38th Annual Meeting
OF THE
MIDWEST AQUATIC PLANT MANAGEMENT SOCIETY

February 26 - March 1, 2018

Program / Abstracts / Posters

MISSION

The purpose of the Midwest Aquatic Plant Management Society (MAPMS) is to:

- Promote sound and appropriate technologies for the management of aquatic resources
- Provide opportunities for educational advancement
- Encourage relevant scientific research in the discipline
- Promote the exchange of information
- Expand and develop public interest in aquatic resources and their sustainable management

VISION

MAPMS vision is to be a relevant, respected and responsive resource for the Aquatic Resource Management Community

MAPMS provides information and assistance required by those who work with the unique ecological, sociological, economical and regulatory concerns associated with managing aquatic plants in lake systems affected by exotic species, nutrient pollution, use conflicts and intense recreational demands.

STRATEGIC GOALS

- Improve and expand communication with regulators
- Improve and expand communication with students and academia
- Improve our website and internet presence
- Engage membership
- Fundraising

www.mapms.org

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The opinions expressed by presenters, speakers, discussion panelists, committee members, and exhibitors are those of said individuals and are not necessarily those of The Midwest Aquatic Plant Management Society, its Board of Directors, or sponsors.

Past Presidents / Meeting Sites

2017	Dick Pinagel	Milwaukee, WI
2016	Jacob Meganck	Grand Rapids, MI
2015	John Goidosik	Indianapolis, IN
2014	Tyler Koschnick	Lombard, IL
2013	Matthew Johnson	Cleveland, OH
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2010	David Isaacs	Indianapolis, IN
2009	Jason Broekstra	Lisle, IL
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2004	David Isaacs	Lisle, IL
2003	Bill Kirkpatrick, Jr.	Columbus, OH
2002	Ray VanGoethem	Milwaukee, WI
2001	Edward Braun	Grand Rapids, MI
2000	Bill Ratajczyk	Indianapolis, IN
1999	Robert Johnson	St. Charles, IL
1998	Joe Bondra	Huron, OH
1997	Shane Orr	Madison, WI
1996	Steve Metzer	Battle Creek, MI
1995	Scott Jorgenson	Indianapolis, IN
1994	Greg Cheek	St. Charles, IL
1993	Everett Lienhart	Huron, OH
1992	Gary Johnson	Milwaukee, WI
1991	G. Douglas Pullman	East Lansing, MI
1990	Howard Krosch	Indianapolis, IN
1989	Richard Hinterman	South Bend, IN
1988	James Schmidt	Columbus, OH
1987	Carole Lembi	Grand Rapids, MI
1986	David Eisentrout	Genova Fontana, WI
1985	Nick Gowe	Ft. Wayne, IN
1984	Richard Hinterman	Indianapolis, IN
1983	Robert Johnson	Ft. Wayne, IN
1982	Richard Soper	Midland, MI
1981	Robert Johnson	West Lafayette, IN
1980	Robert Johnson	West Lafayette, IN

HONORARY MEMBERS

Has contributed significantly to the field of aquatic vegetation management. A voting member of the Society for no less than five years. Has actively promoted the Society and its affairs during their membership. Elected by unanimous vote of the Board of Directors. Honorary Members shall hold all rights of active membership in perpetuity.

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Ed Braun

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Dr. Greg Cheek

Jim Schmidt

Distinguished Service Award (President's Award) Recipients

Awarded at the President's discretion. Successful completion of a project taking considerable effort and time resulting in advancement of plant management science, educational outreach and performance above and beyond the call of duty as an officer, chair or special representative of MAPMS; or member or non-member achievement in the science of aquatic plant management and/or participation in MAPMS leading to the advancement of its members, goals, and objectives. Award may be used for an individual, agency, corporation, institution, or other organization in recognition of service.

Joe Bondra (2012)

David Isaacs (2014)

Leah Rust-Essex (2017)

Robert L. Johnson Memorial Research Grant Recipients

Grants are competitively awarded to qualified graduate students pursuing a degree in aquatic plant management or related field at any accredited university or college, or independent research which contributes to the mission of the Society. MAPMS considers all applications pertaining to research dealing with aquatic plant management, including ecology or biology of aquatic plants, and chemical, mechanical, or biological control of aquatic weeds. Winners are announced at the annual conference each year. Recipients are required to present their research findings at the annual conference the following year.

Ryan Van Goethem - Michigan Technological University (2017)

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Ciera Kinley - Clemson University (2016)

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Alyssa Calomeni - Clemson University (2015)

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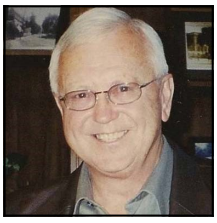
Justin Nawrocki - North Carolina State University (2013)



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2020 Time and Place - Indianapolis:	*Jake Britton—Chair*
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Special class of membership for institutions and organizations interested in the advancement of the Society and its goals. MAPMS is grateful to these companies for their support!

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2018 MAPMS 38th ANNUAL CONFERENCE

Schedule of Events

February 26th - March 1st, 2018

MONDAY February 26, 2018

1:00 pm - 5:00 pm	MAPMS Pre-Conference Board Meeting	(Stelis)
1:00 pm - 5:00 pm	Conference Registration	(Orchid Foyer)
1:00 pm - 5:00 pm	Exhibitor Set-Up	(Orchid East)
5:30 pm - 6:30 pm	Student & New Member Mixer	(House of Blues)
6:30 pm - 10:00 pm	*President Hausler invites you to join him for a catered reception with cash bar and live music*	(House of Blues)

TUESDAY, February 27, 2018

6:00 am - 7:00 am	Exhibitor Set-Up	(Orchid East)
7:00 am - 8:00 am	Continental Breakfast	(Orchid East)
7:00 am - 5:00 pm	Exhibits Open	(Orchid East)
7:00 am - 5:00 pm	Conference Registration	(Orchid Foyer)
8:00 am - 9:20 am	Session A (HAB Session I)	(Orchid West)
9:20 am - 10:00 am	Refreshment Break / Posters- Sponsored	(Orchid East)
10:00 am - 11:20 am	Session B (HAB Session II)	(Orchid West)
11:20 am - 1:00 pm	Lunch - On your own	
11:20 am - 1:00 pm	Past President Luncheon	(Caladenia 7th Floor)
1:00 pm - 2:20 pm	Session C (Invasive Awareness & Management)	(Orchid West)
2:20 pm - 3:00 pm	Refreshment Break / Posters - Sponsored	(Orchid East)
3:00 pm - 4:40 pm	Session D (General Management Practices)	(Orchid West)

TUESDAY February 27, 2018

SESSION - A (HAB Session I) 8:00 am - 9:20 am (Orchid West)

Moderator: Matthew Johnson, Director MAPMS

8:00 am	Opening Announcements and Welcome. Paul Hausler, President MAPMS
8:10 am	Lake Erie Algae, Nutrient Loading, and Current Research Efforts. Dr. Kristen Fussell, OSU & Ohio Sea Grant
8:40 am	The Role of Phosphorus, Nitrogen, and Light on Lake Erie Cyanobacterial Bloom, Biomass & Toxicity. Justin Chaffin, Research Coordinator, Stone Laboratory OSU & Ohio Sea Grant
9:00 am	Microcystin-LR Degradation Following Copper-Based Algaecide Exposures. Ciera M. Kinley, Ph.D. Candidate, Clemson University ***Student Presentation***
9:20 am	*BREAK/POSTER VIEWING* (Orchid East)

SESSION B (HAB Session II) 10:00 am - 11:20 am (Orchid West)

Moderator: David Nicholson, Director MAPMS

10:00 am	Effects of Nitrifying Bacteria in Limiting Cyanobacteria Growth. Dalton Sink, Aquatic Biologist, Aqua-Weed Control, Inc. ***Student Presentation***

10:20 am	Control of HABs Through a More Rational Use of Copper: Deepening the Conversation About Cell Lysis and Cyanotoxins—"What's Really Happening?" David Hammond, Ph.D., Senior Scientist, Earth Science Labs
10:40 am	Cyanobacteria Management in California with Liquid Activated Peroxygen Algeacide/ Cyanobacteriacide. Tom Warmuth, BioSafe Sytems, Inc.
11:00 am	HAB Panel Discussion—Question and Answer Session Moderated by Dr. John Rodgers , Including All HAB Speakers.
11:20 am	LUNCH (on your own) Past President's Luncheon Plated Lunch (Caladenia 7th Floor)

SESSION C (Invasive Awareness and Management) 1:00 pm - 2:40 pm (Orchid West)

