Photo: Carrie Hause

R.B. ANNIS WATER RESOURCES INSTITUTE

2010 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 points:

Research into major questions about biogeochemistry, aquatic ecology, environmental chemistry and toxicology, fisheries biology, hydrology, limnology, microbial ecology, stream ecology, watershed ecology and management, and wetlands ecology.

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

1960 50 2010
Years of Shaping Lives
GRAND VALLEY STATE UNIVERSITY

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2010 Success in Difficult Times

Dr. Alan Steinman, Director

These are perilous times for publicly-funded higher education in Michigan, and indeed, in most of the US. Despite study after study reporting that money spent in higher education yields powerful returns on investment, "higher ed" remains on the chopping block simply because it is one of the very few funding categories in state budgets that are not protected from cuts.

As I look at the highlights from AWRI's 2010 Year in Review, I am thrilled with our accomplishments over the past year, especially in light of these difficult financial times. I attribute AWRI's continued success to 5 main factors:

1) the quality of our faculty, staff, and students—our human resources are the foundation of our success. Without their creativity, intellectual curiosity, and collegiality, no amount of money would guarantee success.

2) prior leadership—my predecessor, Ron Ward, working with former President Don Lubbers and former Dean Doug Kindschi, helped establish endowments, which provide AWRI with resources that allow us to sustain ourselves during difficult financial times.

3) extramural funding—this fancy term used by higher education administrators merely refers to the amount of grants and contracts brought into the university from external funding sources. In institutes such as AWRI, where research funding is absolutely essential to fulfill our mission, our success is predicated on obtaining funding. AWRI faculty and staff continue to excel in this area; in 2010, over $2 million in new grants and contracts have been secured.

4) community support—we are blessed with tremendous support from the Muskegon and entire west Michigan community. In 2010, for example, we received a beautiful painting by Lori McElrath-Eslick that was donated by Ellen Rockwood in honor of her late husband, Albert Rockwood, a renowned fly fisherman. In addition, AWRI was the beneficiary of proceeds from the selling of an ArtPrize piece: Woven Landscape, created by Laurie Angell and many other craftspeople from the Woodland Weavers and Spinners Guild. Knowing that our community recognizes and appreciates our work helps build morale and ultimately, leads to new opportunities.

5) productivity—success breeds success. As AWRI continues to produce top-notch graduate students, receive more grants, publish more studies in high-quality journals, collaborate with researchers from throughout the region, nation, and world, and serve on state, national, and international committees and panels, more opportunities become available.

So despite these difficult times, it is with both pride and joy that I can report that AWRI continues to thrive. We keenly recognize that our success would be impossible without the foundation laid by GVSU, our donors, the community, and all the faculty, staff, and students that preceded us at AWRI. Our mission remains inviolate: "to integrate education, outreach, and research to enhance and preserve freshwater resources".

Golman Fly-Fishing the Muskegon, by Lori McElrath-Eslick.

Woven Lakescape at the ArtPrize competition. Pictured are Margaret Jager (left), Secretary for the Michigan League of Handweavers, and Joni Rosen (right), President of the Woodland Weavers and Spinners Guild.

The Lake Michigan Center, home of AWRI, sits at Muskegon Lake in downtown Muskegon.

Muskegon's Economy

A new study by Dr. Paul Isely of GVSU's Seidman College of Business shows that AWRI's economic impact on Muskegon County is significant. We are proud to be a catalyst in the revitalization of Muskegon, and to help transform the region into a knowledge-based economy. Some of Dr. Isely's findings:

- AWRI and its visitors averaged $3 million annually in direct spending in Muskegon County from 2006-2009. This is money that would not have been added to Muskegon's economy without the presence of AWRI.
- AWRI and businesses in Muskegon that support AWRI have provided an average of 49 full-time jobs each year from 2006-2009.
- Construction of the Lake Michigan Center in 2001 supported more than 100 jobs across Muskegon for one year.
- Over the last 3 years AWRI has had nearly 11,000 visitors from outside Muskegon County use conference rooms or participate in research on the *W.G. Jackson*.

Aileen Leinenbach (left, with Dr. Janet Vail), a student from the University of Cologne in Germany, completed her master's thesis (Building Climate Change Literacy: An Analysis of Climate Change Material for Education) while working with the education and outreach team at AWRI during the summer. She represented the GVSU GLOBE program at the GLOBE international conference in Calgary, Canada.

Water Quality Index for West Michigan

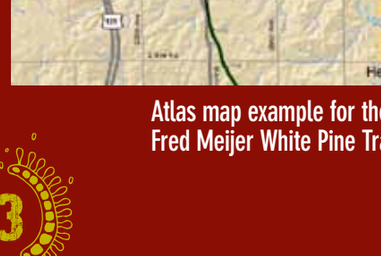
Prepared for the West Michigan Strategic Alliance as part of their Vital Signs Reporting Process

Understanding the overall water quality of our numerous lakes, rivers, and streams is critical to the sustainability of our region. Is their condition getting better or worse? This is an important question given that so much of our social and economic well-being is related directly to high-quality beaches, water-related recreational opportunities, and safe, clean water resources.

