# R. B. ANNIS WATER RESOURCES INSTITUTE 2015 YEAR IN REVIEW

**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.

Located in Muskegon, Michigan, the Institute's work centers around three main focal areas:

**RESEARCH** into major questions about aquatic ecology, chemistry and toxicology, fisheries ecology, hydrology, microbial ecology, aquatic molecular ecology, ecosystem restoration, and ecological modeling.

# INFORMATION SERVICES use state-

of-the-art geospatial technology to collect and analyze data, and condense them into useful information for those who make critical decisions about natural resources management.

# EDUCATION & OUTREACH to graduate

GVS

and undergraduate students, K-12 students, policymakers, educators, and the general public.

W.G. JACKSON

MUSKEGON, MI



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DR. ALAN STEINMAN, DIRECTOR

Fresh water continues to be a focal point in the local, national, and global media. Whether the concern is over drinking water availability because of toxic algal blooms in Lake Erie, drought conditions in California, or water security in Yemen, the quality and quantity of fresh water is a growing

concern. Of course, those of us who live, work, and recreate in our region are reminded of this daily, as water is part of our identity.

As I reflect back on the education, research and outreach that we at AWRI have engaged in this past year, I realize how much our activities help inform and influence the decisions affecting this increasingly valuable resource.

On the educational front, our efforts extend from the youngest ages to life-long learners. We have now placed over 160,000 passengers on our research vessels, providing them with a hands-on learning experience about our Great Lakes. In addition, our undergraduate intern programs are growing, with the addition this year of a National Science Foundation-funded REU (research experience for undergraduates) program, which targets underrepresented students from throughout the US.

Our research continues to focus on the key factors affecting water quality and quantity in this region, and solutions to those problems. Just a few of the new initiatives this year include a better understanding of yellow perch behavior, state-of-the-art genetic testing of beach pathogens, and using aquatic fungi as a potential anti-cancer treatment. Read on for more details.

Finally, we are also engaged in key policy questions, whether it deals with Michigan's Blue Economy or examining new ways to manage Michigan's water in a more efficient manner.

Collectively, the AWRI students, staff, and faculty are engaged in helping ensure that our region's water resources remain protected and preserved, and when necessary, restored. We count on you, and you can count on us.

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GREAT LAKES **FUNGI** 

During 2014, Lake Michigan sediments yielded some extraordinary fungal diversity that demonstrated a tremendous capacity to destroy cancer cells. During 2015, Dr. Mark Luttenton continued his search, extending sampling to the deepest parts of Lake Michigan and into Lake Superior. Dr. Luttenton, working off the *W.G. Jackson*, was able to collect Lake Michigan sediment samples at water depths of nearly 900 feet, off the coast of Manistee County, MI. "We are optimistic that these new samples will be as useful as the 2014 samples," said Dr. Luttenton.



The report titled Michigan Blue Economy: *Making Michigan the World's Freshwater and Freshwater Innovation Capital* was released in April. Co-authored by AWRI Director Al Steinman and John Austin from the Michigan Economic Center, and funded by the C.S. Mott Foundation, this report and associated website (<u>http://</u> <u>michiganblueeconomy.org/</u>) tells the stories and draws lessons from how Michigan's people, communities, companies, higher education institutions and conservation organizations are creating a new Blue Economy—and what could support their efforts. The on-line report has received international attention, and has been viewed by readers from 45 states and 40 countries to date.

# MANAGING **Michigan's Water**

The C.S. Mott Foundation, with additional support from the Community Foundation for Muskegon County and the Frey Foundation, has awarded funding to AWRI Director AI Steinman to take a fresh look at managing the water resources in Michigan. This oneyear study will examine the feasibility of governing our water resources at the watershed level. Dave Kraff has been hired to oversee the day-to-day activities of this project; Dave has a M.S. degree in political science from Portland State University (OR), where his thesis focused on international water policy.