Moderator: Eric Schutman, Director MAPMS

1:00 pm	Invasive Aquatic Plants in Missouri. Kendra Flores, Aquatic Habitat Specialist, Missouri Dept. of Conservation
1:20 pm	Wisconsin DNR's Decontamination and Disinfection Manual Code. Maureen Ferry, Statewide Aquatic Invasive Species Monitoring Lead, Wisconsin Dept. of Natural Resources
1:40 pm	Effects of Invasive Macrophytes on Littoral Primary Producers in North-Temperate Lakes. Ryan Van Goethem, Graduate Student, Michigan Technological University; ***Student Presentation***, *2017 Robert L. Johnson Memorial Research Grant Recipient*
2:00 pm	Ohio's Reaction to the Discovery of Grass Carp Reproduction in the Sandusky River. John Navarro, AIS Program Administrator, ODNR Division of Wildlife
2:20 pm	An Update on Aquatic Plant Management Policy Development in Wisconsin Scott Provost, Wisconsin Statewide Aquatic Plant Management Coordinator
2:40 pm	*BREAK/POSTER VIEWING* (Orchid East)

SESSION D (General Management Practices) 3:10 pm - 4:50 pm (Orchid West)

Moderator: Amy Kay, Director MAPMS

3:10 pm	New Uses For Stingray (Carfentrazone-ethyl) For Invasive Aquatic Weed Management. Leif Willey, Lake & Special Projects Supervisor, Aquatic Control, Inc.
3:30 pm	Field Response of Crested Floating Heart to Endothall Treatments Over Two Years. Justin Nawrocki, Accounts Manager, UPI
3:50 pm	Hard Water Affect on Chemistry. Moe Finke, Account Manager, Brewer International
4:10 pm	Small Pond Management Using Harpoon Herbicide. Ryan M. Wersal, Lonza Water Care; Gray Turnage, Mississippi State University; Craig Aguillard, Winfield United; and Adam Hater, Jones Fish Hatcheries, Inc.
4:30 pm	Aeration of a Shallow Eutrophic Lake, What To Expect. Patrick Goodwin, Research Scientist, CLM, Vertex Water Features
4:50 pm	**ADJOURN**

WEDNESDAY February 28, 2018

7:00 am - 8:00 am	Continental Breakfast	(Orchid East)
6:00 am - 4:50 pm	Exhibits Open	(Orchid East)
7:00 am - 11:00 am	Conference Registration	(Registration Table)
8:00 am - 9:30 am	Session E (Invasive Milfoil)	(Orchid West)
9:30 am -10:00 am	Refreshment Break / Posters	(Orchid East)
10:00 am - 11:30 am	Session F (Starry Stonewort)	(Orchid West)
11:30 am - 1:00 pm	Lunch - On your own	
11:30 am - 1:00 pm	Student/Govt Affairs Lunch	(Stanhopea)
1:00 pm - 2:40 pm	Session G(Hydrilla & Curly-leaf Pondweed Management)	(Orchid West)
2:40 pm - 3:10 pm	Refreshment Break / Posters	(Orchid East)
3:10 pm - 4:10 pm	Session H (Membership Meeting)	(Orchid West)
3:10 pm - 5:00 pm	Exhibit Tear-down	(Orchid East)
7:00 pm - 10:00 pm	**38th Annual MAPMS Awards Banquet**	(Orchid West)

SESSION E (Invasive Milfoil) 8:00 am - 9:30 am (Orchid West)

Moderator: Jake Britton, Vice President MAPMS

8:00 am APMS Update. Dr. John Rodgers, APMS President

8:20 am Mesocosm and Field Evaluation of Eurasian and Hybrid Watermilfoil Response to Endothall in Jefferson Slough, Montana. Paula Guastello, Graduate Student, Montana State University, ***Student Presentation***

8:40 am Planning and Evaluating Large-Scale Herbicide Treatments for Control of Invasive Milfoil in Challenging Scenarios. Eddie Heath, Aquatic Ecologist, Onterra, LLC

9:00 am Eurasian and Hybrid Watermilfoil Management in Michigan. Dr. G. Douglas Pullman, Ph.D., Aquest Corporation

9:30 am *BREAK/POSTER VIEWING* (Orchid East)

SESSION F (Starry Stonewort) 10:00 am - 11:30 am (Orchid West)

Moderator: John Goidosik, Secretary MAPMS

10:00 am AERF Update & Applicator Safety. Carlton Layne, Executive Director, AERF

10:20 am Management of *Nitellopsis obtusa* (starry stonewort) in a Recently Infested Minnesota Lake Using a Copper-Based Algaecide. Tyler Geer, Ph.D. Student, Clemson University, ***Student Presentation***

10:40 am Assessment of Starry Stonewort Plant Heights, Control, and Pre and Post Treatment Bulbil Counts in Long Lake Wisconsin. Jeff Stelzer, VP of Operations/Senior Biologist, Lake and Pond Solutions Co.

11:00 am Strategies for Intervening in *Nitellopsis obtusa* (Starry Stonewort) Infestations. Dr. John H. Rodgers Jr., Professor of Environmental Toxicology, Clemson University

11:30 am Student/Govt Affairs Luncheon, Plated Lunch
Sponsored by AERF (Stanhopea)

11:30 am LUNCH (on your own)

WEDNESDAY February 28, 2018

SESSION G (Hydrilla & Curly-leaf Pondweed Management) 1:00 pm - 2:40 pm (Orchid West)

Moderator: Landon Wiet, Director MAPMS

1:00 pm	Battling Hydrilla-A Multifaceted Approach to Eradication. Kara Tvedt, Fisheries Management Biologist, Missouri Dept. of Conservation
1:20 pm	Successful Eradication of Monoecious Hydrilla From Lake Manitou, Indiana. JT Gravelie, Field Research Assessment Coordinator/GIS Administrator, SePRO Corp.; Eric Fischer, Aquatic Invasive Species Coordinator, IDNR; Doug Keller, Aquatic Habitat Coordinator, IDNR; Mark Heilman, Ph.D., Senior Aquatic Technology Leader, SePRO Corp.
1:40 pm	Early Detection and Rapid Response to *Hydrilla verticillata* in the Lake Erie Drainage Basin. Mark Warman, Hydrilla Project Coordinator, Cleveland Metroparks
2:00 pm	Efficacy of Endothall+2,4-D for Curlyleaf Pondweed (*Potamogeton crispus*) Control Under Simulated Fall Conditions. Kristen Tanz, Graduate Student; Mirella F. Otiz, Graduate Student; Scott J. Nissen, Professor, Colorado State University; and Cody J. Gray, Field Development Representative, UPI, ***Student Presentation***
2:20 pm	Managing Lake Water Clarity and Color. Patrick Goodwin, Research Scientist, Research and Development, Vertex Water Features and Aquatic Systems Inc.
2:40 pm	*BREAK/POSTER VIEWING* (Orchid East)

SESSION H (Membership Meeting) 3:10 pm - 4:10 pm (Orchid West)

3:10 pm	MAPMS Annual Membership Meeting and Election of Officers. Paul Hausler, President MAPMS
3:10 pm	Tear Down: Exhibitor tear-down. Exhibitors

BANQUET

6:30 - 7:00 pm	Reception/Silent Auction	(Orchid West)
7:00 - 10:00 pm	**38th ANNUAL MAPMS AWARDS BANQUET**	(Orchid West)
	**Silent Auction * Box Raffle *Cash Bar *Great Food* **Installation of Officers and Directors*	

THURSDAY March 1, 2018

MAPMS BOARD OF DIRECTORS MEETING

8:00 am - 2:00 pm Post Conference Board of Directors Meeting (Boardroom 23rd Floor)

MAPMS members welcome to attend. Please notify a Board Member prior to the meeting so that seating arrangements can be made.

Technical Poster Presentations

Managing Invasive Aquatic Macrophytes Using Controlled Water-Level Drawdowns in a Temperate Flowage

Maxwell Beal, Northland College
bealm786@myemail.northland.edu

The aquatic invasive Eurasian watermilfoil (*Myriophyllum Spicatum*) has become a common problem in Wisconsin lakes. Eurasian watermilfoil outcompetes native species forming dense mats that can impede recreation and outcompete native aquatic plants. Many management strategies have been developed for controlling Eurasian watermilfoil but most struggle to deal with the issue on a large scale. The presence of a dam on a lake creates a unique opportunity for large-scale Eurasian watermilfoil management through controlled water-level drawdowns. In summers from 2005 to 2017, we monitored Eurasian watermilfoil and native aquatic macrophytes through point intercept surveys on the Chippewa Flowage in Sawyer County, WI. Throughout this time, we have been able to compare compositions of aquatic macrophytes communities using the Floristic Quality Index (FQI) with and without water-level drawdowns. Preliminary results suggest that controlled water-level drawdowns greatly reduce Eurasian watermilfoil populations, increase the FQI score of the lake, and benefit species with high coefficients of conservatism.

