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Aquatic Sciences Chronicle

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

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Eat Wisconsin Fish



State of the Bay



Sturgeon Migrate to Chicago

WATER RESOURCES RESEARCH



STRONTIUM FOUND IN EASTERN WISCONSIN WELLS

Young children in high-strontium areas at risk

undreds of millions of years ago, geologic forces squirted massive layers of hot salty water underground through aquifers from Michigan to Wisconsin. As the hot brine raced along, it carried dissolved minerals, such as arsenic, iron, strontium and sulfur. Just like when hot salt water cools and forms crystals, when the hot brine came into contact with cooler rocks, it either mixed with other fluids—diluting itself—or cooled and deposited its minerals for later discovery by enterprising miners or scientific researchers.

One such ancient hydrothermal brine migration occurred in eastern Wisconsin, and University of Wisconsin Water Resources Institute researchers have discovered it is impacting drinking water quality for thousands of people. The element they found is strontium. Not to be confused with the radioactive version that is a byproduct of nuclear fission, this type of strontium is contained within a mineral known as celestine, Children who drink water containing strontium levels higher than 4 mg/L face an increased risk of developing health problems.

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Aquatic Sciences Chronicle

University of Wisconsin Aquatic Sciences Center 1975 Willow Drive Madison, WI 53706-1177

Telephone: (608) 263-3259 Email: *chronicle@aqua.wisc.edu*

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

Communications Manager Moira Harrington

Editor Elizabeth A. White

Writers

Aaron R. Conklin, Moira Harrington, Anne Moser and Marie Zhuikov

Designer Yael Gen

Circulation Manager Linda Campbell

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FEATURED SOCIAL MEDIA + WEB

Eat Wisconsin Fish eatwisconsinfish.org

It's a website that favors both taste buds and brain cells. It's **eatwisconsinfish.org**. The site provides great detail on the delicious fish you can purchase from local waters, whether it is a wild-caught species like whitefish or burbot or farm-raised fish like yellow perch or tilapia. It offers recipes and beverage pairing suggestions, and it explains the taste and nutritional content of 10 species.



Visitors to the site can also feed their brains with the biology and history of Wisconsin's fish for consumption.

"Wisconsinites are strong supporters of their local food producers," said Kathy Kline, a Sea Grant outreach specialist who is leading the team working on eatwisconsinfish.org. "After surveying grocery store customers, we found that people wanted to know more about the local fish they could purchase. Wisconsin has a long and proud tradition of commercial fishing, as well as a thriving fish-farming industry. This site is chock-full of everything you need to know about the delicious local fish you can purchase at the grocery store, fish market or farmers' market."

Currently, more than 90 percent of the seafood eaten by Americans is imported from other countries. Through eatwisconsinfish.org and other communication materials, Sea Grant hopes that more people will choose to put healthy, local fish on their dinner tables.





SEA GRANT RESEARCH

GREEN BAY REPORT OUTLINES PROGRESS, IDENTIFIES PROBLEMS

fter several years of work, Wisconsin Sea Grant has Good news can be found for fish populations. Green Bay finalized "State of the Bay: The Condition of the supports a walleye trophy fishery, which remains unchanged. Bay of Green Bay/Lake Michigan 2013." This third Spotted muskies are also faring well due to stocking efforts edition of the report, written by Theresa Qualls, and hatchery production. Northern pike are holding their own Bud Harris and Victoria Harris, and published 20 years after and currently receiving considerable attention with spawning the previous edition, presents new data on water quality, as habitat restoration. well as data on fish and wildlife populations, aquatic inva-Beach closings due to bacterial contamination are at a fair sive species, beach conditions and the status of contaminants level and seem to be decreasing at most sites as a monitoring in the region. The authors point out the advantage of having program progresses and communities work at identifying and data over such a long period of time is that it allows scientists controlling sources of the bacteria. and citizens to identify trends. Coastal wetlands are currently in fair condition but remain

AREAS OF PROGRESS

Progress has been made from the 1970s and 1980s in the Lower Green Bay and Fox River area of concern on levels of ammonia and dissolved oxygen found in the water. The report attributes the decrease in ammonia to improved wastewater treatment. Dissolved oxygen levels are also generally good in large portions of the bay. Nevertheless, hypoxic areas ("dead zones") develop in isolated bottom waters during late summer.

