

**R.B. ANNIS
WATER
RESOURCES
INSTITUTE**

2024

YEAR IN REVIEW



**GRAND VALLEY
STATE UNIVERSITY**
ROBERT B. ANNIS
WATER RESOURCES INSTITUTE

THE MISSION

of the Robert B. Annis Water Resources Institute (AWRI) at Grand Valley State University is to integrate education, outreach, and research to enhance and preserve freshwater resources.

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DIRECTOR'S COMMENTS



As I write my third Year in Review message, it is with the knowledge that my service as Interim Director is coming to an end. Serving as interim director has been an extraordinary experience. I have gained a whole new perspective of the work and dedication of my colleagues at AWRI. The commitment of AWRI to a healthy environment is evident in the research we do, much of which is conducted in West Michigan. This commitment is also obvious in our K-12 programming, the courses our faculty teach at GVSU, and the numerous presentations and interviews provided by faculty and staff that help inform the public about the water and environment we depend on.

Of course, much of what we do at AWRI would not happen without those who work behind the scenes. Although there are too many to name individually, I want to collectively thank all of them now for their dedication and hard work during the year.

One unexpected benefit from my time as interim director was the opportunity to have greater interaction with the Muskegon community and West Michigan in general. Only since serving as the interim director, have I realized what a kind and generous community the Lakeshore is, and how fortunate we are to have AWRI located in Muskegon. The support and kind words I have received during my time as interim director exemplifies the collective personality of the region. I have tried to repay some of that kindness by hosting various groups at AWRI, giving them the opportunity to see our facilities, Muskegon, and West Michigan. One group in particular, the Northeastern Association of Marine and Great Lakes Laboratories, held their meeting at AWRI in early October. To a person, they were surprised and impressed with what Muskegon has to offer and the general nature of the region. These comments take on greater meaning when you consider that each of those visitors live relatively close to a coastline or coastal community. I have received similar comments from the other groups that have visited over the past year.

As I step away from my current role, I will remain associated with AWRI, and I am excited to have the chance to see the next chapter unfold. With that it is my great pleasure to welcome Dr. Stuart Jones as the new Executive Director. Stuart comes to us with a wealth of knowledge and will help AWRI continue to thrive and contribute to our understanding of our environment. I hope everyone will have a chance to meet Stuart as he transitions into his new role.

In the meantime, please join me in wishing Stuart all the best as he begins his tenure as the new Executive Director of AWRI.

You may notice that this Year in Review, unlike prior years, contains a pledge card informing our readers about AWRI's Saving our Shores campaign. We encourage you to examine the card, and if so inclined, to donate to this initiative, which will provide the Institute with the resources necessary to both tackle the very significant issues facing water resources and educate the emerging water stewards of the 21st century.

Interim Director, AWRI
Professor of Biology

WELCOME, STUART JONES!



Dr. Stuart Jones. Photo credit: Ashley Streeter.

AWRI faculty, staff, and students are excited to welcome Dr. Stuart Jones as the new Executive Director of the institute, officially starting his tenure in January 2025. Dr. Jones joins us from the University of Notre Dame's Department of Biological Sciences, where he served as a professor and was previously the associate director of the University of Notre Dame Environmental Research Center. In addition to his new leadership and administrative duties at AWRI, Dr. Jones will be continuing his research in ecology, environmental biology, genetics, and genomics.

Dr. Jones has called the Executive Director position "a dream job". The group that's there at the AWRI is outstanding, and I can't wait to get started collaborating with them and with those who think about aquatic ecology on the main campus."

"There's a long history of aquatic research at the AWRI, and, obviously, there's been a really great foundation that's been set over the last 20 years by (Allen and Helen Hunting Research Professor) Al Steinman. It's a launching pad for great research and community engagement that I hope to facilitate over my time there."

Saving Our Shores



How do you comprehend the idea that water is rapidly becoming a scarce resource worldwide when you live near the Great Lakes that stretch beyond the horizon? In the Michigan we know and love, water flows liberally from the tap, and we enjoy a seemingly endless supply of rivers and inland lakes. With abundant freshwater year-round, it's all too easy to get complacent and take water for granted. Our West Michigan waters, while abundant, are not immune from danger. New and growing threats include microplastics, harmful algal blooms, salinization, groundwater sustainability, infectious disease and pathogens, population-driven stressors, and climate change.

AWRI was founded in 1986 as the first freshwater research, outreach, and education organization working in and for West Michigan, with a mission to ensure the future of our lakes, rivers, and wetlands for our families and communities to enjoy long into the future. We need your help to remain proactive and effective in the face of new and growing environmental threats, expanding our capacity to train the next generation of scientists, increasing our ability to research and develop solutions to the newest threats to our

freshwaters, and expanding our outreach efforts to help more citizens and policy makers understand the urgent need to protect our West Michigan waters.

You can help us achieve this important work by donating using the enclosed reply envelope, visiting www.gvsu.edu/wri/donate, or scanning the QR code below.

Together, we will continue to steward and protect our extraordinary Great Lakes and inland waterways.



The Lasting Effect of Outreach

Since 1986, over 195,000 people have experienced hands-on science aboard AWRI's research and education vessels. Evaluations regularly demonstrate the impactful nature of this experience, and for some, it turns out to be life changing. Audrey Whitaker never thought science was for her until she took a cruise as a GVSU student. The tangible experience of the vessel allowed her to see this new possibility and inspired her to add a major in Environmental Studies alongside her Multimedia Journalism major. The cruise helped her realize that she could communicate and connect with people about important scientific information, and "empowered me to share what I cared about." Audrey went on to become an outreach intern at AWRI, and currently works as a local government reporter for the Kalamazoo Gazette.

Audrey's is one of many stories we often hear about the impact of learning on the water. People who participated



GVSU alumna Audrey Whitaker, '23, takes the wheel of the W.G. Jackson. Photo credit: Bob Myers.

in our cruises as young students have returned to AWRI as graduate students or researchers or pursued other careers in conservation. Others credit their experiences for a more conscious relationship with water as informed citizens. A cruise may be only a snapshot in time, but for some, it can build a connection to science that lasts a lifetime. If you have experienced our cruises, we would love to hear about their impact on you.