Importance of Phosphorus Mitigation in Managing Nuisance Algae

Ben Willis, Aquatic Development Scientist, SePRO Corporation
ben.willis@sepro.com

Phosphorus pollution can significantly impair freshwater resources due to correlations with nuisance algae, densities and degraded water quality parameters (i.e. pH, biological oxygen demand, turbidity, total suspended solids). Strategies to address external inputs of phosphorus (e.g. best management practices) are important for source control, although there are still numerous inputs unable to be controlled and cycling of accumulated phosphorus can be a significant source for decades. Managing nutrient ratios (N:P; Si:P) by specifically removing in situ P can positively shift nutrient ratios and govern algal types/densities. Understanding sediment P sources is also important in management as exploitation of legacy P is a critical aspect of nuisance algal ecology. This research measured the impact of a specific P mitigation technology (Phoslock) at removing water column P and immobilizing sediment associated P. The shift in N:P ratios and algal assemblage composition were also analyzed. Multiple sites throughout the United States (CA, NC, VA) will be presented where Phoslock was applied. Objectives of field case studies included: 1) to measure the change phosphorus levels post-treatment, 2) to measure impacts of Phoslock on water quality, and 3) to evaluate algae types and densities through time. Phoslock significantly ($p<0.005$) decreased total (>80 %) and free reactive (>95 %) phosphorus in the water column and significantly shift potentially releasable sediment phosphorus fractions to residual forms after treatment in field applications. This shift in P availability altered the subsequent N:P ratio as well as the availability of sediment P stores. Algal assemblages either maintained beneficial types (i.e. offset nuisance cyanobacteria from arising) or shifted away from cyanobacterial dominance. Specific targeting of in situ P sources is important to consider in algal management programs especially with increased regulatory scrutiny and restrictions on pesticide use. Phoslock can provide an effective and ecologically friendly approach to combat the eutrophication process and restore water quality.

Evaluation of Chemical Control Strategies for Starry Stonewort (*Nitellopsis obtusa*)

Ben Willis, Aquatic Development Scientist, SePRO Corporation
ben.willis@sepro.com

Starry Stonewort (Nitellopsis obtusa; SSW) is an invasive macroalga spreading throughout the Northeast and Midwest US. It can form dense growths known as 'pillows' that outcompete native plants and obviate wildlife habitat. More information is needed on effectiveness of control measures to inform management decisions. In this research, USEPA registered chemical control products were evaluated in order to provide effective options for rapid response to prevent spread and control existing populations. Bench and mesocosm scale testing from stable cultures maintained at the SePRO Research and Technology Campus were used to assess impacts to SSW filaments, rhizoidal tissue and bulbil viability. The granular ethylene diamine chelated copper complex (Komeen Crystal® aquatic herbicide) delivered copper to the benthic growing mats and provided significant control of above ground biomass as well as impacts to bulbil viability. Stingray herbicide, a PPO inhibitor, provided rapid loss of integrity of apical growing tips as well as control of above ground biomass alone and when combined with diquat dibromide. This research demonstrates the potency of different active ingredients and formulations for interacting with toxic sites of action and increasing the extent and longevity of SSW control.

Oral Presentations

Sessions A thru D Tuesday, February 27

SESSION A

HAB Session I

Lake Erie Algae, Nutrient Loading, and Current Research Efforts

Dr. Kristen Fussell, Assistant Director of Research and Administration, The Ohio State University
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A glimpse into the >50 projects currently managed by Ohio Sea Grant and OSU's Stone Laboratory with assistance from the University of Toledo (~$6,800,000). These research efforts aim to: (1) improve use of existing technologies and to develop new methods to detect HABs and their movements; (2) assess the health impacts of HABs and their associated toxins; (3) develop new treatment methods for contaminated drinking water that removes both algal particles and the toxins produced by cyanobacteria; and (4) assess the ability of land use changes to reduce nutrient inputs into aquatic ecosystems. Additionally, talk will highlight: (1) nutrient sources today, (2) our understanding of agricultural nutrient losses, (3) effective best management practices (BMPs), (4) farmer decisions, (5) possible strategies to move toward a 40% P reduction, and (6) information gaps and research needs.

The Role of Phosphorus, Nitrogen, and Light on Lake Erie Cyanobacterial Bloom Biomass and Toxicity

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Nitrogen (N), phosphorus (P), and light are known to have constraining effects on cyanobacteria growth and microcystin (MCY) production, but their interactive effects are less known. Samples collected from Lake Erie and analyzed for N, P, MCY, and cyanobacteria biomass have indicated that the bloom becomes less toxic throughout the summer as N availability decreases. Laboratory experiments showed that additions of N to late summer bloom water stimulated bloom growth and toxin production, whereas P additions had no effect. The effects of N were more profound at high light than low light levels. Taken together, these results suggest N has a larger role than P on bloom toxicity; however, P remains important for overall bloom biomass.

Microcystin-LR Degradation Following Copper-Based Algaecide Exposures

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Copper-based algaecides are used in aquatic systems to decrease densities of cyanobacteria, and the fate of endotoxins (e.g. microcystins; MCs) is often of concern, due to their potential for human health and ecological risks. In addition, episodic low dissolved oxygen (DO) concentrations (< 2 mg L^{-1}) are possible, due to oxygen consumed via microbial oxidation of algal detritus which may alter rates of MC degradation. In this study, the influence of rapid onset of low DO conditions on resident bacterial assemblages, and potential for altered rates of microcystin-LR (MC-LR) degradation were evaluated. Densities of cyanobacteria were expected to positively correlate with rates and extents of DO decline given the mass of DO required for microbial degradation of cyanobacteria detritus following an algaecide exposure. In addition, since each cell should produce a given amount of MC-LR, total MC-LR concentrations (sum of aqueous and cellular) were also anticipated to correlate with cell density of cyanobacteria. Mesocosm experiments were conducted in a pond in Anderson, SC frequently experiencing cyanobacteria blooms. Three densities of cyanobacteria ($1x10^6$ [low], $5x10^6$ [medium], and $1x10^7$ [high] cells mL^{-1}) were exposed to a copper ethanolamine algaecide. DO and total MC-LR concentrations were measured with time following algaecide exposures to determine rates and extents of declines. DO concentrations had the highest rate of decline in the highest cell density treatment, followed by medium and low cell densities, and DO concentrations remained < 2 mg L^{-1} through the duration of MC-LR degradation in all treatments. MC-LR degradation occurred at similar rates (half-lives 1 to 1.9-d) among different initial cell densities. *Acinetobacter* and *Aeromonas* were dominant in treatments following copper exposures, yet, occupied minimal fractions of bacterial assemblages in untreated controls, indicating these genera may be able to utilize MCs for carbon and energy, especially in low DO (i.e. < 2 mg L^{-1}) conditions. MC-LR half-lives were comparable to measured half-lives in previous studies under both aerobic and anaerobic conditions. Although half-lives of degradation were similar, at higher cell densities, MC-LR concentrations were increased, confirming the benefits of taking action in early growth stages to minimize densities of cyanobacteria and concentrations of MCs.

SESSION B

HAB Session II

Effects of Nitrifying Bacteria in Limiting Cyanobacteria Growth

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Cyanobacteria (blue-green algae) in waterbodies, like Microcystsis aeruginosa can have negative impacts on the overall health of the water body. The cyanobacteria can outcompete other types of algae and form a monoculture. This has been seen more in recently due to increased global temperature, causing warmer water temperatures, and higher nutrient levels due to increased run-off and erosion, known as cultural eutrophication. Increased growth of cyanobacteria is referred to as cyanobacteria harmful algae blooms (cHAB). As the blooms increase in size the chance of cyanotoxins being released increases, which can cause harm to humans. Currently, the only method to reduce the cHAB is to react to their presence with algaecides. This can be an effective method for smaller blooms, but as the bloom grows it is no longer a viable method. The algaecides lyse the cyanobacteria killing the cell. If any cyanotoxin is present when the cell is lysed it is released into the system. If a high enough concentration of cyanotoxin is present in the water, it can cause harm to humans when it enters the body. The current strategy used to eliminate cyanobacteria is restricted by the manufacturers, state, and federal governments; making it challenging to properly manage these blooms. To get ahead of these blooms proactive methods need to be investigated. Nitrifying and denitrifying bacteria have the potential to outcompete cyanobacteria for nutrients like nitrogen and phosphorus. Using nitrifying bacteria to compete with Microcystsis aeruginosa for nitrogen could be a way to deter the growth. These nitrifying bacteria can also temporarily bind phosphorous adding more stress to the cyanobacteria causing reduced growth. The nitrifying bacteria are cultured in a laboratory setting by a company called Aquafix Inc. Their main goal is to create products using microbes to limit nutrients in waterbodies and create healthier water systems. The purpose of this study is to determine if nitrifying bacteria can compete with Microcystsis aeruginosa to deter their growth. Mesocosm studies will be conducted in a controlled environment to test the science behind these proactive methods and products and determine if they are a viable alternative to the current reactive methods used.

