

TWINE LINE

Ohio Sea Grant + Stone Laboratory

A Team Effort

*Initiative Deals with Algal
Toxins from All Angles*

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LAB NOTES

Ohio Sea Grant
by the Numbers

> Great Lakes Shipwrecks



6,000+
SHIPWRECKS

have occurred in
the Great Lakes

277
shipwrecks



have been
discovered
to date

LAKE ERIE HAS HAD MORE THAN



1,700
SHIPWRECKS
according to
historical records

**DURING THE "WHITE HURRICANE"
IN NOVEMBER 1913:**

12 SHIPS
WERE LOST



31 MORE SHIPS
were driven ashore
by wind and waves



More than
250
SAILORS
LOST THEIR LIVES



THERE ARE
30
maritime
museums and
lighthouses
on the Lake Erie
Coastal Ohio Trail



DIVERS FLAG

is not less than one foot square having a diagonal white stripe extending from the masthead to the opposite lower corner that when displayed indicates that divers are in the water.



**MOORING
BUOYS**

are placed seasonally
to mark popular

*Lake Erie
shipwrecks*



Learn more at
ohioshipwrecks.org

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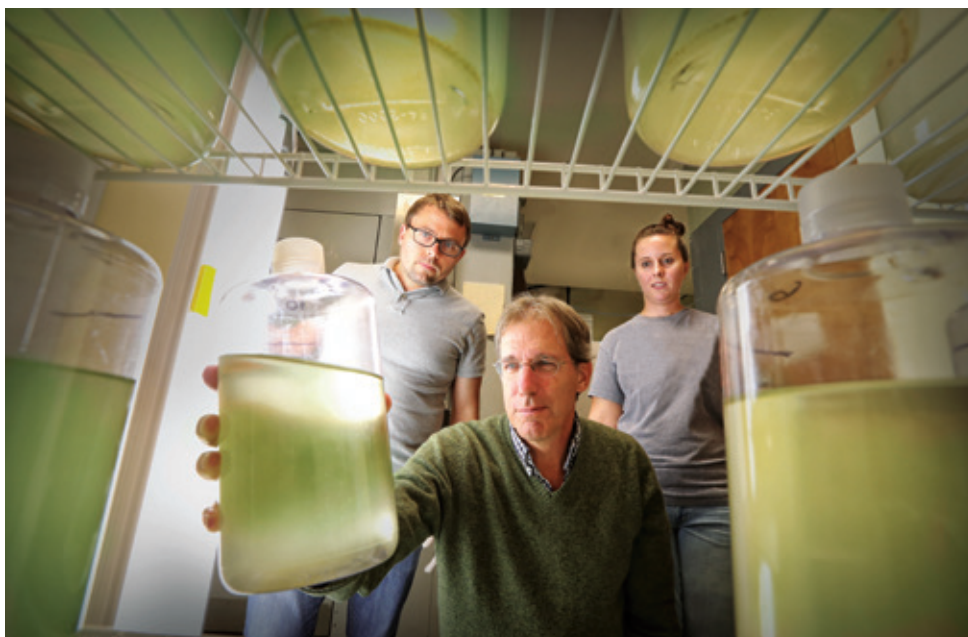
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STORY BY
**CHRISTINA
DIERKES**



Cover Photo and Photo Above: Courtesy of Bowling Green State University

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ABOUT TWINE LINE

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Photo: David J Ruck/Great Lakes Outreach Media

Harmful Algal Bloom Interactive Fact Sheet

What are harmful algal blooms? Where do they come from? How safe is Lake Erie water? These are questions everyone who's been affected by algal blooms asks.

A new Ohio Sea Grant online fact sheet answers these and other questions with videos, an interactive "Q&A with Experts" feature and resources to dig deeper.

VIEW FACT SHEET ONLINE

go.osu.edu/facts

Science on the Shallowest Great Lake

Put-in-Bay teacher brings hands-on Lake Erie science back to her classroom

By Christina Dierkes

Living on South Bass Island means Stone Lab, Ohio State's island campus located across the water from Put-in-Bay, is never far from people's minds. For Melissa Kowalski, the science teacher for the 34 students in grades 7-12 at Put-in-Bay schools, the lab building is a familiar sight, and she's taken classes there in the past.

But last summer, Kowalski took her professional development to the next level, spending a week on a research vessel working with scientists and other educators on bringing hands-on Lake Erie science back to her classroom.

The Great Lakes Shipboard Science Workshop connects teachers with scientists aboard the U.S. EPA ship *R/V Lake Guardian* for an immersive program that offers first-hand exploration of a Great Lake's ecology and geology. This year, the Lake Erie cruise focused on harmful algal blooms, plastic pollution and zooplankton populations.

"It was all just really an incredible experience," Kowalski said. "My bachelor's is in biology and geology, so being able to do actual research science in a lab with other people that are like-minded was really... it was transformative, honestly. It renewed my excitement for teaching and science in general and I think it's going to really be beneficial for my students."

Kowalski worked in the ship's algae lab with Dr. George Bullerjahn of Bowling Green State University, studying mud samples from the bottom of the lake to see if algal toxins from harmful algal blooms remain in the mud after the bloom has dissipated. Data she and the other teachers in the lab collected will be part of a larger partnership between BGSU and researchers at The University of Toledo, but Kowalski will also bring that real-world scientific experience back to her students.

Ohio Sea Grant and Stone Lab education specialists Lyndsey Manzo and Angela Greene were part of the instructor team for the workshop. In addition to helping teachers integrate their shipboard experience into their curriculum, they presented teaching tools ranging from Google Maps to video apps that can make teaching more engaging and effective.

"In teacher education, it's not just about the content, it's not just about how you teach, but you have to be able to use instructional technology," Manzo said. "Not just presentation technology, but there are so many tools now that make learning more efficient, and we really try to integrate those pieces into our workshops."