A Water Quality Index (WQI) assigns a single score or "grade" to a lake or stream that expresses the overall condition of the water body. This summer the Information Services Center (ISC) staff, led by Jon VanderMolen, researched the different types of WQIs being used in Michigan. A report titled *Recommendations for a West Michigan Water Quality Index* was developed based on this assessment.

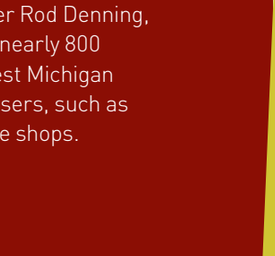
Photo: Travis Ellens

Three Post-Doctoral Researchers Join AWRI



- **Dr. Yakuta Bhagat** is assessing variation in fish community structure and environmental factors as part of the Muskegon Lake Long-Term Monitoring Study. Her results will be used in the ongoing effort to delist Muskegon Lake as a Great Lakes Area of Concern (AOC).

- **Dr. Nadia Gillett** is evaluating the relationship between phytoplankton community structure and water quality as part of the Muskegon Lake Long-Term Monitoring Study. Her results will help set realistic restoration targets for Muskegon Lake as a Great Lakes AOC.



- **Dr. Liqiang Xie** is evaluating the factors that contribute to cyanotoxin production and the fate of cyanotoxins in aquatic food webs. Her results will provide important information on the ecological effects of cyanobacteria blooms and why toxin production varies among and within lakes.

AWRI expresses its deep gratitude for the generous donations from an anonymous donor (Drs. Bhagat and Xie) and the Paul C. Johnson Foundation and the Hines Corporation (Dr. Gillett) that support these scientists and their research.

Atlas map example for the Fred Meijer White Pine Trail

ISC Creates West Michigan Trail Atlas

Access to a high-quality system of non-motorized trails has been identified as a priority by the Meijer Foundation and the West Michigan Trails and Greenways Coalition, and is considered yet another sustainability objective by the AWRI's Information Services Center (ISC). In an effort headed by project manager Rod Denning, the ISC published a 60-page atlas that documents nearly 800 miles of both existing and proposed trails in the west Michigan region, including various features that serve trail users, such as parking areas, restaurants, campgrounds, and bike shops.

Angela Defore, AWRI graduate student, conducting metabolism measurements through the ice on Muskegon Lake.

CARBON CYCLING IN MUSKEGON LAKE

Photosynthesis of organic carbon in both terrestrial and aquatic ecosystems links carbon dioxide in the atmosphere to the biosphere. Terrestrial ecosystems contribute significant amounts of inorganic nutrients and organic carbon compounds to lakes, which are then transformed by in-lake photosynthesis and respiration. Thus, freshwater ecosystems are highly reactive sites of carbon metabolism, and the land-water-air link is a key component of the global carbon cycle.

"Photosynthesis and respiration are two sides of the same metabolic coin – the yin and yang of the biosphere"
- B. A. Biddanda (2006)

Angela Defore, a graduate student working with Dr. Bopi Biddanda, studied the photosynthesis and respiration of carbon (carbon cycle) over the course of a year in Muskegon Lake. Angela went on spring and summer sampling trips aboard the *W.J. Jackson*, and braved the cold Michigan winter to drill through ice-covered Muskegon Lake. By measuring plankton metabolism and concurrently gathering environmental data, she was able to identify environmental factors that drive the carbon cycle in Muskegon Lake. Light and temperature were drivers of photosynthesis, and phytoplankton abundance was co-limited by nitrogen and phosphorus availability. Dissolved organic carbon and temperature were drivers of respiration.

On an annual cycle, Muskegon Lake generally produces more organic matter than it consumes, supporting a productive local food web – including fisheries. Angela's observations provide a baseline for future studies of Muskegon Lake's response to changing regional climate.

Research to Improve Global Access to Fresh Water

Clean freshwater is a shrinking resource and has become a limiting commodity in large parts of the globe. Overuse, pollution, and contamination in developing countries have contributed to this dire issue. The BioSand Filter is an inexpensive remedy, as it delivers purified, potable water at the point of use. Many of these systems are in use worldwide, but their physical, chemical, and biological functions are inadequately documented and poorly understood. Using Biosand Filters (Hydraid) donated by Cascade Engineering of Grand Rapids, AWRI faculty and students are conducting the following research:

- Nicole Horne's Master's Thesis (advisor: Biddanda) – biofilm structure and function in BioSand Filters using modern microscopic, molecular, and other analytical tools.
- Andrew Sisson's Master's Thesis (advisor: Rediske) – treatment efficiency and optimization methods for high turbidity water.
- Meagan Sesselmann's summer project (advisor: McNair) – experimental and modeling studies of factors affecting transport through BioSand Filters.

Results will be used to document and improve the performance of BioSand Filters.

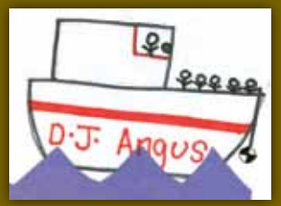
Meagan Sesselmann, Purdue University student volunteer, performing experiments with the BioSand Filter.