"Control of HABs Through a More Rational Use of Copper: Deepening the Conversation About Cell Lysis and Cyanotoxins – What's Really Happening?"

David Hammond Ph.D., Senior Scientist, Earth Science Labs
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Frequency and severity of Harmful Algae Blooms (HABs) across the U.S. have increased markedly in recent years, affecting plant operations and even forcing temporary closure of several WTPs as a result of taste and odor issues and/or fear of cyanotoxins. Copper-based algaecides have been an important tool for many decades in management of source water – to the extent that in some jurisdictions copper has been over-used and there has been a backlash against it. But recent advances have led to more efficient formulations of copper, permitting superior performance with less chemical applied and less impact on the environment. Data from real world case studies will be presented, illustrating that a formulation of liquid copper delivered as cupric ions yields superior results, superior pest control, and better cost-effectiveness at lower doses of active ingredient. The data to be presented suggest that in most instances, facilities switching from conventional copper to liquid copper are able to achieve similar results by applying only 20% of the elemental copper previously applied, reducing cost and the impact on the environment. One such liquid copper product, EarthTec, has also been reported by some municipalities to reduce taste and odor by directly removing or degrading the compounds responsible, especially geosmin, and data from these municipalities will be presented along with a discussion of possible mechanisms for the chemical destruction or conversion to less offensive compounds. Copper also has bactericidal properties and aids in disinfection of drinking water without contributing to disinfection by-products. There has been much debate and controversy around the topic of cyanotoxins and the role of cell lysis in determining threats to human health. The latest data and microscopy-based evidence of the consequences from treating HABs will be presented, helping to answer the critical and timely question of "when should I treat and when should I not?"

Cyanobacterial Management in California with Liquid Activated Peroxygen Algaecide/Cyanobacteriacide

Tom Warmuth
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Effective copper alternative treatments for cyanobacterial management are emerging as a needed option as the threat to our waters by these organisms becomes more realized and understood. The development of effective treatments for the "Bad Players", or what are identified as cyanobacteria that are known to produce harmful toxins or even taste and odor compounds, has never been more imperative. Both San Francisco Public Utilities and Santa Cruz Water, through their programs of monitoring, sampling and algal enumeration, developed an algaecide treatment regime with Clean Lakes, Inc. (contracted California Certified Pest Control Advisor and licensed aquatic applicator) and delivered effective control of various cyanobacteria throughout the season using GreenClean Liquid, a NSF/ANSI 60 Certified, liquid activated peroxygen algaecide, in their reservoirs. Peroxide based algaecides have been identified as effective in selective treatments for cyanobacteria, where it is not greatly effecting the population of beneficial green algae/phytoplankton. The use and delivery of "granular peroxide", SCP – Sodium Carbonate Peroxyhydrate, can have challenges not only in the delivery of the treatment to the water, but also in effectively controlling the target organism depending on where it may be in the water strata. The chemistry of GreenClean Liquid has shown to be effective, while also being easier to apply than SCP and having the ability to be more effectively applied. This all leading to a better potable water source through better control of target cyanobacteria while preserving most of the green phytoplankton; an overall healthier and productive algal population while limiting the input of copper based algaecides to the system.

HAB Panel Discussion
Question and Answer Session

Dr. John Rodgers, including all HAB Speakers
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Session C

Invasive Awareness and Management

Invasive Aquatic Plants in Missouri

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Invasive aquatic plant species are a constant threat to Missouri Natural Resources. Outreach and Education are some of the best strategies to decrease these threats. Electronic and social media have proven effective in reaching targeted groups.

Wisconsin DNR's Decontamination and Disinfection Manual Code

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Clean Boats, Clean Waters Watercraft Inspection survey results indicate that 77% of boaters clean equipment using these standard steps: Inspect, Remove, Drain, and Never Move. While these methods are sufficient for the general public, the Wisconsin Department of Natural Resources follow a more rigorous protocol as outlined in the Boat, Gear, and Equipment Decontamination and Disinfection Manual Code due to the variety of water related work and programs involved (Fish Management, Law Enforcement, and Water Quality, etc.). This manual code was recently revised to make the Department's steps more effective for all aquatic invasive species and also to apply to Department agents and contractors, and some permitees. This presentation will describe the revisions that were made and the process.

Effects of Invasive Macrophytes on Littoral Primary Producers in North-Temperate Lakes

Ryan Van Goethem, Graduate Student, Michigan Technological University,
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In littoral habitats, primary producers (macrophytes, phytoplankton, attached algae or periphyton) compete for space, light, and nutrients. Macrophytes create complex physical structure and release nutrients that may be utilized by attached algae, while also shading other macrophytes, periphyton, and phytoplankton below. Invasive Myriophyllum spicatum and hybrid M. spicatum x sibiricum can dramatically increase physical structure of littoral habitats. Because of these complex interactions, we hypothesized M. spicatum and M. spicatum x sibiricum could have dramatic effects on standing crop and production rates of all primary producers in lake littoral zones. To test this hypothesis, we conducted a field study during summer 2017 where we established a pair of 500 m2 plots, one invaded and one un-invaded, in 6 lakes in the Northern Lower and the Upper Peninsula of Michigan. In each plot we measured open water metabolism, which incorporates primary production and respiration by all organisms in the littoral zone. Simultaneously, we measured standing crops, primary production and respiration rates of phytoplankton, macrophyte-attached algae, and sediment periphyton using light-dark chambers. Preliminary results suggest that invaded and uninvaded plots have similar rates of primary production and respiration measured using the open water technique. Primary production rates of invaded and uninvaded plots were 4.52±0.83 and 3.73±1.09 g O2 m-2 d-1 (paired t-test, p=0.42) and respiration of invaded and uninvaded plots were -5.48±1.62 and -3.92±1.68 g O2 m-2 d-1 (paired t-test, p=0.21). Although, rates were similar between invaded and uninvaded plots, production rates measured using light-dark chambers may reveal differences among the different groups of primary producers. This study will ultimately determine if and how M. spicatum and M. spicatum x sibiricum invasion changes the production rates and standing crops of different primary producers, which may be key for predicting how this nuisance plant alters production of invertebrates and fish in lake littoral zones, and for better managing in invaded lakes.

Ohio's Reaction to The Discovery of Grass Carp Reproduction in The Sandusky River

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Grass Carp are an important tool to control aquatic vegetation in place of chemicals, and are actively stocked in low densities by private and public resource managers in states where allowed by regulation. Certified sterile Grass Carp are functionally sterile and provide an environmentally safer alternative to diploid fish by preventing establishment and sustained impacts. Fertile Grass Carp is an invasive species in the Great Lakes region, and is one of four species commonly identified as "Asian Carp". Grass Carp are well distributed throughout the eastern United States outside the Great Lakes basin and are found in low densities within the Great Lakes basin. Previous detections of wild Grass Carp in Lake Erie were historically assumed to be escapees from sterile stocking; however, evidence suggests that the majority of feral Grass Carp recently captured in Lake Erie are fertile. In addition, successful reproduction of fertile Grass Carp has been documented in the Sandusky River. The increased knowledge of Grass Carp life history in western Lake Erie gained through research will allow natural resources agencies to develop science-based management approaches and evaluate the effectiveness of individual control actions and potential eradication strategies. Field testing of current Grass Carp capture techniques using traditional sampling gears will inform capture efficiencies; and help determine if alternate techniques could increase capture efficiencies. Ohio and partner agencies will implement detection and control evaluation actions in 2018 to remove Grass Carp using information gained from previous and on-going research activities.

An Update on Aquatic Plant Management Policy Development in Wisconsin

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The State of Wisconsin recognizes, in statute and administrative rules, that a balanced aquatic plant community is a vital and necessary component of a healthy aquatic ecosystem. The State of Wisconsin also gives the Wisconsin Department of Natural Resources the authority to regulate the introduction and management of aquatic plants. Aquatic plant management (APM) is an important tool that affects ecosystem health, industry, tourism, and recreation in our waters. Years of management and research has resulted in an abundance of new information and technology, evolving APM beyond the scope of existing administrative rules. In this presentation, we will provide an update on APM policy development in the state, including the APM Strategic Analysis and efforts to engage interested stakeholders as we move towards ultimately revising existing rules to incorporate advances in knowledge since the last revision to APM policy in 1989.

