40th Annual Indiana Water Resources Association Symposium

Water and Health: Exploring Healthy Water for Human, Animal, and Environment

Hilltop Banquet Center, Oakwood Resort
1111 Conklin Hill Dr, Syracuse, IN 46567
June 26-28, 2019

Cosponsored by

INDIANA WATER RESOURCES RESEARCH CENTER

Applied Biochemists

40th Annual Indiana Water Resources Association Symposium

Water and Health: Exploring Healthy Water for Human, Animal, and Environment

Wednesday, June 26

Time	Topic	Speaker
12:00	**Registration**	Upper Hilltop
1:00	Opening and Welcome	Ginger Davis, Hamilton Co SWCD, 2019 IWRA President
1:05	Water, Diseases, and the Public's Health	Thomas J. Duszynski, Lecturer, IU
1:35	Current Efforts to Enhance Indiana's SWWF Program: Truly a "Feel Good" Story	Mark Basch (DNR), Allison Mann (DNR) & Jeff Frey (USGS)
2:00	The Hoosier Resilience Index: A Tool for Local Government	Janet McCabe, IU Environmental Resilience Institute
2:25	PFAS Characteristics, Fate and Effects on Amphibians	Linda Lee, Dept. of Agronomy, Purdue University
2:55	**Break**	Upper Hilltop
3:15	Developing a Practical Guide on Identifying Algae and Potentially Harmful Algal Blooms for Hoosiers	Kassia Groszewski, IDEM Watershed Assessment & Planning Branch
3:35	Blue-Green Algae Patterns and Prediction in 12 Lakes in Kosciusko County, Indiana	Nathan Bosch, Lilly Center for Lakes & Streams, Grace College
4:00	Wawasee Inlet Nutrient Study: A novel approach to lake ecosystem	Herb Manifold, Wawasee Area Conservancy Foundation
4:25	Design and Development of an Unmanned Underwater Sediment Sampling System	Jun Han Bae, PhD Student, Purdue University
4:50	Introduce Poster Presentations	1 minute each
5:00	**Social Hour / Poster Presentations / Cash Bar**	Lower Hilltop
6:30	**IWRA Banquet and Awards**	Lower Hilltop
	Poster Presentations:	Lower Hilltop
	Assessing the Effectiveness of Resident Water Quality Improvement Practice Adoption on Non-Point Source Pollution Across Urban-to-Rural Landscapes in NW Indiana	Jonathan Mills, Graduate Student, Purdue University
	Mitigating Water Crisis in East-Central Indiana under a Changing Climate	Bangshuai Han, Ball State University
	Effects of a Novel Antidepressant on Stress-Related Behaviors and Learning in a Fish Model	Hannah Mullinax, Undergraduate Student, Ball State University
	Biomass and Composition of Macroinvertebrate Communities Across a Gradient of Peatland Types: Implications for boreal peatland food web dynamics	Hannah M. Ferguson, Graduate Student, Ball State University
	Does the River Continuum Concept or the Riverine Ecosystem Synthesis Better Explain Fish Assemblage Variation in Western US and Mongolian Rivers?	Caleb Artz & Mark Pyron, Ball State University

Thursday, June 27 (Breakfast on your own)

Time	Topic	Speaker
8:30	Naturalization of the Kankakee River Corridor in Indiana	Bob Barr, IUPUI
8:50	An Examination of Short-Term Variations in Water Quality at a Karst Spring	Martin Ryan, Environmental Resources Management
9:10	Analyzing FEW Nexus Modeling Tools for Water Resources Decision-Making and Management Applications	Val Schull, PhD Student, Purdue University
9:30	Computation of Water Scarcity Indices for the White River Basin in Indiana	Todd Royer, Indiana University
9:50	Analysis of Two Decades of Water Quality Change of the White River	Shahin Alam, Graduate Student, Ball State University
10:10	**Break**	Upper Hilltop
10:40	Utility Source Water Protection in Indiana	Katie Jamriska, Indiana American Water
11:00	Determining the Effects of Water Temperature and Ionic Strength on the Speciation of Lead in a Residential Water Heater	Mackenzie Davies, Graduate Student, Purdue University
11:20	Exploring Stakeholder Priorities for Successful Watershed Management	Emily Usher, Indiana Water Resources Research Center
11:40	Eel River Ecosystem: Stream Response to Holistic Restoration Strategies	Jerry Sweeten, Manchester University
12:00	**Lunch**	Lower Hilltop
1:20	Relating Relative Watershed Residence Times to Stream Nitrate Concentrations in Artificially-Drained Landscapes Using Stable Isotope Variability	Alexandra Meyer, PhD Student, Purdue University
1:40	Comparing the Role of Biotic and Abiotic Factors Influencing Phosphorus Cycling in Constructed Floodplains of Multiple Agricultural Streams in Indiana	Matt Trentman, PhD Student, University of Notre Dame
2:00	Quantifying the Recovery of Denitrification Following Restoration-Related Construction in an Agricultural Watershed	Shannon Speir, PhD Student, University of Notre Dame
2:20	Twelve Years of Drainage Water Management Research in Randolph County: What We Learned	Jane Frankenberger, Purdue University
2:40	**Break**	Upper Hilltop
3:10	Developing a Conservation Strategy for Oxbow Lakes in Southwest Indiana	Brad Smith, The Nature Conservancy
3:30	Periphyton Response to N, P, and Si Enrichment in a South-Central Indiana Stream: A potential indicator of harmful algal blooms	Lienne Sethna, PhD Student, Indiana University
3:50	Effects of Land Use Type on Abundance and Type of Microplastic Pollution – A Contaminant of Emerging Concern in Indiana Rivers?	Whitney Conard, PhD Student, University of Notre Dame
4:10	Effects of Cyanotoxins on Risk-taking Behaviors in a Common Freshwater Fish	Gina Lamka, Graduate Student, Ball State University
4:30	Short- and Long-term Effects of Neurodegenerative Algal Metabolites on Predator-Prey Interactions in a Larval Freshwater Fish	Jessica Ward, Ball State University
4:50	**Session ends- Dinner (On your own)**	
7:00	**40th Year Celebration - White Elephant (Gift Exchange)**	Presidential Suite 225
	IWRA Business Meeting and Social All members and friends are welcome!	Presidential Suite 225

Friday, June 28 (Brunch provided)

