exception. Sure, the final score of 49 Marshfield High School and 44 Shorewood High School was noticed, but some different sets of numbers were also a highlight of the competition that is a qualifying round for the National Ocean Sciences Bowl taking place this spring in North Carolina.

Also of note were the nearly 70 volunteers who make things tick. Pictured above is Fran Luebke (middle photo, right), who has been a volunteer for the event for every single one of the 15 years that the bowl has existed in Wisconsin. It attracts high-schoolers from around the state to a combination buzzer-round and team analysis on all facts related

to water to encompass the biological, physical and social sciences.

Luebke and six others were honored for that 15-year string of service. They, and their fellow 2016 volunteers, fulfill roles such as science judge, rules judge and moderator. Scorekeepers, time-keepers and runners are also invaluable to the event. One of the event coordinators, Katie Wipfli, is pictured above (right photo).

One final number to call out would be the 16 young people who themselves were Lake Sturgeon Bowl competitors in prior years. A group spanning in age from their early to late 20s addressed this year's students, explaining what paths they took beyond high school. Most had gone into science-related fields and all were inspiring.—MH

Volunteers are vital to the success of the Lake Sturgeon Bowl. From left, a competitor from a previous year speaking about his post-bowl career choices, 15-year veteran volunteer Fran Luebke (right) and one of the event coordinators, Katie Wipfli.

Scaling the Summit

Minds met, partnerships were forged and much delicious local seafood was consumed at the inaugural Eat Wisconsin Fish Summit, hosted by Wisconsin Sea Grant Jan. 13 in Sheboygan.

A total of 63 attendees, a group that included fish farmers, chefs, retailers, commercial fishers and local food enthusiasts, convened to learn about the ever-growing movement to support and eat locally caught and raised fish. The event's experts panels in particular were a big hit.

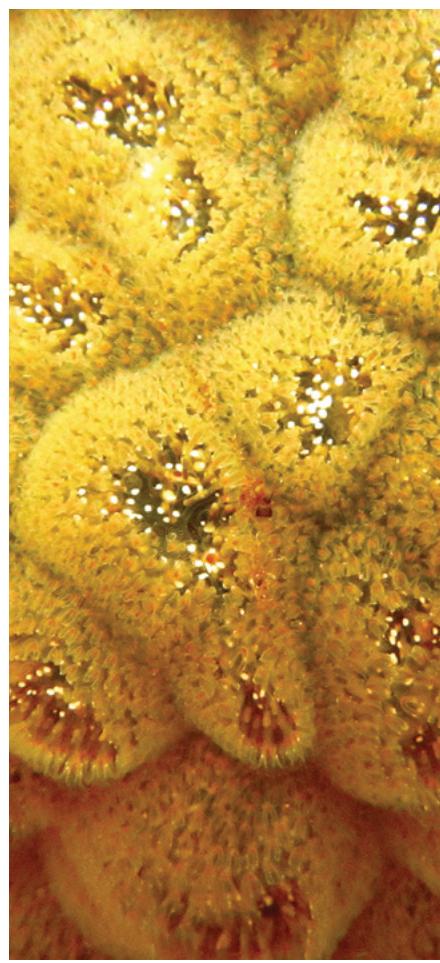
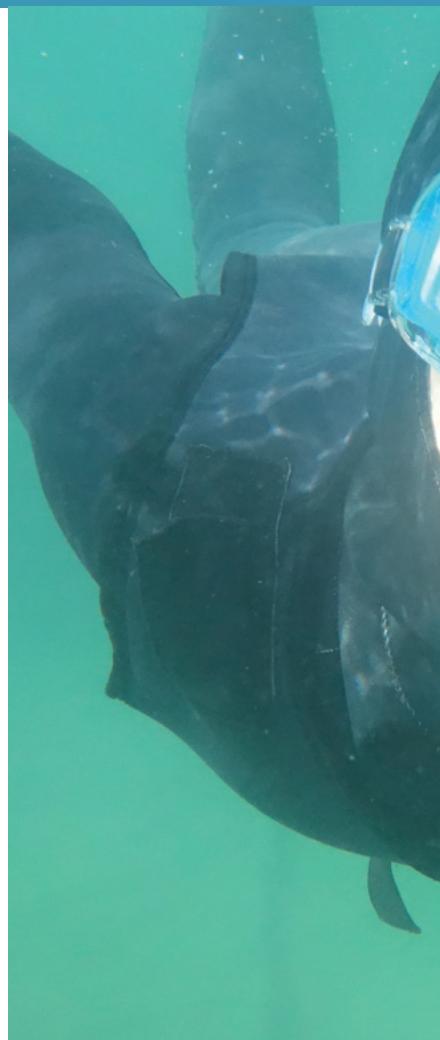
"We had a lot of deep discussion and it was great because of the mix of people we had," said Kathy Kline, Wisconsin Sea Grant education outreach coordinator and one of the event's primary organizers. "For instance, chefs and retailers were surprised to learn that most of the fish caught in the Great Lakes aren't consumed here — they're shipped out East."