New DNA Instrumentation at AWRI

AWRI's Molecular Ecology lab became the home to GVSU's DNA analysis facility in 2010. The facility features an automated genetic analyzer that can sequence and analyze DNA. The shared research instrumentation provides students and faculty with hands-on training in DNA sequencing and genotyping, key research components in molecular biology. Demonstrations of the research facility are given to a number of GVSU classes by Adjunct Research Assistant Dustin Wcisel, who heads the facility. Ultimately, the DNA analysis facility enhances GVSU's research environment, and encourages and prepares students for careers lying at the intersection of molecular and environmental biology. The facility was initiated by an award from the National Science Foundation's Major Research Instrumentation program.

Dustin Wcisel shows Liz LaRue how to load samples on the DNA sequencing instrumentation at AWRI.

Over 5,800 students and other visitors participated in activities on the ***D.J. Angus*** and the ***W.G. Jackson*** this year. An example of the many positive notes we receive from students is "thank you for the best field trip! It was one of the highlights of my sixth grade year – awesome."



Wetland Loss in the Lower Grand River Watershed

Forested terrene basin wetland in the Dickerson Creek watershed.

Wetlands are highly valued for their numerous ecological services, many of which help protect and improve water quality. Wetlands are also home to various plant and animal species that contribute enormously to our region's biodiversity. Earlier this year the Information Services Center (ISC), led by project manager Rod Denning, completed the first ever investigation of how the wetland resources in the Lower Grand River Watershed (LGRW) have changed in geographic extent over the decades since European settlement.

Results from this investigation revealed the following:

- The LGRW has lost approximately 170,002 acres or 42% of its original wetland resources.
- The ecological services most directly impacted include the loss of sediment retention, interior forest bird habitat, stream shading, and floodwater storage.
- Wetlands along our streams have been reduced by 43,341 acres or 35% since European settlement. The overall average size of our wetlands has shrunk from 37.2 acres to 12.8 acres.
- Wetlands located in headwater tributaries of the Grand River have been reduced from 242,533 acres to 120,297 acres, a loss of greater than 50%.
- Those subwatershed areas that have lost the most wetlands include: Bass River, Libhart Creek, and Rush Creek.

This study was paid for by the U.S. Environmental Protection Agency, took 3 years to complete, and included the cooperation of the Lower Grand River Organization of Watersheds and the Michigan Department of Natural Resources and Environment. Recommendations from this investigation have already been included in the recent update to the LGRW Management Plan. Products include a digital atlas and 3 wetland action plans. The results from this investigation are expected to help drive wetland conservation and restoration strategies throughout the LGRW.

Genetic Study Identifies Movement Patterns of the Invasive Round Goby

Liz LaRue sets traps to collect round gobies for her genetic work.

Invasive species are a significant problem in the Great Lakes, and the round goby is no exception. The round goby is a small fish that lives on the bottom of lakes and rivers. It can outcompete native, bottom-dwelling fishes and eat the eggs of many game fish species. Originally from Eurasia, the round goby was accidentally transported to the Great Lakes by ocean-going ships. Discovered in the St. Clair River in 1990, the round goby rapidly spread throughout the five Great Lakes.

How did this tiny fish spread across the Great Lakes in such a short time?

Elizabeth LaRue, an undergraduate student at GVSU, addressed this question using genetic tools. Elizabeth's research was made possible by support from the Student Summer Scholars program; the Diana and Bill Wipperfurth Scholarship; and the help of her faculty mentors, Drs. Ryan Thum and Carl Ruetz.

Elizabeth sampled round gobies from 12 pierheads around the perimeter of Lake Michigan. Genetic tools revealed that round gobies naturally disperse over small distances (e.g., <10 km). However, they are not likely to rapidly spread over large distances (e.g., > 100 km), as was observed after their introduction to the Great Lakes. Her research showed that the spread of round goby is facilitated by human activities that involve long-distance movements, such as commercial shipping. Thus, shipping not only introduced this invasive species to the Great Lakes, but likely played an important role in its subsequent spread after introduction. Elizabeth co-authored a manuscript with her faculty mentors summarizing her research findings, which has been accepted for publication in a peer-reviewed journal.

Liz LaRue sets up polymerase chain reactions (PCRs) to amplify microsatellite markers for her work on round goby genetics.

W.G. JACKSON GETS SOME TLC

This August, the *W.G. Jackson* was hauled out for its 5-year Coast Guard dry dock inspection, which it passed with flying colors. Over 18 days, 740 person-hours were spent making these improvements to the vessel:

- Painted the entire hull above and below water
- Removed the paint and nonskid from the aft deck and replaced with new nonskid surface
- Replaced all the aluminum hull anodes
- Installed a new Raymarine DSM 300 Digital Depth Sounder
- Removed the original shaft Cutlass Bearings and installed new bearings
- Performed engine maintenance

Pressure washing the bottom of *W.G. Jackson* on haul out day.

The *W.G. Jackson* on launch day.

Our very dedicated vessel staff, Captain Tony Fiore, Captain Jim Winks, Dave Fisher, James Rahe, Bob Marx, and Brian Hanson, put in a tremendous amount of blood and sweat (and perhaps tears) to keep the *W.G. Jackson* running and looking great. AWRI extends our deep appreciation to Moe Bronson of Van Eck Diesel Services, Mike Beckman, and the DeVos family for facilitating the haul-out.

