

17th Annual Meeting
The OHIO ACADEMY of SCIENCE
Hosted by
THE UNIVERSITY OF TOLEDO
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Ohio Science Symposium

***Declining Water Quality
in the
Western Lake Erie Basin:
Increasing Invasion of
Blue-Green Algae (Cyanobacteria),
and Increasing Levels of
Soluble Reactive Phosphorus***

April 12, 2008

The University of Toledo

\$20.00

Please register by April 1.

Registration form available online at:

<http://www.ohiosci.org/UTRegistrationForm.pdf>

**A Symposium co-sponsored by:
The Ohio Fracture Flow Working Group**

Organized by Dr. Julie Weatherington-Rice
Co-Coordinator Ohio Fracture Flow Working Group
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Worthington, Ohio 43085
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Symposium:

Declining Water Quality in the Western Lake Erie Basin: Increasing Invasion of Blue-Green Algae (Cyanobacteria), and Increasing Levels of Soluble Reactive Phosphorus

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Podium Session

9:00 AM
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Engineering, Mathematics and Environmental Sciences

Podium Session

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Ecology and Molecular Ecology

Podium Session

9:00 AM
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Medicine and Health

Podium Session

9:00 AM
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Declining Water Quality in the Western Lake Erie Basin: Increasing Invasion of Blue-Green Algae (Cyanobacteria), and Increasing Levels of Soluble Reactive Phosphorus

A Symposium co-sponsored by: The Ohio Fracture Flow Working Group

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Statement of Need/Purpose and Background of Topic

Through the combined efforts of numerous federal, state, and local agencies, Ohio research colleges and universities, and citizens of the Western Lake Erie Watersheds, the water quality of Western Lake Erie has improved significantly, from the poor water quality in the 1950's and 1960's. The improvement has continued even while invasive species populations have expanded in the lake. By the mid-1990s, the total phosphorus levels in the lake had been reduced to the recommended US Environmental Protection Agency levels. However, about the same time, the levels of soluble reactive phosphorus began to climb. Soluble reactive phosphorus was found in surface water flowing in from the watersheds, feeding the western lake. The rising quantity and storm-driven pattern of delivery was identified by the National Center for Water Quality Research members associated with Heidelberg College in Tiffin, Ohio. Members of this research group began notifying colleagues in professional organizations and at the relevant agencies of the upturn in soluble reactive phosphorus levels entering the western basin.

In the fall of 2006, after a prolonged northeastern storm, a species of blue-green algae (cyanobacteria), *Lyngbya wallei*, washed up on the shores of Maumee Bay. This species has never been documented in the Lake; it is found in the southern United States, especially in Alabama, Florida, and North Carolina and has not been found to be winter hardy. But when washed into the shallow warm waters of the Bay (which did not freeze during the winter of 2006-2007), the invasive algae successfully over-wintered and underwent a prolonged bloom, beginning in late March 2007. The condition was quickly reported to local governments and news outlets by local citizens who live and recreate on the bay. The Toledo Blade has published a number of feature stories on the invasion of the new type of blue-green algae.

The blue-green algae continues to inhabit the western basin, along with the natural summer bloom of the warm weather *Microcystis* blue-green algae. Dead algal mats that do not wash up on shore sink to the bottom of the lake and are carried out into the central basin. There, the biodegradation of these algae by microbes on the lake's bottom remove dissolved oxygen from the Lake's water. This depletion of dissolved oxygen expands the "dead zone" in the bottom of the lake.

This cycle and its impacts on fishing and tourism in the region were the topics of a recent article in the Columbus Dispatch on September 25, 2007. The article can be found at the following web link:

http://www.dispatch.com/live/content/science/stories/2007/09/25/sci_Erialgae.ART_ART_09-25-07_B4_7H7UMMK.html?print=yes&sid=101

To date, the only controlling mechanism that has been recognized to reduce the levels of blue-green algae growth in the western lake is reduction of the levels of soluble reactive phosphorus reaching the lake. To that end, the Ohio Environmental Protection Agency (EPA) has convened a Lake Erie Phosphorus Task Force, made up of the Federal and State agencies and university researchers who are studying/controlling the problem. The Task Force is charged with identifying the sources of soluble reactive phosphorus in the watersheds and making recommendations to reduce the delivered concentrations. The activities of the Task Force are tracked on the following Ohio EPA Surface Water web site:

<http://www.epa.state.oh.us/dsw/cafo/PTaskForce/PTaskForceWorkgroup.html>

Significance of Topic to Science and Society, Including the Economy and Quality of Life

