

# TWINE

2017 WINTER/SPRING EDITION VOL. 39/NO. 1

## *Microcystin* and Your Food

Researchers at The Ohio State University  
are looking at exposure to this toxin  
from a different angle.





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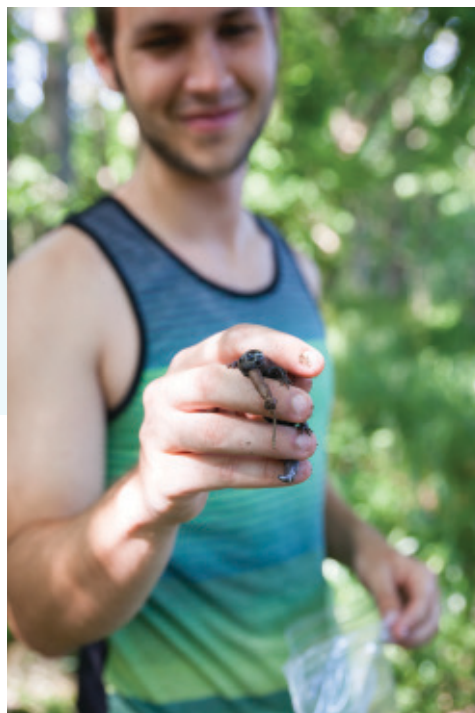
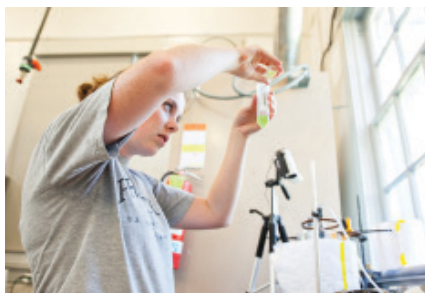
2017 WINTER/SPRING EDITION



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## TWINE LINE

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# MICROCYSTIN:

## *It May Not Just Be In The Water*

*by Christina Dierkes, Ohio Sea Grant Communications*

Microcystin, one of the major toxins produced by harmful algal blooms (HABs) has been implicated in a number of health issues, from skin rashes to liver and nervous system damage. A main focus of preventing these negative health impacts has been limiting exposure to contaminated water, but researchers at The Ohio State University have been looking at things from a different angle: microcystin exposure from food.



► **Above:** Most people who live on Lake Erie are familiar with the green scum produced by harmful algal blooms, and with the potential drinking water problems they cause. Ohio State researchers are now looking at bloom impacts on fish and produce.

Lake Erie fish like walleye and yellow perch often swim through algal blooms, breathing in potentially contaminated water through their gills and eating up smaller critters that in turn may have been exposed to toxin. And produce grown along the Lake Erie shoreline – the Maumee River watershed is largely agriculture, after all – may well have been watered with surface water, either from the lake itself or from smaller lakes and streams that also contain cyanobacteria, the organisms that cause harmful algal blooms.

What isn't known so well is whether those fish and vegetables actually retain any of the algal toxin they are exposed to, and if they do, whether those toxin concentrations are high enough to be of concern. Researchers Drs. Jay Martin, Stu Ludsins and Jiyoung Lee, with funding from Ohio Sea Grant and the

Ohio Department of Higher Education's Harmful Algal Bloom Research Initiative (HABRI), have been working on addressing those questions for the past few years, and so far results have shown that in both cases there is some toxin accumulation, but no reason to completely avoid consumption.

"An important result that really needs to be emphasized based on this work is that while we did find microcystin in these fish, they're not at a level that impacts public health," explains Martin, professor in Ohio State's Department of Food, Agricultural and Biological Engineering. "If anglers and the public abide by the advisories that are sent out from the Ohio Environmental Protection Agency, which are usually about one fish meal per week, then they're going to be fine."





## COVER STORY

**L**ed by Master's student David Witiszinski, the researchers started with a method most commonly used to detect microcystin in fish tissue, a technique called enzyme-linked immunosorbent assay (ELISA). They found relatively high levels of the toxin in their walleye, yellow perch and white perch samples, but some previous studies suggested that using ELISA to quantify this algal toxin in fish may lead to false positive results and indicate higher concentrations than are actually present in the fish.

So the next step was to develop a procedure to use liquid chromatography tandem-mass spectrometry (LC-MS/MS) with the fish samples, as that method has been shown to offer more reliable results than ELISA in identifying specific types, or congeners, of microcystin. With the help of post-doctoral researcher Manjunath Manubolu and Dr. Ken Riedl, associate director of Ohio State's Food Innovation Center, the scientists are now able to quantify nine different types of algal toxins from fish tissue samples, including some of the most abundant and most toxic forms of microcystin.

"We've used that procedure to process samples from Lake Erie and Grand Lake St. Marys for the Ohio Environmental Protection Agency and the Ohio Department of Natural Resources, so the state is already benefiting from the development of this method," said Ludsin, associate professor and co-director of Ohio State's Aquatic Ecology Laboratory.

The team is also working with a testing method called MMPB to quantify total microcystin in tissue samples (instead of detecting specific types that may not add up to total microcystin concentrations with the LC-MS/MS method). That approach allows agencies like the Ohio Environmental Protection Agency to issue any needed drinking water warnings based on a conservative estimate of potential toxicity, while the more detailed analysis by type offers information specifically about some of the most toxic forms of microcystin.

Photo: Jeremy Keith



► **Above:** Researchers examined how microcystin, the toxin produced by harmful algal blooms, accumulated in carrots, lettuce and green beans watered with toxin-contaminated water. They found some toxin in their produce, particularly the roots, but not enough to raise concerns about eating the vegetables.

While Ludsin's lab focused on analyzing fish samples, Lee and doctoral student Seungjun Lee grew three types of vegetables – lettuce, carrots and green beans – while watering them with microcystin-contaminated water at different concentrations. Once harvested, they used ELISA to determine not just how much microcystin was present in those plant samples, but also where exactly the toxin was present: did it accumulate more in the roots, or the leaves, or possibly more in the soil surrounding the plant?

"We found that green beans accumulate more than carrots, and both accumulate more than lettuce," Lee summarized. "And then it looks like there is generally more toxin in the roots, and that makes sense because we water around the root area."

Total toxin accumulation isn't the end result when it comes to public health impacts though. The researchers also calculated health risk based on a number of factors, including data on average monthly consumption for adults and children. They found that, when it comes to health risk, contaminated lettuce is actually of more concern than contaminated carrots, because on average, people tend to eat more lettuce and therefore take in more of any accumulated pollution from that.