Time	Topic	Speaker
8:30	Tour Announcements	Ginger Davis, Hamilton Co SWCD, 2019 IWRA President
8:45	Lake Wawasee History & WACF	Diana Castell, Wawasee Area Conservancy Foundation
9:30	**Embark S.S. Lillypad**	Oakwood Resort Pier
9:45	Lake Tour Topics: -Past water level, vegetation, fish -Early research dating back to 1875 -Past legal discussions: Ecozones & Pier installations -Current challenges: Starry stonewort, blue-green algae, and boating activities -Ongoing lake and stream sampling efforts around the lake (Demo sampling equipment) -Future research -K-12 education programs -Collaborative projects -Wawasee Area Conservation District -Traditional Limnology Vs. Remediation	-Nate Bosch, Lilly Center for Lakes & Streams, Grace College -Adrienne Funderburg, Lilly Center for Lakes & Streams, Grace College -Jerry Sweeten, Wawasee Area Conservancy Foundation
10:30	**Brunch**	SS Lillypad
11:30	USGS Rapid Water Quality Monitoring System	Tom Ruby, USGS
12:00	Introduction to Campbell Scientific dataloggers and example monitoring data from Indiana Water Balance Network	Bob Autio, Indiana Geologic and Water Survey
12:30	Disembark S. S. Lillypad at Oakwood Resort	
1:00	**Adjourn**	

2019 Symposium Committee:

Ginger Davis, Jeff Martin, Sally Letsinger, Rosy Hansell, Dave Lampe, Cyndi Wagner, Joe Schmees, Mark Basch, Harold Templin, Kathleen Fowler, Martha Clark Mettler, Laura Esman, Linda Prokopy, Emily Usher, and Jeff Frey.

This is the Fortieth annual Indiana Water Resources Association Symposium.
IWRA is a scientific and educational not-for-profit organization established to encourage interdisciplinary communication between persons working in all aspects of water resources.
IWRA is an affiliate of the ***American Water Resources Association****.*

http://www.iwra.info/

Water and Health: Exploring Healthy Water for Human, Animal, and Environment

June 24, 2019

To our attendees and presenters,

It is a great honor to be the president of Indiana Water Resource Association (IWRA). This year marks a milestone for our association as a state affiliate for 40 years. IWRA was founded in 1979 as a state affiliate of the American Water Resources Association to promote water resources research, education, and communication in Indiana. The IWRA Officers and I are honored, humbled, and excited for this chance to recognize the many outstanding contributions and achievements of IWRA past participants, along with giving gratitude for this year's participants. Those pioneers led us to where we are, while providing support, professional development, and a vision to the future of our water resources. I cannot think of a better group of people and water resource leaders to facilitate this information exchange of new research, established programs, and problems dealt with in the water resource world.

We are so very grateful to this year's professionals and student presenters for their work and efforts to share their research with the water resource community. When planning an event such as this, it is imperative to gain the participation of experts in the field. Your willingness to share your time and expertise in the area of water health will undoubtably create momentum toward your research showcased in the symposium. We are fortunate to have a wide range of speakers from all arenas including universities, industry, state and federal agencies, nonprofits, etc. Their shared voice will carry on through the research and collaboration created here.

For our participants, thank you for supporting students, the industry, and most importantly, each other. Your ongoing commitment to building and maintaining the relationships to keep our association strong are the reason we are where we are, and the way we will get to where we are going. It is through information sharing, networking, and efforts like yours that make our community a strong one. I am looking forward to a great meeting, a memorable celebration, and another amazing year.

Again, thanks so much for your enthusiastic participation in our conference. I have no doubt that it would not have been the success that it was without your presence.

Sincerely,

Ginger Davis

Ginger C. Davis

2019 IWRA President

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Wednesday Abstracts:

Title: Water, Diseases, and the Public's Health

Speaker: Thomas J. Duszynski, MPH, PhD(c), Director of Epidemiology Education, Indiana University

The importance of water and its quality are highly correlated to the health of any population. History has demonstrated time and again that water, sanitation, and human health share a unique bond and any fluctuations in that relationship can have devastating effects on a population in a very short period of time. The number of diseases, event, injuries associated with water are vast and the fragile balance between health and illness hinge on the availability of clean water and proper sanitation. The impact of climate change on the human and animal population is a threat that must be addressed to protect not only our safe water supply, but our own health.

Title: Current Efforts to Enhance Indiana's SWWF Program: Truly a "Feel Good" Story

Speakers: Allison L. Mann, Mark E. Basch; IDNR, Division of Water

Jeffrey W. Frey; USGS Ohio-Kentucky-Indiana Water Science Center

The Indiana Department of Natural Resources (IDNR), Division of Water (DOW) was awarded a USGS Water -Use Data and Research Program grant by the USGS in 2016 to "help support the collaboration between the IDNR and the Indiana Geological and Water Survey (IGWS) to perform a quality assurance review of existing registered significant water withdrawal facilities (SWWF) well and intake locations and identify new unregistered SWWFs to ensure that the State is providing the U.S. Geological Survey (USGS) with accurate water use data". DOW staff were provided a list of about 4,600 potentially unregistered SWWFs in Indiana that were identified by the IGWS in their 2018 report to the Indiana Finance Authority (IFA) entitled "Spatial Distribution of Significant Water Withdrawal Facilities in Indiana". The list of potentially unregistered SWWFs was evaluated by the DOW and approximately 3,500 of the sites were believed to qualify for follow up field investigation.

To date, the DOW has had an opportunity to field verify about 375 of the potentially unregistered SWWFs, resulting in the registration of 35 new facilities. All of these new SWWFs are located within the Great Lakes Basin of Indiana, the DOW's initial focus area, and most are used for agricultural irrigation. DOW staff will continue with field investigations within the Great Lakes Basin through 2019, but plans to shift its focus to central Indiana in order to assist with the evaluation of existing and future water supply needs set forth by the IFA's "Central Indiana Water Study". The USGS water use program and new USGS Water Mission Area Water Priorities for the Nation will be discussed to showcase potential monitoring and modeling opportunities for Indiana.

Title: The Hoosier Resilience Index: A Tool for Local Government

Speaker: Janet McCabe, Assistant Director for Policy and Implementation, IU Environmental Resilience Institute.

As documented in the Indiana Climate Change Impacts Assessment and numerous other studies, Indiana is experiencing the impacts of climate change in ways that are becoming more frequent, more obvious, and more impactful. In particular, local communities are facing higher risk of extreme storms that cause flooding, erosion, water quality impacts, economic disruption and threats to public health and safety. The Environmental Resilience Institute, a project of Indiana University's Grand Challenge Prepared for Environmental Change initiative, is developing a tool for Indiana communities to better understand their vulnerability to the impacts of climate change (including changes in precipitation, severe weather, and flooding) and their readiness to be resilient in the face of these changes. The Hoosier Resilience Index will guide counties and incorporated cities and towns of all sizes as they take their first steps in preparing for climate change. The Index helps local governments (counties and municipalities) understand which climate change impacts are most relevant to their specific community and prioritize response actions, making them more resilient to storms, floods, droughts, and increasing temperatures. Knowing

their greatest vulnerabilities will allow local governments to take local action and/or seek outside resources and expertise. The tool was designed for Indiana but could be replicated for other Midwestern states.