In short, if a method to reduce the levels of soluble reactive phosphorus reaching the western lake is not found, this part of the lake is likely to become eutrophic and stagnant. The tourist industry of the 'North Coast' of Ohio centers on lake activities and the masses of blue-green algae will significantly impact these activities. In addition to the public nuisance of rotting mats of *Lyngbya wollei* and *Microcystis* on the beaches and in the shallow waters of the Lake, these algae are toxic. If these algae are collected in the raw water intakes of public-water supplies of the area, the suppliers will either have to explore new methods to treat the water or find alternative sources and these options will require extensive outlays of public funds. The algal mats not washed up on the shores and beaches of the western lake will be carried into the central basin where their decomposition will enhance and expand the 'dead zone'. The expanding dead zone will further impact fishing and tourism in the central and eastern basin of the lake.

As we are learning from the research undertaken by the Ohio EPA Task Force members, even if delivery of soluble reactive phosphorus is reduced, the tipping point in the watersheds and the western lake may have already been reached. Reversing the trend in soluble reactive phosphorus inputs to the Lake will involve more science and educating the people living in the contributing watersheds to undertake land use and lifestyle changes.

Audiences

This interdisciplinary topic requires researchers from a variety of fields to investigate the issues and help solve the problems. The outcomes have extensive ramifications in both public health and the economic stability of the region. One goal of this symposium is that it will attract not only a good cross section of all of the members of the Ohio Academy and their students, but that interested members of the affected community also will attend. To that end, we will publicize this symposium in the area.

This is an extremely complicated, interdisciplinary problem without simple answers. It will require the dedicated efforts of a host of scientists and engineers to define and solve the myriad components of the problem. However, in the end, the solution(s) to the problem will have to be implemented by the citizens living in the watersheds that feed the lake. They will have to modify their lives and their land uses to reduce the food for the exploding blue-green algae populations. If the citizens of the watershed do not understand the magnitude of the problem, they will not be willing to undertake the life-style changes that are necessary to reverse the delivery processes of the soluble reactive phosphorus.

Intended Learning Objectives and/or Benefits for Participants

For a number of the Ohio Academy members coming to the symposium, this may be their first introduction to the topic. The Ohio EPA Task Force members are still identifying the segments of the basins' populations who will hold the keys to solving the problem. We need to expose as many scientists and engineers to the problem as we can so that we can broaden the problem-solving base. It is possible that we will trigger the interest of a student or an established researcher who will then, in later research efforts, help to find some of the solutions we need to keep the soluble reactive phosphorus out of the lake and/or economically remove it once it is there. It has been our experience in the Working Group that broad outreach helps to find the scientists and engineers who can help us answer our questions and concerns. We have found that very often, the people best able to help solve our problems did not even know we needed their help.

As the Ohio EPA Task Force has established, the symposium will provide an atmosphere that will allow people of all backgrounds and disciplines to discuss the issues related to soluble reactive phosphorus and algae in the lake. The symposium will provide the ability for the group present to explore the Lake's condition from a variety of positions. It will promote the atmosphere of synergism that may lead to creative solutions of the problem(s). The symposium should help the current researchers collect ideas and approaches. It will expand our collective knowledge base and may also help to increase the ranks of those working to research/solve the issues at hand.

Symposium Content, Format and Schedule

The Symposium consists of a series of invited presentations. While we have identified several speakers, others were identified as part of the general abstract review. Currently, the following individuals and groups have been identified as presenters.

1. Julie Weatherington-Rice, Co-Coordinator Ohio Fracture Flow Working Group. The Ohio Fracture Flow Working Group will convene the symposium. To begin the discussion, Julie Weatherington-Rice will host the symposium and present an overview of the situation, identify the researchers involved, and outline the land-use practices identified to date by the Ohio EPA Lake Erie Phosphorus Task Force that may be driving the delivery of the soluble reactive phosphorus.

2. The second presentation discusses the topic of the exploding populations of blue-green algae in the western basin and its implications to the economy and health of the region. University of Toledo professor Tom Bridgeman will present this topic.

3. Expanding on Tom Bridgeman's presentation, Hui Wang, also from the University of Toledo, will discuss issues relating to the detection and quantification of the historic *Microcystis* algal blooms in the lake.

4. A connection between the blue-green algae populations and the increase in available reactive phosphorus in the water column is the next necessary link to understanding the problem. This link will be presented by Douglas Kane, Defiance College, building on the work of a team of researchers located at Defiance College, Heidelberg College, and The Ohio State University.

