R.B. ANNIS WATER RESOURCES INSTITUTE

2009 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 Geographic Information System 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.

GRAND VALLEY STATE UNIVERSITY

Remembering 2009 and Ramping up for Restoration in 2010

table of contents

A Message from our DIRECTOR DR. ALAN STEINMAN

As I reflect back on 2009, I am thrilled at what AWRI has accomplished in the past year. Simultaneously, my reflections forward to 2010 fill me with both excitement and a bit of trepidation.

AWRI achieved several major successes in 2009. After several years of effort, the GVSU Board of Trustees approved AWRI's request to become an official academic unit. This may seem like meaningless academic jargon to many of you, but it finally allows the principal investigators at AWRI to become regular faculty and eligible for tenure. Not only will this help us with faculty retention and recruitment, it signifies that we are viewed as equals with our faculty peers on main campus.

AWRI faculty and staff continue to be successful in obtaining grants and contracts. These dollars allow us to hire more staff and students, provide economic return to the community, and solidify our reputation. Of particular note are the grants obtained from the National Science Foundation (by Ryan Thum) and the National Oceanic and Atmospheric Administration (by Bopi Biddanda, Al Steinman, and Carl Ruetz), as there is fierce competition for these federal grants. In addition, we were awarded funds from state agencies, foundations, and private donors, resulting in almost 2 million dollars in new grants and contracts in 2009. All of our faculty and principal investigators are well-funded, providing educational and training opportunities for students and staff.

This upcoming year brings with it new challenges and spectacular opportunities. Clearly, we must continue our long record of fiscal responsibility, as state funding for higher education becomes tighter and tighter. AWRI has ably met this challenge in the past, with conservative spending, wise use of our resources, and record success in securing new grants and contracts. Despite these fiscal challenges, 2010 brings with it new opportunities. First, we will be welcoming the arrival of Yakuta Bhagat from Trent University in Canada, who is a new postdoctoral research associate. Thanks to the generosity of an anonymous donor, Yakuta will be working on the impacts caused by invasive fish species in local lakes. Second, the Great Lakes Restoration Initiative will become a reality in 2010, with hundreds of millions of dollars available for ecosystem restoration of the Great Lakes. The Annis Water Resources Institute is wonderfully positioned to be a major part of this initiative. Finally, we continue to identify and address our infrastructure needs at AWRI. A major goal for the next few years is to retrofit our field station so that it can accommodate our continuing growth.

We thank all our readers and supporters for their interest and contributions. Please feel free to contact me if you wish to discuss any of the issues mentioned above or found throughout this Year in Review.

How do we measure "Quality of Life"?

To access WMSA's Vital Signs Regional Indicator Report, visit www.wm-alliance.org.

Since 2006, researchers at AWRI have been working with stakeholders throughout West Michigan to answer this question as part of a Regional Indicators Project for the West Michigan Strategic Alliance (WMSA). A significant outcome of this process was the creation of the annual report titled *Vital Signs*. WMSA's *Vital Signs* report contains social, economic and environmental indicators designed to increase awareness and enhance understanding of issues affecting West Michigan. Besides tracking trends, *Vital Signs* examines how West Michigan compares with 26 other similar regions around the United States.

"This (report) helps us know more specifically where we are doing well and where we need to focus more efforts at addressing gaps relative to other regions," said Greg Northrup, WMSA President. "We certainly have much to be proud of, but this report also challenges us to do better."

Great Lakes water levels:
too high, too low or just right?

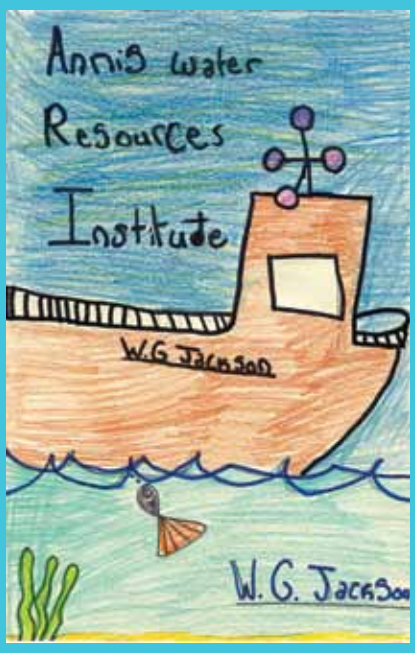
One of the most contentious issues facing the Great Lakes is water levels. Low water levels over the past few years prompted the International Joint Comamission (IJC) to fund a major study investigating what controls the water levels of the Great Lakes. The IJC selected the Lake Michigan Center (home of AWRI) as a "hub" location to present the initial findings of the Study to interested citizens in June, 2009. Al Steinman, AWRI Director, is part of this study, serving on both its Public Interest Advisory Group and its Ecosystem Technical Work Group. More details about the Study and the IJC can be found at: **www.iugls.org**