FROM DATA TO ART & MUSIC

Inspired by NASA's work to create data symphonies to identify patterns in large data sets, sonification is being used in outreach landside programming to aid students in interpreting data from the vessel program. Using homemade instruments from recycled items, students use the data points as musical notes to hear the seasonal changes happening in local waterways. The use of art and music in outreach programming provides an opportunity for students to connect to the environment in new ways.



Visiting middle school students participating in AWRI Outreach programming. Photo credit: Amanda Syers.

Outreach in Action



Faculty and staff from AWRI labs are inspiring the next generation of scientists through exciting presentations that highlight real-life experiences and demonstrate the "tools of the trade" to landside groups who visit AWRI throughout the year.

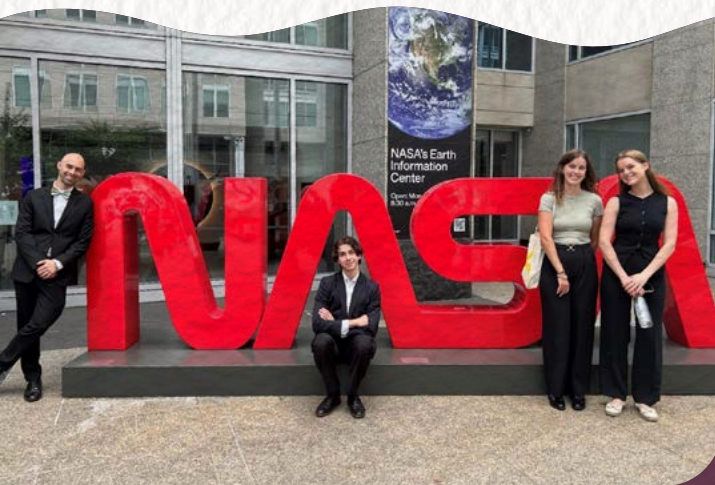
Adjunct research assistant Leah Wilson discusses research with visiting students. Photo credit: Amanda Syers.

DIY SCIENCE MEASURES GREENHOUSE GASES



Ashtyn Gluck (left), Jillian Greene (center), and Dr. Sean Woznicki (right) deploy a DIY GHG chamber at Heritage Landing on Muskegon Lake. Photo credit: Bopi Biddanda.

How much methane and carbon dioxide do our lakes release? Woznicki Lab students Jillian Greene and Ashtyn Gluck spent the summer building DIY autonomous greenhouse gas (GHG) monitoring chambers to answer that question. Each chamber and platform housed methane and carbon dioxide sensors powered by a solar panel and battery. The electronic case also housed data loggers and radio modules for real-time data transmission. They deployed two chambers in each of Lake Macatawa, Muskegon Lake, and White Lake from June through October 2024. The chambers monitored GHG emissions released from decomposition, with the goal of comparing emissions across the lakes. Jillian and Ashtyn calibrated the sensors against in situ samples collected at each chamber and run through a LICOR Trace Gas Analyzer in collaboration with the Philben Lab at Hope College. Data collected from the chambers will be used to create a satellite image-based model to predict methane emissions from Michigan's drowned river mouth lakes as Jillian's Master's thesis product. The students and Dr. Woznicki are grateful to lakefront homeowners for allowing deployment along their shorelines.



CCRI team at NASA Headquarters on August 7th, 2024. AWRI graduate student Jillian Greene is second from right.

Greene Images Algae Blooms for NASA

Graduate student Jillian Greene completed a NASA Climate Change Research Initiative (CCRI) fellowship, where she used the Landsat satellite to image algal blooms in New York lakes. CCRI pairs graduate students with K-12 teachers to bring STEM research into the classroom and build curriculum around emerging research topics. Her project used handheld Landsat sensors loaned to NY schools for a hands-on remote sensing experience. This summer, she presented her research at NASA Headquarters and City College of New York.



AWRI VESSELS MONITOR MERCURY

AWRI intern Mitchell Fedewa was the leader of a joint project between the AWRI outreach program and the Otter Lab's effort to understand pollution in West Michigan. Using samples collected by educational cruise passengers, the project highlights the interdisciplinary effort of AWRI scientists to bridge the gap between technical science and environmental education.

Intern Mitchell Fedewa kayaking in Muskegon Lake.

Expanding Pathogen Monitoring

In response to the COVID-19 pandemic, the State of Michigan began monitoring wastewater for pathogens as an early warning system for public health officials. In 2024, the State of Michigan expanded its wastewater monitoring efforts beyond just COVID-19 to now include influenza, respiratory syncytial virus (RSV), and norovirus.

AWRI scientists have been involved in the monitoring of West Michigan wastewater since 2020, analyzing samples from over 15 sites across Muskegon and Ottawa Counties on a weekly basis. AWRI continues to be a leading laboratory in Michigan in the field of wastewater monitoring and is excited about the community focused impact of this work that bridges the gap between molecular biology and public health.

Adjunct research assistant Leah Wilson displays a bottle of wastewater for pathogen analysis.



SPIDERS SAMPLE SEDIMENT TOXINS



Otter Lab graduate students Josie Kuhlman (left) and Addison Plummer (right).

Scientists in the Otter Lab have started collecting a special group of spiders to study pollution levels around Michigan. These spiders (known as long-jawed orb weavers) eat a strict diet of insects that live most of their lives underwater in sediment before going through metamorphosis and leaving the water as a flying insect (e.g., dragonflies, mayflies). These spiders are ideal for monitoring polluted sediment and great for training students interested in environmental toxicology.

Whose Poop is This?



Otter Lab researchers Leah Wilson, Brendan May, and Alexis Porter.

Otter Lab scientists continue their efforts to help communities identify sources of fecal contamination (e.g., humans, dogs, cows, pigs, and ruminant animals).

Fish as *E. coli* Bioindicators

The presence of *Escherichia coli* (*E. coli*) on Michigan beaches poses significant health risks and can result in beach closures. Less known, however, is the threat of *E. coli* in streams and rivers where ~ 50% of water bodies studied exceeded total body contact standards. Graduate student Mitchell Olszewski and Dr. Kevin Strychar are examining whether *E. coli* contamination in rivers and streams bioaccumulate on fish, and if so, what percentage of bacteria from fish can affect human health. Bluegill, yellow perch, and largemouth bass are being collected from various locations to better understand *E. coli* transmission and potential more effective monitoring and management strategies.