The Index, Version 1.0, is scheduled for launch in fall 2019, and is being developed with significant input from its intended users (local governments) and experts in the fields of climate change and resilience. In this session, we will present the Index, explain its intended uses, design, the data it is using, and the online platform being developed for users. We believe IWRA attendees will be interested in this tool, and will be able to provide valuable input as we finalize Version 1.0.

Title: PFAS Characteristics, Fate and Effects on Amphibians

Speaker: Linda S. Lee, Department of Agronomy, Purdue University

Per/polyfluoroalkyl substances (PFAS) have been widely used in commercial and industrial products. Several perfluoroalkyl acids (PFAAs) such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) from multiple sources are being found in groundwater, surface water, and potable waters. PFAS sources leading to water contamination range from fire-fighting activities, industrial spills and dumping, leaky landfills, wastewater effluent discharge, land-applied biosolids and storm runoff. The increased awareness of potential adverse effects of PFAS and their frequent occurrence in water resources as well as the biota served by these resources have prompted state and federal agencies to re-examine PFAS risk assessments and establish aggressive health advisory levels. Many PFAAs are terminal products of microbial degradation of precursor PFAS present in commercial products, waste-based fertilizers and wastewater influent; therefore, mitigation or reduction of PFAS in the water and wastewater treatment process are limited to abiotic technologies. Discharges in the ecosystem can lead to contamination of drinking water sources and exposure to wildlife. PFAS characteristics will be presented along with highlights of PFAS in waste-based fertilizers (composts and land-applied biosolids), environmental fate and subsequent effects on the amphibian trophic level reflecting work at Purdue University.

Title: Developing a Practical Guide on Identifying Algae and Potentially Harmful Algal Blooms for Hoosiers

Speaker: Kassia Groszewski, Senior Environmental Manager, Targeted Monitoring Section, Indiana Department of Environmental Management

Algae is a normal and natural component of all aquatic ecosystems, but when algae grow out of control, they can create blooms that are unsightly, smelly, or a nuisance to boating or recreation. However, one group of algae, the cyanobacteria (AKA Blue-Green algae), can produce toxins that are harmful or even lethal to people, pets, livestock, or fish. This presentation discusses the signs and symptoms of a harmful algal bloom, the visual differences between harmful and non-harmful types of algae (and algal look-alikes!), who monitors for harmful algae in Indiana, and two handouts/posters that have been created to help Hoosiers quickly identify potentially harmful algae and what they can do to keep themselves safe.

Title: BLUE-GREEN ALGAE PATTERNS AND PREDICTION IN 12 LAKES IN KOSCIUSKO COUNTY, INDIANA

Speaker: Nathan S. Bosch, Lilly Center for Lakes & Streams, Grace College

Blue-green algae can produce microcystin, a toxin harmful to people and their pets, which has been found to be a global and local health threat. We studied 12 popular lakes in Kosciusko County, Indiana, during 2015-17 to determine spatial and temporal patterns of algae populations and toxin concentrations as well as potential predictive methods. Strong potential exists for harmful microcystin toxin levels, based on high algae populations in these lakes, though toxin levels were not found to be consistently elevated. All 12 lakes were dominated by blue-green algae compared to other types of algae and often at populations in the moderate to high risk ranges for human health. Microcystin levels were often quite different between lakes and reached the moderate risk range on 17 occasions. Some lakes typically had low microcystin levels despite large populations of blue-green algae. Unfortunately, algae populations and toxin concentrations were typically highest in July

when the recreational exposure risk is likely also at its highest. Predictive efforts using rapid screening and complex models provided better understanding of microcystin toxin production and blue-green algae populations in northern Indiana and elsewhere even though they were not strong enough to use for public health and safety determinations. These results have led the Lilly Center to pursue rapid lab analysis of microcystin levels instead of relying on predictive methods to protect local residents and visitors in the future. Exploration of individual algae species populations and potential trends in other lake-specific influences are warranted given the results of this study.

Title: Wawasee Inlet Nutrient Study: A novel approach to lake ecosystem assessment and restoration

Speaker: Herb Manifold & Jerry Sweeten, Ph.D., Wawasee Area Conservancy Foundation

Lake Wawasee is the largest glacial lake in Indiana with an area of 3,060 acres (1,238 hectares) and a watershed of 24,498 acres (9,914 hectares). The watershed land use is predominantly residential and agriculture. Like other glacial lakes in Indiana, excess nutrients (Nitrogen and Phosphorus) and suspended sediment are the most prevalent nonpoint source pollutants entering the lake. It is well known these pollutants may result in lake hypoxia, algal blooms, sedimentation, and altered lake biota. These patterns of poor water quality in glacial lakes may result in lower property values and/or limited recreational opportunities. While there is a large body of literature relevant to lake trophic status through traditional limnology research, data that quantifies nutrient and sediment loads entering the lake by sub-watershed is lacking. The Wawasee Inlet Nutrient Study (WINS) is a novel experimental design, started 1 January 2019, with a gage station located at each of the four major tributaries and the outflow of the lake. Each station is equipped with an automatic water sampler, pressure transducer, data logger, rain gauge, and temperature probes. Six samples are collected daily April-June and weekly grab samples are collected July-March (N=580 per gage station/year). A stream discharge rating curve is being calculated for each site and a biological assessment will be calculated once each year. This data rich approach will allow the Wawasee Area Conservancy Foundation to target priority restoration/conservation areas, open opportunities for dialogue and partnerships, and evaluate the efficacy of conservation initiatives. Early provisional data suggests Phosphorus, Nitrogen, and sediment exceeds ecological target values.

Title: Design and Development of an Unmanned Underwater Sediment Sampling System

Speaker: Jun Han Bae, Student, Purdue University

We present an unmanned sediment sampling system consist of unmanned surface vehicle (USV) and remotely operated vehicle (ROV) based sediment sampling robot to develop more effective and consistent water and sediment monitoring system. The main goal of this study is to reduce the human intervention from the process of sediment sampling and provide an unmanned solution to the process of water and sediment monitoring in smaller water bodies (river systems, lakes, ponds, and reservoirs).