A Tribute to Bill Jackson

The lakes in our area, Grand Valley State University, and the Annis Water Resources Institute all lost a friend, visionary, and supporter on October 7, 2009, when Dr. William (Bill) G. Jackson passed away. Bill was much more than a friend to us—he also was a partner with respect to education, research, and environmental stewardship. His fight for clean water, long before it was fashionable to be "green", took courage, integrity, and passion—three qualities Bill certainly had in ample supply. It was his fight for environmental restoration and protection that laid the foundation for Muskegon's future. Perhaps his most endearing quality, though, was his humility. Bill and Kay, his wonderful wife of 66 years, never sought credit or attention for all their accomplishments and philanthropy; indeed, they usually shied away from them.

Bill also was generous, extremely generous. We are proud and privileged that Bill's legacy will live on at the Annis Water Resources Institute in tangible ways through our vessel, the *W.G. Jackson*, and through the endowment fund that is named in his honor, which helps fund the long-term monitoring of Muskegon Lake. But we also will remember Bill through his memory, smile, optimism, and courage. The community, GVSU, and AWRI all shine a little less brightly with the passing of Bill Jackson.

Many K-12 students express their appreciation for their experiences on the *W.G. Jackson* or the *D.J. Angus* through art and thank you notes. For instance, a student remarked "I want to thank you for a great time on the science boat. I learned a lot about science and I might even want to do what you do for a job!"



The walleye is a species enjoyed by many anglers. However, Muskegon River's walleye population has low natural reproduction and is primarily sustained through stocking. Jordan Allison—a graduate student advised by Dr. Carl Ruetz—is conducting field research to identify possible causes of this low natural reproduction in the Muskegon River. Several aspects of the walleye's reproductive cycle are being studied, including quantifying the deposition and survival of eggs in the river bottom, as well as the number of recently hatched drifting walleye in the river. Information gained from this research will aid in the restoration of natural reproduction of walleye in the Muskegon River. Jordan completed his first year of field sampling in 2009 and plans to complete his research in 2010. This project is in collaboration with Dr. Ed Rutherford at the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory and is funded by the Michigan Department of Natural Resources.

Restoration Affects Walleye in Saginaw Bay

Saginaw Bay is one of the 43 most heavily impacted locations in the Great Lakes, earning it a spot on the U.S. Environmental Protection Agency's (EPA) Great Lakes Area of Concern (AOC) list (just like Muskegon Lake and White Lake). This designation came, in part, from contaminated sediments in the Bay. Ongoing restoration activities in the Saginaw Bay AOC have included the removal of sediments contaminated with polychlorinated biphenyls (PCBs) from areas in the lower Saginaw River.

AWRI researchers Dr. Richard Rediske and James O'Keefe, along with scientists from the University of Michigan and the United States Geological Survey (USGS), studied how the sediment removal affected PCB concentration in Saginaw Bay walleye. The team of researchers measured PCB concentrations in multiple size classes of walleye and their food web, and compared their results to a previous study conducted before sediment remediation.

Following sediment removal, average PCB concentrations in walleye decreased by 65%. Similar contaminant reductions in prey fish also were noted. A strong gender difference was present in adult walleye as PCBs levels were nearly 3 times higher in males than in females, both before and after remediation. Habitat differences were thought to cause the gender difference, as male walleye spend more time in the Saginaw River while females spend more of their life cycle in the Bay.

Polychlorinated biphenyls (PCBs) are organic compounds that, due to their toxicity and classification as a pollutant, are no longer produced in the United States.

This project can serve as a model for monitoring the effects of sediment remediation on contaminant levels in fish. The use of spawning aggregations of walleye and male/female ratios provides a powerful tool to evaluate the effects of sediment removal in rivers on their discharge basins. The significant reduction in the levels of PCBs in sediments and living organisms is a critical component of habitat restoration for the Saginaw Bay AOC.