Status and Trend Assessments of Green Bay Indicators

INDICATOR	STATUS	TR
Total Phosphorus	Poor	Ur
Ammonia	Good	Ur
Nitrate	Fair to Good	De
Total Suspended Solids	Poor	Ur
Chlorophyll a	Poor	Ur
Water Clarity (Secchi)	Poor	Ur
Dissolved Oxygen (DO)	Fair	Im
Toxic Contaminants	Poor	Ur
Water Levels	Below Average	De
Beach Health	Fair	Ur
Aquatic Invasive Species	Poor	De
Benthic Macroinvertebrates	Poor	Ur
Coastal Wetlands	Fair	De
Walleye	Good	Ur
Yellow Perch	Mixed	Im
Spotted Musky	Fair	Im
Northern Pike	Fair	Ur
Lake Sturgeon	Recovering Population	Im
Colonial Nesting Birds	Mixed	Im

Coastal wetlands are currently in fair condition but remain endangered due to development pressures and an increase in sediment in the water, which limits the amount of light available for plants.

AREAS NEEDING WORK

Phosphorus concentrations are known to be tied to harmful algal blooms. Until levels can be reduced, algal blooms are expected to persist.

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The "State of the Bay" reports data collected over 20 years, allowing scientists and citizens to identify trends. Status and trend category details available at **seagrant.** wisc.edu/sotb



wisconsin'swaterlibrary

H₂Ode

POETRY FOR CHILDREN

The famous poet John Keats once said, "The poetry of earth is never dead."

Poetry is a powerful way of bringing the natural world to life in the imaginations of young and old alike. For children, poetry also introduces tools that will inspire them to become enthusiastic and proficient readers. Here are some of our favorite poetry books about water and the environment for children of all ages.

IN THE SWIM: POEMS AND PAINTINGS

By Douglas Florian. San Diego: Harcourt, Inc., 1997. Water-dwellers from salmon to manatees are featured in this wonderful creation full of poetry and delightful illustrations.

LIZARDS, FROGS AND POLLIWOGS

By Douglas Florian. San Diego: Harcourt, Inc., 2001. Florian's 21 rhyming poems about reptiles and amphibians are a "toadal" delight. The author/illustrator has created an ingenious way for children to learn about these creatures.

SONG FOR THE WHOOPING CRANE

By Eileen Spinelli. Grand Rapids, Mich.: Eerdmans Books for Young Readers, 2000. Eileen Spinelli has written a poetic celebration of the whooping crane, one of the rarest birds in North America. It is beautifully illustrated by Elsa Warnick.

SONG OF THE WATER BOATMAN AND OTHER POND POEMS

By Joyce Sidman. Boston: Houghton Mifflin, 2005. A collection of poems that provide a sneak peek at the animals, insects and plants that are found in ponds, with accompanying scientific information about each.

If you wish to see more books on this topic, visit our recommended reading list at **go.wisc.edu/68rd34.**

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



programpeoplenews

Geographic and Intellectual Journeys Lead Sarah Wilkins to Knauss Fellowship

Sarah Wilkins is the 2014 Dean A. Knauss Fellow from Wisconsin and the 24th from the state. She has been shaped by far-ranging geographic and intellectual journeys.

Midwest: Illinois native with an abiding childhood curiosity in the coastlines of the Great Lakes. The hunt for Petoskey stones and surfing Lake Michigan's waves forged an early interest in coastal and freshwater resources.

Bi-coastal: Academic success at the University of Vermont in the study of water resources in a convergence of earlylife passions and deeper learning; interacting with streamside landowners in Puget Sound; and studying saltmarshes north of Boston while at the Marine Biological Laboratory in Woods Hole, Mass. (below).