Student Success Highlight

Matt Breen, past AWRI Graduate Student. Where is he now?

JOB TITLE: Native Aquatics Project Leader (Northeastern Region), Utah Department of Natural Resources, Division of Wildlife Resources. I administer the native aquatics program in Utah's Northeastern Management Region, which includes several projects for the Upper Colorado River Endangered Fish Recovery Program and Tier I State Sensitive Species (fish and amphibians).

"I received an excellent education at GVSU, but what really helped me develop professionally was the opportunity to work with researchers at AWRI while an undergraduate and graduate student. AWRI's research staff is genuinely interested in student involvement in research activities, providing students with hands-on experience for an education that goes far beyond the classroom. Working at AWRI for several years on a variety of projects provided me with real-world applications of many cutting-edge field and laboratory techniques used in biological research. The Internship and Graduate Assistantship I received through AWRI were both amazing opportunities that were instrumental in my success as a Fisheries Biologist. I highly recommend these programs to prospective students."

Matt Breen holds a Colorado pikeminnow that was captured and released in a tributary of the Green River, Utah.

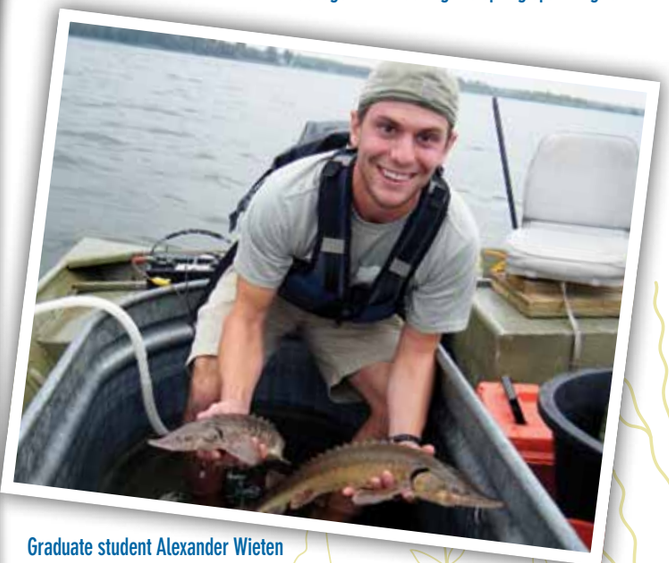
AWRI at Work 2010

Graduate student Elizabeth Tromp
collecting water from Bear Lake for
cyanobacteria (blue-green algae) analysis.

Lab technician Travis Ellens holding a
Lake Sturgeon caught via electrofishing in the
Muskegon River during the spring spawning run.

Research Assistant Mary Ogdahl
removing porewater from Spring Lake sediments
for analysis of phosphorus content.

Lab technician Maggie Weinert collecting
tiles from Ruddiman Creek for analysis of diatoms.



Graduate student Alexander Wieten
holding juvenile Lake Sturgeon captured in Muskegon Lake.

Graduate student Whitney Nelson
rinsing a sediment sample from Muskegon Lake
to collect benthic invertebrates.

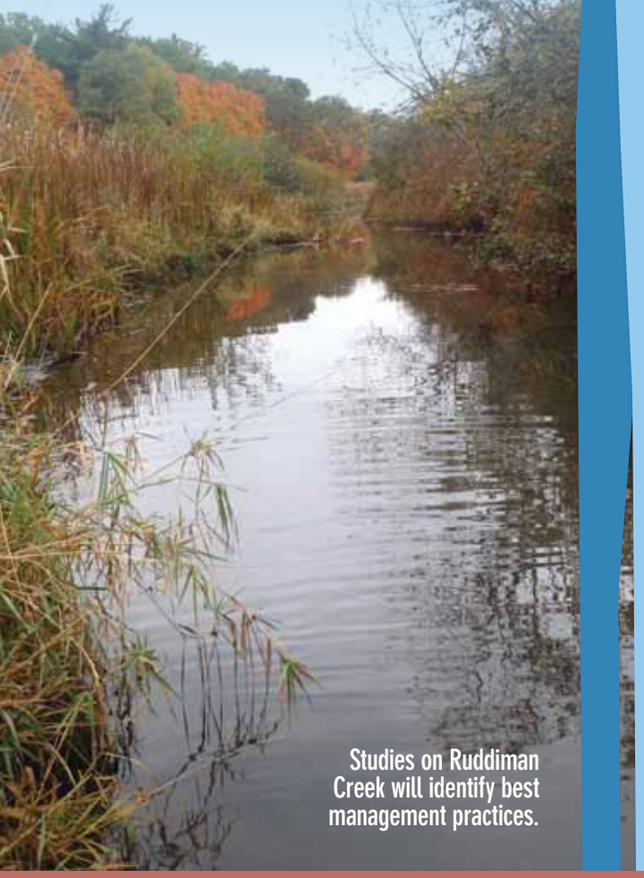
Undergraduate student Andrea Koster retrieving tiles in Pentwater
Lake, in an effort to assess zebra and quagga mussel populations.