Poster Abstracts:

Title: Assessing the effectiveness of resident water quality improvement practice adoption on non-point source pollution across urban-to-rural landscapes in NW Indiana

Speaker: Jonathan Mills, Student, Dept. of Agricultural and Biological Engineering, Purdue University

Effective control of nonpoint source (NPS) pollution is critical for both long-term health of freshwater ecosystems and the socioeconomic welfare of human communities. Previous research has focused primarily on water quality management through implementation of best management practices (BMPs) to reduce NPS pollution from agricultural and urban land uses. However, there is a critical need to incorporate individual property owners' willingness to adopt conservation practices to more accurately quantify the cumulative water quality improvement potential at the watershed scale. This project sent out

2866 surveys to residents of the East Branch—Little Calumet River watershed and the Trail Creek watershed in Northwest Indiana. These surveys ascertained the level to which stakeholders believe they contribute to NPS pollution, their background knowledge of BMPs, and willingness to adopt various BMP types. The survey divided the population into 5 resident groups including urban, suburban, rural residential, small agricultural, and large agricultural. Survey results showed that agricultural BMPs such as conservation tillage (30.54% of applicable residents), composting manure (29.71%), cover crops (27.81%) as well as urban BMPs such as rain barrels (26.12%) and rain gardens (7.50%) were likely to be adopted within the next year. From the survey responses, the Generalized Watershed Loading Function – Enhanced version (GWLF-e) hydrologic model is being used to estimate the loading of N, P, sediment, and F. coliform bacteria under current conditions, several BMP implementation scenarios applied to the urban and agricultural regions, and with BMPs applied to the level of landowner willingness to adopt. Model results with BMP implementation scenarios are currently processing. Baseline model results show higher pollutant loads from agricultural residents, but with the survey showing that agricultural residents have higher levels of background knowledge of BMPs as well being more likely to implement BMPs, results are expected to show higher levels of pollutant mitigation from agricultural residents throughout the various scenarios. Survey results will allow us to project different groups' willingness to adopt conservation practices onto the watershed and to calculate the resulting reduction of pollution loading to Lake Michigan. Both the survey and model results can be used in conjunction to help watershed managers and planners to better identify, prioritize and implement conservation practices with the highest water quality improvement potential and social acceptance.

Title: Mitigating Water Crisis in East-Central Indiana under a Changing Climate

Speaker: Bangshuai Han, Natural Resources and Environmental Management, Ball State University

It is projected that Indiana's warming rate is accelerating, with an increase of precipitation in winter and spring. Indiana will experience drier and warmer crop growing seasons and wetter winters in the future. These conditions lead to various water management challenges in Indiana, including adaptation to more flooding and droughts, potentially a shift from rainfed agriculture to irrigation agriculture, and water quality degradation. There is a critical need for scientists to help Indiana residents better adapt to future climate change, e.g., by providing a better understanding of the effects of conservation practices, controlling extreme flow events (including high and low flows), improve water quality in freshwater and groundwater bodies etc.

This poster presents an overall picture of the research projects currently being conducted in our lab at Ball State University. Specifically, we will demonstrate our preliminary efforts on 1) development a modeling approach to simulate wetland restoration effects to streamflow under future climate change scenarios; 2) assessment of water quality improvement of a local reservoir after 10-yrs of conservation practices; 3) analysis of long-term water quality change in the White River using a novel modeling approach; 4) assessment of irrigation suitability of the water from the White River; 5) development of a simple modeling approach of nutrient load based on compiled data in the White River Watershed.

All these projects aim to advance our understanding of the hydrologic cycle and water quality under a changing climate and conservation practices, and the results will assist elected officials at the state and local levels, decision makers, and local communities to better adapt to future climate change when making conservation or restoration plans to support soil and water conservation and healthy environment. The goal of the presentation is to share and communicate our research with IWRA participants including professionals, students and various water-related groups.

Title: Effects of a Novel Antidepressant on Stress-related Behaviors and Learning in a Fish Model

Speaker: Hannah Mullinax, Undergraduate Student, Ball State University

Contamination of aquatic ecosystems is a common consequence of urbanization. A variety of compounds are known to alter the physiological function of affected organisms, with corresponding changes in behavior. One emerging contaminant of concern in urban environments is ketamine, a pharmaceutical frequently prescribed for off-label use as an antidepressant and

a popular party drug. Despite the detection of ketamine in streams and rivers, few studies have assessed its effect on the behavior of aquatic organisms. In this study, we evaluated the effects of ketamine on stress-related behaviors and learning in zebrafish (Danio rerio). Adult fish were exposed to either 0, 5, 20, or 40 mg/L ketamine for 1 h before being tested in a suite of behavioral assays. To infer the effect of exposure on stress and anxiety, we quantified changes in exploratory behavior in novel environments. We utilized a plus maze to assess the effects of ketamine in an associative learning task. We found that exposure to ketamine reduced stress-related behaviors and impaired learning and memory. These data have implications for the persistence of populations in urban aquatic systems.

Title: Biomass and Composition of Macroinvertebrate Communities Across a Gradient of Peatland Types: Implications for boreal peatland food web dynamics

Speaker: Hannah M. Ferguson, Graduate M.S. Student, Ball State University

Recent research in Alaskan peatlands has revealed the presence of an algae-based food web in boreal peatlands, which may explain why peatlands tend to maintain higher than expected rates of macroinvertebrate production despite the low quality of the dominant detritus resources. Yet, there is currently too little information on the aquatic components of the peatland food web to test this hypothesis. The goals of this study were to 1) document spatial and temporal variability in macroinvertebrate community composition across a gradient of peatland types, and 2) quantify the influence of increased nutrient availability on macroinvertebrate biomass. To do this, we established replicate m2 plots within a rich, moderate, and poor fen within the Tanana River floodplain in interior Alaska and quantified temporal variation in macroinvertebrate community composition and biomass with and without nutrient enrichment over the course of the 2017 growing season (May–Aug). Macroinvertebrate biomass (mg•m-2) increased over time in all peatland types irrespective of nutrient availability and was greatest in the moderate fen and lowest in the rich fen. Increases in biomass were greater in enriched plots compared to unenriched plots across all peatland types, but differences were not significant. Within each peatland type, community structure shifted over the growing season from grazer to predator dominated. Community composition was similar between the rich and moderate fen which were both more species rich than the poor fen. Although similar taxa were found within each peatland, the relative abundance of the dominant herbivore and predatory taxa varied among fen types. These data provide insight into patterns of natural variation within the aquatic macroinvertebrate community of boreal peatlands, which has important implications for food-web dynamics.

Title: Does the River Continuum Concept or the Riverine Ecosystem Synthesis Better Explain Fish Assemblage Variation in Western US and Mongolian Rivers?

Speaker: Caleb Artz & Mark Pyron, Ball State University

The river continuum concept (RCC) and the riverine ecosystem synthesis (RES) are models to explain river variation. The RCC explains river ecosystem variation based on river distance. The RES explains river ecosystem variation based on unique geomorphological reaches that can repeat with river distance. We used the ArcGIS hydrogeomorphic model RESonate to identify functional process zones for river basins in the western US and Mongolia. This model uses digital elevation models, precipitation, geology, and downloadable tools (www.macrorivers.org) to plot and outline river channels and their corresponding geomorphological features. Fishes were collected by backpack electrofisher, supplemented by hook and line where water conductivity was low. We used multivariate analysis to ordinate fish assemblage data and tested if variation was better explained by functional process zones or by river distance.

