Aquatic Plant Management Society

63rd ANNUAL MEETING

Indianapolis, IN
July 24-27, 2023

Meeting Sponsors

The Aquatic Plant Management Society appreciates the generous support of the following meeting sponsors. Through their support and contributions, we can conduct a successful and enjoyable meeting.

Platinum Level

UPL NA Inc.
King of Prussia, PA

SePRO
Carmel, IN

Gold Level

Syngenta, US
Greensboro, NC

Bronze Level

Lawrenceburg, TN

Alsip, IL

Opelika, AL

Springfield, IL

Rogers, AR

Vero Beach, FL

Rocky Mount, VA

Contributor Level

Aquatic Control
Seymour, IN

Keycolour
Phoenix, AZ

APMS Presidents and Meeting Sites

1961	T. Wayne Miller, Jr.	Fort Lauderdale, FL
1962	T. Wayne Miller, Jr.	Fort Lauderdale, FL
1963	William Dryden	Tampa, FL
1964	Herbert J. Friedman	Tallahassee, FL
1965	John W. Woods	Palm Beach, FL
1966	Zeb Grant	Lakeland, FL
1967	James D. Gorman	Fort Myers, FL
1968	Robert D. Blackburn	Winter Park, FL
1969	Frank L. Wilson	West Palm Beach, FL
1970	Paul R. Cohee	Huntsville, AL
1971	Stanley C. Abramson	Tampa, FL
1972	Robert J. Gates	Miami Springs, FL
1973	Brandt G. Watson	New Orleans, LA
1974	Alva P. Burkhalter	Winter Park, FL
1975	Luciano Val Guerra	San Antonio, TX
1976	Ray A. Spirnock	Fort Lauderdale, FL
1977	Robert W. Geiger	Minneapolis, MN
1978	Donald V. Lee	Jacksonville, FL
1979	Julian J. Raynes	Chattanooga, TN
1980	William N. Rushing	Sarasota, FL
1981	Nelson Virden	Jackson, MS
1982	Roy L. Clark	Las Vegas, NV
1983	Emory E. McKeithen	Lake Buena Vista, FL
1984	A. Leon Bates	Richmond, VA
1985	Max C. McCowen	Vancouver, BC
1986	Lars W. J. Anderson	Sarasota, FL
1987	Dean F. Martin	Savannah, GA
1988	Richard D. Comes	New Orleans, LA
1989	Richard Couch	Scottsdale, AZ
1990	David L. Sutton	Mobile, AL
1991	Joseph C. Joyce	Dearborn, MI
1992	Randall K. Stocker	Daytona Beach, FL
1993	Clarke Hudson	Charleston, SC
1994	S. Joseph Zolczynski	San Antonio, TX
1995	Steven J. de Kozlowski	Bellevue, WA
1996	Terence M. McNabb	Burlington, VT
1997	Kurt D. Getsinger	Fort Myers, FL
1998	Alison M. Fox	Memphis, TN
1999	David F. Spencer	Asheville, NC
2000	J. Lewis Decell	San Diego, CA
2001	Jim Schmidt	Minneapolis, MN
2002	David P. Tarver	Keystone, CO
2003	Richard M. Hinterman	Portland, ME
2004	Ken L. Manuel	Tampa, FL
2005	Eric P. Barkemeyer	San Antonio, TX
2006	Jeffrey D. Schardt	Portland, OR
2007	Donald W. Doggett	Nashville, TN
2008	Jim Petta	Charleston, SC
2009	Carlton Layne	Milwaukee, WI
2010	Greg MacDonald	Bonita Springs, FL
2011	Linda S. Nelson	Baltimore, MD
2012	Tyler Koschnick	Salt Lake City, UT
2013	Terry Goldsby	San Antonio, TX
2014	Michael D. Netherland	Savannah, GA
2015	Cody Gray	Myrtle Beach, SC
2016	Rob Richardson	Grand Rapids, MI
2017	John D. Madsen	Daytona Beach, FL
2018	John H. Rodgers, Jr.	Buffalo, NY
2019	Craig Aguillard	San Diego, CA
2020	Mark Heilman	*Canceled*
2021	Ryan Wersal	New Orleans, LA
2022	Ryan Thum	Greenville, SC
2023	Brett Hartis	Indianapolis, IN

APMS Award Recipients

Honorary Members

Awarded to persons who have been voting members of the Society for no less than ten years, have contributed significantly to the field of aquatic vegetation management, and must have actively promoted the Society and its affairs during their membership.

William E. Wunderlich	1967
F. L. Timmons	1970
Walter A. Dun	1976
Frank S. Stafford	1981
Robert J. Gates	1984
Herbert J. Friedman	1987
John E. Gallagher, Luciano "Lou" Guerra	1988
Max C. McCowen	1989
James D. Gorman, T. Wayne Miller, Jr.	1995
A. Leon Bates, Richard Couch	1997
N. Rushing	1997
Alva P. Burkhalter	2002
J. Lewis Decell	2004
Paul C. Myers	2005
David L. Sutton	2006
Dean F. Martin	2007
Robert C. Gunkel, Jr.	2008
Allison M. Fox, Randall K. Stocker, Steven J. de Kozlowski	2010
Carole Lembi	2011
Lars W.J. Anderson, David Tarver	2012
Don Doggett, Richard Hinterman	2013
David Spencer	2015
Jim Schmidt	2016
Joseph C. Joyce, Jeff Schardt	2017
David A. Issacs, Vernon V. Vandiver	2018
Eric P. Barkemeyer	2019
Linda Nelson, Ken Manuel, Steve Brewer	2020
Kurt Getsinger, John Rogers, Jr., Terry Goldsby	2021
William Culpepper, Joe Bondra	2022

President's Award

An individual, designated by the current President, who has displayed "*Many Years of Dedication and Contributions to the Society and the Field of Aquatic Plant Management*".

T. O. "Dale" Robson	1984
Gloria Rushing	1991
William T. Haller	1999
David Mitchell	1999
Jeffrey D. Schardt	2002
Jim Schmidt	2003
Robert C. Gunkel, Jr.	2004
Victor A. Ramey	2006
William H. Culpepper	2007
Kurt Getsinger	2008
Richard Hinterman	2009
Steve D. Cockreham	2010
Donald W. Doggett	2012
Carlton Layne	2013
Ken Langeland, Jeff Schardt, Dan Thayer, Bill Zattau	2014
Greg MacDonald	2015
Linda Nelson	2015
John Madsen, Mike Netherland	2016
Jason Ferrell	2017
Robert Blackburn	2018
Sherry Whittaker	2018
Eric P. Barkemeyer	2019
Dave Petty, Bill Torres, Rob Richardson	2020
Mark Heilman	2021
Ryan Wersal	2022

APMS Award Recipients

Max McCowen Friendship Award

A special recognition given to an APMS member whose demeanor and actions display sincerity and friendship in the spirit of being an ambassador for the APMS. Criteria include warmth and outgoing friendship, sincerity and genuine concern, gracious hospitality, positive attitude and smile.

Judy McCowen	1995
John E. Gallagher	1997
Paul C. Myers	2000
William T. Haller	2002
Bill Moore	2006
Vernon V. Vandiver, Jr.	2012
Tommy Bowen	2014
Steve Hoyle	2015
Ken Manuel	2016
David Isaacs	2017
John Gardner	2018
William A. Ratajczyk	2019
Tom Warmuth	2020
Todd Olson	2021
Dean Jones	2022

T. Wayne Miller Distinguished Service Award

An individual recognized for *"Service to the Society and the Profession"*. Considerations include completion of a relatively short-term project taking considerable effort resulting in advancement of aquatic plant management; performance beyond the call of duty as an APMS officer, chair, or representative; or non-member achievement leading to the advancement of APMS goals and objectives.

Gerald Adrian	2005
Linda Nelson	2007
Surrey Jacobs	2009
Amy Richard	2010
Michael Netherland	2011
John H. Rodgers, Jr.	2012
John Madsen	2013
Jim Schmidt	2014
Jeffrey D. Schardt	2015
Craig Aguillard	2016
Tommy Bowen	2017
Tyler Koschnick	2018
Robert J. Richardson	2019
Jeremy Slade	2020
Jason Ferrell	2021
Mark Heilman	2022

Outstanding Graduate Student Award

A student recognized for outstanding achievement during graduate studies in the field of aquatic plant management.

Ryan Wersal	Mississippi State University	2010
Joe Vassios	Colorado State University	2011
Sarah True-Meadows	North Carolina State University	2013
Justin Nawrocki	North Carolina State University	2014
Erika Haug	North Carolina State University	2015
Kyla Iwinski	Clemson University	2016
Alyssa Calomeni	Clemson University	2017
Andrew Howell	North Carolina State University	2018
Tyler Geer	Clemson University	2019
Gray Turnage	Mississippi State University	2020
Mirella Ortiz	Colorado State University	2021
Jens Beets	NC State University	2022

Outstanding International Contribution Award

An individual or group recognized for completion of research or outreach activities that is international in nature.

Deborah Hofstra	National Institute of Water & Atmospheric Research	2013
Paul Champion	National Institute of Water & Atmospheric Research	2016
John Clayton	National Institute of Water & Atmospheric Research	2017
Tony Dugdale	Agriculture Victoria	2018

Outstanding Journal of Aquatic Plant Management Article Award

An award voted by the Editor and Associate Editors for research published in the JAPM during the previous year.

James Johnson, Ray Newman	University of Minnesota	2012
Michael D. Netherland and LeeAnn Glomski	U.S. Army Corps of Engineers	2014
Greg Bugbee, M. Gibbons, and M.J. Wells	Connecticut Agricultural Experiment Station	2016
Justin Nawrocki, Robert Richardson and Steve Hoyle	North Carolina State University	2017
Ryan A. Thum, Syndell Parks, James N. Mcnair, Pam Tyning, Paul Hausler, Lindsay Chadderton, Andrew Tucker, and Anna Monfils	Montana State University	2018
Alyssa J. Calomeni, Ciera M. Kinley, Tyler D. Geer, Maas Hendrikse, and John H. Rodgers Jr	Clemson University	2019
Melaney Dunne and Raymond Newman	University of Minnesota	2020
John Madsen and Kurt Getsinger	USDA and USACE	2022

Outstanding Research/Technical Contributor Award

An individual or group recognized for completion of a research project or technical contribution related to aquatic plant management that constitutes a significant advancement to the field.

Michael Netherland, Dean Jones, and Jeremy Slade	University of Florida	2010
Kurt Getsinger	U.S. Army Corps of Engineers	2011
Mark Heilman	SePRO Corporation	2013
John Rodgers	Clemson University	2015
Rob Richardson	North Carolina State University	2016
Ryan Thum	Montana State University	2017
Scott Nissen	Colorado State University	2018
John D. Madsen	Unites States Department of Agriculture	2019
Patrick Moran and the DRAAWP	Unites States Department of Agriculture	2020
Tera Guetter	Pelican River Watershed Dist.	2021
Stephen Enloe	University of Florida	2022

Michael D. Netherland Graduate Student Research Grant

Student initiatives are among the most important core values of the Aquatic Plant Management Society. High on the list of student support programs is the APMS Graduate Student Research Grant. This $40,000 academic grant, co-sponsored by APMS and the seven regional APMS chapters, provides funding for a full-time graduate student to conduct research in an area involving aquatic plant management techniques (used alone or integrated with other management approaches) or in aquatic ecology related to the biology or management of regionally or nationally recognized nuisance aquatic vegetation.

Recipient	Affiliation	Year	Amount
Mary Bremigan	Michigan State University	1999	$34,000
The Indirect Effects of Sonar Application on Lake Food Webs			
Katia Englehardt	University of Maryland	2001	$40,000
Controlling Non-native Submersed Aquatic Macrophyte Species in Maryland Reservoirs: Plant Competition Mediated by Selective Control			
Susan Wilde	University of South Carolina	2005	$40,000
Investigating the Role of Invasive Aquatic Plants and Epiphytic Cyanobacteria on Expression of Avian Vacuolar Myelinopathy (AVM)			
John Madsen and Ryan Wersal	Mississippi State University	2007	$60,000
The Seasonal Phenology, Ecology and Management of Parrotfeather [Myriophyllum aquaticum (Vellozo) Verdecourt]			
Rob Richardson, Sarah True, Steve Hoyle	North Carolina State University	2010	$40,000
Monoecious Hydrilla: Phenology and Competition			

Ryan Thum	Grand Valley State University	2012	$40,000
A Quantitative Genetics Approach to Identifying the Genetic Architecture of Herbicide Susceptibility, Tolerance, and Resistance in Hybrid Watermilfoils (Myriophyllum spicatum x sibiricum)			
Scott Nissen	Colorado State University	2014	$40,000
Exploring the Physiological Basis of 2,4-D Tolerance in Northern Watermilfoil x Eurasian Watermilfoil Hybrids			
Rob Richardson	North Carolina State University	2015	$40,000
Aspects of Monoecious Hydrilla Physiology and Response to Herbicide Combination Treatments			
Christopher R. Mudge and Bradley T. Sartain	Louisiana State University	2016	$40,000
Exploring Alternative Giant Salvinia (Salvinia molesta D.S. Mitchell) Management Strategies			
John Rodgers and Tyler Geer	Clemson University	2017	$60,000
Evaluation of Management Options for Nitellopsis obtusa (Desvaux in Loiseleur) J. Groves, (1919) (Starry Stonewort) in the United States			
Ryan A. Thum and Greg M. Chorak	Montana State University	2018	$40,000
Identifying Eurasian and Hybrid Watermilfoil Gene Expression Differences in Response to Frequently Used Herbicides for Improved Adaptive Management			
Rob Richardson and Jens Beets	North Carolina State University	2020	$40,000
Evaluation of Effect of Biotype on Biology and Response to Herbicides of Aquatic Macrophyte Species			
Alyssa Anderson and Ryan Wersal	Minnesota State University - Mankato	2022	$40,000
The Photosynthetic Ecology of Parrotfeather (Myriophyllum aquaticum) and Implications for Future Spread			

Sustaining Members

AgroShield has been serving the Agriculture and Aquatic industries since 2015. Our Vodaguard product was developed to cure infections in the upper water column. Vodaguard's unique follow the bloom technology concentrates the cure where it is needed the most. Vodaguard C is a copper sulphate pentahydrate product. Vodaguard O is a sodium percarbonate that becomes hydrogen peroxide when introduced to water. Both products have a patented formulation that allows them to be buoyant for 24 to 36 hours. Reduces manpower, machinery, and un-necessary product which reduces cost. Please visit us at: https://www.agro-shield.com/our-products/algaecides.

Since 1981, **Applied Aquatic Management, Inc.**, (AAM) has provided innovative and effective water management services, selective vegetation control, wetland management and exotic weed control. AAM has clients throughout Florida including developers, homeowners associations, golf courses, mobile home communities, utilities, local, state and federal government agencies and industry. Our experienced professional staff provides unique knowledge along with advanced equipment to manage all types of waterway, right-of-way, wetland, and upland systems.

AquaTechnex, LLC is a lake and aquatic plant management firm that operates in the Western United States. The company is expert in the use of aerial and boat GIS/GPS technologies to assess aquatic environments. The firm is also expert in the management of invasive aquatic weed species and phosphorous mitigation to suppress toxic cyanobacteria blooms. Our web site is www.aquatechnex.com; please drop by regularly to get news updates as we have moved our blog onto the site.

Aquatic Control, Inc. has been managing aquatic resources since 1966. As a distributor of lake management supplies, floating fountain aerators, and diffused aeration systems, Aquatic Control represents all of the major brands of quality supplies and equipment. Aquatic Control has eight offices that offer aquatic vegetation management services including vegetation mapping, application services, fountain and aeration system installation, equipment maintenance, and factory-trained service and warranty repair throughout the Midwest. Harmful Algae Bloom monitoring programs with our in-house laboratory allow us to customize treatment plan design through control of the algae causing taste and odor or toxin production issues. Learn more at www.aquaticcontrol.com.

Aquatic Vegetation Control, Inc. (AVC) is a Florida corporation founded in 1986 offering vegetation management and general environmental consulting services throughout the southeast. Since its establishment as an exotic/nuisance vegetation management company specializing in the control of invasive wetland, aquatic and upland species, AVC has broadened its scope of capabilities to include; certified lake management, fish stocking, re-vegetation, mitigation and restoration services, mitigation monitoring services, aquatic, roadside, forestry and utility vegetation management, and environmental/ecological consulting.

Atlantic-Oase is a proud member of the Oase Group, the global leader of the Water Feature industry. We offer a continuously growing roster of the most respected products in the world. From enchanting Fountain and Water Entertainment systems of every size imaginable, to innovative Formal Spillways, Spouts and WaterWalls, we offer unique products for the hardscape. From the strongest Pond-free Vaults, Eco-Blox and FastFalls to the most advanced filtration products, we satisfy the most demanding landscaper and hobbyist. We also design, build and bring to market the most extensive line of water garden and fountain pumps, along with dependable aeration products, pond accessories and lighting systems.

Black Lagoon advocates for a proactive and integrated approach to waterbody management. We mitigate conditions impacting water quality, land use, ecosystem balance, property value, recreation, and overall aesthetics by implementing technically sound management programs. We establish connected, long-term relationships with our clients to manage the water quality challenges faced by their lakes, ponds, and wetlands…because everybody deserves clean, safe, enjoyable water.

Brewer International is a reputable manufacturer of aquatic and land management adjuvants that has been providing distribution services nationwide for over 40 years, with its headquarters located in Vero Beach, Florida. The company specializes in producing surfactants designed to improve pesticide penetration, wetting, bonding, and drift control. Our products are widely utilized by aquatic and land managers across the country to enhance pesticide uptake, thereby increasing efficiency while reducing the chemical footprint in natural environments. As a family-owned business, Brewer International is committed to producing only the highest-quality products and has consistently invested in product development and manufacturing innovation to provide its distribution partners with the best possible value. We take great pride in our reputation as a reliable partner, providing superior quality products that meet and exceed industry standards.

