2015 volume 1

Aquatic Sciences Chronicle

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<u>UNIVERSITY OF WISCONSIN SEA GRANT INSTITUTE UNIVERSITY OF WISCONSIN WATER RESOURCES INSTITUTE</u>

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Eat Wisconsin Fish



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WATER RESOURCES RESEARCH

From a Water Nuisance to a Water Cleanser

WATER RESOURCES INSTITUTE PROJECT LOOKS AT MANGANESE IN THE MADISON WATER SYSTEM

f you've ever turned on the tap only to have rusty or gray water gush out, you can sympathize with what residents of Madison, Wis., experienced in 2005. Routine flushing of the water mains by the city caused discolored water, which tasted strange and stained laundry in homes and businesses.

The culprits? Dissolved manganese and iron. In a quest to access the safer drinking water in deeper aquifers, the city drilled into water rich in these two elements. When the water mains were flushed during warm months to remove sediment and minerals in the pipes, the action also pushed through gray-black dissolved manganese and rusty-red iron.

Although these elements are more a nuisance than a health hazard, two University of Wisconsin-Madison researchers are concentrating on manganese because, ironically, it might be useful in cleaning water, including removing bisphenol A. With funding from the University of Wisconsin Water Resources Institute, assistant professors Matthew Ginder-Vogel and Christina Remucal are looking at the source of manganese in the aquifer rocks and how the manganese that ends up dissolved in the water reacts with other compounds, especially pollutants.

"Madison has set up filters to remove manganese from the water," said Ginder-Vogel. "This generates reactive solids that could be used

Researchers have found that naturally occurring manganese, which is filtered out of drinking water in Madison, Wis., is capable of degrading organic pollutants.

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UNIVERSITY OF WISCONSIN

Aquatic Sciences Chronicle

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University of Wisconsin Water Resources Institute

researches and safeguards state water assets. It is one of 54 such institutes nationwide authorized by the federal Water Resources Research Act and administered through the U.S. Geological Survey. *wri.wisc.edu*



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FEATURED SOCIAL MEDIA + WEB

Plunge Into New Wisconsin Shipwrecks Website

wisconsinshipwrecks.org

Everything you've ever wanted to know about Great Lakes shipwrecks is now available in one beautiful website.

Wisconsinshipwrecks.org, a joint project with the Wisconsin Historical Society (WHS), offers details on 760 lakes Superior and Michigan shipwrecks. Information on the ships' construction, service history, final voyage and location are searchable, as are any relevant videos and photos.

Nearby attractions such as historic waterfronts, lighthouses, museums, maritime trail markers, historic vessels, charter services, theaters, waterfront parks or archeological sites (and other shipwrecks) are also linked with each ship's story. These attractions are searchable by location and category as well.

The "learn" section of the site provides visitors with information about underwater archeology, the value of studying shipwrecks and how the studies are undertaken, field reports, a calendar of shipwreck-related events, a glossary of ship terms and a list of archival newspaper stories about the waters and their wrecks.

Each boating season, the WHS deploys 30 mooring buoys at wrecks that allow people to tie up directly above the site while protecting the shipwreck from inadvertent anchor damage and providing a safe point of ascent and descent for divers. Find buoy information at the site as well.





SEA GRANT RESEARCI

andy Lehr wants to prepare Chequamegon Bay for the worst.

"Chequamegon Bay is arguably the least climate-adapted spot in the country from an infrastructure viewpoint," said Lehr, Bro Professor of Sustainable Regional Development at Northland College in Ashland, Wis.

Precipitation estimates for the Bayfield Peninsula developed decades ago fail to take into account the unique local weather caused by geography and Lake Superior.

"As we've learned more about how weather patterns set up around here, we were way off—40 to 50 percent off on precipitation estimates on the lower side," Lehr said.

Unfortunately, the area's protection from heavy storms—culverts, road crossings and ditches—were all built based on these erroneous data.

Climate change exacerbates the problem. Chequamegon Bay is large and sits on the south shore of Lake Superior.

"If climate change is going to have an impact anywhere, Chequamegon Bay will be that place," Lehr said. "It's shallow and will probably warm up the quickest, and there are anomalies with the way we've built out the land surrounding the bay."