In addition to toxin accumulation in both plants and the soil surrounding them, Lee and her team found that microcystin exposure can stunt plant growth, distort shape and cause yellowing, making the vegetables less valuable as commercial crops.

So what can be done about this specific contamination while research continues to try to solve the overall harmful algal bloom problem in Lake Erie? For agriculture, Lee suggests finding an alternative source of water for irrigation. Most large farms already use groundwater in their operations, while smaller farms tend to use more surface water, which can lead to microcystin contamination during bloom season. In those cases, regular water testing and switching to alternative water sources is essential to reduce or



Photo: Mike Tewkesbury

► **Above:** Produce for the study was grown in greenhouses at The Ohio State University campus, and watered with water containing known amounts of microcystin toxin. Once harvested, the vegetables and the surrounding soil were tested for microcystin contamination. // **Left:** Lake Erie's Maumee River watershed is largely agricultural, and many smaller farms use surface water that may have come in contact with harmful algal blooms to water their fields.

prevent exposure that can lead to microcystin contamination. If the toxin is found in soil, rotating cropland gives the toxin time to degrade before planting new crops.

Though fish are unlikely to avoid exposure to microcystin while they're in the lake, anglers and other consumers don't have to worry too much about toxin exposure from eating them. Fish can metabolize toxins like microcystin via the liver, which means that unless toxin concentrations are so high that the liver becomes overloaded, the edible muscle tissue is unlikely to contain levels high enough for concern beyond normal fish consumption advisories.

"What we don't know yet is whether these fish are really taking in toxin but the liver is

handling it, or if they're not taking it in at all," Ludsin said. "We don't have that data yet, but we will look at exposure to see whether fish are taking in toxin but handling the load or if they're just not living in areas where there are blooms."

Results from fish caught in 2015 so far show that out of 73 analyzed fish, only six showed detectable levels of microcystin in edible tissues, which don't include the liver and other organs, and those levels were still well below consumption limits. "So if a person follows the guideline of no more than one fish meal per week, there would be no concern of getting any sort of toxicity from consuming the edible fraction of either walleye or yellow perch," Ludsin concluded.

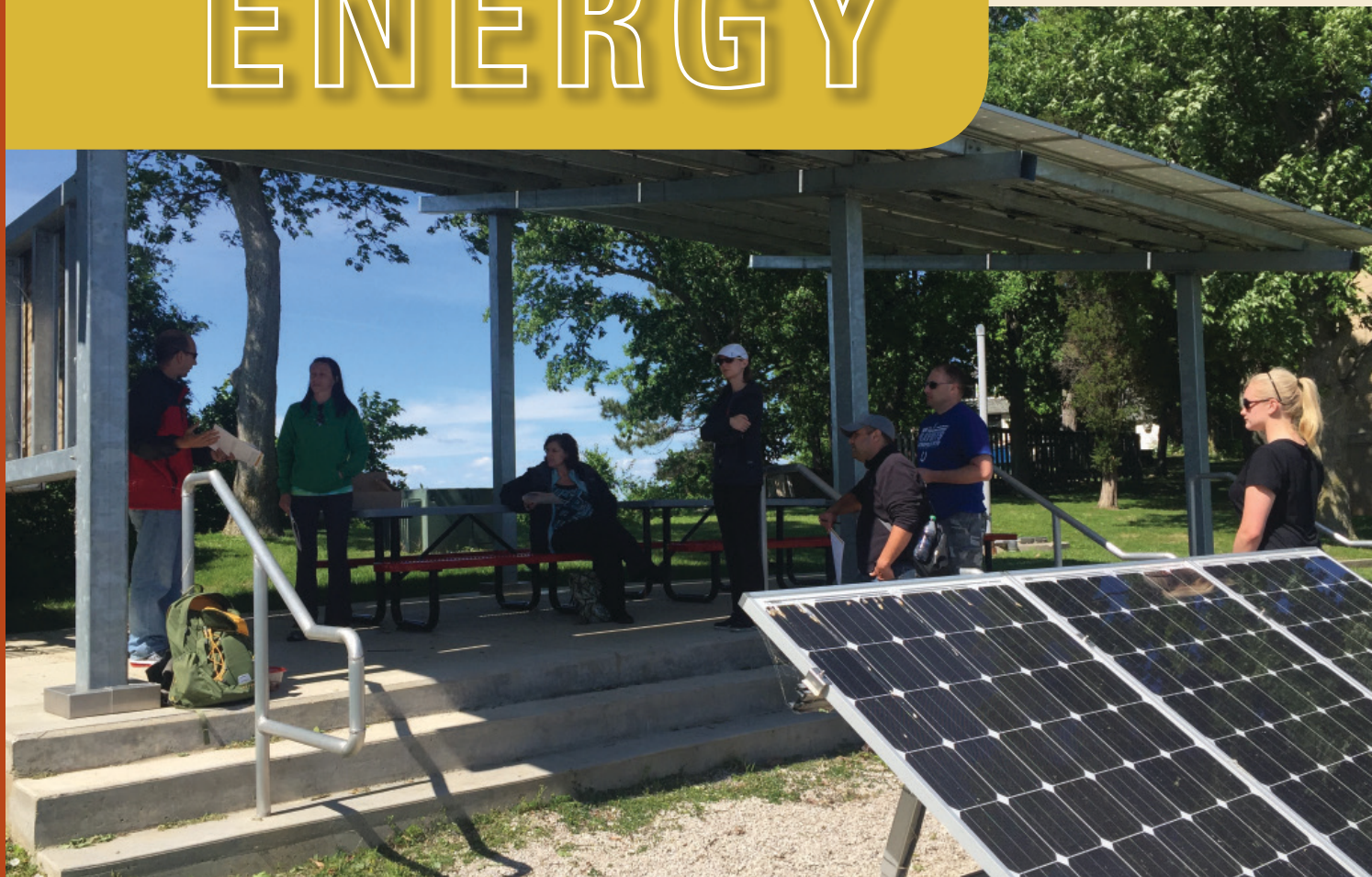
And of course, while some scientists are focusing on the impacts of harmful algal blooms on everything from food to recreational opportunities, research also continues to help address the algal blooms themselves. The Harmful Algal Bloom Research Initiative (HABRI), funded by the Ohio Department of Higher Education and managed by Ohio Sea Grant, connects research teams across the state and beyond to find new approaches to reducing harmful algal blooms in Lake Erie, using input from stakeholders that range from state agencies to local farmers.

