R.B. Annis Water Resources Institute

2025

Year in Review

ROBERT B. ANNIS WATER RESOURCES INSTITUTE

GRAND VALLEY STATE UNIVERSITY®

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.

Table of CONTENTS

DIRECTOR'S Comments

Stuart Jones, Ph.D.

Hello! I am honored to be writing my first Director's Comments for the AWRI Year in Review. It is hard to believe that only a year ago I was teaching my last course at my previous institution and making final plans for my move to AWRI and West Michigan. My first ten months were exciting and overwhelming at the same time. I frequently tell those that ask, the new experiences and learning that come with the job transition have reinvigorated me and my love of science.

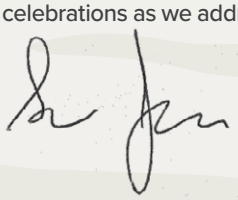
The other energizing part of this position is the opportunity to interact with so many outstanding people at AWRI, at GVSU, and across West Michigan. I have felt sincerely welcome at GVSU, but also in Muskegon and across the region. Our list of collaborators and partner institutions grows by the day. Each week our faculty work with state and federal agencies, lake and watershed groups, local municipalities, community volunteers, educators, and school children. It is rewarding for all of us to work with partners that share our dedication to enhancing and preserving freshwater resources.

When at a new institution, I find learning about the history of the place to be important. Luckily, we have a few long-term scientists and staff, as well as a published history of the institute[1], to provide me with that background. Three hallmarks of AWRI's history are GVSU's belief and investment in the AWRI mission, the genuine partnerships formed between AWRI and West Michigan's communities, and strong leadership. I look forward to continued partnership with GVSU and West Michigan and want to thank past AWRI directors Ward, Steinman, and Luttenton for their leadership.

Some tremendous milestones reached this year made it a good time to become the director of AWRI. Although I can take no credit for these accomplishments, I was blessed to participate in their celebration! On September 26, Muskegon Lake was officially removed from the Great Lake's Area of Concern (AOC) list. Muskegon Lake and dozens of other sites were placed on the AOC list under the Great Lakes Water Quality Agreement over thirty years ago. As a result of decades of effort by many, including AWRI scientists, we were able to celebrate this environmental success story on October 1 at an event held here in Muskegon. Close on the heels of the AOC delisting, we celebrated our 200,000th participant in our boat-based education program. It is amazing to think that no stadium in Michigan could hold the number of people that we have hosted since 1986.

Taking time to rejoice in research, environmental restoration, and educational successes is important. However, these events highlight the growing importance of AWRI's work and ever-increasing challenges faced by our water resources. AWRI scientists are working to document, understand, and remediate a host of environmental concerns from emerging contaminants, like microplastics and PFAS, to the spread of invasive species to water supply issues in the face of rising demand by agriculture and data centers. As an academic institution, our work locally, regionally, and globally has also grown in importance as federal and state partners in these efforts face increasing uncertainty.

Through celebrations and challenges, I am thankful to be here and excited for the coming years. I am confident that AWRI faculty and staff, along with our numerous community partners, will be the cause of many more celebrations as we address current and future challenges.



[1] Olson, Gordon L., "Dedicated to Our Aquatic Resources: A History of the Robert B. Annis Water Resources Institute". (2006). Grand Valley Reports and Histories. 19.

200K PASSENGERS
on the boats since 1986!

Fruitport middle schoolers celebrate 200,000 passengers at the *W.G. Jackson* dock. Photo credit: Christina Catanese.

On October 9, the outreach program celebrated a big milestone: 200,000 passengers since AWRI started offering aquatic science cruises in 1986!

The lucky group containing the 200,000th passenger was Fruitport Middle School. These sixth graders were welcomed back to the dock by AWRI faculty and staff to celebrate, and they received stickers (including algae illustrated by Dr. Sarah Hamsher's former student Sofia Martinez), activity books, and blue popsicles. The school also received a packet of water education posters and books, and a voucher for one free AWRI cruise in 2026. Fruitport has brought students to AWRI nearly every year since 2006.

This milestone allowed an opportunity to commemorate the vessel program's achievements over nearly four decades. It's amazing to consider how many people have connected with regional waters and the Great Lakes through this program, and the myriad potential ripple effects - from career choices in science or natural resources, to simply being more conscious of the impact we have on our water environment. Here's to the next 200,000 people onboard!

15 Years
of Monitoring
GREAT LAKES COASTAL WETLANDS

Great Lakes coastal wetlands are important habitats for maintaining biodiversity. To better understand their ecological condition, the Great Lakes Coastal Wetland Monitoring Program was initiated in 2011 to survey over 1,000 wetlands throughout the basin on a 5-year cycle. AWRI students have been involved in this monitoring from the beginning. Graduate student Emily Eberly is using these observations to assess how ecological indicators relate to human disturbance by developing models that provide detailed information on wetland condition to help mangers identify strategies for improving coastal wetlands.

Graduate student Emily Eberly holds an assortment of fish captured in a coastal wetland.

NSF Grant
Focused on
AUTONOMOUS UNDERWATER VEHICLES

Autonomous underwater vehicle investigates a group of bluegill. Photo credit: Mengxue Hou.

Along with collaborators from Northwestern Michigan College and the University of Notre Dame, the Jones Lab led a successful one-million-dollar proposal to the National Science Foundation to support a training program in the smart-deployment of autonomous underwater vehicles. This project is evidence of growing partnerships in Traverse City and the contributions that AWRI makes to the development of the water-based blue economy in the Great Lakes region.

Surveying SALT POLLUTION

The application of salt to de-ice roads has been increasing over the past 5 decades, resulting in increasing chloride concentrations in lakes, streams, and groundwater. The Steinman Lab has been studying this problem in 3 impacted lakes in Grand Rapids and was curious about its prevalence throughout West Michigan. With funding from the US Geological Survey through MSU's Institute of Water Research, and assistance from the Woznicki Lab on GIS analysis, researchers surveyed 50 additional lakes in West Michigan for chloride contamination. They were pleased to find that none of these lakes had chloride concentrations exceeding the State of Michigan chloride standard (150 mg/L), although they found that the amount of land developed around the lake and distance from the lake to the nearest road increased the likelihood of salt contamination.

Steinman Lab researchers Mya Harmer (top), Katie Tyrrell (left), and Alexis Porter (right) collect water samples in Lake County, MI. Photo credit: Cory Morse.

Steinman Receives AWARD OF EXCELLENCE

Al Steinman received the Award of Excellence at the 2025 Annual Meeting of the Society for Freshwater Science (SFS) held in San Juan, Puerto Rico. This award recognizes a person's outstanding contributions to freshwater science and is the Society's highest award. Steinman's presentation reflected on the lessons he derived from his career's failures and near failures, and how they can make us better scientists, colleagues, and mentors.

SFS President David Arscott (left) bestows the 2025 Award of Excellence to Al Steinman (right).

Sailing through MARITIME HISTORY

The *W.G. Jackson* visited the Michigan Maritime Museum in South Haven in June. The Museum features maritime exhibits and offers tall ship and other boat cruises with a historical focus. The *W.G. Jackson* was their first ever visiting research vessel, offering a science perspective on maritime history and careers.