Graduate student Mitchell Olszewski collects fish from various rivers and streams to sample their mucus and associated *E. coli* concentrations.



AWRI & MDNR SUPPORT ARCTIC GRAYLING RESTORATION



(L to R) Eleanor Newcomb, Max Petsch, and Joe Greendyk conduct a backpack electrofishing survey in an experimental reach of Hunt Creek.

The goal of the Michigan Arctic Grayling Initiative is to re-establish this native fish to their historic range. The Ruetz Lab has conducted research to support the reintroduction effort since 2017. In 2024, the lab partnered with the Michigan Department of Natural Resources to conduct pilot experiments in Hunt Creek focused on assessing how young Arctic Grayling grow and survive in the presence of wild trout. Although several challenges prevented us from accomplishing our research goal, the work will inform future research and support the reintroduction effort.

Live vs. Dead *E. coli*


Undergraduate student researcher Christopher Kotkowicz (right) conducts fieldwork with graduate student Mitchell Olszewski (center) and technical call-in Jacob Kotkowicz (left).



Beaches in Michigan are frequented by hundreds of thousands each year. To ensure public safety, a genetic method called qPCR is often used to monitor harmful bacteria. However, qPCR cannot distinguish live vs. dead cells, and as such, a beach could close despite posing no human health risk. Undergraduate Christopher Kotkowicz is testing a novel method called PMA-qPCR to determine whether this technique can improve beach monitoring identifying pathogenic live versus dead cells.

SPIDERS COLLECT eDNA


*"There's a web like a spider's web,
Made of silk and light and shadow,
Spun by the moon in my room at night.
It's a web made to catch a dream."*
- Camp Scott Girl Scouts Song



While it's questionable whether webs can catch dreams, the Partridge Lab is testing if spider webs can help track invasive forest pests by catching their DNA. The Partridge Lab studies environmental DNA (eDNA), which is DNA that individuals leave behind in their environment. Spider webs could be a perfect eDNA sampler because they are naturally present and sticky. To test this, undergraduate student, Kate Geller, sampled 20 spider webs from Meinert Park in Muskegon County. From these webs, we were able to identify 114 different arthropod genera, including invasive species like hemlock woolly adelgid (HWA) and spongy moth. The lab is further refining this approach, but we think it could significantly enhance invasive species monitoring in coastal forests.

A spider web being sampled for eDNA.
Photo credit: Madison Stibel.

Innovative Controls for Invasive Milfoil



Controlling the aquatic invasive plant Eurasian water milfoil (EWM) has been a challenge for lake managers. Historically, treatments have included the use of herbicides, harvesting, or natural herbivores such as a small beetle. The success of each approach has been mixed. Dr. Mark Luttenton and graduate student Anna Briem have been working with the Lake Leelanau Lake Association and Grand Traverse Band of Ottawa and Chippawa Indians to evaluate burlap barriers as a control method. In general, a sheet of burlap is laid over the top of a EWM bed to block sunlight and kill the plants. The method appears to be very effective controlling EWM. In addition, the method does not appear to have any persistent or long-term negative environmental impacts. And, because burlap is a natural material, it will biodegrade over time.

**Spool of burlap fabric being
deployed in Lake Leelanau.**
Photo credit: Anna Briem.



Alex Wieten displays a wild rice plant.
Photo credit: Fox 17 West Michigan.

WILD RICE POPULATION ASSESSMENT

Dr. Charlyn Partridge and Gun Lake Tribe Environmental Resource Specialist (and AWRI alumnus) Alex Wieten were the plenary speakers at the Kellogg Biological Station All Scientist Meeting. They spoke about their collaborative work assessing wild rice populations in Michigan.

Angler Attitudes on Drowned Rivermouth Lakes

What considerations lead to successful fisheries management? Many of us think about ecological considerations that inform success, but human dimensions – like the attitudes and motivations that determine angler participation – are also important. In eastern Lake Michigan, drowned river mouth (DRM) lakes are important habitats for fish and consequently support opportunities for anglers. During the winter and summer of 2024, AWRI faculty and students studied the interests and motives driving angler activity on Muskegon, Pentwater, and Pere Marquette lakes. We asked anglers about the reasons they fish, the species they catch, and what makes a good day fishing, aiming to understand variation between seasons and among DRM lakes. Our preliminary findings suggest that angler specialization varies between seasons. Additionally, the importance of recreational fisheries for provisioning was more important to anglers on Muskegon Lake compared to Pentwater, and Pere Marquette Lakes, suggesting differences in the dietary importance of angler activities across lakes.

Undergraduate students Amanda Francis and Steven King surveyed recreational anglers at Muskegon Lake.



TROUT MOVEMENT CHANGES WITH THE WEATHER



Graduate student Logan Clark tracking trout on the Au Sable River.

Dr. Mark Luttenton and graduate student Logan Clark have been tracking the movement of 35 trout in the Au Sable River since 2023, after parts of the Au Sable River hit 80°F in early June. Summer 2023 was moderately warm, and trout tended to move relatively little. During 2024, temperatures were cooler, and trout tended to be more active than during 2023. Even moderately warm temperatures appear to reduce fish activity.

22 Years of Muskegon Lake Fish Monitoring

Nearly 50,000 fish have been captured and released in Muskegon Lake since monitoring began in 2003 by AWRI. These data provide an invaluable record of ecological conditions in Muskegon Lake as well as an opportunity for students to gain real-world field experience.

Undergraduate student John Lawrence holds a channel catfish captured in Muskegon Lake during July sampling.