5. Following Douglas Kane's presentation, there will be two presentations led by The Ohio State University researchers exploring other relationships that also impact the water quality in the lake. Joseph Conroy will discuss the annual trends of dissolved oxygen depletion in the lake as it relates to weather.

6. Another member of Conroy's team will further discuss the importance of light penetration and chlorophyll concentrations on metalimnetic oxygen maxima in the lake which drives the formation of the lake's "dead zone".

7. This set of six speakers completes the morning session. At the end of the six presentations, the presenters will convene a panel to answer questions from the audience and/or from the other speakers. The morning session is scheduled to begin at 9:00 AM and finish at 11:00 AM in time for the All-Academy lecture.

8. To begin the afternoon session, the seventh presentation will explain the identification of ever-increasing volumes of soluble reactive phosphorus moving from predominantly agricultural watersheds into the western basin. David Baker from the National Center for Water Quality Research at Heidelberg College will present their historic and current findings.

9. Once the incoming levels of soluble reactive phosphorus have been identified, the next issue is the identification of the source(s) of the phosphorus. Rick Wilson, Ohio EPA Division of Surface Water, will present his experience in sampling for phosphorus, including soluble reactive phosphorus, and then couple those experiences with information gathered from an exhaustive literature search on the topic. This presentation will document the relationship between high phosphorus levels in the surface soils in agricultural land uses and the movement of that excess phosphorus into the surrounding surface water.

10. John Crumrine's research at Heidelberg College's National Center for Water Quality indicates that there is a linkage between existing phosphorus soil test data and soluble reactive phosphorus levels in the watersheds feeding Lake Erie. His findings will be presented in this ninth presentation.

11. After these nine presentations have been given, all of the presenters will convene as a panel of experts who will address questions from the audience. The panel members will discuss current voids in the understanding of the system and identify additional research that needs to be undertaken. Where possible, the panel will make recommendations to the citizens that can be implemented to begin to reduce the loading rates to the lake. The afternoon session is scheduled to begin at 1:30 PM and continue until 3:00 PM and/or until the audience and panel has completed their discussions.

Schedule

It is assumed that a meaningful symposium will last two hours in the morning and at least one hour in the afternoon. Each presenter will need approximately 15 minutes to provide quality information to the attendees. We are expecting that the National Center for Water Quality Research presentation by David Baker may require up to 30 minutes. Therefore, the six presentations and the first panel should be completed in the first two hours of the symposium. The last three speakers and the larger panel are scheduled for at least one and one-half hours in the afternoon.

Qualifications of Speaker and Arranger(s)

The speakers and/or organizations that are being represented are all recognized for their long-term commitment to the topic as well as for the quality of their research and presentations. It is the objective of the Ohio Fracture Flow Working Group to insure the same level of excellence in the symposium presentation.

The Ohio Fracture Flow Working Group has a long and successful working relationship with The Ohio Academy of Science. First organized under the umbrella of the Earth and Space Sciences Section in 1993, the Working Group has held numerous bi-annual stand-alone symposia and field days and joint symposia with The Ohio Academy of Science since the first symposium organized at the 1994 meeting that was also held in Toledo. In addition, members of the Working Group also conducted a symposium and field trip during the April 2006 Geological Society of America North Central Meeting at the University of Akron. The Working Group has also published two special issues of *the Ohio Journal of Science*, the June-September 2000 and the April 2006 issues. A third issue on the broader topic of fractured glacial till is planned to showcase the continuing critical research on this topic.

Abstracts for Each Presentation and the Symposium

Abstracts for each of the presenters have been submitted, peer-reviewed and published beginning on page 8. Abstracts were requested by the Working Group from many of the identified presenters. Other abstracts were identified as part of the general abstract review process.

Dissemination of working papers or presentations

Typically, presentations from Working Group symposia are collected and made available to interested attendees for the nominal cost of duplication and mailing. That effort can be offered for this symposium. In the past, we also have video-taped presentations and made the tapes available in the same way. Both options are available here. These activities clearly fall under the mandate of the Working Group and can be handled without additional assistance from The Ohio Academy and/or by members of the organizing committee.

The Ohio Academy of Science
Annual Meeting-April 12, 2008
The University of Toledo
Lake Erie Symposium Morning Session

Nitschke Auditorium

09:00 AM

INTRODUCTION TO THE "DECLINING WATER QUALITY IN THE WESTERN LAKE ERIE BASIN" SYMPOSIUM. Julie P. Weatherington-Rice, weatherington-ri.1@osu.edu, Bennett & Williams Environmental Consultants Inc., Columbus, OH 43231.