Hybridization
the secret to success for invasive plants?

It is no secret - especially in the Great Lakes region - that invasive species have a negative impact on our environment, economy, and recreation. A great deal of effort goes into trying to stop the spread of invasive species. However, very little is known about how human efforts to control invasive species may impact their evolution - and success - as invaders.

Some species have the ability to rapidly evolve in response to human efforts to control their growth. A species with high genetic variation is more likely to have this adaptability. Recent studies reveal that many invasive species have great genetic diversity, which may play an important role in explaining their success as invaders. In the case of invasive aquatic plants, herbicides used to control their growth may become ineffective as the invaders develop tolerance to the chemicals.

One mechanism invasive species may use to quickly increase genetic variation is hybridization with native species. Genetic studies have shown that hybridization may be quite common in invasive species, especially plants. However, the extent to which hybridization is important in invasions is not well understood. Two graduate students in the Thum lab are studying how hybridization might influence the evolution of aquatic plant invaders.

Hannah Tavalire is conducting ecological experiments that compare the degree of invasiveness between hybrid and non-hybrid genotypes of variable-leaf watermilfoil *(Myriophyllum heterophyllum)*, a species that is native to much of the US, but is non-native and invasive in the northeastern US. Hannah's research represents one of only a very small handful of experimental studies of this kind.

Matthew Zuellig is using molecular genetic tools to study the amount of genetic diversity in invasive populations of Eurasian watermilfoil *(Myriophyllum spicatum)* that have hybridized with our native northern watermilfoil *(Myriophyllum sibericum)*. His research also explores the relationship of herbicide tolerance in invasive populations with the occurrence of hybrid watermilfoil populations.

New Researcher Joins AWRI

AWRI and GVSU welcome Dr. James McNair as a new principal investigator! Jim's expertise in modeling and quantitative ecology is a valuable resource and we look forward to the new collaborations, research activities, and courses he brings.

AWRI and GVSU Host International Conference in Grand Rapids

The Annis Water Resources Institute was the proud host of the 2009 Annual Meeting of the North American Benthological Society (NABS) in Grand Rapids, MI. NABS is an international society whose purpose is to promote better understanding of the living communities of lake and stream bottoms, and their roles in aquatic ecosystems. Given the tremendous diversity of lakes, streams, and wetlands in west Michigan, and all the work that AWRI does in these systems, we were a perfect match for NABS. The event was held at the Amway Grand on May 16th – 22nd.

AWRI Green Meeting Strategy:

- **Carbon offsets: NABS attendees contributed over $1,000 that is being donated to the City of Grand Rapids for planting trees in Riverside Park**
- **Promoting the re-use of tote bags**
- **Providing reusable water bottles in lieu of bottled water**
- **Meeting program and notepads printed on 100% recycled paper**

The theme of the conference was "Climate Change: Interfacing Science, Sustainability, and Aquatics". There was a "green meeting initiative", which included the Amway Grand's Stay Green program (energy-efficient lighting, water and heat conservation practices, waste reduction practices, comprehensive recycling, composting all protein-based materials), as well as several actions implemented by the organizing committees at AWRI. A total of 873 people attended the Conference, from 17 countries (Australia, Canada, Czech Republic, Finland, Germany, Great Britain, Italy, Japan, Netherlands, New Zealand, Portugal, Puerto Rico, Russia, Spain, Switzerland, United Kingdom, United States) and 49 states within the US. During the conference, over 600 scientific presentations were given.

Dr. Paul Ehrlich, of Stanford University, kicked off the conference as the featured plenary speaker.

Mayfly experts held a taxonomy workshop during the conference.

Hosting the conference was a fantastic way to increase the visibility of AWRI, GVSU, and west Michigan. We are indebted to the numerous faculty, staff, students, and sponsors who made this event possible. While limited space prohibits listing all these people, special thanks are extended to Mark Luttenton (local arrangements chair), Kurt Thompson (audio/visual consultant), Mary Ogdahl (local arrangements/program assistant), and Al Steinman (program chair).

Graduate Students Study Michigan's Most ANCIENT FISH

Melissa Conte, AWRI graduate student, is investigating trout as predators on young sturgeon.