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AWRI AT WORK

1 Adjunct research assistant Alexis Porter inspects flow cell sequencing components.

2 Intern Caden Shannon holds a snapping turtle.

3 Adjunct research assistant Rachel Pietscher with Lake Huron benthic sediment.

4 AWRI Outreach & Education staff pose on the *W.G. Jackson*.

5 Graduate student Kate Lucas starts a sand capping study.

6 AWRI staff face off against students in a summer volleyball game.

7 Biddanda and Steinman Lab students and technicians sampling Muskegon Lake on the *W.G. Jackson*.

8 Otter Lab Beach Monitoring team surveying *E. coli*.

9 Graduate student Emily Eberly holds a catfish.

10 Fleet Captain Eric Hecox piloting AWRI's pontoon.

11 Adjunct research assistant Katie Tyrrell enjoys fieldwork while intern Noah Tucker rows.

12 Undergraduate student Kathryn Gellar collects spider webs for eDNA genetics analysis.



SEASONAL CARBON BALANCE



Inland waters are recognized as hotspots of carbon cycling. We have been monitoring carbon metabolism in Muskegon Lake since 2004 and found that it is seasonally variable with peak production during the warmer summer months, a signal of high atmospheric carbon uptake. Annually, the lake takes up more carbon than it respires, making it a net sink for atmospheric carbon. Positive net annual primary production is the reason why this Great Lakes estuary supports one of the most productive fisheries in the state of Michigan. A changing climate and anthropogenic stressors could shift this system away from its current carbon sink status to one where it becomes a carbon source. Future studies will focus on high-frequency measurements of lake metabolism to better assess the impacts of factors such as changing trends in warming, precipitation, river loading, anthropogenic nutrients, and pollution on the carbon sink potential of this ecosystem.

Graduate student Kaylynne Dennis collecting surface water at the Muskegon Lake Channel to measure plankton metabolism.

Unpleasant Relations: Bottom Water Hypoxia and Acidification

Lakes are experiencing warming and anthropogenic eutrophication worldwide. Many temperate lakes exhibit annually recurring bottom water hypoxia (deoxygenation) during summer due to a combination of thermal stratification and eutrophication. Additionally, time-series observations (Muskegon Lake Observatory, www.gvsu.edu/buoy/) revealed that bottom water deoxygenation (from >8 to <3 mg/L) co-occurs with declining pH (from 8.6 to 7.2) or increasing acidification. The double whammy of seasonal deoxygenation and acidification of bottom waters has implications for habitat quality, life cycles and biogeochemistry.

Biddanda Lab researchers Nicole D'Arienzo, Dee Phillips, Anna Maki, and Connor Gabel clean-up biofouling on sensors for Muskegon Lake Observatory routine maintenance.



HIGH SCHOOLERS SURVEY FISH



This spring, AWRI affiliate Dr. Amanda Buday collaborated with John Ball Zoo and a Ravenna High School (RHS) class to participate in the Shedd Aquarium sucker migration monitoring program. Students, community volunteers, the Muskegon Conservation District, and Dr. Buday documented daily weather conditions, stream depth, and the number of suckers at Patterson Park in Muskegon County, identifying migratory patterns and sharing data with research scientists at the Shedd Aquarium.

RHS students set up sucker migration monitoring station at Patterson Park in Muskegon County.

Photo credit: Kendra Stanley-Mills.

Al Awarded Accolades



Dr. Al Steinman was the recipient of two awards in 2024. In January, the West Michigan Environmental Action Council awarded Al the C.R. Everson Award for long-term dedication and contribution to environmental protection in Michigan. In October, Al received the Dr. Niles R. Kevern Lifetime Achievement Award, given to a Michigan limnologist or aquatic scientist who has significantly contributed to the advancement of the understanding of lakes, has provided leadership in addressing key lake issues, and has exhibited excellence in promoting lake ecology and/or management. The award was presented by the Michigan Chapter of the North American Lake Management Society at the Michigan Inland Lake Convention in Grand Rapids.

Dr. Al Steinman (center) holding the Dr. Niles R. Kevern Lifetime Achievement Award, accompanied by the Kevern Family.

White Lake Monitoring

White Lake was declared a Great Lakes Area of Concern in 1987. In 2014, White Lake was removed as an AOC after years of remediation and restoration work to address a long history of chemical manufacturing, waste disposal practices, municipal wastewater discharges, tannery operations, and other activities that caused degradation. Ten years after de-listing, there are concerns about the status of White Lake. At the request of the White Lake Association, AWRI started monitoring White Lake in 2024, confirming there is “life after de-listing”.

Scientific technician Mike Hassett collects a water sample from White Lake.



DE-ICER IMPACT ON INSECTS



Summer intern Noah Tucker using a Petite Ponar sediment sampler to collect insects from the bottom of a lake.

Noah Tucker was a summer undergraduate intern in the Steinman Lab in 2024. Noah worked in Church and Westboro Lakes in Grand Rapids, which are impacted by road salt runoff due to high chloride concentrations. Noah found a strong negative correlation between invertebrate density and chloride concentration. Additional research is needed to see if this negative effect on aquatic insects is also negatively impacting fish in these lakes.

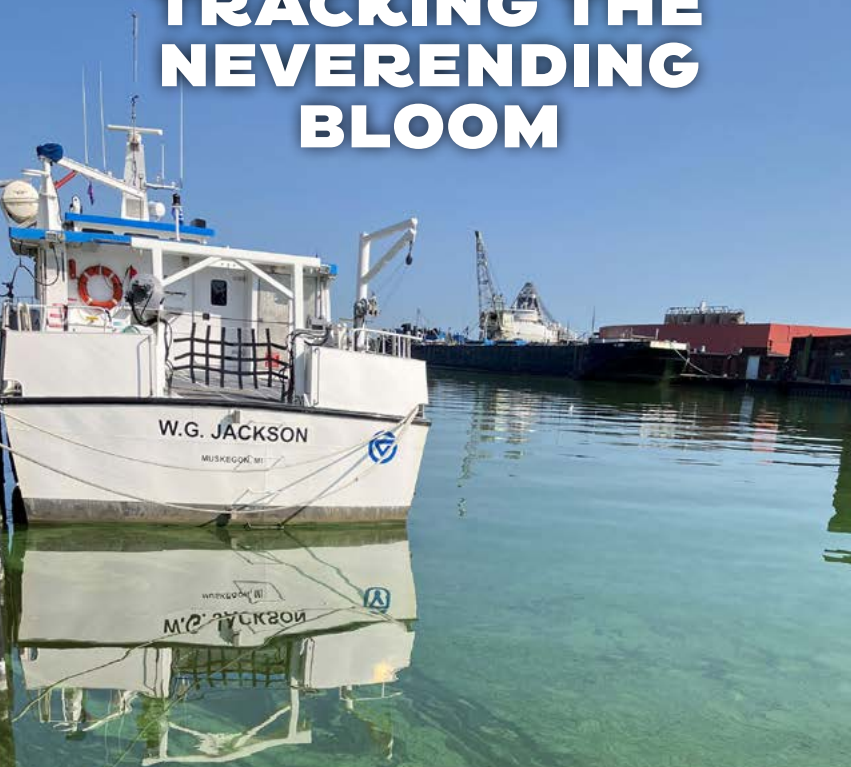
Macro-Alga Growth in Higgins Lake

Higgins Lake is considered an oligotrophic lake with very high water clarity and quality. However, Dr. Mark Luttenton attributes this in part to the introduction of zebra and quagga mussels which have likely contributed to water clarity and transfer of nutrients to the bottom. This condition has allowed for extensive growth of the macro-alga, *Nitella*. In one location, *Nitella* covers almost 20 acres and grows up to two feet thick. Dr. Luttenton continues mapping additional locations.