Thursday Abstracts:

Title: Naturalization of the Kankakee River Corridor in Indiana

Speaker: Robert C. Barr, Research Scientist, Center for Earth and Environmental Science, IUPUI

The Kankakee River Basin is one of the most modified and studied watersheds in Indiana. Since the channelization of the river in Indiana was completed in 1918, studies have been done almost every decade to address continuing issues with sediment and flooding. Climate change has increased the amount of precipitation received and the frequency of very heavy rains. The response to the higher rainfall has been to increase the number of drain tiles, upsize the tiles and drainage ditches, and erect more berms or make them higher, all of which has increased the amount of flow in the river even further. Flooding problems that were bad are now worse. The flooding is now to the point where a new plan needs to be considered. A plan that would try to manage sediment before it gets into the river – not after it is in; and a plan that recognizes that the river needs room to adjust to a changing climate. This is the story of that plan.

Title: An Examination of Short-Term Variations in Water Quality at a Karst Spring

Speaker: Martin Ryan, Environmental Resources Management

Water quality at many karst springs undergoes very high amplitude but relatively brief degradation following influxes of runoff. Accurately recording transient variations requires more rigorous sampling strategies than traditional grab methods. A study was implemented by the authors to determine the usefulness of high-frequency, flow-dependent sampling strategies, combined with coincidental quantitative dye tracer tests, at the Big Spring Groundwater Basin in Mammoth Cave National Park, Kentucky.

Data recorded following two separate runoff events showed that the concentrations of two nonpoint source pollutants, fecal coliform bacteria and suspended sediment, greatly exceeded pre-runoff event values for very short periods of time. A phreatic conduit segment, calculated at 17 million liters in volume, instantaneously propagated head changes, caused by direct runoff entering the aquifer, from the ground-water inputs to Big Spring. A significant delay between the initial increases in discharge and the arrival of direct runoff, as indicated by a decrease in specific conductance, represented the time required to displace this volume of phreatic water. The delay showed that sampling a karst spring only during peak discharge could be an unreliable sampling method for documenting “worst-case” conditions.

Runoff from two different sub-catchments was tagged with tracer dye and the timing of the passage of the resultant dye cloud through Big Spring was compared to water quality variations. Distinct lag times between the arrival of direct runoff at Big Spring and the bacteria and suspended sediment waveforms were shown through the concurrent quantitative tracer tests to be related to the areal distribution of land-cover type within the groundwater basin.

Title: Analyzing FEW Nexus Modeling Tools for Water Resources Decision-Making and Management Applications

Speaker: Val Schull, PhD Student, Purdue University

Social changes such as growing population, urbanization, globalization, and economic growth, compounded with uncertainties due to climate change are expected to result in substantial shifts in the demand for food, energy, and water. The interdependence of these sectors indicate a need to assess current and future stressors considering the Food-Energy-Water (FEW) nexus. This study is aimed at analyzing FEW nexus modeling tools with a specific focus on addressing issues of water management at the nexus. In particular, an exploratory approach is taken in order assess available FEW nexus modeling tools to determine the accessibility, knowledge gaps, and potential for including aspects that provide better insight into the nexus such as water quality, futuristic scenarios due to climate change, and varying scales within the nexus. A case study in the Matson Ditch Watershed in northeastern Indiana is presented to illustrate the use of the WEF Nexus Tool 2.0 in this regard.

Title: Computation of Water Scarcity Indices for the White River Basin in Indiana

Speaker: Helen Scales and Todd V. Royer, Indiana University- O'Neill School of Public and Environmental Affairs

Indiana averages 41.7 inches of rain annually, and the southern half of the state tends to receive 3-5 inches more per year than the northern half of the state. Indiana in general is a water-rich state. However, because of the state's economic dependence on agriculture and industry, both of which require reliable water supplies, it is essential to have accurate information on past and present water demand and supply. In this presentation, two well-known water scarcity indices are calculated: the Falkenmark index and the Consumption to Q90 index. These indices were calculated for three areas of study: the *Patoka-White* HUC-6 sub-basin and for two HUC-8 basins within it, the *Upper White* which contains Indianapolis, and the *Patoka* in southern Indiana. Indices were calculated for years 2000 to 2017.

The Falkenmark index is a simple measure of scarcity that does not explicitly consider actual water demand or withdrawals; still it provides valuable baseline information about watershed population and water availability. It is calculated by dividing annual river flow by population. Values below 1700 m3 per capita indicate water stress; less than 1000 m3 per capita indicates water scarcity. In the present study, annual population for each watershed was estimated using 2000 and 2010 census data and GIS area-weighting techniques. Discharge data were obtained from USGS stream gauging records.

The Consumption-to-Q90 index is calculated by dividing monthly water consumption by monthly low-flow discharge for a given watershed. In this analysis, consumption was represented by monthly surface and groundwater withdrawals for Significant Water Withdrawal Facilities. Low-flow discharge (Q90) was obtained from USGS gauging records. Consumption-to-mean discharge was also calculated for comparison.

According to the Falkenmark index, the HUC-6 *Patoka-White* basin has not experienced water scarcity. However, the HUC-8 *Upper White* watershed, which includes Marion County, has experienced water scarcity while the *Patoka* watershed has experienced none. Both spatial scales had similar patterns in years of drought such as 2000, 2010, and 2012. The HUC-6 *Patoka-White* basin has at times exceeded a Consumption-to-Q90 value of 1, meaning water withdrawals exceeded river flow during low flow conditions. During these periods, water is extracted, used, and returned to the river network more than once. Monthly scarcity is often obscured when computing yearly indices such as the Falkenmark index. We conclude that local water scarcity is not observable in the larger HUC-6 *Patoka-White* basin but is revealed when examining smaller watersheds within it. This highlights the importance of considering spatial scale when examining water scarcity. We argue that if Indiana were to experience a multi-year drought, it could result in significant local water scarcity during baseflow conditions with associated ecological, economic, and water quality impacts.

Title: Utility Source Water Protection in Indiana

Speaker: Katie Jamriska, Water Quality and Environmental Compliance Lead, Indiana American Water

Drinking water quality standards can be difficult to meet with monitoring and treatment alone which is why source water protection requirements from regulatory agencies and protection efforts by utilities have increased throughout the United States in recent years.

The Safe Drinking Water Act and the Indiana Wellhead Protection Rule (327 IAC 8-4.1) requires all community water systems to have a wellhead protection program. The size of the water utility often determines the strength and endurance of the source water protection program.

