

ASC

Aquatic Sciences Chronicle

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

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SEA GRANT RESEARCH

"Fingerprinting" Wild Rice

EXAMINING ITS GENETIC MAKEUP MAY REVEAL
CRITICAL EVIDENCE TO AID RESTORATION



Tribal members from the Bad River Band of Lake Superior Chippewa (Ojibwe) harvest wild rice on the Kakagon Sloughs near Ashland, the only large, pristine coastal population of wild rice remaining in the entire Great Lakes region.

Wild rice was once so abundant in Wisconsin that it gave its name to many bodies of water throughout the state. One or more "Rice Lakes" are located in 21 of Wisconsin's 72 counties, but today many of them are rice lakes in name only. Since the settlement of Europeans, people have altered the landscape and made it difficult for the plant to succeed.

Along the shores of Lake Superior and Lake Michigan, wild rice has suffered a similar fate. Today, just one large population remains—on the Lake Superior shore of Ashland County—along with a few other small, remnant populations scattered around the Wisconsin coastline. A Sea Grant-funded researcher is examining the genetic makeup of these remaining populations to find out how to preserve the identity of wild rice while expanding its distribution along the Lake Superior and Lake Michigan coastlines.

Anthony Kern is a plant geneticist at Northland College in Ashland, Wis. He said that in coastal habitats, wild rice (*Zizania palustris*) thrives in shallow water with a current and silty bottom—typically at the mouths of river estuaries. Over the years, channelization, sedimentation,

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The Aquatic Sciences Center is the administrative home of the **University of Wisconsin Sea Grant Institute** & **University of Wisconsin Water Resources Institute**.

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University of Wisconsin Sea Grant Institute is part of a national network of 32 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. www.seagrant.wisc.edu

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. www.wri.wisc.edu



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FEATURED VIDEO

All Washed Up: Lake Michigan's Algae Challenge

What's green and slimy, smells like sewage, and ruins vacations? Excessive algae piling up on Wisconsin's Lake Michigan shores, that's what. It's called *Cladophora*, and it blunts tourism spending, lowers property values, and clogs industrial water intake pipes. The costs add up to millions of dollars each year.

Find out more in a new video from Wisconsin Sea Grant. The 18-minute video features interviews with beachgoers, lakeshore property owners and coastal residents about the problem, and it turns to biologist Harvey Bootsma of the UW Great Lakes WATER Institute for an explanation of the science behind the stink. Also included is a eight-minute version, for those in a hurry.

"All Washed Up" can be viewed online at www.seagrant.wisc.edu/algae. Free DVDs of the video can be ordered at the UW Aquatic Sciences Center's online publication store, <http://aqua.wisc.edu/publications>.

programpeoplenews



photo by Jeff Kline

Rashid wading in the Wolf River during sturgeon spawning season.

ASC Mourns Death of Bob Rashid

Staff at the Aquatic Sciences Center (ASC) were saddened by the sudden death of Bob Rashid in October at the age of 59. A freelance photographer/writer whose work appeared in *Time*, *Newsweek*, and *The New York Times*, Rashid worked with many departments on the UW-Madison campus, including the ASC.

He published three books: *Wisconsin's Rustic Roads*, *Backroads of Wisconsin*, and *Gone Fishing*. A fourth, *People of the Sturgeon*, is scheduled to be published in October 2009 by the Wisconsin Historical Society Press. ASC Science Writer Kathleen Schmitt Kline coauthored the book with Ron Bruch of the Wisconsin Department of Natural Resources and ASC Aquaculture Advisory Services Specialist Fred Binkowski. Rashid spent two years chronicling the cultures surrounding lake sturgeon in the Lake Winnebago region, and the book will feature more than 150 of his best color photographs.

"Bob was a gifted artist and a wonderful human being," said Kline. "We were so fortunate to have him as a partner on this project. It was always a pleasure to spend time with him, whether driving out on frozen Lake Winnebago, wading in the Wolf River, or attending a pow-wow. I feel lucky to have known him, and we all miss him."

Rashid's portfolio can be viewed at rashidphoto.com.

For more information about *People of the Sturgeon*, see winnebago.sturgeon.org.