The macro-alga *Nitella* forms dense growth on the bottom of Higgins Lake.



TRACKING THE NEVERENDING BLOOM



An unprecedented lake-wide bloom of toxic cyanobacteria proliferated in Muskegon Lake from mid-June into early October this year, reversing a two-decade-long trend of steadily improving water quality. Continued monitoring and study of water quality and the potential factors affecting it (such as warming, nutrient loading, changing precipitation patterns and water residence times) are crucial for determining the causes and consequences of such wide-spread and long-lasting harmful cyanobacteria blooms, and addressing them.

View of cyanobacterial blooms at AWRI's Muskegon Lake dock.

Muskegon Lake Harmful Algae Bloom

This summer was the year of the algal bloom in Muskegon Lake. Renée Tardani, a graduate student in the Partridge Lab, is trying to figure out why. Renée collected samples from beaches around Muskegon Lake once the blooms started in early July and continued sampling into September. She is looking at how microbial communities (including cyanobacteria) change over time and evaluating how differences in nutrients, temperature, and other abiotic factors drive those changes.

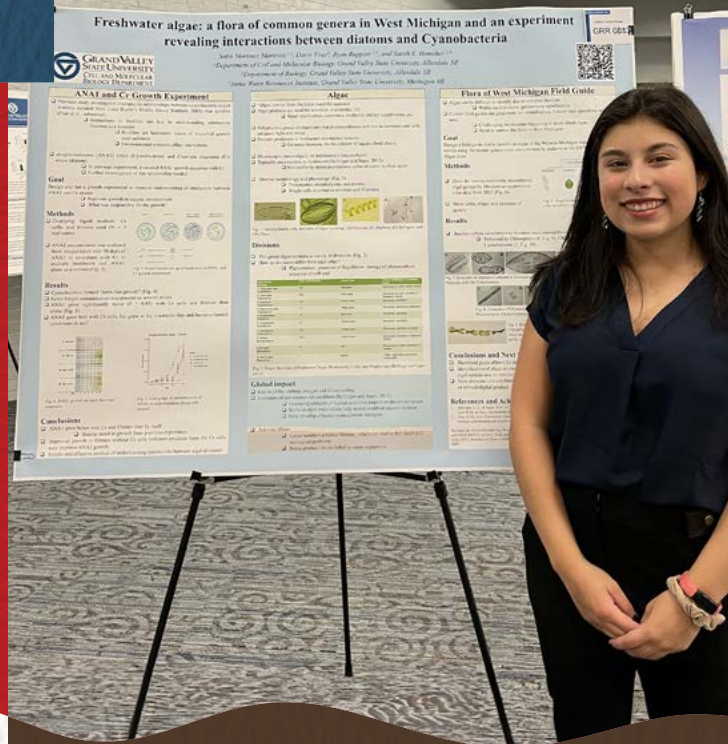
Microscope image of Muskegon Lake cyanobacteria. Photo credit: Renée Tardani.



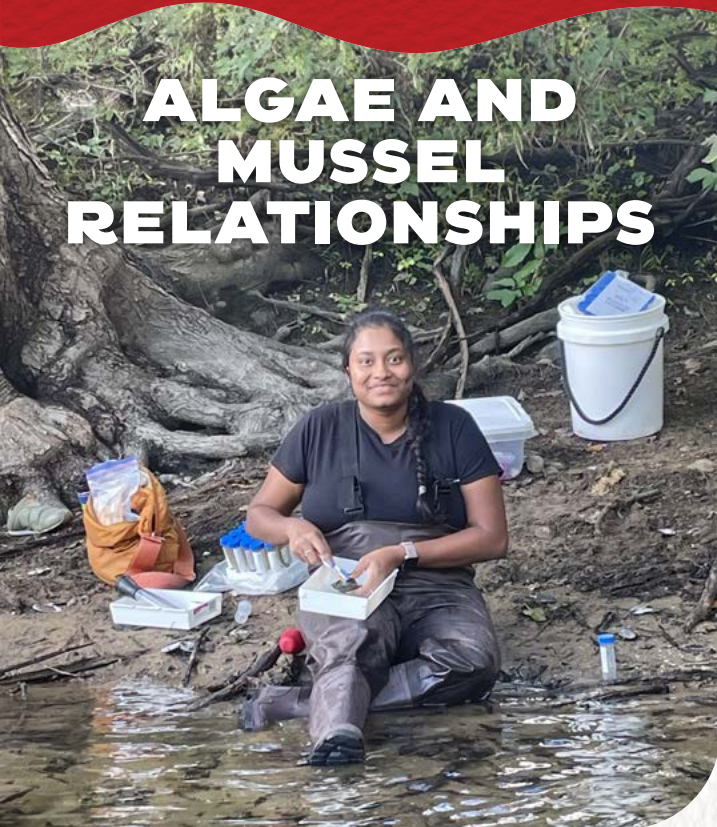
ILLUSTRATING COMMON ALGAE OF WEST MICHIGAN

Sofia Martinez Martinez, an undergraduate student working with Dr. Sarah Hamsher, has an interest in both biology and art. She decided to combine her skills in a project using illustration to improve students' ability to recognize common genera of freshwater algae. Sofia used the collection information gathered from the 2021 and 2023 Freshwater Algae classes at GVSU to determine the algal genera encountered by the students most often. She chose to illustrate the 20 most common genera using colored pencils. Her resulting images were scanned and printed on stickers that were auctioned at algae-related conferences this summer to raise funds for student travel awards. The stickers will also be given to K-12 students involved in the AWRI outreach program. A poster of Sofia's images will be printed and hung in the Freshwater Algae classroom next semester to aid students in identifying these genera.