► More information on HABRI is available at [go.osu.edu/habri](http://go.osu.edu/habri) and on page 12 of this issue.



# Shining a Light on SOLAR ENERGY

*by Christina Dierkes,  
Ohio Sea Grant Communications*



Over the past few years, Stone Lab's solar pavilion and the solar panels on the Classroom Building have been a staple view from Put-in-Bay harbor on South Bass Island. Aside from the positive environmental impact, the set-up, along with solar thermal tubes on the Dining Hall roof, offer an exciting opportunity for research and education into solar energy, and a newly developed Solar Technology Curriculum is the first to put that plan into action.

Stone Lab had already taken advantage of its solar energy set-up in developing educational opportunities for guests who come to Gibraltar Island. Panels from the Climate Expedition field trip activity explain how solar panels work and how solar energy can help reduce the impacts of climate change and save the lab money. The new solar lessons take that education a step further, bringing solar energy knowledge and activities to students who may not be able to take a field trip to Lake Erie.

The solar energy technology at the lab – solar photovoltaic panels for electricity production and solar thermal tubes to provide the Dining Hall with hot water – provides data on power production to a website at [go.osu.edu/SLsolar](http://go.osu.edu/SLsolar), and staff wanted to make sure that freely available data was used in some way, so creating classroom activities for educators was a logical next step.

Curriculum development was funded by an OSU CARES (Community Access to Resources and Educational Services) grant from The Ohio State University Extension. The program focuses on connecting OSU Extension with Ohio State faculty and staff to





► **Above:** Stone Lab Education & Outreach Assistant Angela Greene (center) introduces teachers to the new solar curriculum at a Stone Lab workshop in June 2016. **Below:** A hands-on lesson on solar technology had students take apart solar desk toys to learn what makes them tick (or wave, or wiggle).

expand resources and address needs for Ohio communities. More information about the program is available at [osucare.osu.edu](http://osucare.osu.edu).

Led by Dr. Kristen Fussell, Ohio Sea Grant research development and grants manager, and Dr. Kristin Stanford, Stone Lab's education and outreach coordinator, the team got together at a kickoff meeting on Gibraltar Island to outline lessons. Additional contributors included Stone Lab educators Lyndsey Manzo, Sue Bixler and Angela Greene, as well as Program

Assistant Erin Monaco and former Friends of Stone Lab President and high school teacher Sheila Lewicki.

The grant also required input from an Extension partner, so the team brought in Eric Romich, who leads the Energize Ohio program and offered technical expertise on solar energy. "Eric was really integral to the project," Fussell said.

At the meeting, the group outlined five lessons to be developed: a general introduction to solar energy, along with four hands-on lessons focusing on how solar electric and solar thermal energy is produced, how electric circuits can influence that energy output, and how the sun's location can affect how much sunlight is converted to usable power.

The lessons are structured similarly to Ohio Sea Grant's *Great Lakes Climate Change Curriculum*, including teacher sections, student activities and links to background materials. All will be freely available online at [go.osu.edu/teachers](http://go.osu.edu/teachers) when final reviews are completed.

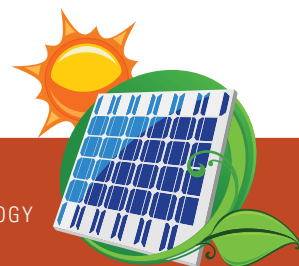
Sea Grant and Stone Lab staff also held two workshops for teachers and informal educators at Stone Lab last summer to introduce the lessons to the intended users and fine-tune things based on feedback from those workshops. They had originally intended to hold just one workshop, but

demand quickly outpaced available space, so a second workshop day was added.

"We had 80 teachers from Ohio, Indiana and Michigan at the lab for a day," said Fussell. "We then took all of the feedback we got from the teachers and adjusted lessons accordingly."

That meant the original five lessons expanded to seven, with three developed specifically for the Nearpod interactive learning system, which Fussell jokingly calls "PowerPoint on steroids." The platform allows teachers and students to go through lessons on mobile devices, which not only lets teachers quickly share outstanding student responses with the whole class, but also gives them the option to monitor answers on activities and quizzes in real time.

"It's definitely not just a teacher standing at the board and talking at students," Fussell said. "I tried it for the first time during our workshops, and it was really fun! I wanted to keep going through the sample lesson, so we hope it'll work the same for these activities."



SOLAR TECHNOLOGY  
CURRICULUM

## Understanding the Mechanics of Solar Technology

- » Introduction
- » Understanding the Mechanics of Solar Technology
- » Using Models to Investigate Solar Technology
- » Building a Solar Photovoltaic Array by Exploring Series and Parallel Circuits
- » Using Real-Time Data to Relate Solar Energy Production to the Sun's Location
- » Reference Documents



» Nearpod lesson development was led by Greene, an education and outreach assistant at Stone Lab and teacher at Tecumseh Middle School in New Carlisle, Ohio. The eventual goal is an Ohio Sea Grant Nearpod store on the company's website, with freely downloadable lessons for teachers to use. That link will be posted at [go.osu.edu/teachers](http://go.osu.edu/teachers) when it becomes available.

# A WALK ON THE wild side

By Lisa Aurand Rice, Ohio Sea  
Grant Communications



Photo: Shari Insley

Thanks to a technology loan program from the U.S. EPA and Illinois-Indiana Sea Grant, students in Shari Insley's math class got hands-on experience with water quality sampling and monitoring on three field trips to Rocky River Reservation in Cleveland.

**Stone Lab and science** — the two go hand-in-hand. Anyone who has visited Stone Lab knows about its connection to scientific education and discovery. The 25-plus college-credit courses and workshops hosted there each summer focus on biological and environmental sciences of all stripes.

But the lessons taught at Stone Lab extend beyond that singular discipline, and eighth grade math teacher Shari Insley is proving it. Insley, a teacher at North Olmsted Middle School in North Olmsted, Ohio, is putting what she learned during the Stone Lab course Water & Wildlife Training for Educators to use in her math classes. Insley's math students are monitoring water quality in the Rocky River through a partnership with Cleveland Metroparks this year.

Insley was introduced to Stone Lab through a workshop on solar technology education held there in June 2016, where Stone Lab Education and Outreach Assistant Angela Greene, one of the workshop facilitators, told attendees about the water and wildlife class she would be co-teaching the next month.