Being on a working EPA research ship also gave the teachers an opportunity to watch EPA research staff in their element. When some of the sampling gear used to collect microplastics broke, the technicians went to work, engineering a solution in real time and salvaging most of the planned sample collections.

"It's one thing to read about the scientific process in a book and do it in a lab course in college, but to actually be out there, doing this novel research that nobody's ever done before is really a pretty cool thing," Kowalski said. "I think it solidifies people's understanding of how things actually go."

Kowalski continues to work with the teachers she met on the *Lake Guardian* on how to integrate their experiences into their classrooms. Teachers partnered with other educators from similar school settings to create a collaboration plan that helped them note how each activity



“It’s one thing to read about the scientific process in a book and do it in a lab course in college, but to actually be out there, doing this novel research that nobody’s ever done before is really a pretty cool thing.”

MELISSA KOWALSKI

› SCIENCE EXPERIENCE

Science teacher Melissa Kowalski is bringing hands-on science from the Lake Guardian back to her classroom.





BRINGING LIFE TO SCIENCE

Stone Lab's Lake Erie Science Field Trip Program has brought life to Lake Erie science to 282,000 kids and adults since 1973. Students in grades 5-12, college students and adults can become scientists for a day or two, participating in a research cruise, collecting data for long-term studies and experiencing first-hand what it's like to study the lake and its inhabitants.



LEARN MORE

Watch the story at
go.osu.edu/fieldtripvid



LAKE SCIENCE

Educators on the Lake Guardian got to do it all, from working in a U.S. EPA lab to handling sampling equipment. A stop at Stone Lab also introduced them to Lake Erie science opportunities directly available to their students.

or piece of information could be used with their students. Feedback from the larger group of educators also helped to refine those plans.

"I don't have other science teachers to collaborate with at my school," Kowalski said. "So I really love when I get the chance to go and talk to other teachers. It just gives me so many good ideas."

That's true regardless of where teachers work – Great Lakes educator workshops like this one not only offer professional development opportunities, but help educators build community beyond their school district. That continued collaboration helps bring new knowledge to the classroom, re-energizes teachers' commitment to education, and helps them do their best work for their students and their community. ●



Scholarships Support Science Experiences

Friends of Stone Lab
Award Stone Laboratory
Scholarships to State Science
Day Competitors

By Christina Dierkes

The Friends of Stone Laboratory (FOSL) awarded Stone Laboratory scholarships to 15 students from across the state at the 2019 State Science Day, held May 11, 2019 at The Ohio State University. Each student receives free room and board for a one-week course held at Stone Laboratory.

Since 1996, FOSL has awarded scholarships to more than 200 top State Science Day participants to allow them to experience hands-on science at Stone Lab.



LEARN MORE ABOUT THE FRIENDS OF STONE LAB

Information about joining FOSL can be found at ohioseagrant.osu.edu/giving/fosl

If you would like to volunteer as a judge for the 2020 State Science Day, held on May 9, please contact FOSL liaison Erin Monaco at monaco.25@osu.edu.



2019 Recipients

› **Molly Jean Batchelder**

Anna High School, Anna
Effects of sunscreen ingredients on turbidity of ocean water

› **Caylee Bree Combs & Brynn Eleanor McGrail**

Rutherford B. Hayes
High School, Delaware
How much runoff is too much for duckweed?

› **Hannah Adams Gemmell**

Firestone High School, Akron
Would you kill the ocean to save your skin? The effect of reef-safe sunscreen, oxybenzone and octocrylene on bioluminescent dinoflagellates

› **Emily Ann Kruse**

Bloom-Carroll High School, Carroll
Testing local water sources for microplastic pollution and its effects on agriculture

› **Makayla Lerner**

Bloom-Carroll High School, Carroll
Bio-stimulation of oleophilic microbes for oil spill bioremediation

› **Nicole S. Lim**

Ursuline Academy, Cincinnati
Determining if Chitosan nanoparticles aid in treatments for E. coli

› **Jason Tan Hui Lin, Brayden Shaver & Gregory Tan**

Ontario High School, Mansfield
Correlations between amphibian populations and water chemistry in a constructed wetland

› **Elyse Lauren Reed**

Ashland High School, Ashland
The effects of decomposing polyethylene on ocean acidification

› **Julia Elizabeth Schleeter**

Ottoville Elementary School, Ottoville
The effects of fertilizer runoff containing phosphorus, nitrogen and potash on Amoeba proteus

› **Madeline Shumaker**

Pettisville High School, Pettisville
The effect of water transparency on the growth of algae

› **Andy Smith**

Mentor High School, Mentor
The effects of environmental factors on phosphorus leaching from Lake Erie soil

› **Letty Grace Weimer**

Dayton Regional STEM School, Kettering
Hydroponics: Ditch the dirt

New Stone Lab Gear for the Holiday Season

Stone Lab merchandise shows off your alumni pride and supports scholarships for future students. T-shirts, sweatshirts and water bottles make great gifts for any science students in your life, and proceeds help future Lake Erie scientists get a head start on their careers.

Check out the selection and place your order at ohioseagrant.osu.edu/giving/merch



Stone Lab Featured in Big Ten Network's LiveBIG Series

Sometimes science requires that we get a little wet and a little dirty in the spirit of discovery. Nowhere is that more evident than at The Ohio State University's Stone Lab, the nation's oldest freshwater biological field station, located on Gibraltar Island in Lake Erie. Students and researchers use the unique space to explore problems facing Lake Erie, its wildlife and the region in order to better preserve and protect the vital ecosystem.



WATCH "INSIDE OHIO STATE'S ISLAND LABORATORY" AT

go.osu.edu/BTN2019

COMMUNITY OUTREACH



COMMUNITY SCIENCE PARTNERSHIPS

Ohio Sea Grant, Stone Lab and the Lake Erie Islands Nature and Wildlife Center on South Bass Island have partnered to bring scientific expertise and programming to each other's events and

enhance the experience for visitors and the local community. Stone Lab provides faculty and staff for guest lectures and hands-on presentations at the wildlife center, while LEINWC adds programming and staff to the lab's events, enhancing the experiences for visitors and the local community.