Photo Credit: Janet Va

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# YELLOW PERCH STOCK STRUCTURE

Yellow perch is a native fish that is highly sought after by anglers, yet fisheries management of the species in Lake Michigan is hampered by an incomplete understanding of the species' natural history. A grant from the Great Lakes Fishery Trust will provide funding for Dr. Carl Ruetz and graduate student Greg Chorak (left) to assess spatial patterns of yellow perch spawning populations in eastern Lake Michigan. The research will test whether yellow perch in Lake Michigan constitute different spawning populations from fish inhabiting drowned river mouth lakes (e.g., Muskegon Lake) and evaluate whether yellow perch migrate between Lake Michigan and drowned river mouth lakes.



# CEDAR CREEK BROOK TROUT STUDY

Graduate students Justin Wegner (left) and Graeme Zaparzynski (right), working with advisor Dr. Mark Luttenton and supported by Trout Unlimited, want to know if internal body temperatures in brook trout in Cedar Creek (a tributary of the Rogue River) are stable or change with their environment. Preliminary data indicate that brook trout maintain a cooler body temperature when ambient water temperatures are below 18 °C, but are slightly warmer when temperatures are above 18 °C.

UNRAVELING MYSTERIES OF LAKE STURGEON MOVEMENT

Since 2011, researchers at AWRI have been studying the movements of adult lake sturgeon in Muskegon Lake and the Muskegon River. Currently, 21 tagged adults are being monitored and tracked with an array of stationary underwater receivers that detect ultrasonic signals emitted by the tags. Funding by Consumers Energy will allow the project to continue through 2017, providing a rich data set to gain important insights into the movement patterns of lake sturgeon.

Graduate student Travis Ellens (left and right) deploys and retrieves underwater receivers to track lake sturgeon movements.

# GREAT LAKES COASTAL WETLAND MONITORING

Dr. Carl Ruetz's laboratory completed fieldwork for a 5-year project funded by the U.S. Environmental Protection Agency to monitor the ecological health of Great Lakes coastal wetlands by sampling fish, aquatic invertebrates, and water quality. The overall project is led by Central Michigan University.



Graduate students Travis Ellens (left) and

Greg Chorak (right)

pulling a gill net.

Students sampling coastal wetlands.



# Muskegon Lake Buoy Observatory Real-Time Water and Weather Information for

Real-Time Water and Weather Information for Researchers, Educators, Boaters, Fishermen & Public <u>www.gvsu.edu/buoy</u>



The Muskegon Lake Buoy Observatory completed its fifth year of successful operation, providing a world class weather and water quality time-series buoy observatory on Muskegon Lake. Serving as a lake sentinel, the Muskegon Lake Buoy Observatory enables local and regional communities of scientists, students, policy-makers, anglers, sailors, and the public to track ecosystem changes in the lake as they happen (www.gvsu.edu/buoy/).



# AWRI'S NEW NSF-FUNDED PROGRAM PROVIDES **SUMMER RESEARCH EXPERIENCES FOR UNDERGRADUATES**

2015 marked the first year of AWRI's new 3-year Research Experiences for Undergraduates (REU) summer program, overseen by AWRI scientists Drs. Jim McNair and Kevin Strychar with funding obtained from the National Science Foundation (NSF). Though open to all students, the program especially targets undergraduates from minority groups that are underrepresented in the biological sciences. The 10 students recruited for the 2015 program came from across the United States and Puerto Rico, and included a Navajo student from New Mexico, a Comanche student from Oklahoma, four Hispanic students (from Puerto Rico, New Jersey, and Connecticut), Asian and native Hawaiian students from Illinois, and two African American students from Missouri and Connecticut. Students were provided with real-world research experiences by working on projects in ecology, evolutionary biology, and environmental science, closely guided by faculty mentors. Further information about AWRI's REU program is available on its website at www.gvsu.edu/wri/mcnair/reuguest.