Session D

General Management Practices

New Uses for Stingray (Carfentrazone-ethyl) for Invasive Aquatic Weed Management

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Stingray (carfentrazone-ethyl) is a protoporphyrinogen oxidase (PPO) inhibitor that was first registered for use as an aquatic herbicide in 2004. The primary use of this herbicide has been focused historically in the southern most regions of the United States for control of floating plants. Compared to other fast acting herbicides, Stingray can improve selectivity, especially for a majority of monocots, and offer greater efficacy in treatments with extremely short contact times. Field and laboratory studies have identified Stingray alone or in combination with diquat or triclopyr as an effective treatment of Myriophyllum (spicatum, spicatum x sibiricum, aquaticum, heterophyllum, humile) under short contact times. Butomus umbellatus, a species predominantly managed with diquat, has shown extreme susceptibility to Stingray in mesocosm and field evaluations. Fontinalis spp., an aquatic weed more frequently growing to unwanted densities is susceptible to Stingray, offering a unique alternative treatment. Research is ongoing to investigate new uses and combination treatments with Stingray and identify benefits of such treatments. By discovery of new treatments with currently registered herbicides water resource managers will be better equipped for making decisions and improving efforts to manage nuisance aquatic weeds.

Field Response of Crested Floating Heart to Endothall Treatments Over Two Years

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Currently five species of Nymphoides are found in the United States, three are invasive while two are native. *Nymphoides cristata* (Roxb.) Kuntze or crested floating heart is one such invasive species. Crested floating heart was first discovered in Florida but quickly spread north and is now found in large expanses of the Santee Cooper lakes in SC as well as several ponds in NC. In order to better understand how to control this new invasive threat NC State University undertook an expansive herbicide trial on Lake Marion, SC. Numerous herbicides were tested with varying formulations, herbicide combinations, application techniques and season of treatment. Treatment sites ranged from 1.6A to 7A in size and repetitious treatments were performed in spring, summer and fall. Depending on time of treatment visual percent control ratings were taken at 2 weeks after treatment, 1, 1.5, 2, 3, 10 and 15 months after treatment (MAT). The summer treatments faired the best with 3 of the treatments having 95% or better control at 15 months. Whereas all spring treatments had 0% control after 1 month. Timing the treatment when all the reserves of the plant are expended in the floating leaves appears to provide the greatest level of control. A foliar application of 0.3 ppm Hydrothol 191 attained the best and longest control with zero regrowth seen at 15 MAT. Secondly 3 ppm Aquathol K + 0.18 ppm Hydrothol 191 showed 99% control at 15 MAT. Being a relatively new invader there is still much to learn about controlling crested floating heart.

Hard Water Affect on Chemistry

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Explain how hard water (Ca++, Mg++ and Fe++) affect the performance of weak acid chemistry (2,4-D, tricolpyr and glyphosate) are tied up in hard water and reduce uptake into the plant. Explain how Water Conditioners tie up the hard water cations and keep them from reducing the control of the target plants.

Small Pond Management Using Harpoon Herbicide

Ryan Wersal, Gray Turnage, Craig Aguillard, John Cortell, Adam Hater, and Bill Ratajczyk
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Small ponds comprise a large proportion of land area (21,000 km^2) in the United States, and as such provide recreational opportunities, water sources for humans and livestock, flood prevention, irrigation reservoirs, and aquaculture to name a few the services ponds provide. Ponds are however prone to aquatic plant problems because of shallow water and excess nutrient availability that will promote plant growth. Excessive plant growth will in turn limit the goods and services provided by small ponds. One macro-algae that can become a nuisance in small ponds in chara. Chara is often the first species to colonize an area and forms a dense mat that covers the bottom substrates. Mats can dislodge and float in the water column thereby becoming more of a nuisance. Harpoon® Liquid and Granular Aquatic Herbicides were used to control chara in a number of small ponds in Louisiana, Mississippi, and Indiana. Both formulations offered greater than 90% control of chara in most ponds. Rake fullness ratings in Mississippi ponds were 3.8 (reference) and 0 (treated) at 4 weeks after treatment. Treatments made to small bands of vegetation around the perimeter were not as effective due to high dilution from non-treated waters. A follow-up application will likely be needed in these areas to maintain effective copper residues.

Aeration of a Shallow Eutrophic Lake: What to Expect

Patrick M Goodwin, Research Scientist, CLM, Vertex Water Features
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Aeration is a commonly recommended management technique used to meet a variety of lake management goals including: (i) habitat improvement by eliminating thermal gradients and improving water chemistry, which allows for a more diverse and robust food web, and/or (ii) reducing symptoms associated with eutrophication, especially in regards to Harmful Algal Blooms (HABs), taste and odor issues, and water clarity. An evaluation of this technique was conducted on Lake Mohegan, a shallow 100-acre lake, located in the suburbs of northern Westchester County, New York. Even with the operation of an aeration system, Lake Mohegan exhibited weak to strong (episodic) stratification and anoxia at the sediment-water interface, HAB's, poor zooplankton community composition, and poor transparency. Some of these results were possibly caused and exacerbated by inadequate mixing/design of the system. Other, more explainable factors were due to lake characteristics (i.e., iron deficiencies and mixing depth). However, the aeration approach did result in some benefits. Increased zooplankton abundance, improved fish habitat, nitrate to ammonium ratios, and changes in phytoplankton species composition suggested direct benefits of aeration. Modifications of the aeration approach, maximizing benefits while minimizing impacts, offer substantial improvement potential. This presentation will discuss aeration as a management approach and its applicability to Lake Mohegan and other problematic lakes.

Oral Presentations

Sessions E thru H Wednesday, February 28

Session E

Invasive Milfoil

APMS Update

John H. Rodgers Jr., Professor of environmental toxicology, Clemson University
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Mesocosm and Field Evaluation of Eurasian and Hybrid Watermilfoil Response to Endothall in Jefferson Slough, Montana

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Genetic variation in Eurasian watermilfoil populations, including variation derived from hybridization with native northern watermilfoil, may affect herbicide efficacy in managed populations. However, the design and evaluation of operational management programs do not commonly take genetic variation into account. Given the evident variability among genotypes in their responses to herbicides, site-specific studies to predict the response of the particular genotypes in a waterbody to proposed control tactics could help evaluate and optimize management strategies. In this study, we evaluated the potential to control nuisance pure and hybrid Eurasian watermilfoil with endothall in a riverine environment (Jefferson Slough, Montana). Molecular genetic surveys indicated that only one genotype of each taxon was present throughout the Slough at the onset of the study. We first compared vegetative growth and endothall response of the hybrid and Eurasian watermilfoil genotypes in the greenhouse, and we did not identify any clear difference in response to endothall. However, hybrids exhibited faster vegetative growth rates in the absence of endothall. Next, we evaluated the efficacy of an operational endothall treatment in Jefferson Slough. The abundances of both Eurasian and hybrid watermilfoil were significantly and substantially, and similar to what we observed in the greenhouse study, hybrid and Eurasian watermilfoil were reduced to the same average biomass seven weeks after endothall treatment in Jefferson Slough. Taken together, the greenhouse and operational field treatment indicate that the hybrid watermilfoil genotype in Jefferson Slough was not inherently more tolerant to endothall than the Eurasian watermilfoil genotype. However, one year after treatment, the watermilfoil abundances were similar to their pre-treatment levels. We only found the same two genotypes (one hybrid, one Eurasian) one year after treatment as post-treatment, indicating that the plants had grown back after treatment, as opposed to recruitment of new genotypes from seeds. We observed an increase in the relative frequency of occurrence of hybrids in a section of Jefferson Slough where pure and hybrid Eurasian watermilfoil overlapped pre-treatment, as well as an increase in hybrid frequency across the entire slough. These observations, along with faster hybrid growth rates in the greenhouse, may indicate subtle differences in the relative potential for re-growth and re-establishment of hybrid versus pure Eurasian watermilfoil after endothall treatment in the Jefferson Slough. We recommend that, wherever possible, aquatic plant managers use genetic surveys to identify specific genotypes for small-scale, site-specific growth and herbicide evaluations, and incorporate genetic monitoring into field evaluations of control efficacy and re-establishment.