Chem One is a national leader of Organic Copper Sulfate for aquatic management. With eight standard EPA label grades; Fine 20, 25, 30, 100, 200, Small, Medium and Large. Chem One has a grade to meet every customer’s needs. With our corporate offices and 78,000+ square foot warehouse in Houston, Texas, Chem One is a national wholesale company that is certified to ISO 9001, ISO 14001, OHSAS 18001.

Compliance Services International (CSI) is a leading regulatory consultancy providing innovative solutions for organizations faced with regulatory and environmental challenges. CSI’s experienced scientists and regulatory specialists in the USA and the EU provide innovative approaches to solving regulatory and environmental challenges – combining traditional sciences with developing technologies to deliver economically sensible and scientifically sound results.

Cygnet Enterprises, Inc. is the largest, single source distributor of aquatic management products in the United States. With strategically placed offices and warehouses in Michigan, Indiana, Pennsylvania, North Carolina, California, and Idaho we provide quick access to any product you may need for your lake, pond, reservoir, or irrigation district. Our dedicated and experienced staff assures aquatic managers receive outstanding service to manage our valuable water resources.

Duke Energy "Building a smarter energy future". Duke Energy (NYSE: DUK), a Fortune 150 company headquartered in Charlotte, N.C., is one of the largest energy-holding companies in the U.S. It employs 30,000 people and has an electric generating capacity of 51,000 megawatts through its regulated utilities, and 3,000 megawatts through its nonregulated Duke Energy Renewables unit. Duke Energy is transforming its customers' experience, modernizing the energy grid, generating cleaner energy, and expanding natural gas infrastructure to create a smarter energy future for the people and communities it serves. More information about the company is available at duke-energy.com. Follow Duke Energy on Twitter, LinkedIn, Instagram and Facebook.

Since 1973, **Diversified Waterscapes, Inc**. has offered lake management services and ecological products to professional applicators. Our proven field experience in pond and lake cleaning enabled us to develop an eco-friendly line of products that show dramatic results in any aquatic environment. With more than 45 years of experience, we have been providing aquatic treatment products and maintenance service for some of the world's best water features, including the famous Bellagio Fountain in Las Vegas – delivering clearly better results without harming the environment. Our mission is to combine extensive industry experience, mechanical aptitude and scientific knowledge to bring clarity, cleanliness and beauty to water features across the country.

Lake Restoration, located in MN, has specialized in controlling pond weeds, lake weeds, and nuisance algae since 1977. Lake Restoration's product line-up includes: Mizzen, a copper based algaecide, Spritflo and Dibrox herbicides, a variety of pond dyes and nutrient reducers. Lake Restoration also manufactures the TORMADA product application boat, Vitaflume floating fountains, the retractable Goose D-Fence system. For more information, visit www.lakerestoration.com.

The Lee County Hyacinth Control District was formed by the Florida Legislature in June 1961to curtail excessive growths of water hyacinth. That same year, water managers from across the state convened in Lee County and formed the Hyacinth Control Society, now APMS, to share control strategies and develop a comprehensive management approach to Florida's most prolific aquatic plant. T. Wayne Miller, Jr. of Lee County served as the Society's President for the first two years and Lee County has been a supporting member of APMS since its inception.

Maxunitech is an integrated enterprise focusing on the Research and Development, production, sales of agrochemicals, and relevant intermediates and other fine chemicals. Established in 2000, under the principles of "people oriented, united for innovation and pursue excellence", we have been researching and developing new products, solving commercial issues from the perspective of technology, and fulfilling enterprise value with value added for our clients.

For more than 100 years we've been growing with you, bringing crop protection choices to our supply partners and the growers they serve. Nufarm solutions are developed and manufactured right her in America from three state-of-the-art US manufacturing facilities.

Nutrien Solutions is a full-service vegetation management company, providing innovative solutions and quality products for the aquatic plant management industry. The cornerstone of our success is our highly educated and trained field staff. With strong commitments to environmental stewardship, innovation, and technology, Nutrien Solutions provides customized programs tailored to specific locations throughout the U.S. We are the country's leading vegetation management provider, and we're excited to introduce you to everything Nutrien Solutions has to offer. Visit: NutrienAgSolutions.com/Specialty.

SOLitude Lake Management is a nationwide environmental firm committed to providing sustainable solutions that improve water quality, enhance beauty and preserve natural resources.

SOLitude's team of aquatic scientists specializes in the development and execution of customized lake, stormwater pond, wetland and fisheries management programs. Services include water quality testing and restoration, algae and aquatic weed control, installation and maintenance of fountains and aeration systems, shoreline erosion control, muck and sediment removal and invasive species management. SOLitude partners with homeowners associations, golf courses, private landowners, businesses and municipalities. For more information, visit SOLitude Lake Management at solitudelakemanagement.com.

Invasive weeds can devastate both natural and commercial habitats. **Syngenta** provides high performance products to control destructive weeds while helping to restore the habitat of aquatic environments. Syngenta offers proven aquatic herbicides like Reward® and Tribune™ that provide fast burn-down, work well in cool weather and are rainfast in as little as 30 minutes. The active ingredient, diquat dibromide, has been used successfully in sensitive aquatic areas for over 25 years.

UPL NA, Inc. is a premier supplier of crop protection products and technologies designed for the agricultural, specialty, fumigation and aquatic markets. The Aquatics Division is part of the Environmental Solutions group which has manufactured aquatic herbicides and algaecides for the management of lakes, ponds, rivers and irrigation canals for more than 40 years. These products are marketed as Aquathol®, Hydrothol®, AquaStrike®, Current®, Symmetry®, Cascade®, Teton®, and Top Deck™. Most recently the development and commercialization of the ADAPT aquatic drone boat for improved application accuracy and efficiency was launched. With a customer-centric focus, UPL is committed to providing product stewardship and technical support to ensure your plant management operations are successful. Visit us at: https://uplaquatics.com/

Exhibitors

The Aquatic Plant Management Society thanks the following companies for exhibiting their products and services. This list was current when the Program was submitted for printing. Please visit the exhibit hall in the Gallery for all Exhibitors, including not-for-profit organizations.

Alligare, LLC
Opelika, AL

Aquatic Control, Inc.
Seymour, IN

Aquatic Ecosystem Restoration Foundation (AERF)

Aquatic Consulting and Testing
Tempe, AZ

AquaMaster Fountains
Kiel, WI

Atticus, LLC
Cary, NC

BioSafe Systems
East Hartford, CT

Brandt Consolidated, Inc.
Springfield, IL

Brewer International
Vero Beach, Florida

Cygnet Enterprises
Flint, MI

EazyPro Pond Products
Grant, MI

Heritage PPG
McKinney, TX

Hydro BioScience
Piney Flats, TN

Kasco
Prescott, WI

KeyColour
Phoenix, AZ

North American Lake Management Society
Madison, WI

NuFarm Americas
Alsip, IL

Nutrien Solutions
Loveland, CO

Orion Solutions
Rocky Mount, VA

Phoslock Environmental Solutions
Cullman, AL

Responsible Industry for a Sound Environment (RISE) *Arlington, VA*

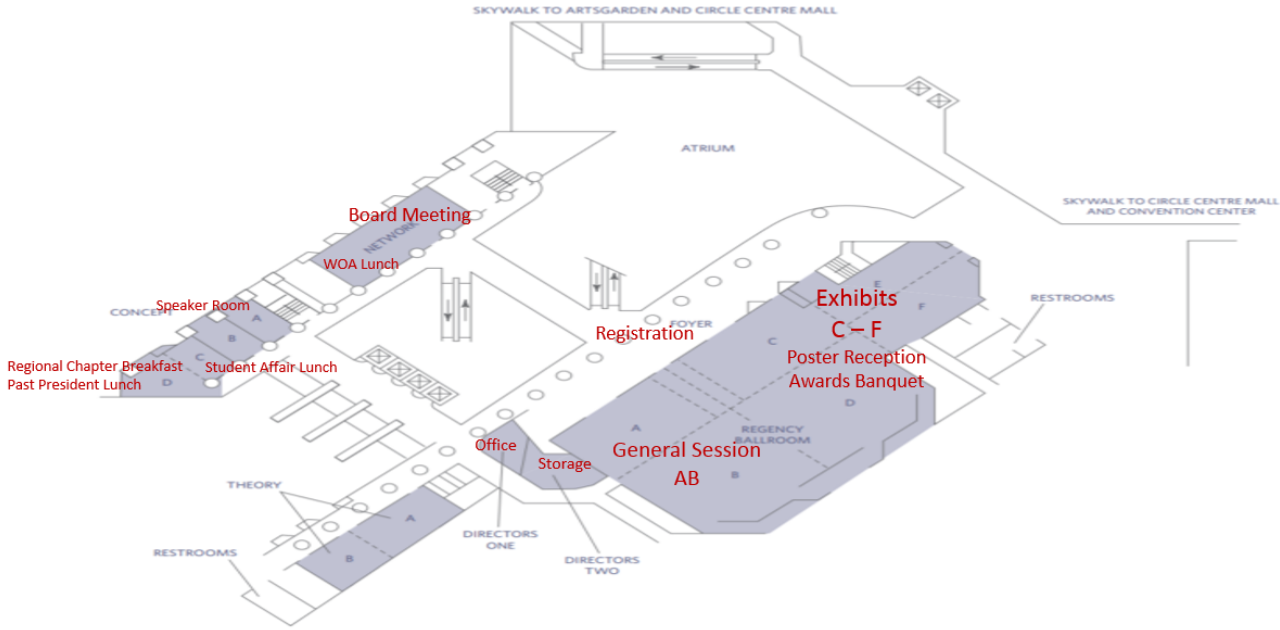
SePRO
Carmel, IN

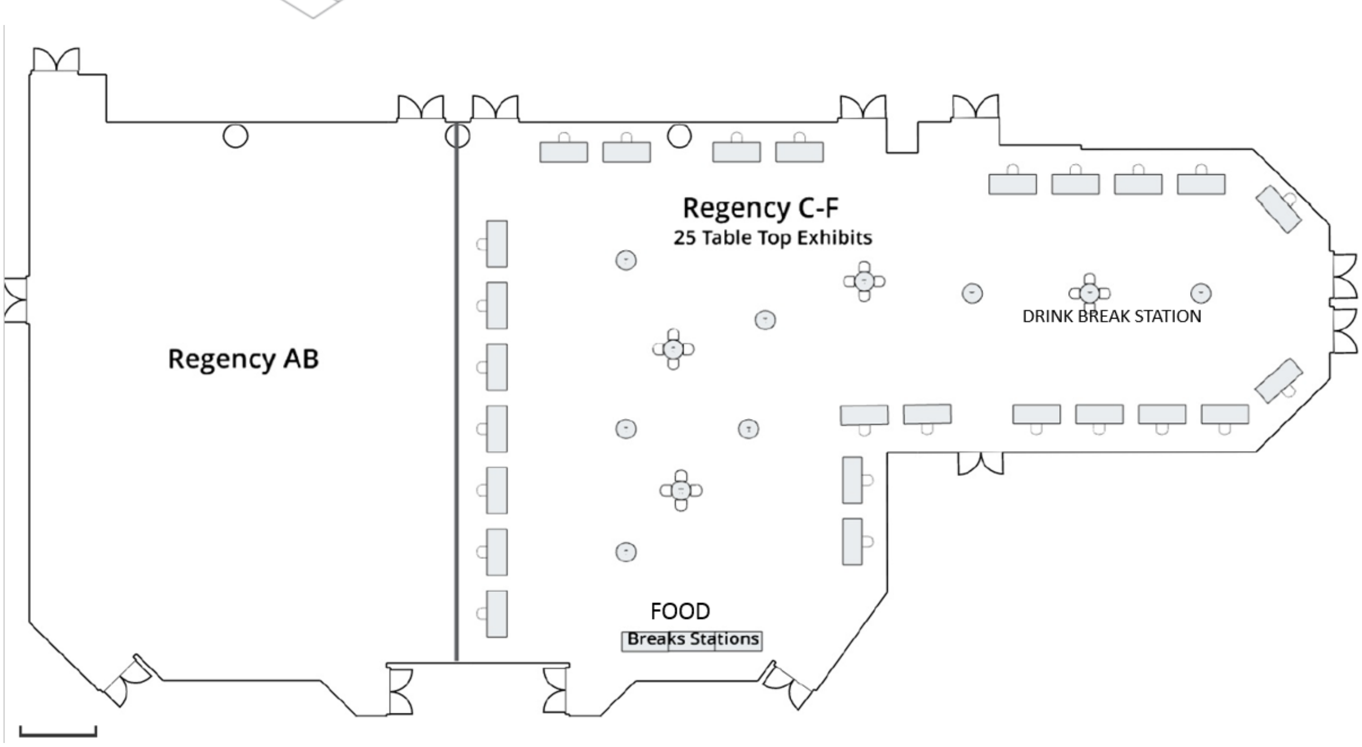
Syngenta
Greensboro, NC

UPL Environmental Solutions
King of Prussia, PA

UF/IFAS Center for Aquatic and Invasive Plants
Gainesville, FL

Western Aquatic Plant Management Society


SKYWALK TO ARTSGARDEN AND CIRCLE CENTRE MALL
ATRIUM
SKYWALK TO CIRCLE CENTRE MALL AND CONVENTION CENTER
Board Meeting
NETWORK
WOA Lunch
CONCEPT
Speaker Room
Regional Chapter Breakfast
Past President Lunch
Student Affair Lunch
Registration
FOYER
Exhibits
C – F
Poster Reception
Awards Banquet
RESTROOMS
REGENCY BALLROOM
Office
Storage
General Session
AB
THEORY
RESTROOMS
DIRECTORS ONE
DIRECTORS TWO


Regency AB
Regency C-F
25 Table Top Exhibits
DRINK BREAK STATION
FOOD
Breaks Stations

General Information and Events

Program Organization
The agenda is organized by day and time. For more event information, please see the Agenda-at-a-Glance pages for each day in this Program. Messages will be posted at the meeting registration desk. Most events will take place in the Regency Ballrooms. See the hotel site map on previous pages for event locations.

Name Badges
Your name badge is your ticket for all events at the meeting. Wear it to all activities during the meeting. All individuals participating in meeting events or activities must be registered and have a name badge. Non-registered guests may purchase tickets for the President's Reception, Poster Session Reception, and Awards Banquet at the meeting registration desk.

Meeting Registration Desk
The meeting registration desk will be in the Regency Foyer from noon to 5:00 pm on Monday and will continue from 7:00 am – 5:00 pm on Tuesday and Wednesday, and 7:00 am – noon on Thursday.

Exhibits
Exhibits will be open from 7:00am Tuesday through 5:00pm Wednesday in Regency C-F.

Continental Breakfasts / Refreshment Breaks
Continental breakfasts and mid-morning and afternoon refreshment breaks will be served each day in Regency C-F. Please see the Agenda-at-a-Glance for specific times. Also, take time to visit with Exhibitors while enjoying your breakfast or break.

Spur of the Moment Meeting Room
We have a room set up for break out discussion and conference needs. Check at the meeting registration desk to reserve.

Student Meet-and-Greet:
Monday, July 25, 6:00 pm to 7:00 pm, Punch Bowl
All students registered for the meeting are invited to gather at *Punch Bowl* to get to know other students prior to the Presidents' Reception. Beverages and light snacks will be provided. This students-only event is open to all students who are registered for the meeting.

President's Reception:
Monday, July 24, 6:00 pm to 9:00 pm, Punch Bowl
Join your APMS friends and colleagues at the President's Reception to "kick-off" our annual meeting while enjoying a game atmosphere with food and beverages. The President's Reception is open to all registered delegates, guests, and students. Non-registered guests may purchase tickets at the meeting registration desk.

Regional Chapters Breakfast:
Tuesday, July 25, 7:00 am to 8:00 am, Concept CD
Two representatives from each APMS regional chapter are invited to attend the Regional Chapter Discussion, provided by APMS sponsors. Regional Chapters Committee Chair Gray Turnage will be the moderator for discussions on aquatic plant management activities in each region. Please contact Gray to confirm your attendance.

Women of Aquatics Luncheon:
Tuesday, July 25, noon to 1:30 pm, Network
Amy Kay will host the APMS Women of Aquatics Luncheon to discuss opportunities for women in the field of aquatic plant management. Please contact Amy to confirm your attendance.

Poster Session Reception:
Tuesday, July 25, 6:00 pm to 7:00 pm, Regency C-F.
Posters will be available for viewing from 8:00 am Monday to noon Wednesday in *Regency C-F.* Poster presenters will be on hand during the Evening Poster Reception on Tuesday, July 25, 6:00 pm to 7:00 pm in Regency C-F.

Past Presidents' Luncheon:
Wednesday, July 26, 12:00 pm to 1:30 pm, Concept D
All APMS Past Presidents are invited to attend the Past Presidents' Luncheon to provide insight into matters facing APMS and aquatic plant managers. Ryan Thum, Immediate Past President, will be the moderator. Please contact Ryan to confirm your attendance.

Student Affairs Luncheon:
Wednesday, July 26, 12:00 pm to 1:30 pm, Concept C
All students registered for the meeting are invited to attend. This luncheon, provided by our sponsors, is a great opportunity to meet other students, interact with guest speakers and APMS leadership, and learn how to become more involved in the Society. Candice Prince, Student Affairs Committee Chair, will be the moderator. Please contact Candice to confirm your attendance.

Awards Reception/Banquet:
Wednesday, July 26, 6:00 pm to 10:00 pm, Reception (Regency Foyer A-D), Banquet (Regency E-F)
Registered delegates, guests and students are invited to the Awards Banquet to be held in the hotel. After dinner, we will recognize those who have served APMS, welcome new officers and directors. Our evening will conclude with a fund-raising raffle to support APMS student and other education initiatives.