We've already seen evidence of these problems. Intense storms this fall breached a barge connection system in the harbor designed to protect

the Northern States Power Superfund site. Soil and groundwater at the site are contaminated with tar, oil, metals and other chemical pollutants. The damage postponed cleanup efforts until next spring, providing more time and opportunity for the substances to spread. Lehr's research, funded by Wisconsin Sea Grant, could help prevent such weather-related damage and delays in the years to come. To help the area prepare for future conditions, which include increased temperature and rainfalls, Lehr and his team are developing computer



useful to fishery managers, engineers, researchers and city planners. The next steps are to build draft models based on the data collected and to analyze the species found in the plankton tows the team conducted during the summer of 2014. Lehr hopes to have an understanding of all the data collected by spring so that he can refine the field sampling protocol for the upcoming field season. —MEZ

MATE CHANGE EFFECTS NCHEQUAMEGON BAY AREA

at temperature and rainfalls, Lehr and his team are developing computer models of the bay that focus on water circulation and the interactions between physical, chemical and biological processes. They are "ground-truthing" the models with measurements of temperature, nutrients, phosphorus, nitrogen, oxygen, etc., from area streams and 11 sampling sites in the bay.

Lehr expects the models developed through the Sea Grant project will be Precipitation estimates for the Bayfield Peninsula failed to take the unique local weather into account, and climate change will only exacerbate the problem.

wisconsinwaterlibrary



Spring Into (Greener) Gardening!

Even while you are gardening in your very own backyard, you can make a big difference in the health of our water ecosystems. Fertilizers and other chemicals used in conventional gardening are washed into watersheds where they can harm aquatic life. Check out these books for some ideas to kick-start you on the way to greener gardening.

GOOD BUG, BAD BUG: WHO'S WHO, WHAT THEY DO, AND HOW TO MANAGE THEM ORGANICALLY: **ALL YOU NEED TO KNOW ABOUT THE INSECTS IN YOUR GARDEN**

By Jessica Walliser. Pittsburgh: St. Lynn's Press, 2008. Lets you quickly identify the most common invasive and beneficial insects (and other tiny critters) in your garden, and gives the best organic advice on how to attract the good guys and manage the bad guys without reaching for the toxic chemicals.

LANDSCAPING WITH NATIVE PLANTS OF WISCONSIN

By Lynn M. Steiner. St. Paul, Minn.: MBI Pub. Co., 2007. Aimed at beginners and veteran gardeners alike, this book is designed to help Wisconsin gardeners find, plant and maintain the best native species for their specific sites, however modest or lavish

THE NATURAL HABITAT GARDEN

By Kenneth Druse. Portland, Or. : Timber Press, 2004. The use of native plants and natural habitats is a simple and effective way to establish and keep a low-maintenance and environmentally sound lawn or garden. Druse's photographs and descriptions of natural habitat gardens will inspire readers to adopt this approach in their own yards!

NATURAL LANDSCAPING: DESIGNING WITH NATIVE PLANT COMMUNITIES

By John Diekelmann. Madison, Wis: University of Wisconsin Press. 2002.

This work is unique in its focus on plant communities—approaching landscape design as the establishment of natural ecosystems rather than mere planting of specimens. It is filled with great advice, plenty of illustrations and a thorough discussion of issues.

YOUR ECO-FRIENDLY YARD: SUSTAINABLE IDEAS TO SAVE YOU TIME, MONEY AND THE EARTH By Tom Girolamo. Iola, Wis.: Krause;

Newton Abbot: David & Charles [distributor], 2009. Shows you how to plan and create a personalized ecosystem in your own yard with 20 projects, such as selecting appropriate native plants for your region, practicing water efficiency and conservation, and proper placement of trees and vegetation, plus tips and expert advice for saving the Earth, as well as time and money.

If you wish to see more books on this topic, visit our recommended reading list: go.wisc.edu/02mln6

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

programpeoplenews



Hart Named Assistant Director for Extension

Although the University of Wisconsin's Aquatic Sciences Center looked thoroughly, it didn't have to look far for the next assistant director for extension for the Wisconsin Sea Grant Institute. Twenty-year Wisconsin Sea Grant employee David Hart has been chosen for the position.

Hart's hire marks the final step in reorganization of the center's administrative structure by Director Jim Hurley, who divided up duties of retiring and departed staff members among a new assistant director for operations, an assistant director for research and student engagement, a grants and finance specialist and Hart's position.