Beginning in the mid-1990s, the National Center for Water Quality Research at Heidelberg College, Tiffin OH, noted an increase in the soluble reactive phosphorus portion of the total phosphorus in surface water collected at their sampling stations in northern Ohio. The levels of soluble phosphorus have continued to increase during the last decade (1997 through 2007), although levels of total phosphorus have remained constant or declined. During the fall of 2006, an invasive southern fresh-water blue-green algae (cyanobacteria), *Lyngbya wollei*, was first identified in Maumee Bay. Identification and habitat research was spearheaded by researchers at University of Toledo's Lake Erie Center. These two research organizations and the Western Lake Erie Association convinced the Ohio Environmental Protection Agency to convene the Lake Erie Phosphorus Task Force, which was charged with identifying the source(s) of the increased levels of soluble phosphorus (consumed by the blue-green algae), and making recommendations for curtailing loading levels. The Task Force has identified a number of sources of soluble phosphorus and is examining them methodically to determine which provide major contributions. Identified sources include agriculture, point sources, urban/residential sources, internal loading in the lake, and other natural sources. This symposium will report on the research efforts of Task Force members and other scientists, including discussions of identified phosphorus reduction techniques that can be adopted by the citizens of the watersheds to slow down and/or reverse the eutrophication of the Lake, ostensibly caused by degradation of algal mats at the bottom of the Lake.

09:15 AM

CHRONOLOGY OF HARMFUL ALGAL BLOOMS IN WESTERN LAKE ERIE: 2002-2007 Thomas B. Bridgeman, Thomas.Bridgeman@utoledo.edu, University of Toledo Lake Erie Center, 6200 Bayshore Rd Oregon OH 43618

Since the mid-1990s, harmful algal blooms have plagued the waters of western Lake Erie with increased frequency. These blooms adversely affect water quality in terms of aesthetics, recreational use, and potentially, human health. In vessel-based observations made from 2002-2007, the most common nuisance species was *Microcystis aeruginosa*, a cyanobacteria that forms blooms during summer months. *Microcystis* blooms from 2002-07 were quantified using biweekly plankton tows (N=145) and a density separation method to separate *Microcystis* from other species. Patterns of bloom timing and density were then compared to USGS data from a major nearby tributary, the Maumee River, that is linked to bloom development by delivering the algal nutrients phosphorus and nitrogen to Lake Erie. Highest summer bloom volumes occurred in years with highest summer river flow (2003, 2004), while the lowest *Microcystis* volume occurred in the driest summer (2002). In addition to *Microcystis*, another cyanobacteria species, *Lyngbya wollei*, previously unreported in Lake Erie, formed large benthic mats along the southern shoreline of Maumee Bay in late summer of 2006. In September 2006, *Lyngbya* mats washed ashore, fouling beaches, private marinas, and shoreline property with layers of biomass up to 1.3 m thick. Early observations of *Lyngbya* mats suggest that the extent of shoreline fouling may depend on wind direction and water currents during the period in late summer when mats become mobile.

9:30 AM

DETECTION AND QUANTIFICATION OF MICROCYSTIS IN LAKE ERIE, OH. Hui Wang (jywanghui@hotmail.com), Cyndee Gruden, Cyndee.Gruden@UToledo.Edu Dept of Civil Engineering, University of Toledo, 2801 W Bancroft St, Toledo OH 43606.

Microcystis blooms occur annually in the Western Lake Erie Basin. *Microcystis* produces a toxin which can be fatal to livestock and humans. Since Lake Erie is a drinking water source and a recreational site, it is necessary to minimize direct impacts to human health. The main objective of this research was to determine the factors affecting the spatial and temporal variation of *Microcystis* during and after a bloom in Western Lake Erie. In this study, surface water samples were collected from six sites (4P, GR1, 8M, MB18, MB20 and 7M) varying in distance from 2 to 30km from the mouth of the Maumee River. In situ measurements included dissolved oxygen concentration, pH, turbidity, and temperature. Samples were collected over a period of 3 months (6 events from July to October) in 2007. Each sample was settled in the graduated cylinder for 48 hours to separate *Microcystis*, and fluorescence microscopy was used to count *Microcystis* cells. *Microcystis* density ranged from 56 to 1.03×10^7 cells/ml. The massive *Microcystis* bloom occurred from mid-July to August when most sites sampled (11 of 18) had densities over 10,000 cells/mL. Site 8M located approximately 15km from the Maumee River had the highest concentration of *Microcystis* for 4 of the 6 sampling events. ANCOVA model was set up and analysis of environmental data as compared to *Microcystis* densities was performed by SAS program. The results suggest that temperature, nutrient concentration, turbidity, and DO concentration may have an impact on the *Microcystis* density.