STUDYING THE BUGS THAT FIGHT BACK

**THE MORE ANTIBIOTICS
THE BACTERIA
ENCOUNTER, THE FASTER
THEIR RAPIDLY EVOLVING
POPULATIONS DEVELOP
RESISTANCE, MAKING
THE DRUGS POTENTIALLY
INEFFECTIVE...**

Antibiotics fight dangerous bacteria in humans, farm animals, and farm-raised fish, but their use—and overuse—has led to bacteria that fight back—by the billions. The more antibiotics the bacteria encounter, the faster their rapidly evolving populations develop resistance, making the drugs potentially ineffective when they are most needed.

The bodily waste of antibiotic users contain both drug residue and resistant bacteria, and even after they pass through waste treatment processes, they are still found in the environment in high enough concentrations to be considered pollutants.

Katherine “Trina” McMahon, associate professor of civil and environmental engineering at UW–Madison, is trying to determine whether these pollutants could find their way into our water supply. She and her students are using cutting-edge technology to examine the genetic make-up of bacteria that are known to be resistant to the antibiotic tetracycline. If the resistance genes are mobile, they could move from one bacterium to another, allowing their rapid reproduction rates to spread their drug-resistant traits even faster.

In contrast to traditional methods of culturing bacteria in the lab, McMahon used molecular techniques to extract DNA from tetracycline-resistant bacteria found in two completely different settings—a new subdivision and four aquaculture facilities, all located in Wisconsin.

With funding from the Water Resources Institute, McMahon tested water samples from a subdivision’s individual on-site septic tanks, groundwater monitoring wells, and the homes’ water taps to see if tetracycline-resistance genes were present and, if so, at

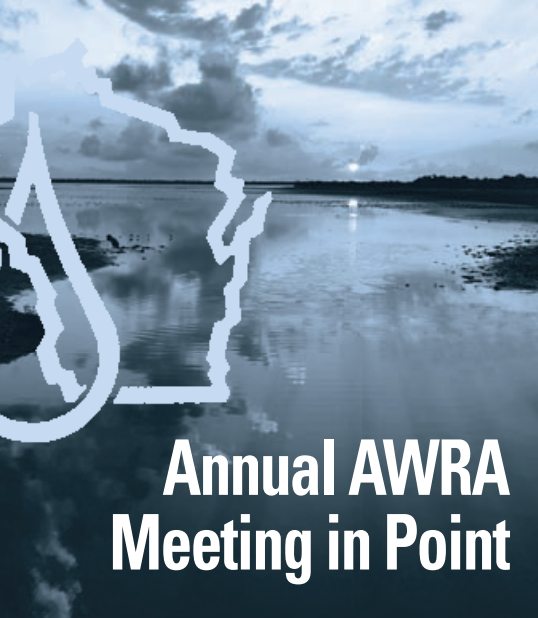
what concentrations. The objective was to determine if the nearby septic tanks and drain fields could contaminate the drinking water with the resistant bacteria.

The analysis showed no human health risks from antibiotic-resistant bacteria in the drinking water systems in this particular subdivision. More antibiotic-resistance genes were found in the septic tanks and monitoring wells than in the drinking water supplies. The sources of the genes could be the ubiquitous presence of bacteria in the human gut, the use of antibiotics by homeowners, past agricultural activity, or natural background levels.

With Sea Grant funding, McMahon applied the same genetic testing in four trout hatcheries; two of the facilities had at one time treated their fish with the antibiotic oxytetracycline, and the other two had not. The unexpected finding was that water in all four facilities tested positive for the tetracycline-resistance genes. McMahon determined that the likely source was the fish food, even if it was labeled as nonmedicated feed. Fish food is made up of processed fish mostly of unknown origin, so McMahon theorizes that at least some of the fish that made up the feed must have been exposed to antibiotics during some phase of their lives.

Hatchery managers in Wisconsin use antibiotics sparingly and need to know that the medicine will be effective when most needed. McMahon feels confident that her findings will be put to good use in the hatcheries.

“If the source was the atmosphere, there wouldn’t be much we could do. But when the source of the gene is as obvious as the feed,” said McMahon, “that is something that we can control.” —CRB



Annual AWRA Meeting in Point

“Wisconsin’s Changing Water Resources” is the theme of this year’s annual meeting of the Wisconsin section of the American Water Resources Association (AWRA) March 5–6 at the Ramada Stevens Point Hotel in Stevens Point, Wis.

The meeting will include more than 50 oral and poster presentations addressing a wide range of water resources topics. Students are strongly encouraged to attend the conference to learn, network, and gain experience in presenting their work. As such, AWRA offers a special reduced student registration rate, as well as several awards for the best student presentations.