***W.G. Jackson* stationed at the Michigan Maritime Museum docks.**

Revealing the Freshwater **DEOXYGENATION-ACIDIFICATION CYCLE**

Previous studies in marine environments have observed the co-occurrence of deoxygenation and acidification. However, these interconnected phenomena are largely understudied in freshwater environments. Using time-series data from the Muskegon Lake Observatory (www.gvsu.edu/buoy), the Biddanda Lab tracked changes in dissolved oxygen and pH over a decade. Their results revealed synchronized daily, monthly, and seasonal cycles of deoxygenation and acidification at four different depths as the lake stratifies in summer and mixes in the fall. Dissolved oxygen and pH oscillate together throughout daily and seasonal cycles, driven by a combination of stratification and photosynthesis in surface waters, and respiration at deeper, darker depths. The Biddanda Lab is currently investigating the relationship between these cycles, the factors driving these changes, and the short- and long-term impacts of deoxygenation and acidification on freshwater ecosystems.

Solar-powered Muskegon Lake Observatory (www.gvsu.edu/buoy) records dissolved oxygen and pH in Muskegon Lake.

LAKE IN A BOTTLE: Carbon Cycling in the Light and Dark

Inland waters are key sites of carbon cycling. The Biddanda Lab has been tracking carbon metabolism in Muskegon Lake since 2004 using in-lake light and dark bottle incubations of surface water. Lake metabolism varies seasonally, with peak production occurring during the warmer summer months. Each year, the lake absorbs more carbon than it releases, making it a net sink for atmospheric carbon. This net primary production supports Muskegon Lake's valuable fishery.

Bopi Biddanda (left), technical call-in Delaney Phillips (center), and graduate student Kaylynne Dennis (right) finish setting up in-lake metabolism experiments.

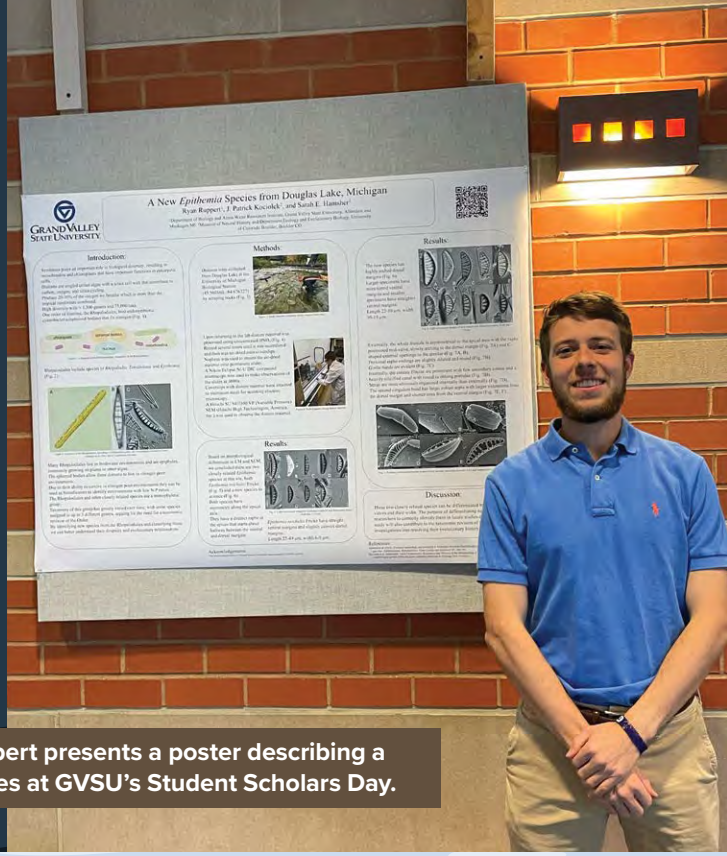
ESTUARY: Confluence of Good, Bad, and Ugly

While the Muskegon Lake is a highly productive estuary and boasts one of Michigan's best fisheries, its less savory features include a legacy of pollution, eutrophication, bottom water hypoxia, and nuisance blooms. Here, using an in-lake time-series observatory and weekly plankton tows, the Biddanda Lab monitors the rise of cyanobacterial blooms.

Undergraduate student Bridget Rozema hauls up a plankton tow from Muskegon Lake.

A New Diatom Species FROM DOUGLAS LAKE

Ryan Ruppert, a former NSF-sponsored AWRI intern, Dr. Sarah Hamsher (AWRI), Dr. Patrick Kociolek (University of Colorado), Megan Greenwood (CU), Dr. Scott Miller (University of Montana), Dr. Jinchun Li (CU), and Dr. Jonathan Taylor (North-West University, South Africa) have described a new diatom species, *Epithemia lacus-douglasi*, from Douglas Lake, Michigan. This new species was documented using both light and scanning electron microscopy and differs in size and outline from *E. reicheltii*, a close relative found in the same samples. Although molecular data are not yet available to determine the relationship between these two species, they appear to be closely related and could be an example of sympatric speciation wherein two or more species evolve in the same location.



Ryan Ruppert presents a poster describing a new species at GVSU's Student Scholars Day.

Caught in the Act DOCUMENTING DIATOM SEX!

Dr. Sarah Hamsher and colleagues collected samples of *Epithemia lacus-douglasi* and *E. reicheltii*, from Douglas Lake, Michigan that were having sex! Diatoms produce specialized cells called auxospores as part of their sexual life cycle, but because diatoms usually reproduce asexually, these cells are not often documented. Hamsher and colleagues caught these diatoms at just the right moment to reveal their unique reproductive structures.

Dr. Sarah Hamsher collecting diatoms from Douglas Lake.

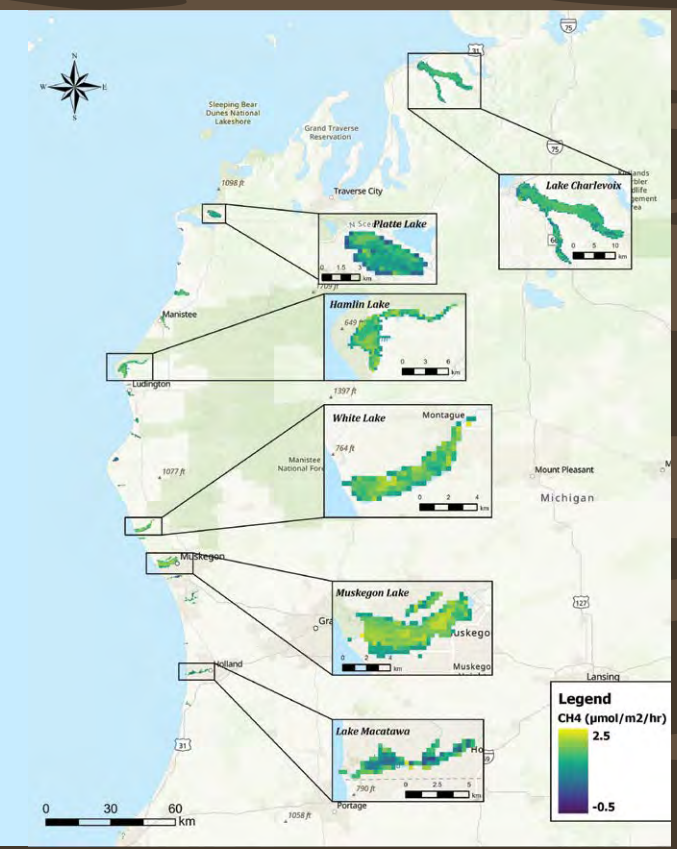
Pursuing UNIQUE DIATOMS

Mykah Mallory, an NSF-sponsored AWRI intern, and Dr. Sarah Hamsher collected algal samples in search of a special group of diatoms, the Rhopalodiales, this summer. These diatoms harbor cyanobacteria as endosymbionts (cells that live within cells). The cyanobacteria inside the diatom cells fix nitrogen for the diatom, but the cyanobacteria can no longer photosynthesize or live on their own. Collecting these diatoms is part of an NSF-sponsored project to investigate the evolution of this fascinating relationship.