When Europeans arrived in the upper Great Lakes region, the lake sturgeon was abundant throughout the basin. Reports of large numbers of spawning sturgeon filling streams are recorded in diaries left by early settlers. But loss of habitat and overharvesting has reduced lake sturgeon populations to dangerously low numbers. The lake sturgeon is now considered a threatened species in Michigan. Subsequently, state, federal, and tribal agencies have focused considerable resources on restoration of lake sturgeon habitat in an effort to facilitate spawning and rebuild populations. Two graduate students at AWRI are conducting research to aid in the sturgeon restoration effort.

Matt Altenritter, a graduate student working with Dr. Carl Ruetz, is collaborating with the Michigan Department of Natural Resources on a project in Muskegon Lake. Adult sturgeon are present in the spring as they prepare to migrate up the river to spawn. However, little is known about juvenile lake sturgeon, particularly related to their use of Muskegon Lake as a nursery habitat.

Matt hopes to unravel the many mysteries related to juvenile lake sturgeon. He is capturing juvenile lake sturgeon in Muskegon Lake and implanting them with miniature transmitters to track their movements. The fish that have been tracked so far generally prefer sand/silt substrate and use both shallow and deep-water habitats. Juveniles are capable of moving long distances over short periods of time with one individual moving more than 1.2 miles in a day. Movement patterns also may change seasonally, with the onset of colder water temperatures prompting juveniles to move to deeper water.

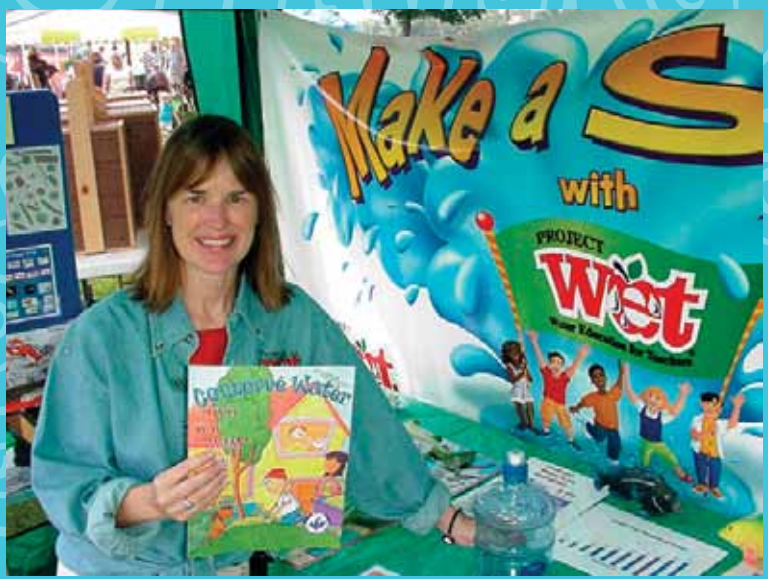
Adult sturgeon migrate up the Muskegon River to spawn.

Matt Altenritter, AWRI graduate student, is tracking the movements of juvenile sturgeon.

Melissa Conte, a graduate student working with Dr. Mark Luttenton, is collaborating with fishery biologists from the Little River Band of Ottawa Indians on a project in the Big Manistee River, which supports one of the remaining lake sturgeon populations. Restoration efforts there have had limited success, leading fishery managers to look for possible answers why.

To answer that question, Melissa is looking at the most vulnerable stage of the sturgeon life cycle, the larvae. Because they have little swimming ability, the larvae are swept along in the current. Like many other small drifting organisms the larvae become an easy meal for a host of predators, including trout. There are a lot of trout in the Big Manistee River. Melissa's thesis work focuses specifically on the question, do trout consume sturgeon larvae, and if so, does trout predation present a significant risk to sturgeon populations?

Melissa and Matt's work will add an important element to the way managers approach sturgeon restoration projects and be significant in restoring Michigan's largest, and most ancient fish.



Janet Vail was awarded the 2009 GVSU Service to Community Award for going above and beyond her professional responsibilities in contributing her expertise and service to the community. Her award is a reflection of her dedication to environmental outreach and education activities, such as coordinating Michigan Project WET (Water Education for Teachers).

Diver working against a background of purple and white colored microbial mats in sinkhole.

Diving

What is a sinkhole? We are familiar with aboveground sinkholes, but underwater sinkholes in the Great Lakes are a new and exciting discovery. When water dissolves part of an ancient underlying seabed, a submerged sinkhole is created.