9:45 AM

DECLINING WATER QUALITY IN WESTERN LAKE ERIE: CORRELATIONS BETWEEN SOLUBLE REACTIVE PHOSPHORUS (SRP) LOADING AND PHYTOPLANKTON BIOMASS. Douglas D. Kane, dkane@defiance.edu, Joseph D. Conroy, conroy.27@osu.edu, R. Peter Richards, prichard@heidelberg.edu, David B. Baker, dbaker@heidelberg.edu, David A. Culver, culver.3@osu.edu Defiance College, Natural Sciences and Mathematics Division, Defiance, OH 43512.

Many hypotheses have been advanced to explain recurrent algal blooms in the western basin of Lake Erie, including abiotic (e.g., total phosphorus load) and biotic (e.g., dreissenid mussel excretion) explanations. We used two long-term (10 + year) datasets to test whether total phytoplankton biomass and cyanobacterial biomass correlated with soluble reactive phosphorus (SRP) loading from agriculturally-influenced tributaries (Maumee and Sandusky rivers) to the western basin of Lake Erie. We constructed linear regression models to determine if total phytoplankton biomass (and cyanobacterial biomass, individually) increased with recent SRP-load increases. Both total phytoplankton and cyanobacterial seasonal (May-October) average (arithmetic mean) wet-weight biomasses (mg L^{-1}) significantly increased with increased water-year total SRP load (metric tons = Mg) for the Maumee River (both total phytoplankton and cyanobacteria biomass vs. SRP load: $P = 0.008$, $R^2 = 0.56$) and the sum of SRP load for the Maumee and Sandusky rivers (total phytoplankton biomass vs. SRP load; $P = 0.007$, $R^2 = 0.57$; cyanobacteria biomass vs. SRP load: $P = 0.008$, $R^2 = 0.56$), but not for the Sandusky River ($P > 0.05$). However, when using seasonal median total phytoplankton and cyanobacterial biomasses as response variables to remove the influence of bloom events and the Beale Ratio Estimator to account for missing SRP data, only the relationship between median cyanobacterial biomass and Beale-ratio estimated SRP load were significant ($P < 0.05$). In conclusion, recent increased western basin tributary SRP loads possibly contribute to increases in phytoplankton biomass and more frequent algal blooms, especially cyanobacteria, in the western basin of Lake Erie.

10:00 AM

COMPARING ANNUAL TRENDS OF DISSOLVED OXYGEN DEPLETION IN LAKE ERIE: THE IMPORTANCE OF WEATHER. Joseph D. Conroy, conroy.27@osu.edu, Aquatic Ecology Laboratory, Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH 43212.

Studies of the temporal dynamics (e.g., dissolved oxygen depletion rate) and the annual areal extent of zones of hypoxia (low oxygen, $< 4 \text{ mg O}_2 \text{ L}^{-1}$) and anoxia (no oxygen, $< 1 \text{ mg L}^{-1}$) in Lake Erie often focus on the perceived influence of external nutrient load and, in turn, the perceived effects of people on affecting oxygen loss. However, bulk hydrodynamic processes as induced by weather may serve to diminish (e.g., through storm-caused mixing) or amplify (e.g., through water-column stagnation with low storm frequency) the effects of nutrient load on hypolimnetic oxygen loss. Here, I investigated how weather (wind speed) and associated hydrodynamic processes (wave height, water level) affected water

column dissolved oxygen concentration (DO) in the Sandusky subbasin of Lake Erie during 2005 and 2006. I measured temperature and DO at 0.5-m intervals with a calibrated multiparameter instrument (YSI Model 6600) at a site in the middle of the Sandusky subbasin on 19 and 17 dates in 2005 and 2006, respectively. Weather and hydrodynamic process data for both years were downloaded from National Oceanic and Atmospheric Administration websites (wind speed and wave height station 45005: <http://www.ndbc.noaa.gov>; water level station 9063079: <http://tidesandcurrents.noaa.gov>) and daily means were calculated. Initial water column stratification occurred in late-May following periods of calm, low wave-height weather conditions. Hypolimnetic DO dropped below 1 mg L⁻¹ by late-June in both years. The hypoxic zone maintained its volume under stagnant conditions and expanded and contracted with increased wind speed, wave height, and water level oscillations indicating the importance of weather and hydrodynamic processes on DO dynamics in Lake Erie.