Undergraduate Sofia Martinez Martinez presents her algal illustrations at Student Scholars Day.



ALGAE AND MUSSEL RELATIONSHIPS



Undergraduate Haarika Hebbur collects algae from the Grand River for her honor's project.

Haarika Hebbur, an undergraduate student collaborating with Dr. Sarah Hamsher (AWRI) and Dr. Eric Snyder (Biology), is focusing her honor's project on the relationship between algae and mussels. Haarika is performing a literature review to provide some background information on how mussel and algal communities may interact and a mini project evaluating whether algal biomass is influenced by substrate (growth on live mussel shells versus rocks) in a stream ecosystem.

Presenting the Rhopalodiales

Dr. Sarah Hamsher and her collaborators are continuing to study the Rhopalodiales, a group of diatoms (algae with glass cell walls) that have cyanobacterial endosymbionts (cells within cells) that fix nitrogen for their diatom hosts. Hamsher and her collaborators presented some of their findings at the annual meeting of the Phycological Society of America in Seattle, WA this summer.

Dr. Sarah Hamsher (AWRI, center) with her collaborators, Dr. Aimee Caye Chang (University of Colorado, Boulder, left) and Heidi Abresch (University of Montana, right).



AWRI

FACULTY & STAFF

Mark Luttenton, Interim Director
Stuart Jones, Executive Director

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Heidi Feldpausch, Office Coordinator
Cheryl Kastas, Secretary
Colleen Black, AWRI Student Clerical Assistant
Lauren Calkins, AWRI Student Clerical Assistant
Ben Morrison, Front Desk Worker

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Len Wittlief, Maintenance

Geospatial Information Lab:

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Jamie Cross, Lead Instructor WGJ
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Ann Hesselsweet, Science Instructor
Tom Jackson, Science Instructor
Jill Keisling, Science Instructor
Lynn Knopf, Science Instructor
Bob Myers, Science Instructor
Jessica O'Donnell, Science Instructor
Lisa Schanhals, Science Instructor
Margaret Stang, Science Instructor
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Gabriella Gaston, Assistant Science Instructor

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Terry Boersen, Deckhand
Dave Fisher, Engineer WGJ
Paul Haley, Captain WGJ
Tim Halloran, Deckhand WGJ
Tom Hampton, Captain DJA and WGJ
Pete Hewett, Engineer DJA
Jeffrey Hughes, Deckhand
Jill Johnson, Captain DJA
Ben Morrison, Deckhand
Ed Perrault, Captain, DJA and WGJ
William Young, Deckhand

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Brendan May, Public Health Graduate Student
Alexis Porter, Adjunct Research Assistant
Brian Scull, Laboratory Supervisor
Leah Wilson, Adjunct Research Assistant

Ecological Research, Environmental Biology:

Bopaiah Biddanda, Professor
Anthony Weinke, Technical Call-in
Connor Gabel, Technical Call-in
Anna Maki, Volunteer

Sarah Hamsher, Associate Professor
Parker Miller, Undergraduate Student

Mark Luttenton, Professor of Biology

Jim McNair, Associate Professor

Charlyn Partridge, Associate Professor

Colleen Black, Undergraduate Student

Kathryn Geller, Undergraduate Student

Syndell Parks, Technical Call-in

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James Switzer-Moe, Undergraduate Student

Carl Ruetz III, Professor

Emily Eberly, Biology Graduate Student (Cooper)

Steven King, Undergraduate Student

Grayson Kosak, Biology Graduate Student (Snyder)

Caden Shannon, Undergraduate Student

Eleanor Newcomb, Undergraduate Student

Joseph Greendyk, Undergraduate Student

John Gargas, Undergraduate Student

Max Petsch, Technical Call-in

Alan Steinman, Professor

Aaron Dunnuck, Adjunct Research Assistant

Michael Hassett, Scientific Technician

Sophia Lindsay, Technical Call-in

Rachel Pietscher, Adjunct Research Assistant

Katie Tyrrell, Adjunct Research Assistant

Keely Dunham, Technical Call-in

Allison Romanski, Undergraduate Student

Kathryn Geller, Technical Call-in

Kevin Strychar, Professor

Christopher Kotkowicz, Undergraduate Student

Jacob Kotkowicz, Technical Call-in

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Cal Yackin, Biology Graduate Student (Hunt)

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Dr. Jennifer Haverkamp, University of Michigan

Dr. Carol Johnston, South Dakota State University (emerita)

Dr. Gary Lamberti, University of Notre Dame, Chair

Graduate Students

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Kaylynne Dennis

Luttenton, major advisor

Anna Briem

Logan Clark

Michael Trapp

Victoria Vander Stelt

Otter, major advisor

Addison Plummer

Josie Kuhlman

Partridge, major advisor

Keely Dunham

Renée Tardani

Grace Forthaus

Ruetz, major advisor

Maria Scarborough

Steinman, major advisor

Kate Lucas

Paris Velasquez

Strychar, major advisor

Katelyn Anderson

Mitchell Olszewski

Woznicki, major advisor

Jillian Greene

Jamshid Jalali

Internships & Scholarships

AWRI provides opportunities for students to pursue their interests in our environment. The following students received internships during 2024.

Herbert VanderMey (summer) Intern

Alexander Baetz (Mark Luttenton/Sean Woznicki)

Robert B. Annis Foundation (summer) Interns:

Nicole D'Arienzo (Bopi Biddanda)

John Lawrence (Carl Ruetz)

Mitchell Fedewa (Ryan Otter)

AWRI Interns (summer)

Ashtyn Gluck (Sean Woznicki)

Bill and Diana Wipperfurth (fall) Scholarship:

Delainey Phillips (Bopi Biddanda)

Allen and Helen Hunting Intern (summer):

Noah Tucker (Alan Steinman)

NSF (summer) Intern

Olivia Sandman (Sarah Hamsher)

CFFMC Greatest Needs Gift (summer) Intern

Kathryn Geller (Charlyn Partridge)