APMS Post-Conference Board of Directors Meetings:
Newly elected officers, directors, and committee members will attend the post-conference board of directors meeting. Members will be provided a web link for the meetings which will be held virtually following the conference.

Events-at-a-Glance

Monday – July 24:

7:30-5:00	APMS Board of Directors Meeting (Network)
8:00-5:00	Exhibits and Poster Setup (Regency Ballroom C-F)
12:00-5:00	Registration (Regency Foyer A-D)
6:00-7:00	Student Meet & Greet (Punch Bowl)
7:00-9:00	President's Reception (Punch Bowl)

Tuesday – July 25:

7:00-5:00	Exhibits (Regency Ballroom C-F)
7:00-8:00	Continental Breakfast (Regency Ballroom C-F)
7:00-8:00	Regional Chapters Breakfast (Concept CD)
8:00-5:00	Registration (Regency Foyer A-D)
8:00-5:00	General Session (Regency Ballroom A-B)
12:00-1:30	Women of Aquatics (Network)
5:30-7:30	Reception Poster Session (Regency Ballroom C-F)

Wednesday – July 26:

7:00-5:00	Exhibits (Regency Ballroom C-F)
7:00-8:00	Continental Breakfast (Regency Ballroom C-F)
8:00-5:00	Registration (Regency Foyer A-D)
8:00-5:00	General Session (Regency Ballroom A-B)
12:00-1:30	Past-Presidents Lunch (Concept D)
12:00-1:30	Student Affairs (Concept C)
6:00-7:00	APMS Awards Banquet Reception (Regency Foyer A-D)
7:00-10:00	APMS Awards Banquet (Regency E-F)

Thursday – July 27:

7:00-12:00	Exhibits (Regency Ballroom C-F)
7:00-8:00	Continental Breakfast (Regency Ballroom C-F)
7:00-12:00	Registration (Regency Foyer A-D)
8:00-12:00	General Session (Regency Ballroom A-B)
12:00-5:00	Student Tour

PROGRAM

Poster Session

LOCATION: Regency C-F

PRESENTER † STUDENT CONTEST

†Effects of salinity on sprouting success of flowering rush (*Butomus umbellatus*).
Andrew B. Coomes[1], Bradley T. Sartain[2]
[1]USACE-ERDC-EEA, Vicksburg, MS
[2]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS

†Alligator Weed Produces Seeds in North America: Implications for Invasive Alligator Weed Reproduction. **Samuel A. Schmid**, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

†Developing Novel, Remote Sensing Techniques to Accurately Detect the Impact of Biological Control on Water hyacinth, *Pontederia crassipes* Mart.
Usman Mohammed[1], Carey Minteer[1], Aditya Singh[2], Sriyanka Lahiri[2]
[1]University of Florida, Fort Pierce, FL
[2]University of Florida, Wimauma, FL

†The Effect of Light Interruption on Dioecious Hydrilla Propagule Production.
Daniel C. Canfield[1], Benjamin P. Sperry[2], Candice M. Prince[1], Michael W. Durham[1], Greg MacDonald[1]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers, Gainesville, FL

†Aquatic Macrophyte Community Response to Carp Removal and Invasive Macrophyte Management in Staring Lake, Minnesota.
Maija E. Weaver[1], Raymond M. Newman[2]
[1]University of Minnesota, Saint Paul, MN
[2]Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St Paul, MN

†Native and Invasive Aquatic Plant Species Response to Water Quality Conditions after Alum Treatments. **Kaitlyn M. Hembre**[1], Ray Newman[2]
[1]University of Minnesota, Twin Cities, Princeton, MN
[2]University of Minnesota, Twin Cities, Minneapolis, MN

†Efficacy of intermittent exposures of three herbicides for monoecious hydrilla management.
Jens P. Beets[1], Erika J. Haug[2], Benjamin P. Sperry[3], Robert J. Richardson[1]
[1]North Carolina State University, Raleigh, NC
[2]NCSU, Raleigh, NC
[3]US Army Corps of Engineers, Gainesville, FL

Effects of Aquatic Plant Invasion and Long-Term Management on Native Plants in Florida.
Candice M. Prince[1], Amy Kendig[2], Luke Flory[1], Mark Hoyer[1], James Leary[3]
[1]University of Florida, Gainesville, FL
[2]Minnesota Department of Natural Resources, St. Paul, MN
[3]Center Aquatic and Invasive Plants, UF/IFAS, Gainesville, FL

Integrated Management of Cuban bulrush Grown in Mesocosms.

Gray Turnage
Mississippi State University, Starkville, MS

Identifying Optimal Spray Components for Waterhyacinth Control with Unoccupied Aerial Sprayers.
Andrew W. Howell[1], Michael W. Durham[2], Benjamin P. Sperry[3], Robert J. Richardson[4]
[1]North Carolina State University, Pittsboro, NC
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers, Gainesville, FL
[4]North Carolina State University, Raleigh, NC

Overview of triploid grass carp stocking in North Carolina reservoirs.
Robert J. Richardson[1], Mark Fowlkes[2], Jessica Baumann[3], Rob Emens[4], Drew Gay[4], Brett M. Hartis[5]
[1]North Carolina State University, Raleigh, NC
[2]North Carolina Wildlife Resources Commission, Raleigh, NC
[3]North Carolina State University / Dept. Crop and Soil Sciences, Raleigh, NC
[4]North Carolina Department of Environmental Quality, Raleigh, NC
[5]Duke Energy, Huntersville, NC

Translating Herbicide Use Pattern for Floating Plant Control with Spray Tracker Technology.
Jonathan Glueckert[1*], Louis Tirado[1], Amber Riner[1], Alex Dew[2] and James Leary[1]
[1] Center for Aquatic and Invasive Plants, Institute of Food and Agricultural Science, University of Florida
[2] Invasive Plant Management Subsection, Florida Fish and Wildlife Conservation Commission

TUESDAY MORNING JULY 25

7:00 AM Regional Chapters Breakfast (Concept CD)

Special Session -- Navigating Conflict with Improved Communication

LOCATION: Regency A-B
TIME: 8:00 AM - 10:00 AM Eastern Time
MODERATOR: Jason Ferrell
University of Florida
Gainesville, FL

SPEAKER

08:00 AM Presidential Address

08:10 AM Navigating Conflict with Improved Communication: Introduction.
Jason Ferrell and Christine Krebs
UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL

08:20 AM Who Wants a Seat at the Table? Being Proactive to Involve Anglers in Aquatic Vegetation Management Decisions.
Gene Gilliland
B.A.S.S., LLC, Norman, OK

08:50 AM Navigating Internal Agency Struggles with Our Most Complicated Freshwater Issue.
Jason Dotson
Florida Fish and Wildlife Conservation Commission, Gainesville, FL

09:20 AM Aquatic Plant Management Communication: A Contractor's Perspective.
Nathan W. Long
Aquatic Control, Seymour, IN

09:50 AM **Navigating Conflict with Improved Communication: Wrap-up.**
Christine Krebs and Jason Ferrell
UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL

10:00 AM **Break**

Student Oral Competition

LOCATION: Regency A-B
TIME: 10:20 AM - 12:00 PM Eastern Time
MODERATOR: Candice M. Prince
University of Florida
Gainesville, FL

SPEAKER † STUDENT CONTEST

10:20 AM **†Developing Aerial Surveillance Methods for Identifying Cryptic Water Hyacinth (Eichhornia crassipes [Mart.] Solms) on Lake Lochloosa in Florida.**
Amber E. Riner[1], Jonathan Glueckert[1], Ayesha Malligai[2], Luis R. Tirado[2], Amr Abd-Elrahman[3], James Leary[1]
[1]UF/IFAS Center for Aquatic and Invasive Plants, University of Florida, Gainesville, FL
[2]University of Florida, Gulf Coast REC, Plant City, FL
[3]University of Florida, School of Forest Resources and Conservation, Gainesville, FL

10:40 AM **†Seasonal Resource Allocation and Accumulated Degree Day Estimation for Cuban Bulrush (*Oxycarum cubense*) in the Southeastern U.S.**
Allison C. Squires[1], Gray Turnage[2], Ryan M. Wersal[3]
[1]Minnesota State University, Mankato, St. Peter, MN
[2]Mississippi State University, Starkville, MS
[3]Minnesota State University, Mankato, Mankato, MN

11:00 AM **†Life History Strategies of Diploid Flowering Rush (*Butomus umbellatus*) Harvested from Field Populations in New York and Ohio.**
Maxwell G. Gebhart[1], Ryan M. Wersal[1], Bradley T. Sartain[2], Nathan Harms[3]
[1]Minnesota State University, Mankato, Mankato, MN
[2]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[3]U.S. Army Corps of Engineers-ERDC, Lewisville, TX

11:20 AM **†The effect of granular endothall placement on control of *Vallisneria americana*.**
Corrina J. Vuillequez, Michael W. Durham, Dr. Benjamin P. Sperry, Dr. Candice J. Prince
University of Florida, Gainesville, FL

11:40 AM **†Testing New Chemical and Integrated Control Methods on Invasive Alligator Weed in the Southeast.**
Samuel A. Schmid, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

12:00 PM **Lunch on Your Own**

12:00 PM **Women of Aquatics (Network)**

TUESDAY AFTERNOON JULY 25

Student Oral Competition Continued

LOCATION: Regency A-B
TIME: 1:30 PM – 4:40 PM Eastern Time
MODERATOR: Ryan Wersal
University of Minnesota - Mankato

01:30 PM **†Evaluating Photosynthetic Efficiency of Parrotfeather (*Myriophyllum aquaticum*) at a Range of Temperatures to Determine Invasive Potential in the Midwest .**
Alyssa J. Anderson, Christopher T. Ruhland, Ryan M. Wersal
Minnesota State University, Mankato, Mankato, MN

01:50 PM **†Integrating Nutrient Control and Aquatic Plant Management Technologies.**
Daniel C. Canfield[1], Benjamin P. Sperry[2], Michael W. Durham[1], Candice M. Prince[1]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers, Gainesville, FL

02:10 PM **†Documenting physical and phenological growth patterns of the Connecticut River hydrilla biotype.**
Kara J. Foley, Jens P. Beets, Robert J. Richardson
North Carolina State University, Raleigh, NC

02:30 PM **†Incipient *Lygodium microphyllum G*ametophyte Response to Inundation.**
Minjin Choi[1], Stephen F. Enloe[2]
[1]UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL
[2]University of Florida, Gainesville, FL

02:50 PM **Industry Update - UPL**

03:00 PM **Break**

03:30 PM **†Evaluation of Small-Scale Subsurface Penoxsulam Treatments on Waterhyacinth and Waterlettuce.**
Hannah J. Brown[1], Candice M. Prince[2], Benjamin P. Sperry[3]
[1]University of Florida Center for Aquatic and Invasive Plants, Gainesville, FL
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers, Gainesville, FL

03:50 PM **†A practical guide for genetic surveying and monitoring for Eurasian watermilfoil management.**
Ryan Thum[1], **Ashley L. Wolfe**[1], Raymond M. Newman[2]
[1]Montana State University, Bozeman, MT
[2]Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St Paul, MN

04:10 PM ***Solanum tampicense*, a growing threat to forested wetlands in Florida.**
Stephen F. Enloe[1], Minjin Choi[2], Maximus Chou[1]
[1]University of Florida, Gainesville, FL
[2]UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL

04:30 PM **APMS Annual Business Meeting**

05:30 PM **Poster Session and Reception (Regency C-F)**

WEDNESDAY MORNING JULY 26

LOCATION: Regency A-B
TIME: 8:00 AM - 12:00 PM Eastern Time
MODERATOR: Bradley T. Sartain
US Army Corps of Engineers Engineer Research and Development Center
Vicksburg, MS

SPEAKER

08:00 AM **Seasonal starch allocation of starry stonewort (*Nitellopsis obtusa*) growing in Lake Koronis, MN.**
Ryan M. Wersal, Alyssa M. Haram
Minnesota State University, Mankato, Mankato, MN

08:20 AM **Herbicide Studies to Manage Four Aquatic Weeds in the Sacramento-San Joaquin River Delta.**
John D. Madsen[1], John Miskella[2]
[1]Retired, Eads, TN
[2]US Department of Agriculture, Agricultural Research Service, Davis, CA

08:40 AM **Importance of Surface Aeration in Shallow Pond Management.**
Cory R. Richmond
Kasco, Columbus, OH

09:00 AM **Application of Florpyrauxifen-benzyl for Control of Monoecious Hydrilla at Raystown Lake, PA.**
Bradley T. Sartain[1], Benjamin P. Sperry[2], Kurt Getsinger[3], Mark A. Heilman[4]
[1]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[2]US Army Corps of Engineers, Gainesville, FL
[3]U.S. Army Corps of Engineers-ERDC, Vicksburg, MS
[4]SePRO Corporation, Carmel, IN

09:20 AM **Evaluation of preventative algaecide treatments for cyanobacterial resting cells in sediments of a central USA lake.**
Ciera M. Kinley-Baird[1], Elizabeth Smith[2], Alyssa J. Calomeni[3], Andrew D. McQueen[3], Grace O. Patchett[1], Marvin Boyer[4], Katlynn N. Decker[2], Gerard A. Clyde[5]
[1]Aquatic Control, Inc., Seymour, IN
[2]Kansas Department of Health and Environment, Topeka, KS
[3]US Army Engineer Research and Development Center, Vicksburg, MS
[4]U.S. Army Corps of Engineers, Kansas City District, Kansas City, MO
[5]United States Army Corps of Engineers, Tulsa District, Tulsa, OK

09:40 AM **Industry Update - SePRO**

09:50 AM **Break**

10:20 AM **A Stateside, Standardized Approach to Triploid Grass Carp Stocking: Development, Implementation, Outcomes.**
Robert J. Richardson[1], Mark Fowlkes[2], Jessica Baumann[3], Rob Emens[4], Drew Gay[4], Brett M. Hartis[5]
[1]North Carolina State University, Raleigh, NC
[2]North Carolina Wildlife Resources Commission, Raleigh, NC
[3]North Carolina State University / Dept. Crop and Soil Sciences, Raleigh, NC
[4]North Carolina Department of Environmental Quality, Raleigh, NC
[5]Duke Energy, Huntersville, NC

10:40 AM **Control of Terrestrial Alligatorweed in Mississippi.**

Gray Turnage[1], Weston Thompson[2]
[1]Mississippi State University, Starkville, MS
[2]Mississippi Department of Wildlife, Fisheries, and Parks, Grenada, MS

11:00 AM **Laboratory Evaluation of Algaecides for the Proactive Treatment of Overwintering Cyanobacteria.**
Alyssa J. Calomeni[1], Andrew D. McQueen[1], Ciera M. Kinley-Baird[2], Gerard Clyde Jr.[3], Grace Gusler[4], Marvin Boyer[5], Elizabeth Smith[6]
[1]US Army Engineer Research and Development Center, Vicksburg, MS
[2]Aquatic Control, Inc., Seymour, IN
[3]USACE - Tulsa District, Tulsa, OK
[4]Aquatic Control, Seymour, IN
[5]U.S. Army Corps of Engineers, Kansas City District, Kansas City, MO
[6]Kansas Department of Health and Environment, Topeka, KS

11:20 AM **Connecticut River Hydrilla Research and Demonstration Project.**
Benjamin P. Sperry[1], Bradley T. Sartain[2], Nathan Harms[3], Kurt Getsinger[4]
[1]US Army Corps of Engineers, Gainesville, FL
[2]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[3]U.S. Army Corps of Engineers-ERDC, Lewisville, TX
[4]U.S. Army Corps of Engineers-ERDC, Vicksburg, MS

11:40 AM **Using Artificial Intelligence to Detect Submerged Aquatic Weeds to Protect Aotearoa New Zealand's Waterways.**
Daniel Clements[1], Jeremy Bulleid[2]
[1]National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand
[2]National Institute of Water and Atmospheric Research (NIWA), Christchurch, New Zealand

12:00 PM **Lunch on Your Own**

12:00 PM **Student Affairs Luncheon (Concept C)**
12:00 PM **APMS Past Presidents Luncheon (Concept D)**

WEDNESDAY AFTERNOON JULY 26

LOCATION: Regency A-B
TIME: 1:30 PM - 4:30 PM Eastern Time
MODERATOR: Lyn A. Gettys
University of Florida
Davie, FL

SPEAKER

01:30 PM **Evaluating Modified Basal Bark Band Heights to Enhance Triclopyr Efficacy.**
Conrad A. Oberweger[1], Stephen F. Enloe[2], Candice M. Prince[2], Benjamin P. Sperry[3]
[1]Center for Aquatic and Invasive Plants - University of Florida, Gainesville, FL
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers, Gainesville, FL

01:50 PM **Aquatic Alligatorweed (*Alternanthera philoxeroides*) Management Field Trials in the Waikato, New Zealand: A Collaboration Between NIWA, Waikato Regional Council and Mississippi State University.**
Daniel Clements[1], Ben J. Elliot[2], Deborah E. Hofstra[1], Paul D. Champion[1], Iñigo Zabarte-Maeztu[1], Gray Turnage[3]
[1]National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand
[2]Waikato Regional Council, Hamilton, New Zealand
[3]Mississippi State University, Starkville, MS

02:10 PM **Evaluating the Efficacy of Herbicide Combinations on Hydrilla Control in Flowing Systems.**

Michael W. Durham[1], Benjamin P. Sperry[2], Bradley T. Sartain[3]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers, Gainesville, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS

02:30 PM **Confusion and Ambiguity with the Terms Resistance and Tolerance in Aquatic Plant Management.**
Ryan Thum[1], Benjamin P. Sperry[2], Gregory M. Chorak[3], Ramon G. Leon[4], Jason Ferrell[5]
[1]Montana State University, Bozeman, MT
[2]US Army Corps of Engineers, Gainesville, FL
[3]Montana State University Department of Plant Science, Bozeman, MT
[4]North Carolina State University, Raleigh, NC
[5]University of Florida, Gainesville, FL