Zanzibar, Tanzania: A study-abroad program in coastal ecology aids an emerging aquaculture program.

Midwest: Completing the circuit and returning to the region for a master's program in conservation biology and sustainable development at the University of Wisconsin-Madison.

Wilkins's next step is acting as the Ocean and Coastal Policy Analyst Fellow at the National Ocean Service. She said, "I am excited to work with such a dynamic team and have the opportunity to understand how NOAA science becomes integrated into policy!"

For 34 years, the Knauss Fellowship has provided hundreds of the nation's graduate students the opportunity to explore ocean, coastal and Great Lakes national policy decisions affecting aquatic resources.

Watch our blog on **seagrant.wisc.edu** for updates penned by Wilkins throughout the year.



Sturgeon for the Shedd

Making the 90-mile drive between Milwaukee and Chicago is generally unremarkable thanks to modern roadways. Yet one recent trip was anything but. That's because scientist Fred Binkowski from the School of Freshwater Sciences at the University of Wisconsin-Milwaukee and a Wisconsin Sea Grant aquaculture specialist was transporting something very special, something even prehistoric, on that jaunt south on I-94.

In a 300-gallon tank, he was trucking the biological equivalent of 135 million years of Great Lakes ecosystem history in the form of 14 lake sturgeon for public display at the Shedd Aquarium. That display is likely to happen sometime this spring following quarantine for the safety of all the fish already at the Shedd and the new ones soon to take up residence.

Binkowski said, "These fish represent a tale of evolutionary survival, triumph over human callousness, and a renewed commitment to their habitats and health. Taking them to the Shedd Aquarium means that many more people will be exposed to them. People will learn about how sturgeon have been on this planet for millions of years—an important species for Great Lakes ecosystems."

Binkowski delivered the fish to Jim Robinett at the Shedd Aquarium for display in the facility's "At Home on the Great Lakes" exhibit.

"Lake sturgeon are an integral part to telling our Great Lakes stories in that gallery," Robinett said. He is the Shedd's senior vice president of external and regulatory affairs. He termed lake sturgeon a keystone species in the Great Lakes and said once Shedd guests become interested in and inspired by the fish, "Then you can share conservation messages."

The new Shedd fish represent four class years— 2010-13. Binkowski said he is anticipating they will fare quite well in their new home, a 6,000-gallon tank with a recreated Great Lakes native shoreline.

Tracking the Economic Impact of AOC Cleanup

The environmental impacts of cleaning up one of the 43 Great Lakes areas of concern (AOC) designated by the U. S. Environmental Protection Agency are typically easy to spot—cleaner, clearer water, improved vegetation and healthier fish and wildlife populations.

The economic impacts? Well, those are a little trickier to quantify.

But that's what Jane Harrison, social scientist for Sea Grant, and Catherine Simons, a graduate student working on a Master of Science degree in water policy at UW-Milwaukee's School of Freshwater Sciences, are seeking.

In the fall of 2013, they surveyed 100 anglers fishing in the recently remediated Sheboygan River AOC about the effects, if any, the cleanup had on their fishing experience or decision to fish at the Sheboygan River in the future. They also estimated the economic impact of the average sport fisherman—\$152 per day.

Their next step will be to survey waterfront business owners along the Sheboygan River to see

The estimated economic impact of the average sport fisherman—\$152 per day.

if cleanup efforts have inspired them to make new investments in their businesses.

Since its original designation in 1987, more than \$80 million has been spent in the effort to remediate the Sheboygan River AOC, including \$5 million spent to dredge contaminated sediment from the river over the past year.

While there are several studies that have attempted to predict the economic benefit of cleanup to an AOC, this study is the first of its kind to ask about the economic benefits after one has been completed. Because the cleanup is so recent, Harrison said this year's survey is intended to create a baseline comparison to similar surveys planned for 2015 and 2017. That long-term picture will give a clearer sense of the cleanup's true economic impact.

For a more detailed version of this story, see go.wisc.edu/s6788t.