# WHERE ARE THEY NOW? MATT ALTENRITTER

Matt Altenritter earned a M.S. in Biology at AWRI in 2010 while working with Dr. Carl Ruetz, and a Ph.D. at the University of Maine in 2015 under the supervision of Drs. Gayle Zydlewski and Michael Kinnison. At both AWRI and University of Maine, Matt's research focused on studying the population ecology of imperiled sturgeon. He studied lake sturgeon in Muskegon Lake and shortnose sturgeon in the Penobscot River. Matt is now a post-doctoral research associate at Texas A&M Corpus Christi, working in Dr. Benjamin Walther's laboratory, where he is studying marine fish ecology. When Matt reflects on his time at AWRI, he says "My time at AWRI allowed me to grow immensely both personally and professionally. It also solidified my commitment to providing an effective and positive mentoring experience to future students. Long term, I hope to attain a university faculty position where I can foster such an environment."



# PROJECT CLARITY: FISH MONITORING IN LAKE MACATAWA

AWRI has completed the second year of fish monitoring in Lake Macatawa as part of Project Clarity. Fish monitoring will provide baseline data to assess the response of fish to restoration activities in the watershed, and sampling techniques will allow comparisons with trends in

Muskegon Lake, where AWRI has conducted monitoring since 2003. Preliminary results suggest differences in the fish community between the two lakes are likely related to poorer water quality in Lake Macatawa.

Dr. Carl Ruetz holds a white suck



AWRI staff set and pull fyke nets.

# USING HIGH-RESOLUTION TERRESTRIAL LIDAR TO **MEASURE BANK EROSION**

Bank erosion can be an important source of sediment in many streams, especially in areas with sandy soils. AWRI scientists are using a relatively new technology—high-resolution terrestrial lidar—to measure bank erosion in streams draining to Lake Macatawa and its watershed. This method uses a laser scanner to rapidly capture surface elevations with millimeter accuracy. By scanning a stream bank at different times, the volume of sediment eroded during the interim can be accurately calculated.

Top: Lidar scan data capture of an eroding stream bank in the main branch of the Macatawa River. Bottom: High resolution digital image of the scanned stream bank.







# **DR. MATTHEW COOPER** CLAS DISTINGUISHED ALUMNI-IN-RESIDENCE 2015!

The College of Liberal Arts and Sciences (CLAS) at GVSU awarded Matt Cooper, former GVSU graduate student, as its AWRI Distinguished Alumni-in-Residence. Matt earned his M.S. in Biology at AWRI in 2009, conducting research with Drs. Al Steinman and Don Uzarski, and his Ph.D. at the University of Notre Dame in 2014. He has accepted a position as Research Scientist with Northland College's Mary Griggs Burke Center for Freshwater Innovation in Ashland, WI and will continue to focus his research efforts upon environmental issues within the Great Lakes.

# INVASIVE SPECIES IN HE GULF OF MEXICO

Dr. Kevin Strychar and his students are studying a coral invader called *Tubastraea coccinea* (see picture, orange color) in the Gulf of Mexico. Over the past 60-70 years, it has invaded and destroyed native coral populations. More recently, a second coral invader called *T. micrantha* (see picture, black color) has been showing up and appears more aggressive than *T. coccinea*. Their research question is how do they eliminate these invaders and keep them from expanding their range.

> Tubastraea coccinea, orange color and Tubastraea micrantha, black color. Photo credit: K.B. Strychar.



Viral particles (arrows) detected in Muskegon Lake water. Photo credit: Vingie Ng.

# USING FLOW CYTOMETRY **TO** IMAGE VIRUSES

This summer visiting students participated in AWRI's National Science Foundation – Research Experiences for Undergraduates (NSF-REU) program called QUEST (QUantitative Environmental Science and Technology). One particular project was to identify viruses in Muskegon Lake water using AWRI's stateof-the-art benchtop flow cytometer, which allows users to visualize cells (including viruses) as they pass through the cytometer.