Planning and Evaluating Large-Scale Herbicide Treatments for Control of Invasive Milfoil in Challenging Scenarios

Eddie Heath, Aquatic Ecologist, Onterra, LLC, Michelle Nault (Water Resources Management Specialist, Wisconsin Department of Natural Resources) and Tim Hoyman (Aquatic Ecologist, Onterra, LLC)
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Resource managers in Wisconsin are currently studying various strategically employed management techniques to control invasive milfoil populations, with an overarching goal of attaining long-term ecological restoration. Operationally, this largely consists of implementing early-season herbicide control strategies; either as spatially targeted small-scale spot treatments or low-concentration, large-scale (whole lake) treatments. This presentation will focus on the planning and evaluation of large-scale herbicide use patterns that have elements of implementation complexity (i.e., scale, water exchange), difficult target species (i.e., hybrid watermilfoil), or have adopted herbicides less-commonly utilized in Wisconsin (i.e., fluridone, combination 2,4-D/endothall). This presentation couples quantitative aquatic plant monitoring with field-collected herbicide concentration data to evaluate efficacy, selectivity, and longevity of chemical control strategies implemented on a subset of Wisconsin waterbodies.

Eurasian and Hybrid Watermilfoil Management in Michigan

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The Management of Eurasian Watermilfoil in Michigan was published by the Midwest Aquatic Plant Management Society 25 years ago. Much has changed since 1993 relative to the management of this pernicious aquatic weed. Eurasian/northern watermilfoil (*Myriophyllum spicatum* L. x *Myriophyllumsibericum* Kom) hybrids have certainly been present in Michigan for at least 25 years; however, genetic testing did not definitively reveal the presence of hybrid milfoil genotypes in Michigan inland lakes until it was identified in White Lake, Oakland County, MI in 2003. Field identification of distinct Eurasian watermilfoil and hybrid milfoil variants is nearly impossible from observations made during routine field studies because most specimens reveal phenotypic characteristics that reside on a gradient that gradually spans between the characteristics of the two parental specie types. Since there are other significant watermilfoil hybrids, the term ebrid watermilfoil is used to describe Eurasian watermilfoil and the Eurasian x northern watermilfoil hybrids. Various interspecific crosses and back-crosses, coupled with the recognition of studies confirming a wide range of Eurasian watermilfoil genotypes combine to create a vast number of ebrid watermilfoil genotypes. This genotypic variability not only contributes to the possibility of wide-ranging phenotypic and morphological expression, but to wide-ranging ecological adaptabilities and variable responses to management interventions. For example, the same level of aggressive growth and domination of Michigan inland lake floras that was commonly observed from the early 1970's to the early 1990's is not commonly observed today and ebrid milfoil populations can range from nuisance levels to being present as a relatively inconspicuous part of the submersed flora. The extreme sensitivity of ebrid watermilfoil to biological and herbicide based management intervention strategies and technologies observed in the 1980's is now a rare occurrence. The possible mechanisms that contribute to disappointing or compromised management program outcomes must become primary considerations in the development of any management program. Many of these factors shall be considered in historical context and possible treatment improvements shall be presented for management recalcitrant ebrid watermilfoil populations.

Session F

Starry Stonewort

AERF Update

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Management of *Nitellopsis obtusa* (Starry Stonewort) in a Recently Infested Minnesota Lake Using a Copper-Based Algaecide

Tyler D. Geer, PhD student, Clemson University, John H. Rodgers Jr. (Professor of environmental toxicology, Clemson University)
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Nitellopsis obtusa (starry stonewort) is an invasive species of Eurasian origin that was likely transported and introduced to the United States in ballast water. Since it was first identified along the St. Lawrence River, *N. obtusa* has spread rapidly among inland lakes across the Great Lakes region of the United States. Initiating an aggressive control plan as soon as possible after discovery of *N. obtusa* is important for an efficient and effective management program. In West Lake Sylvia (Wright Co. MN), *N. obtusa* was first confirmed in September of 2016 in the vicinity of the public boat access. Management of *N. obtusa* in the immediate vicinity of the boat access in West Lake Sylvia began early in the summer of 2017. The goal of these efforts was to control *N. obtusa* throughout the year and contain regrowth and any potential recolonization or re-infestation of the area. This situation provided an opportunity to measure the responses of *N. obtusa* to algaecide exposure. To target growth and regrowth of *N. obtusa*, the copper-based algaecide Cutrine®-Plus was applied four times between June and October 2017 in the vicinity of the public boat access. Weighted drop hoses were used in each treatment to target an initial concentration of 1000 µg Cu/L in the bottom two feet of the water column. Samples collected after each treatment confirmed that >90% of the targeted initial exposure was achieved. Aqueous copper concentrations dissipated to background concentrations (i.e. pre-treatment aqueous copper concentrations) within 4-days following each treatment. Post-treatment *N. obtusa* surveys by an independent auditor confirmed that the spatial extent of *N. obtusa* and the frequency of *N. obtusa* at sample sites declined in the treated area from June to December. These preliminary results indicate that algaecide treatments can be used control and contain infestations of *N. obtusa* in recently infested lakes.

Assessment of Starry Stonewort Plant Heights, Control, and Pre and Post Treatment Bulbil Counts in Long Lake, Wisconsin

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In July of 2015, Long Lake located in Racine County, Wisconsin became the third confirmed Wisconsin lake with Starry Stonewort (SSW). After a year and a half of trial treatments and survey work under a state grant, Lake and Pond Solutions Co. set out to identify the effects of continual treatments on SSW height and bulbil production. It was our hope that with SSW biomass maintained at low levels, in-lake spreading would be reduced and bulbil counts would decline. Bulbils were collected in March and October of 2017 using an Eckman dredge at twenty-six established points in known SSW beds. These beds were monitored and height was recorded every 2-3 weeks throughout the season. Treatments were performed on areas of varying size repeatedly before biomass significantly increased using two different previously successful approaches: Komeen Crystal and Captain XTR/Clipper/Enzyme. The 2017 treatments were able to maintain SSW to less than half the normal height with an overall 77% success rate (20/26). Captain XTR/Clipper/enzyme had favorable results in 100% of the treatments (6/6) while Komeen Crystal was successful in 70% of the treatments (14/20). Overall, SSW acreage dropped from 6.63 acres in 2016 to 3.73 acres at the end of 2017. Initial results from our spring bulbil survey showed three sites with over one hundred bulbils in a single 6 x 6 inch Eckman dredge. This extrapolates to over 13 million bulbils per acre. Fall bulbil analysis revealed that 77% of the sites (20/26) had counts that either dropped or remained at zero. This resulted in a 92% bulbil reduction in these sites. There were six sites that saw bulbil increases including one that contained 1168 bulbils. In fact, the six sites with increases accounted for almost 96% of the bulbils found in the fall. Through 2.5 years of field work, we've identified appropriate treatment regimes, treatment timing, and demonstrated an ability to reduce acreage, biomass and bulbils in a majority of the sites.

Strategies for Intervening in *Nitellopsis obtusa* (Starry Stonewort) Infestations

John H. Rodgers Jr., Professor of environmental toxicology, Clemson University; Tyler D. Geer, PhD student, Clemson University; Ciera M. Kinley, PhD student, Clemson University; and Kevin Farnum, Koronis Lake Association
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Nitellopsis obtusa (Starry Stonewort) is a non-native benthic algal species in the Characeae family and a relatively new aquatic invasive species (AIS) in the northern tier of the U.S. *N. obtusa* is native to Europe and western Asia was likely introduced to the Great Lakes in North America in ballast water carried in trans-oceanic ships. *N. obtusa* has rapidly spread into New York, Vermont, and Pennsylvania, and west into Michigan, Minnesota, and Wisconsin, as well as south into Indiana. *N. obtusa* grows robustly in the water column of lakes as a macro-alga and is anchored by unpigmented rhizoids that often contain as many as several dozen 4-5mm star-shaped bulbils with starch-containing tissue. The bulbils are capable of sprouting and forming a new thallus. Efforts are underway to slow the spread of this noxious species. Recent investigations have indicated that in-lake management of Starry Stonewort must be accompanied by prevention programs to slow the lake-to-lake movement of this noxious alga. To date, in-lake management of Starry Stonewort can be achieved by applications of copper-based algaecides. Repeated applications are needed due to sprouting of bulbils (recruitment). Among noxious benthic algae, Starry Stonewort is relatively easy to control, but requires diligence and persistence to manage.

Session G

Hydrilla & Curly-leaf Pondweed Management

Battling Hydrilla – A Multifaceted Approach to Eradication

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Hydrilla (*Hydrilla verticillata*) has been called the "perfect weed." Its fast growth rates, ease of movement, and tuber longevity are just some of the reasons that allow the plant to out-compete and overtake aquatic systems. When battling a plant with multiple modes of spread and propagation, a successful eradication plan must also be multi-faceted. Herbicide treatments are just part of Missouri's long-term plan to eradicate the plant. Early detection and education are just as critical. This is also a battle that Missouri Department of Conservation cannot wage alone. Partnerships are key to success. This multi-faceted attack has been applied for almost five years. It has been a learning process but we are close to moving several hydrilla sites from active treatment and into monitoring-only; getting us one step closer to our goal of eradication.