STRONTIUM RISKS

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which is white or light blue in color. Strontium dissolves in water and has no taste or odor.

The study, by John Luczaj, associate professor in the Department of Natural and Applied Sciences at the University of Wisconsin-Green Bay, with UW-Green Bay graduate student Joseph Baeten and Associate Professor Michael Zorn, involved collecting 115 water samples from municipal and private wells in Brown and Outagamie counties near Green Bay.

Why Look for Strontium?

Researcher John Luczaj said people have known there is a significant amount of strontium in the water since the 1950s, but the issue simply fell by the scientific wayside.

Luczaj credits Dave Johnson, a hydrogeologist with the Wisconsin Department of Natural Resources for resurrecting the investigation. Johnson credits Dennis Rohr, a science teacher at Seymour High School. Rohr credits Michael Hanton, general manager with Clean Water Testing in Appleton.



In 2007, Rohr and his high school science club students were awarded a prestigious Toyota TAPESTRY grant to study the connection between 23 heavy metals that are found in well water along with naturally occurring arsenic, a known contaminant in the area. "Often, other heavy metals increase when you have increasing amounts of arsenic in the water," Rohr said. He worked with Hanton's company, which provided professional testing of the water samples.

"Hanton had tested water in Brown County and suggested we get samples from there, and that's where we discovered the high levels of strontium," Rohr said. "It was our grant that found it, but it was Hanton's insight that led us to it. I really can't take credit for it."

In the meantime, Johnson had seen the mineral celestine in local guarries and heard about strontium levels in water in conversations with Rohr. "Then Luczaj came to me looking for an issue that needed research. I suggested he look at strontium and told him about Rohr's findings. I didn't do anything other than that." Johnson said.

No matter whose idea it was, the project turned out to offer valuable insight into Wisconsin's water quality.

> In preliminary findings, 73 samples (63 percent) contained strontium levels higher than the Environmental Protection Agency's lifetime health advisory limit of 4 mg/L, which means samples (five percent) contained levels above 25 mg/L, which exceed the short-term exposure levels for Strontium?" sidebar.)

identified by the EPA. Children who drink the water for more than between one and 10 days face an increased risk of developing health problems.

The researchers also determined that the source of the strontium is natural. In addition to the water samples analyzed, they examined the chemistry of more than 100 rock samples collected during other studies. Their analysis showed the primary source of dissolved strontium in the groundwater originates from celestine and possibly strontianite, another mineral.

On the periodic table, strontium's upper and lower neighbors are calcium and barium. Strontium's similarity to calcium and its behavior in water is what makes this mineral problematic for humans, especially children.

"When children's tooth enamel and bones are developing, exposure to strontium can cause tooth mottling and strontium rickets," said Luczaj.

While tooth mottling is mainly a cosmetic issue, causing white spots or brown stains to be deposited on the teeth, rickets can affect bone development and quality of life. The body mistakes strontium for calcium and tries to incorporate it into developing bones. This softens the bones, leading to bowed legs, widened wrists, skull abnormalities, spinal deformities, and an increased likelihood for bone fractures.

Luczaj has suggestions for readers in the areas that have high strontium. (See map.) "If they are drinking water-softened water or reverse-osmosis water, there's probably little strontium in it," he said. "But if they have young children and they are in the high-strontium area, they should definitely have their water tested."

Although evaluating the distribution and sources of strontium in Brown and Outagamie counties was the focus of the study, the researchers also tested several household samples of water treated with water softeners and found them effective at removing 97 percent of the dissolved strontium. Municipal systems were less effective in removing strontium because they are designed to remove radium. In two municipal samples, 57 percent and 74 percent of strontium were removed.

Dennis Rohr, a science teacher at Seymour High School, encourages people to be aware of strontium in the water supply. "Many people think that when the water comes out of their tap, it's clean and fresh. If they don't smell anything bad, they people drinking the water over the long term face assume everything's okay," he said. Rohr was an increased risk for health problems. Six water among the first to realize that strontium was an issue in local drinking water. (See the "Why Look



SEA GRANT RESEARCH

GREEN BAY REPORT continued from page 3

Nitrate and nitrite concentrations in the river have been increasing, likely a reflection of increased fertilizer use in the watershed.