There are various ways to protect water from contamination and degradation in quality, thus safeguarding drinking water sources. Completely eliminating a threat of contamination is not possible; there will always be a contamination risk to water because of human activity. However, by using the hierarchy of source water protection and implementing the higher ordered protection barriers the risk and likelihood go down.

Most utilities focus on preserving the source water (hold meetings, complete inventories of contaminants, conduct public education, etc.), because incidents don't happen every day. But, there are two other protection aspects that are important to ensure a quality source water; react and respond. These additional parameters ensure a water utility is ready to effectively execute protection directives when an incident takes place.

Water utility's face numerous challenges in protecting the source of drinking water to communities across the state. By far, the biggest challenge is maintaining an updated and accurate inventory of potential contaminant sources. Other challenges include land control, stakeholder engagement, public education, availability of resources, and economies of scale for the program.

This presentation will dive into the importance of a source water protection plan, the challenges utilities face, key activities to protect source water, and an action plan for the future.

Title: Determining the Effects of Water Temperature and Ionic Strength on the Speciation of Lead in a Residential Water Heater

Speaker: Mackenzie Davies, M.S. Student, Environmental & Ecological Engineering

Lead contamination of drinking water poses a serious human health risk, specifically targeting kidneys and the nervous system. While lead in distribution systems has been extensively studied, the effect(s) of residential water heaters and ion-exchange water softeners on lead present in distribution systems or plumbing systems remains relatively unknown. The aim of this project is to determine if varying temperature or ionic strength influence the speciation of lead in residential potable water. Initial enthalpy models based on tabulated values (MINEQL+) at STP conditions were developed to determine how lead(II) and (IV) could change with these new variables. Lead(IV) solid PbO_2 dissolution is monitored with an iodometric test via UV-vis spectrometry. Additionally, using an ICP-OES, lead(II) nitrate precipitation is measured over several time-series to determine the effects of variable carbonate concentrations, relevant temperature gradients, and ionic strength changes. Results prove that these methods of detection and analysis are effective ways to measure lead in each of these forms.

Title: Exploring Stakeholder Priorities for Successful Watershed Management

Speaker: Emily Usher, Natural Resources Social Science Lab, Purdue University

The USDA-Natural Resource Conservation Service's (NRCS) National Water Quality Initiative (NWQI) is a watershed improvement program that provides technical and financial assistance to accelerate on-farm voluntary adoption of conservation practices in targeted watersheds across the US. This presentation provides an overview of NWQI and shares results of participatory forums conducted in five NWQI watersheds across the country (NC, WA, IL, VT and OK) with diverse stakeholder groups. Using Q-methodology, a mixed method approach that reveals social perspectives while preserving participant subjectivity, researchers identified three distinct stakeholder perspectives of priorities for successful watershed management. Results highlight unique stakeholder perspectives including stakeholder concerns, watershed planning, and outreach. Differences and similarities between perspectives provide insights and rationale to stakeholder priorities for successful watershed management, and informs improvements to NRCS supported watershed management programs. This research also highlights an innovative approach to stakeholder engagement that offers insight to stakeholder priorities that can be used to develop effective place-based watershed management strategies.

Title: Eel River Ecosystem: Stream Response to Holistic Restoration Strategies

Speaker: Jerry Sweeten, PhD, Manchester University

The Eel River of northern Indiana is a 5th order stream and flows southwest from western Allen County to Cass County where it joins the Wabash River at Logansport. The stream is approximately 110 miles (177 km) long with a watershed of 842 mi^2

(2,180 km^2). Row-crop agriculture represents 85% of the land use and there are seven small towns scattered throughout the watershed. From 2004 to present, there have been research opportunities to examine the ecological response of the Eel River to numerous conservation initiatives in partnership with Manchester University Environmental Studies Program. These initiatives were a direct response to conservation partnerships with State and Federal agencies and private donors. Over 60 undergraduate student interns participated in these various ecological research initiatives over a 12-year period. These projects ranged from removal of three low-head dams, a paired-watershed study, construction of a natural channel design stream, augmentation of redside dace (*Clinostomus elongatus*) a state endangered species, reintroduction of clubshell mussel (*Pleurobema clava*) a federally endangered species, construction and monitoring of a prototype fish passageway around the Stockdale dam, efficacy of fall cover crops on water quality in the Eel River, and the effect of suspended sediment on year-class strength of smallmouth bass (*Micropterus dolomeiu*). Collectively, these research projects added over $4 million to the local economy. In fact, local farmers financially supported the paired watershed water quality research. Restoration of streams and lakes is possible, but dependent on holistic strategic planning within the human endeavors of the watershed and continuity in funding.

Title: Relating Relative Watershed Residence Times to Stream Nitrate Concentrations in Artificially-Drained Landscapes Using Stable Isotope Variability

Speaker: Alexandra Meyer, PhD Student, Purdue University

Watershed discharge from agricultural lands is known to contain high levels of nutrients leading to harmful algae blooms and eutrophication of freshwater ecosystems. Watershed discharge is a combination of recent precipitation, soil water on the order of months to a year old, and decades-to-centuries old ground water. The proportions of these vary with hydrology and land management including subsurface tile drainage. Their relative contribution to nutrient loading of streams and rivers is often poorly understood. We aim to investigate the variability of residence time in small watersheds using stable isotope tracers and examine relationships with nitrate concentration variability. This work leverages 5 years of water stable isotope data and 10 years of nutrient concentrations from community scientist collections of ~220 streams near Lafayette, IN. Sampling occurs in the spring and fall under varying weather conditions. Stable water isotope time series have been used extensively for hydrograph partitioning and residence-time calculations but interpreting twice-yearly sampling of highly variable stream waters presents a challenge. We hypothesize that isotope variability in individual watersheds is correlated with relative residence times, resulting in a spectrum of nutrient dynamics within similar land-use.

Stream samples were analyzed for temperature and pH in the field and filtered samples were analyzed in the lab for nutrient concentrations including: nitrate, nitrite, orthophosphate, and sometimes E-coli and ammonia (Muenich et al., 2016). We used USGS discharge measurements from Wildcat Creek at Lafayette, IN in our analysis to estimate antecedent moisture conditions. We also analyzed water stable isotope compositions, δ D and δ 18O, for 4 of the spring events and 6 fall events. We calculated the standard deviation of isotope variability over sampling events if a site was sampled at least 4 times and classified each watershed residence time as fast, medium, and slow based on the magnitude of isotope variability across events. Land use classifications were assigned for drainages over 50% urban, agriculture, or forest. We also estimate tile-drained areas for each watershed for grids that are in agriculture and poorly-drained soils (Jiang et al., 2014).