"It was just an amazing week with amazing (teachers)," Insley said of the week-long Water & Wildlife class. "As soon as I got home, I thought, 'How can I use this in the classroom to make the students' education more meaningful and more real?'"

She used connections made at the lab, contacting her water and wildlife training classmate Mark Warman, then a naturalist at Cleveland Metroparks. Through the Limno Loan program, a partnership between the U.S. EPA and Illinois-Indiana Sea Grant, Insley was able to borrow a Hydrolab, a water quality data sonde, and Warman helped arrange a set of three field trips to Rocky River Reservation for the students to use the sonde and track water quality over the course of the school year.

But even before they could take their first trip, there was science – and math – to be done. She led the students in the Ohio Sea Grant activity How Well Do You Know the Great Lakes? The students used string to depict the shoreline length of each Great Lake and used their knowledge to predict how the total water volume, human population of the watershed and annual commercial fishing harvest of the Great Lakes were distributed. In another activity, the students practiced using Secchi disks to measure water turbidity.





Photo: Shari Insley

**Above:** Cleveland Metroparks Naturalist Mark Warman (left) helps students collect macroinvertebrates, an indicator of water quality, during a field trip to Rocky River Reservation. **Below:** The three field trips showed Insley's math students how what they were learning in the classroom could be applied to different professions out in the world.

Insley and Warman, who had been lab partners during Water & Wildlife Training, worked together to develop four activities for the approximately 90 students that attended the field trip: collecting macroinvertebrates, using Secchi disks to measure turbidity, conducting sensory observation (estimating cloud cover and weather conditions and the geology of the area), and using the Hydrolab sonde.

Warman led the students in collecting macroinvertebrates and said he was impressed with their enthusiasm.

"They couldn't wait to get the nets in their hands and walk into the stream," Warman said. "I know they were surprised to find a wide variety. They were curious and they were very engaged, even if they were just waiting on the shore for their turn."

Using the Hydrolab, the students were able to measure dissolved oxygen, conductivity, pH, chlorophyll a, and temperature.

Insley, too, said the students were excited by the lessons.



*"I am hoping that they can see the real-world application for math in different professions and that you need math to understand science," she said. "I'm hoping they are exposed to a variety of jobs that they never thought they could do."* — SHARI INSLEY

"They thought it was the best experience they've had in their eight or nine years of education. They felt like real scientists, getting to use scientific equipment and apply what we'd been learning."

The students will return to that same area of the river twice more – in March and May – to take additional measurements and then will calculate the differences and correlations and what that data might mean.

"I am hoping that they can see the real-world application for math in different professions and that you need math to understand science," she said. "I'm hoping they are exposed to a variety of jobs that they never thought they could do."

Insley said science teachers at North Olmstead are intrigued by the cross-curricular education approach she is modeling with this project and hope to incorporate similar programming in years to come.

The class Insley and Warman took, Water & Wildlife Training for Educators, is being offered again this July and is one of four courses and workshops offered at Stone Lab this year specifically designed for educators. Participants in Water & Wildlife Training for Educators leave the course with the certifications and materials necessary to implement activities from five national curricula: Project Wild; Project Wild Aquatic; Science & Civics; Project Wet; and Healthy Water, Healthy People.



Photo: Shari Insley

For more information on the Limno Loan program, visit [limnoloan.lakeguardian.org](http://limnoloan.lakeguardian.org).  
For Ohio Sea Grant's Great Lakes curriculum, visit [go.osu.edu/curriculum](http://go.osu.edu/curriculum).

A full course listing is available at  
[go.osu.edu/SLeducation](http://go.osu.edu/SLeducation).



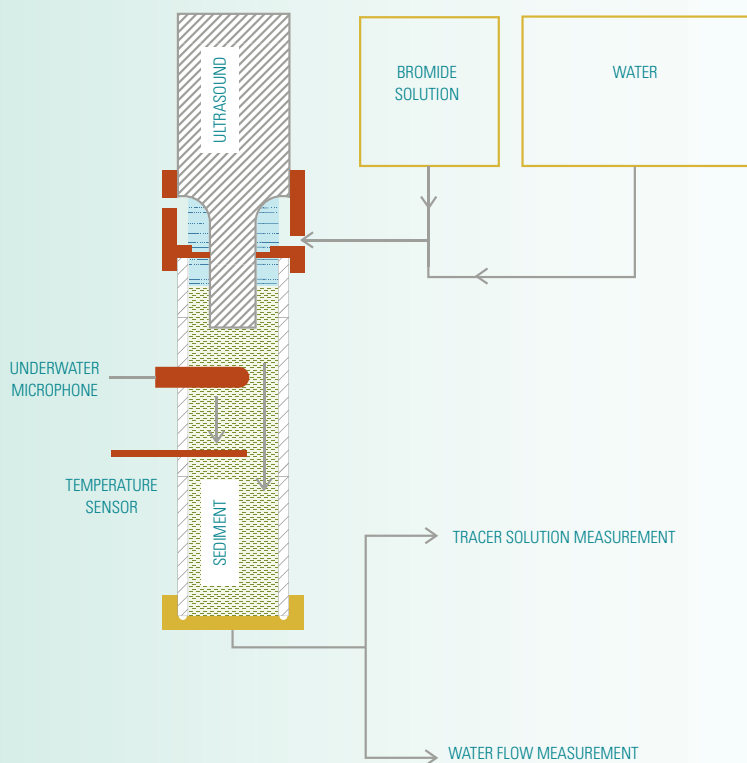
Photo: Washington DNR



# INCHING CLOSER to SOLUTIONS

ONE ESSENTIAL STEP AT A TIME

*“We start with simple systems, and then we try to build on those as we understand what’s happening in them. Because if you just go to the complicated system right away, you can observe effects, but you can’t really figure out what they’re related to.”*



## HOW ULTRASOUND AFFECTS WATER FLOW THROUGH SEDIMENT

The current lab set-up allows researchers to “hear” the ultrasound they’re sending through sediments to loosen contaminants from sediment particles. A tracer solution indicates that water flows more easily through the sediment with ultrasound than without, an important consideration for washing away contaminants once they’re no longer stuck to individual sediment particles.

That’s Linda Weavers, a professor in the Department of Civil, Environmental and Geodetic Engineering at The Ohio State University, talking about one of the fundamental rules of doing science: one step at a time. Weavers and her team are studying the potential use of ultrasound to clean contaminated sediments in Lake Erie and its tributaries, a complicated process no matter what approach is taken.