In 2018, for example, Stone Lab helped LEINWC offer three weeks of adult outdoor education through the Road Scholar program to 73 participants from across the United States and Canada, and six weeks of Nature Camp for 148 children ages 4-14. Staff also supported ten weeks of WILD Tuesday animal programs averaging 100 weekly participants, daily tours of the museum and nature trails to more than 5,000 visitors, and special programming on astronomy, birding and pollinator insects.



RETHINKING PLASTIC USE AT PUT-IN-BAY

Single-use plastics, like water bottles, straws and bags are an everyday occurrence in our lives. These items of convenience are meant to be used once and then discarded. But where do they actually end up?

Unfortunately, many of these items can end up in our waterways from poor waste management, littering and storm water discharges. They are found in rivers, streams, ponds, lakes and the world's oceans. But their impact doesn't stop there. Plastics are also showing up in the stomachs of most animals, the air we breathe, the water we drink and the food we consume. Plastic is reducing the beauty of our beaches, rivers and other once pristine areas.

To help combat the plastic pollution problem, Ohio Sea Grant and Stone Laboratory received funds from the NOAA Marine Debris Program to educate visitors to Put-in-Bay about the negative effects of plastic pollution and simple steps we can all take to reduce our plastic use.

Those steps can include skipping straws at restaurants, choosing reusable bags when you shop, and properly disposing of cigarette butts and cigar tips.



For more information about the project and more tips to reduce your own plastic use, follow @PlasticFreePIB on Twitter.

Life and Science on the High Seas

Extension educator Jill Bartolotta becomes Teacher at Sea on NOAA Ship *Okeanos Explorer*

By Christina Dierkes

“

It makes you realize how little we actually know about the ocean, and that we're this tiny little dot on the surface, on this little ship. It's just humbling.”

That's Ohio Sea Grant Extension educator Jill Bartolotta, talking about her experience aboard the NOAA Ship *Okeanos Explorer* as part of NOAA's Teacher at Sea Program. The program gives teachers the opportunity to participate in cutting-edge ocean science, working side-by-side with scientists. Now in its 29th year, the program has provided nearly 800 teachers the opportunity to gain first-hand experience participating in science at sea.

Bartolotta spent two weeks aboard *Okeanos Explorer* during a mission to map the Atlantic Ocean floor near Florida, learning about the science of ocean mapping and the many careers represented among the ship's crew.

“That was my role on the ship, to learn about the science but then also to learn about everyone on the ship, what they do and how they got there,” said Bartolotta. “They all have great stories of how they came to be living a life at sea and their stories of traveling the world on ships were just really phenomenal.”

Many of those stories will inform future Ohio Sea Grant outreach work as well.



“Now that I have a better understanding of what is involved, I will create this career journey board that we'll take to outreach events so that when we meet with young people, we can introduce these careers to them.”

JILL BARTOLOTTA

› FAR HORIZONS

Extension educator Jill Bartolotta was selected as one of 19 NOAA Teachers at Sea. She joined a research cruise to map parts of the ocean floor near Florida.

Bartolotta is planning to create displays that lay out the career paths available on NOAA ships, and how students interested in a career at sea can prepare for those paths.

“Now that I have a better understanding of what is involved, I will create this career journey board that we’ll take to outreach events so that when we meet with young people, we can introduce these careers to them,” she said. “We’ll let them know what opportunities are out there for them, including Stone Lab as one place to get experience in this type of work.” Stone Lab, Ohio Sea Grant’s research, education and

outreach facility on Lake Erie, offers summer courses and professional skills workshops to those interested in aquatic sciences.

The officers on a NOAA ship are part of the NOAA Commissioned Officer Corps, a non-military branch of the federal uniformed services. NOAA Corps members usually have science backgrounds and hold 4-year degrees, and complete U.S. Coast Guard training before their first assignment.

Civilian professional mariners are responsible for the ship’s everyday operations, from kitchen to engine room and everywhere in between. Lab technicians who run sampling equipment and sonar operations are included in this career path.

But participation in the Teacher at Sea Program extends far beyond the few weeks spent on a NOAA ship. “Teachers describe this authentic research experience as transformative and one that allows them to bring new knowledge and excitement back to their classrooms,” said Jennifer Hammond, the program’s director.

This year, NOAA received applications from nearly 300 teachers, and chose 19 to participate in research cruises. These educators are able to enrich their classroom work with the depth of understanding they gain by living and working alongside scientists studying the marine environment.

Educators who participate in the program often take an active role in developing those curricula as well. Bartolotta will include aspects of life at sea into her lesson plans, from naming parts of a ship to commonly used phrases that aren’t part of most people’s vocabulary. In addition, a science lesson plan will let students build test ships to see which shapes move through water the best, and relate those shapes back to the aquatic animals that inspire how sea-going vessels are designed.

“These resources are available for teachers all over the world to teach their students about what’s going on across the ocean,” Bartolotta said. ●



➤ SALT LIFE

Teachers at Sea experience the full range of life on a research ship, from learning about sonar results to watching the local marine life.

This year, NOAA received applications from nearly



300
TEACHERS

19



WERE CHOSEN TO PARTICIPATE IN RESEARCH CRUISES



LEARN MORE

More information about the NOAA Teacher at Sea Program is available at teacheratsea.noaa.gov



LESSON PLANS

The final lesson plans will be available through NOAA’s Office of Ocean Exploration and Research at oceanexplorer.noaa.gov/edu as well as through the Ohio Sea Grant website.