Successful Eradication of Monoecious Hydrilla From Lake Manitou, Indiana

JT Gravelie, Field Research Assessment Coordinator/ GIS Administrator SePRO Corporation ; Eric Fischer , Aquatic Invasive Species Coordinator, Indiana Department of Natural Resources; Doug Keller, Aquatic Habitat Coordinator, Indiana Department of Natural Resources; Mark Heilman, Ph.D., Senior Aquatic Technology Leader, SePRO Corporation
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The monoecious variety of submersed invasive hydrilla (*Hydrilla verticillata* (L. f.) Royle) is a major threat to lakes and other waterways of Midwest US. A number of early infestations of monoecious hydrilla have been detected in recent years in Midwestern sites as the apparent frontline of an infestation still moving west from initial introduction in the Mid-Atlantic states. The first of these sites was Lake Manitou, an 808-acre small reservoir system in north central Indiana where hydrilla was first detected in 2006. As part of its Aquatic Invasive Species program, the Indiana DNR initiated a rapid response to the Manitou in the late summer of 2006 and then starting in 2007, began repeated annual season-long, lake-wide treatments of the hydrilla infestation to eradicate the population from the lake. These applications utilized multiple formulations of Sonar® Aquatic Herbicide (a.i., fluridone) in an adaptive management approach to fully deplete hydrilla tubers from infested areas of the lake by maintaining low -level concentrations for entire growing seasons. Herbicide applications were complemented by twice-yearly lake-wide vegetation surveys (IN DNR LARE Tier II protocol), analytical monitoring of herbicide dissipation, and routine reconnaissance of the lake. Sediment core sampling was also utilized to quantify hydrilla tuber bank attrition during the first 5 years of the eradication effort. By 2011, hydrilla tuber densities had decreased by greater than 99%, and hydrilla detection strategies switched to intensive SCUBA diver surveys with again adaptive designs between 2012 and 2017 to improve hydrilla detection and enhance confidence in a potential eradication outcome. Diver surveys last detected hydrilla in 2013. From 2014 to 2016, Sonar treatments were gradually decreased in scale and intensity to promote native plant populations that had been reduced during the nearly decade-long eradication program. In 2017, the first year without any herbicide treatment on the lake since the initial hydrilla finds in 2006, further recovery of the lake's aquatic plant community has been documented. This presentation will provide a broad overview of the successful hydrilla eradication program on Lake Manitou and comment on how its implementation and results can inform future hydrilla eradication projects in the Midwest.

Early Detection and Rapid Response to *Hydrilla verticillata* in The Lake Erie Drainage Basin

Mark Warman, Hydrilla Project Coordinator, Cleveland Metroparks
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In 2011 Cleveland Metroparks discovered an infestation of *Hydrilla verticillata* and, to date, has detected five additional populations within park boundaries. After five years of battling *H. verticillata*, the park district was awarded a GLRI grant to expand the detection network to the Cuyahoga River Area of Concern and Lake Erie drainage basin. In order to be successful and to guard the vulnerable, shallow western basin of Lake Erie, the geographic footprint for trained observers must extend to the entirety of the Lake Erie watershed in Ohio. This oral address will present the known distribution, surveillance methods, and herbicide treatment schedule for *H. verticillata* in the Lake Erie Basin in Ohio. Results from the first year of expanded surveillance at 184 total sites include no new infestations and supports the early detection and rapid response model for aquatic invasive species control.

Efficacy of Endothall+2,4-D for Curlyleaf Pondweed (*Potamogeton crispus*) Control Under Simulated Fall Conditions

Kristen Tanz[1], Mirella F. Ortiz[1], Scott J. Nissen[1], and Cody J. Gray[2]
[1]Graduate Student, Graduate Student, and Professor,
Department of Bioagricultural Sciences and Pest Management, Colorado State University

Invasions of non-native aquatic plants such as curlyleaf pondweed (*Potamogeton crispus*) (CLP) can have wide-ranging negative effects on whole lake ecosystems. Herbicide treatments have been shown to successfully control invasive aquatic plants during treatment years. Endothall and 2,4-D have been used in combination to control CLP for over 10 years. The objective of this research was to determine the efficacy of endothall (Aquathol® K) alone and endothall+2,4-D (Chinook®) for CLP control under simulated fall conditions. CLP plants were grown from turions in 50ml falcon tubes containing field soil, slow release fertilizer and fine, unwashed sand at the top. When the plants reached 15cm, they were treated with either endothall or endothall+2,4-D. Five-gallon mesocosms filled with 4 gallon of tap water were treated with one of the five treatments (non-treated, endothall 1.5ppm and 0.75ppm, or endothall+2,4-D 1.5+0.6ppm and 0.75ppm+0.3ppm, respectively). Three plants were exposed for 3, 6 or 12 hours to each treatment, triple rinsed in clean water and transferred to five-gallon mesocosms containing non-treated water. The plants were kept in growth chamber, at 14C with 12 hour day length. Visual control ratings were taken at 7, 14, 21 and 28 days after treatment (DAT). All the endothall+2,4-D treatments provided over 95% of CLP control, while treatments with only endothall did not. In addition, plants treated with endothall+2,4-D had more rapid symptom development than those treated with endothall alone. Two parameters were used to compare single and combination treatments: 1) t_{50} (days required to achieve 50% of CLP control) and 2) % control 28 DAT. The low rate of endothall+2,4-D with a 6 hour exposure time provided 100% CLP control with 7 day t_{50}, while the highest endothall rate alone with 12 hour exposure time had a longer t_{50} and provided only 81% CLP control. The combination treatment (Chinook) appears to require lower CET compared to endothall alone (Aquathol).

Managing Lake Water Clarity and Color

Patrick M. Goodwin, Research Scientist, CLM, Vertex Water Features
Patrick.goodwin@vertexwaterfeatures.com

The clarity and color of a lake is attributed to a variety of constituents in water, and can be broken down by suspended (i.e., sediments, algae, and other organic matter) and dissolved (i.e., humic and fulvic acids) substances. The major sources of these substances include high nutrient loading, soil erosion, and organic decay. The amount of these constituents in water can be directly related to how clear or turbid a lake will be and its overall use. This presentation will discuss the ecological impacts of poor water clarity, important thresholds from which management objectives can be based, and how to obtain those objectives using a variety of lake management tools.

Session H

Membership Meeting

Annual Business Meeting 2017

Call to order (1:22p.m.) – Pinagel

Roll Call – Goidosik for Donahoe (all members present)

Additions/deletions to the agenda (motion to approve):

No additions or deletions

DeJonghe = first, Hausler = second, **Motion Carries**

Review of previous Annual Business Meeting minutes: (Goidosik for Donahoe) (motion to approve)

Electronic copy on file

Johnson = first, Kay = second, **Motion Carries**

Financial Report: (Zulinski) (motion to approve)

Electronic copy on file

Account balance = $160,309.77. RLJ account balance = $30,686.25

Thum = first, Meganck = second, **Motion Carries**

Standing Committee Reports:

Nominating (3) Meganck – Chair (distribute/collect ballots)(nominations from the floor, if any)

Announced the nominees for all open positions, asked all nominees to stand and introduce themselves No nominations from the floor

Distribution and collection of ballots

DeJonghe = first, Grant = second, **Motion Carries**

Membership (3) Kay – Chair

End of 2016 we had 254 members

As of 3/1/17 we have 211 members

Provided survey highlights from 2016 Conference (electronic graphs on file)

Editorial (3) DeJonghe – Chair

3 job postings over the year

2 Facebook promotions to promote the Society

Website maintenance throughout the year

Email correspondence

New AV equipment & presentation laptop

55% WHOVA adoption rating

By Laws (3) Isaacs – Chair
No report

Internal Audit (2) Meganck – Chair
Looked at books with Zulinski on 12/9/16, no discrepancies found.