Building on previous research also funded by Ohio Sea Grant, the researchers are moving from a model where the contaminated sediment samples are mixed into water to one where the sediment has settled into the bottom of a glass column, closer to how they would find contamination in an actual river or lake. The eventual goal is to treat contaminated sediments on site, right where they are, instead of having to dredge them up for treatment or disposal.

Depending on the pitch and volume of the ultrasound used, the higher energy that comes with higher volumes can create cavitation bubbles in the water around the sediment particles that carry contaminants. As those gas bubbles are formed and then collapse again, the tiny shockwaves produced in the process act a little like a pressure washer, pushing water against the sediment particles and removing stuck-on contaminants.

The researchers were successfully able to use that powerwashing effect to remove contaminants in the previously tested slurry of sediment and water, and they are seeing similarly positive results in the settled sediment system they’re testing now.

“What we observed is that with the ultrasound and the cavitation it generates, we see an enhanced flow of water through [the model waterway],” Weavers said. “And when we looked at our bromide tracer in the water, we saw it spread through the sediment more with ultrasound than without. So if you





“With ultrasound, we have a better ability to reach more spaces within the contaminated sediment and are able to affect a larger area.” — LINDA WEAVERS

think about the bigger picture, if we look at our contaminants, we have a better ability to reach more spaces within the contaminated sediment and are able to affect a larger area.” This means more sediment can be scrubbed more thoroughly with each round of treatment, potentially making pollutant clean-up faster and less costly.

Of course, once contamination is no longer stuck on sediment particles, it still has to be removed from the environment. For that, the researchers are adding another piece to the puzzle: persulfate. That particular chemical has been used in groundwater treatment in the past, but needs to be activated – which makes it more prone to reacting with contaminants – to do its work. One of the ways to do that is to heat it up.

“When cavitation bubbles collapse, they create heat,” Weavers said, connecting the dots. “So with ultrasound, we could in theory have both contaminant release and clean-up via activated persulfate.” Future studies will have to show that this theory holds up in practice, as

research so far has only shown that persulfate works, but not exactly how.

“We want to really understand how it works so that we can figure out how to piece the lab model together best,” Weavers said.

Persulfate is an oxidant: when it’s activated, it produces radicals, which are highly reactive toward other molecules. In some cases, those reactions can cause serious damage. For example, free radicals played a role in the depletion of the ozone layer, and are of concern to health professionals. That’s where the recommendation to eat foods high in antioxidants comes from, as those can bind some radicals and keep them from causing damage in the body. When sediments are treated with persulfate, radicals attack contaminants to neutralize their effects.

The research team consulted with Frederick Villamena from the Davis Heart & Lung Research Institute at The Ohio State University Wexner Medical Center to dig into the details of that process via a technique called electron

paramagnetic resonance, which detects specific radicals actually present in treated sediment samples. Because radicals play a role in human health as well, making them a concern for medical professionals, the partnership was a natural fit.

Currently, Weavers and her students are working on actual samples of sediment that were provided by the Ohio Environmental Protection Agency. Those samples contain polycyclic aromatic hydrocarbons (PAHs, for short), which are a major problem for Lake Erie and its tributaries.

“We have these contaminated sediments from a former creosote facility, which is one of the sources of PAH contamination,” Weavers said. “If you think of wood telephone poles, they don’t decay even though they’re made of wood, and that’s because they’re treated with creosote, which is heavy in PAHs.”

Another example of creosote compounds is the black tarry sealant used on many driveways, which makes it easy to imagine how difficult removing that contaminant can be. However, with patience and the help of ultrasound-created powerwasher bubbles, Weavers and her team are moving slowly but surely down the path toward a solution.

► To learn more about this ongoing research, contact Dr. Weavers at [weavers.1@osu.edu](mailto:weavers.1@osu.edu).



Photo: Susemah Anderson

Creosote is used to keep wooden telephone polls and docks from rotting away. But if the black tarry substance ends up contaminating the landscape, it can be difficult to remove and tends to leach damaging chemicals. Dr. Weavers and her team hope to use ultrasound to make clean-up of this type of pollution easier.

## Harmful Algal Bloom

by Christina Dierkes, Ohio Sea Grant Communications

**Below:** An algal bloom around South Bass Island colors Lake Erie waters green. The Harmful Algal Bloom Research Initiative (HABRI) seeks to reduce and prevent blooms and their impacts on Lake Erie residents through research and outreach.



**T**he Ohio Department of Education (ODHE) Harmful Algal Blooms Research Initiative (HABRI) was started in response to the August 2014 water crisis in Toledo, when hundreds of thousands of residents were advised not to drink their tap water due to toxins from a harmful algal bloom. Led by representatives from The Ohio State University and the University of Toledo and managed by Ohio Sea Grant, HABRI brings together researchers from a number of Ohio universities and partners as far-flung as South Dakota and Japan to help solve the harmful algal bloom problems plaguing Lake Erie and Ohio's inland lakes.

# Research Initiative UPDATES

Photo: Steve Ruberg



**Above:** Autonomous underwater vehicles (small robot submarines, essentially) provide part of the data used in tracking how algae move through the water column during typical days and nights.

### *Up and Down and Up Again: Tracking Algae's Travels Through the Water Column*

**TOM BRIDGEMAN, UNIVERSITY OF TOLEDO**

Researchers from the University of Toledo, along with researchers from NOAA, Bowling Green State University, and Sinclair Community College, are working on ways to understand the vertical movement of different types of algae – such as green algae, cyanobacteria and diatoms – throughout the water column to help water treatment plants better prepare for and reduce the amounts of algae they're taking into their system over the course of a day.

During the 2016 harmful algal bloom season, water samples from boats, automated sensor buoys and autonomous underwater vehicles (small robot submarines, essentially) combined to provide a profile of how algae



were moving throughout the water column during two separate days and nights. In a related project, a drone equipped with a specialized camera developed by NASA scanned the lake surface for floating cyanobacteria.

The results left lead investigator Tom Bridgeman “pretty puzzled.” During rough lake conditions that should lead to an even mixing of algae types, green algae still somewhat concentrated near the surface, while cyanobacteria (which produce the problematic toxin in harmful algal blooms) were more evenly spread out. Only at night were all types of algae distributed evenly in the water column.

In calm conditions, when the team expected to see dense surface scum, green algae again concentrated somewhat near the surface during the day, while at night the even distribution of algae types was only disrupted by diatoms, which sank closer to the bottom of the lake.