# ARE ZEBRA MUSSELS VIRAL VECTORS **KILLING NATIVE SPECIES?**

*Diporeia* is a freshwater amphipod (scud) that used to be the dominant, bottom-dwelling crustacean in the Laurentian Great Lakes. High in lipid content, *Diporeia* was considered the primary food source for a variety of fish. However, since the late 1980's, the *Diporeia* population has steadily declined. The disappearance of *Diporeia* has been hypothesized to be the result of the invasion of zebra and quagga mussels in the Great Lakes. AWRI researchers hypothesize that zebra mussels serve as a vector for pathogens to infect *Diporeia*. If this is the case, then it may have significant implications to the many other invasive species entering the Great Lakes, any of which may also provide an avenue for pathogens to infect native species.

AWRI graduate student Nick Gezon (inset) is working on examining viruses in aquatic invasive species. Photo credit of virus: (<u>https://rybicki.wordpress.com/tag/circovirus/</u>).



Graduate student Nicole Horne helping Oakview Elementary School students.



A Journey Into Water Educate

## MAKING LAKE MICHIGAN GREAT REACHES THOUSANDS OVER THE YEARS

Since 1998, AWRI's two research and education vessels, the W. G. Jackson and the D. J. Angus, have been engaged in annual Making Lake Michigan Great (MLMG) tours. MLMG events have included educational cruises, open houses, and educator workshops. Over the years, we have visited 33 Lake Michigan ports of call in four states. Funding for the tours has come largely from the U.S. Environmental Protection Agency's Great Lakes National Program Office and the Great Lakes Restoration Initiative. The 2015 tour had cruises and open houses in Michigan City, IN; Port of Indiana – Burns Harbor, IN; Waukegan, IL; and Holland and Muskegon, MI. Local partners arranged events, helped fund port visits in some cases, and were key to the tour's success. The 2015 partners included the Sanitary District of Michigan City, Indiana Department of Environmental Management, Macatawa Area Coordinating Council, and Waukegan Harbor Citizens Advisory Group.



After a session in the R. B. Annis Educational Foundation classroom, a 4th grade student remarked "I want to be a scientist" while another said "I don't want to leave – science is so much fun!" K-12 classes visiting AWRI engage in hands-on activities that relate to the work of AWRI scientists. For example, students explore real-time data from the Muskegon Lake Observatory and they identify, count, and graph a simulated fish catch. Contact Dr. Janet Vail for classroom reservations.

**PROJECT WET WATER FESTIVAL** LEARNING ABOUT THE WATER CYCLE AT THE WATER FESTIVAL

As the State of Michigan coordinator for Project WET, AWRI has facilitated the Michigan Project WET Community Water Festival every year since 2002. Elementary school students rotate through several hands-on learning stations as they participate in water-related activities. <text><text><text>

Dr. Bopi Biddanda (left) looks on as AWRI's Muskegon Lake Observatory buoy is winched aboard NOÁA's vessel.



R. B. Annis Foundation intern Drew McWilliams filters bacteria from beach water to prepare the samples for genetic analysis.

Grad student Travis Ellens (left) and research assistant Andrya Whitten (right) pull a fyke net from Muskegon Lake.





Science Instructor Shirley McIntire (left) and Dr. Bopi Biddanda (right) provide a scientific narrative to . citizens aboard the W.G. Jackson



Graduate student Susanna LaGory assists with a project studying the food web of Stegman Creek in Kent County.



Ruetz lab members pick and sort aquatic invertebrates.



Graduate student Greg Chorak collects tissue (fin clip) from a yellow perch for genetic analysis.





D.J. Angus-Scientech Educational Foundation intern Christina Scott measures a fish.