"We conducted a national search for this position and it led right back to David," said Hurley. "He is already a leader in regional and national Sea Grant outreach issues. David is admired not only by us at Sea Grant but nationally for his reputation of creativity and excellence. I've always admired David's personal approach with students and staff who have worked alongside him. He's always treated them with respect and with a calm, kind heart. I'm proud to have him as part of our management team."

Hart began his Sea Grant career in 1994, when he was hired as a geographic information systems specialist, a joint position with the Land Information and Computer Graphics Facility (LICGF) at the University of Wisconsin-Madison. Through the LICGF, Hart conducted research and provided technical assistance and outreach to Wisconsin government officials regarding applications of geographic information system technology for Great Lakes coastal management. In 2002, Hart began full-time work for Wisconsin Sea Grant as a scientist, focusing on research and outreach that support sustainable coastal development.

Prior to moving to Wisconsin, Hart worked in Louisiana in urban and environmental planning. Hart earned his Ph.D. in land resources from the University of Wisconsin-Madison, a master's degree in urban and regional planning from the University of New Orleans and a bachelor's degree in natural resources from the University of Michigan.

Hart's outreach philosophy? "We've had wonderful and helpful people head up the extension staff in the past, including current Director Jim Hurley," Hart said. "Jim's philosophy was that it was his job to get the staff the resources they needed to succeed. That's mine, too."

As assistant director for extension, Hart will be overseeing the work of Sea Grant extension agents in Madison and four field offices. He will participate in regional and national networks on planning and program development, and ensure that extension efforts are cohesive. He will also continue his current work on coastal-management issues. -MEZ

Hauxwell Named Assistant **Director for Research and Student Engagement**

The Aquatic Sciences Center (ASC) has turned to extensive experience and expertise in naming Jennifer Hauxwell as the engagement.

organization's new assistant director for research and student Hauxwell has spent the last six years directing the Wisconsin Department of Natural Resources Fisheries and Aquatic Sciences Research program, leading a team of researchers in a mission that shares many of the same issues and priorities as Wisconsin Sea Grant's research portfolio. She's also quite familiar with the program's overall strategic priorities and organizational structure, having been a member of Wisconsin Sea Grant's Advisory Council since 2012. "Jennifer brings a wide range of experience to our program and many exciting new ideas to help move us forward on mul-

tiple fronts," said Wisconsin Sea Grant director Jim Hurley. "We're all extremely excited to add her to our team."

Hauxwell, who holds a Ph.D. in aquatic ecology from Boston University's Marine Program at the Woods Hole Marine Biological Laboratory, has a long history with the Great Lakes, dating back to a childhood spent on the shores of Lake Michigan, and Wisconsin's inland waters, after conducting nutrient and aquatic invasive species research here since 2001. She also knows the ocean coasts, having conducted nutrient-related research in New England estuaries (1994–2000) and Florida springs and estuaries (2000–01) and having worked with Florida Sea Grant in the early 2000s on a set of outreach materials related to the effects of nutrient loading on Florida's coastal waters. Given that the effects of nutrient loading-specifically phosphorus and nitrogen-are one of the biggest issues threatening the quality of Wisconsin's coastal waters, Hauxwell's experience is especially apropos.

I appreciate working as a team and in partnership with others toward our mission to support multidisciplinary research,



education and outreach for the protection and sustainable use of Wisconsin's water resources, and to increasingly engage students in this process," said Hauxwell. "Combining the ASC's strengths in the areas of scientific excellence and communications with an increased focus on making that science actionable for society will mean better-informed decisions for our and future generations."

In addition to managing Wisconsin Sea Grant's extensive research portfolio, Hauxwell will also be charged with tackling one of the organization's most important new priorities-finding ways to engage and leverage the nearly 200 undergraduate and graduate students Wisconsin Sea Grant and WRI support each year as part of their research and outreach activities. One of the top items on Hurley's agenda is to make sure these students, many of whom will now be known as Sea Grant Fellows, get the full experience of being part of Sea Grant, including professional development and opportunities to interface with each other and with experts in a wide range of disciplines. -ARC

Local Healthy Delicious



EAT WISCONSIN FISH Looking Back, Moving Forward

Ben Hunter of Underground Food Collective and Kathy Kline of Sea Grant

Eat Wisconsin Fish.