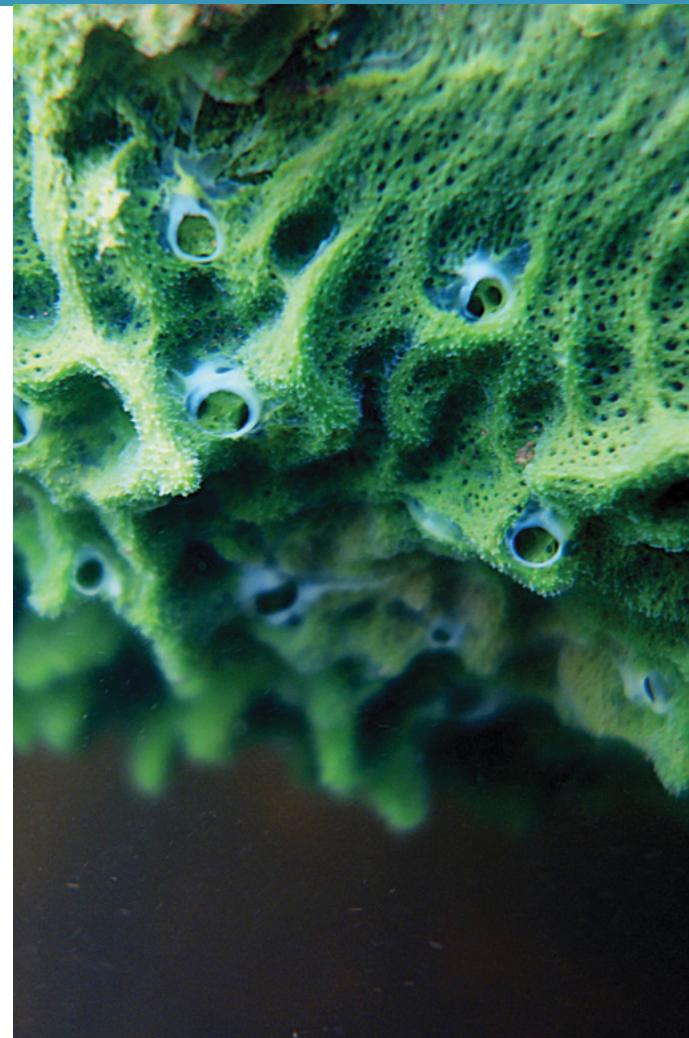
The Eat Wisconsin Fish Summit was scheduled to coincide with the annual Wisconsin Local Food Summit, also held in Sheboygan, to synergize audiences interested in supporting local food. Kline said she's planning to make the summit an annual event and hopes to involve the Lakeshore Culinary Institute, the culinary school that prepared Wisconsin seafood dishes for the summit's reception, as a future partner.—ARC



Wisconsin Sea Grant
Education Outreach
Coordinator Kathy Kline
deep in conversation
with a chef during the Eat
Wisconsin Fish Summit.







New Two-Year Cycle of Sea Grant Research Projects

Sea Grant will fund 16 new research and education projects and three ongoing in 2016-18.