# AWRI IMPLEMENTS RAPID BEACH MONITORING PROTOCOL WITH qPCR

AWRI was selected as one of 11 laboratories in Michigan to implement rapid testing methods that can identify potential health hazards from bacteria contamination. In partnership with Public Health Muskegon County and the Michigan Department of Environmental Quality, AWRI was awarded a grant to develop guantitative polymerase chain reaction (gPCR) methods to measure the DNA of E. coli in 4 hours. Traditional beach monitoring methods require an 18 hour incubation that delivers notification long after potential exposures have occurred; using the qPCR rapid testing method provides same-day notification of whether a beach is safe for swimming. AWRI faculty/staff involved with the project include Richard Rediske, Charlyn Partridge, and Brian Scull in addition to Rod Morgan (Biology) and graduate students Tori Harris and Ben Giffin. In the future, gPCR methods can be applied to a variety of environmental DNA monitoring programs, including differentiating between human and animal pathogens, waterborne parasites, toxic cyanobacteria, and the presence of Asian carp.

> Graduate student Tori Harris conducts qPCR testing of beach monitoring samples.



#### AVVRI BEGINS INVESTIGATION OF **THE IMPACT OF MILL DEBRIS ON BENTHIC MACROINVERTEBRATES** ALONG THE NORTH SHORE OF MUSKEGON LAKE

As part of a major effort to restore degraded habitats in the Muskegon Lake Area of Concern, AWRI is investigating the impact of mill debris on benthic macroinvertebrates along the north shore of Muskegon Lake. The project is funded by National Oceanic and Atmospheric Administration (NOAA) through a grant awarded to the West Michigan Shoreline Regional **Development Commission (WMSRDC)** and is designed to examine the extent and environmental effects of historic sawmill debris on organisms that inhabit the lake bottom. Where impacts are identified, restoration efforts will include removal of wood debris.

Brian Scull and Tori Harris sample benthic macroinvertebrates in areas of Muskegon Lake impacted by sawmill debris.



For the past 14 years, AWRI has conducted monitoring of Muskegon County beaches in partnership with Public Health Muskegon County. This season introduced the analysis of *E. coli* DNA into their monitoring protocol.

Graduate student Tori Harris prepares samples for DNA analysis.

# RESULTS: **RESTORATION OF RIPARIAN AREAS IN THE MUSKEGON RIVER WATERSHED**

AWRI partnered with the Muskegon River Watershed Assembly, Huron Pines, Muskegon Conservation District, Land Conservancy of West Michigan, and the Conservation Resource Alliance to recently complete a 3-year project to improve forest cover and water quality in the Muskegon River Watershed. "This was a comprehensive effort across the watershed to promote and implement practices that will improve water quality in the watershed," said Rod Denning, AWRI Project Manager.

#### The completed project tasks include:

- 10 Forest Stewardship Plans prepared for private non-industrial forest lands,
- 451 acres of new trees planted in riparian areas of the watershed,
- 100 acres of land permanently protected in a conservation easement, and
- 520 feet of streambank stabilized.

#### What are the estimated beneficial impacts to the watershed?

- 107 tons of sediment reduced annually
- 410 pounds of phosphorus reduced annually
- 1,600 pounds of nitrogen reduced annually

#### CRITICAL LANDS PROJECT – UPPER-CENTRAL MUSKEGON RIVER WATERSHED

AWRI continues to work with partners (Cadillac Area Land Conservancy, Muskegon River Watershed Assembly, and the Missaukee, Wexford, and Osceola Conservation Districts) in the Upper-Central Muskegon River Watershed to identify potential conservation areas. "We are attempting to identify lands that may be experiencing a variety of environmental



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stressors and areas that potentially provide high quality natural characteristics to the local ecosystem," said Rod Denning, AWRI Project Manager.

Gabrielle Thelen, a sophomore in Mechanical **Engineering at GVSU** and a recipient of the R. B. Annis Foundation Undergraduate Summer Internship, demonstrates Godzilla", as calibrate sensors on the robot are used to program its movement along a line. This was part of the "Trash Bot" event included at the Grandparents, Grandkids, and Grand Valley (G3) Camp held at the Lake Michigan Center on June 24, 2015.