Master's Thesis Duly Recognized

Matt Cooper, former graduate student of Al Steinman and Don Uzarski (now at CMU), keeps piling up awards! In 2009, Matt received both the Graduate Dean's Citation for Academic Excellence for Outstanding Master's Thesis and the Outstanding Student in Biology at Grand Valley State University. The quality of his Master's thesis was further reflected in being GVSU's nominee for the Midwest Association of Graduate Schools 2010 Distinguished Thesis Award. Matt is now a Ph.D. candidate at the University of Notre Dame. Congratulations, Matt!

into Great Lakes Sinkholes

One of the most surprising findings in the Great Lakes in the last decade was the discovery of sinkholes in Lake Huron. AWRI Researcher Dr. Bopi Biddanda, along with collaborating researchers and students, discovered such sinkholes and have been studying the little-known underwater habitats thriving in these peculiar geological formations.

Life in these sinkholes consists of brilliant purple mats of cyanobacteria (blue-green algae) and finger-like projections of other microbial life. The salty, sulfur-rich waters lack oxygen, which makes it a hostile environment to more familiar, larger-forms of organisms such as fish. Cyanobacteria thrive in the oxygen-depleted conditions because they are able to use sulfur as a source of energy, instead of light as typical plants do. These sinkhole communities are similar to those found in such diverse environments as Antarctic lakes and deep-sea vents.

This research, funded by the National Science Foundation and NOAA's Office of Ocean Exploration, has been described in the American Geophysical Union (AGU) publication, the world's largest organization of Earth and space scientists. These exciting discoveries have also been featured on the Discovery channel as well as in newspapers and radio.

Detailed diver image of green, purple and white microbial mats in a sinkhole.

Aerial photo of a sinkhole (~200 m diameter semi-circlular bowl) in coastal Lake Huron.

Graduate student T. Garry Sanders out catching fish to trace food web linkages in the vicinity of submerged sinkholes.

AWRI Faculty and Staff

Director:

Alan Steinman

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Tonya Brown, AWRI Assistant
Heidi Feldpausch, Office Coordinator
Lois Hennings, Part-time Clerical
Anna Sears, Part-time Clerical
Roxana Taylor, Secretary

Facilities/Maintenance:

Roger Hillstead, Maintenance

Information Services Center:

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Bonnie Cowles, Science Instructor
Leslie De Vries, Science Instructor
John Gort, Science Instructor
Shirley McIntire, Science Instructor
Keith Shell, Science Instructor
Michele Smith, Science Instructor
Amanda Syers, Technical Call-in
Chuck Vanderlaan, Science Instructor
Diane Veneklasen, Science Instructor
Elizabeth Wilgenburg, Science Instructor

GVSU Vessels/Field Station Operations:

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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
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John Fahnenstiel, Technical Call-in
Jim O'Keefe, Research Associate
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Scott Kendall, Technical Call-in
Mark Luttenton, Professor
Jim McNair, Associate Professor
Carl Ruetz III, Associate Professor
Travis Ellens, Technical Call-in
Nikki Koehler, Technical Call-in
Betsy Shafer, Technical Call-in
Alan Steinman, Professor
Matt Cooper, Adjunct Research Assistant
Elaine Sterrett Isely, Adjunct Research Associate
Mary Ogdahl, Research Assistant
Kurt Thompson, Research Associate
Maggie Weinert, Technical Call-in
Kelli Johnson, Technical Call-in
Ryan Thum, Assistant Professor
Dustin Wcisel, Adjunct Research Assistant

Postdoctoral Aquatic Ecologist:

Yakuta Bhagat

Graduate Students:

Jordan Allison, AWRI Assistantship (major advisor: Carl Ruetz)
Matt Altenritter, AWRI Assistantship (major advisor: Carl Ruetz)
Jessica Brinks (major advisor: Mark Luttenton)
Melissa Conte (major advisor: Mark Luttenton)
Matt Cooper, EPA STAR Grant Fellowship (major advisor: Al Steinman)
Angela Defore, AWRI Assistantship (major advisor: Bopi Biddanda)
Deb Dila, AWRI Assistantship (major advisor: Bopi Biddanda)
Elizabeth Hanna, AWRI Assistantship (major advisor: Rick Rediske)
Jessica Higgins, AWRI Assistantship (major advisor: Michael Chu/Rick Rediske)
Nicole Horne, Graduate Student
Kelli Johnson, AWRI Assistantship (major advisor: Al Steinman)
William Keiper, AWRI Assistantship (major advisor: Carl Ruetz)
Kristin Nelson, AWRI Assistantship (major advisor: Carl Ruetz)
Whitney Nelson, AWRI Assistantship (major advisor: Al Steinman)
Amanda Oracz Potter, AWRI Assistantship (major advisor: Rick Rediske)
Hannah Tavalire, AWRI Assistantship (major advisor: Ryan Thum)
Beth Walker, (major advisor: Mark Luttenton)
Weiyi Zhang, (major advisor: Rick Rediske)
Matt Zuellig, AWRI Assistantship (major advisor: Ryan Thum)