Mykah Mallory collecting algal samples.

Satellite Data Links LAKE WATER QUALITY to Methane Emissions

Methane is a potent greenhouse gas that contributes to global warming. Lakes are significant emitters of methane, but it can be challenging to measure, particularly over large water bodies. The Woznicki Lab developed an approach to see if satellite-based remote sensing could be a reliable alternative. Graduate student Jillian Greene and undergraduate Ashtyn Gluck developed methods to use remotely sensed images of lake physical conditions and water quality as proxies for methane emissions measured with autonomous floating chambers. Using the European Space Agency's Sentinel-3 Ocean and Land Colour Instrument, they were able to extend emissions estimates from individual chambers to entire lake surfaces. Their model was used to predict emissions from Lake Macatawa, Muskegon Lake, and White Lake, and was extended to estimate emissions in other drowned river mouths along Lake Michigan's eastern shore. They hope this proof-of-concept will support and improve quantification of greenhouse gas emissions from lakes globally.



Satellite-based estimates of methane emissions (CH_4) at Lake Michigan drowned river mouth estuaries.

Who Makes the Toxins in HARMFUL ALGAL BLOOMS?

Cyanobacteria bloom creating a paint-like film on the surface of a lake.

The Strychar Lab evaluated the combination of Imaging Flow Cytometry with a molecular tagging technique called Recognition of Individual Genes by Fluorescence In-Situ Hybridization (RING-FISH) to identify toxin-producing cells. Toxicity can vary among different cyanobacteria species and even within strains of the same species. This combined technique distinguishes toxin creators in a way that wouldn't be possible through traditional microscopy techniques.

Probing the PLENTIFUL *PITHOPHORA*

Summer intern Mya Harmer prepares a nutrient bioassay study.

Mya Harmer was a summer undergraduate intern in the Steinman Lab in 2025 who examined what environmental factors are influencing the prolific growth of a filamentous green alga (*Pithophora* sp.) in the Thornapple River between the Cascade and Ada dams. Her experiments revealed the importance of light, phosphorus, and ammonia.

Tracking Juvenile
LAKE STURGEON
in the Muskegon and Manistee Rivers

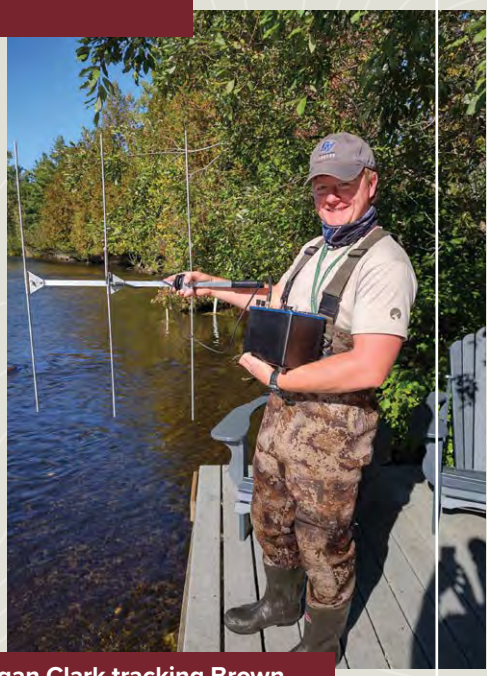
An acoustic Doppler current profiler used to measure velocity and depth of rivers.

Elliot Hoinville holds a juvenile Lake Sturgeon prior to release in the Muskegon River.

Lake Sturgeon are a native fish in Michigan. Incredibly, adults can live more than 50 years, reaching sizes greater than 100 pounds. Unfortunately, Lake Sturgeon numbers have dwindled throughout the Great Lakes, making the species a conservation priority. AWRI is working with state, federal, and tribal agencies to better understand the type of habitat juvenile Lake Sturgeon use in rivers during their first year of life. Graduate students Elliot Hoinville and John Lawrence mapped substrate and measured water velocity and depth – key habitat characteristics for Lake Sturgeon. Additionally, the students tracked radio-tagged juvenile Lake Sturgeon in the Muskegon River in 2025 (next year they will track fish in the Manistee River) to determine their habitat preferences. This data will be used to evaluate rivers throughout the Great Lakes basin for their potential to support Lake Sturgeon as part of reintroduction efforts, supporting conservation of this imperiled species.

Warming Temperatures and
BROWN TROUT MOVEMENT

Temperatures in upper portions of the North Branch Au Sable River (NBAR) now exceed 80 °F for short periods. Graduate student Logan Clark working with Dr. Mark Luttenton studied Brown Trout movement in response to changing water temperatures in the NBAR. Brown Trout remained active at temperatures below 71 °F. In contrast, trout became less active when temperatures exceeded 71 °F and contrary to previous studies, very few trout sought cold water refuge during warmer temperatures.



Logan Clark tracking Brown Trout movement.

Faculty Member Recognized for
EARLY-CAREER SCHOLARLY ACTIVITY

Dr. Sean Woznicki was selected as the recipient of the GVSU Center for Scholarly and Creative Excellence Distinguished Early-Career Scholar Award.

Vice Provost for Research Administration Robert Smart (left), Dr. Sean Woznicki (center), and Provost Jennifer Drake (right).

Bluegill-Pumpkinseed HYBRIDIZATION

This year, Jones Lab graduate student Max Larson tackles questions about hybridization patterns in two common sunfish species: bluegill and pumpkinseed. The aim of this study is to understand what lake features can affect hybridization, the relative abundance of hybrids, and whether or not hybrids grow larger or faster than their purebred counterparts. Max and undergraduate student Jailyn Jacob spent most of their time this summer on West Michigan lakes, angling and electrofishing to investigate these questions. In the lab, Max is working on genetic analyses, looking at the morphological differences between hybrids and purebreds, and using dorsal spines to determine age and growth estimations. So far, a positive relationship has been identified between hybrid abundance and habitat availability along shorelines. He continues to dive into these results, trying to figure out what is causing that relationship.

Graduate student Max Larson (right) and undergraduate Jailyn Jacob (left) collect and measure sunfish.

Outreach Program Connects Agriscience Students to WATER SCIENCE RESEARCH

Ravenna FFA Stream Team collecting monitoring data at a field site along the Musketawa Trail.

This year the Water Science in Agriscience Stream Team program brought 75 FFA students from three West Michigan high schools into the field to monitor local streams. Supported by six GVSU students, five water technicians, and three AWRI vessel instructors, the program connected young scientists with mentors and hands-on experience in water stewardship.

Undergraduate Researchers Interview GRAND RIVER STEELHEADERS

This spring, GVSU undergraduates studying fisheries and aquatic sciences and sociology surveyed anglers along the Grand River during the annual steelhead run. The project – a collaboration with Carleton University and Virginia Tech – explores how fish harvested by anglers contribute to household food provisioning. Although 60% of steelheaders planned to eat their catch, most (80%) described it as a supplement rather than a main protein source, highlighting recreational fishing's modest but meaningful role in local food systems.