# GOLDILOCKS ZONE: WATERSHED Productivity peaks in Muskegon lake estuary

Graduate student Deb Dila and advisor Bopi Biddanda examined seasonal changes in plankton production and respiration, as well as carbon and nutrient inventories, along a land-to-lake gradient in the Muskegon River watershed. Results of a 2-year study published in *Journal* of Great Lakes Research (2015), show that both phytoplankton biomass and productivity peaked in the Muskegon Lake estuary. Here in this land-water transition zone, multiple environmental and resource factors converge to set the stage for maximum ecosystem productivity.





Drivers of seasonal hypoxia in the lake's interior: major physical and biological processes affecting Muskegon Lake's dissolved oxygen level.

# STIRRING THE CAULDRON: MIXING'S INFLUENCE ON HYPOXIA, PLANKTON AND FISH

Wind-induced mixing, or lack thereof, plays a major role in engineering the structure and function of lake ecosystems. In summer, when calmer winds prevail, warmer surface water separates from colder deeper water during thermal stratification. Without regular mixing, organisms in the dark bottom waters use up the available dissolved oxygen, leading to hypoxia, a low-oxygen condition that can negatively impact many sensitive invertebrates and fish. The Biddanda lab is using Muskegon Lake Observatory data and field studies to investigate this issue. Graduate student, Anthony Weinke, has found that hypoxia diminishes the number and species of fish that use deep waters in summer, and that wind events alone are unable to alleviate this condition. However, postdoctoral research scientist Dirk Koopmans has observed that periodic intrusions of high-oxygen water from Lake Michigan into Muskegon Lake may mitigate the negative effects of bottom water hypoxia.

# AWRI DIRECTOR PRESENTS TWICE IN WASHINGTON D.C.

Dr. Al Steinman and Rep. Brenda Lawrence following Steinman's testimony.

Al Steinman was busy in Washington DC in the latter part of 2015. He first presented at a congressional briefing entitled "Coastal Science

Fueling Coastal Economies: Using Geoscience Research to Accelerate Innovation and the Coastal Economy" where he discussed the return on investment associated with the restoration of Muskegon Lake. In early December he testified before the Subcommittee of the Interior, under the House Oversight Committee, on the impacts of invasive species in the Great Lakes. He was invited by ranking member Rep. Brenda Lawrence from MI's 14th congressional district.

# WELCOME DR. PARTRIDGE!

AWRI is very pleased to welcome our new faculty member, Dr. Charlyn Partridge. Charlyn's research combines her experience in genomics and ecology to address how environmental and genetic factors influence selection processes and adaptive potential in natural populations. Her research employs a variety of behavioral, molecular, and genetic techniques to address questions related to: 1) sexual selection, 2) invasive species colonization, and 3) adaptation to global climate change.

#### FIRST MOVEMENT: CYANOBACTERIA MOVE TOWARDS SUNLIGHT, AND THE WORLD CHANGES Bopi Biddanda and his students Adam McMillan, Steven Long, Michael Snider and Anthony Weinke studied the motility of filamentous mat-forming cyanobacteria growing under lowlight, low-oxygen, and high-sulfur conditions in Lake Huron's submerged



Sinkhole cyanobacteria filament phototaxis. Dispersed filaments in a thin mat layer respond rapidly coordinating their position in the zone of light. The GVSU logo was cut out of foil and placed over a plastic Petri dish. The before and after images were taken 30 minutes apart.



Mary Ogdahl, the lab manager for Al Steinman the past 11 years, left us this past year and has accepted a new position as project manager at CILER—the Cooperative Institute for Limnology and Ecosystem Research in Ann Arbor. CILER's mission is to foster University and NOAA

partnerships in the Great Lakes region. While Mary's departure has left a huge hole in AWRI, we take solace in that she and husband Matt are now closer to family and that CILER has gained a truly extraordinary employee.

sinkholes. As reported in the journal

Frontiers (2015), the researchers

report on rapid (for a filament!)