02:50 PM **Industry Update - Syngenta**

02:55 PM **Break**

03:20 PM **Implementation of the Control Management Test (CMT) at the Tahoe Keys Lagoons.**
Justin J. Nawrocki[1], Lars W J Anderson[2]
[1]UPL, Holly Springs, NC
[2]WaterweedSolutions, Davis, CA

03:40 PM **Response of Six Genotypes of Minnesota Watermilfoil (*Myriophyllum spp.*) to Three Commonly-Used Auxin Mimic Herbicides.**
Raymond M. Newman[1], John Gerritsen[2], Ryan Thum[3]
[1]Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St Paul, MN
[2]Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St. Paul, MN
[3]Montana State University, Bozeman, MT

04:00 PM **International Development of ProcellaCOR (florpyrauxifen-benzyl) for Aquatic Plant Management.**
Mark Heilman[1]
[1]SePRO, Carmel, IN

04:20 PM **Industry Update - AERF.**

Session Concludes

06:00 PM **Awards Banquet Reception (Regency Foyer A-D)**

07:00 PM **Awards Banquet (Regency E-F)**

THURSDAY MORNING JULY 27

LOCATION: Regency A-B
TIME: 8:00 AM - 12:00 PM Eastern Time
MODERATOR: Mike Greer
U.S. Army Corps of Engineers - ERDC
Buffalo, NY

SPEAKER

08:00 AM **Keeping Tools in Your Toolbox: An Update on Regulatory and Legislative Issues of Importance to the Aquatic Plant Management Industry.**
Megan Provost
RISE (Responsible Industry for a Sound Environment), Arlington, VA

08:20 AM **Novel Hydrilla Invades the Northeast.**
Greg Bugbee
CT Agricultural Experiment Station, New Haven, CT

08:40 AM **Long-Term Effects of Managed Invasive Macrophytes on Largemouth Bass Populations.**
Vinicius Londe, Luke Flory, Candice M. Prince
UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL

09:00 AM **APC Hydrilla Demo's in FL.**
Ian J. Markovich[1], **Benjamin P. Sperry[2]**, Jeremy Crossland[3], Kelli Gladding[4], Michael Durham[4]
[1]US Army Corps of Engineers, Clewiston, FL
[2]US Army Corps of Engineers, Gainesville, FL
[3]US Army Corps of Engineers, Jacksonville, FL
[4]UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL

09:20 AM **Genetic Diversity Characterization of *Microseira wollei* Populations from North Carolina.**
Ramon G. Leon, Saket Chandra, Jessica Baumann, Erika Haug, Robert Richardson
Department of Crop and Soil Sciences, North Carolina State University, Raleigh, NC

09:40 AM **Growing Degree Day and Growth Rate Calculations for Water Hyacinth (*Eichhornia crassipes*) in Florida.**
Greg MacDonald
University of Florida, Gainesville, FL

10:00 AM **Break**

10:20 AM **Collaborative Action: A Regional Approach to Managing Invasive Phragmites and European Frog-Bit.**
Samantha Tank, Taaja Tucker-Silva, Theresa Gruninger, James Polidori
Great Lakes Commission

10:40 AM **Great Lakes Aquatic Invasive Species Regional Coordination and Invasive Aquatic Plant Control Prioritization and Needs Assessment.**
Ceci Weibert[1], Alisha Davidson[1], Lindsay Chadderton[2], Theresa Gruninger[1]
[1]Great Lakes Commission
[2]The Nature Conservancy

Meeting Concludes

64th Annual Meeting
Hilton St. Petersburg Bayfront
St. Petersburg, Florida

Notes:

The **Aquatic Plant Management Society, Inc.** is an international organization of scientists, educators, students, commercial pesticide applicators, administrators, and concerned individuals interested in the management and study of aquatic plants. The membership reflects a diversity of federal, state, and local agencies, universities and colleges around the world, corporations, and small businesses. Membership applications are available at the meeting registration desk and online at www.apms.org.

The **Vision** of the Aquatic Plant Management Society is to be the leading international organization for scientific information on aquatic plant and algae management.

The **Mission** of the Aquatic Plant Management Society is to provide a forum for the discovery and dissemination of scientific information that advances aquatic plant and algae management policy and practice.

Follow us on social media @APMSociety (on Facebook @APMS1961)

POSTER

Alligator Weed Produces Seeds in North America: Implications for Invasive Alligator Weed Reproduction. **Samuel A. Schmid**, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

Fruiting and seed production in some flowering plants are affected by the external environment, but these processes are complex and multifaceted. Alligator weed (*Alternanthera philoxeroides*) has spread extensively as an invasive species on multiple continents, but its capacity for sexual reproduction seems greatly diminished in the invaded range. Reports of alligator weed seeds and fruits in the invasive range remain sporadic and no instances of viable seeds in invasive alligator weed have been confirmed. While breakdowns in sexual systems have been reported in other invasive plants, there has been little investigation into the sexual reproduction of invasive alligator weed. In 2022, two instances of invasive alligator weed fruiting and seed production were observed in disparate communities in northern Mississippi. While no fruiting was observed in aquatic alligator weed, both instances of fruiting were observed in terrestrial conditions. Additionally, alligator weed in the western site exhibited taproots which are only expressed in the terrestrial growth form. This suggests terrestrial conditions as a requirement for fruit and seed formation in alligator weed. Germination was attempted on seeds collected from these sites, but all efforts resulted in failed germination. Seeds also showed signs of maldevelopment. A potential cause of failed germination may be a genetic factor that renders these populations incapable of viable seed production (e.g., low genetic diversity, inbreeding depression, or polyploidy). This record of alligator weed seeds is the first in over forty years in the US. These findings suggest that further investigation into alligator weed sexual reproduction is needed.

Aquatic Macrophyte Community Response to Carp Removal and Invasive Macrophyte Management in Staring Lake, Minnesota. **Maija E. Weaver**[1], Raymond M. Newman[2]
[1]University of Minnesota, Saint Paul, MN
[2]Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St Paul, MN

Staring Lake is a shallow (4.9 m maximum depth) 66-hectare lake located in Eden Prairie, Minnesota. In 2011, the lake was turbid with poor water clarity and a high population of common carp (*Cyprinus carpio*; > 450 kg/ha). To improve water quality and the native aquatic macrophyte community, carp removal began in 2012 and concluded in 2015 with a reduction to approximately 100 kg/ha. Point intercept surveys were conducted 2-3 times a summer from 2011-present and biomass was assessed on a subset of points. Directly following carp removal there was an increase in plant diversity, frequency of occurrence, and biomass. Native plant frequency of occurrence increased from below 20% to 67% in 2016 and was up to 89% in 2022. Native biomass increased from <100 g/m^2 in August 2015 to 615 g/m^2 in August 2016 and remained above 250 g/m^2 in 2022. These numbers were also influenced by the expansion and treatment of the invasive macrophytes curlyleaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*). Curlyleaf pondweed frequency peaked at 65% in June 2016, so a 16-hectare endothall treatment took place in May 2017. Since then, curlyleaf frequency has remained below 30% through 2023. Eurasian watermilfoil was spot-treated in fall 2015 and 2016 with triclopyr. Eurasian remained low after these treatments but increased to 34% in August 2021, so in summer 2022, a whole lake fluridone treatment was conducted to control invasives and increase native plant frequency. By August 2022, Eurasian watermilfoil was only observed at 2% frequency and was not observed in early season 2023 sampling. Staring Lake is an illustrative case study for improvement of native macrophyte communities and water quality post-carp removal. A combination of water quality improvements and herbicide treatments for invasives, may be needed to improve native plant communities of lakes with similar characteristics.

Developing Novel, Remote Sensing Techniques to Accurately Detect the Impact of Biological Control on Water Hyacinth, *Pontederia crassipes* Mart. **Usman Mohammed**[1], Carey Minteer[1], Aditya Singh[2], Sriyanka Lahiri[2]
[1]University of Florida, Fort Pierce, FL
[2]University of Florida, Wimauma, FL

Water hyacinth (*Pontederia crassipes* Mart. Solms) is an aquatic plant from the family Pontederiaceae?. It is native to South America and has become one of the world's most invasive aquatic weeds. It was first introduced into the United States in 1800. Water hyacinth causes extensive damage by covering water bodies, altering aquatic habitat by reducing dissolved oxygen and light penetration and blocking access to agricultural and recreational activities?. A biocontrol program has been established to control water hyacinth and mitigate its effect on freshwater ecosystems. Two weevils, *Neochetina* spp (Coleptera: Cucurlionidae), and a planthopper, *Megamelus scutellaris* (Hemiptera: Delphacidae) were released in Florida to control water hyacinth. Assessing the impact of biocontrol on water hyacinth is essential in evaluating biocontrol agents' efficacy. Methods of accessing aquatic habitats for surveillance or impact assessment are cumbersome, costly, and can be dangerous. For example, accessing the interior of the Everglades ecosystem in Florida requires airboats or helicopters?. Other methods rely on ground-based visual surveys such as physical searches via transects, grids or points. These methods are subjective, often restrictive, challenging, and time consuming. The use of remote sensing can overcome most of these limitations in surveillance and assessment methods. Unmanned Aerial System (UAS) based remote sensing can provide a safe, quick, and efficient survey in areas where access is difficult and dangerous for traditional survey methods. The aim of this study is to develop a remote sensing technique that accurately detects the impact of biocontrol on water hyacinth. Hyperspectral data were collected in the lab on water hyacinth plants with varying levels of biocontrol agent pressure. These data will be used to quantify herbivore densities and impact. The application of UAS based remote sensing could potentially provide mapping and monitoring solutions to identify invasive aquatic plant species and detect biocontrol damage.

Effects of Aquatic Plant Invasion and Long-Term Management on Native Plants in Florida.
Candice M. Prince[1], Amy Kendig[2], Luke Flory[1], Mark Hoyer[1], James Leary[3]
[1]University of Florida, Gainesville, FL
[2]Minnesota Department of Natural Resources, St. Paul, MN
[3]Center Aquatic and Invasive Plants, UF/IFAS, Gainesville, FL

Over the past several years, Florida stakeholders have expressed concerns about the impacts of aquatic herbicide use on native biodiversity, water quality, and fish populations. While the direct, short-term effects of aquatic herbicide use have been well-studied, there is limited information about the effects of long-term herbicide use on public waterbodies. The Florida Fish and Wildlife Conservation Commission (FWC), Florida LAKEWATCH, and US Army Corps of Engineers (USACE) have maintained several long-term datasets on aquatic herbicide use, water quality, fish populations, and plant communities in Florida. With this project, we collated these datasets to address the following questions: 1) how are *Hydrilla verticillata* (hydrilla), *Eichhornia crassipes* (water hyacinth), and *Pistia stratiotes* (water lettuce); impacting native plant communities, and 2) how is chemical control of these species impacting native plant communities? To answer these questions, we identified common lakes among datasets and fit panel data models and generalized linear mixed-effect models, where appropriate. We found that increased *E. crassipes* cover had a negative effect on native plant richness, but that there were no effects of *H. verticillata* or *P. stratiotes* cover. Results also found an overall net-positive impact of herbicide use on native species, although the impact was dependent on individual species and habitat (emersed, floating, or submersed). Future work should evaluate the effects of specific herbicide active ingredients and other management strategies on native ecosystems.

Effects of Salinity on Sprouting Success of Flowering Rush (*Butomus umbellatus*). Andrew B.
Coomes[1], Bradley T. Sartain[2]
[1]USACE-ERDC-EEA, Vicksburg, MS
[2]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS

This study aimed to investigate the sprouting success of vegetative propagules of four different genotypes (three diploid and one triploid) of flowering rush across a range of salinity levels. Seven salinity treatments, ranging from 0ppt (control) to 35ppt, were evaluated. A completely randomized design was utilized, with five replicates for each treatment combination. Sprouting was assessed tri-weekly for a duration of 45 days after planting, with sprouting determined by the presence of an emergent green shoot = 3 millimeters in total length. Salinity levels were also assessed tri-weekly and maintained within +/- 1ppt of the target treatment salinity. If sprouting was observed, propagule width, length, and wet weight were recorded and sprouted propagules were removed from the petri dish to avoid recounts. Sprouting success exceeded 30% for diploid flowering rush propagules at salinities =15ppt, whereas =71% sprouting was observed in triploid propagules at salinities up to 20ppt. Minimal (=1%) sprouting was observed for all genotypes at the maximum salinity treatment (35ppt). At the conclusion of the 45-day study, non-sprouted propagules were placed in freshwater and 69% sprouting was documented after 14 days. The results suggest that different genotypes of flowering rush may have varying levels of salt tolerance and propagules exposed to saline conditions possess the ability to endure and persist until more favorable environmental conditions become available.

Efficacy of Intermittent Exposures of Three Herbicides for Monoecious Hydrilla Management.
Jens P. Beets[1], Erika J. Haug[2], Benjamin P. Sperry[3], Robert J. Richardson[1]
[1]North Carolina State University, Raleigh, NC
[2]NCSU, Raleigh, NC
[3]US Army Corps of Engineers, Gainesville, FL

In recent years, hydrilla (*Hydrilla verticillata* (L.f) Royle) has invaded lotic, or flowing systems where it is even more difficult to control. Notable infestations include the Erie Canal, Ohio River, Cape Fear River, and Deep River. Concentration exposure time is pivotal to management of submersed invasive macrophytes (e.g. hydrilla) and can be difficult to achieve in lotic systems such as these. Increased concentration exposure time improves herbicide efficacy, particularly with herbicides requiring or benefitting from intermediate to long exposure times such as endothall, fluridone, and florpyrauxifen-

benzyl. There is a current gap in knowledge concerning the efficacy of intermittent applications, particularly with endothall and florpyrauxifen-benzyl and we sought to improve this understanding. Monoecious hydrilla was grown in mesocosms and exposed to three concentrations of endothall (2, 3, or 4 ppm), fluridone (5, 10, or 15 ppb), or florpyrauxifen-benzyl (10, 30, or 50 ppb). Plants were exposed to herbicides for relatively short exposure times with varying intervals between reapplication. Highest efficacy was observed in florpyrauxifen-benzyl treatments at 30 ppb with a 6 day treatment interval, endothall treatments at 4 ppm with a 16 or 40 hour rest period, and fluridone at 5, 10, and 15 ppb with a 6-day rest period. Observed interactions between rest period and rate of herbicide will be discussed. These treatments may prove beneficial for use in lotic systems where water exchange can interrupt continuous herbicide exposure.

Identifying Optimal Spray Components for Waterhyacinth Control with Unoccupied Aerial Sprayers. **Andrew W. Howell**[1], Michael W. Durham[2], Benjamin P. Sperry[3], Robert J. Richardson[4]
[1]North Carolina State University, Pittsboro, NC
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers, Gainesville, FL
[4]North Carolina State University, Raleigh, NC

Whether by boat, land-based vehicle, or aircraft, aquatic herbicide operations are time and labor-intensive. Likewise, treatment activities can be greatly impacted by limited target site access. Over the past decade, unoccupied aerial sprayers (UAS) have shown potential to increase applicator safety while precisely delivering herbicide treatments where treatment sites limit ground-based spray equipment. However, very little is known of the comparative efficacy between UAS and standard herbicide application systems, especially in aquatic weed management. A major difference in UAS and standard aquatic herbicide application systems concerns payload size. Watercraft frequently utilized for herbicide applications commonly carry 189 to 946 L spray tanks and apply herbicides at 468 to 1871 L ha^{-1}. Conversely, UAS typically have tank capacities of 10 to 15 L due to regulatory constraints. Mesocosm studies were conducted in Florida (FL) and North Carolina (NC) to determine the optimal carrier volume, nozzle selection, and spray coverage required for multiple herbicides to control waterhyacinth. In the first study, 2,4-D provided the greatest (a =0.05) water hyacinth control at carrier volumes = 47 L ha^{-1} in NC, whereas the most effective herbicides applied at carrier volumes = 47 L ha^{-1} in FL were 2,4-D and glyphosate (a =0.05). Results from the second study showed no difference (a =0.05) between nozzle type (XR or TTI) and herbicide (diquat or glyphosate) at the lowest carrier volume evaluated (23 L ha^{-1}) which, provided >94% waterhyacinth control. However, nozzle selection (spray droplet size) appears to be more critical as carrier volumes increase > 47 L ha^{-1} for diquat. In conclusion, managers should have several herbicide options available, which provide effective control of waterhyacinth at UAS appropriate carrier volumes (= 47 L ha^{-1}). Further field UAS evaluation is needed to confirm spray component selections and results from these studies.

Integrated Management of Cuban Bulrush Grown in Mesocosms. **Gray Turnage**
Mississippi State University, Starkville, MS

Invasive aquatic plants degrade water quality, reduce usable habitat for aquatic fauna, and negatively impact human uses of water resources. Floating invasive aquatic plants are some of the hardest to manage due to difficulty finding and tracking their movement by water currents. Cuban bulrush (*Oxycaryum* *cubense*) is one such floating invasive plant that is spreading across the southeastern United States. Cuban bulrush can trap sediment in its roots causing the formation of large floating islands called tussocks. Cuban bulrush tussocks can block boat launches and piers, cover fish spawning habitat, and serve as habitat for other invasive species. Emergent Cuban bulrush biomass senesces in winter but maintains a dry thatch layer into early summer which may inhibit chemical control by intercepting herbicide droplets. Prescribed fire to reduce thatch has been investigated to enhance control of other emergent aquatic plants that maintain emergent thatch (e.g., common reed and torpedograss). The purpose of this work was to assess prescribed fire alone and as part of integrated management strategy with herbicide (triclopyr) for control of Cuban bulrush. Plants were grown in metal mesocosms for 2 years prior to implementing treatments. Treatments consisted of prescribed fire alone administered early spring (pre-emergence) or mid-spring (post-emergence), triclopyr (16.3 kg ae/ha) mid-spring, or early-spring fire followed by mid-spring triclopyr applications. Prescribed fire alone did not reduce Cuban bulrush biomass in mesocosms but triclopyr alone and prescribed fire followed by triclopyr applications yielded 83 and 100% height reduction (respectively) 6 WAT. Emergent and submersed Cuban bulrush biomass were reduced 100% by fire followed by triclopyr applications but were not reduced by any other treatments. These data suggest integrated control techniques utilizing prescribed fire may enhance control of Cuban bulrush compared to stand-alone herbicide treatments, but this should be validated in field sites prior to recommendation for operational use.