The amount of "gunk" in the water in the form of suspended solids (things like algae, soil, decaying plant matter and wastewater particles) equal many dump-truck load equivalents every day in some parts of the bay and are considered excessive. Better land-use practices and other measures are needed for this factor to improve.

Levels of a crucial plant pigment called chlorophyll a are found in too great a quantity in water samples. This means there is excess growth of algae, including the potentially toxic blue-green kind, which can reduce water quality and cause human health problems for people in contact with the water.

The water clarity in Green Bay averages half a meter. To seagrant.wisc.edu/sotb meet ecosystem health targets, it needs to be twice that.



Researcher John Luczaj said testing for strontium costs between \$30 and \$75, depending on what other chemicals are included in the test. To find a state-certified water testing laboratory, search the lab lists on the Wisconsin Department of Natural Resources website: dnr.wi.gov/regulations/labCert/LabLists.html.

"Our study confirms there's a significant problem in eastern Wisconsin for strontium levels in drinking water," Luczaj said. "The public needs to be aware of this, and we recommend that a strontium advisory area be established for the region."

According to the Outagamie County Public Health Division, rickets is not a reportable illness, so data on its prevalence are not available.

To learn more, read the Wisconsin Department of Health Services' "Strontium in Drinking Water" fact sheet. (dhs.wisconsin.gov/eh/Water/strontium. htm) —MEZ

Levels of toxic chemicals in the bay, such as PCBs, dioxins, DDT, arsenic and mercury continue at unacceptable levels. These chemicals pollute fish and bay sediments and pose health risks for wildlife and humans. They come from many sources and require coordinated, long-term cleanup efforts.

Although restoration projects and public outreach and education efforts have helped limit the spread of aquatic invasive species, they continue to take a toll on the health of the bay.

Bottom-dwelling animals, called benthic macroinvertebrates, are important food sources for fish and waterfowl and play a crucial role in keeping bay ecosystems healthy. Population levels of these bottom-dwellers are too low due to contaminated sediment and other pollution.

For more information, read the full report online at

SEA GRANT INSTITUTE OWNER RESOURCES INSTITUTE



University of Wisconsin Aquatic Sciences Center 1975 Willow Drive Madison, WI 53706-1177

Aquatic Sciences Chronicle

a joint newsletter from UW Sea Grant and UW Water Resources



CALENDAR OF EVENTS

MAY 12 – 14, 2014

American Water Resources Association Spring Specialty Conference Salt Lake City *awra.org/meetings/SnowBird2014/*

MAY 18-23, 2014

Association for the Sciences of Limnology and Oceanography Joint Aquatic Sciences Meeting Portland sgmeet.com/jasm2014/

JUNE 1 – 6, 2014 Association of State Floodplain Managers Annual Conference Seattle floods.org/index.asp?menuID=223

JUNE 3 AND 4, 2014 Organisms in Trade Invasive Species Conference Milwaukee seagrant.wisc.edu/oit

JUNE 18 – 20, 2014 Water Systems, Science and Society Under Global Change Medford, Mass. ucowr.org/conferences/2014-conference

Updated Fish of the Great Lakes Poster Swims Onto the Scene

Joseph Tomelli

The Great Lakes are historically home to 210 species of fish. An updated 26.5 x 38.5 inches "Fish of the Great Lakes" poster features 35 species, many suggested by Wisconsin residents who wanted to see their favorites immortalized.

Swimming onto the poster are the bowfin, spottail shiner, channel catfish, longnose gar, bluegill, round whitefish, trout-perch and siscowet. Some fish remained, including the lake sturgeon, walleye and musky. Others floated off into retirement.

To get a copy, visit **aqua.wisc.edu/publications.** "Fish of the Great Lakes" is priced at \$6, which includes shipping and handling.