10:15 AM

THE IMPORTANCE OF LIGHT PENETRATION AND CHLOROPHYLL CONCENTRATION ON METALIMNETIC OXYGEN MAXIMA (MOM) DEVELOPMENT IN LAKE ERIE. Joseph D. Conroy¹, conroy.27@osu.edu , Gwen L. Dubelko², dubelko.2@osu.edu , Sophie B. Lehmann³, slehmann08@wooster.edu , Douglas D. Kane⁴, dkane@defiance.edu , and David A. Culver¹, ¹Dept of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, Ohio 43212, ²School of Environment and Natural Resources, The Ohio State University, ³Dept of Geology, College of Wooster, and ⁴Natural Science and Mathematics Division, Defiance College.

Recurring seasonal hypoxia (low dissolved oxygen DO concentration, < 4 mg O₂ L⁻¹) and anoxia (< 1 mg L⁻¹) greatly affects pelagic and benthic biota in Lake Erie's central basin. Here, we report the presence of metalimnetic oxygen maxima (MOM) throughout the Sandusky subbasin, the southwest portion of the central basin during 2005, 2006, and 2007. Using weekly (or more frequent) vertical-profile sampling of water temperature (degrees Celsius) and DO at 0.5-m intervals at seven sites in the Sandusky subbasin during summer (June-August), we found that MOM frequently occurred (in 72 of 135 DO vertical profiles) during 2005-2007. We hypothesized that the shallow depth (mean depth = 13.3 m relative to the central basin mean depth = 18.5 m) and high productivity (as chlorophyll *a* concentration, Chl *a*) of the Sandusky subbasin permitted adequate light penetration (as Secchi Disk transparency, SD) facilitating metalimnetic phytoplankton growth. We tested this prediction in 2007 and found that deeper, eastern subbasin sites more frequently had DO profiles with MOM than shallower, western subbasin sites (about 67% of the profiles versus 33% for eastern and western sites, respectively). However, neither Chl *a* nor SD predicted MOM occurrence ($P > 0.05$, $R^2 < 0.10$). These results reveal that either light penetration or the presence of primary producers is unimportant for MOM occurrence or that our temporal and spatial scales of investigation did not appropriately identify effect scales. Nevertheless, occurrence of MOM in the Sandusky subbasin and possibly the rest of the central basin may ameliorate hypoxic and anoxic conditions.

10:30-11:00 AM: Morning Panel Discussion

Lake Erie Symposium Afternoon Session Nitschke Auditorium

1:30 PM

INCREASING TRENDS IN DISSOLVED PHOSPHORUS LOADING TO LAKE ERIE FROM NORTHWESTERN OHIO WATERSHEDS: 1994-2007. David B. Baker dbaker@heidelberg.edu, John P. Crumrine jcrumrin@heidelberg.edu, R. Peter Richards prichard@heidelberg.edu, and Jack W. Kramer jkramer@heidelberg.edu. National Center for Water Quality Research, 310 E. Market St, Tiffin OH 44883.

To support nutrient management programs in the Lake Erie Basin, the National Center for Water Quality Research at Heidelberg College has been monitoring the export of nutrients and suspended sediments from northern Ohio watersheds since 1975. Using automatic samplers located at U.S. Geological Survey stream gages, three or four samples per day have been collected on a year-round basis, with multiple samples per day analyzed during storm events and single samples per day during non-storm periods. Between 1976 and 1985, total phosphorus loads to Lake Erie averaged 13,299 metric tons, with nonpoint sources accounting for 72% of the total. These observations led to the initiation of various conservation tillage programs to reduce erosion and export of suspended sediments and particulate phosphorus. Between 1976

and 1995, these conservation programs resulted in reductions in suspended solids and total phosphorus loading from the Maumee and Sandusky watersheds by 22% and 44%, respectively. Dissolved reactive phosphorus had dropped by an even larger 86%. Although suspended sediment and particulate phosphorus loading has continued to decline since 1995, dissolved reactive phosphorus loading has increased dramatically, now reaching or exceeding the late 1970 values. Because 100% of dissolved reactive phosphorus is bioavailable to algae, these loading trends warrant examination as potential causes of recently observed increases in blue-green algal growth in western Lake Erie. The dissolved phosphorus loading from the Maumee and Sandusky watersheds is primarily associated with storm runoff events, which indicates that agricultural runoff is the major cause of the increased soluble phosphorus export.