Graduate students Jordan Allison (right) and William Keiper participated in the
2010 spring walleye egg take conducted by the Michigan Department of Natural
Resources and Environment along the Muskegon River.

Post-doctoral researcher Yakuta Bhagat on a dive to collect zebra and quagga
mussels at Pentwater pier along Lake Michigan.

Intern Amanda Maycroft and lab technician Amanda Syers releasing
salmon raised in the classroom at AWRI.

AWRI Researchers at the Forefront of Great Lakes Restoration



Studies on Ruddiman Creek will identify best management practices.

In November 2009, the U.S. Environmental Protection Agency announced that approximately $160 million would be available through competitive grants, as part of the Great Lakes Restoration Initiative. Only 270 of the more than 1,000 proposals that EPA received in response to their announcement were invited to submit final applications. Of those 270 finalists, researchers at AWRI received nearly $1.4 million in funding through four projects.

Alan Steinman, director of AWRI, said: "Given how competitive the funding was for these grants, the success of AWRI is truly impressive. The outcomes from these projects will help in the protection and restoration of the Great Lakes, as well as help educate the public about critical problems facing the Great Lakes. Ultimately, our goal is to make sure these findings translate into solutions."

The projects include:

- An observatory for ecosystem changes in Muskegon Lake ($568,449). This buoy-based system will establish a long-term, multi-sensor observatory in Muskegon Lake to track physical, chemical and biological changes taking place in real-time. Principal Investigator: Dr. Bopi Biddanda.
- Coordinated lake-specific onboard education and outreach ($291,721). This project is a collaboration between AWRI, MSU's Sea Grant Extension Program, Inland Seas Education Association, and BaySail to deliver onboard educational experiences for the general public, public officials, educators, and K-12 students in areas of Lake Michigan, Lake Huron, Lake Erie, Lake St. Clair, and the Detroit River. Principal Investigator: Dr. Janet Vail.
- Studies to support Ruddiman Creek implementation-ready TMDL ($247,212). An integrated assessment approach will be used to study hydrology and sediment transport within the Ruddiman Creek watershed, and select appropriate best management practices to reduce storm flow volume, velocity and sediment loads. Principal Investigator: Dr. Alan Steinman.
- Implementing Great Lakes coastal wetland monitoring ($232,910). Great Lakes coastal wetlands will be monitored, including fish, invertebrate, bird, amphibian, and plant communities, along with water quality variables, over 5 years. Co-Principal Investigator: Dr. Carl Ruetz.

Monitoring buoys will track changes in Muskegon Lake.

The *W.G. Jackson* will be a part of coordinated education across the Great Lakes.

Coastal wetlands will be monitored for 5 years.

Dr. Janet Vail (second from left) received the lifelong environmental education achievement award from the leadership team of the Michigan Alliance for Environmental and Outdoor Education (MAEOE) at the MAEOE conference at the University of Michigan Biological Station. Congratulations, Janet!

Pacific Salmon Transport Pollutants to Streams

AWRI researchers Richard Rediske, James O'Keefe, and Brian Scull, and students Elizabeth Tromp and Autumn Trombka recently completed a two-year research project with investigators from the University of Notre Dame and Lake Superior State University. The study, funded by the Great Lakes Fisheries Trust, examined the role that Pacific salmon play in the transport of PCBs into trout streams within the Lake Michigan, Superior, and Huron basins. The results were dramatic: in all Great Lakes basins studied, the PCB concentrations in the native fish species were significantly greater–up to 50X–in areas accessible by salmon compared to areas where salmon migration was blocked (e.g., by dams). While salmon is an important economic fishery in the Great Lakes, this research shows that their migration into coastal streams has a significant impact on the levels of PCBs found in native fish populations. Hence, the removal of dams may have negative ecological impacts with respect to upstream contaminant transfer, in contrast to the positive impact of restoring the stream's natural flow regime.

Graduate student Elizabeth Tromp grinds fish for PCB analysis.

What does it all mean?

Analyzing 7 years of fish data from Muskegon Lake

Seven of years of monitoring a water body can provide a wealth of information. It presents a great opportunity to explore patterns that are meaningful for biologists and resource managers, and draw conclusions about the future of the system under investigation.

This was the challenge that awaited post-doctoral researcher Dr. Yakuta Bhagat when she joined AWRI. The Muskegon Lake Long-Term Monitoring Project was spearheaded in 2003 in an effort to better understand short- and long-term ecological dynamics in the lake. As part of this project, Dr. Carl Ruetz's laboratory has sampled the fish community at four locations along the shoreline of the lake from 2003 to the present.

Drs. Bhagat and Ruetz found patterns of seasonal variation in the fish community that indicated local migratory patterns influenced by changes in weather. The surprising finding, however, was that no annual (or year-to-year) variation appeared in the community over the course of the 7-year study. Interestingly, fine-scale spatial variation in the community was detected, which is a pattern more typical of rivers than lakes.