It's a statement, simple and direct, using just three words.

It's also a directive, charging the listener to think about expanding dinner choices and changing buying habits.

And, for the past year and a half, it's been a statewide campaign led by the staff of Wisconsin Sea Grant, designed to educate consumers on the availability and health benefits of sustainable and healthy fish farmed in Wisconsin or caught in the waters of Wisconsin's Great Lakes.

"THERE WASN'T ONE PLACE YOU COULD GO TO GET INFORMATION ABOUT WHERE TO BUY LOCAL, FARM-RAISED FISH, NOW, THERE IS."

-Kathy Kline, Education Outreach Coordinator

The first wave began with a surge of social science. Wisconsin Sea Grant Social Scientist Jane Harrison and Education Outreach Coordinator Kathy Kline conducted multiple focus groups in Milwaukee and Madison to gauge consumers' familiarity with Wisconsin fish and determine

what, if any, barriers prevented them from purchasing and cooking it. They discovered there was a lot of interest...but not quite as much knowledge.

"There wasn't one place you could go to get information about where to buy local, farm-raised fish," said Kline. "Now, there is."

Kline's talking about the **eatwisconsinfish.org** website, packed with extensive information about the various types of Great Lakes and Wisconsin fish, a set of home preservation fact sheets and a map that displays locations where Wisconsin fish can be purchased. There's also a Twitter stream (**@EatWIFish**) sharing weekly recipes and information about local seafood.

The campaign has hosted several dinner events that brought together local fish, producers, chefs, diners and Sea Grant staffers Kline, Harrison and Fisheries Specialist Titus Seilheimer.

Harrison, meanwhile, has applied for a Wisconsin Department of Agriculture Buy Local Grant. If she's successful, it would fund further efforts to connect producers of Wisconsin seafood to retailers, restaurants and consumers.

"We have a long way to go to making local fish products available in our grocery stores, farmers' markets, and restaurants," said Harrison. "The grant would allow us to purchase some valuable marketing space, including targeted social media and online advertisements, as well as hosting events to strengthen the fish product food chain."

Other building blocks are already in place. Wisconsin Sea Grant Aquaculture Outreach Specialist Fred Binkowski is the man who perfected a process that allows yellow perch to spawn year-round. Binkowski is currently working with Milwaukee-based Will Allen Farms to produce and distribute yellow perch crops to local restaurants. And Wisconsin Sea Grant is also partnered with Chris Hartleb, director of the UW-Stevens Point's Northern Aquaculture Demonstration Facility, supporting the development of new sustainable fish species like saugeye.

"2014 was a great year to start building the program and message in different outreach events," said Seilheimer. "Each interaction educated people on Wisconsin fish and then those people hopefully reached more. Once people start making the conscious choice to 'Eat Wisconsin fish,' then everyone's a winner!" —ARC

Sea Grant Goes Under the Microscope

The National Oceanic and Atmospheric Administration will conduct its quadrennial administrative review of the Wisconsin Sea Grant College program in April. The program's stakeholders and partners are invited to submit comments.

The director of the National Sea Grant College Program is convening this review to fulfill a Congressional mandate that state Sea Grant programs be regularly reviewed. A site review team of experts will visit and evaluate Wisconsin Sea Grant on April 21 and 22, 2015. The last such review was conducted in 2011.

The National Sea Grant Office will review the following aspects of Wisconsin Sea Grant's operations:

- Program management and organization (organization, program team approach and support)
- Stakeholder engagement (relevance, advisory services, and education and training)
- Collaborative activities (relationships and coordination)

You are encouraged to email comments to **oar.sg.feedback@noaa.gov** by April 14, 2015.

Learn more about Wisconsin Sea Grant's history, leadership, mission and current activities at **bit.ly/1Awv8ry**.

For further information about this review process, please email **moira@aqua.wisc.edu**.

PRESIDENT-ELECT HURLEY National Sea Grant Association Has Leadership



t's okay to begin practicing your rendition of "Hail to the Chief." You'll just have to wait a few more years-more specifically, until 2017—to use it.

Jim Hurley, director of Wisconsin Sea Grant, has been named president-elect of the national Sea Grant Association, the organization of representatives from the 33 academic institutions that make up the National Sea Grant College Program.