Governmental Affairs (2) Long – Chair
Reviewed the continuing education credits (TN, IN, KS, KY, MI, OH, MD, DC & PA)
Referenced the need to promote Government employee presentations

Exhibits (2) Schutman – Chair
28 exhibitors with 30 tables
Showed slide of all exhibitors (electronic copy on file)
Reviewed best exhibitor award to be awarded at the banquet

Publicity (3) Kay – Chair
MAPMS booth has been displayed at APMS and various State conferences/symposiums
Updating plant ID charts (currently being worked on)

Past Presidents Advisory, Meganck – Chair
No report

2017 Program, Hausler – Chair
Off-site President's Reception at Buck Bradley's
32 presentations, 3 posters, 5 student papers, 5 University Professor presentations, 10 Agency presentations, 10 Industry presentations and 2 Other presentations

2017 Local Arrangements (3) Heath – Chair
Increased room block size
Reviewed the cost of the off-site President's Reception vs. others in the past (electronic copy on file)

Student Affairs, Thum – Chair
2 submissions for the Robert L. Johnson Memorial Research Grant
6 students attending (5 oral presentations & 1 poster)
Reviewed the Student-Government Affairs luncheon
Discussed the future possibility of a Student Director
Encouraged membership to reach out to students regarding participation

Special Committee Reports:
Silent Auction/Raffle, Britton – Chair
6 items this year vs. 5 in previous years: Mathews Sniper Lite Crossbow and case, Yeti Cooler Package, GoPro Hero 5, Prepaid Cash Card, DJI Phantom 3 Drone and Garmin Montana 610 GPS.
Thanked all those who donated
Tasked the membership to provide ideas to the BOD for box raffle items for future conferences

2018 & 2019 Time and Place (Cleveland = Paul)(Chicago = Nate)

2018, Westin, Downtown Cleveland Ohio, 2/26 – 3/1
2019, Palmer House, Downtown Chicago Illinois, 2/25 – 2/28

Strategic Planning, Schutman – Chair
No report

Sponsorship, Meganck – Chair
Showed slide of all sponsors by level of contribution (total of 70 all) Thanked them for their support

Finance, Pinagel – Chair
Two (2) accounts at the State Bank
Account #1 (CD account) = Robert L. Johnson Memorial Research Grant Fund = $15,198.69
Account #2 = Midwest Aquatic Plant Management Society Fund = $51,909.13

Motion to approve Committee Reports, Thum = first, Britton = second, Motion Carries

Old Business: *No old business

New Business: *No new business

Temporarily Adjourn until the Banquet, DeJonghe = first, Hausler = second, **Motion carries. (2:03p.m.)**

Meeting re-convened at the Annual Banquet, (8:12p.m.)

−Pinagel = recognized the following:
*Honorary Members
*Past Presidents

−Meganck = recognized all sponsors and presented plaques to those at the Diamond Level

−Schutman = recognized all exhibitors and presented the "best exhibit award" to Airmax

−Thum = recognized all student participants and presented awards as follows:

***Winner of the Robert L. Johnson Memorial Research Grant ($10,000) = Ryan Van Goethem**

MS student at Michigan Technological University, Department of Biological Sciences. "Seasonal Dynamics of Littoral Primary Production and Effects of Invasive Macrophytes in North-Temperate Lakes".

***Presentation winners:**

***First Place ($300)**
Ciera M. Kinley, Ph.D. Student, Clemson University. "Distinguishing copper exposure vs. dose to Microcystis aeruginosa and relationships with microcystin-LR release".

***Second Place (Tied; $150)**
Mirella Oritz, Ph.D. Student, Colorado State University. "Translocation of Endothall in Eurasian Watermilfoil and Two Hydrilla Biotypes".

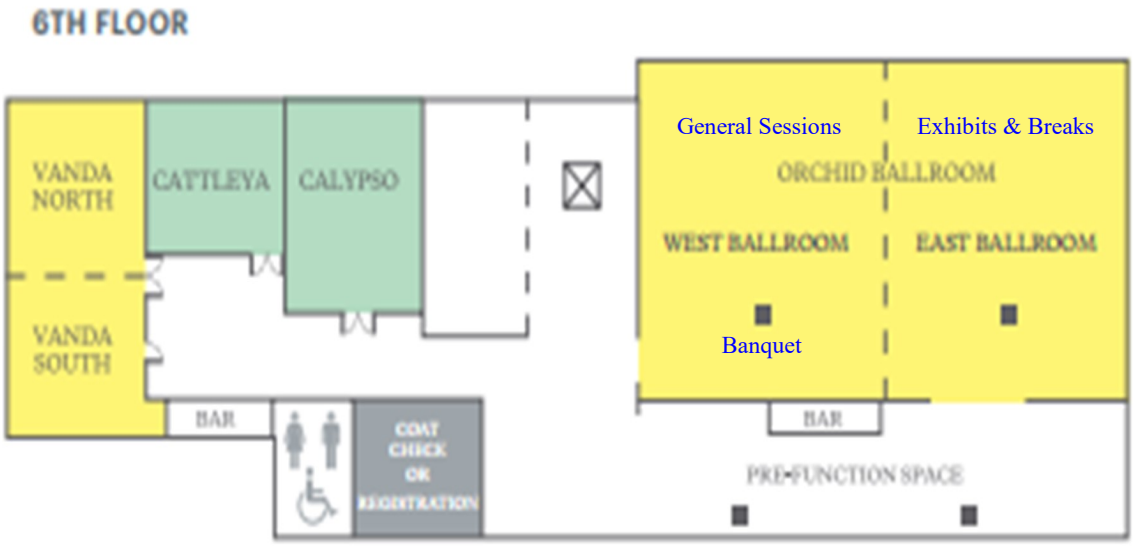
***Second Place (Tied; $250)**
Tyler Geer, Ph.D. Student, Clemson University. "Predicting in Situ Responses to Taste and Odor Producing Algae in a Southeastern U.S. Reservoir to a Sodium Carbonate Peroxyhydrate Algaecide Using a Laboratory Exposure-Response Model".

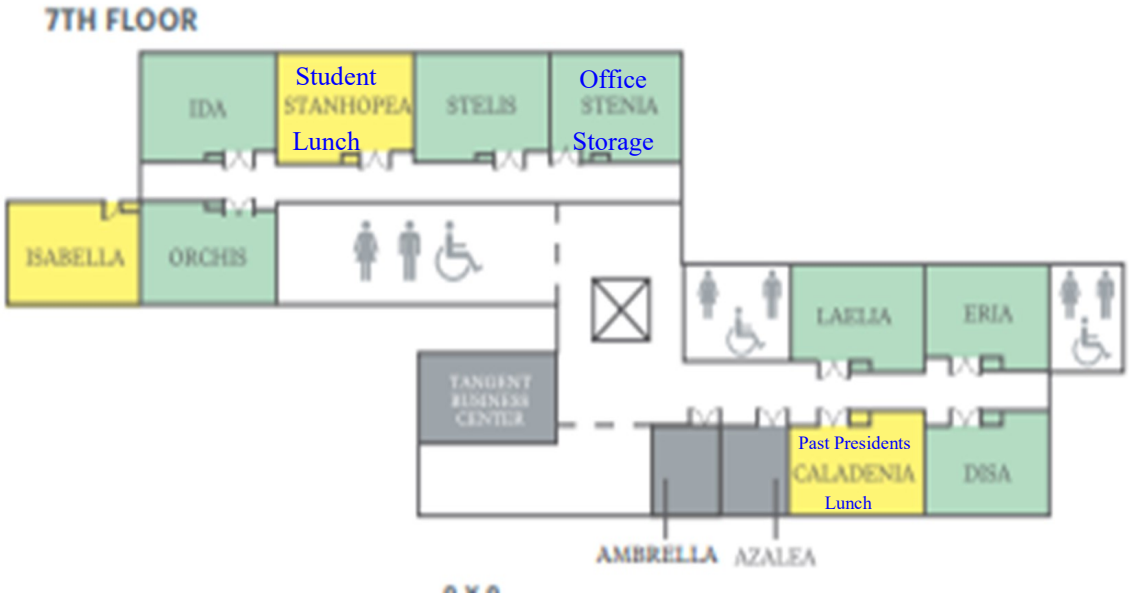
***Poster ($200)**
Carli Wagner, undergraduate student, University of Minnesota. "Starry stonewort (*Nitellopsis obtusa*) remains viable following herbicide treatments in a Minnesota lake".

Pinagel = passed the gavel to Hausler

Adjourn, Bondra = first, DeJonghe = second, **Motion carries.** (8:47p.m.)

Westin Cleveland
Floor Plans





Upcoming MAPMS Conferences

39th Annual Conference

Palmer House - A Hilton Hotel

Chicago, IL

February 25, 2019 thru February 28, 2019

40th Annual Conference

Hyatt Regency Indianapolis

Indianapolis, IN

February 9, 2020 thru February 13, 2020

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OUR MISSION:
to promote sound and appropriate technologies for the management of aquatic resources
to provide opportunities for educational advancement
to encourage relevant scientific research in the discipline
to promote the exchange of information
to expand and develop public interest in aquatic resources and their sustainable management
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