Research assistants Caden Shannon (left, GVSU Biology) and Amanda Francis (right, GVSU Sociology) conducting surveys with steelhead anglers along the Grand River.

AWRI AT WORK

1. Captain Jill Johnson driving the *D.J. Angus*.
2. Graduate student Max Larson pilots the electrofishing boat.
3. Graduate student Emily Eberly holds a map turtle.
4. Partridge lab students before the first day of field work.
5. Technician Ruby Johnson and graduate student John Lawrence measure water quality in Stony Creek, Oceana County.
6. Graduate student Elliot Hoinville and technician Ruby Johnson tracking sturgeon on the Muskegon River.
7. Graduate students, Dee Philips and Kaylynne Dennis, take a pause with Dr. Bopi Biddanda, after hauling out the sensor string from the Muskegon Lake Observatory for mid-season maintenance.
8. AWRI undergraduate summer intern Zulekha Alemaye observes plankton obtained from a plankton tow in Muskegon Lake.
9. Science Instructors Diane Veneklasen (left, retiring from AWRI this year after teaching with us since 2007) and Paula Capizzi (right).
10. Graduate student Logan Clark, Terry Lyons, and Dr. Mark Luttenton (left to right) electrofishing and radio tagging Brown Trout on the North Branch Au Sable River.
11. Captain Eric Hecox steers the *W. G. Jackson* through the navigational channel to Lake Michigan.
12. Graduate student Grace Forthaus presenting their poster at the Stewardship Network Conference.

4

5

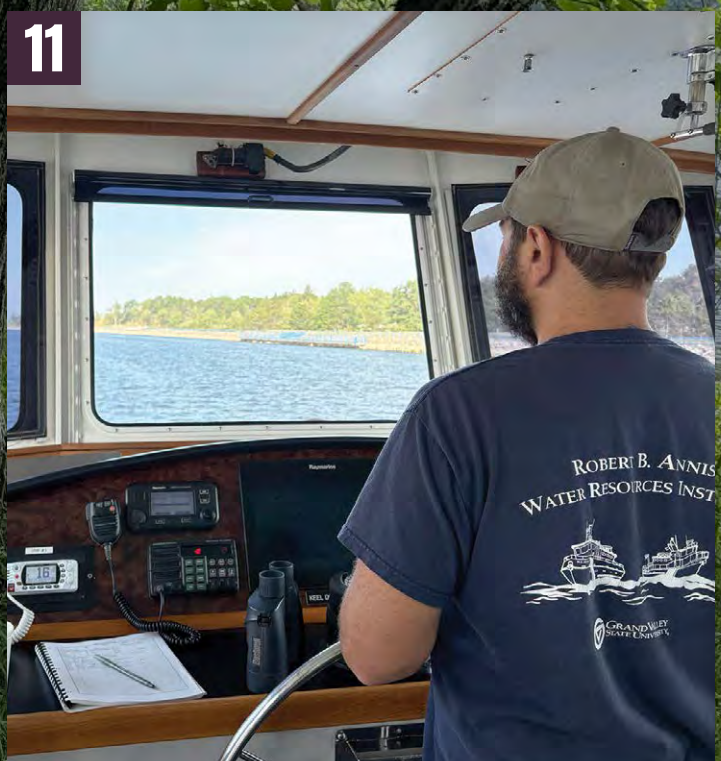
8

9


NO SMOKING

10

11


ROBERT B. ANNIS
WATER RESOURCES INST
GRAND VALLEY STATE UNIVERSITY

12


Unraveling the Invasion: Genomic Insights into the Spread and Adaptation of Hemlock Woolly Adelgid in Eastern North America
Introduction
Methods
Project Goals

Partridge Lab Receives NSF Grant to Understand

INVASIVE SPECIES' TRAIT-INFLUENCED ADAPTATION

Grace Forthaus, graduate student in the Partridge Lab, sampling HWA from infested hemlock trees. Photo credit: Madison Stibel.

Invasive species provide an optimal system to study evolutionary processes since they are 'real-life' experiments allowing researchers to assess mechanisms shaping how species respond to environmental change. Dr. Charlyn Partridge recently received an NSF Mid-Career Advancement grant to study hemlock woolly adelgid (*Adelges tsugae*, HWA), one of the top invasive threats to forest ecosystems in eastern North America. HWA populations in eastern North America are invasive and display rapid population growth and range expansion, while western North American populations are native, and population growth is limited by natural predation. Her research will compare eastern and western HWA populations to explore how invasive traits, such as rapid range expansion and population growth, influence genomic structure and adaptive potential as invasive populations expand their distribution range. The data collected will improve HWA management by identifying dispersal patterns and improving future range expansion models.

Using Spider Webs to Track

INVASIVE FOREST PESTS

The Partridge Lab is working to improve environmental DNA (eDNA) sampling methods to detect invasive pests within Michigan's coastal forests. The lab is collaborating with regional, tribal, and federal partners to monitor for hemlock woolly adelgid throughout Michigan's upper and lower peninsulas. They are assessing how their traditional eDNA traps compare to a novel method of using spider webs as eDNA samplers. Thus far, spider webs have detected HWA at all sites with a known HWA infestation, regardless of infestation level.

Zoe Gondeck, summer undergraduate intern in the Partridge Lab, sampling spider webs.
Photo credit: Kathryn Geller.

GVSU Graduate School

3-MIN THESIS COMPETITION

Renée Tardani with 3MT award.

Congrats to Renée Tardani, graduate student in the Partridge Lab, for her 2nd place finish in the Graduate School 3-minute Thesis (3MT) Competition at GVSU!

Eight-Legged POLLUTION INDICATORS

Dr. Ryan Otter (above) and graduate student Addison Bryan (below) collecting long-jaw orb weavers. Photo credit: Cory Morse.

In the Otter Lab, graduate student Addison Bryan has been collecting a group of spiders found on the river's edge to study mercury pollution for her master's thesis. These spiders, long-jawed orb weavers, eat mainly aquatic emergent insects. These insects live the majority of their lives in the river sediment and then go through metamorphosis, leaving the water as flying insects. By analyzing spiders, the Otter Lab hopes to better understand how pollutants like mercury move through aquatic food webs and how they can be transported out of water and incorporated into terrestrial food webs.

Using Burlap Barriers to CONTROL INVASIVE AQUATIC PLANTS

Graduate student Anna Briem in the field.

Invasive aquatic plants, particularly Eurasian watermilfoil (EWM), are typically controlled with herbicides. Working with the Grand Traverse Band of Ottawa and Chippewa Indians and the Lake Leelanau Lake Association, graduate student Anna Briem and Dr. Mark Luttenton evaluated the ecological impacts of burlap barriers (BB) as an alternative method to control EWM. The data indicates that BB effectively controlled EWM, had relatively little impact on water chemistry, and promoted regrowth of native plants.

AWRI Students Honored with EXCELLENCE-IN-A-DISCIPLINE Awards

Jillian Greene (left) and Ashtyn Gluck (right) at the awards convocation.