2:00 PM

PHOSPHORUS TRANSPORT FROM THE SOIL TO SURFACE WATER, FIELD OBSERVATIONS SUPPORTED BY A REVIEW OF CURRENT LITERATURE. Patrick D. (Rick) Wilson Rick.Wilson@epa.state.oh.us. Ohio EPA, Division of Surface Water, CAFO Unit, Columbus, Ohio, 43216.

As part of the investigative practices of the Division of Surface Water-Concentrated Animal Feeding Operation Unit at the Ohio EPA, surface and subsurface drainage and in-stream water quality samples are collected during runoff events from the agricultural landscape (including manure application sites). Water quality analyses of these events indicate that the soluble phosphorus component of the total phosphorus concentration may be more significant than is regularly reported, and demonstrates the need for more multivariate data collection at the sub-watershed scale. These analyses support the data collected by the National Center for Water Quality Research at Heidelberg College, and also highlight the need to associate water quality data with watershed nutrient management and soils data. Because of significant increase of both soluble reactive phosphorus loads in watersheds draining into Lake Erie and blue-green algae populations in the western basin, the Ohio EPA established the Lake Erie Phosphorus Task Force. The Task Force has conducted an extensive literature review to further understanding of the relationship of phosphorus build-up in soils, nutrient management in the agricultural landscape and the translocation of soluble reactive phosphorus to surface water. Although cursory, field investigations and sampling of runoff in agricultural regions of the state (where nutrients are applied in the form of manure, and inorganic fertilizer) seem to correlate well with research conclusions from literature that suggest nutrients will be lost where nutrients are applied to land such that it is prone to runoff. Consequently, improved nutrient management techniques for fertilizers (timing, rate, form) will reduce the load of runoff from land.