PEER-REVIEWED PUBLICATIONS

AWRI Staff in bold

Undergraduate Students*

Graduate Students**

Post-doctoral Fellows***

Bergstrom, R.D., L.B. Johnson, R.W. Sterner, J.D. Lenters, M. Twiss, and **A.D. Steinman**. 2024. Climate Change: A Bibliometric Study of the Great Lakes Basin. *Journal of Great Lakes Research*, 50(3), Article 102316. <https://doi.org/10.1016/j.jglr.2024.102316>

Biddanda, B.A., A.D. Weinke, I.P. Stone*, S.A. Ruberg, and P.A. Hartmeyer. 2024. Modern microbial mats offer glimpses of other times and places. *Eos, American Geophysical Union*, 105. <https://doi.org/10.1029/2024EO240019>

Di Paolo C., I. Bramke, J. Stauber, C. Whalley, **R.R. Otter**, Y. Verhaegen, A. Ryan. 2023. Implementation of the CREED approach for environmental risk assessments. *Integrated Environmental Assessment and Management*. <https://doi.org/10.1002/ieam.4909>

Fray, D.**, C. McGovern*, D. Casamatta, **B.A. Biddanda** and **S.E. Hamsher**. 2024. Metabarcoding reveals unique microbial mat communities and evidence of biogeographic influence in low-oxygen, high-sulfur sinkholes and springs. *Ecology and Evolution*, 2024;14:e11162. <https://onlinelibrary.wiley.com/doi/10.1002/ece3.11162>

Fray, D.**, C. D. Casamatta, R. Rupert*, S. Martinez-Martinez*, C. McGovern*, **B.A. Biddanda** and **S.E. Hamsher**. 2024. Friends and Foes: competition experiments reveal growth facilitation and interference between cyanobacteria and diatoms strains in microbial mats. *Hydrobiologia* <https://link.springer.com/article/10.1007/s10750-024-05635-x>

Glandon, H.L. E.M. Reed, S.D. Peterson, C.R. Roswell, A.R. Schmidt, J.H. Chick, S.M. Thomas, P.S. Forsythe, **C.R. Ruetz III**, and S.J. Czesny. 2024. Nearshore and embayment zooplankton community structure in Lake Michigan, implications for invasion by bighead carps. *Journal of Great Lakes Research*. 50(5):102405. <https://doi.org/10.1016/j.jglr.2024.102405>

Kerr, S., and **R.R. Otter**. 2024. Diet Affects Egg Laying, Biomass, and Stable Isotope Values in Tetragnathid Spiders. *Bulletin of Environmental Contamination and Toxicology*, 112(3), 47. <https://doi.org/10.1007/s00128-024-03872-3>

Kociolek, J. P., M. Greenwood, **S.E. Hamsher**, S. Miller, & J. Li. 2024. Valve ultrastructure of *Rhopalodia constricta* (W. Smith) Krammer (Rhopalodiales, Bacillariophyceae) and a consideration of its systematic placement. *Diatom Research*, 39(2), 51–60. <https://doi.org/10.1080/0269249X.2024.2378769>

NON-PEER REVIEWED PUBLICATIONS

Biddanda, B.A. 2023. Water Q & A. *GVMagazine*. <https://www.gvsu.edu/gvmagazine/bopi-biddanda.htm>

Biddanda, B.A. 2024. Surf the Underwater Waterfall. *Teach me about the Great Lakes* Podcast by IN-IL Sea Grant. <https://www.teachmeaboutthegreatlakes.com/98>

Biddanda, B.A., and S. Ruberg. 2024. Book review of *The Blue Machine: How the Ocean Works* by Helen Czersky (2023), Norton & Co., NY. 446p. *Limnology and Oceanography Bulletin* 33 (3): 137-138. <http://dx.doi.org/10.1002/lob.10638>

Biddanda, B.A., A.D. Weinke, M. Villar-Argaiz, and J. Medina-Sanchez. 2023. Cryosphere Lost: Vanishing continental glaciers pose a critical threat to humanity's dwindling water reserves and Earth's fragile climate resilience. *STEM Connections for the Classroom*, InterChange. <https://www.gvsu.edu/rmsc/interchange/2024-january-stem-connections-1761.htm>

Biddanda, B.A., A.D. Weinke, C. Howard, D. Velazquez, and S. Ruberg. 2024. What is the age of groundwater venting at submerged karst sinkholes? *Eos, American Geophysical Union*, 105 (9): 32. September 2024. <https://eos.org/wp-content/uploads/2024/08/Sept24.pdf>

Biddanda, B.A., J.C. Weber, **A.D. Weinke**, J.M. Medina-Sánchez, M. Villar-Argaiz, P. Carrillo, and J.M. González-Olalla. 2024. Book review of *Dust: the modern world in a trillion particles* by Jay Owens (2023), Abrams Press, NY. 392p. *International Geology Review*, 1–3. <https://doi.org/10.1080/00206814.2024.2394832>

Biddanda, B.A., C. Gabel*, **N. D'Arienzo***, **D. Phillips****, **K. Dennis****, **A. Maki*** and **A.D. Weinke**. 2024. Summer blooms trouble Great Lakes estuaries. *American Geophysical Union Tumblr*. <https://american-geophysicalunion.tumblr.com/post/757375684231479296/summer-blooms-trouble-great-lakes-estuaries>

Biddanda, B.A., K. Dennis**, **T. Weinke**, E. Snyder and S. Ruberg. 2024. Estuarine Carbon Cycle. *Eos, American Geophysical Union*, 105 (5): p.32 (May 2024). <https://eos.org/wp-content/uploads/2024/04/May24.pdf>

Buday, A. and B. Dykes, Little Manistee Management Survey. 2023. Report of Results (LMWCC): [https://www.gvsu.edu/cms4/asset/46326646-90A1-796F-7917AE00DCC9F7F0/lmms_report_web\(2\).pdf](https://www.gvsu.edu/cms4/asset/46326646-90A1-796F-7917AE00DCC9F7F0/lmms_report_web(2).pdf)

Dugener, N.** and **B.A. Biddanda**. 2023. Warming and Eutrophication's Child: Rising Hypoxia in Earth's Natural waters. *InterChange* 30 (4), November 2023. <https://www.gvsu.edu/rmsc/interchange/2023-november-stem-connections-1752.htm>

Gabel, C.* and **B.A. Biddanda**. 2023. Book review of *The Three Ages of Water: Prehistoric Past, Imperiled Present and a Hope for the Future* by P. Gleick. PublicAffairs, New York, NY. 368p. *Limnology and Oceanography Bulletin* 32 (4): 152-153. <https://doi.org/10.1002/lob.10599>

Hassett, M.C. and **A.D. Steinman**. 2024. Project Clarity 2023. Annual Monitoring Report (Dec. 2022-Nov. 2023).