Nitrogen Trackers

Ohio Sea Grant researchers hone in on the role of nitrogen in harmful algal blooms

By Christina Dierkes

► BEYOND PHOSPHORUS

Researchers Silvia Newell and Mark McCarthy are examining the impact of nitrogen runoff on Lake Erie harmful algal blooms and toxin production.

N

itrogen is quite literally all around us: 78 percent of Earth's atmosphere is made up of nitrogen gas, and all living things include some form of nitrogen. It's a necessary part of life, but as with most nutrients, too much of a good thing can quickly become a bad thing.

In Lake Erie, excess nitrogen can affect harmful algal blooms (HABs), from increasing the overall size of the bloom to making it produce more of the algal toxins that can affect human and wildlife health. Ohio Sea Grant researchers at Wright State University have been looking into these impacts for several years, and their results suggest that controlling HABs is about more than phosphorus runoff.

Nitrifying bacteria and archaea are the only microorganisms that can recycle nitrogen from its fertilizer forms – such as urea, ammonia or the organic nitrogen contained in manure – into nitrate. That nitrate is the main compound that can be removed from the ecosystem naturally by another microbial process called denitrification. Dr. Silvia Newell and Dr. Mark McCarthy have found that the cyanobacteria that cause harmful algal blooms disrupt denitrification and outcompete nitrifying bacteria, exacerbating bloom problems because more nitrogen is available to fuel its growth instead of being released back into the atmosphere as nitrogen gas.

“The trouble is that these nitrifiers have to compete with the harmful algal bloom for the kind of nitrogen they can use,” said Newell. “And they’re really not very good at competing with the harmful algal bloom, it turns out. Most of the data from our doctoral student Daniel Hoffman are showing that when the bloom is smaller or not around, nitrifiers’ rates of processing nitrogen are much higher than when the bloom is around.”



Research by their Master's student Ashlynn Boedecker confirmed that denitrification, the natural pathway for removing nitrogen, is seriously reduced during high bloom years. Focusing on sediments, where most of the nitrogen-containing organic compounds are decomposed, she determined that the bacteria contained in western Lake Erie sediments removed about 35 percent of the basin's annual nitrogen load in 2016. However, denitrification rates were inhibited during the larger 2017 bloom.

Of additional concern when it comes to nitrogen are the toxins many harmful algal blooms can produce. Not all blooms become toxic, and large blooms aren't necessarily more toxic than small blooms, but a growing body of research suggests that the amount of excess nitrogen in the ecosystem is closely connected to toxin production.

"In this particular case, what happens if you've got extra nitrogen around is that not only do you get a much bigger bloom, but if you reduce phosphorus inputs to the lake and not nitrogen, you're likely to produce a more toxic bloom," Newell said.

Scientists aren't sure why cyanobacteria produce toxins, but they do know that each molecule of microcystin, the most common algal toxin in Lake Erie, contains ten nitrogen atoms and no phosphorus, making nitrogen availability a major factor in the bloom's ability to become toxic.

With Ohio's continued attention on Lake Erie, harmful algal blooms and their impacts on residents, Newell emphasized that research into the effects of nitrogen on these problems is mostly in its beginning stages.

"As a whole, the research community is starting to shift to looking at the role of nitrogen, and that's the first step before we can



make policy recommendations," Newell said. "Less nitrogen is probably a good idea, and there are things that farmers are already doing to control phosphorus that are also going to help control nitrogen."

With researchers addressing similar problems across the world – harmful algal blooms also happen in lakes throughout Europe and China – the hope is that reducing external nutrient loads beyond phosphorus will help address modern blooms and their impacts from a range of angles, making it easier to get a handle on a global problem with direct impacts on local communities. ●

> A CLOSE LOOK
In addition to playing a role in algal toxin production, sample data has shown that Lake Erie bacteria process nitrogen at a lower rate when harmful algal blooms are present.

“As a whole, the research community is starting to shift to looking at the role of nitrogen, and that's the first step before we can make policy recommendations.”

SILVIA NEWELL

OTHER HABS RESEARCH



HABS FROM THE PAST COULD PREDICT FUTURE ALGAL BLOOM SEASONS

Researchers at Bowling Green State University are developing a model that focuses on the impacts of increasing water temperatures on the timing of harmful algal blooms in Lake Erie. Once validated, the model can help

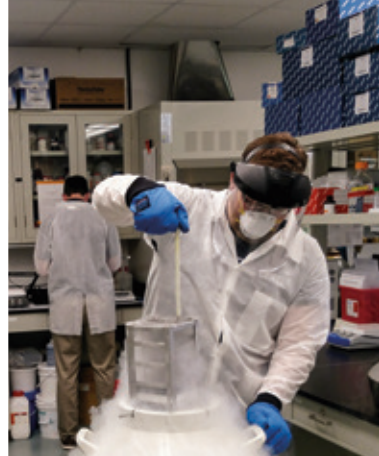
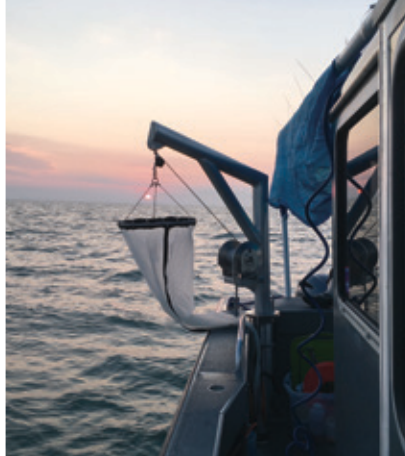
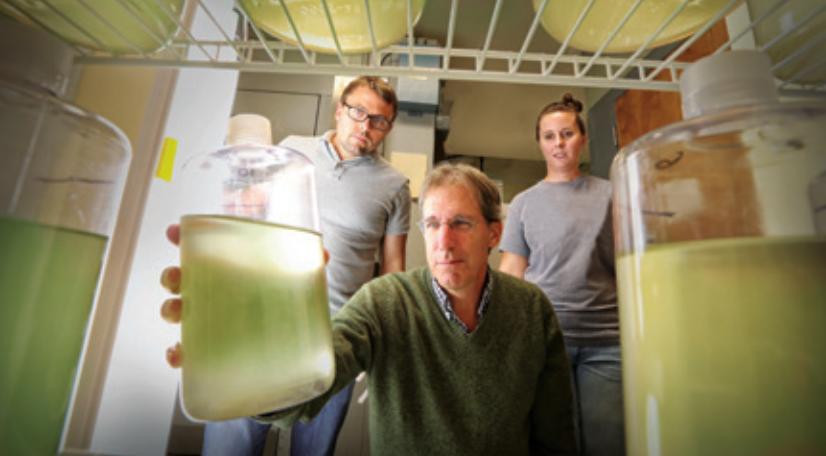
water managers and other stakeholders better prepare for the onset of harmful algal bloom season.