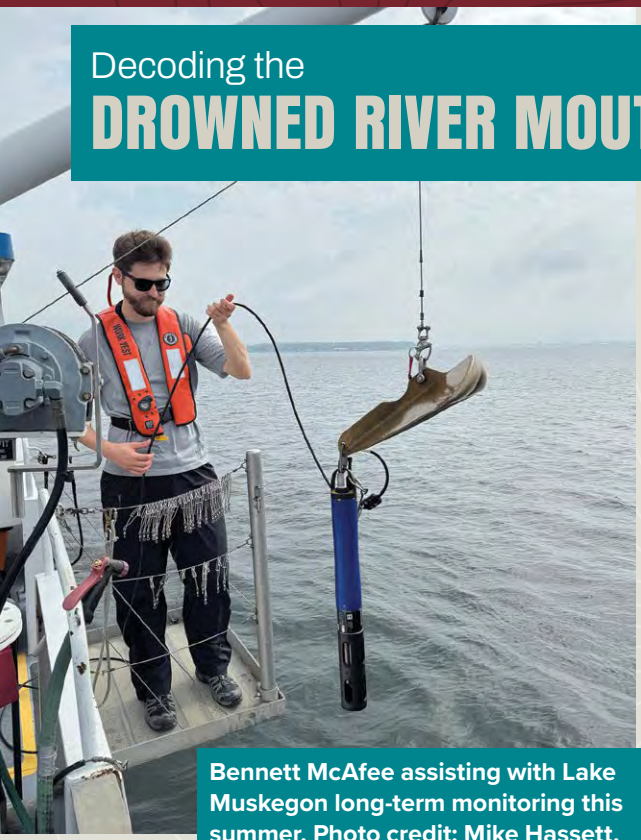
Graduate student Jillian Greene (Biology, M.S.) and undergraduate student Ashtyn Gluck (Environmental and Sustainability Studies, B.S.) of the Woznicki Lab were selected as Excellence-in-a-Discipline award recipients. The award honors one student from each discipline. Congratulations!

Mitchell Olszewski collects fish from various rivers and streams to sample their mucus and associated *E. coli* concentrations. (left) Brown Trout, (middle) Mottled Sculpin, (right) Creek Chub.

Evaluating *E. coli* CONTAMINATION IN FRESHWATER FISH

Studying water quality is vital as it directly impacts how people live, early life stages of fish and their behaviors, and subsequently, human health. Recent studies suggest increased pathogens on the mucus of fish may be a vector for *E. coli* stunting fish growth and/or causing premature death during early life stages. Equally concerning is the transfer of *E. coli* to humans (e.g., hands, face). Continuing efforts by graduate student Mitchell Olszewski working with Dr. Kevin Strychar examining Brown Trout (*Salmo trutta*), Creek Chub (*Semotilus atromaculatus*), and Mottled Sculpin (*Cottus bairdii*) show various concentrations of *E. coli* on the surface mucus with some concentrations exceeding safety standards. We also observed transference of those pathogens from fish to humans.

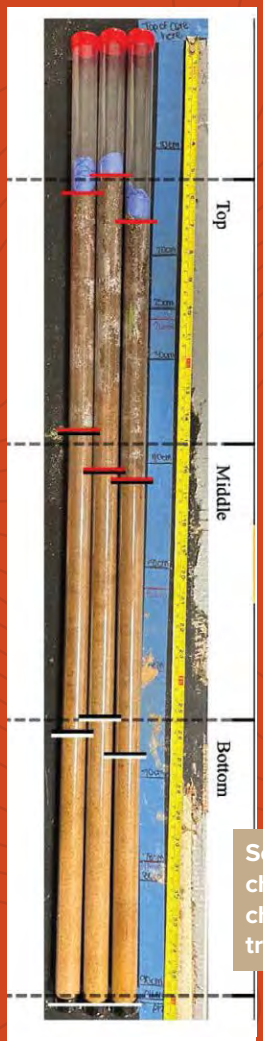
Decoding the DROWNED RIVER MOUTH



Bennett McAfee assisting with Lake Muskegon long-term monitoring this summer. Photo credit: Mike Hassett.

For over two decades, Muskegon Lake has been monitored by dedicated researchers at AWRI. Now, data scientist Bennett McAfee is collaborating with these research teams to synthesize this vast dataset and address new ecological questions. This ongoing effort offers new insights into the lake's water quality dynamics, metabolism, and fish communities, advancing our understanding of Muskegon Lake's unique ecosystem.

Pumpkins (*Cucurbita pepo*) as ORGANIC FERTILIZER

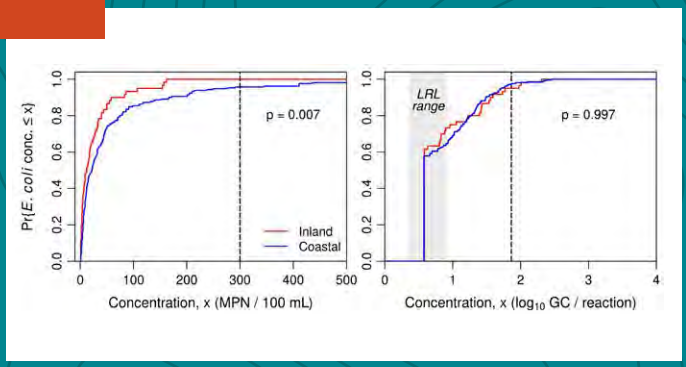


Soil profile cores show changes in sediment chemistry between treatment sites.

This year the Strychar Lab conducted a study focused on organic pumpkin fertilizer (OPF) and how its application to farm fields impacts nutrient, heavy metal, and *E. coli* concentrations in the soil. They found significant differences in nitrate concentrations between fields with and without OPF and that total nutrient concentrations decreased from fall to spring. However, phosphate, potassium, metal, and *E. coli* concentrations were not significantly different before or after OPF albeit spot applications resulted in high bacterial concentrations.

Some Recent Patterns of
FECAL CONTAMINATION
at Michigan Beaches

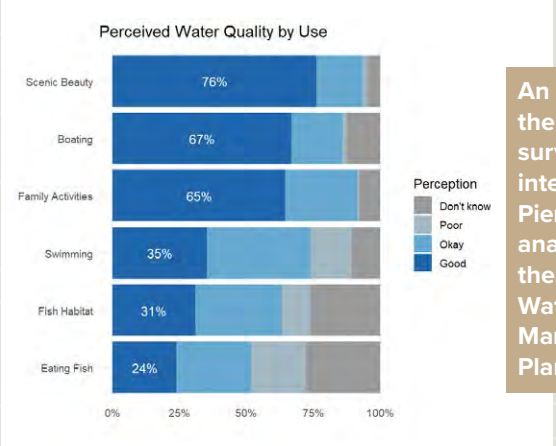
Fecal contamination at Michigan's recreational beaches is usually assessed by estimating concentrations of the gut bacterium *E. coli* using the 18-hour Colilert method or real-time quantitative PCR (qPCR). An advantage of qPCR for assessing beach safety is that results are available within a few hours of sampling, whereas Colilert results are not available until the next day, when contamination levels may be very different. The McNair Lab compared contamination levels at inland and coastal (Great Lakes) beaches measured during 2019 and 2020 in Muskegon County, MI with both methods, using 3081 pairs of Colilert and qPCR estimates for split samples. They found that Colilert data was more precise and provided strong evidence at both the state and county levels that contamination tends to be higher at coastal beaches than at inland beaches (p = 0.007). However, qPCR data was less robust and precise as well as inconclusive regarding an inland vs. coastal difference (p = 0.997).