A planning meeting before the next field season will bring together a number of related research groups to work out planning details for additional sampling trips next year, and to discuss potential explanations for this odd pattern. For now, the researchers are hitting planned milestones as expected, and they have ironed out a number of kinks, from flight permits to sampling equipment breakdowns, that will make next year’s field season more efficient.

## Offering Realistic Phosphorus Reduction Goals to Management Agencies and Farmers

**MARGARET KALCIC,**  
**THE OHIO STATE UNIVERSITY**

Phosphorus runoff from predominantly agricultural watersheds in northwestern Ohio has been linked to water quality problems in Lake Erie. To reduce the negative impacts in the lake, policy makers have set 2025 as the target year to reduce phosphorus loading by 40 percent, with an interim goal of a 20 percent reduction by 2020.

A multi-university team of modeling experts is developing computer models to

determine which conservation practices are most likely to lead to target reductions in phosphorus runoff from the Maumee River watershed into Lake Erie. The tools will be used to evaluate how adoption of conservation measures over time would impact overall water quality, along with predicted effects of climate change.

This project builds on an existing network of collaboration and modeling efforts. The first step was to improve the existing watershed models to more realistically simulate phosphorus application rates, including manure, as well as combined sewer overflows. Then models were calibrated to predict water quality near the mouth of the Maumee River.

Meaningful engagement of a diverse advisory group provides important guidance for the project. In September 2016 the team provided an update and sought feedback from environmental policy groups, agricultural producer groups and state agencies. This first advisory group meeting included a productive conversation about agricultural conservation options to analyze with the models, such as changing fertilizer and manure application rates, timing and level of incorporation into the soil, in addition to growing cover crops, managing subsurface drains and restoring headwater wetlands.

The next advisory group meeting is planned for March 2017 to discuss preliminary results and make plans for developing conservation adoption strategies over time and under anticipated changes in climate.

## Algal Blooms Don’t Just Happen in Near-Shore Waters

**JUSTIN CHAFFIN,**  
**THE OHIO STATE UNIVERSITY**

While much of the current research on harmful algal blooms focuses on Lake Erie’s western basin, researchers at Ohio State’s Stone Lab are also exploring what’s happening in the central basin, between Lorain, Ohio and Erie, Penn.

Stone Lab vessels are sampling four fixed locations once a week, collecting data on dissolved nutrients, water temperature and algal types. In addition, the researchers work with NOAA and other scientists to chase blooms as they occur to determine which types of algae are involved and pass that information on to other agencies.

One example included a bloom of what turned out to be *Dolichospermum* (formerly called *Anabaena*) near Fairport Harbor, Ohio in July 2016. Interestingly, conditions there were far from textbook for this type of algae, with nitrate and dissolved oxygen concentrations almost the opposite of what the species usually prefers. Additionally, the toxin microcystin was not detected in samples.

Plans for next year include lowering the minimum amount of microcystin needed to detect its presence in the water (current detection limits aren’t particularly low, but can be lowered) by testing a filtered sample instead of whole water from lake samples.



Agriculture is a major Ohio industry, so researchers and farmers are working together to balance fertilizer runoff reduction to reduce algal blooms with continued success for farming businesses.

Photo: Linda Tanner

## Research Initiative UPDATES

### *How Much Is Too Much For Algal Treatment in Drinking Water?*

**TERESA CUTRIGHT & DONALD W. OTT,  
UNIVERSITY OF AKRON**

**LAN ZHANG, TEXAS A&M UNIVERSITY**

Like any standing body of water, reservoirs that collect water to be used as drinking water tend to grow algae. In the case of reservoirs in the Lake Erie watershed, these algae could well be toxic cyanobacteria – *Microcystis* or *Aphanizomenon*, for example – and generally tend to clog up pipes and filters, so water treatment plants use algaecides to control their growth.

The problem with killing off cyanobacteria in this way is that quite often, the dead algae release toxin from their cells into the water. So the optimal dosage for a given algaecide addressing a certain type of algae is a delicate balance between what kills a reasonable amount of algae and what keeps toxin release to a minimum.

Researchers at the University of Akron are now working to better understand that balance in four Ohio reservoirs: two near Akron, one near Willard, and one near Norwalk. The team is working with the water treatment plants associated with these four spots to obtain samples and information on algaecide use, and will share all information from the study to help improve water treatment effectiveness and reduce costs where possible.

The goal is to create tailored solutions to various treatment goals for each reservoir, with the primary goal of minimizing the



**Above:** While human exposure to harmful algal bloom toxins via drinking water is a major area of research, not much attention has been paid to recreational and work exposure through fishing, swimming or boating. Researchers at the University of Toledo are now surveying recreational visitors and those who work on or close to Lake Erie to see if that exposure is linked to known health effects of microcystin, such as skin rashes, liver problems and respiratory issues.

impact of algae removal while limiting toxin release from dead algal cells. So far, experiments have shown that factors like reservoir volume and shape, the types of algae present, the types of algaecide used and overall water chemistry all affect treatment outcomes, and work on cataloging those outcomes is moving forward.

### *Health Effects of Exposure to Harmful Algal Blooms in Northwest Ohio Residents*

**APRIL AMES & MICHAEL VALIGOSKY,  
UNIVERSITY OF TOLEDO**

The current phase of this project is focused on recreational and occupational water use behaviors in the western Lake Erie basin. This prepares the research team for the next phase, where they will examine the health impact from recreational and

occupational exposure to cyanotoxins, in combination with measuring aerosolized microcystin. The end goal is to connect those exposures to any self-reported health impacts. Skin rashes, liver problems and respiratory issues are common examples of health effects caused by cyanotoxins.

Currently the researchers are collecting survey responses from recreational users who may be exposed to cyanotoxins through swimming or boating – the majority of responses have been collected and are being analyzed. The group is solidifying their sampling methods for airborne exposure to aerosolized microcystin. They're also starting to get back in touch with groups that represent those who work on or close to the lake – charter boat captains, fishing boat crew or beach vendors, for example – after a busy summer season to collect data on those occupational exposures.



## Using Lake Erie Bacteria to Remove Microcystin from Drinking Water

JASON HUNTLEY, UNIVERSITY OF TOLEDO

Some bacteria have the ability to degrade the microcystin toxin MC-LR into non-toxic component parts, including bacteria naturally found in Lake Erie. A previous HABRI project isolated and identified groups of these bacteria, which are now being examined at the genetic level to potentially produce enzymes that can be used in water treatment plants.