These results point to broader implications for what is presently known about drowned-river mouth systems, like Muskegon Lake. On one hand, these unique water bodies have characteristics that resemble lakes; however, their direct connectivity to a major river (e.g., Muskegon River) and a Great Lake (e.g., Lake Michigan), results in a fish community and environmental conditions that resemble both lakes and rivers. Over the long term, observations from this study will provide valuable information on changes in the fish community along the Muskegon Lake shoreline.

The Muskegon Lake Long-Term Monitoring Project is directed by Dr. Alan Steinman and funded in part by the William G. Jackson Muskegon Lake Research Endowment Fund, administered by the Community Foundation for Muskegon County (CFFMC).

Dr. Bhagat and student intern Andrea Koster set a fyke net in Muskegon Lake, as part of the Muskegon Lake Long-Term Monitoring Project.

Travis Ellens counts and measures fish caught in a fyke net

New Office Coordinator at AWRI

Paula Wicklund joined the AWRI administrative support staff in June this year. She is our new Office Coordinator, the position formerly held by Heidi Feldpausch. Paula is a Muskegon native and previously worked in the GVSU College of Liberal Arts and Sciences (CLAS) Dean's office. Welcome, Paula!

Study Links Water Level Change and Nutrient Release

Al Steinman and Matt Cooper (University of Notre Dame) collect a sediment core from an upland area at Lake Macatawa.

Al Steinman at Lake Macatawa, collecting water for re-wetting cores.

Maggie Weinert prepares sediment cores for incubation in our mesocosm facility.

Coastal wetlands are unique and valuable components of the Great Lakes ecosystem because they provide critical habitat for fish and wildlife, help provide flood control, and also filter nutrients from polluted runoff. And they do all of this for free. Unfortunately, they are under attack due to development, pollution, and human desire to create stable water levels. Fluctuating water levels (both high and low) are part of the natural cycle for these wetlands, and these fluctuations are critical for coastal wetlands to function well.

Al Steinman is on a team of Great Lakes researchers working on the International Joint Commission's Upper Great Lakes Water Level Study. Steinman's role is to investigate the effects of lake level change on nutrient release from coastal wetland sediments. His lab simulated lake level drawdown and recovery by drying and re-wetting sediment cores, and measured the resulting nutrient concentrations in the overlying water. "We found that when previously dry areas were inundated, they released significantly more phosphorus than areas below the water line. This nutrient release can be a critical factor helping to drive productivity in these systems. Clearly, changes in water levels impact the way these wetlands function," said Steinman. This information will be used to help inform decision-making regarding the regulation of water levels in the upper Great Lakes.

Concerns over Harmful Algal Blooms Prompt Studies

Harmful algal blooms (HABs), usually formed by cyanobacteria – or blue-green algae – during the warm summer months, are on the rise across the Great Lakes basin. Cultural eutrophication, global climate change, and selective feeding by invasive mussels have all been implicated in the increased formation of HABs. Richard Rediske, Jim O'Keefe, Liqiang Xie, and Brian Scull conducted research to better understand various aspects of HABs, including:

- The effects of algicide application on the release of cyanobacteria toxins, with Public Health-Muskegon County.
- A specialized method for the measurement of anatoxin as part of the Target Inquiry Program. Matt LeaTrea, a Chemistry teacher at Montague High School, and Jim O'Keefe collaborated on this effort.
- Cyanobacteria toxins at Lake Erie water intakes and the calibration of satellite images for the detection of HABs, with the National Oceanic and Atmospheric Administration (NOAA).
- Water quality factors influencing HABs in Bear and Muskegon Lakes and the bioaccumulation of toxins in fish.

Algal bloom on Mona Lake.

Researchers Brian Scull and Liqiang Xie prepare samples from Bear and Muskegon Lakes for cyanobacteria analysis.

Algal bloom in a cup, taken from Mona Lake.

AWRI Faculty and Staff


Photo: Kurt Thompson

Director:
Alan Steinman

Staff/Administrative:
Tonya Brown, AWRI Assistant
Heidi Feldpausch, Office Coordinator (through 4/2010)
Anna Sears, Part-time Clerical
Roxana Taylor, Secretary
Paula Wicklund, Office Coordinator (6/2010 onward)

Facilities/Maintenance:
Roger Hillstead, Maintenance

Information Services Center:
John Koches, Associate Research Scientist
Nichol De Mol, Research Assistant
Rod Denning, Research Associate
Betty Gajewski, Technical Call-in
Brian Hanson, Research Assistant
Jon VanderMolen, Technical Call-in

Outreach & Education:
Janet Vail, Associate Research Scientist
Paula Capizzi, Science Instructor
Paul Carlson, Science Instructor
Bonnie Cowles, Science Instructor
Leslie De Vries, Science Instructor
John Gort, Science Instructor
Shirley McIntire, Science Instructor
Michele Smith, Science Instructor
Amanda Syers, Technical Call-in
Chuck Vanderlaan, Science Instructor
Diane Veneklasen, Science Instructor

GVSU Vessels/Field Station Operations:
Anthony Fiore, Jr., Fleet Captain
Ronald Brown, Captain WGJ
Dave Fisher, Marine Engineer WGJ
Robert Marx, Deckhand WGJ
Brad Nieboer, Marine Electrician
Robert Pennell, Deckhand DJA
Jim Rahe, Deckhand WGJ
George Thibault, Deckhand DJA
Jim Winks, Captain DJA