An opening plenary session will highlight the effects of climate change on water resources in Wisconsin, featuring invited speakers Chris Kucharik, senior scientist at the UW–Madison Center for Sustainability and the Global Environment; John Magnuson, UW–Madison emeritus professor of zoology and limnology; and George Stone, natural sciences instructor at the Milwaukee Area Technical College. In addition, featured evening speaker John Zappa, brewmaster at the Stevens Point Brewery, will share some of the history of the 152-year-old brewery and discuss water uses in the brewing process and daily operations.

For more information about the conference, including a registration form, please visit www.awra.org/state/wisconsin. The meeting is hosted by the AWRA–Wisconsin Section, UW Water Resources Institute, Center for Watershed Science and Education at UW–Stevens Point, Wisconsin Department of Natural Resources, and the Wisconsin District of the U.S. Geological Survey.



wisconsin'swaterlibrary



Water Library Launches 'AquaLog' Blog

Looking for an online source of up-to-date, water-related news, publications and resources for Wisconsin and the Great Lakes region? Check out Wisconsin's Water Library's "AquaLog" at aqualog2.blogspot.com!

The Water Library chose to incorporate blog technology into its new Web site (aqua.wisc.edu/waterlibrary) as a way to connect with library patrons, water researchers, and Great Lakes residents on a daily basis. In this era of information overload, the library staff hopes AquaLog can provide an organized way to share information on current trends in the water field and new, useful, and reliable resources. AquaLog posts are searchable by topic, and a monthly archive is available.

The blog highlights resources provided by such organizations as the Wisconsin Department of Natural Resources and U.S. Environmental Protection Agency, and many others.

If you wish to receive notices of updates to the blog, you can sign up for an RSS feed on the Web site. The library staff welcomes comments and suggestions at askwater@aqua.wisc.edu.

Wastewater Treatment Manuals Now Available

Wisconsin's Water Library partnering with the Wisconsin Department of Natural Resources and the Wisconsin Wastewater Operator's Association (WWOA) to make available technical manuals that support the educational needs of current and potential wastewater operators around Wisconsin.

These manuals aid the 2,000 WWOA members in preparing for their required license examinations as well as support their ongoing educational needs.

The library will catalog, house, and loan essential technical manuals purchased by WWOA. These include:

ADVANCED WASTE TREATMENT: A FIELD STUDY TRAINING PROGRAM

by Kenneth D. Kerri. Sacramento: California State University Sacramento Foundation, 2006.

OPERATION OF MUNICIPAL WASTEWATER TREATMENT PLANTS

New York: WEF Press; McGraw Hill, 2008. 3 volumes.

OPERATION OF WASTEWATER TREATMENT PLANTS: A FIELD STUDY TRAINING PROGRAM

Sacramento: California State University Sacramento Foundation, 2007.

OPERATION OF MUNICIPAL WASTEWATER TREATMENT PLANTS STUDY GUIDE

New York: WEF Press, McGraw Hill, 2007.

HANDBOOK OF WATER AND WASTEWATER TREATMENT PLANT OPERATIONS

by Frank R. Spellman. Boca Raton, Fla.: Lewis Publishers, 2003.

FOR MORE, PLEASE VISIT THE WATER LIBRARY AT

<http://aqua.wisc.edu/waterlibrary>.

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



Exploration Workshop Focuses on Lake Superior in 2009



EPA Research Vessel Lake Guardian
Source: EPA GLNPO



Teachers and other educators have a unique opportunity to work with Great Lakes scientists this summer aboard the research vessel *Lake Guardian* as it explores Lake Superior. The seven-day workshop is sponsored by the Great Lakes Centers for Ocean Sciences Education Excellence (COSEE Great Lakes) for those who work with students in grades 4–10 in either a classroom or non-classroom setting.

UW Sea Grant Education Coordinator Jim Lubner will lead the team of instructors on the Lake Superior cruise. The intensive curriculum will focus on a variety of topics, including coastal processes, hydrology, ecology, and water quality.

Aboard ship, participants will collect water samples for chemical and biological analysis, identify plankton and benthic species, and measure the water clarity of the lake. They will also learn more about Great Lakes ecosystems through hands-on laboratory work and presentations by water scientists. At the end of the workshop, participants will meet to summarize their findings and to reflect on how they will use their new knowledge in their own educational programs.