The primary role of the SGA president is educating members of the U.S Congress about the goals and accomplishments of the Sea Grant programs, as well as helping to coordinate their activity. The SGA works closely with the National Sea Grant Office to coordinate activities and help move the program in new directions. In this sense, Hurley will be able to hit the ground sprinting. Not only did he serve a year in the offices of the National Oceanic and Atmospheric Administration, Sea Grant's parent organization, but he also made an annual pilgrimage to Washington to visit legislators when he served as Wisconsin Sea Grant's assistant director from 2002 to 2011.

"I've really seen the process from both sides, both from an advocacy standpoint and from someone who's had to put together a budget each year," said Hurley. "I think that dual perspective will be valuable for all our programs."

Hurley also sees his SGA role over the next three years as a great opportunity to help guide and hone Sea Grant's missions and objectives, incorporating more social science research and increasing a growing national focus on resilient coastal communities and the effects of climate change.

"I follow in the footsteps of some of the core players in developing the framework to promote innovative coastal research, outreach and education," said Hurley. "It's humbling to have the support of Sea Grant directors, some of the most creative and respected coastal scientists. I look forward to working with them to promote this great program."



The Journey Begins for Knauss Marine Policy Fellows

By the time you read this, Wisconsin Sea Grant's three 2015 Knauss Marine Policy Fellows will be about a month into their new year-long assignments in Washington, D.C. Caroline Mosley, Catherine Simons and Kristina Surfus headed east last November for placement week, where each discovered her exciting fate: Mosley is serving as a communications specialist for NOAA Research, Simons is the policy liaison to the U.S. Navy oceanographer and Surfus will work in the office of Wisconsin Sen. Tammy Baldwin. Look for ongoing updates on their progress on Great Lakes Takes, Wisconsin Sea Grant's Tumblr blog: uwiscseagrant.tumblr.com.



Knauss Fellows Caroline Mosley (left), Kristina Surfus and **Catherine Simons in** Washington, D.C., during placement week.

To residents like Bob Cragin, the St. Louis River, which forms a far northwest border between Minnesota and Wisconsin, transcends cultural and political boundaries. To others like Lynelle Hanson, the river provides a home for birds and the opportunity to educate children about nature. Their stories and others are presented along with information and examples of scientific work going on in the St. Louis River in a new website.

The "Stories and Science of the St. Louis River Estuary" site was created by faculty and staff from the University of Minnesota Duluth and

University of Wisconsin-Madison with help from many partners and with funding by the Wisconsin and Minnesota Sea Grant programs and the Minnesota Pollution Control Agency. Featured topics include wild rice, fishing, recreation, community and restoration projects. Site visitors can challenge themselves with "GeoQuests"-iPhonebased games and geocaches that highlight key places and issues in the estuary, or they can use the "deep map" to explore the ecology and history of this special place.

Visit stlouisriverestuary.org to learn more.

Landlocked but Water Wise

Two Wisconsin teachers have made exceptional use of the educational resources that Sea Grant has to offer.

The teachers are Lynn Kurth and Cindy Byers. Kurth works as a science teacher for Prairie River Middle School in Merrill, Wis. Just a 50-minute drive away, Byers works as a science and reading teacher for Rosholt Middle School in Rosholt, Wis.

They met in 2011 during a week-long voyage on the Lake Guardian, a research vessel owned by the U.S. Environmental Protection Agency (EPA). They were partici-

pating in a Shipboard and Shoreline Science Workshop, a program conducted by the Great Lakes Sea Grant programs through the former Centers for Ocean Sciences Education Excellence (which has become the Center for Great Lakes Literacy). Kurth and Byers bonded over a Hydrolab—a large, tubular piece of water testing equipment-and they saw the opportunity to partner in the future.

"We supported each other's teaching and enriched each other's classrooms by having this collaboration," Byers said. "We had the kids Skype with each other a couple of times and present the Hydrolab data they collected. Even though our schools are not that far apart, it seemed quite exotic to the kids and they were excited to use a piece of equipment that scientists use. A lot of the reasons we've been able to do so much with the program is that we've been supporting each other all along."

After sharing among themselves, the two got the idea to share their methods with other teachers. They've conducted several teacher workshops with the Hydrolab in cooperation with Wisconsin Sea Grant and Illinois-Indiana Sea Grant on the Denis Sullivan schooner out of Milwaukee. They've also shared their techniques at a National Marine Educators Association conference in Alabama in cooperation with Illinois-Indiana Sea Grant, and they gave a presentation at a Wisconsin science teachers workshop last fall. Minnesota Sea Grant provided the duo with funding to go to an International Association for Great Lakes Research conference at Purdue University as well.