Ecological Research, Environmental Chemistry:
Richard Rediske, Professor
Liqiang Xie, Post-doctoral Researcher
Eric Fahnenstiel, Technical Call-in
Matt LeaTrea, Project Inquiry Teacher, Montague Schools
Jim O'Keefe, Research Associate
Brian Scull, Research Assistant

Ecological Research, Environmental Biology:
Bopaiah Biddanda, Associate Professor
Scott Kendall, Adjunct Research Assistant
Mark Luttenton, Professor of Biology
Jim McNair, Associate Professor
Anusha Sunkara, Technical Call-in
Carl Ruetz III, Associate Professor
Yakuta Bhagat, Post-doctoral Researcher
Travis Ellens, Technical Call-in
Brandon Harris, Technical Call-in
Alan Steinman, Professor
Nadia Gillett, Post-doctoral Researcher
Carrie Hause, Technical Call-in
Elaine Sterrett Isely, Adjunct Research Associate
Mary Ogdahl, Research Assistant
Kurt Thompson, Research Associate
Maggie Weinert, Technical Call-in
Ryan Thum, Assistant Professor
Dustin Wcisel, Adjunct Research Assistant

Graduate Students:
Jordan Allison, AWRI Assistantship (major advisor: Carl Ruetz)
Matt Altenritter, AWRI Assistantship (major advisor: Carl Ruetz)
Melissa Conte (major advisor: Mark Luttenton)
Angela Defore, AWRI Assistantship (major advisor: Bopi Biddanda)
Deb Dila, AWRI Assistantship (major advisor: Bopi Biddanda)
Travis Foster (major advisor: Mark Luttenton)
Tiffany Harrington (Cell & Molecular Biology intern with Ryan Thum)
Nicole Horne, AWRI Assistantship (major advisor: Bopi Biddanda)
Kelli Johnson, AWRI Assistantship (major advisor: Al Steinman)
William Keiper, AWRI Assistantship (major advisor: Carl Ruetz)
Elizabeth LaRue, AWRI Assistantship (major advisor: Ryan Thum)
Aileen Leinenbach, visiting graduate student from Germany (with Janet Vail)
Whitney Nelson, AWRI Assistantship (major advisor: Al Steinman)
Jeremy Newton (Cell & Molecular Biology intern with Ryan Thum)
Amanda (Oracz) Potter, AWRI Assistantship (major advisor: Rick Rediske)
Stephanie Sherburn (major advisor: Ryan Thum)
Andrew Sisson, AWRI Assistantship (major advisor: Rick Rediske)
Neal Swanson (major advisor: Mark Luttenton)
Hannah Tavalire, AWRI Assistantship (major advisor: Ryan Thum)
Elizabeth (Hannah) Tromp, AWRI Assistantship (major advisor: Rick Rediske)
Beth Walker (major advisor: Mark Luttenton)
Alex Wieten, AWRI Assistantship (major advisor: Carl Ruetz)
Matt Zuellig, AWRI Assistantship (major advisor: Ryan Thum)

Undergraduate Student Assistants:
Travis Bisson
Sara Damm
Kaitlyn Driza
Heather Hayward
Caleb James
Amanda Mercer
Carson Prichard
Heather Schellie
Meagan Sesselmann, volunteer (Purdue University)
Alex Wieten

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

Internships & Scholarships

AWRI provides opportunities for students to pursue their interests in our environment. The following students received internships during 2010.

D. J. Angus-Scientech Educational Foundation Interns:
Kate Coveney
Aaron Ferguson
Patricia Phillips

Herbert VanderMey Intern:
Kaitlyn Driza

Robert B. Annis Foundation Interns:
Andrea Koster
Amanda Maycroft
Lee Schoen

Bill and Diana Wipperfurth Scholarship:
Aaron Koch

AWRI Peer Reviewed Publications 2010

(AWRI staff in Bold)

Allen, M.R., **Thum, R.A.** and Caceres, C.E. 2010. Does local adaptation to resources explain genetic differentiation among *Daphnia* populations? Molecular Ecology 19(15): 3076–3087.

Isely, E.S., Isely, P., Seedang, S., Mulder, K., **Thompson, K.** and **Steinman, A.D.** 2010. Addressing the information gaps associated with valuing green infrastructure in west Michigan: INtegrated Valuation of Ecosystem Services Tool (INVEST). Journal of Great Lakes Research 36(3): 448-457.

Jude, D.J., **Rediske, R., O'Keefe, J.**, Hensler, S. and Giesy, J.P. 2010. PCB concentrations in walleyes and their prey from the Saginaw River, Lake Huron: A comparison between 1990 and 2007. Journal of Great Lakes Research 36(2): 267-276.

LaRue, E.A., Ruetz, C.R., Stacey, M.B. and **Thum, R.** In Press. Population genetic structure of the round goby in Lake Michigan: implications for dispersal of invasive species. Hydrobiologia.