Graph showing the proportions of samples (y-axis) with *E. coli* concentrations less than or equal to the concentrations on the horizontal axis for Colilert (left) and qPCR (right). MPN: most probable number, GC: gene copies, LRL: lower reporting limit. Dashed vertical lines indicate Michigan's recreational water-quality thresholds.

AWRI Summer Intern Assists with
MONA LAKE WATERSHED
Management Plan

AWRI summer intern Zach Pierson worked with the Muskegon Conservation District to analyze survey data about water quality concerns and awareness in the Mona Lake watershed. The Conservation District collected responses from 245 property owners and 28 local officials as part of its watershed management plan. Comparing the two datasets revealed points of alignment and divergence between residents and local leaders, helping to inform the development of a community engagement toolkit tailored to Mona Lake watershed.

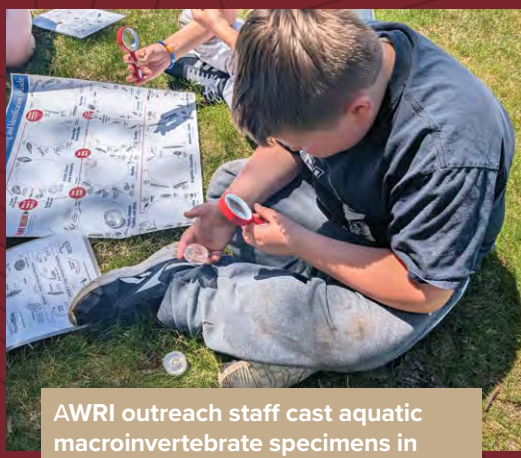


An example of the community survey data intern Zach Pierson analyzed for the Mona Lake Watershed Management Plan.

Water Tent Glow Up
FROM GLOBE

AWRI's Outreach Program received funding from NASA's GLOBE program for a water tent with vibrant mural panels depicting artistic representations of student science observations, as well as a suite of engaging supplies related to water quality monitoring.

The tent and supplies were used at outreach events in the community and with visiting school groups at AWRI. Photo credit: Kathy Agee.



AWRI outreach staff cast aquatic macroinvertebrate specimens in resin, giving students a unique up-close look at these important indicator species.

AWRI FACULTY & STAFF

Executive Director
Stuart Jones

Staff/Administrative
Tonya Brown, AWRI Assistant
Heidi Feldpausch, Office Coordinator
Cheryl Kastas, Secretary
Lauren Calkins, AWRI Student Clerical Worker
Zulekha Alemayehu, AWRI Student Clerical Worker
Dustin Kosbar, AWRI Student Clerical Worker

Facilities/Maintenance
Len Wittlieff, Maintenance

Geospatial Information Lab
Sean Woznicki, Assistant Professor
- Ashtyn Gluck, Technical Call-in

Outreach & Education
Christina Catanese, Education Specialist
- Kathy Agee, Science Instructor
- Paula Capizzi, Lead Instructor DJA
- Jamie Cross, Lead Instructor WGJ
- Doug Haywick, Science Instructor
- Ann Hesselsweet, Science Instructor
- Jen Judson, Science Instructor
- Jill Keisling, Science Instructor
- Lynn Knopf, Science Instructor
- Bob Myers, Science Instructor
- Jessica O'Donnell, Science Instructor
- Lisa Schanhals, Science Instructor
- Brittany Sweezer, Science Instructor
- Amanda Syers, Science Education Specialist
- Diane Veneklasen, Science Instructor

GVSU Vessels/Fleet Operations
Eric Hecox, Fleet Captain
- Terry Boersen, Deckhand
- Dave Fisher, Engineer WGJ
- Allen Girving, Deckhand 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

Ecological Research, Environmental Chemistry
Ryan Otter, Professor (promoted to Interim Vice Provost for Research and Innovation July 2025)
- Brian Scull, Laboratory Supervisor
- Leah Wilson, Technical Call-in

Ecological Research, Environmental Biology
Bopaiah Biddanda, Professor
- Delaney Phillips, Technical Call-in
- Anthony Weinke, Technical Call-in

Sarah Hamsher, Associate Professor
Stuart Jones, Professor
- Emma Campbell, Scientific Technician
- Daniel Gschwentner, Research Scientist
- Bennett McAfee, Data Scientist

Mark Luttenton, Professor of Biology
Jim McNair, Associate Professor
Charlyn Partridge, Associate Professor
- Kathryn Geller, Adjunct Research Assistant
- Syndell Parks, Technical Call-in
- James Switzer-Moe, Undergraduate Student

Carl Ruetz III, Professor
- John Gargasz, Undergraduate Student
- Joseph Greendyk, Undergraduate Student
- Eden Hodgson, Undergraduate Student
- Ruby Johnson, Undergraduate Student
- Steven King, Undergraduate Student
- Grayson Kosak, Technical Call-in
- Brenden Reid, Technical Call-in
- Caden Shannon, Undergraduate Student

Alan Steinman, Professor
- Aaron Dunnuck, Adjunct Research Assistant
- Michael Hassett, Scientific Technician
- Rachel Pietscher, Adjunct Research Assistant
- Alexis Porter, Adjunct Research Assistant
- Katie Tyrrell, Adjunct Research Assistant

Kevin Strychar, Professor
- Katelyn Anderson, Technical Call-in
- Jacob Kotkowicz, Technical Call-in

Affiliate Faculty
Amanda Buday, Associate Professor of Sociology

AWRI Science Advisory Board
Dr. Harvey Bootsma, University of Wisconsin-Madison
Dr. Jennifer Haverkamp, University of Michigan
Dr. Carol Johnston, South Dakota State University (emerita)
Dr. Gary Lamberti, University of Notre Dame, Chair

Graduate Students
Biddanda, major advisor
- Kaylynne Dennis

Buday, major advisor
- Madilyn Roy

Jones, major advisor
- Max Larson

Luttenton, major advisor
- Anna Briem
- Logan Clark
- Michael Trapp
- Victoria VanderStelt

Otter, major advisor
- Josie Kuhlman
- Addison Plummer

Partridge, major advisor
- Grace Forthaus
- Renée Tardani

Ruetz, major advisor
- Emily Eberly
- John Lawrence
- Elliot Hoinville

Steinman, major advisor
- Ashley Suttner

Strychar, major advisor
- Christopher Kotkowicz
- Mitchell Olszewski

Woznicki, major advisor
- Jillian Greene
- Elliot Hoinville

INTERNSHIPS AND SCHOLARSHIPS

AWRI provides opportunities for students to pursue their interests in our environment. The following students received internships during 2025.