Native and Invasive Aquatic Plant Species Response to Water Quality Conditions After Alum Treatments. **Kaitlyn M. Hembre**[1], Ray Newman[2]
[1]University of Minnesota, Twin Cities, Princeton, MN
[2]University of Minnesota, Twin Cities, Minneapolis, MN

Many lakes in Minnesota are impaired for water quality (eutrophication), specifically, water clarity (secchi depth), algae (chlorophyll-a) or nutrients (total phosphorus). Interventions like carp removal and alum treatments are used to reduce internal loading after external loads are controlled. Water quality and clarity improvements from reductions in nutrient loading often led to increases in aquatic macrophytes, which provide desired fish habitat and stabilize water quality. If aquatic invasive plants are present, those species may expand rapidly with greater clarity and displace native aquatic plants. Thus, management of invasive species may be required to restore native plant communities even after treatment for nutrient loading. We are examining how native and invasive aquatic plants respond to management to improve water quality in two western Wisconsin and five Twin Cities Metro Area lakes. These lakes were all treated with alum to improve water quality. Previously collected water quality and plant survey data from these lakes was obtained (all lakes have at least 2 years of data prior to alum treatment) and we conducted early and late summer point-intercept surveys in 2022 (and continue in 2023) to assess the relationships between alum treatment, water quality, and the macrophyte community response. Our preliminary results indicate improvements in both water quality and the plant community after alum treatment, with variability between lakes. Midsummer Secchi depth increased in all treated lakes and plant frequency of occurrence and maximum depth of occurrence increased in most lakes. Preliminary results also suggest that native species have increased over time with greater clarity, but herbicidal control of invasives was needed in some lakes. Our study will provide insight into the relationships between water quality conditions, after alum treatments, and native and invasive aquatic plants allowing for a deeper understanding of how aquatic macrophytes are impacted by the effects of alum treatments.

The Effect of Light Interruption on Dioecious Hydrilla Propagule Production. **Daniel C. Canfield**[1], Benjamin P. Sperry[2], Candice M. Prince[1], Michael W. Durham[1], Greg MacDonald[1]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers, Gainesville, FL

The invasive submerged aquatic vegetation (SAV) species hydrilla (*Hydrilla verticillata)* has been dubbed the "perfect aquatic weed" due to its competitive ability. The primary obstacle to managing hydrilla is its production of vegetative propagules, especially below-ground subterranean turions (hereafter referred to as 'tubers'). Previous research identified that photoperiod controls reproduction in hydrilla, with the dioecious type reproducing under short photoperiods. Interrupting the dark period can disrupt tuber production, but the length of photoperiod interruption required for this has not been well-defined. In this pilot study, we evaluated the effects of different lengths of photoperiod interruption on hydrilla reproduction. Twelve shoot clippings of dioecious hydrilla were established in 95 L mesocosms. We evaluated into four photoperiod interruption treatments (0, 1, 10, and 100 minutes) with six replications per treatment. A plywood construction was used to suspend light fixtures and separate treatment groups. A digital timer was used to control six 45-watt incandescent bulbs per treatment. Photoperiod interruption occurred at 2:00 am each night from October 24, 2022 until May 1, 2023. Data loggers were used to verify photoperiod interruption was occurring at 2:00 am. Total propagule count for the 100 minutes treatment was 47% of the control treatment. However, results were not statistically significant ($p = 0.089$). Experimental challenges likely contributed to some variation within treatment groups. Future variations of this experiment should investigate longer photoperiods, the impact of light intensity, and the impact of light spectrum on hydrilla reproduction. Future research should also investigate the potential of combining photoperiod interruption and herbicide to increase hydrilla control. Areas with suitable infrastructure, such as public marinas and private docks, may benefit from adding photoperiod interruption to herbicide routines for hydrilla control.

Translating Herbicide Use Pattern for Floating Plant Control with Spray Tracker Technology
Jonathan Glueckert[1*], Louis Tirado[1], Amber Riner[1], Alex Dew[2] and James Leary[1]
[1] Center for Aquatic and Invasive Plants, Institute of Food and Agricultural Science, University of Florida
[2] Invasive Plant Management Subsection, Florida Fish and Wildlife Conservation Commission;

Maintenance control of floating plants is a critical component of aquatic plant management (APM) programs on public lakes. The intent is to keep populations at low levels with frequent interventions using highly experienced, professional applicators trained to find small patches and precisely dispense small amounts of herbicide to targets while minimizing non-target injury. Maintenance control is a dynamic strategy that requires intense effort and is difficult to monitor. GPS fleet vehicle tracking technology was developed over two decades ago for commercial applications to monitor and evaluate transportation activities leading to many improvements in operational efficiency and cost reduction. GPS fleet tracking has recently been introduced to aquatic plant management on Florida public lakes with the advent of Spray Tracker technology providing real-time monitoring from a live web portal. The Spray Tracker device has an added feature of a spray valve actuator for signaling spray on/off to further display where and when herbicides have been applied. This operational data is downloadable in multiple forms including a comma separated value (.csv) format with georeferenced coordinates, time stamps and the added binary spray designation. Here, we build on this data by adding an attribute for how much herbicide was applied (i.e., active ingredient per unit area) when the sprayer was “on” by integrating sprayer calibration data (e.g., range and nozzle flow rate) and herbicide batch recipes. This gives a more spatially relevant account of how much (or little) herbicide is used in floating plant management. The adoption of this information technology is evidence to APM embracing the principles of precision pest management maximizing productivity, optimizing resources and minimizing footprint.

ORAL

Developing Aerial Surveillance Methods for Identifying Cryptic Water Hyacinth (Eichhornia crassipes [Mart.] Solms) on Lake Lochloosa in Florida.

Amber E. Riner[1], Jonathan Glueckert[2], Ayesha Malligai[3], Luis R. Tirado[1], Amr Abd-Elrahman[4], James Leary[5]
[1]Center for Aquatic and Invasive Plants, Institute of Food and Agricultural Science, University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]Gulf Coast Research and Education Center, Plant City, FL
[4]Gulf Coast Research and Education Center, Gainesville, FL
[5]Center Aquatic and Invasive Plants, UF/IFAS, Gainesville, FL

Water Hyacinth (Eichhornia crassipes [Mart.] Solms) is an invasive, free-floating plant that has been managed in Florida for over a century. It is currently under statewide maintenance control to prevent small incipients from becoming large infestations. This requires an intense use of resources dedicated to monitoring and treatment efforts over large aquatic systems. This plant can migrate over long distances, colonize new areas and blend into native pad communities, making it difficult for an applicator to locate from a boat. The advent of small unmanned aerial systems (UAS) advances the opportunity for integrating aerial surveillance into the maintenance control of hyacinth. Affordable UAS outfitted with optical sensors and automated flight planning can cover large areas with high resolution imagery that is able to discriminate hyacinth from other species. We are testing this utility on Lake Lochloosa (2400 ha) with line point intercept missions capturing images from a nadir position at 1 cm resolution along transects that follow the littoral shoreline. We are learning that these missions are highly efficient, e.g., covering over 20 km and capturing over 900 images in less than 2 hours on the water. Each image can be manually scored with a presence/absence classification by an experienced analyst in less than 60 seconds and displayed in GIS for interpretation. To make this process even more efficient, we are integrating convolutional neural networks to automate the detection of hyacinth. In this presentation, we will discuss mission planning, image geo-referencing, model training and accuracy assessment. These technologies are accessible and user-friendly to practitioners with basic technical skills used in invasive plant management. The adoption of these technologies will greatly enhance intelligence that goes into management decisions for optimizing effort and resources.

Seasonal Resource Allocation and Accumulated Degree Day Estimation for Cuban Bulrush (*Oxycarum cubense*) in the Southeastern U.S.

Allison C. Squires[1], Gray Turnage[2], Ryan M. Wersal[3]
[1]Minnesota State University, Mankato, St. Peter, MN
[2]Mississippi State University, Starkville, MS
[3]Minnesota State University, Mankato, Mankato, MN

Seasonal Resource Allocation and Accumulated Degree Day Estimation for Cuban Bulrush (*Oxycarum cubense*) in the Southeastern U.S. Allison Squires[1], Gray Turnage[2]., and Ryan M. Wersal[1]. [1]Department of Biological Sciences, Minnesota State University, Mankato [2]Geosystem Research Institute, Mississippi State University Abstract: Cuban bulrush [*Oxycaryum cubense* (Poepp. & Kunth) Lye] is an epiphytic C3 invasive perennial plant native to South America. Currently, it has spread to parts of Africa, Mexico, and the Southeastern United States from Texas to Florida. The floating tussocks impact flowing water,

drinking water, hydro-electric power, aquatic food such as fish, outdoor recreational activities, and navigation for commercial military vessels. There are two inflorescence forms invading the United States: polycephalous (*Oxycaryum cubense* forma *cubense*) and monocephalous (*Oxycaryum cubense* forma *paraguayense*). The objectives of this work was to quantify resource allocation patterns of Cuban bulrush from Mississippi, Louisiana, and Florida, and to develop a predictive growth ADD (accumulated degree day) model. Preliminary results indicate that starch allocation patterns are similar among the different states, with starch not being disproportionately stored in any one tissue (<1.5% DW for all plant tissues); however, biomass shows different allocation trends between all three states, while also showing distinct patterns within the polycephalous and monocephalous form. For instance, both Louisiana and Florida (polycephalous) inflorescence biomass peaked within the winter months (November-January), while Mississippi (monocephalous) peaked in the summer (June-August). Biomass was greatest in plants from Mississippi (emergent=350 g DW m^{-2}) and (submersed = 250 g DW m^{-2}); emergent biomass in Louisiana was 250 g DW m^{-2} and submersed biomass was 80 g DW m^{-2}; emergent biomass from Florida populations was 180 g DW m^{-2} and submersed biomass was 80 g DW m^{-2}. Upon completion of this project, these data will provide a better understanding of the life history characteristics of Cuban bulrush across its invaded range in the Southeastern U.S. with the goal of refining management recommendations to exploit weak points in its growth.

Life History Strategies of Diploid Flowering Rush (*Butomus umbellatus*) Harvested from Field Populations in New York and Ohio. **Maxwell G. Gebhart**[1], Ryan M. Wersal[1], Bradley T. Sartain[2], Nathan Harms[3]
[1]Minnesota State University, Mankato, Mankato, MN
[2]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[3]U.S. Army Corps of Engineers-ERDC, Lewisville, TX

Flowering rush (*Butomus umbellatus*) is an invasive perennial monocot from western Asia that is known to block canals and reduce water recreation throughout the U.S. and Canadian border. Currently there are two cytotypes (diploid and triploid) within North America, however there is a lack of information regarding the life history strategies for the diploid type. To gain an understanding of life history strategies in diploid flowering rush, 2 field populations in New York and 1 population in Ohio were sampled May to November 2021 and 2022. Each field population had 20 randomly selected samples collected using a PVC coring device once a month. The plant tissues were divided into the following four groups: aboveground, rhizome, rhizome buds, and the inflorescence. These tissues were then dried and weighed to assess seasonal biomass allocation by dividing the tissue weight by the area of the PVC coring device (0.018 m^2.) Peak aboveground biomass (500 to 1400 g DW m^{-2}) occurred between July and August across all sites. Peak belowground biomass (500 to 1100 g DW m^{-2}) occurred between September and November. The diploid cytotype was found to make almost double the amount of aboveground and rhizome tissue than that of the triploid. The diploid cytotype was also found to have a rhizome bud density averaging around 13300 per m^{-2}, almost twenty times as numerous as what has been reported for the triploid cytotype. A third year of life history data is currently being collected for 2023. Diploid flowering rush has high spread potential due to incredibly high rhizome bud production which can break off the rhizome and move through river systems possibly invading new aquatic systems. Management for diploid flowering rush should focus on reducing the rhizome bud densities which can be done by removing the aboveground tissue between June and July.

The Effect of Granular Endothall Placement on Control of *Vallisneria americana*. **Corrina J. Vuillequez**, Michael W. Durham, Dr. Benjamin P. Sperry, Dr. Candice J. Prince
University of Florida, Gainesville, FL

Eelgrass (*Vallisneria americana*) is a native submersed aquatic plant in the US that is considered a nuisance under certain conditions, such as in private waters and hydropower reservoirs. Unfortunately, eelgrass control recommendations are limited to anecdotal evidence from operations and university extension guidance from the 1960s. Recent operational success with endothall suggests that eelgrass may be controlled with granular formulations. However, little is known about the effect that granular placement may have on management success. We conducted a mesocosm experiment using both the granular amine salt and potassium salt formulations of endothall at 3ppm, set to 24hr and 48hr half-lives. Five mesocosms were each divided into two sections using a stiff barrier, with five pots of eelgrass in each section. Granular endothall was applied to half of each tank. Six weeks after treatment, above and below ground biomass were collected, dried, and weighed. Data was analyzed using Anova. Biomass reduction was similar in both sides of the mesocosms, indicating that herbicide placement did not affect eelgrass control. This suggests that the effects of granular applications of endothall in-field can spread outside of the treated area, controlling more eelgrass than the area it was placed in.There was no difference detected between the amine salt and potassium salt of endothall on aboveground biomass. Belowground biomass was slightly lower in tanks treated with the amine salt, however this may be due to variability in half-life. Future research on eelgrass control should investigate granular placement of endothall in-field to evaluate the full radius of control provided.

Testing New Chemical and Integrated Control Methods on Invasive Alligator Weed in the Southeast. Samuel A. Schmid, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

Alligator weed, is globally problematic, but particularly troublesome in California and the Southeastern United States and native to South America. In surveys of waterbodies in Mississippi, for example, alligator weed occurs more frequently than any other aquatic plant, native or non-native. Alligator weed has a long history of control in the United States where chemical and biological control showed initial success. This plant exhibits high mortality following foliar applications of common herbicides, but this period of successful biomass reduction is often followed by robust regrowth, likely facilitated by an extensive stolon network. With regards to biocontrol, the alligator weed flea beetle (*Agasicles hygrophila*) performs well at reducing large, dense populations of alligator weed by feeding on the shoots and defoliating the plants. Unfortunately, the flea beetle has a low tolerance for cold winters, and as alligator weed expands into increasingly temperate habitats, flea beetle control becomes decreasingly feasible. To address these shortcomings in current alligator weed management we designed a study to test in-water herbicide applications and a different biocontrol vector: the alligator weed thrips (*Amynothrips andersoni*). Alligator weed thrips is known to be highly tolerant of cold, but research on this vector is scarce. We designed mesocosm studies in two phases. Phase one assessed five herbicides (bispyribac-sodium, fluridone, imazamox, penoxsulam, and topramezone) applied as in-water treatments at high and low rates. Phase two compares these herbicide treatments to thrips biological control and combines them in integrated treatments. We found multiple herbicide treatments that were highly effective at reducing alligator weed biomass with some chemistries effective at high and low rates. As we continue to our second phase, we will assess the efficacy of herbicides and thrips in an integrated control strategy.

Evaluating Photosynthetic Efficiency of Parrotfeather (Myriophyllum Aquaticum) at a Range of Temperatures to Determine Invasive Potential in the Midwest . Alyssa J. Anderson, Christopher T. Ruhland, Ryan M. Wersal
Minnesota State University, Mankato, Mankato, MN

Parrotfeather (Myriophyllum aquaticum) is an invasive, heterophyllous, aquatic plant from South America. Parrotfeather creates large, dense mats on the water's surface that prohibit recreation, clog canals and waterways, and provide habitat for mosquito breeding. Emergent growth also shades out submersed, native vegetation resulting in a loss of habitat complexity. To date, parrotfeather has yet to establish itself in the Midwest. During Midwest winters when lakes are covered in ice, the water cannot mix which results in the majority of the hypolimnion being 4°C. In order to gain a better understanding as to why parrotfeather has not established in the Midwest, photosynthetic capabilities at a variety of temperatures were examined. Chlorophyll fluorescence was used on both leaf forms (emergent and submersed) to determine photosynthetic efficiency at temperatures between 0-45°C. The maximum quantum efficiency of photosystem II in a dark-adapted state is approximately 0.83-0.84 and lower values typically indicate stress that may limit photosynthesis. Dark-acclimated (Fv/Fm) measurements, or measurements that depict photosynthetic potential, for submersed tissue yielded an average of 0.7270 and emergent tissue at 0.8010 at just above 0°C. Light-acclimated (fPSII) measurements at the same temperature resulted in an average submersed photosynthetic yield of 0.0420 and an emergent yield of 0.4860. Preliminary results indicate that the temperature optimum for both leaf forms is around 20-25 °C. Yields decline between 25°C and 40°C as the dark-acclimated submersed leaves' yield dropped by 20% and emergent leaves dropped by nearly 10%. These data suggests that parrotfeather has potential to photosynthetically thrive in cooler temperatures that are indicative of winter conditions in lakes of the Midwest. Future research will further assess the photosynthetic abilities of parrotfeather by conducting more chlorophyll fluorescence measurements at more temperatures and by conducting gas exchange analyses as well as accumulated degree day modeling for both the submersed and emergent forms.