GLYPHOSATE, PRESENT IN COMMON HERBICIDES, RELEASES PHOSPHORUS FROM FARM FIELDS INTO LAKE ERIE

Glyphosate, the active ingredient in herbicides like RoundUp™, significantly contributes to releasing dissolved phosphorus from soils into Lake Erie. Researchers at Ohio Northern University have found that this dissolved phosphorus is potentially fueling harmful algal blooms by making

more nutrients available to the cyanobacteria that cause them. Other herbicides and pesticides tested did not have the same effect.



A TEAM Effort

The Harmful Algal Bloom Research Initiative Continues to Help Protect Ohio Residents from Algal Toxins

By Christina Dierkes

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LEARN MORE ABOUT
HABRI RESEARCH
AND ITS IMPACTS AT

go.osu.edu/habri



agency collaboration and researcher partnerships have been the keys to the success of the Harmful Algal Bloom Research Initiative (HABRI) since it began in 2015. With more than \$7.5 million invested so far, the initiative aims to address Ohio's harmful algal bloom problem, both in Lake Erie and in its watershed.

Fifty-four science teams at ten Ohio universities, funded by the Ohio Department of Higher Education, are on the case: working with front-line health, environmental and agricultural agencies, as well as water treatment plants and coastal communities, to bring them the answers they need to get the state – and region – ready to deal with HABs from all angles.

The third round of funded projects recently reported in from their first year of work, and researchers are making promising progress on solutions for tracking blooms, protecting drinking water, reducing public health impacts and supporting sustainable agriculture efforts. Some of their findings are presented here.

Photo Top Left: Courtesy of Bowling Green State University

Engage Stakeholders

DEVELOPING A BETTER MANURE FERTILIZER

Dr. W. Robert Midden, Bowling Green State University

Manure from concentrated animal feeding operations (CAFOs) can negatively impact water quality. If too much is applied to too little land, this can lead to relatively large amounts of nutrients in field runoff. The same manure can also be used as a beneficial agricultural fertilizer, but the cost of transporting it to fields is often high relative to its fertilizer value because of the high water content.

HABRI researchers are developing a low-cost treatment for manure from concentrated animal feeding operations, focused on separating manure nutrients from wastewater and producing a dry product that could reduce transportation cost by 20 to 40 times. That dry product would also release nutrients more slowly into the soil, thus enhancing crop yield and improving water quality.

In the past year, they treated 3000 gallons of liquid manure from a dairy CAFO with a wastewater treatment coagulant that allowed them to separate solid and liquid manure components and ensure that nutrients remained in the solid portion. They compared this treated manure to raw manure by placing it on experimental farm fields, tilling the fields to incorporate the fertilizer and then planting soybeans. During this pilot test, water samples were collected during rain events and analyzed for agricultural nutrients.

Results show higher phosphate concentrations in runoff from plots fertilized with raw manure, compared to plots that received the treated manure solids. Crop yields from both field types were similar, suggesting that plants can absorb nutrients from the treated manure just as well as from the



► **ON THE FIELD**
Researchers at Bowling Green State University are developing a low-cost way to make manure from concentrated animal feeding operations more effective with less of an impact on Lake Erie algal blooms.

Top Photo: Courtesy of Bowling Green State University

raw manure. Overall, the treated manure seemed to have a positive impact on reducing agricultural nutrients in runoff from farm fields.

The researchers are also working on a way to trace nutrient runoff back to its source based on organic nitrogen and phosphorus compounds that are specific to where the runoff came from. They are identifying specific compounds present in each type of manure treatment, along with contaminants like hormones and antibiotics potentially present in manure from large animal operations in order to determine whether the treatment process can help prevent problems from these substances.

Future funding will hopefully expand their experiments to manure from swine facilities, and to testing new polymers they have developed in the lab that offer performance advantages and possible cost savings.



Results show higher phosphate concentrations in runoff from plots fertilized with raw manure, compared to plots that received the treated manure solids.

Track Blooms from the Source

BUILDING A BETTER SATELLITE FOR HARMFUL ALGAL BLOOM MONITORING

Dr. Catharine McGhan, University of Cincinnati

Satellites equipped with sensors that target harmful algal blooms offer early warning systems for drinking water protection, as they allow scientists and water managers to track blooms and their movements on a large scale.

However, current satellite monitoring efforts are limited to days without cloud cover and very coarse imagery from a small number of expensive satellites available to researchers.

HABRI scientists are working together with UC CubeCats, an undergraduate engineering student group at the University of Cincinnati, to incorporate a much less expensive system for cyanobacteria detection into a CubeSat, a type of small standardized satellite that the students are designing. This detection system will operate effectively in space, gathering useful imagery from low Earth orbit. The system looks for the presence of phycocyanin, the blue pigment that gives cyanobacteria in some toxic and nontoxic “algal” blooms their color.