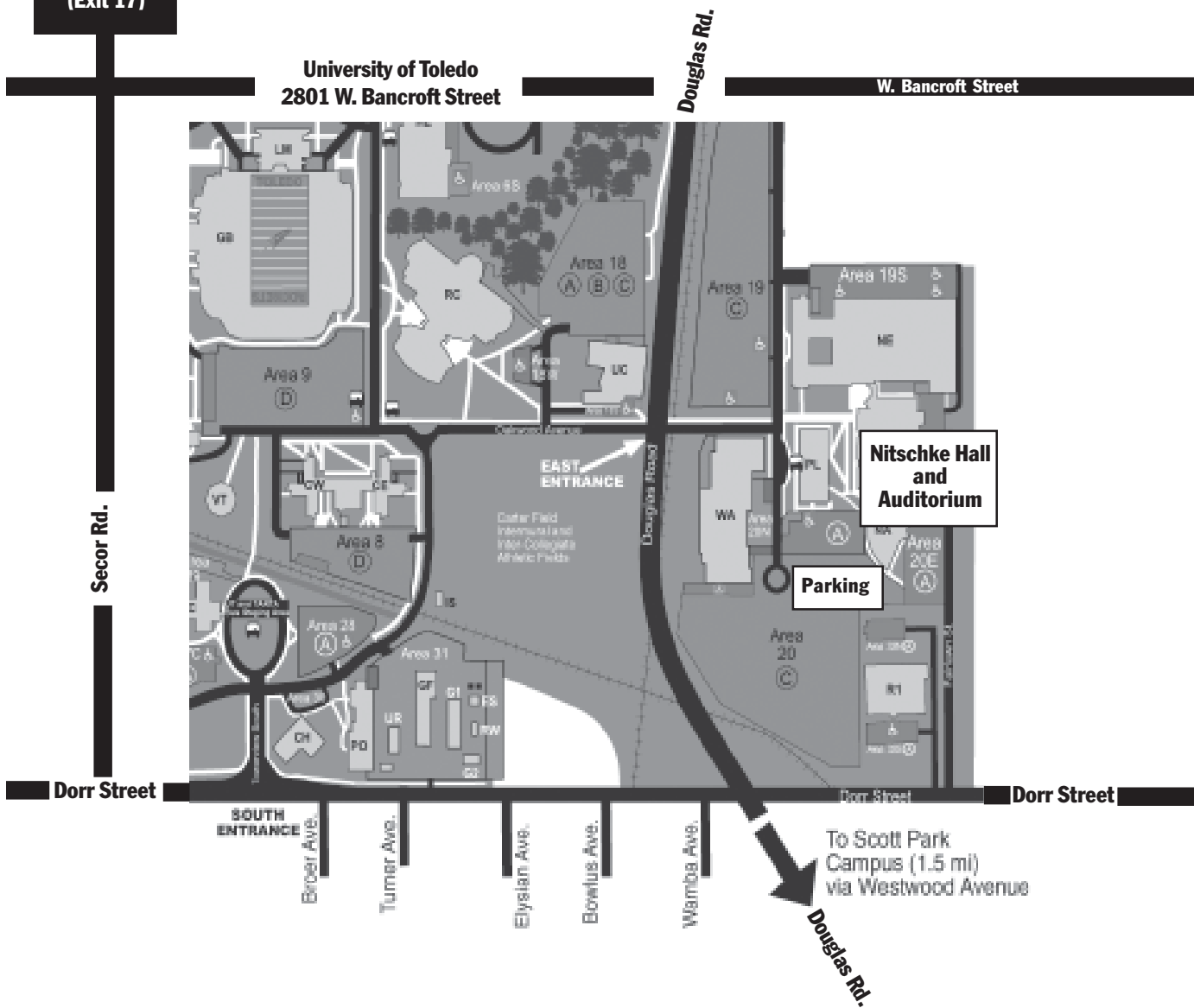
2:15 PM

ELEVATED SOIL TEST PHOSPHORUS LEVELS MAY EXPLAIN INCREASING DISSOLVED REACTIVE PHOSPHORUS CONCENTRATIONS AND LOADS IN WESTERN LAKE ERIE TRIBUTARIES. John P. Crumrine jcrumrin@heidelberg.edu, David B. Baker dbaker@heidelberg.edu, R. Peter Richards prichard@heidelberg.edu. National Center for Water Quality Research, 310 E. Market St, Tiffin, OH 44883.

Over the past 12 years concentrations and loads of dissolved reactive phosphorus (DRP) have been increasing in western Lake Erie tributaries and may be leading to increased blue green algae growth and degraded water quality for swimming, fishing, and drinking. In the predominantly agricultural watersheds of the Maumee and Sandusky rivers, northwest Ohio DRP increases came from one or more of three sources: commercial fertilizers, animal manures, and soil fertility measured by soil test phosphorus (STP). An evaluation of STP data from commercial laboratories indicates that STP levels average twice those needed for optimal corn and soybean production. Data further show that reduced and no-tillage crop production systems can elevate STP levels at the 0-2 inch (0-5 cm) depth by as much as two times over levels from a standard 0-8 inch (0-20 cm) soil test. In counties having large livestock or poultry numbers, where past manure application has produced high standard STP levels, reduced tillage and no-till can cause very high STP levels at the 0-2 inch (0-5 cm) depth. In a study to evaluate phosphorus stratification in cropland soils of the Rock Creek watershed, Seneca County, Ohio, STP levels at the 0-2 inch (0-5 cm) depth were doubled under no-tillage and increased one and a half times under reduced tillage systems compared to a standard 0-8 inch (0-20 cm) soil test. As contrasted to commercial laboratory data, standard STP levels were not highly elevated, partly because of low livestock numbers within the watershed.

Registration and all sessions are in Nitschke Hall in the extreme southeast section of the campus.

<http://enrollmentservices.utoledo.edu/pages/directions.asp>



How to get to The University of Toledo

2801 W. Bancroft
Toledo, Ohio 43606-3390

See: <http://enrollmentservices.utoledo.edu/pages/directions.asp>

From the Ohio Turnpike (Use Exit 64):

- Follow I-75 north to I-475 (Exit 204).
- Travel west on I-475 to the fourth exit, Secor Road (Exit 17).
- Turn left onto Secor Road.
- Proceed on Secor Road past Bancroft Street.
- You are now at UT. Please refer to the map (or confirmation letter, if applicable) for specific program locations.

Via I-75 from the North:

- Continue south on I-75 to I-475 (Exit 204).
- Travel west on I-475 to the fourth exit, Secor Road (Exit 17).
- Turn left onto Secor Road.
- Proceed on Secor Rd. past Bancroft Street.
- You are now at UT.

Via I-75 from the South:

- Continue northbound on I-75 past downtown Toledo to I-475 west (Exit 204, Ann Arbor/Sylvania).
- Note: Do not take the first I-475 exit south to Perrysburg.
- Travel west on I-475 to the fourth exit, Secor Road (Exit 17).
- Turn left onto Secor Road.
- Proceed on Secor Rd. past Bancroft Street.
- You are now at UT. Please refer to the map .

Via U.S. 23 from the North:

- Continue south on U.S. 23 to I-475 east (Exit 14, bear left).
- Follow I-475 east to the second exit, Secor Road (Exit 17).
- Turn right onto Secor Road.
- Proceed on Secor Rd. past Bancroft Street.
- You are now at UT. Please refer to the map (or confirmation letter, if applicable) for specific program locations.