Undergraduate Student Assistants:

Kaitlyn Driza
Karen Ickes
Elizabeth LaRue
Carson Prichard
Heather Schellie
Michael (Ben) Stacey
Anthony Straley
Maggie Weinert
Alex Wieten

AWRI Science Advisory Board

Harvey Bootsma, Great Lakes WATER Institute, U 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 the environment. The following students received internships during 2009:

D. J. Angus-Scientech Educational Foundation Interns:

Anne Santa Maria
Anusha Sunkara
Autumn Trombka
Alex Wieten

Herbert VanderMey Intern:

Maggie Weinert

Robert B. Annis Internship:

Kaitlyn Driza
Aaron Ferguson
Maggie Weinert

Summer Student Scholar:

Elizabeth LaRue

Bill and Diana Wipperfurth Scholarship:

Elizabeth LaRue

Professional Science Masters:

Mimoza Grajqevci
Tiffany Harrington

2009 Publications

Peer Reviewed

(AWRI Staff in Bold)

Baskaran, M., P.W. Swarzenski, and **B.A. Biddanda**. 2009. Constraints on the utility of MnO2 cartridge method for the extraction of radionuclides: A case study using 234Th. Geochemistry, Geophysics, Geosystems 10, Q04011, doi:10.1029/2008GC002340.

Biddanda, B. A., S.C. Nold, S.A. Ruberg, **S.T. Kendall**, **T.G. Sanders**, and J.J. Gray. 2009. Great Lakes sinkholes: A microbiogeochemical frontier. Eos, Transactions American Geophysical Union 90: 61-62.

Biddanda, B. A., J.B. Cotner and T.H. Johengen. 2009. Toast to a lake brew. American Society of Limnology and Oceanography Bulletin 18(3): 76.

Breen, M.J., **C.R. Ruetz III**, **K.J. Thompson**, and S.L. Kohler. 2009. Movements of mottled sculpins in a Michigan stream: how restricted are they? Canadian Journal of Fisheries and Aquatic Sciences 66: 31-41.

Chu, X. and **A.D. Steinman**. 2009. Event and continuous hydrologic modeling with HEC-HMS. ASCE Journal of Irrigation and Drainage Engineering 135: 119-124.

Cooper, M.J., **R.R. Rediske**, D.G. Uzarski, and T.M. Burton. 2009. Sediment contamination and faunal communities in two subwatersheds of Mona Lake, Michigan. Journal of Environmental Quality 38: 1255-1265.

Cooper, M.J., **C.R. Ruetz III**, D.G. Uzarski, and **B.M. Shafer**. 2009. Habitat use and diets of round gobies in coastal areas of Lakes Michigan and Huron. Journal of Freshwater Ecology 24: 477-488.

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Gajewski, B.M. 2009. Best practices in protecting green infrastructure: Benchmarking county park systems. In: Sustaining Michigan: Metropolitan policies and strategies. Editors: R.W. Jelier and G. Sands. Michigan State University Press. East Lansing, MI

Isely, E.S. and V. Pebbles. 2009. U.S. Great Lakes policy and management: A comparative analysis of eight states' coastal and submerged lands programs and policies. Coastal Management 37(2):197-213.

Johnson, S.S., **M.R. Luttenton**, and A.G. Nikitin. 2009. Genetic variation at the mtDNA ND-1 locus among North American wild and hatchery brown trout (*Salmo trutta*). Journal of Great Lakes Research 35(1): 163-167.

McNair, J.N. 2009. Two new methods for predicting effects of landcover-related stressors on stream biotic integrity at the catchment scale. Proceedings of the Academy of Natural Sciences of Philadelphia 158: 61-88.