Kociolek, J. P., M. Greenwood, D. Rogers, **S.E. Hamsher**, S. Miller, J. Li, G. Caye, A. Chang, and J. Taylor. 2024. Light and Scanning Observations on a *Denticula* species reported from South Africa and endemism of the diatom genus *Tetralunata* (Rhopalodiales, Bacillariophyceae). *Phytotaxa*, 652 (4). <https://doi.org/10.11646/Phytotaxa.652.4.4>

Kociolek, J. P., D. M. Williams, **S.E. Hamsher**, S. Miller, and J. Li. 2024. Studies on type material from Kützing's diatom collection VIII. Species assigned to the genera *Epithemia* Brébisson ex Kützing and *Rhopalodia* O. Müller. *Diatom Research*. <https://doi.org/10.1080/0269249X.2024.2388108>

Linz, D., I. Struewing, N. Sienkiewicz, **A.D. Steinman**, **C. Partridge**, K. McIntosh, J. Allen, J. Lu and S. Vesper. 2024. Periodic Addition of Glucose Suppressed Cyanobacterial Abundance in Additive Lake Water Samples during the Entire Bloom Season. *Journal of Water Resource and Protection*, 16, 140-155. <https://doi.org/10.4236/jwarp.2024.162009>

Mader, M.M.**, **C.R. Ruetz III**, **S.A. Woznicki**, and **A.D. Steinman**. 2023. Land cover and water quality of drowned river mouths: evidence of an environmental gradient along the eastern Lake Michigan shoreline. *Journal of Great Lakes Research* 49(6):102237 <https://doi.org/10.1016/j.jglr.2023.09.008>

McNair, J.N., D. Frobish, **E.K. Rice****, and R.A. Thum. In press. Alternative study designs and nonparametric statistical methods for adaptive management studies of invasive plants. *Invasive Plant Science and Management*.

National Academies of Sciences, Engineering, and Medicine. 2024. Progress Toward Restoring the Everglades: The Tenth Biennial Review – 2024. Washington, DC: The National Academies Press. (authors: Saiers, J. (chair), W.G., Brown, C., Calloway, J., Dixon, P.M., Driscoll, C.T., Emery, M.R., Gitau, M.W., Harwell, M.C., Hopkins, W.A., Quirk, T., Reddy, K.R., Regan, H.M., **Steinman, A.D.**, Walters, J.R., and Wegner, D.L.)

Otter R.R., M.A. Mills, K.M. Fritz, J.M. Lazorchak, D.P. White, G.B. Beaubien, D.M. Walters. 2023. PCB concentrations in riparian spiders (*Tetragnathidae*) consistently reflect concentrations in water and aquatic macroinvertebrates, but not sediment: Analysis of a seven-year field study. *Science of the Total Environment*. <https://doi.org/10.1016/j.scitotenv.2023.169230>

Petersen M.**, and **C. Partridge**. 2024. Impacts of weathered microplastic ingestion on gastrointestinal microbial communities and health endpoints in fathead minnows (*Pimephales promelas*). *Journal of Great Lakes Research*. <https://doi.org/10.1016/j.jglr.2024.102374>

Sheets, K.**, **M.C. Hassett**, **R.M. Orzechowski**, and **A.D. Steinman**. 2024. Ecological status of a retired mine lake in a protected dune ecosystem. *Inland Waters*. <https://doi.org/10.1080/20442041.2024.2330858>

Van Zenen, A., S. Hughes, and **A.D. Steinman**. 2024. Assessing Policy Drivers and Barriers for Sustainable Groundwater Management in Michigan. *Michigan Journal of Public Affairs*. 20: 42-57.

Hassett, M.C., **Tyrrell, K.J.**, and **A.D. Steinman**. 2024. Lake Macatawa Water Quality Dashboard 2023.

Livernois, J., J. Ballinger, D. Dupont, S. Hayder, J. Hoffman, L. Johnson, D. Kashian, C. Pastoria, S. Polasky, **A.D. Steinman**, R. Sterner, J. Vincent, and M. Xenopoulos. 2024. Great Lakes Ecosystem Services Valuation: A Scoping Study. A report submitted to the International Joint Commission by the Great Lakes Science Advisory Board.

Luttenton, M. 2023. Summary Report of Chemical and Biological Conditions in Higgins Lake, Summer 2023. Higgins Lake Foundation.

McKee, K.*, **N. Dugener****, **K. Dennis****, **C. Gabel***, **A.D. Weinke** and **B.A. Biddanda**. 2023. A Dockside Mini-Observatory keeps watch over a Troubled Lake. *American Geophysical Union Tumblr* <https://americangeophysicalunion.tumblr.com/post/739072973244383232/a-dockside-mini-observatory-keeps-watch-over-a>

Steinman, A.D., **M.C. Hassett**, and **K.J. Tyrrell**. 2024. Mona Lake Celery Flats Reconnection Pre-Restoration Monitoring Report.

Steinman, A.D. and **M.C. Hassett**. 2024. Muskegon Lake Water Quality Dashboard.

Swart, S. and **A.D. Steinman**. 2024. Removal Recommendation: Eutrophication and Undesirable Algae Beneficial Use Impairment – Muskegon Lake Area of Concern.

2024 MASTER OF SCIENCE THESES

Dunham-Adkins, K. (Advisor: Partridge) - Using airborne eDNA to assess hemlock woolly adelgid (*Adelges tsugae*) infestations and their impact on Michigan coastal forests.

Hoyt, T. (Advisor: Ruetz) - Morphological variation of yellow perch inhabiting Lake Michigan and connected water bodies.

Jalali, J. (Advisor: Woznicki) - Assessing contributions of agricultural land use and climate change to water scarcity in Serbia.

Lucas, K. (Advisor: Steinman) - Impact of climate change and restoration on phosphorus loading in an impaired wetland.

Velasquez, P. (Advisor: Steinman) - Effects of Microplastic Biofilms on an Anthropogenically Impacted Urban Lake.

Photo Credit: Katie Tyrrell

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