The project has already trained a number of undergraduate students who were able to contribute original research on various components of the satellite, including working with suppliers and presenting results at conferences. The research team is now moving into the fabrication stage, as well as testing solar panels and targeting methods for the satellite’s sensors. The imaging sensors will be tested on small aircraft during the spring of 2020 to prepare for integrating them into the satellite.

Once completed and placed in orbit, the satellite will supply imagery of the Great Lakes that allows for the early detection of harmful algal blooms for up to two years. The data will be received by a ground station at the University of Cincinnati, which is currently being upgraded to support this mission.

The researchers will use the satellite images to better understand how algal blooms grow and move in the Great Lakes, and to support other early warning systems that help protect drinking and recreational waters for the region’s residents. Lessons learned from this satellite development will also inform future monitoring satellite systems.



Once completed and placed in orbit, the satellite will supply imagery of the Great Lakes that allows for the early detection of harmful algal blooms for up to two years.



> EYE IN THE SKY

A team at the University of Cincinnati is building a CubeSat satellite that will help with early detection of harmful algal blooms from space.





► SMALL WONDERS

Researchers are working with an undergraduate student group to build a small satellite that can track harmful algal blooms in the Great Lakes from space. Once completed, the satellite will be launched as part of NASA's CubeSats program.

Protect Public Health

HOW DOES MICROCYSTIN AFFECT LIVER CANCER DEVELOPMENT?

Dr. Thomas Knobloch, The Ohio State University

Harmful algal blooms can release toxins that affect the liver, kidneys and heart, as well as the digestive and nervous system in people and animals. Exposure from drinking contaminated water is most common, and can be either chronic, such as from drinking water that contains minute amounts of toxin daily over a long period, or acute, such as swallowing water with high levels of toxin just once while swimming in a contaminated lake.

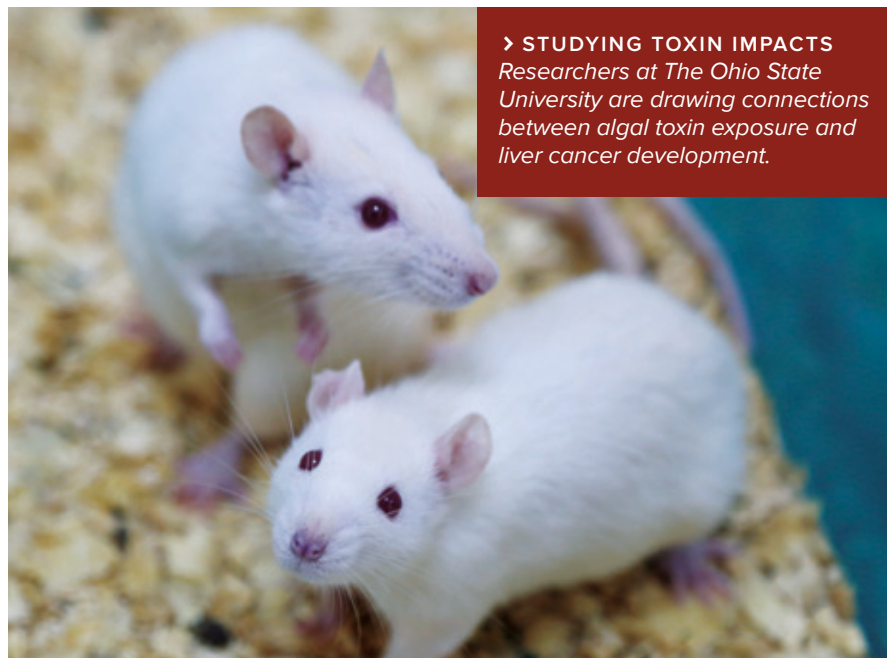
Long-term and high doses of algal toxins can lead to an increased risk for liver cancer, but researchers don't really know how dosage and chronic or acute exposure affect that risk. HABRI scientists are working to better understand the mechanisms of algal toxin damage, as well as whether dosage and timing of exposure changes those mechanisms.

Microcystins, the toxins that most Lake Erie harmful algal blooms produce, cause tissue damage in liver cells, which can turn into liver cancer with prolonged or concentrated exposure. This damage can exacerbate problems in patients with pre-existing liver disease such as non-alcoholic fatty liver disease, one of the most common pre-existing liver conditions. The researchers are using mice to mimic both short-term concentrated exposure to algal toxins, such as would happen on a weeklong vacation to a contaminated beach, and long-term exposure to levels generally considered safe to drink.

Results showed that liver damage in mice exposed to high doses of microcystin was higher the more toxin they had ingested. Other systems like kidneys and reproductive organs were also affected. Unexpectedly, three of four mice that died early in the study were female, suggesting that although liver cancer is more common in males, acute impacts of algal toxins may be more severe in females.

The mice exposed to low levels of microcystins developed more pre-cancerous and liver tumors than control mice, especially in high-risk individuals with pre-existing liver disease. So while microcystin alone or in healthy individuals may not pose a significant health risk at low doses, exposure in high-risk populations can promote damaged liver cells to become cancer cells.

The researchers continue to study the mechanisms involved in producing this liver damage, in the hopes of eventually finding biomarkers that let them predict who may be at greatest risk for toxin-induced liver cancer before it develops.



► STUDYING TOXIN IMPACTS

Researchers at The Ohio State University are drawing connections between algal toxin exposure and liver cancer development.