Lubner, who taught last summer's workshops on Lakes Ontario and Michigan, spoke enthusiastically about the experience: "It's a great way to span the bridge between research scientists and educators." Teacher Barb LaMourea agreed: "We are like sponges soaking up the knowledge to squeeze out on our students."

For more information, teachers can check the Web site www.coseegreatlakes.net or contact Jim Lubner at jflubner@aqu.wisc.edu.

Applicants Sought for 2010 Knauss Fellowship Program

Graduate students who have an interest in ocean, coastal, and Great Lakes resources and in the national policy decisions affecting those resources have a unique opportunity to work in Washington, D.C., through the National Sea Grant Knauss Marine Policy Fellowship Program which matches highly qualified graduate students with "hosts" in the legislative and executive branches of government.

Wisconsin's Sea Grant College Program is currently seeking applications for the one-year paid internship that begins in February 2010.

To date, 17 Wisconsin students have been selected to participate in the program, which is partly funded by UW Sea Grant. Applications are due by 4 p.m. Friday, February 20, 2009, and should be addressed to Terri Klousie, Aquatic Sciences Center, 267 Goodnight Hall, 1975 Willow Drive, Madison, Wisconsin 53706-1177.

More information about the fellowship program is available at www.seagrants.noaa.gov/knauss.



Great Lakes maps

All 76 maps of the Great Lakes published by the U.S. Lake Survey from 1852 to 1882 are now available online at www.greatlakesmaps.org. "No public institution has all of these rare historical documents," said ASC librarian Anne Moser. "Digitizing and putting them online is probably the only way that anyone will ever be able to see them all together." The Lake survey, created in 1841 by Congress, was charged with conducting a "hydrographical survey of the Northern and Northwestern Lakes" and preparing and publishing nautical charts and other navigation aids. This pioneering effort eventually grew into a comprehensive program of scientific investigations and monitoring of the Great Lakes conducted through NOAA's Great Lakes Environmental Research Laboratory in Ann Arbor, Mich.



Lake Superior NERR moves forward

Governor Jim Doyle announced that the National Oceanic and Atmospheric Administration (NOAA) approved his nomination of the St. Louis River as a National Estuarine Research Reserve (NERR). The St. Louis River is the largest U.S. tributary to Lake Superior and forms the headwaters of the entire Great Lakes System. Its waters and wetlands are nationally significant and provide critical habitat for birds, fish, and plants. The approved nomination continues the progress toward federal designation that will raise the national profile of Wisconsin's Great Lakes resources and bring more federal funds to the region for research and outreach.

Beth McGee of the Chesapeake Bay Foundation and Gene Clark visit the Thompson Hill Overlook in Duluth for a view of the St. Louis River Estuary. Photo by Marie Zhuikov/Minnesota Sea Grant

Dredging on Lower Fox to begin in spring

Dredging of the Lower Fox River to remove PCBs (polychlorinated biphenyls) is expected to begin this spring. A 39-mile section of the river contains approximately 8 million cubic yards of contaminated sediment. Approximately 4 million cubic yards will be removed by dredging, and roughly 600 cubic acres will be capped. For nearly two decades, one Fox River mill used PCBs to produce carbonless copy paper, and other mills recycled the paper. Together the mills discharged nearly 700,000 pounds of PCBs into the Fox River before the chemical was banned by the federal government in 1976. PCBs can cause a variety of developmental, immunological, reproductive, and neurobehavioral problems in humans and wildlife. The Lower Fox River is the largest single tributary source of PCBs on Lake Michigan.



"Fingerprinting" Wild Rice

continued from page 1



and industrialization altered most coastal areas where the grain once thrived. Even in areas where the habitat has improved, boat traffic, shoreline development, beavers, and carp can make it difficult for the remaining stands to persist. But Kern said these outside factors aren't the only problems facing wild rice—one problem may be found in the plant itself, buried deep in its genetic makeup.

The St. Louis River estuary near Superior is one of many areas in Wisconsin that was once filled with wild rice. Today, only a few isolated populations remain. "These populations have become separated from

each another—they've become fragmented," Kern said. If these populations have become so isolated that they no longer share pollen, and therefore genes, "there's some concern from a genetic standpoint," he said. "Small populations—especially of annual plants like wild rice—will inevitably be subject to inbreeding."

Just like in humans, inbreeding can result in problems that impair individuals and entire populations. Previous research suggests that inbred wild rice plants are smaller, weaker, and produce less seed—characteristics that could cause a dramatic decline in an already small, struggling wild rice population.