Herbert VanderMey (summer) Intern
Jailyn Jacob (Stuart Jones)
Zachary Pierson (Amanda Buday/Carl Ruetz)

Robert B. Annis Foundation (summer) Interns
Emma Van Eerden (Ryan Otter)

AWRI Interns (summer)
Bridget Rozema (Bopi Biddanda)

Bill and Diana Wipperfurth (fall) Scholarship
Eleanor Newcomb (Carl Ruetz)

Allen and Helen Hunting Intern (summer)
Mya Harmer (Al Steinman)

NSF (summer) Intern
Mykah Mallory (Sarah Hamsher)

CFFMC Greatest Needs Gift (summer) Interns
Zoe Gondeck (Charlyn Partridge)
Chloe Spradlin (Charlyn Partridge)

Photo Credit: Katie Tyrell

PEER-REVIEWED PUBLICATIONS

AWRI Staff in bold
Undergraduate Students*
Graduate Students**
Post-doctoral Fellows***

Bertinetti, C., C. Mosley, **S.E. Jones**, and J. Torres-Dowdall. 2025. Robust sensory traits across light habitats: Visual signals but not receptors vary in centrarchids inhabiting distinct photic environments. Molecular Ecology. 34(8):e17721. https://doi.org/10.1111/mec.17721

Biddanda, B., J. Weber, **A. Weinke**, J. Medina-Sánchez, M. Villar-Argaiz, P. Carrillo and J. González-Olalla. 2025. Dust: the modern world in a trillion particles, International Geology Review. 67(3):405-407. https://doi.org/10.1080/00206814.2024.2394832

Chang, A.C.G., M.W.W. Amaral, M. Greenwood, C. Ikudaisi, J. Li, **S.E. Hamsher**, S.R. Miller & J.P. Kociolek. 2025. Evolutionary dynamics in plastomes and mitogenomes of diatoms. PLOS One. 20(9):e0331749. https://doi.org/10.1371/journal.pone.0331749

Cheng, C., **A.D. Steinman**, Q. Xue, and L. Xie. 2025. Homeostatic response of calcium and potassium ions in *Microcystis* and *Chlorella* to MC-LR. Ecotoxicology and Environmental Safety. 304:119144. https://doi.org/10.1016/j.ecoenv.2025.119144

Dick, G, J., M. Shriberg, M. Ogdahl, K. Alofs, **B. Biddanda**, H. Karrick, P.J. Doran, A.T. Fisk, **S.E. Jones**, R. Klaper, D. McCauley, A. Moerke, R. Meuninck, C.M. O'Reilly, J.T. Overpeck M.S. Phanikumar, L.G. Rudstam. 2025. Investing in Great Lakes Science is Critical for Safety and Prosperity. J. Great Lakes Research. 51(4):e102614. https://doi.org/10.1016/j.jglr.2025.102614

Dunham, K.**, **K. Geller**, **M. Sanders****, **C. Partridge**. In Press. Assessing the use of 3D printed traps to assess hemlock woolly adelgid (*Adelges tsugae*) infestation levels. Journal of Economic Entomology.

Harman, T.E.**, D. Barshis, B.H. Salas, and **K.B. Strychar**. 2025. Cellular responses of *Astrangia poculata* (Ellis and Solander, 1786) and its symbiont to experimental heat stress. Water. 17(3):411. https://doi.org/10.3390/w17030411

Hammersmith, A., **A. Buday**, R. Campbell, K. VanderHoff, M. Childers, **L. Cousino***, and **A. Phillips***. 2025. Toward a Citizen Social Science Training Model. Teaching Sociology. 53(4):285-300. https://doi.org/10.1177/0092055X251369083

Hoyt, T.J.**, and **C.R. Ruetz III**. 2025. Temporal effects of preservation on the shape and size of Yellow Perch: implications for morphological analyses. Ecology and Evolution. 15(10):e71968. https://doi.org/10.1002/ece3.71968

Jalali, J.**, N. Bhattarai, **J. Greene****, T. Liu, O. Marko, M. Radulović, M. Sears and **S.A. Woznicki**. 2025. Climate change threatens water resources for major field crops in the Serbian Danube River Basin by the mid-21st century. Journal of Hydrology: Regional Studies. 59: 102404. https://doi.org/10.1016/j.ejrh.2025.102404

Kociolek, J.P., K. Buczko, M. Greenwood, **S.E. Hamsher**, S. Miller, and J. Li. 2025. Observations and typification of diatoms or the Order Rhopalodiales (Bacillariophyta) in the Josef Pantocsek Collection, Hungarian Natural History Museum. I. Epithemia species from Élesd. Diatom Research. 40(3):221-228. https://doi.org/10.1080/0269249X.2025.2480138

Kociolek, J.P., **R. Ruppert***, **S.E. Hamsher**, M. Greenwood, S.R. Miller, J. Li, & J.C. Taylor. 2025. A consideration of *Epithemia reicheltii* Fricke (Rhopalodiales, Bacillariophyceae) and the description of two new species of the genus. Phycologia. 64(3):208-215. https://doi.org/10.1080/00318884.2025.2503038

NON-PEER REVIEWED PUBLICATIONS

Biddanda, B., and J.B. Cotner. 2025. Book review of *Essentials of Water: Water in the Earth's Physical and Biological Environments* by P. D. Blanken (Cambridge University Press, 2025). Limnology and Oceanography Bulletin. ISBN 9781108984379. 342p. https://doi.org/10.1002/lob.10715

Biddanda, B., and J. Kessler. 2024. Shelf Ice Gift-Wraps the Great Lakes Shoreline in the New Year. American Geophysical Union Tumblr, March 25, 2025 https://americangeophysicalunion.tumblr.com/post/779023287470702592/shelf-ice-gift-wraps-the-great-lakes-shoreline-in

Biddanda, B., and J. M. Medina-Sánchez. 2025. Orbital Musings: A Luminous Love Letter to Earth from Space. Book review of *Orbital* by Samantha Harvey (2024). InterChange 32 (1), August 2025. https://d31hzlhk6di2h5.cloudfront.net/20250813/1f/b9/94/40/5627a6d3c9798ce63f04c8cd/Orbital_Book_Review_Fall_2025_InterChange.pdf

Biddanda, B. Harnessing Mountain Water Towers: Machu Picchu. Eos, American Geophysical Union. 106 (5): 32. https://eos.org/wp-content/uploads/2025/04/May25.pdf

Biddanda, B., P. Hartmeyer and S. Ruberg. 2025. Refugia of Hope: Life in Submerged Karst Sinkholes. Lakes Letter, International Association for Great Lakes Research, Winter 2025 (1): 12. https://iaglr.org/lakesletter/contents/2025-winter/

Dick, G., M. Ogdahl, and **B. Biddanda**. 2025. Great Lakes scientists unite: Crucial need for investment in science. Lakes Letter (International Association for Great Lakes Research), 26: 26-27. https://iaglr.org/ll/2025-3_Summer_LL26.pdf

Hassett, M.C., **Tyrrell, K.J.**, and **A.D. Steinman**. Lake Macatawa Water Quality Dashboard 2023. February 2025.

Hassett, M.C., and **A.D. Steinman**. Project Clarity 2024. Annual Monitoring Report (Dec. 2023-Nov. 2024). February 2025.