Integrating Nutrient Control and Aquatic Plant Management Technologies. **Daniel C. Canfield**[1], Benjamin P. Sperry[2], Michael W. Durham[1], Candice M. Prince[1]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers, Gainesville, FL

Eutrophication commonly causes negative water quality impacts that damage freshwater ecosystems and local economies. For example, eutrophication has been linked to increased occurrence of anoxia, fish kills, and harmful or nuisance algal blooms. Consequently, decades of research have been focused on nutrient mitigation products in an effort to offset the deleterious effects of eutrophication. Parallel to aquatic nutrient issues, aquatic resource stakeholders and managers often express concern about aquatic plant management practices affecting nutrient concentrations. For example, mechanical harvesting of aquatic weeds has been viewed as "environmentally neutral" in part because most stakeholders consider biomass harvesting as a viable nutrient management strategy. Conversely, chemical aquatic plant management techniques are often viewed as less desirable because decaying plants release phosphorous back into the system. Released phosphorous is more available to other organisms, such as phytoplankton. Though evidence of algae blooms caused by aquatic plant management operations is largely limited to anecdotal field observations, integrating nutrient control technology could address manager and stakeholder concerns. Therefore, we investigated integrating a phosphorous removal technology (EutroSORB® Water Column) with common aquatic herbicide treatments under mesocosm conditions. This presentation will present results on how timing and dosage affect the efficacy of phosphorous removal after herbicide application. This pilot work will inform future research directions related to integrating aquatic plant management and nutrient control practices.

Testing the Application of Two Remote Sensing Platforms for Water Quality Monitoring of Residential Stormwater Ponds in Coastal South Carolina. **Julia Chrisco**
College of Charleston, Charleston, SC

Stormwater ponds in the Southeastern United States are prone to eutrophic levels of nitrogen and phosphorus present in stormwater runoff, which can spur growth of algae and algal blooms during warm summer months. Harmful algal blooms (HABs) can be damaging ecologically, economically, and to public health. Previous research has used satellite remote sensing to monitor HABs and water quality in large water bodies such as lakes and oceans; however, this approach is more difficult in smaller water bodies such as stormwater detention ponds. The potential for real-time monitoring of algal blooms over a broad geographic range would provide a tool that can be used for multiple purposes, such as describing temporal trends of algal bloom frequency, or creating a real-time system for rapid public health notification that could help mitigate the negative impacts of the bloom. The objectives of this project are to combine GIS, remote sensing, field sample collection, and in situ and lab water quality analyses to: 1) Assess the operating space to apply remote sensing via two different satellite platforms, Sentinel-2 and PlanetScope, to monitor optical water quality for stormwater ponds/lakes and 2) Develop water quality band ratio models to associate remote sensing and in-field water quality data from select residential stormwater ponds (ongoing work). ArcGIS Pro was used to screen an existing South Carolina pond inventory layer based on land use classification and size. Of 3,186 ponds in the residential inventory for the six coastal counties selected for the study, 2.4% have a size and shape that could allow for remote sensing using Sentinel-2 based on a 60m2 continuous pixel area. The application of PlanetScope data, which has a higher spatial resolution (3m compared to Sentinel-2's 10m and 20m), would increase this percentage significantly. Field work was conducted in September 2022 in 14 coastal South Carolina residential ponds on nearly cloudless days corresponding with Sentinel-2 acquisition. Research will continue with further water quality model development using satellite imagery and the water quality data collected.

Incipient *Lygodium microphyllum G*Ametophyte Response to Inundation. **Minjin Choi**[1], Stephen F. Enloe[2]
[1]UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL
[2]University of Florida, Gainesville, FL

Lygodium microphyllum, also known as Old World climbing fern (OWCF), is an invasive fern in south and central Florida. It impacts native plant communities by forming dense smothering mats and creates fire ladders into the forest canopy, altering the fire ecology of invaded ecosystems. OWCF exhibits an alternation of generations in its life cycle that is typical of ferns. These include a cryptic sexually reproductive gametophytic stage and a vegetative sporophytic stage that blankets landscapes. OWCF sporophytes are highly tolerant of extended periods of inundation, but little is known regarding how gametophytes respond to inundation. A better understanding of OWCF gametophyte ecology could potentially inform land managers on ways to improve integrated management efforts. To address this, we investigated OWCF gametophyte responses to inundation in growth chambers at the UF Center for Aquatic and Invasive Plants. We hypothesized that younger gametophytes would be more susceptible to inundation than older gametophytes and that longer periods of inundation would reduce gametophyte growth and survival to a greater extent than shorter periods of inundation, independent of gametophyte age. OWCF spores were collected from Loxahatchee NWR. Gametophytes were grown from spores on agar plates to varying ages and submerged in water for 0, 7, or 14 days. Flooding stress was then removed, and gametophyte growth and survival were measured with digital image analyses software. Experiments are ongoing, but preliminary results indicate older gametophytes are highly tolerate of the inundation periods tested. Future studies will be conducted to assess how sexually mature gametophytes respond to inundation stress.

Documenting Physical and Phenological Growth Patterns of the Connecticut River Hydrilla Biotype. **Kara J. Foley**, Jens P. Beets, Robert J. Richardson
North Carolina State University, Raleigh, NC

The monoecious and dioecious biotypes of *Hydrilla verticillata*, a federally listed noxious weed in the United States, have become widespread in US freshwater resources and their negative impacts to aquatic ecosystems are well documented. Recently, a genetically dissimilar biotype of *H. verticillata* was introduced to the Connecticut River and has spread to cover over 800 acres of its shoreline. This biotype exhibits several morphological differences when compared to the well-understood monoecious and dioecious hydrilla biotypes, which include a leaf arrangement of whorls of 3 to 8+ and the formation of exceptionally robust axillary turions. Researchers from North Carolina State University compared biomass production and timing of phenological events of the three US hydrilla biotypes over the span of a growing season at two distinct climates (Raleigh, NC and Laurel Springs, NC). Additionally, the short-term growth rate of each biotype was compared in a greenhouse setting under varying sediment nutrient levels. During the first year of the phenology study, the Connecticut River hydrilla biotype formed male flowers approximately 90 days after sprouting, and produced significantly more axillary turions (over 90 turions/plant) than monoecious and dioecious hydrilla biotypes by the end of the growing season in the Raleigh, NC study site. Short-term nutrient growth trials documented that Connecticut River hydrilla apical tips grew 1.3 cm/day when planted in high sediment nutrient conditions. This research will provide insight into the life history of the novel Connecticut River hydrilla biotype and will help to inform future field-based management decisions.

Evaluation of Small-Scale Subsurface Penoxsulam Treatments on Waterhyacinth and Waterlettuce. **Hannah J. Brown**[1], Candice M. Prince[2], Benjamin P. Sperry[3]
[1]University of Florida Center for Aquatic and Invasive Plants, Gainesville, FL
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers, Gainesville, FL

Waterhyacinth [*Eichhornia crassipes* (Mart.) Solms] and waterlettuce [*Pistia stratiotes* L] are considered the most aggressive invasive floating plants in the southeast United States. Application techniques used to manage these macrophytes are primarily foliar based and have remained mostly unchanged for decades, save for the introduction of several new herbicide chemistries in the last 20 years. Recent research suggests that up to ¼ of foliar spray used to treat these plants is lost to the water column, highlighting that current techniques leave room for improvement. Therefore, there is a need to evaluate other management techniques for floating plants, such as subsurface herbicide applications. Here, we collected pilot data on small-scale static subsurface treatments for waterhyacinth and waterlettuce in a mesocosm study. Plants were grown in 18.9 L mesocosms filled with well-water amended with fertilizer. There were three plants per mesocosm, and four mesocosms per treatment. Plants were allowed to grow for two weeks before penoxsulam was applied at 0, 2, 5, 9, 19, 38, 75, and 150 ppb. Applications were made to the water using a syringe and were held static throughout the experiment. Phytotoxicity data was collected weekly, and biomass was collected at 8 weeks. Between species, waterhyacinth was more sensitive to subsurface penoxsulam treatments. This data provides a framework for researchers to effectively scale-up floating plant subsurface treatment experiments that may contribute to optimizing a new application technique for aquatic plant management.

A Practical Guide for Genetic Surveying and Monitoring for Eurasian Watermilfoil Management.
Ryan Thum[1], **Ashley L. Wolfe**[1], Raymond M. Newman[2]
[1]Montana State University, Bozeman, MT
[2]Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St Paul, MN

Invasive watermilfoil strains can differ in their growth, spread, impacts and herbicide response. For example, strains of both Eurasian (*Myriophyllum spicatum*) and hybrid (*M. spicatum* x *M. sibiricum*) watermilfoil (collectively referred to as Eurasian watermilfoil) have been characterized as resistant or susceptible to specific herbicides (e.g. fluridone). Identifying resistant and susceptible strains can inform managers as to whether a specific herbicide should be used to treat a lake. One practical challenge is that herbicide response data is missing for most watermilfoil strains, and characterizing every strain is not feasible. Integrating genetic surveying and monitoring could help prioritize strains to characterize. In this presentation, we provide practical guidelines for genetic sampling, and describe several basic signatures of genetic data that can prioritize strains for herbicide response characterization. To date, we have identified over 250 strains from over 400 lakes across the United States sent by state agencies, aquatic plant managers and citizen scientists. From these data, we have identified several geographically widespread and common Eurasian strains that we have prioritized for herbicide characterization. However, most hybrid strains have localized distributions, and temporal genetic monitoring and/or higher density sampling of lakes is needed to identify which hybrid strains should be prioritized for herbicide characterization. We are building a user-friendly application where users can identify which strain(s) are present in a lake, what other lakes also have the strain(s), and herbicide responses for characterized strains. We encourage people to incorporate genetic surveying and monitoring into their Eurasian watermilfoil management plans to help identify strains to prioritize for herbicide characterization.

Evaluating Modified Basal Bark Band Heights to Enhance Triclopyr Efficacy. **Conrad A. Oberweger**[1], Stephen F. Enloe[2], Candice M. Prince[2], Benjamin P. Sperry[3]
[1]Center for Aquatic and Invasive Plants - University of Florida, Gainesville, FL
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers, Gainesville, FL

Basal bark treatment involves applying an oil soluble herbicide in an oil carrier to the lower 0-45-cm of bark around a tree. Recently, triclopyr acid (Trycera) was labeled for aquatic use, permitting wetland applications. However, reports of non-target injury have followed and direct application to the trunks base is not feasible in standing water. Elevated band height applications may offset these challenges, but no research had examined this. To evaluate efficacy under this approach, a field study with two experimental runs occurred in Melbourne, FL and Wimauma, FL in Spring 2022. Both trials involved a CRBD of 28 plots containing Brazilian peppertree (*Schinus terebinthifolia*). Treatments included Trycera at 5%, 10%, and 20% v/v and band heights of 0-45-cm and 61-107-cm. Data analysis indicated elevated band height applications required greater time, while herbicide output decreased, in comparison to lower band heights. Defoliation data at 180 DAT in run one indicated effective control at both band heights at 20% and 10%, however, both bands at 5% were less effective. Defoliation was extensive at all concentrations in run two. Run one epicormic shoot data, and tree survival data at 360 DAT, indicated 20% provided long-term control at both band heights, while control decreased with elevated band heights at 10% and 5%. In run two, epicormic shoots and tree survival were only observed in elevated treatments at 5%. Efficacy data collection is ongoing. If successful, these findings may support an effective management strategy for peppertree in inundated wetlands that provides better prevention of non-target injury.

Seasonal Starch Allocation of Starry Stonewort (*Nitellopsis obtusa*) Growing in Lake Koronis, MN. (1) **Ryan M. Wersal**, Alyssa M. Haram
Minnesota State University, Mankato, Mankato, MN

Starry stonewort (*Nitellopsis obtusa*) (Desvaux in Loiseleur) J. Groves is an invasive macro alga that can take over entire water columns and outcompete native species. Previous research has quantified seasonal life history and phenology but there is no research quantifying carbohydrate allocation. The current study utilized samples harvested from Lake Koronis, Minnesota, USA from 2020 and 2021 to quantify starch allocation patterns in *N. obtusa*. Starch was quantified using the amylase/amyloglucosidase method.

Starch data were related to light transmittance (%), pH, and water temperature (°C) via mixed procedures models in SAS. Seasonal average low and high points of starch storage were observed to be June (3.3%) and April (9.9%) for thalli biomass then June (41.7%) and November (54.6%) for bulbils. In regard to allocation patterns, above ground thalli reallocates carbohydrates to the below ground rhizoids in May. Carbohydrates are then transported to bulbils from July through September as rhizoid starch decreases and the bulbil starch increases. Ultimately, the carbohydrates are converted to starch and stored in bulbils (21.0□73.7%). In its invaded range, bulbils are important for energy store, vegetative reproduction and spread, as well as temporal distribution. These bulbils spread easily, spread rapidly, can store a lot of energy (73% starch), and are a major concern for the invasion of *N. obtusa*. Water temperature and light availability were shown to negatively influence starch content of thalli. These findings suggest that in the invaded range, *N. obtusa* is capable of accumulating large amounts of starch later into the growing season. The energy reserves may give *N. obtusa* a competitive advantage over native species by allowing a longer growing season resulting in the production of more vegetative propagules and greater longevity in the environments it invades.

Herbicide Studies to Manage Four Aquatic Weeds in the Sacramento-San Joaquin River Delta.
John D. Madsen[1], John Miskella[2]
[1]Retired, Eads, TN
[2]US Department of Agriculture, Agricultural Research Service, Davis, CA

The Delta is a tidal water resource that is infested with invasive aquatic weeds. We examined four species in three studies to evaluate herbicide use patterns. Australian ribbonweed (*Vallisneria australis*) is a recent introduction, for which we screened nine active ingredients (endothall, carfentrazone-ethyl, copper-ethylenediamine, diquat, endothall, florpyrauxifen-benzyl, flumioxazin, imazamox, penoxsulam) in eleven formulations. Exposure times were either 4 weeks (contact herbicides) or 12 weeks (systemic herbicides). The study was conducted in 20 L buckets with one 1-L pot of ribbonweed planted in soil placed in each bucket. Only the three formulations of endothall (dipotassium salt of endothall in liquid and granular formulations, and the dimethylalkylamine salt of endothall) provide better than 80% control. South American spongeplant (*Limnobium laevigatum*) is a California state noxious weed. We collected plants from the Delta, and placed spongeplant into 20 L buckets for treatment in a spray chamber. Plants were harvested 6 weeks after treatment (WAT). Nine active ingredients (2,4-D, glyphosate, imazamox, penoxsulam, carfentrazone-ethyl, flumioxazin, triclopr, florpyrauxifen-benzyl and imazapyr) were tested; herbicides that produced 80% or more control were glyphosate, imazamox, imazapyr, and flumioxazin. Eurasian watermilfoil (*Myriophyllum spicatum*) and egeria (*Egeria densa*) create nuisance growths in the Delta, and were examined in concentration / exposure time studies with the potassium salt of endothall and diquat. Endothall concentrations range from 1 to 5 ppm and exposure times of 3 to 24 hours. Diquat concentrations were either 90 or 190 ppb at 0.5 to 12 hours. Endothall was effective on Eurasian watermilfoil at concentrations above 3 ppm and exposure times of more than 12 hours. In contrast, no endothall treatments controlled egeria. Diquat controlled Eurasian watermilfoil at exposure times of more than 3 hours. Egeria was controlled at the higher concentration and 3 hours exposure, and both concentrations with 6 hours exposure.

Importance of Surface Aeration in Shallow Pond Management. Cory R. Richmond
Kasco, Columbus, OH

Shallow basins provide many challenges when managing nuisance vegetation. Utilizing surface aeration helps facilitate management of nuisance vegetation by improving water quality. Water quality parameters examined in this presentation are dissolved oxygen, nutrient availability, water clarity and beneficial bacteria.

Application of Florpyrauxifen-benzyl for Control of Monoecious Hydrilla at Raystown Lake, PA.
Bradley T. Sartain[1], Benjamin P. Sperry[2], Kurt Getsinger[3], Mark A. Heilman[4]
[1]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[2]US Army Corps of Engineers, Gainesville, FL
[3]U.S. Army Corps of Engineers-ERDC, Vicksburg, MS
[4]SePRO Corporation, Carmel, IN

Florpyrauxifen-benzyl (FPB) plus rhodamine WT (RWT) dye was applied simultaneously to a 3.8-hectare plot at Raystown Lake, PA to evaluate control of monoecious hydrilla. A point intercept survey prior to treatment indicated a 73% occurrence of hydrilla growing primarily as newly developed immature plants less than 30 cm in length. On 26 July 2022, FPB and RWT were applied simultaneously via conventional subsurface injection at 48 and 10 µg L^{-1}, respectively. Following treatment, RWT measurements were collected discretely (handheld fluorometers) and remotely with data sondes at 15-minute intervals. Water samples were collected to determine FPB and florpyrauxifen acid (FPA) concentrations within and outside the treatment area. Water exchange data indicated an estimated RWT dye half-life of approximately 3.7 hours; however, =20% of the target RWT dye concentration was maintained for up to 30 hours after treatment (HAT). Furthermore, FPB/FPA and RWT concentrations were positively correlated (R^2 = 0.937). Therefore, target FPB concentrations were also short lived (estimated 2-hour half-life), but low FPB/FPA concentrations were maintained at detectable levels (3-5 µg L^{-1}) out to 30 HAT. Hydrilla symptoms including epinasty and brittle shoots/leaflets were observed at 24 HAT and no hydrilla occurrence was recorded at 10 weeks after treatment. These preliminary findings suggest that the elevated concentrations of FPB measured in the initial hours following application and average parent herbicide concentrations above 5 µg L^{-1} at 24 HAT project to favorable reductions in monoecious hydrilla in the treatment area.