Jennifer Hauxwell, assistant director for research and student engagement, said, "We received a record number of proposals this year submitted either to our base focus areas or to one of our special calls, including a joint call with Minnesota and one with Illinois-Indiana Sea Grant, as well as our first ever call for Integrated Assessments to tackle some of society's most difficult natural resources challenges."

There were 83 research preproposals and 49 full proposals. Along the path to funding, each of those proposals — whether in the initial or the full stage — was a regional and international expert vetting of ideas, methodologies and outreach plans. The Sea Grant Advisory Council also provided a perspective on relevance to Great Lakes and Wisconsin-specific needs.

The work will be carried out on six campuses and involves nearly three dozen principal and co-investigators. Additionally, the

Wisconsin Historical Society will conduct underwater archaeological investigations of two shipwrecks and the effects of invasive mussels and changing water levels on the wrecks.

Each proposal falls into a broadly defined category. Those categories are healthy coastal ecosystems, sustainable fisheries and aquaculture, resilient communities and economies, and environmental literacy and workforce development. Some project examples are: the optimum means to grow walleye through aquaculture, a genetically based examination of the Lake Michigan food web, an analysis of the success and shortcomings of urban green infrastructure projects, improving on flash flood forecasting and the power of underwater photography for at-risk teenagers.

Send an email to terri@aqua.wisc.edu with "RFP mailing list" in the subject line to be added to the mailing list for future Sea Grant or Water Resources Institute requests for proposals.

Photographs taken by students participating in a program through Northwest Passage, Ltd., explore nature as a means to further healthy human development. It's one of the new education projects funded by Sea Grant.

OUR OCEAN



\$50,000 Grant to Assess, in an Integrated Manner, Lake Michigan Bluff Stability

There's a Chinese folktale that includes an anthropomorphized wall claiming invincibility as he stares down the power of the wind only to be later felled by a small mouse nibbling at his base. Much like that wall, the sweeping heights of Lake Michigan's coastal bluffs can seem invincible. Yet we all know the immutable power of water to wear on soil and even solid coastal structures, compromising stability.

Wisconsin Sea Grant is heading a new \$50,000 grant from the Graham Sustainability Institute at the University of Michigan that's looking at the variability of Great Lakes water levels and how those levels affect the "nibbling" of bluff bases.

A team of investigators representing the disciplines of coastal engineering, geology, urban and regional planning, law, policy

studies, ecology, landscape architecture and social science is adding to work completed in an earlier planning grant. The new project will engage local stakeholders and broader partners to explore policy options and decision tools for increasing resilience to coastal erosion.

"The integrated assessment comes at an opportune time," said David Hart, assistant director for extension. "Besides a rapid increase in Lake Michigan water levels from record lows in January 2013, the Wisconsin Legislature changed the enabling legislation for shoreland zoning in July 2015."

Shoreland zoning is one of the primary management tools for addressing development along both inland and Great Lakes waters in Wisconsin.

Wisconsin beaches have benefited from redesign and cleanup over the past 10 years, but how significant have the results been?



New National Marine Sanctuary Much Closer to a Berth in Wisconsin

The nation's newest NOAA national marine sanctuary is moving closer to designation of a site in Lake Michigan offshore from Manitowoc, Sheboygan or Ozaukee counties. The proposed 875-mile sanctuary has met preliminary national significance criteria and management considerations.

Three scoping meetings were held in November and a public comment period ended in January. NOAA will use feedback from these sources to help direct the shaping of the sanctuary and will continue to reach out to groups not yet included in the process.

The timeframe has not been set, but Titus Seilheimer, Sea Grant fisheries specialist, says, "This will not be a fast process, but the sanctuary will probably start taking shape this year. I think that realistically it could actually exist in 2017 or 2018."

If successful, Wisconsin would host one of 14 National Marine Sanctuaries and only the second one in fresh water.

The Wisconsin site has been selected, in large measure, based on the success of shipwreck explorations in state waters of Lake Michigan. Since 1998, Sea Grant has supported maritime explorations through grant funding in collaboration with the Wisconsin Historical Society's maritime archeology program. There are 59 Wisconsin shipwrecks listed on the National Register of Historic Places, far more than any other state. Of that number, a proposed 15 would be within the designated sanctuary boundaries. Another 24 known wrecks are in the proposed sanctuary but are not, at this point, on the register.