Phillips, D.**, **A. Maki***, **K. Dennis****, **N. D'Arienzo***, **C. Gabel***, and **B. Biddanda**. An illustrated journey through our world under climate change. Book review of H is for Hope: Climate Change from A to Z by Elizabeth Kolbert. InterChange, Dec. 2024. https://www.gvsu.edu/rmsc/interchange/2024-december-stem-connections-1787.htm

Kociolek, J.P., S.E. Sala, J. Guerrero, N. Uyua, **S.E. Hamsher**, S. Miller, J. Li, & T. Borsa. 2025. Valve ultrastructure, systematics and diversity of the Rhopalodiales. I. Introduction and consideration of morphological groups within the genus *Epithemia* Brébisson ex Kützing. Nova Hedwigia. 120:109–185. https://doi.org/10.1127/nova_hedwigia/2025/1016

Landaverde J., C.I. Olson, M. Montesdeoca, M. Hannappel, **R.R. Otter**. 2025. Impacts of seasonality on mercury concentrations, polyunsaturated fatty acids, and stable isotopes: Implications for the use of Tetragnathid spiders as sentinels. Environmental Toxicology and Chemistry. 11(2):534-541. https://doi.org/10.1093/etojnl/vgae052

Lucas, K.M.** and **A.D. Steinman**. 2025. Impact of climate change and restoration on phosphorus loading in an impaired wetland. Science of the Total Environment. 981:179515. https://doi.org/10.1016/j.scitotenv.25179515

McNair, J.N., D. Frobish, **E.K. Rice****, and R.A. Thum. 2024. Alternative study designs and nonparametric statistical methods for adaptive management studies of invasive plants. Invasive Plant Science and Management 17(3):157–171. https://doi.org/10.1017/inp.2024.17

McNair, J.N., R.R, Rediske, **J.J. Hart****, and S. Briggs. 2025. Performance of Colilert-18 and qPCR for monitoring *E. coli* contamination at freshwater **beaches** in Michigan. Environments. 12(1):21–40. https://doi.org/10.3390/environments12010021

McNair, J.N., D. Frobish, **J.J. Hart****, M.N. Jamison, R.R. Rediske, and D.C. Szlag. 2025. The theoretical basis of qPCR and ddPCR copy number estimates for water samples: A critical review and exposition. Water 2025. 17(3):381. https://doi.org/10.3390/w17030381

Moore, E.K.**, **B.L. Keck***, K.G. Karol, **S.A. Woznicki** and **S.E. Hamsher**. In Press. Growth of starry stonewort (*Nitellopsis obtusa* (Desvaux) J. Groves, Characeae) in two Michigan, USA, drowned river mouth lakes. Journal of Great Lakes Research.

Moore, M., M. Greenwood, P. Kociolek, **S.E. Hamsher**, S. Miller, & J. Li. 2025. A new fossil species of *Rhopalodia* O. Müller (Bacillariophyceae, Rhopalodiales) from Mexico. Diatom Research.40(3):229-236. https://doi.org/10.1080/0269249X.2025.2478955

Romanski, A.*, **C. Partridge**, and **A.D. Steinman**. 2025. Periphyton response to chemical additions to control cyanobacteria blooms. Journal of Water Resources and Protection. 17:47-67. https://doi.org/10.4236/jwarp.2025.172004

Steinman, A.D., A. Suchy, and A. Harrison. In Press. Phosphorus. In: Limnology of Coastal Wetlands with Large Freshwater Lakes. (Eds: Uzarski, D.G., Wilcox, D., and M. Cooper). Springer Publ.

Steinman, A.D., **K.J. Tyrrell**, and **M.C. Hassett**. 2025. Effect of sand capping on phosphorus release from phosphorus-enriched Coastal Wetland sediments. Journal of Water Resources and Protection. 17(8):575-589. https://doi.org/10.4236/jwarp.2025.178030

Strychar, K.B. and R.R. Rediske. In Press. The development of rapid assessment methods for harmful algal bloom (HAB) toxins using imaging flow cytometry (IFCM). International Journal of Water.

Tang, X., **A.D. Steinman**, S. He, Q. Xue, Y.Xu, and L. Xie. 2025. Simultaneous electrochemical removal of three microcystin congeners and sulfamethoxazole in natural water. Chemosphere. 367:143558. https://doi.org/10.1016/j.chemosphere.2024.143558

Woznicki, S.A., J. Barber, J.B. Butcher, J. Essoka, M. Harris, M. Mehaffey, B. Pluta, A. Shabani, P. Whung, 2025. Compound impacts of fluvial flooding and sea-level rise on benzo[a]pyrene transport at the Lower Darby Creek Area, Pennsylvania, USA Superfund Site. Environmental Science and Technology: Water. 5(7):3613-3627. https://doi.org/10.1021/acsestwater.4c00814

Yin, X., C.E. Schraidt, M.M. Sparks, P.T. Euclide, **T.J. Hoyt****, **C.R. Ruetz III**, T.O. Höök, and M.R. Christie. 2025. Parallel genetic adaptation amidst a background of changing effective population sizes in divergent yellow perch (*Perca flavescens*) populations. Proceedings of the Royal Society B: Biological Sciences. 292(2038):2024339. https://doi.org/10.1098/rspb.2024.2339

Pierson, Z.* and **A. Buday. 2025**. "Mona Lake Watershed: Social Indicators Survey Report (2024)." Technical Report for the Muskegon Conservation District.

Rosema, B.*, and **B. Biddanda**. 2025. Estuaries: Confluence of good, bad, and ugly. American Geophysical Union, Tumblr. July 2025 https://americangeophysicalunion.tumblr.com/post/789247949666435072/estuaries-confluence-of-the-good-the-bad-and

Ruetz, C.R. III, M. Petsch, and T. Zorn. 2025. Field experiments at Hunt Creek to support Arctic Grayling reintroduction efforts. Final Report to the Manistee County Community Foundation (January 6).

Slayer, J., S. Gandulla, S. Ruberg and **B. Biddanda**. 2024. A metazoan visitor in a microbial world. Eos, American Geophysical Union, 106 (3): 32. https://eos.org/wp-content/uploads/2025/02/Mar25.pdf

Steinman, A.D. Thornapple River Report: A report to the Thornapple River Board. July 2025.

Steinman, A.D. and **M.C. Hassett**. Muskegon Lake Water Quality Dashboard. January 2025.

Steinman, A.D., **M.C. Hassett**, and **K.J. Tyrrell**. Bear Lake Annual Monitoring Report (Dec. 2023-Nov. 2024). February 2025.

2025 MASTER OF SCIENCE THESES

Anna Briem (Advisor: Luttenton)
Managing Eurasian Watermilfoil with Burlap Barriers: Response of Biological Communities with Nutrients.

Jillian Greene (Advisor: Woznicki)
Assessing greenhouse gas emissions from Michigan's drowned river mouths using *in situ* and remote sensing methods.

Katelyn Anderson (Advisor: Strychar)
Impact of Pumpkins (*Cucurbita pepo*) as an organic fertilizer on nutrient, heavy metal and *Escherichia coli* (*E. coli*) concentrations on the soils of a West Michigan farm.

Photo Credit: Elliot Hoinville

If you would like more information about **AWRI'S PROGRAMS,** please contact us.

MAIL
Grand Valley State University
Annis Water Resources Institute
Lake Michigan Center
740 W. Shoreline Dr.
Muskegon, MI 49441

PHONE
616-331-3749
231-728-3601

FAX
616-331-3864

ONLINE
www.gvsu.edu/wri

FOLLOW US ON:

gvsu.awri

gvsu_awri

gvsu-awri

@gvsu-awri.bsky.social

GIVING OPPORTUNITIES

to support the operations of the Annis Water Resources Institute are available at:
GVSU Office of Development
www.gvsu.edu/giving,

Community Foundation for Muskegon County
www.muskegonfoundation.org

Or scan to donate.

HELP US SAVE A TREE

In the future, if you would like to receive our Year in Review electronically, please join our email list at:
www.gvsu.edu/wri/review

Photo Credit: Cory Morse

ROBERT B. ANNIS WATER RESOURCES INSTITUTE
GRAND VALLEY STATE UNIVERSITY

Non Profit Org.
U.S. Postage
PAID
Grand Valley
State University