Produce Safe Drinking Water

USING BACTERIA TO REMOVE MICROCYSTIN FROM DRINKING WATER

Dr. Jason Huntley, The University of Toledo

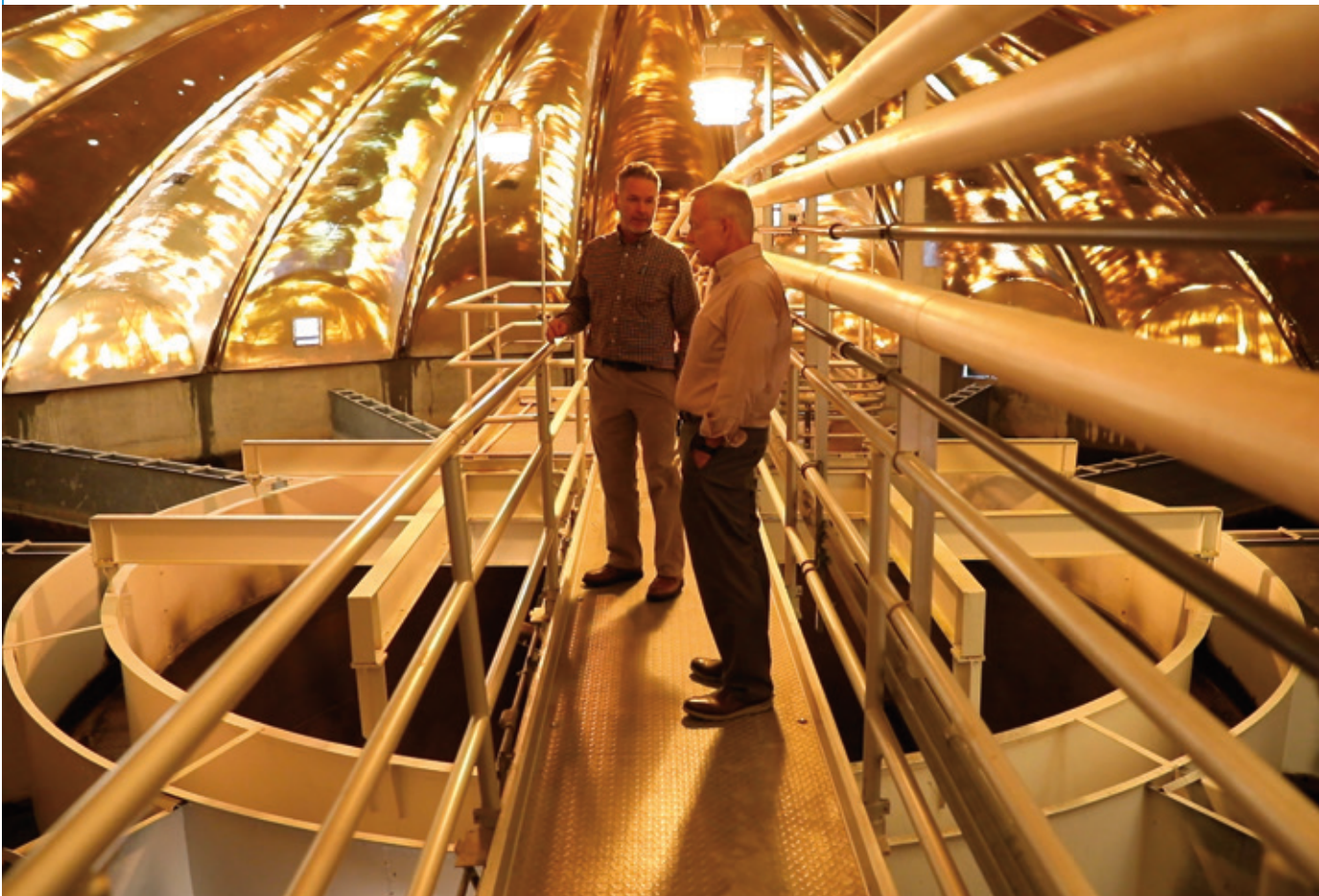
► SCALING UP

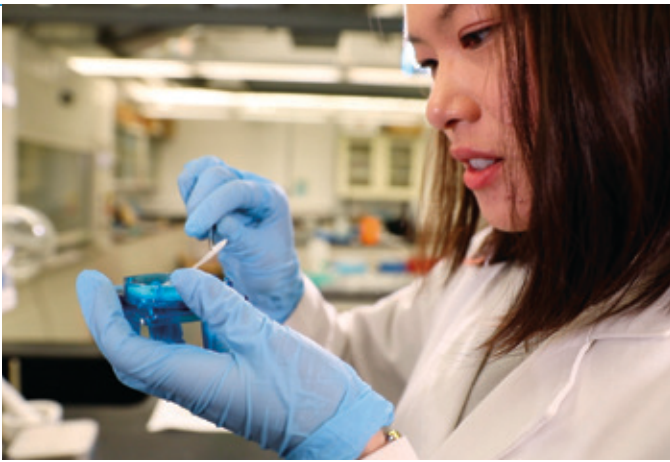
Researchers at The University of Toledo are developing approaches to drinking water treatment that target low levels of algal toxins. Their goal is to give plant operators more options and avoid unnecessary treatment costs.

Many Ohio communities draw their drinking water from Lake Erie, so making sure that any harmful algal bloom toxins are removed before the water reaches consumers is essential to maintaining public health. While water treatment plants currently use activated carbon to treat for algal toxins, researchers are developing new approaches that use microcystin-degrading bacteria to remove toxins from their source water.

State agencies like the Ohio EPA and the Ohio Department of Health have expressed a need for new technologies that drinking water plants can use to remove algal toxins from their raw water. In particular, they require ways to effectively treat low levels of toxin without incurring the same cost required to remove higher toxin levels from the water.

HABRI researchers are now exploring biofilters, built by growing bacteria in thin layers called biofilms on solid surfaces, which could potentially purify drinking water that contains low levels of algal toxins. The bacteria they are using occur naturally in freshwater, and have been shown to break down microcystin toxin into non-toxic component parts. The researchers have already filed provisional patents on this technology.





> APPLIED RESEARCH

HABRI scientists are working directly with water treatment plants to develop cost-effective ways of keeping drinking water safe from algal toxins.

Their current work focuses on determining the right combination of bacteria to grow, to ensure that the largest amount of toxin is removed from the water. In addition, they are scaling up their previous bench-scale laboratory experiments from small filters to a filter size more likely to be used in a water treatment plant.