"Wisconsin has a rich maritime heritage and an equally rich legacy of preserving that heritage," said Jim Hurley, Sea Grant's director. "We are thrilled the national panel looking at siting the newest sanctuary has chosen the Great Lakes to move forward. It means continued historic preservation, along with tourism for an important area of the state and highlights an important ecosystem."

In addition, work is underway to initiate the nomination of a Lake Superior location for a sanctuary that is likely to include

Chequamegon Bay and possibly extend north to include the waters surrounding the Apostle Islands. Interested citizens and resource agencies held an initial public comment presentation in December, and meetings will continue as organizers answer questions and gather community support.



For more information about the proposed Lake Michigan sanctuary, see sanctuaries.noaa.gov/wisconsin.

For more information about the proposed Lake Superior sanctuary, see lakesuperiorsanctuary.org.

New Grant to Provide a First-Ever Examination of Beach Redesign Effectiveness

Adam Mednick, a post-doctoral fellow at Sea Grant, recently secured a \$16,985 grant from the Fund for Lake Michigan to evaluate the effectiveness of beach redesign and cleanup on six beaches that have been addressed in the last 10 years with the latest methods to ensure a safe experience for Wisconsin families and tourists.

Strategies have included traditional infrastructure improvements such as re-engineering stormwater systems, green infrastructure like rain gardens, beach grooming and natural or seminatural beach restoration.

Not only have there been a number of approaches used to meet the beach-health challenges, there have been a number of funding sources investing in the projects—the U.S. Environmental Protection Agency, the Wisconsin Coastal Management Program, the Fund for Lake Michigan and local taxpayers.

But, just what have been the results of this work? That's never been fully explored. Mednick's study will be the first of its kind to provide quantitative estimates of the impact that such efforts

have, or could have, on water quality—controlling for environmental conditions that otherwise mask their outcomes.

Using the wealth of historical data on *E. coli* and contributing environmental conditions at beaches all along the Lake Michigan coast, together with the advanced data-processing and analytical capabilities of the Environmental Data Discovery and Transformation and "Virtual Beach" systems, he will estimate the impact of completed redesign/remediation projects at three "restored" beaches together with the potential impacts of planned projects at three "reference" beaches.

"This is an exciting project because it takes recent advances in Great Lakes monitoring and 'big data' and repurposes them for a very tangible use—to evaluate the effectiveness of monetary investments being made to clean up Lake Michigan beaches," Mednick said. "This will hopefully help government agencies and private foundations better target future investments to ensure that beaches all across the Great Lakes are healthy and safe for families looking to enjoy a day at the beach."

Using Our Wells Well

continued from page 1

contaminants like chromium, iron and manganese into the groundwater. With the support of funding from the UW Water Resources Institute, Bahr, UW-Madison graduate student Joshua Olson and Madeline Gotkowitz, a hydrogeologist with the Wisconsin Geological and Natural History Survey, will use a new groundwater flow model to determine the extent of the changes.

"...when we use that groundwater for drinking, iron and manganese levels are important."

The Dane County Regional Flow Model, developed by the Wisconsin Geological and Natural History Survey and the U.S. Geological Survey, is a sophisticated and geologically detailed model of groundwater flow in the area that includes large municipalities such as Madison, Verona, Middleton and Fitchburg. Olson, a graduate student in the UW's Nelson Institute for Environmental Studies

who's pursuing master's degrees in hydrogeology and water resources management, will use the model to run simulations of physical water flow and current conditions in the Dane County watershed.

Olson will focus on a technique called particle tracking — creating an imaginary water molecule and tracing its path through the model, focusing on advective flow, i.e., what moves along with the groundwater itself. The larger long-term goal of the project will be using the tool to identify hydrogeological units that may be contributing to elevated concentrations of chromium, iron and manganese.