Dr. Jason Huntley and his research group had hoped to find already known MC-LR degradation genes, based on studies from Australia, Japan and China. However, those genes were nowhere to be found in Lake Erie bacteria, so new genetic pathways have to be identified.

Current work focuses on using next generation genomic sequencing technology to examine the genetic information from these bacteria in the presence and absence of MC-LR. The toxin triggers an increase in the production of enzymes that attack it, so a gene that is observed in a higher number of copies when MC-LR is present is a likely candidate for further use. Huntley and his group have partnered with investigators at a number of Ohio universities to achieve these results, including the University of Toledo, Bowling Green State University, The Ohio State University and Kent State University.



**Above:** Lake Erie bacteria that can degrade microcystin may soon become the next technology water treatment plants can employ to remove the toxin from drinking water.

# #actuallivingscientist Takes Over Science Twitter



Scientists, including these Ohio Sea Grant and Stone Lab researchers, took to Twitter in February to introduce themselves to the public using the hashtag #actuallivingscientist. Did you participate? Tag us in your post and we'll share it on our social media channels!

You can meet these and other Ohio Sea Grant and Stone Lab researchers at events like our summer island tours ([ohioseagrant.osu.edu/visit](http://ohioseagrant.osu.edu/visit)) or the annual Stone Lab Open House, this year held on September 9!

>> Visit [ohioseagrant.osu.edu/news/calendar](http://ohioseagrant.osu.edu/news/calendar) to stay updated on other Ohio Sea Grant events across the state.



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# STONE LAB *courses*



## TAKE STUDENTS ON A JOURNEY THROUGH LAKE ERIE NATURE AND SCIENCE

*By Lisa Aurand Rice, Ohio Sea Grant Communications*

Stone Laboratory's summer science classes are full of unique experiences students just can't get elsewhere. Students earn college credit for visiting Niagara Falls, banding birds or trawling for fish, giving them the first-hand knowledge they need to be successful in their careers – whether they'll end up as teachers, wildlife managers, scientists or something else entirely.



### **JULY 15-21** | Field Geology for Educators: Geologic Setting of Lake Erie

You can't study the ground beneath your feet if you're inside a classroom, so Dr. Lawrence Krissek's geology class for educators and education majors takes students where geology really happens – outdoors. The course begins at the Ohio State Columbus campus and takes students on a week-long trip along the southern shore of Lake Erie to examine its geologic features. Students will stay at Stone Lab on Saturday night and take a field trip to the glacial grooves on Kelleys Island on Sunday. Other planned stops include Old Woman Creek National Estuarine Research Reserve, Cuyahoga Valley National Park and Niagara Falls.



### **JULY 23-29** | Introduction to Biological Studies – Birds

What are birds, how do they work and how do we manage and conserve bird populations? This introductory class, taught by Ohio State's Dr. Christopher Tonra, aims to answer those questions for advanced high schoolers and college students in any major. Tonra mixes lectures, labs and field trips to observe birds in the wild to give students both basic bird knowledge and hands-on experience. Possible field trips include jaunts to Ottawa National Wildlife Refuge in Oak Harbor, Ohio and to Oak Openings Metropark in Swanton, Ohio. Students will leave the class able to identify common Lake Erie bird species, explain their ecological roles and the challenges of bird conservation, and evaluate a species management plan.



### **JUNE 18-JULY 22** | Ichthyology

Stone Lab's five-week courses are chances for upper-level college students to dive deep into topics that interest them, and this class is no exception. Students will leave ichthyology knowing Lake Erie fish inside and out – from fish physiology and ecology to identification and anatomy to ways to collect and study fishes. Expect to participate in seining, trawling, shock boat sampling and fish dissection, and in sampling field trips on the mainland, the Lake Erie islands and in the open waters of Lake Erie. A group research project gives students the chance to work as a team to design an experiment, collect and interpret data and write a short scientific paper.



To view the full course listings, visit [stonelab.osu.edu/courses](http://stonelab.osu.edu/courses).



# EVOLUTION IN ACTION

By Lisa Aurand Rice,  
Ohio Sea Grant Communications

**W**hen Adam Cupito started his course in evolution at Stone Lab, he knew he would see real-life examples of how evolution changes animal populations, but he had no idea that he would be undergoing a form of evolution himself.

A junior at The Ohio State University majoring in Forestry, Fisheries and Wildlife, Adam was selected for Stone Laboratory's Research Experience for Undergraduates (REU) Scholarship Program, which pays for students' tuition, room and meals for one of the lab's five-week courses.

The Cincinnati native knew he wanted to study science in college after his first high school biology course, but until he attended Stone Lab in June and July of 2016, he hadn't had much up-close experience with animals.

That quickly changed as he started working on his REU project with Dr. James Marshall on the survivorship rates of Lake Erie island birds and going on field trips with Marshall's Evolution class.

"Stone Lab is a great place to see evolution in action," Adam says, describing trips to Kelleys Island to look for fossils and hunt for salamanders. "All the field work we did was tied into the concepts we were learning. The class was a really good mixture of lecture and hands-on field work."

For his REU project, Adam set up mist nets in an attempt to recapture birds that had been previously banded and compiled data from six years of bird observation conducted at Stone Lab. He used that data to estimate survival rates for red-winged blackbirds and American robins.

"This was the first year in the data set that it has provided usable estimates," Adam says of the long-term research project. "We hope to come across better findings as the project goes on. Every year is equally as important as the other since it's long-term."



*"Stone Lab is a great place to see evolution in action. All the field work we did was tied into the concepts we were learning. The class was a really good mixture of lecture and hands-on field work."*



Being able to discuss his findings with an avian professor and gaining research experience was invaluable for Adam.

"The REU program is the best deal you can get. You get that really great one-on-one experience," he says. "Having that scholarship and the privilege of being able to attend Stone Lab at low to no cost is incredible."

Recently, Marshall encouraged Adam to submit the findings of the project to a scientific conference. If it is accepted, it will be his first experience presenting research in a professional setting – an important stepping stone to a career in science for Adam, who intends to apply to grad school in the future.

"I hope to get into a master's program that really suits my interests and accelerates my career path after that in something related to wildlife."

In the short term, Adam is focusing on finishing up his studies and is staying connected with Stone Lab alums as secretary of Buckeye Friends of Stone Lab, a club for Ohio State students. **FOSL**

Learn more about Stone Lab's  
REU program at [go.osu.edu/REU](http://go.osu.edu/REU).