Madenjian, C.P., D.J. Jude, **R.R. Rediske**, **J.P. O'Keefe**, and G. E. Noguchi. 2009. Gender difference in walleye PCB concentration persists following remedial dredging. Journal of Great Lakes Research 35(3): 347-352.

Millie, D.F., G.L. Fahnenstiel, J. Dyble Bressie, R.J. Pigg, **R.R. Rediske**, D.M. Klarer, P.A. Tester, and R.W. Litaker. 2009. Late-summer phytoplankton in western Lake Erie (Laurentian Great Lakes): bloom distributions, toxicity, and environmental influences. Aquatic Ecology DOI 10.1007/s10452-009-9238-7:20 pp.

Nelson, K.D., **C.R. Ruetz III**, and D.G. Uzarski. 2009. Colonisation by *Dreissena* of Great Lakes coastal ecosystems: how suitable are wetlands? Freshwater Biology 54: 2290-2299.

Nold, S.C., J.P. Pangborn, H. Zajack, **S. Kendall**, **R. Rediske** and **B.A. Biddanda**. In Press. Benthic bacterial diversity in submerged sinkhole ecosystems. Applied and Environmental Microbiology.

Parker, A.D., C.A. Stepien, O.J. Sepulveda-Villet, C.B. Ruehl, and D.G. Uzarski. 2009. The interplay of morphology, habitat, resource use, and genetic relationships in young yellow perch. Transactions of the American Fisheries Society 138: 899-914.

Parker, A.D., D.G. Uzarski, **C.R. Ruetz III**, and T.M. Burton. 2009. Diets of yellow perch (*Perca flavescens*) in wetland habitats of Saginaw Bay, Lake Huron. Journal of Freshwater Ecology 24: 347-354.

Pope, J.E., **E.S. Isely** and F. Asamoa-Tutu. 2009. Developing a marketing strategy for nonprofit organizations: An exploratory study. Journal of Nonprofit & Public Sector Marketing 21: 184-201.

Ruberg, S.A., **S.T. Kendall**, **B.A. Biddanda**, T. Black, W. Lusardi, R. Green, T. Casserley, E. Smith, S. Nold, **T.G. Sanders**, G. Lang, and S. Constant. 2009. Observations of the Middle Island sinkhole in Lake Huron: a unique hydrologic and glacial creation of 400 million years. Marine Technology Society Journal 42: 12-21.

Ruetz, C.R., III, **D.L. Strouse**, and S.A. Pothoven. 2009. Energy density of introduced round gobies compared with four native fishes in a Lake Michigan tributary. Transactions of the American Fisheries Society 138: 938-947.

Steinman, A.D., X. Chu, and **M. Ogdahl**. 2009. Spatial and temporal variability of internal and external phosphorus loads in Mona Lake, Michigan. Aquatic Ecology 43: 1-18.

Steinman, A.D., **M. Ogdahl**, and **M. Luttenton**. 2009. An analysis of internal phosphorus loading in White Lake, Michigan. In: Lake Pollution research Progress. Editors: F.R. Miranda and L.M. Bernard. Pages 311-325. Nova Science Publishers. N.Y.

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Steinman, A.D., J.R. Nicholas, P. Seelbach, J. Allan, and F. Ruswick. In Press. The role of science in developing policy for the use of groundwater in the state of Michigan. Water Policy.

Silver, P., **A.D. Steinman**, and I. Polls. In Press. The role of a discipline-specific scientific journal in scientific discovery. Journal of the North American Benthological Society.

Steinman, A.D., P. Silver, S.G. Fisher, and J.L. Meyer. In press. The *J-NABS* 25th-year anniversary issue: reflecting on the past, synthesizing the present, and projecting into the future. Journal of the North American Benthological Society.

Thum, R.A. and J.T. Lennon. In Press. 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.

Uzarski, D.G., A.T. Bosch, and **M.J. Cooper**. 2009. Wetland ecology and management for fish, amphibians and reptiles. In: Encyclopedia of Inland Waters. Editor: G.E. Likens. Pages 582-589. Elsevier.

Uzarski, D.G., T.M. Burton, R.E. Kolar, and **M.J. Cooper**. 2009. The ecological impacts of fragmentation and vegetation removal in Lake Huron's coastal wetlands. Aquatic Ecosystem Health and Management. 12(1): 1-17.

Technical Reports/ Manuals and Non-Peer Reviewed

(AWRI Staff in Bold)

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