Evaluation of Preventative Algaecide Treatments for Cyanobacterial Resting Cells in Sediments of a Central USA Lake.
Ciera M. Kinley-Baird[1], Elizabeth Smith[2], Alyssa J. Calomeni[3], Andrew D. McQueen[3], Grace O. Patchett[1], Marvin Boyer[4], Katlynn N. Decker[2], Gerard A. Clyde[5]
[1]Aquatic Control, Inc., Seymour, IN
[2]Kansas Department of Health and Environment, Topeka, KS
[3]US Army Engineer Research and Development Center, Vicksburg, MS
[4]U.S. Army Corps of Engineers, Kansas City District, Kansas City, MO
[5]United States Army Corps of Engineers, Tulsa District, Tulsa, OK

Cyanobacteria can overwinter in sediments of aquatic systems as resting cells and contribute to subsequent harmful algal bloom (HAB) resurgences. This field-scale study was performed to evaluate the effectiveness of preventative algaecide treatments for decreasing viability of cyanobacterial resting cells, with the goal of minimizing planktonic growth in-season. Two treatments of a granular peroxide-based algaecide were applied (48-h apart) in a Kansas, USA lake to a 78-acre treatment zone, separated from a 32-acre control zone using a silt curtain. Treatment design was informed by laboratory algaecide efficacy experiments using site-collected samples. Performance was evaluated based on comparisons of planktonic cyanobacterial densities in the treatment and control zones measured every 2 weeks for 4 months, then monthly for 2 additional months. Other lines of evidence included resting cell densities and recruitment viability in sediments 3 days after treatments were performed. For 9 of 11 sampling events from May to October, average planktonic cyanobacterial densities were lower in the treatment zone than in the control zone (ranging from 6 to 97% lower), providing a line of evidence that preventative treatments effectively decreased resting cell viability. However, declines in sediment cell density and recruitment of resting cells (in laboratory assessments) were not measurable 3 days after treatments were performed. Additional studies will be necessary to strengthen the database supporting use of this

management strategy. However, based on these results, there may be an opportunity to expand the model for how algaecides are used to manage HABs more effectively and efficiently in freshwater resources.

Utilization of Triploid Grass Carp for Hydrilla Management in NC. Robert J. Richardson[1], Mark Fowlkes[2], Jessica Baumann[3], Rob Emens[4], Drew Gay[4], Brett M. Hartis[5]
[1]North Carolina State University, Raleigh, NC
[2]North Carolina Wildlife Resources Commission, Raleigh, NC
[3]North Carolina State University / Dept. Crop and Soil Sciences, Raleigh, NC
[4]North Carolina Department of Environmental Quality, Raleigh, NC
[5]Duke Energy, Huntersville, NC

Triploid grass carp have been the most commonly used hydrilla control strategy in Southeast US reservoirs. From a management perspective, the primary benefit to grass carp is that they will consume most noxious submersed vegetation. However from an ecological perspective, the primary negative is that they are non-discriminate and will consume both beneficial submersed vegetation. Reservoirs, however, are inherently artificial systems and typically support little submersed vegetation, thus grass carp are often a preferred technique. Grass carp do demonstrate a preference for hydrilla and can greatly reduce hydrilla abundance. In North Carolina (NC), hydrilla management has utilized combinations of herbicides and triploid grass carp, with the general strategy of using herbicides to control boom cycles of hydrilla growth and using grass carp for long term control. Grass carp are a regulated species in NC and NC Wildlife Resources Commission (NCWRC) using a permit process to reduce potential negative impacts. Since 2000, over 300,000 triploid grass carp have been stocked in over 50 significant impoundments across NC. To optimize grass carp stockings, NCWRC developed a grass carp stocking analysis tool that utilizes a cohort model to help determine appropriate stocking rates for individual reservoirs. Model input variables include standing hydrilla acres, herbicide treated hydrilla acres (resulting in non-standing hydrilla), total hydrilla tuber bank acres, stocking rate for standing hydrilla, stocking rate for tuber bank, and the number of grass carp previously stocked (by year). The primary biological variables are mortality rates for 1st year and 2+ year grass carp, as well as emigration rates which are derived from the most current and relevant research trials. Utilized in combination with annual vegetation surveys, this model has reduced boom/bust cycles of hydrilla growth successfully on both large impoundments (e.g. Lake Gaston, ~20,000 acres) and small impoundments (e.g. Lake Devin ~140 acres). The model has also allowed for low level grass carp stocking to eliminate remaining hydrilla plants after several years of herbicide application. On the Tar River Reservoir (<2,000 acres), 0.5 grass carp per hydrilla tuber acre were stocked after 6 years of fluridone application for effective hydrilla control.

Control of Terrestrial Alligatorweed in Mississippi. Gray Turnage[1], Weston Thompson[2]
[1]Mississippi State University, Starkville, MS
[2]Mississippi Department of Wildlife, Fisheries, and Parks, Grenada, MS

Alligatorweed (*Alternanthera philoxeroides*) is the most widespread aquatic weed in Mississippi and can grow in aquatic, wetland, and terrestrial sites allowing it to survive stressors such as drawdown or drought. Much is known regarding the control of alligatorweed in aquatic sites, however, less is known regarding control of alligatorweed in terrestrial sites. Muscadine Farms Wildlife Management Area (WMA) is a series of 90 ponds (each 6.1-8.1 hectares in size) that covers approximately 809 ha in the Mississippi flyway in western Mississippi; the WMA is primarily managed for waterfowl habitat. The terrestrial form of alligatorweed infests many ponds in the WMA during summer drawdowns and has displaced desirable vegetation utilized as waterfowl forage. In 2022, an herbicide trial was conducted to assess the short and long term reduction of alligatorweed at Muscadine Farms. High and low rates of imazapyr (8.2 and 4.1 kg a.e. ha^{-1}), bispyribac-sodium (0.11 and 0.055 kg a.i. ha^{-1}), topramezone (11.4 and 5.7 kg a.e. ha^{-1}), florpyrauxifen-benzyl (0.02 and 0.01 kg a.i. ha^{-1}), and fluridone (10.9 and 5.4 kg a.i./ha^{-1}) were tested as stand-alone foliar herbicide treatments. Glyphosate (11.0 kg a.i. ha^{-1}), triclopyr (11.7 kg a.e. ha^{-1}), metsulfuron-methyl (0.036 kg a.i. ha^{-1}), and two-way tank mixes of the three were also tested as foliar treatments. Additionally, integrated management options were assessed to determine efficacy of combining mechanical (disking or mowing) and chemical control options. By 52 WAT, alligatorweed was reduced by imazapyr (78%), bispyribac-sodium (78%), topramezone (84%), and florpyrauxifen-benzyl (81%) compared to references. Mechanical techniques provided excellent short term (12 WAT) reduction of alligatorweed (>90% biomass reduction) but by 52 WAT only disking followed by imazapyr treatments reduced biomass (67%) compared to references. Long term alligatorweed reduction by bispyribac-sodium, topramezone, and florpyrauxifen-benzyl suggests these herbicides can be rotated with existing chemical control techniques in use by resource managers.

Laboratory Evaluation of Algaecides for the Proactive Treatment of Overwintering Cyanobacteria.
Alyssa J. Calomeni[1], Andrew D. McQueen[1], Ciera M. Kinley-Baird[2], Gerard Clyde Jr.[3], Grace Gusler[4], Marvin Boyer[5], Elizabeth Smith[6]
[1]US Army Engineer Research and Development Center, Vicksburg, MS
[2]Aquatic Control, Inc., Seymour, IN
[3]USACE - Tulsa District, Tulsa, OK
[4]Aquatic Control, Seymour, IN
[5]U.S. Army Corps of Engineers, Kansas City District, Kansas City, MO
[6]Kansas Department of Health and Environment, Topeka, KS

Harmful algal blooms (HABs) can occur with an intense and rapid onset, giving water resource managers limited time to respond. An attractive strategy to decrease human, ecological, and economic risks from HABs is to implement proactive algaecide treatments to overwintering cyanobacteria (i.e., akinetes and quiescent vegetative cells) in sediments prior to the formation of a HAB; however, this approach is novel and limited efficacy data exist. Specific objectives of this research were to 1) evaluate copper- and peroxide-based algaecides, applied as single and repeat treatments in the laboratory, to evaluate this proactive strategy, and 2) compare correlations between cell density and other response measurements (i.e., *in vivo* chlorophyll *a* and phycocyanin concentrations and percent benthic coverage), to identify informative metrics to assess overwintering cyanobacteria responses. Twelve treatment scenarios using copper- and peroxide-based algaecides were applied to sediments containing overwintering cyanobacteria prior to a 14-d incubation that simulated late spring growing conditions and cyanobacteria responses were measured. HAB-forming cyanobacteria present after a 14-d incubation were: *Aphanizomenon, Dolichospermum*, *Microcystis, Nostoc*, and *Planktonthrix*. Successive treatments of copper sulfate (CuSulfate) followed by sodium carbonate peroxyhydrate (PeroxiSolid) (second algaecide applied after 24 h) as well as repeat applications of a single algaecide, PeroxiSolid (second treatment applied after 24 h) resulted in statistically significant ($p = 0.05$; $a = 0.05$) declines in cell density relative to untreated controls. Planktonic cyanobacteria responses measured in terms of phycocyanin were strongly correlated with cyanobacteria density measurements ($r = 0.89$). Chlorophyll *a* and percent benthic coverage did not correlate with planktonic cyanobacteria density measurements ($r = 0.37$ and -0.49, respectively) and therefore, were unreliable measurements. These data provide initial evidence of the efficacy of algaecides for treating overwintering cells in sediments and contribute to our overarching hypothesis that proactive treatments may decrease the severity of HABs.

Connecticut River Hydrilla Research and Demonstration Project.
Benjamin P. Sperry[1], Bradley T. Sartain[2], Nathan Harms[3], Kurt Getsinger[4]
[1]US Army Corps of Engineers, Gainesville, FL

[2]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[3]U.S. Army Corps of Engineers-ERDC, Lewisville, TX
[4]U.S. Army Corps of Engineers-ERDC, Vicksburg, MS

A genetically distinct hydrilla [*Hydrilla verticillata* (L.f.) Royle] population was discovered in the lower Connecticut River in 2015 and has since spread and degraded this freshwater ecosystem. Furthermore, there has been little to no management of this unique hydrilla strain which has the potential to spread outside of the Connecticut River. Like most aquatic weeds, successful hydrilla management in public water requires an understanding of phenological patterns, water exchange processes, registered and effective control tools, and coordination between public agencies and stakeholders. Consequently, the US Army Corps of Engineer's Aquatic Plant Management Team (APMT) in partnership with the New England District has initiated an applied research and demonstration project, funded by the Aquatic Plant Control Research Program (APCRP), aimed toward filling data gaps necessary to develop successful hydrilla management strategies on the Connecticut River. This presentation will describe the APMT's detailed research plan to develop operational management guidance for the hydrilla in the ecologically sensitive and hydrodynamically complex Connecticut River.

Using Artificial Intelligence to Detect Submerged Aquatic Weeds to Protect Aotearoa New Zealand's Waterways. **Daniel Clements**[1], Jeremy Bulleid[2]
[1]National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand
[2]National Institute of Water and Atmospheric Research (NIWA), Christchurch, New Zealand

Early detection of an invasive species enables early intervention, and along with prevention, early detection provides the best (most cost-effective) opportunity to successfully manage invasive species that pose a biosecurity risk. Typically, aquatic weed invasions that go unnoticed or are overlooked, or where management interventions are delayed, become problematic resulting in a decline in the values and functions of aquatic ecosystems. Surveillance methods that can be efficiently deployed are required to detect and locate incursions at an early stage of invasion, so that control methods can be implemented. Current surveillance methods are limited and often rely heavily on divers to detect incursions. The development of new detection methods, that operate at larger spatial scales and can be deployed readily by management agencies, will improve detection capability and reduce response times. NIWA researchers have developed a method for remote detection of invasive aquatic weeds utilizing advances in remote sensing, recognition software and machine learning, initially targeting two of New Zealand's worst submerged aquatic weeds, *Lagarosiphon major* and *Ceratophyllum demersum*. This presentation outlines the development of NIWA's portable invasive species detector module, that can be deployed from manned or unmanned surface vessels (USVs) and remotely operated submersible vehicles (ROVs). The project has applied an Artificial Intelligence (AI) Deep Learning (DL) approach to detect submerged target species. A prototype module contains a software 'detector' that has been trained to identify targets in live stream video imagery. When it identifies that the target is present within a video frame, the GPS location, the time and the total number of instances detected within that video frame are recorded. The resulting GPS detection file can then be projected in mapping applications (e.g., ArcGIS), so that subsequent weed control can be undertaken. Whilst the project has primarily developed a detection tool to target invasive species in New Zealand waterways, in principle there is little to prevent global use if the detector was trained to recognize geographically relevant target species (e.g., localized invasive weeds, fish, invertebrates).

***Solanum tampicense*, a Growing Threat to Forested Wetlands in Florida.** **Stephen F. Enloe**[1], Minjin Choi[2], Maximus Chou[1]

[1]University of Florida, Gainesville, FL
[2]UF/IFAS Center for Aquatic and Invasive Plants, Gainesville, FL

Solanum tampicense, known as wetland nightshade or aquatic soda apple, is native to the West Indies and Central America. It was first discovered in Florida in the 1970's and has spread across several counties. It is a sprawling, semi-woody shrub that rambles to a height of five meters and forms tangled thickets. It is distinguished from other invasive Solanum species by its growth habit, long narrow leaves, recurved prickles, stellate hairs and small clusters of pea-sized red berries. It occupies disturbed open areas and forested wetlands and is tolerant of seasonal inundation. Management options include glyphosate and triclopyr amine, but land managers have expressed concern over a lack of consistent control. The wetland conditions typical of invaded sites generally require the use of aquatic labeled herbicides. However, its presence in seasonally dry wetlands may allow for applications of additional chemistries not labeled for aquatic use, including metsulfuron and aminopyralid, which are effective on many Solanaceae species. Therefore, a greenhouse study evaluated aminopyralid, metsulfuron, and a triclopyr acid formulation against glyphosate. Plants were propagated from stem cuttings and grown for approximately two months in 3.8-L pots. Eight herbicide treatments were foliar applied and included glyphosate, triclopyr acid, aminopyralid, and metsulfuron at two rates each and compared to a nontreated control. Sixty days after treatment, aminopyralid at 0.09 kg ha^{-1} provided good foliar burndown and was comparable to the triclopyr acid formulation at 0.8 and 3.2 kg ha^{-1}. These treatments were more effective than glyphosate at 4.44 kg ha^{-1}. Metsulfuron at 0.04 kg ha^{-1} was not as effective as glyphosate. These initial results indicate that both aminopyralid and triclopyr acid may be useful tools for managing wetland nightshade. Future research should incorporate operational field trials and examine potential non-target issues with these herbicides in forested wetlands.

Aquatic Alligatorweed (*Alternanthera philoxeroides*) Management Field Trials in the Waikato, New Zealand: A Collaboration Between NIWA, Waikato Regional Council and Mississippi State University. **Daniel Clements**[1], Ben J. Elliot[2], Deborah E. Hofstra[1], Paul D. Champion[1], Iñigo Zabarte-Maeztu[1], Gray Turnage[3]
[1]National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand
[2]Waikato Regional Council, Hamilton, New Zealand
[3]Mississippi State University, Starkville, MS

Alligatorweed (*Alternanthera philoxeroides*) is an aggressive invader of both aquatic and terrestrial environments. It is particularly successful in aquatic and semi-aquatic environments where it is capable of extremely rapid growth. Floating mats of alligatorweed can choke waterbodies, restricting human use, excluding desirable plant species, interfering with aquatic ecology and impeding water flow. Alligatorweed poses a significant threat to New Zealand's waterways, wetlands, flood prone agricultural land, hydroelectric generation, drainage networks and irrigation systems. Alligatorweed is now found and managed in several parts of New Zealand's North Island, including the Waikato region. Infestations have recently been detected in adjacent regions further south. Alligatorweed is currently not known to be present in the South Island. Active management programs (eradication or progressive containment) aim to minimize the spread and impacts of alligatorweed within these regions. These actions limit further spread and protect currently unimpacted regions. While new infestations if detected early can be physically removed, herbicides are the most effective control tool for larger sites and when access is hazardous. However, herbicides currently used in New Zealand provide sub-optimal levels of control with a single application. Our research team has conducted field trials in the Waikato region to evaluate the effect of herbicide combinations (glyphosate, triclopyr, metsulfuron-methyl) and follow-up treatments to improve the management of alligatorweed in New Zealand. A similar trial was conducted by Mississippi State University in the USA. This presentation will outline the results of the field trials.

Evaluating the Efficacy of Herbicide Combinations on Hydrilla Control in Flowing Systems.
Michael W. Durham[1], Benjamin P. Sperry[2], Bradley T. Sartain[3]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers, Gainesville, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS

Hydrilla [*Hydrilla verticillate* (L.F.) Royle] is found in both flowing and static systems which require different strategies for effective control. Developing herbicide use patterns through concentration and exposure time studies has provided valuable information for individual herbicides. Continuing this same work with herbicides combinations may yield new use patterns that allow for control in previously untreatable situations, or increased control for current ones. A series of mesocosm studies were conducted in 2022 exploring various herbicide combinations. Study 1 examined six herbicides (endothall, florpyrauxifen-benzyl, fluridone, diquat, flumioxazin, and topramezone) at a 48-hour exposure time, either alone or with all possible two-herbicide combinations. Studies 2, 3 and 4 examined 48-hour exposure times of endothall paired with either diquat, penoxsulam, or 2,4-D at various concentrations. All four studies were conducted twice: once in January 2022 and once in June 2022. Results from these initial studies are forthcoming and should provide insight into the development of future studies that will exam select combinations over a course of exposure times.