# Friends Of Stone Laboratory

## A Champion for the Castle

In 1972, zoology graduate student Tom Hall spent a summer at Stone Lab, studying everything from ornithology to fish ecology while spending nights in Cooke Castle, then the men's dormitory. Today, emergency medicine physician Dr. Thomas Hall, who just retired from a position as medical director at an insurance company, is working with Ohio Sea Grant and the Friends of Stone Lab (FOSL) to raise funds for renovations that could turn that same Cooke Castle into a unique meeting destination.

Hall has been a Stone Lab donor since FOSL was started and participates in volunteer opportunities as often as possible. With his recent retirement, he wanted to become more involved in supporting the lab through volunteer work and was able to take on the role of committee chair for FOSL's Cooke Castle Committee.

"I'm one of the primordial fossils," Hall joked – FOSL members often run the letters together into "fossil" instead of pronouncing each one separately – "which means I've been a donor since the early 80s, and I thought someday I'd like to be more involved." Previous conversations about the castle renovations prompted Hall to offer his involvement after he retired from his job, and both Ohio Sea Grant and FOSL were happy to accept.

Hall credits Stone Lab with many of the things that shaped his life after college, including acceptance to medical school, where he met his wife Beth.

"The university had that 'But For Ohio State' campaign," Hall said. "For me, it was 'but for Stone Lab.' I may not have been accepted into medical school if I hadn't done well at Stone Lab and gotten references that helped me get in. That's been a large part of my success, and it helped me meet my wife. So for me it's 'but for Stone Lab, I probably wouldn't be where I am today.'"

While there are still a number of obstacles to overcome before Cooke Castle can welcome donors, board members and legislators for small conferences – renovating a building listed on the National Register of Historic Places is never easy – Hall is confident that the project will move forward as long as the funds are raised.

"It's very costly – the number is probably in the \$5-6 million range right now. Building anything on an island is hard and not cheap, so we're trying to balance all that to refine the project and the business plan for it, and then push forward," Hall said. "I'm one of the few people who like asking people for money, so I'd like to help build on what's already a good development program."

*"I'm one of the primordial fossils, which means I've been a donor since the early 80s, and I thought someday I'd like to be more involved."* – TOM HALL

Photo: Katy Spittell



To help support the Cooke Castle renovations, visit [ohioseagrant.osu.edu/giving](https://ohioseagrant.osu.edu/giving) and select the Cooke Castle Fund. Donors also become members of the Friends of Stone Lab and will receive periodic updates about the lab and the group's work.



*The Friends of Stone Laboratory (FOSL) began in 1981 as a support group to “bring Stone Laboratory into the 21<sup>st</sup> century with the best possible facilities, equipment and professors, and make this an unequalled learning experience available to all outstanding students.” Members of the Friends provide a way for former students to support the facility by raising awareness and funds for scholarships, research, and equipment.*

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# FOSL

## Dates to Remember

**April 21-23, 2017** Spring Work Weekend  
**September 9, 2017** Stone Lab Open House  
**October 20-22, 2017** Buckeye Island Hop

## Winslow's appointment as Ohio Sea Grant director announced at 19th Annual Winter Program

*By Christina Dierkes and Lisa Aurand Rice,  
Ohio Sea Grant Communications*

Dr. Chris Winslow has been named the new director for Ohio Sea Grant and Ohio State's Stone Laboratory, effective February 1, 2017.

Dr. Carolyn Whitacre, senior vice president for research at The Ohio State University, made the announcement February 7 at the 19th annual Friends of Stone Lab Winter Program and Silent Auction, which was held at the Longaberger Alumni House at The Ohio State University.

“Chris brings a wealth of experience and expertise to this position in the areas of strategic planning, Ohio Sea Grant administration, grant management, research, outreach and teaching,” Whitacre said.

Winslow has served as the interim director of Ohio Sea Grant & Stone Lab since April 2015. He joined Ohio Sea Grant as assistant director in 2011, after having taught courses at Stone Lab and mentoring students in the Research Experience for Undergraduates (REU) program for eight years. He was promoted to associate director in 2014 and took on the leadership of Ohio Sea Grant in 2015 with the retirement of former director Dr. Jeffrey Reutter.

Winslow holds a bachelor's degree from Ohio University and a PhD in biology from Bowling Green State University. His research focused on invasive round gobies and their impact on smallmouth bass populations.

“It's a real pleasure tonight to make him the permanent director,” Whitacre said at the February event. “Congratulations, Chris. It's very, very well deserved.”



About 100 people were in the audience for the announcement, a surprise highlight of the annual event.

The event's guest speaker this year was State Climatologist and Ohio State University Professor of Geography Dr. Bryan D. Mark. Mark shared dramatic photos from his research on glacial discharge in Peru and how it affected people who live in the area.

Other speakers included Dr. Lonnie King, acting vice president for agricultural administration and dean of the College of Food, Agricultural and Environmental Sciences, FOSL President Ken Scott, Buckeye Friends of Stone Lab President Madelyn Strahan and Ohio Sea Grant Program Assistant Sue Bixler. Caroline McElwain, a 2016 Stone Lab ichthyology REU, presented her research on how well emerald shiners can see in murky water.

The event, including the silent auction fundraiser, raised a total of \$1,514 for Stone Lab programs and scholarships. **FOSL**

## TURNOVER WEEKENDS AT STONE LAB

FOSL members have been lending a hand getting Stone Lab ready for new visitors in between classes. If you're interested in volunteering for one or more of these dates, please contact Ken Scott at [ks24@columbus.rr.com](mailto:ks24@columbus.rr.com).

June 10-11, June 17-18  
July 22-23  
August 5-6, August 8-9-10-11

## Winter Program Donors

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In the summer of 2000, Shawn Sweeney took an introductory aquatic biology course at Stone Lab, learning all about Lake Erie while wading hip-deep in local streams and taking water quality measurements on research cruises.

Today, he's the senior director of community engagement for the Jane Goodall Institute, helping to protect habitat for chimpanzees and gorillas and supporting sustainable agriculture in African nations.

"My time at Stone Lab was one of the most formative of my life," Sweeney said. "Though I work in communications and marketing these days, my courses in biology truly gave me not only the know-how to help protect species and ecosystems, but also my appreciation, passion and motivation for protecting them."



You can help make sure that future students have the same opportunity to find their passion by donating to Stone Lab scholarships at [go.osu.edu/SLgift](https://go.osu.edu/SLgift).