mat cohesion, photosynthetic

efficiency and sedimentary

coordinated filament movement

(~1  $\mu$ m per second) that optimizes

carbon burial in these modern-day

representative of those undertaken

by cyanobacteria in shallow seas

~3 billion years ago, resulting in

the oxygenation of early Earth.

sinkholes. These phenomena may be





# WELCOME DIRK KOOPMANS!

AWRI welcomes Dirk Koopmans, a new postdoctoral research scientist who joins the Biddanda lab to collaboratively operate the Muskegon Lake Observatory and analyze lake ecosystem changes over time. Dirk completed his Ph.D. at the University of Virginia, and conducted research at the School of Freshwater Sciences, UW – Milwaukee before coming to GVSU. He has studied river hydrology and Green Bay estuary metabolism – skills that are well suited to studies of drowned river mouth lakes in West Michigan.

# AWRI FACU

DIRECTOR:

Alan Steinman, Professor

# STAFF/ADMINISTRATIVE:

Tonya Brown, AWRI Assistant Roxana Taylor, Secretary Paula Wicklund, Office Coordinator

# FACILITIES/MAINTENANCE:

Roger Hillstead, Maintenance

#### **INFORMATION SERVICES CENTER:**

John Koches, Associate Research Scientist Rod Denning, Research Associate Betty Gajewski, Technical Call-in Jackson Rieger, High School Volunteer

## **OUTREACH & EDUCATION:**

Janet Vail, Associate Research Scientist Paula Capizzi, Lead Instructor DJA Paul Carlson, Science Instructor Cheri Gerhart, Science Instructor Ann Hesselsweet, Science Instructor Fallon Januska, Technical Call-in Shirley McIntire, Science Instructor Michele Smith, Science Instructor Diane Veneklasen, Science Instructor

#### **GVSU VESSELS/FIELD STATION OPERATIONS:**

Anthony Fiore, Jr., Fleet Captain John Bontrager, Captain WGJ Dave Fisher, Marine Engineer WGJ Kevin Fitch, Captain DJA Allan Girvin, Deckhand WGJ Robert Marx, Deckhand WGJ Brad Nieboer, Marine Electrician Jim Rahe, Deckhand WGJ Gerry Weinert, Deckhand DJA

# ECOLOGICAL RESEARCH, Environmental chemistry:

Richard Rediske, Professor Jim O'Keefe, Research Associate Brian Scull, Research Assistant

# ECOLOGICAL RESEARCH, Environmental Biology:

Bopaiah Biddanda, Professor Scott Kendall, Technical Call-in Dirk Koopmans, Postdoctoral Researcher Mark Luttenton, Professor of Biology Jim McNair. Associate Professor Ariana Carlson, Volunteer Charlyn Partridge, Assistant Professor Andrew Pyman, Technical Call-in Carl Ruetz III, Professor Brandon Harris, Technical Call-in Andrya Whitten, Adjunct Research Assistant Alan Steinman, Professor Michael Hassett, Scientific Technician Dave Kraff, Adjunct Research Assistant Mary Ogdahl, Research Associate James Smit, Technical Call-in Kurt Thompson, Research Associate Maggie (Weinert) Oudsema, Adjunct Research Assistant Kevin Strychar, Associate Professor

#### **AWRI SCIENCE ADVISORY BOARD:**

Harvey Bootsma, University of Wisconsin - Milwaukee Carol Johnston, South Dakota State University Gary Lamberti, University of Notre Dame; Chair Don Scavia, University of Michigan