Confusion and Ambiguity with the Terms Resistance and Tolerance in Aquatic Plant Management.
Ryan Thum[1], Benjamin P. Sperry[2], Gregory M. Chorak[3], Ramon G. Leon[4], Jason Ferrell[5]
[1]Montana State University, Bozeman, MT
[2]US Army Corps of Engineers, Gainesville, FL
[3]Montana State University Department of Plant Science, Bozeman, MT
[4]North Carolina State University, Raleigh, NC
[5]University of Florida, Gainesville, FL

The Weed Science Society of America (WSSA) defined the terms "resistance" and "tolerance" in 1998 to ensure that these terms are used accurately in all WSSA communications. The Aquatic Plant Management Society adopted the WSSA's official definitions, but distinguishing between tolerance and resistance has proven comparatively difficult for the aquatic plant management community, with a tendency to default to using the word "tolerance" to describe cases of reduced plant response to an herbicide. We dissect the WSSA definitions of resistance and tolerance to provide clarity as to their meaning and usage. We highlight the key distinction that herbicide tolerance describes differences in herbicide response *between* species, whereas resistance refers to differences among lineages *within* a species. We also note potential sources of confusion and ambiguity in applying these terms for aquatic plant management versus the agricultural settings from which the original definitions emerged, including ambiguity about: 1) what the "wild-type" herbicide response is for a taxon, 2) what dose is normally lethal, 3) operational rates versus label rates. We contend that one major improvement to aquatic weed science would be to include a range of natural variation when conducting dose-response studies to evaluate herbicides. In addition, the term resistance should not be used in a binary manner. Instead, it should be qualified with the magnitude of resistance, and evaluation of control options should include whether the herbicide can be used at a higher rate to accomplish site-specific management goals.

Implementation of the Control Management Test (CMT) at the Tahoe Keys Lagoons.
Justin J. Nawrocki[1], Lars W J Anderson[2]
[1]UPL, Holly Springs, NC
[2]WaterweedSolutions, Davis, CA

The planning, design, and implementation of the CMT is the result of a 5-year sustained collaboration among Tahoe Keys homeowners (Tahoe Keys Property Owners Association), regulatory agencies (Lahontan Reginal Water Quality Control Board and Tahoe Regional Planning Agency), The League to Save Lake Tahoe and other stakeholders, and with a high-level of public input and interest. Implementation of the CMT required coordination of multiple contractors coupled with necessary compliance with extensive regulatory requirements. This has achieved a successful multi-method management test that included the herbicides endothall and triclopyr applied in a tank mix with Rhodamine WT dye, as well as UV-C light and combinations of herbicides and UV-C. These treatments were applied in three replicates per treatment, including control sites. Double turbidity curtains were installed at strategic locations to mitigate movement of herbicides or degradant to Lake Tahoe proper. In addition to the extensive water quality and aquatic plant monitoring, herbicide residues were monitored pre-treatment and several weeks after application.The results of the first year (2022) will determine where and how the second and third year will be conducted as non-herbicide treatments "Group B" methods. The Group B methods include diver-assisted suction removal, bottom barriers, UV-C light treatments. Monitoring will continue as in year 1; however, since no herbicides will be used in years 2 or 3, monitoring will not include monitoring for herbicides or degradants in the water.

Response of Six Genotypes of Minnesota Watermilfoil (*Myriophyllum spp.*) to Three Commonly-Used Auxin Mimic Herbicides. **Raymond M. Newman**[1], John Gerritsen[2], Ryan Thum[3]
[1]Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St Paul, MN
[2]Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St. Paul, MN
[3]Montana State University, Bozeman, MT

Assessing and managing for herbicide resistance should be a key component of any invasive plant management program. In North America, non-native Eurasian watermilfoil (*Myriophyllum spicatum)* and its hybrids with native northern watermilfoil (*M. sibiricum)* are among the most commonly managed invasive aquatic plants. Numerous studies have shown that some strains of watermilfoil, often hybrid watermilfoil *(M. spicatum* x *M. sibiricum*), are more difficult to control or less susceptible to a particular herbicide such as fluridone, 2,4-D, triclopyr, or diquat. However, the plants tested were often not identified to genotype, so inferences to other populations or lakes cannot be made. In Minnesota alone, 18 *M. spicatum* genotypes, 89 hybrid genotypes and over 100 northern genotypes have been identified. We used strain level genetic monitoring to identify six genotypes of *Myriophyllum* spp. to assess: a widespread Eurasian strain (identified in 60 lakes in Minnesota), a relatively widespread hybrid strain found in Otter Lake and 12 others, three other hybrid strains with limited distributions, and a northern strain from Phelps Bay, Lake Minnetonka. We exposed the strains, in common garden experiments (265L tanks, 56cm deep), to a gradient of doses of three commonly used auxin-mimic herbicides: 2, 4-D, triclopyr, and florpyrauxifen-benzyl. We found significant differences among genotypes for each herbicide, but also differences among herbicides. Three genotypes, including northern, were not controlled with 2,4-D at 0.25 and 0.5 mg/L AI. All genotypes were controlled by triclopyr (although 2 less so at lower doses), Preliminary results indicate all plants were controlled with 24h exposure to florpyrauxifen-benzyl, but there was variation in response among genotypes. Genetic monitoring should be used to guide herbicide and dose selection for known genotypes. It will also suggest additional genotypes for formal herbicide challenge testing. Further genetic sequencing analysis may allow identification of gene regions or genes associated with resistance.

International Development of ProcellaCOR (florpyrauxifen-benzyl) for Aquatic Plant Management. **Mark A. Heilman**[1], Tobias O. Bickel[2]
[1]SePRO, Carmel, IN USA
[2]Department of Agriculture and Fisheries (DAF), Queensland, Australia

Since its initial US registration for aquatic use in 2018, ProcellaCOR® (a.i., florpyrauxifen-benzyl) a novel selective systemic herbicide technology for selective control of several major North American aquatic invasive plants has seen further regulatory action, laboratory studies, and field development for potential future use in several other international geographies. In May 2023, this effort led to ProcellaCOR being the first new herbicide active ingredient for in-water aquatic applications in Canada approved under modern regulatory processes implemented by Health Canada's Pest Management Regulatory Agency (PMRA). This approval was supported by extensive data available from US registration efforts and past scientific publications, particularly those in the APMS Journal of Aquatic Plant Management, but also assisted by additional field evaluations under a two-year Research Authorization in Canada. A similar regulatory and development process is nearing completion in Australia where ProcellaCOR is in late stages of review by the Australian Pesticides and Veterinary Medicines Authority (APVMA) . The weed spectrum of interest for potential use in Australia has both similarities and differences from the US and Canada. Over the last several years, as a follow-up to discussions at the 2018 International Symposium on Aquatic Plants in Queenstown, New Zealand, where APMS was a partner Society, additional ongoing collaborative work led by the Queensland Department of Agriculture and Fisheries has demonstrated favorable efficacy on several aquatic plant invaders in Australia that are not described on US product labels including Delta arrowhead (*Sagittaria platyphylla*). This presentation will review new research results in support Canadian and Australian regulatory efforts and summarize latest status of ProcellaCOR in these countries and several other global locations.

Keeping Tools in Your Toolbox: an Update on Regulatory and Legislative Issues of Importance to the Aquatic Plant Management Industry. Megan Provost
RISE (Responsible Industry for a Sound Environment), Arlington, VA

As aquatic plant managers, your job requires you to stay up-to-date on the latest state information surrounding products you may use, or measures you need to take. But what about legislative and regulatory issues that are occurring in different parts of the country? Join Megan Provost, President of RISE (Responsible Industry for a Sound Environment) to learn about trending issues of importance to our industry, ways to talk about the importance of the industry, and what messages work when discussing the need for pesticide solutions to be available to us.

Novel Hydrilla Invades the Northeast. (2) **Greg Bugbee**
CT Agricultural Experiment Station, New Haven, CT

Hydrilla (*Hydrilla verticillata*) is among the most troublesome invasive aquatic plants in many southern states. It crowds out native vegetation, harms fisheries, limits recreation, impedes navigation, and reduces property values. In addition, it can harbor cyanobacteria that have been linked to lethal neurological disorders in bald eagles and other wildlife. Following reports of hydrilla in the southern portion of the Connecticut River in 2016, a task force formed by the Northeast Aquatic Nuisance Species Panel performed a preliminary survey of the river in 2018 and 2019. No hydrilla was found in the New Hampshire/Vermont portions of the river with the northern-most sightings occurring in southern Massachusetts. A more detailed survey was completed by the Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program in 2021. Nearly 1000 acres were documented. From the Connecticut border south, hydrilla is common. Portions of the river, its tributaries and coves are choked with the weed. In some areas, hydrilla spreads out over the surface making access by boat nearly impossible. Finding such dense stands in a northern state is alarming and could be associated with climate change. Furthermore, the Connecticut River hydrilla is far more robust than seen elsewhere in the northeast. This could be a result of river flow, nutrients, or genetics. Genetic testing found the CT River hydrilla is a distinct strain from that found anywhere else. The most notable difference is a lack of tubers which could enhance its management. Initial control efforts began with small scale benthic barrier placements in a marina and an herbicide treatment in a cove. Led by the United States Army Corp of Engineers, demonstration projects involving dye tests are scheduled for 2023 followed by herbicide trials in 2024. Management efforts entail many complications including river flow, tidal action, suspended sediment, numerous protected species, and large numbers of stakeholders.

Long-Term Effects of Managed Invasive Macrophytes on Largemouth Bass Populations. (3)

Vinicius Londe, Luke Flory, Candice M. Prince
University of Florida, Gainesville, FL

Monitoring is a key step in determining whether management activities are required and whether management has been effective. Long-term monitoring provides crucial information on the dynamics of habitat conditions, species status, and interactions. Plant and fish populations have been monitored by the Fish and Wildlife Conservation Commission since 2006 across Florida, providing a unique opportunity to answer ecological and practical questions. We used this dataset to investigate how managed invasive macrophytes affect populations of young, subadult, and adult largemouth bass (LMB, *Micropterus salmoides*). Data from 39 lakes were modeled using generalized additive mixed models, in which water-hyacinth (*Eichhornia crassipes*), hydrilla (*Hydrilla verticillata*), water-lettuce (*Pistia stratiotes*), and total non-native cover predicted LMB abundance, length, and biomass. Plant cover was estimated at both habitat (shoreline) and lake scales. Water conductance, temperature, Secchi depth, and dissolved oxygen were also included as covariates. We found increased young LMB abundance and biomass with increased invasive macrophyte cover at the habitat scale, probably because they serve as a refuge for young fish. Subadult abundance and biomass were also positively correlated with invasive plants at the habitat scale, but length was negatively correlated. We found a similar relationship for adult LMB, except that abundance and biomass decreased after more than 50% hydrilla cover. At the lake scale, subadults and adults showed increased abundance and biomass with increased water hyacinth, hydrilla, and total invasive plant cover, up to a certain level (~7%). Fish were negatively affected after this point, likely because invasive macrophytes decreased fish foraging efficiency and food source availability. Intermediary conductance values were important for the three size classes because electrical current flows through the water and fish more efficiently. Adults were more abundant and larger at intermediate temperatures (a direct effect on fish metabolism) and when there was more dissolved oxygen (improved bodily functions).

APC Hydrilla Demo's in FL. **Ian J. Markovich**[1], Benjamin P. Sperry[2], Jeremy Crossland[3], Kelli Gladding[4], Micheal Durham[4]
[1]US Army Corps of Engineers, Clewiston, FL
[2]US Army Corps of Engineers, Gainesville, FL
[3]US Army Corps of Engineers, Jacksonville, FL
[4]University of Florida, Gainesville, FL

The USACE have been conducting APC Demonstration & Research on Hydrilla management techniques looking at flowing water intermittent Endothall drips application, timing optimization with plant growth regulator, and refinement of herbicide techniques in whole lake, small plot, and boat trails. The goals of this work is to control hydrilla in priority areas to improve navigation and aquatic ecosystem function, as well as increase the technical knowledge for operational hydrilla management. These demonstrations are to educate USACE and partnering agency personnel about hydrilla management strategies in the Southern US. Treatments occurred on Lake Tohopekaliga (Toho), Lake Cypress, Fish Lake, and Merritt's Millpond.

Growing Degree Day and Growth Rate Calculations for Water Hyacinth (*Eichhornia crassipes*) in Florida. (5) **Greg MacDonald**
University of Florida, Gainesville, FL

Water hyacinth continues to be one of the most managed aquatic invasive species in Florida. While much is known about water hyacinth growth and reproduction, as well as technologies for management, there remains a knowledge gap in when and to what degree management must be employed to maintain this species in 'maintenance control'. Researchers have attempted to understand the growth and expansion dynamics of water hyacinth for several years. Recent work suggest growth rate dynamics are more closely related to temperature and nutrient status, with temperature being the more dominant factor when predicting growth. Given the previous work with water hyacinth and the correlation with temperature and growth rate, we feel the GDD approach can be adapted to predict water hyacinth growth rates. Growth measurements were taken on 88 individual plants every 3 to 7 days based on growth and expansion. Growth was derived from subtracting the measurement on any given day from the initial measurement at the start of the study. Growth was then correlated with the growing degree units derived on a tank by tank basis. We used regression on growth parameters as a function of growing degree units (both air and water) and found a linear relationship between growing degree units and area expansion (cm2), with similar trends observed with leaf number and ramet production. Based on regression analysis, we derived the predicted growth based on air or water temperature for each tank containing 8 plants. These growth rates were averaged (n=88, 8 plants/tank x 11 tanks) and it was found that the growth rate for air was 0.99±0.06 cm2 per growing degree unit for air temperature and 0.87±0.05 cm2 per growing degree unit for water temperature.

Genetic Diversity Characterization of *Microseira wollei* Populations from North Carolina.
Ramon G. Leon, Saket Chandra, Jessica Baumann, Erika Haug, Robert Richardson.
Department of Crop and Soil Sciences, North Carolina State University, Raleigh NC.

Microseira wollei (syn. *Lyngbya wollei*) is a filamentous cyanobacteria that has rapidly invaded water reservoirs in North Carolina (NC) forming dense mats that negatively affect native aquatic vegetation and fisheries. It is not clear whether the different populations detected in NC are the result of a single introduction with similar genetic characteristics, or they are genetically distinct indicating separate introduction events. We collected *M. wollei* populations from Tuckertown Reservoir, Badin Lake, and Lake Gaston, NC. Samples were purified, DNA was extracted and sequenced focusing on the 16S rDNA region. Principal coordinate analysis and phylogenetic analysis indicated that *M. wollei* populations from Tuckertown and Badin were more similar than the one from Gaston. Also, this latter population was less diverse than the former two. The results suggest that *M. wollei* found in Lake Gaston has a different origin than those from Tuckertown Reservoir and Badin Lake, which are likely from the same origin. The implications of these genetic differences for the management of this cyanobacteria are yet to be determined.

Collaborative Action: A Regional Approach to Managing Invasive Phragmites and European Frog-Bit.
Samantha Tank, Taaja Tucker-Silva, Theresa Gruninger, James Polidori
Great Lakes Commission

Invasive aquatic plants present a complex management challenge to natural resource practitioners and are made more challenging when the plant is detected across jurisdictions. Common reed (*Phragmites australis*) and European frog-bit (*Hydrocharis morsus-rane L.*) are two examples of prevalent plant invaders in the Great Lakes region requiring significant cost and time investments to control. The Great

Lakes *Phragmites* Collaborative (GLPC) and European Frog-bit Collaborative (EFBC) were established in 2012 and 2018 respectively to promote basin wide management through the implementation of collective impact. In 2017, the GLPC established a participatory science program, the *Phragmites* Adaptive Management Framework (PAMF), to determine the most effective and cost-efficient ways to manage *Phragmites*. PAMF operates on an annual adaptive management cycle whereby participants collect and submit monitoring and management data to inform the PAMF predictive model. In turn, the model produces site-specific management guidance for participants based on the latest information about which techniques are working most efficiently and effectively to reduce *Phragmites* invasion.
In 2022, the EFBC expanded beyond its initial Michigan focus to meet the needs of the larger Great Lakes region. Through the efforts of the three EFBC work groups (including Delimitation, Management Assessment, and Education/Outreach), standardized protocols have been established and ArcGIS tools developed to delimit and monitor treatment efficacy of European frog-bit. This presentation will highlight the above available tools and resources of both collaboratives that support *Phragmites* and European frog-bit management through the Great Lakes and beyond.

Great Lakes Aquatic Invasive Species Regional Coordination and Invasive Aquatic Plant Control Prioritization and Needs Assessment.

Ceci Weibert[1], Alisha Davidson[1], Lindsay Chadderton[1], Andrew Tucker[2], Theresa Gruninger[1]
[1]Great Lakes Commission
[2]The Nature Conservancy

The need for multijurisdictional coordination and collaboration is essential to effectively implement invasive species prevention and control strategies across jurisdictional boundaries. Specifically, jurisdictions in the Great Lakes region identified the need for a collaborative project to improve coordination of invasive aquatic plant (IAP) control method research and prioritize needs. Great Lakes resources continue to be compromised and are threatened by the introduction, establishment and spread of IAP. Numerous agencies, nongovernment organizations and private interests are implementing control measures for IAP that impede recreation and navigation, degrade habitat for native species, and disrupt natural ecosystems. These entities are also working with research institutions and the private sector to develop new tools for management and improve the efficiency and effectiveness of control efforts. These activities are costing millions of dollars and are widespread throughout the Great Lakes region and across the United States; however, there is no regional approach to coordinate engaged entities, identify needs, share outcomes and lessons learned, and ensure future investments are directed towards the highest priorities. To address this need, the Great Lakes Panel on Aquatic Nuisance Species, with funding support from the U.S. Fish and Wildlife Service via Great Lakes Restoration Initiative, undertook a process to identify and prioritize research needs related to the control of IAP in the Great Lakes region. Through an iterative process, a list of priority IAP species was developed. Literature reviews were conducted for each species, and the species with the greatest knowledge gaps and/or research needs were the focus of a workshop to further discuss species knowledge and needs. This work has culminated in a research agenda outlining the needs for effective control of each priority species, designed to inform both funders and research entities about future work needs.