We found that both high percentages of tile-drained area and strong young water influence resulted in higher nitrate concentrations. However, tile drain area and residence time (young water influence) were not significantly correlated, indicating multiple processes influencing stream nitrate concentrations, perhaps including shallow groundwater flow paths. We estimate that groundwater in this region has approximately 1.9 +/- 2.6 mg/L nitrate. This study provides new context to examine the role of water residence time on nutrient dynamics in artificially-drained landscapes in order to inform decision making about where to concentrate nutrient mitigation efforts.

Title: Comparing the Role of Biotic and Abiotic Factors Influencing Phosphorus Cycling in Constructed Floodplains of Multiple Agricultural Streams in Indiana

Speaker: Matt Trentman, Graduate Student, University of Notre Dame

Maximizing nutrient removal from agricultural streams is one mechanism for alleviating eutrophication to downstream water bodies such as Lake Erie. The construction of inset floodplains in agricultural streams/ditches can increase nutrient removal, yet the impact of floodplains on phosphorus (P) dynamics is understudied compared to nitrogen. We examined the role of biotic and abiotic processes influencing P pools and fluxes on inset floodplains of three agricultural streams in northern Indiana. We predicted that P dynamics would be driven by both P assimilation via soil microbial activity (i.e., respiration; R) and Fe-associated sorption influencing P during soil drying and rewetting. Soil respiration was significantly different among floodplains and was correlated with soil organic matter content, linking microbial P assimilation with carbon availability. The Fe pools also varied significantly among sites, and we found that Fe and available P were significantly correlated, suggesting that Fe-associated P adsorption may vary substantially. Overall, both biotic P assimilation and a strong potential for abiotic P sorption exist in these floodplains; however, the ability of any individual floodplain to remove water column P will vary with soils and their associated physiochemical characteristics. We are currently building a mass balance model to relate biotic and abiotic processes in the floodplain with the water column P loads to better understand how these processes overall affect P export downstream.

Title: Quantifying the Recovery of Denitrification Following Restoration-Related Construction in an Agricultural Watershed

Speaker: Shannon Speir, Graduate Student, University of Notre Dame

In agricultural streams, floodplain restoration via the two-stage ditch has been shown to improve water quality. Constructed floodplains expand bioreactive surface area and enhance nitrate-N removal via microbial denitrification, thereby reducing export to downstream ecosystems. In the Shatto Ditch Watershed (IN), 0.8 km of two-stage were constructed at the watershed outlet in 2007. In 2017 and 2018, an additional 3.7 and 2.7 km were constructed moving upstream. We quantified recovery of denitrification following stream dredging and floodplain construction using experimental incubations of stream sediments and floodplain soils, measuring dinitrogen gas concentrations using membrane inlet mass spectrometry (MIMS). We measured denitrification on stream sediments upstream, which were higher before dredging (0.22 µgN/gDM/h) but were still comparable 3 weeks post-dredging (0.15 µgN/gDM/h). Nevertheless, stream sediment rates upstream remained low relative to sediments in the 2007 two-stage reach where sediments were never dredged (0.57 µgN/gDM/h). Our research suggests that stream sediments recolonize quickly post-dredging, on the order of weeks. In contrast, floodplains soils may take longer to recover with their intermittent hydraulic connectivity, which we are exploring with continued analyses. Lags in ecosystem function are important to consider when implementing any restoration-related construction.

Title: Twelve Years of Drainage Water Management Research in Randolph County: What We Learned

Speaker: Jane Frankenberger, Professor, Agricultural and Biological Engineering, Purdue University

Nitrate contamination of Indiana's streams leads to environmental stresses including hypoxia in the Gulf of Mexico. Drainage water management is one of the practices that reduces nitrate losses from tile-drained agricultural land while maintaining drainage intensity during critical periods of the crop growth cycle. A drainage water management system conserves water by increasing the retention time of water in the soil profile. Removal of excess soil water can be delayed and/or reduced, creating opportunities for more optimum plant growth conditions for crop production while at the same time reducing annual drainage volumes.

In 2005, we established a research site at the Davis Purdue Agriculture Center for assessing drainage water management benefits in Indiana, with research infrastructure capable of producing the continuous, high quality data needed to assess the impact. For 12 years, crop yield was measured with a GPS-enabled yield monitor and drain flow, water table, soil moisture,

and nitrate-N and phosphorus concentration were measured at various intervals. Many different funding sources were used through the years, with changes incorporated into our monitoring techniques as methods improved. The research ended in 2017.

This presentation will summarize all the results from all years, including the (slight) crop yield benefits and significant nitrate load reduction we found through this long-term monitoring effort. It will also address how the results can be used in Indiana's nutrient reduction efforts, and discuss what is next for efforts to reduce nutrient loads from drained agricultural lands.

Title: Developing a Conservation Strategy for Oxbow Lakes in Southwest Indiana

Speaker: Brad Smith, Lower Wabash and Wetlands Program Director, The Nature Conservancy

Oxbow lakes are an important habitat type found along Indiana's major rivers in southwest Indiana. They are an integral part of a river's ecology. Many species of riverine fish use oxbows to reproduce or rear young. Oxbow lakes are also home to many species of rare plants, and they provide wintering and nesting habitat for waterfowl and songbirds.

Despite the ecological importance of oxbow lakes, little is known about their overall health. As a result, there have been no conservation strategies developed around this important habitat-type in Indiana. Oxbow lakes face many threats, including levees, ditching and field tiling within the lake basins, agricultural runoff, and fragmentation of surrounding woodlands.

In addition to these threats, changes in land use and hydrology in the age of European colonization have dramatically altered rates of succession in these habitats. This raises the question of the sustainability of function in the face of high sedimentation and altered flood regimes.

To establish a baseline of data and develop conservation strategies around these lakes, we completed an initial ranking process via GIS, followed by an on-the-ground sampling effort in 2018 including monthly water sampling and fish sampling. We will share our research results to date and discuss the challenges of developing a conservation strategy for a dynamic and large-scale habitat like oxbow lakes along the lower Wabash and White Rivers.

Title: Periphyton Response to N, P, and Si Enrichment in a South-Central Indiana Stream: A potential indicator of harmful algal blooms

Speaker: Lienne Sethna, PhD Student, O'Neill School of Public and Environmental Affairs, Indiana University

Harmful algal blooms are an increasing hazard for streams and lakes in Indiana. My research seeks to characterize the relationship between essential nutrients (nitrogen [N], phosphorus [P], and silica [Si]) and algal community composition in order to better understand the potential for cyanobacterial blooms in streams of Indiana. Dissolved Si is an essential nutrient in aquatic ecosystems, yet the understanding of Si transport and cycling is lacking compared to N and P. A high availability of Si, relative to N and P, is expected to promote diatom growth over cyanobacteria, yet the stoichiometric demands of freshwater diatoms for these nutrients is not well constrained. Diatoms are a beneficial group of algae, providing a nutritious food source without producing toxins. I am studying N:P:Si relationships in a stream in south-central Indiana to document how algal communities respond to stoichiometric variations in nutrient availability.