## **GRADUATE STUDENTS:**

Greg Chorak, AWRI Assistantship (major advisor: Carl Ruetz) Delilah Clement, AWRI Assistantship (major advisor: Alan Steinman) Travis Ellens, AWRI Assistantship (major advisor: Carl Ruetz) Nick Gezon, AWRI Assistantship (major advisor: Kevin Strychar) Ben Giffin, AWRI Assistantship (major advisor: Charlyn Partridge) Victoria Harris, AWRI Assistantship (major advisor: Rick Rediske) Josh Haslun, AWRI/MSU graduate student, (advisor: Kevin Strychar) Brianna Hauff, AWRI/MSU graduate student, (advisor: Kevin Strychar) Emily Kindervater, AWRI Assistantship (major advisor: Alan Steinman) Susanna LaGory, AWRI Assistantship (major advisor: Carl Ruetz) Jason Lorenz, (major advisor: Carl Ruetz) Syndell Parks, AWRI Assistantship (major advisor: Ryan Thum) Lindsev Schulte, AWRI Assistantship (major advisor: Ryan Thum) Rajesh Sigdel, AWRI Assistantship (major advisor: Rick Rediske) John Skutnik, AWRI Assistantship (major advisor: Kevin Strychar) James Smit, AWRI Assistantship (major advisor: Alan Steinman) Sarah Stamann, AWRI Assistantship (major advisor: Rick Rediske) Justin Wegner, AWRI Assistantship (major advisor: Mark Luttenton) Anthony Weinke, AWRI Assistantship (major advisor: Bopi Biddanda) Graeme Zaparzynski, AWRI Assistantship (major advisor: Mark Luttenton) Brian Zuber, AWRI Assistantship (major advisor: Rick Rediske) Jay Zuidema, AWRI Assistantship (major advisor: Jim McNair)

#### UNDERGRADUATE/GRADUATE STUDENT ASSISTANTS:

Nate Akey Logan Knoper (volunteer) Ryan Schiek Megan Zawacki

# INTERNSHIPS & SCHOLARSHIPS

AWRI provides opportunities for students to pursue their interests in our environment. The following students received internships during 2015.

#### D. J. ANGUS-SCIENTECH EDUCATIONAL FOUNDATION INTERN: Christina Scott

#### HERBERT VANDERMEY INTERN: Chris VandenBerg

#### **ROBERT B. ANNIS FOUNDATION INTERNS:**

Brittany Jacobs Emily Luke Andrew McWilliams Gabrielle Thelen Nicholas Weber

#### BILL AND DIANA WIPPERFURTH SCHOLARSHIP: Macy Doster

#### **RON WARD SCHOLARSHIP:**

Josh Berwanger Michaela Castleman Lindsey Short

## **NSF-REU QUEST STUDENTS:**

Muhidin Abdimalik Jorge Berrios-Rivera Shelby Brewer Nicholas Chischilly Hannah Franko Naymar Franqui Kelsey Hubble Melissa Koehler Vingie Ng Isabel Papraniku

Photo Credit: Janet Vail AWRI staff in bold Undergraduate Students\* Graduate Students\*\* Post-doctoral Fellows\*\*\*

# PEER-REVIEWED PUBLICATIONS

**Bhagat, Y.\*\*\***, **C.R. Ruetz III**, and **A.L. Akins (Koster)\***. In Press. Differential habitat use by the round goby (*Neogobius melanostomus*) and *Dreissena* spp. in coastal habitats of eastern Lake Michigan. Journal of Great Lakes Research. DOI: 10.1016/j.jglr.2015.08.005

Biddanda B.A., A.C. McMillan\*, S.A. Long\*, M.J. Snider\*\*, and A.D. Weinke\*\*. 2015. Seeking sunlight: rapid phototactic motility of filamentous mat-forming cyanobacteria optimize photosynthesis and enhance carbon burial in Lake Huron's submerged sinkholes. Frontiers in Microbiology 6:930. DOI: 10.3389/fmicb.2015.00930

**Dila, K.D.\*\*** and **B.A. Biddanda**. In Press. From land to lake: contrasting microbial processes across a Great Lakes gradient of organic carbon and nutrient inventories. Journal of Great Lakes Research. DOI: 10.1016/j.jglr.2015.04.014

Duhamel, S., **G. Nogaro\*\*\***, and **A.D. Steinman**. In Press. Effects of water level fluctuation and sediment–water nutrient exchange on phosphorus biogeochemistry in two Great Lakes coastal wetlands. Aquatic Sciences.

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