"There's so much synergy between us," said Kurth of her and Byers. "One thing has led to the next. Every time we're introduced to something new with Sea Grant, it opens another door."

The two worked with Illinois-Indiana Sea Grant for a year to develop a teacher instruction manual that supplements the technical manual that comes with the Hydrolab. It contains step-by-step instructions and lesson plans.

In the future, the teachers hope to share information at other national science teacher conferences and to work with Wisconsin Sea Grant on using remotely operated underwater vehicles.

"The engineering principles would complement the work my kids are doing with the Hydrolab," Kurth said.



The Shipboard and Shoreline Science Workshop that brought Kurth and Byers together is held yearly on a different Great Lake. It's just one of the many professional development opportunities available to teachers through the Center for Great Lakes Literacy (call.ora)

WATER RESOURCES RESEARCH Water Nuisance... Water Cleanser

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in beneficial ways. Right now, the solids are sent through the sanitary sewer system or disposed of as solid waste. We had the idea of looking at whether the manganese collected on the filters can be beneficially reused down the line, perhaps for stormwater treatment."

Madison does not get its drinking water from the iconic lakes Mendota or Monona but from groundwater more than 320 feet down in the Mt. Simon Aquifer. This aquifer lies beneath many communities in Iowa, southeastern Minnesota, Wisconsin and the Upper Peninsula of Michigan. In the Madison area, the rocks that compose the aquifer contain manganese.

Manganese is naturally occurring in air, soil and water. It is an essential nutrient at low doses, but long-term exposure to high doses can harm the nervous system of people and animals, potentially causing tremors, lethargy and mental disturbances.

After the discoloration episodes in 2005, four out of 24 wells in Madison were found to produce water that exceeded recommended levels of manganese. In response, the city installed filters and employed a different method of flushing problematic water mains, called "unidirectional flushing," which minimizes the water discoloration reaching homes and business.

The researchers and their two graduate students spent time at manganese-rich city Well 29 in eastern Madison, collecting manganese solids from its filters. They also followed water utility workers around in a van full of five-gallon buckets





and collected solids from their water main flushing activities, Ginder-Vogel said.

Remucal said results look promising. "We've found that the manganese solids are capable of degrading organic pollutants. We've been working on bisphenol A, a contaminant that's found in plastic."

The U.S. Department of Health and Human Services has "some concern" for bisphenol A's effects on the brain, behavior and prostate gland in fetuses, infants and children at current exposure levels. Also of concern is the chemical's ability to induce earlier puberty in children.

For Remucal and Ginder-Vogel, the project is one made in academic heaven.

"Christina is a specialist in organic contaminant transformation and has done some minerals surface work. I'm a specialist in mineral surface chemistry. It just seemed like a great way to collaborate on an interesting and applicable problem," Ginder-Vogel said.

The two hope their project will provide guidance to regulators and water quality managers on the sources and reactivity of manganese in the Madison water distribution system. It could also provide information for other water utilities that face elevated manganese. And it just may be a great way to turn a water nuisance into a water cleanser. -MEZ

Top: Christian Dewe a graduate student working with Remuca and Ginder-Vogel, with the filter system at Well 29 that removes manganese from the drinking water.

Bottom: Research students Rosannae Chhouk (left) and Sarah Balgooven



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Aquatic Sciences Chronicle

a joint newsletter from UW Sea Grant and UW Water Resources



CALENDAR OF EVENTS

MAY 25 – 29, 2015 IAGLR, Conference on Great Lakes Research Burlington, Vt. *iaglr.org/iaglr2015*

MAY 31 – JUNE 1, 2015 Association of State Floodplain Managers Annual Conference Atlanta asfpmconference.org

JUNE 15 – 17, 2015 American Water Resources Association New Orleans *awra.org/meetings/NewOrleans2015*

JUNE 16 – 18, 2015 Universities Council on Water Resources Las Vegas ucowr.org/conferences/2015-conference

AUG. 16 – 20 American Fisheries Society Portland 2015.fisheries.org



Sea Grant 2012–14 Biennial Report

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