In order to assess nutrient limitation, including the potential for dissolved silica limitation of diatoms, I am using nutrient diffusing substrata enriched with different combinations of N, P, and Si. The stream is located in Monroe County, Indiana and drains a predominantly forested watershed. Ambient nutrient concentrations, measured in late March 2019, range between 23-27 µg P/L of phosphate, 0.01-0.04 mg N/L of ammonium, 0.3-0.5 mg N/L of nitrate, and 7-11 mg/L of SiO_2.

Incubating nutrient diffusing substrata in natural waters is a well-established method used in stream ecology to identify nutrient limitation and co-limitation. I am using multiple treatments of variable N:P:Si to identify the types of algae that grow under enriched nutrient availability. Treatments will include additions of Si, P, N, N and Si, P and Si, and all three nutrients. The

response variables include total algal biomass (as chlorophyll-a), the relative abundance of major algal groups, and species-level assessment of diatom community structure. The effects of the treatments relative to the control will be analyzed using one-way analysis of variance (ANOVA) with pairwise comparisons. Multivariate techniques may be used to explore the diatom community data. The ultimate goal of this study is to assess the potential for dissolved Si limitation of diatoms and determine the degree to which Si limitation can promote harmful blooms of cyanobacteria in streams.

Title: Effects of Land Use Type on Abundance and Type of Microplastic Pollution – a Contaminant of Emerging Concern in Indiana Rivers?

Speaker: Whitney Conard, Ph.D. Student, University of Notre Dame

Water quality degradation resulting from human activities represents a threat to environmental and human health. Contaminants of emerging concern, including microplastics (i.e., plastic particles <5 mm in size), are understudied in flowing waters of the Midwestern USA including in Indiana. Microplastics enter rivers and streams through a variety of pathways (e.g., wastewater effluent, breakdown of larger plastic debris, atmospheric deposition) and can potentially harm aquatic organisms through both direct consumption with food and indirect contamination from sorbed toxins. Due to their small size, the removal of microplastics is impractical and thus it is essential to track and reduce microplastic input at the source. In this study, we quantified the concentration and types (e.g., beads, fibers, fragments) of microplastics in 31 locations within rivers of nine Indiana watersheds representing a gradient of land use (i.e., agricultural, urban, and forested). We hypothesized that relative to forested systems, watersheds dominated by agricultural or urban land use would have both higher total microplastic concentrations and different types of microplastics due to human activities. We also hypothesized that concentrations would increase with distance downstream due to a larger area of land mass being drained. Our results showed detectable quantities of microplastics (mean = 3.86 particles/liter, range = 0 – 17 particles/liter) in samples but no significant relationship between land use and either total microplastic concentrations or types. Microplastic fibers were ubiquitous across all land use types, suggesting that fibers may be carried through atmospheric deposition rather than associated with adjacent land use type. The results of this study will help to identify the sources and types of microplastics in Indiana waters, which is critical for the development of management actions for this emerging contaminant.

Title: Effects of Cyanotoxins on Risk-taking Behaviors in a Common Freshwater Fish

Speaker: Gina Lamka, Graduate Student, Ball State University

Cyanotoxins are ubiquitous in freshwater systems in the United States and abroad. Emerging evidence suggests that chronic exposure to some cyanotoxins, such as β-Methylamino-L-alanine (BMAA), may have sub-lethal effects on behavior via their effects on the nervous system. These changes in behavior have potential to negatively influence individual fitness. In addition to reducing recruitment, exposure-induced changes in behavior that decrease perception of risk or increase activity may increase the likelihood of predation, and therefore the rate of chemical transfer up the food chain. In humans, exposure to BMAA through the consumption of contaminated fish and other foods is a risk factor for diseases such as amyotrophic lateral sclerosis (ALS), Parkinson's, and Alzheimer's. In this study, we examined how early exposure to BMAA influences potentially 'risky' behaviors in the fathead minnow, *Pimephales promelas*, a common North American freshwater fish. We exposed eggs and larvae to 0, 5, or 25 ug/L BMAA for 21 days and assessed the effect of exposure on boldness, activity, exploration, and locomotor performance beginning on 22 dph and continuing at regular (monthly) intervals until 189 dph. Our preliminary analyses suggest that BMAA reduces locomotor performance early in development. There was also a trend for exposed individuals to show reduced boldness. However, these effects were largely extinguished by 189 dph. These findings contribute to our growing understanding of the impact of contaminants on the development and expression of animal behavior in natural populations. Knowledge of the susceptibility of affected individuals to algal-induced sensorimotor and neural shortfalls has the potential to be used by managers to predict the fates of aquatic populations and communities in ecosystems affected by harmful algal blooms.

Title: Short- and long-term effects of Neurodegenerative Algal Metabolites on Predator-Prey Interactions in a Larval Freshwater Fish

Speaker: Jessica Ward, Department of Biology, Ball State University

Cyanobacteria are prevalent blue-green algae that have adverse impacts on both human health and the environment. At least 8 classes of toxins produced by cyanobacteria have been identified with the potential to affect organismal physiology and function. Of these, β-N-methylamino-l-alanine (BMAA) and its isomer 2,4-diaminobutyric acid (DABA) are potent neurotoxic metabolites of interest because they are a risk factor for neurodegenerative diseases in humans. However, sensorimotor integration is also critical to the successful survival and reproduction of resident aquatic organisms, and these neurodegenerative cyanotoxins have the potential to modify the expression of simple and complex behaviors within individuals and the outcomes of interactions between individuals in aquatic environments. One way that this can happen is through changes that compromise an organism's ability to correctly perceive, process and respond to relevant biotic stimuli (e.g., predators, prey, or mates). In this study, we examined the effects of DABA on the foraging behavior of a larval fish (*Promelas pimephales*). We exposed larvae to a range of environmentally-relevant concentrations of DABA for 21 days. We then tested larvae in prey-capture assays to assess the effect of neural disruption on the outcomes of predator-prey interactions, and recorded individual prey strikes using a high-speed camera to assess changes in both the cognitive and motor aspects of hunting behavior. Compared with nonexposed fish, exposure to DABA was associated with reduced foraging success and changes in the ability of larvae to recognize prey. Moreover, these effects persisted to maturity. These data improve our understanding of how aquatic contaminants affect stimulus-response pathways though their effects on brain function and suggest that even subtle contaminant-induced shifts in perception, processing, or response can have marked effects on fitness.

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