Kern is using molecular tools to discern whether or not inbreeding is taking place in fragmented populations of wild rice. Together with Ronald Phillips at the University of Minnesota, he spent two years combing through the wild rice genome to identify 40 distinct regions of DNA called microsatellites. These are particular locations on a DNA strand that contain a repetitive sequence of genetic information. All wild rice plants will have each sequence of repetitions at each particular chromosome location, but the number of repetitions will vary from population to population, and from plant to plant. (Microsatellites are the same molecular markers used in human DNA fingerprinting, an important tool in forensic and parentage studies.)

Kern will use the molecular markers to determine whether fragmented populations of wild rice, once part of a single continuous population, have now become genetically distinct and are experiencing inbreeding. By noting various physical traits of the plants he samples over the next two seasons and correlating those physical measures with his molecular analyses, he will try to quantify the degree of inbreeding that is taking place and assess how it is affecting the health of the population. Kern will also compare the genetic variability in fragmented populations to that of the Bad River/Kakagon Sloughs near Ashland, the only large, pristine coastal population of wild rice remaining in the entire Great Lakes region.

While still in the first year of the study, Kern is hoping that his results will eventually aid wild rice conservation work that is underway throughout the Great Lakes region by a network of state, federal, and tribal agencies. The molecular markers he developed will be available to anyone seeking to determine the genetic variability of specific wild rice populations. And for the small, remnant populations that agencies may wish to expand, understanding genetic variability is critical to selecting seed sources. The key is to provide enough variability to prevent inbreeding without introducing deleterious traits that could weaken the population. One potential strategy that could result from Kern's study would be to mix seed from nearby fragmented populations within the same river estuary, essentially mimicking historical patterns of gene flow and potentially reducing inbreeding at the same time.

"Some people say throw in seed from a bunch of sources and let the best genotypes win," Kern said. "That may be fine in places where wild rice has been completely wiped out or where it never existed before. But where there is a remnant population, it's a very special, unique situation, because those remnant populations serve as reservoirs for genetic adaptations that are unique to that particular habitat. We want to conserve as much genetic diversity in the plant across its range and maintain as much of the normal, historic patterns of genetic diversity and its distribution as possible. And in the places where there are remnant populations of wild rice, there are some very special considerations for restoration." — KSK



Every year Anthony Kern goes ricing for his own personal use on a small lake in northern Wisconsin using traditional Native American techniques. When he gathers material for his research, he travels in a kayak and only collects leaf tissue, not the wild rice seeds. He admits that sitting in a kayak surrounded by eight-foot tall wild rice plants can be very disorienting. "In some places the rice is so thick that I have to use a GPS to get out of it," he said.

A SIGNIFICANT FOOD FOR WILDLIFE AND PEOPLE

Wild rice is an annual aquatic grass that can reach a height of eight feet. It matures in late summer, attracting huge flocks of waterfowl that feed on it. The rice beds themselves provide important habitat for small aquatic crustaceans and insects, the foundation of wetland food webs.

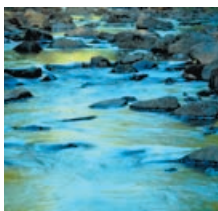
The nutty-flavored, protein-packed grain has been an essential part of the diets of Native Americans throughout the Great Lakes region for hundreds of years. It could be stored for long periods of time and used to add substance and sustenance to soups and stews. In Wisconsin, wild rice is still harvested in the traditional Native American way, using smooth, rounded, wooden rods to gently knock the seeds from the plants into a canoe.



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a joint newsletter from UW Sea Grant and UW Water Resources



CALENDAR OF EVENTS

FEBRUARY 20, 2009

Application Deadline for Knauss Marine Policy Fellowship Program

Washington, D.C.
www.seagrant.noaa.gov/knauss

FEBRUARY 21, 2009

Lake Sturgeon Bowl

University of Wisconsin–Milwaukee
Milwaukee, Wis.
www.glwi.uwm.edu/sturgeonbowl

MARCH 5–6, 2009

American Water Resources Association– Wisconsin Section 33rd Annual Conference

Stevens Point, Wis.
www.awra.org/state/wisconsin

JUNE 2008 – MARCH 19, 2009

Mysteries of the Great Lakes

Milwaukee Public Museum
Milwaukee, Wis.
www.mpm.edu/imax

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2008–10 Directory of Projects and People

University of Wisconsin
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All Washed Up: Lake Michigan's Algae Challenge

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