Nold, S.C., Zajack, H.A. and **Biddanda, B.A.** 2010. Archaeal and eukaryal diversity in a submerged sinkhole ecosystem influenced by sulfur-rich, hypoxic groundwater. Journal of Great Lakes Research 36(2): 366-375.

Nold, S.C., Pangborn, J.P., Zajack, H., **Kendall, S.**, **Rediske, R.** and **Biddanda, B.A.** 2010. Benthic bacterial diversity in submerged sinkhole ecosystems. Applied and Environmental Microbiology 76(1): 347-351.

Ogdahl, M.E., Lougheed, V.L., Stevenson, R.J. and **Steinman, A.D.** 2010. Influences of multi-scale habitat on metabolism in a coastal Great Lakes watershed. Ecosystems 13(2): 222-238.

Ruetz, C.R., III. In press. Poster and oral presentations at professional meetings. *In* Scientific Communication for Natural Resource Professionals. C.A. Jennings, T.E. Lauer and B. Vondracek, editors. American Fisheries Society, Bethesda, Maryland.

Sanders, T.G., Jr., **Biddanda, B.A.**, Stricker, C.A. and Nold, S.C. In Press. Stable isotope analysis reveals benthic macroinvertebrate and fish communities linked to submerged groundwater vents in Lake Huron. Aquatic Biology.

Silver, P., **Steinman, A.D.** and Polls, I. 2010. The role of a discipline-specific scientific journal in scientific discovery. Journal of the North American Benthological Society 29(1): 1-11.

Steinman, A.D. In Press. Environment. Pages 205-214. In: Leadership in nonprofit organizations: A reference handbook (Ed. K. A. Agard). Sage Publ., Los Angeles, CA.

Steinman, A.D., Nicholas, J.R., Seelbach, P., Allan, J. and Ruswick, F. In Press. Science as a fundamental framework for shaping policy discussions regarding the use of groundwater in the State of Michigan: a case study. Water Policy DOI:10.2166/wp.2010.047.

Steinman, A.D., **Ogdahl, M.E.** and **Ruetz, C.R., III**. In Press. An environmental assessment of a small, shallow lake (Little Black Lake, MI) threatened by urbanization. Environmental Monitoring and Assessment DOI:10.1007/s10661-010-1381-z.

Steinman, A.D., Silver, P., Fisher, S.G. and Meyer, J.L. 2010. The *J-NABS* 25th year anniversary issue: reflecting on the past, synthesizing the present and projecting in the future. Journal of the North American Benthological Society 29(1): 372-380.

Thum, R.A. and Lennon, J.T. 2010. Comparative ecological niche models predict the invasive spread of variable-leaf milfoil (*Myriophyllum heterophyllum*) and its potential impact on closely related native species. Biological Invasions 12:133-143.

Thum, R.A., **Zuellig, M.P.**, Johnson, R.L., Moody, M.L. and Vossbrinck, C. In Press. Molecular markers reconstruct the invasion history of variable leaf watermilfoil (*Myriophyllum heterophyllum*) and distinguish it from closely related species. Biological Invasions.

Wiley, M.J., Hyndman, D.W., Pijanowski, B.C., Kendall, A.D., Riseng, C., Rutherford, E.S., Cheng, S.T., Carlson, M.L., Tyler, J.A., Stevenson, R.J., Steen, P.J., Richards, P.L., Seelbach, P.W., **Koches, J.K.**, **Rediske, R.R.** 2010. A multi-modeling approach to evaluating climate and land use change impacts in a Great Lakes River Basin. Hydrobiologia 657(1): 243-262.

AWRI Technical Reports/Manuals and Non-Peer Reviewed 2010

(AWRI Staff in Bold)

Biddanda, B. Freshwater Futures in a Changing World. Interchange, Magazine of the Regional Math and Science Center, Grand Valley State University, Spring 2010. http://www.gvsu.edu/rmsc/interchange/2010-april-science-and-math-update-423.htm

De Mol, N. 2010. Baseline study on Fremont Lake and its connecting waterways. MR-2010-1.

Denning, R. 2010. Landscape level functional wetlands assessment Lower Grand River Watershed. Rod Denning. MR-2010-2.

Koches, J., B. Gajewski, and **J. VanderMolen**. 2010. Lower Grand River Watershed wetland initiative: base knowledge survey for Spring Lake Watershed. MR-2010-3.

Steinman, A.D. and **M. Ogdahl**. 2010. Flooded muck fields as a source of phosphorus to Mona Lake. Final Project Report. Submitted to Michigan Department of Natural Resources and Environment.

Vail, J. 2010. Research Vessel D. J. Angus Use Report 2009. CR-2010-1.

Vail, J. 2010. Research Vessel W. G. Jackson Use Report 2009. CR-2010-2.

VanderMolen, J., **N. De Mol**, **A. Ferguson** and **J. Koches**. 2010. Recommendations for a west Michigan water quality index. MR-2010-4.

Photo: Brian Scull

More about AWRI

If you would like more information about AWRI's programs, please contact us:

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Help us save a tree.

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

Giving opportunities to support the operations of the Annis Water Resources Institute are available at the Community Foundation for Muskegon County (www.cffmc.org) or at the GVSU Office of Development (www.gvsu.edu/development).

Photo: Brian Scull