Gotkowitz explained that in shallow groundwater, the water is younger and more suffused with oxygen; in deeper aquifers, older groundwater contains little to no oxygen, which can lead to increased levels of metals. When the flow is reversed, as it has been in Dane County, the two types of water mix.

"How the flow has changed is obviously of interest," said Gotkowitz. "But when we use that groundwater for drinking, iron and manganese levels are important. It's in part an aesthetic question — these metals tend to impact the color of the

SEA GRANT RESEARCH

MILWAUKEE WATERWAYS

Antibiotic Resistant Hotspot

continued from page 3

happening. Hristova said humans could be exposed to these multi-drug-resistant environmental bacteria through recreational activities in the water or possibly even through drinking water.

"Our biggest concern is that we are creating hotspots in the environment for antibiotic-resistant bacteria," Hristova said. "Our wastewater treatment plants are not designed to remove all bacteria or to destroy the DNA that's released from these bacteria."

She said people can help by not contributing to the problem. "We should not dispose of our unused medication by flushing it down the



Krassimira Hristova (right), examining mussel samples in her Marquette University laboratory with students. Antibiotic resistance gene exchange may also be occurring in the guts of invasive zebra and quagga mussels.



The way a water utility operates may affect the movement of groundwater from shallow to deep, which in turn may affect metal contamination levels in the water.

drinking water — but also, there's a bigger question of safe levels."

Another aspect of the project that intrigues Gotkowitz is gauging the impact of what's called short-circuiting — the points during a day when water utility managers turn well pumps on and off to account for fluctuations in water use/demand. In large, three-foot-diameter wells, these short-circuit points can provide another conduit for water to

move from shallow to deep, providing a potential contributor to trace metal contamination.

The project's only just beginning and won't likely report final results until sometime in 2017.

"The impacts may not be huge," Bahr said. "But this could give us ways to think about both how we pump from our municipal wells and when. This is information that a water utility could use to improve the way they operate." —ARC

toilet — turn it in during community collection events instead," Hristova said. "We should also not use antibacterial products in our daily life. This contributes to the creation of superbugs resistant to antibiotics. The amount of triclosan and other antibacterial chemicals in the waste stream is way higher than the amount of antibiotic medicines in the waste stream."

The researchers think antibiotic-resistance gene exchange processes similar to those that may be happening in the sediment could be occurring in the guts of invasive zebra and quagga mussels, which are found in large numbers in Lake Michigan and its harbors.

"The mussels are filter feeders, and even with short bacteria residence times, we observed in my lab that genetic exchange can happen between the different bacteria that the mussels filter out of the water," Hristova said. "Our findings bring awareness of how important it is that we learn more about antibiotic resistance in the environment and take action to prevent this form of pollution."

The lead author of the study is Anthony Kappell, Marquette University. Besides Hristova, other co-authors are Maxwell DeNies and Neha Ahuja, Marquette University; Nathan Ledebroer, Medical College of Wisconsin and Dynacare Laboratories; and Ryan Newton, University of Wisconsin-Milwaukee.—MEZ

YOU CAN HELP

Avoid soaps, detergents and wipes labelled "antibacterial." Antimicrobial ingredients such as triclosan contribute to the problem of antibiotic-resistant bacteria, and plain soap and water work just as well in most circumstances. Alcohol-based hand sanitizers do not contribute to antibiotic resistance.



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a joint newsletter from UW Sea Grant and UW Water Resources



CALENDAR OF EVENTS

APRIL 25 – 27, 2016

American Water Resources Association, Specialty Conference

Anchorage, Alaska

awra.org/meetings/Anchorage2016

JUNE 6 – 10, 2016

IAGLR, Conference on Great Lakes Research

Guelph, Ontario

iaglr.org/iaglr2016

JUNE 19 – 24, 2016

Association of State Floodplain Managers Annual Conference

Grand Rapids, Mich.

bit.ly/1TZGs92

JUNE 21 – 23, 2016

Universities Council on Water Resources

Pensacola Beach, Fla.

ucowr.org/conferences/2016-ucowr-conference

AUG. 21 – 25, 2016

American Fisheries Society

Kansas City, Kan.

2016.fisheries.org

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