To make sure the bacteria do not pose a separate threat to human health, the scientists are also working on genetic sequencing for the biofilter bacteria to make sure they won't be able to cause disease in humans. Once the bacterial DNA is sequenced, the researchers hope to also use that information to potentially identify the specific enzymes responsible for breaking down microcystin into non-toxic compounds. ●



HABRI researchers are now exploring biofilters which could potentially purify drinking water that contains low levels of algal toxins.



OHIO SEA GRANT ANNOUNCES NEW FUNDED PROJECTS FOR 2020-2022



Ohio Sea Grant has completed reviews for its 2020-2022 research grants program, submitting eight projects at universities across Ohio and along the Lake Erie coast to the National Sea Grant Office for funding consideration. The selected projects focus on various aspects of pharmaceuticals and personal care products in the Lake Erie ecosystem, as well as harmful algal bloom management and the human health impacts of algal toxins, in an effort to continue to help solve critical issues affecting the state's environment and economy.

Researchers will collectively receive about \$930,000 in Ohio Sea Grant support over two years as part of the following projects:

1 *On-site and in laboratory quantitative analysis of pharmaceuticals and PFAS in fish by solid-phase microextraction technology coupled to mass spectrometry*

Emanuela Gionfriddo
The University of Toledo

2 *High-throughput analysis of human toxicity and therapeutics targets of emergent chemicals of concern in liver and kidney systems in health and disease*

Steven Haller
The University of Toledo

3 *Characterization of in-stream phosphorus cycling from high-frequency dissolved phosphorus time series*

James Hood
The Ohio State University

4 *Occurrence and sources of veterinary pharmaceuticals in Lake Erie tributaries*

Laura Johnson
Heidelberg University

5 *Variation in contaminant concentrations in wastewater and in biota of streams in NW Ohio*

Kevin McCluney
Bowling Green State University

6 *Assessing nitrogen dynamics in a closed, integrated aquaponics system*

Silvia Newell
Wright State University

7 *Dredged material blended with organic rich sources to amend farm soils*

Angélica Vásquez-Ortega
Bowling Green State University

8 *Assessing the impact of shore management on the resilience of coastal environmental microbiomes*

Trisha Spanbauer
The University of Toledo



Learn more about Ohio Sea Grant research and funding at ohioseagrant.osu.edu/research.



Student

SPOTLIGHT >>

An Engaging Environment

By Joy Snow

Stone Lab is well known for its hands-on approach to lessons and its unique location on Gibraltar Island, but the magic comes from more than just a great locale, as then-second year biology student Emily Esplandiú learned last summer. Stone Lab puts students in close contact with experts in their field, in the field, giving them the opportunity to ask questions and have dialogues that wouldn't be possible in a traditional classroom.


Emily was working her way through the semester when a flier caught her eye. "Will it be you?" it asked, showing two students standing in a creek and looking into a sample jar, nets and other tools in hand. The poster was for Stone Lab, Ohio State's island campus on Lake Erie. Intrigued, she asked her friend who, it turned out, had attended classes at Stone Lab just the previous summer. That friend urged her to attend.

Heeding her friend's advice, Emily signed up for Evolution and Ecology, two of Stone Lab's five-week advanced courses. She was looking forward to Stone Lab's signature in-the-field class style, but trips out onto the lake and into the field weren't the only perks of class. Emily loved the small class sizes. "I was taking classes that were actually fun and not just sitting in a lecture of 300 people," she said. "It's easier to engage and I feel like I will be more likely to talk and ask questions back on campus."

In fact, Emily's favorite part of her time at the lab was the environment, in every sense of the word. Being out on the boats and in the water was fantastic, and it was enhanced by a cohort of other students, all just as involved and passionate about the subject. When asked about her favorite moments, she answered "I think the best memories are from the friends I made and the good times we had inside and outside of the classroom."

Now, back on Columbus's campus, Emily is reassured in her passion and working toward her goal of becoming a marine biologist. Thinking back, she said "It was one of the best times I've ever had. I already miss it!"

So much so, in fact, that she came back for a limnology class this summer. ●



*"It was one of the best times
I've ever had. I already miss it!"*

EMILY ESPLANDIU

Biology/Pre-Veterinary Medicine, The Ohio State University, Class of 2020

SLSocial

Social Media Highlights

“Sometimes ‘Dirty Jobs’ help save the world! The @stonelab was featured on Discovery Channel for their amazing work saving the endangered Lake Erie watersnakes! So lucky we work with them each summer!”

WILDLIFE EPIDEMIOLOGY LAB,
UNIVERSITY OF ILLINOIS



“Caught this lady out of a tree at Kelley’s Island State Park with nature camp! We love a good Lake Erie Watersnake.”

STONE LAB



“I enjoyed my visit w/ @OhioState’s @OhioSeagrant & @StoneLab today to see the research & projects they are doing on harmful algal blooms that have been funded through my bipartisan Harmful Algal Bloom & Hypoxia Research & Control Act.”

SENATOR ROB PORTMAN

CONNECT WITH US

Keep up with current classes, research and events on social media.



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See more stories on our Instagram, Facebook and Twitter pages.



SARAH
ORLANDO

Some photos from our kayak trip! In all these years this is the first time I’ve kayaked around #Gibraltar island.



“Another amazing week at the @stonelab TAing into aquatic bio. See you next summer!”

SUNGSIK (KEVIN) KONG



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BRANCHING OUT

As a psychology major, Adrian Rodriguez isn't quite the usual Stone Lab student. But the brochures in his residence hall looked intriguing nonetheless, and once the senior at The Ohio State University realized some of the courses would count toward his biology minor, Adrian was off to Gibraltar Island for the summer.

"I discovered many aspects of evolution and ecology that I had never learned before," he said. "I also learned how to apply what I learned from class into the field. Stone Lab is an incredible and unforgettable experience."



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